Health Consultation

Follow-up Evaluation of Recreational Exposure to Residual
Onsite Surface Soil Contamination

STANDARD MINE

GUNNISON COUNTY, COLORADO

EPA FACILITY ID: CO0002378230

Prepared by the
Colorado Department of Public Health and Environment

SEPTEMBER 21, 2011

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Foreword

The Colorado Department of Public Health and Environment's (CDPHE) Colorado Cooperative Program for Environmental Health Assessments has prepared this health consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the United States Department of Health and Human Services and is the principal federal public health agency responsible for the health issues related to hazardous waste. This health consultation was prepared in accordance with the methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful health effects resulting from exposure to hazardous substances in the environment. Health consultations focus on health issues associated with specific exposures so that the state or local department of public health can respond quickly to requests from concerned citizens or agencies regarding health information on hazardous substances. The Colorado Cooperative Program for Environmental Health Assessments (CCPEHA) evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur in the future, reports any potential harmful effects, and then recommends actions to protect public health. The findings in this report are relevant to conditions at the site during the time this health consultation was conducted and should not necessarily be relied upon if site conditions or land use changes in the future.

For additional information or questions regarding the contents of this health consultation, please contact the author of this document or the Principal Investigator/Program Manager of the CCPEHA:

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Statement and Summary of Issues

Introduction

The Colorado Cooperative Program for Environmental Health Assessments' (CCPEHA) and the Agency for Toxic Substances and Disease Registry's (ATSDR) top priority is to ensure that all stakeholders have the best health information possible to protect the public from current and future health hazards associated with environmental contamination at the Standard Mine Superfund site (Standard Mine) in Gunnison County, Colorado.

The Standard Mine is an abandoned mine site located in southwestern Colorado, near the Town of Crested Butte (Figure 1). The Standard Mine is part of the Ruby Mining District, which produced copper, gold, lead, and silver over a hundred-year period from the 1870's - 1970's. Approximately 5 acres of land have been impacted by the former mining activities at the Standard Mine. Acid mine drainage and waste rock/tailings piles are the primary sources of heavy metal contaminants such as arsenic, lead, manganese, and iron found in soil, surface water, and sediment. The Standard Mine was listed on the National Priorities List (NPL) in September 2005, primarily due to the potential impacts of mining contamination on Crested Butte's water supply and the surrounding environment.

A number of activities have taken place at the Standard Mine site since it was listed on the NPL. This includes data collection and analysis, health risk evaluation activities, and response action. In 2007 and 2008, EPA removal teams removed approximately 50,000 cubic yards of waste rock/mine tailings from the site and disposed of it in an onsite, capped repository. In 2008, a health consultation evaluating recreational soil exposures used soil data that was available prior to EPA response actions. This health consultation determined that the Standard Mine site constitutes a public health hazard (i.e., could harm people's health) due to exposure to lead by young children and pregnant women that visit the site on an above-average basis (more than 12 days per year) for recreational purposes such as hiking, camping, and ATV riding.

The purpose of this evaluation is to determine if the potential hazards identified in the initial surface soil evaluation are still present following

EPA response actions. These response actions satisfy the requirements for ATSDR's goal of mitigating the risks of human health effects from toxic exposures. In essence, this evaluation is an update to the 2008 Health Consultation conducted by CCPEHA and ATSDR on recreational surface soil exposures at the Standard Mine site, and is based on additional soil data that was collected by EPA in the summer of 2009.

It is important to note that most of the area near the mine is heavily forested and mountainous with steep slopes. The Standard Mine site and the surrounding area are primarily used for recreation. Accessing the Standard Mine site is difficult and only possible by off-road vehicles, hiking, and mountain biking. In recent years, accessing the site has become even more difficult due to restricted entry points and impassable roads. Since EPA response actions started at the site, no ATV riding has been witnessed by EPA staff or members of the community group that visits the site. However, past anecdotal evidence, in addition to the community survey results, suggests that ATV riding did occur in the past. ATV riding may not be a currently occurring exposure scenario, but it was assumed that it could possibly occur again in the future once the EPA has finished all remedial action at the site.

Overview

CCPEHA and ATSDR have reached one conclusion regarding recreational surface soil exposures based on current land use at the Standard Mine site.

Conclusion 1

Recreational acute (arsenic and copper) and chronic exposures (aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, and manganese) to surface soil at the Standard Mine site are not expected to harm people's health.

Basis for Decision

This conclusion was reached because the estimated theoretical lifetime excess cancer risks are below or within the EPA acceptable cancer risk range (i.e., one in a million to hundred in a million) and the estimated acute and chronic non-cancer exposure doses are below levels of health concern. Overall, the estimated theoretical cancer risks and non-cancer hazards are associated with a very low increased risk.

Next Steps

Based on the results of this evaluation, the following recommendations have been made to be prudent of public health in regard to surface soil exposures at the Standard Mine site:

1) In future, if and when there is a possibility of a heavy use scenario, a land-use survey should be repeated by CCPEHA to determine the appropriateness of using an extremely conservative exposure frequency of 52 days/year as was used in this evaluation; and 2) Recreational exposures to surface water and sediment should be reevaluated in the future as additional data become available.

For More Information

If you have concerns about your health, you should contact your health care provider. For questions or concerns regarding this evaluation, please contact Thomas Simmons at 303-692-2961 or Raj Goyal at 303-692-2634.

Purpose

The purpose of this health consultation is to evaluate the potential public health implications of recreational exposures to residual surface soil contamination at the Standard Mine Superfund site following EPA response actions that occurred in the summers of 2007 and 2008. This health consultation is a follow up activity of CCPEHA's previous health consultation on surface soil exposures at the site that was conducted prior to EPA response actions (ATSDR 2008a). Additional surface soil data were collected in the summer of 2009 following the removal and disposal of mine wastes at the site. This additional soil data were used as the basis for this evaluation.

Background

The Standard Mine is a part of the Ruby Mining District, which is located approximately 5 miles west of the town of Crested Butte in southwestern Colorado. Heavy metals including gold, silver, zinc, and copper were extracted from the Ruby Mining District from approximately 1874 to 1974. The Standard Mine was one of the highest production mines in the district. The mine site is located in a fairly remote and mountainous area approximately 9,000-11,000 feet above sea level on the southern side of Mt. Emmons. The area surrounding the Standard Mine is primarily managed by the U.S. Forest Service.

The Standard Mine consists of 6 operating levels with access to over 8,400 feet of drifts. Mine water drains from 2 open adits, or tunnels. The amount of water released from the Level 1 adit varies by season. In the high-flow season (early summer), the Level 1 adit releases 100-200 gallons of mine drainage per minute (gpm) and 1-10 gpm in the low flow season (late fall). In the past, this mine water drained from the Level 1 adit directly into Elk Creek, which flowed south-southwest through the site, picking up more heavy metals and carrying them downstream. Elk Creek flows predominately south for approximately 3 miles prior to its confluence with Coal Creek. Coal Creek flows through the town of Crested Butte and serves as the drinking water supply for the town. Elevated levels of heavy metals found in surface water include arsenic, barium, lead, iron, zinc, cadmium, copper, and chromium. However, a health consultation conducted in 2006 concluded that the mine site does not pose a public health hazard from consuming Crested Butte's drinking water. In addition, approximately 61,700 cubic yards of waste rock and 29,000 cubic yards of mill tailings were present onsite.

On September 14, 2005, the Standard Mine site was listed on the National Priorities List (Superfund) primarily because of the potential impact of mining related contaminants on Crested Butte's water supply and the surrounding environment. A number of activities have occurred since the Standard Mine was listed. This includes activities ranging from data collection and evaluation to waste rock excavation and disposal. Below is a list of major activities that have occurred at the site, which could have an impact on the human health evaluation.

Remedial Investigation and Sampling Activity

- Summer 2006: EPA surface soil, sediment, and surface water sampling for Remedial Investigation

- Summer 2007: Removal of the tailings impoundment, which held precipitation; Re-routing and passive treatment of the Level 1 adit drainage with a pilot scale bioreactor; and the removal of old mining structures.

- 2007/2008: Removal of waste rock and tailings from the site and disposal in an onsite repository. Fill and re-vegetate onsite surfaces. Cap and cover the repository.

- Summer 2009: additional onsite surface soil sampling in support of the Remedial Investigation

- Summer 2010: The Proposed Plan for remediation was released for public comment. This proposed plan describes the cleanup alternatives that were considered and summarizes the agencies' reasons for recommending the proposed remedy, which is intended to improve water quality in Elk Creek and reduce human and ecological exposure to mine waste remaining at the site (EPA 2010b).

Health Risk Evaluation Activities and the Major Findings

- *Fall 2006: ATSDR Health Consultation on the potential impacts to Crested Butte water supply (ATSDR 2006)*: It was found that the Standard Mine does not impact Crested Butte's drinking water supply (Coal Creek) to a degree that would pose a public health hazard to residents.

- *Spring 2008: EPA Baseline Human Health Risk Assessment (SRC 2008):* EPA performed a baseline human health risk assessment to evaluate non-cancer and cancer risks for a variety of recreational receptors along the drainages and onsite near the mine. It was found that child ATV riders were the only receptors with hazard estimates above EPA's level of concern. This was due mainly to inhalation exposure to manganese in dust particles in air.

- *Summer 2008: ATSDR Surface Soil Health Consultation (ATSDR 2008a):* It was determined that the Standard Mine site constitutes a public health hazard due to exposure to lead by young children and pregnant women that visit the site on the above-average basis for recreational purposes such as camping, ATV riding, and hiking.

- *Fall 2008: ATSDR Health Consultation on the evaluation of recreational exposures to surface water, sediment, and fish consumption (ATSDR 2008b):* It was concluded that exposure to onsite lead contaminated surface water and sediment contaminated with lead poses a public health hazard to children who visit the Standard Mine site for recreational purposes.

- *Fall 2009: Addendum of EPA risk assessment including the surface soil data collected in 2009 after remedial actions (SRC 2009)*: This assessment indicated that the risks to humans who visit the site for recreational purposes are not a significant health concern because the estimated cancer and non-cancer risks for the maximally exposed child ATV riders to on-site soils through inhalation and ingestion are below a level of concern.

Onsite mine waste rock and tailings have been removed from the site and disposed of in a capped repository. Areas where excavation took place have been re-graded, the soils amended with compost and lime, and reseeded. This evaluation examines what affect response activities at the site have had on human health in relation to surface soil exposures.

Human health risks associated with sediment and surface water have been previously addressed (ATSDR 2008b). It is likely that the EPA response actions that have already been completed have had an effect on the concentration of metal contaminants in these media, particularly surface water. However, additional remedial work will be completed in the future that will also have an impact on the levels of contamination in surface water and sediment. The preferred remedial alternative in the Proposed Plan consists of installing a bulkhead in the Level 3 adit to prevent contaminated groundwater from entering the Level 1 adit where it can be released to the environment (EPA 2010b). If necessary, a treatment unit will be installed to treat mine water drainage from the Level 1 adit. Once this remedial activity is complete, CCPEHA will evaluate the newly collected surface water and sediment data and determine if additional health consultation activities are necessary.

Demographics

Figure 1 shows the demographic information for individuals living in the vicinity of the Standard Mine. The vast majority of people live in Crested Butte, a town of just over 1,700 residents, which lies approximately 4 miles east of the Standard Mine site (Census 2010). The large majority of the population (71%) is over the age of 25 years with a median age of 30.8 years. Approximately 3.7 percent of the population is under 5 years of age and 52.4% (812) of the population age 18 years and over are females of reproductive age. The Township of Irwin is located less than 1.5 miles west-southwest from the mine site, although no census data is available for this small community. From aerial imagery, it appears that there are around 10-15 homes in Irwin. This would equate to approximately 18-38 people in the Town of Irwin, based on the average household size for Crested Butte, CO (Census 2010). However, no residents have been identified in the immediate vicinity of the site.

Community Health Concerns

In February 2006, ATSDR participated in an EPA-sponsored public meeting in Crested Butte, CO. Approximately 20 residents, as well as several officials from city, state, and federal organizations attended the meeting. During this meeting, community members conveyed their health concerns regarding the site. These health concerns included: the potential accumulation of cadmium in human tissue from low dose exposures, fishing advisories on Coal Creek, the possibility of multiple sclerosis and other autoimmune diseases from exposure to site-related contaminants, and elevated risks of breast and skin cancers. The health concerns were presented in detail with responses from ATSDR in the initial health consultation on the Standard Mine (ATSDR 2006). In addition, community members were concerned about potential exposures from additional pathways to recreational users, which were evaluated in the previous health consultations on surface soil (ATSDR 2008a) and on recreational exposures to surface water, sediment, and fish consumption (ATSDR 2008b). CCPEHA is not aware of any new community health concerns.

Discussion

The overall goal of this health consultation is to determine if any residual soil contamination remaining after EPA response activities at the Standard Mine site poses a public health hazard and to make the necessary recommendations to protect public health if need be. The first step includes an examination of the currently available environmental data and a determination if contaminants of potential concern (COPCs) exist. The next step is to determine if people are likely to be exposed to site-related contaminants since just having contamination in the environment does not necessarily indicate that a health hazard exists. If exposure pathways to COPCs exist, exposure doses are estimated and compared to health-based guidelines established by the ATSDR and EPA. This is followed by an in-depth evaluation if the estimated exposure doses exceed the health-based guidelines.

Environmental Data

The surface soil data used in this evaluation was collected in July 2009 by EPA in support of the Remedial Investigation. A total of 58 surface soil samples (0-2 inch depth interval) were collected from Levels 1, 2, and 3 of the Standard Mine. Twenty background surface soil samples were also collected from Horseshoe Basin, an offsite location that has not been impacted by mining related contamination. All samples were analyzed for Target Analyte List (TAL) Metals by EPA Method C200.7 at an EPA contract laboratory. As mentioned previously, these soil samples were collected after the EPA removed and disposed of approximately 50,000 cubic yards of mining waste from the Standard Mine in 2007 and 2008. The 2009 soil samples are considered to represent current onsite soil conditions.

The 2009 surface soil data indicate that "hot spots" of contamination still exist following EPA response actions taken to date. In particular, the concentration of arsenic and lead is still high in some areas with respective maximum values of 252 mg/kg and 14,600 mg/kg. Overall, however, the concentrations of most soil contaminants appear to have decreased from 2006 levels. A summary table, shown below, compares major contaminants of potential concern from the 2006 and 2009 surface soil sampling events. The complete data summary is presented in Table A1.

Table 1. Comparison of 2006 and 2009 Major Soil Contaminants

Contaminant	Sampling Description	Maximum (mg/kg)	Minimum (mg/kg)	Mean (mg/kg)
Aluminum	2006	18000	966	7068
	2009	21500	3880	12466
Antimony	2006	28.8	0.8	6.6
	2009	7.5	0.65	2.7
Arsenic	2006	680	4.6	75.5
	2009	252	6.6	47.8
Cadmium	2006	107	0.26	7.8
	2009	33.8	0.1	4.7
Copper	2006	2730	6	243.5
	2009	510	9.1	115.7
Lead	2006	63500	28.4	3658
	2009	14600	73.5	2100
Manganese	2006	12200	185	2248
	2009	11000	413	1999
Zinc	2006	20100	48	1370
	2009	1620	108	634.9

09BG: 2009 Background samples taken from Horseshoe Basin

Contaminants of Potential Concern

To identify surface soil contaminants of potential concern (COPCs) at the Standard Mine site, the 2009 surface soil data was screened with comparison values established by the ATSDR and EPA. The screening values from both agencies were reviewed and the most conservative value was selected as the Comparison Value (CV) for use in the screening process (Table A1). Both sets of the screening values used in this evaluation were derived for residential soil exposures. ATSDR's soil comparison values for chronic exposures are based on daily exposure to soil over a period longer than 1 year. The EPA's residential soil screening values are based on 350 days exposure per year over a period of 30 years (assumes 15 days away from the home per year). Using these CVs for screening is considered conservative and protective of individuals that would visit the Standard Mine site for recreational purposes. Therefore, if the maximum concentration of a particular contaminant is below the CV, it is dropped from further evaluation. If the maximum concentration of the contaminant is above the CV, it is generally retained for further analysis as a COPC. However, exceeding the CV does not indicate that a health hazard exists; only that additional evaluation is warranted. In accordance with CDPHE and EPA Region 8 protocol, if multiple contaminants exist at a site, the CV value for non-carcinogenic contaminants is multiplied by 0.1 (EPA 1994). The CV is multiplied by 0.1 to reduce the potential for additive non-cancer health effects from multiple chemical exposures. Multiplying the CV by 0.1 is thought to be a protective step to reduce the potential for additive non-cancer health effects from multiple chemical exposures.

The soil concentrations of aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, and manganese exceeded the CV for residential exposures and were selected as COPCs. The same contaminants were also selected as COPCs in the initial evaluation of soil exposures at the site, but the concentrations were typically lower in the data collected in 2009. It should be noted that selenium, silver, vanadium, and zinc were selected as COPCs in 2006, but the concentrations found in the 2009 soil data did not exceed the screening value and these contaminants were dropped from further evaluation. A summary of the selected COPCs is shown in Table 2 below and the complete table of the maximum concentration of soil contaminants versus the respective CV for that contaminant is found in Table A1.

Table 2. Summary of COPCs

Soil Contaminant	Maximum Concentration (mg/kg)	Comparison Value[1] (mg/kg)	Source for Comparison Value (CV)
Aluminum	21500	5000	ATSDR Child Chronic EMEG
Antimony	7.5	2.0	ATSDR Child Chronic RMEG
Arsenic	252	0.39	EPA RSL
Cadmium	33.8	0.5	ATSDR Child Chronic EMEG
Chromium	14.8	0.29	EPA RSL
Cobalt	30.2	2.3	EPA RSL
Copper	510	50	ATSDR Intermediate EMEG
Iron	69000	5500	EPA RSL
Lead	14600	40	EPA OSWER CV for Lead
Manganese	11000	300	ATSDR RMEG

NOTE: [1] Comparison Value is 10% of the original value to account for multiple chemical exposures. ATSDR = Agency for Toxic Substances and Disease Registry, EPA = Environmental Protection Agency, EMEG = Environmental Media Evaluation Guide, RMEG = Reference Dose Media Evaluation Guide, RSL = Regional Screening Level, OSWER = Office of Solid Waste and Emergency Response

Conceptual Site Model

A conceptual site model helps to visualize how contaminants of potential concern move in the environment at the site and how people might come into contact with these contaminants. Surface soil is the environmental medium under consideration in this health consultation and three routes of exposure to surface soil contaminants are likely to occur under any given scenario: 1) incidental ingestion of surface soil, 2) dermal contact with surface soil, and 3) inhalation of soil particles suspended in air (fugitive dust). All three of these pathways are considered complete for recreational users at the Standard Mine site. However, dermal contact with metals is considered a relatively insignificant exposure pathway due to the limited ability of metal contaminants to cross the skin barrier and enter the bloodstream. Therefore, dermal contact with metals in surface soil was not quantitatively addressed in this evaluation. Incidental ingestion of surface soil and inhalation of particulates (fugitive dusts) were evaluated quantitatively.

The area surrounding the Standard Mine Site is primarily controlled by the U.S. Forest Service and is only accessible by off-road vehicles, hiking, and mountain biking. The surrounding slopes are steep and heavily forested, which reduces and deters access to some degree. In addition, U.S. Energy controls and prohibits unauthorized access to the only passable road that leads to the Standard Mine site. Land use information at the Standard Mine site is limited. However, a community survey was conducted by the Region 8 EPA and the CDPHE in the summer of 2006 to determine potential land use at the site (SRC 2007, attached as Appendix F). A total of 29 adults responded to the survey and identified recreational use as the primary land use at the Standard Mine. No residents live in the immediate vicinity of the site.

The recreational uses identified in the survey, from most popular response to least popular response, include hiking and mountain biking (28), skiing and snowmobiling (17), ATV and motorcycle riding (14), and camping (6). No one indicated they thought fishing, mining, or other activities were occurring onsite.

Most people thought that the time spent at the Standard Mine would be very little as they believed people would just be passing through the site on their way to other nearby features. All but one person thought the time spent at the site would be less than 5 hrs. per visit and that individual responded up to 10 hrs. per visit. The frequency of site visits was also recorded in the community survey. Approximately 17 people responded to this question and the responses ranged from under 5 days per year to over 20 days per year. The majority of individuals (11/17) who responded to this question marked “under 5 days per year”. Only 1 person stated they visit the site for more than 20 days per year.

With this information, a conceptual site model was developed. Skiing and snowmobiling was not evaluated in this consultation since snowpack eliminates contact with surface soils. The conceptual site model for surface soil exposures by recreational users is detailed below in Table 3.

Table 3. Conceptual Site Model

Source	Transport Mechanism	Point of Exposure	Affected Environmental Medium	Timeframe of Exposure	Exposed Population	Route of Exposure
Mine Workings	Human transport and relocation of mine workings, Mine drainage	Surface Soils at Standard Mine	Surface Soil	Past, current, or future*	Recreational Users Including: Hikers, Campers, and ATV riders	Soil Ingestion
						Inhalation of Fugitive Dust
						Dermal Exposure to Soil Contaminants

NOTE: * see below for discussion on the occurrence of past, current and future exposure pathways
1) Dermal exposure to surface soil contaminants is considered an insignificant exposure pathway for most metal contaminants and is not quantitatively evaluated in this health consultation.
2) Inhalation of fugitive dusts is considered relevant only for ATV riders.

The primary recreational users identified in the land use survey are hikers and mountain bikers, ATV and motocross riders, and campers. To simplify the exposure evaluation, hikers, ATV riders, and campers were used as the representative recreational activities. Child and adult recreational users were evaluated for each activity, however, the ages of children varied by activity. The complete exposure parameters used to estimate exposure doses are presented in Appendix B and the main exposure assumptions are discussed below by exposure scenario.

Based on the community survey and what is known about the site, the exposure parameters used in this evaluation are intended to describe an average user and a high-end user. The general assumptions for the Central Tendency Exposure (CTE), which is intended to describe the 50^{th} percentile exposures (i.e. average user), include 5 visits to the site per year for a period of 2 yrs. for children and 9 years for adults. The general assumptions for the Reasonable Maximum Exposure (RME), which is intended to describe exposures above the 90^{th} percentile (i.e., high-end user), include 20 visits to the site per year for a period of 6 yrs. for children and 30 yrs. for adults. In addition, a future potential exposure scenario was also evaluated to address the possibility of an increase in site use following EPA response activities at the site. The future potential exposure default/ professional judgment recreational assumptions include 52 visits per year over a period of 6 yrs. for children and 30 yrs. for adults, a reasonable assumption that should account for all future potential site use. Scenario-specific exposure parameters are discussed in more detail below.

Recreational Hiker Exposure Scenario

The recreational hiker is perhaps the most representative exposure scenario evaluated in this health consultation. Individuals do hike to the site or otherwise visit the site in a manner that would result in exposures similar to a hiker (i.e., site visits). It was assumed that child and adult hikers would visit the site. The term "child hikers" in this case is a child who is between 7-12 years of age. This age range was used because it is unlikely that younger children would be hiking at the site due to the steep terrain. Incidental ingestion of surface soil is the only exposure pathway that is likely to result in any significant exposure to hikers from contacting surface soil contaminants at the Standard Mine site. Inhalation of fugitive dust was not considered an important route of exposure for this scenario because it was assumed that hikers would not be disturbing the soil in a manner that would result in significant dust generation. Wind-generated dust exposure is possible for hikers, but this was considered a relatively minor exposure pathway and was not evaluated.

Recreational ATV Rider Exposure Scenario

ATV and motorcycle riding were listed as the third most popular activity to occur at the Standard Mine site in the community survey. The exposures from off road motorcycling and ATV riding are similar enough to bundle both into the ATV rider exposure scenario. Since EPA remedial activity at that site began, no ATV riding has been witnessed by EPA staff or members of the community group that visits the site. However, past anecdotal evidence, in addition to the community survey results, suggests that ATV riding did occur in the past. ATV riding may not be a currently occurring exposure scenario, but that it could occur again in the future once the EPA has finished all remedial action at the site.

Both incidental ingestion of surface soil and inhalation of dusts are important routes of exposure for ATV riders and were considered in this evaluation. Dust inhalation was considered important for ATV riders because under normal use, ATVs generate a large amount of dust and the following riders can be exposed to significant amounts of dust. Child ATV riders were also assumed to be between the ages of 7 and 12 years because younger children are not likely to be riding ATVs at the site.

Recreational Camper Exposure Scenario

Camping was also identified in the community survey as an activity that takes place in the area around the Standard Mine site. However, no camping has been observed and it is unlikely that individuals have been camping at the Standard Mine site since EPA response activity began.

Once remedial activity is complete, it is possible that individuals will camp at the site. Therefore, camping is considered a future exposure pathway. Incidental ingestion of soil is the only route of exposure that was considered important for campers at the site. Similar to the hiker scenario, inhalation of fugitive dusts was not considered an important route of exposure for campers in this evaluation.

Exposure Point Concentration

The exposure point concentration (EPC) describes the concentration of soil contaminants that people are likely to come into contact with. As mentioned previously, the concentration of soil contaminants varies throughout the site. The typical user would be exposed to soil over a broad area at the site. Therefore, it was assumed that the entire site was the exposure unit (or area) of concern. Thus, the 2009 soil data that was collected throughout the site was combined for use in estimating the EPCs for each contaminant of potential concern. The data was inserted into EPA's ProUCL software, which calculates the Upper Confidence Limit (UCL) for a data set by various statistical methods, and recommends the appropriate EPC. For example, with a normal data set, the resulting concentration estimation is typically the 95% UCL on the mean concentration of all data. The EPC for all COPCs is shown in Table B1. For estimating EPCs, ½ the detection limit was not used as a substitute for values below the detection limit. Instead, ProUCL recommended statistically rigorous methods (e.g., Kaplan-Meier) were applied.

As mentioned, inhalation of dust was considered an important route of exposure for ATV riders. Dust samples have not been collected from the site and analyzed for metals. Therefore, dust sampling that was conducted while riding ATVs at a different site was used to frame the dust exposure point concentration for ATV riders in this evaluation. The amount of dust generated while riding ATVs in this study was used to derive a particulate emission factor, which could then be used in conjunction with the soil data collected from the Standard Mine site to calculate the EPC of dust. For additional details on this calculation, see Appendix D.

Public Health Implications

The public health implications of recreational exposures to surface soil contaminants at the site were determined using a combination of exposure dose estimations and biokinetic modeling. For all non-lead contaminants of potential concern (COPCs), non-cancer (aluminum, antimony, arsenic, cadmium, chromium, cobalt, copper, iron, and manganese) and cancer doses (arsenic, cadmium, chromium, and cobalt) were estimated and the doses were compared with health-based values. To assess the public health implications of lead exposures, modeling was used as an estimate of the blood lead level in pregnant women and young children (0-6 years). Chronic and acute exposures to non-lead contaminants are described below, followed by a discussion of the lead evaluation. Additional details about the dose calculations and toxicity values are provided in Appendices B and E, respectively.

Recreational Hiker Health Implications of Chronic Exposure

The estimated non-cancer ingestion doses for all COPCs are below the health-based guidelines (Hazard Quotients < 1) for all CTE and RME hikers (Table A2). In addition, the estimated non-cancer Hazard Quotients (HQs) for the high-use, future potential hikers were also less than 1. The highest estimated HQ from hiking at the Standard Mine site was observed for future potential child hikers (age 7-12 years) following exposure to arsenic in site soil. The highest HQ is 0.09, which means that the estimated exposure dose of arsenic for the future potential child hiker is approximately 10 times lower than the health-based guideline for arsenic. For the RME and CTE hiker, the non-cancer doses are at least a hundred times lower than the health-base guideline for all COPCs. In addition, the Hazard Index (total HQ) from exposure to all COPCs combined is also well below the level of health concern (i.e., Hazard Index=1 or below health guidelines) for all hiking scenarios evaluated (Table A2). This indicates that significant non-cancer adverse health effects are not expected from hiking at the Standard Mine site under the exposure assumptions and methods used in this evaluation.

Arsenic is the only known oral carcinogen thought to exist in onsite surface soil. Theoretical cancer risks from exposure to arsenic in soil were estimated using an age-adjusted equation for hikers that accounts for exposures occurring as a child and as an adult (Table A2). Cancer risks are compared to the EPA acceptable cancer risk range of $1 * 10^{-6}$ (low-end) to $1 * 10^{-4}$ (high-end) or 1 excess cancer case per million exposed individuals to 100 excess cancer cases per million exposed individuals. The estimated theoretical cancer risk for the future potential scenario of 52 days of exposure per year is $7.0 * 10^{-6}$, or 7 excess cancer cases per million exposed individuals. The age-adjusted theoretical cancer risk for RME hikers exposed to arsenic in soil is $5.4 * 10^{-6}$, or 5.4 excess cancer cases per million exposed individuals. For CTE hikers, the estimated theoretical cancer risk from exposure to arsenic in soil is $8.4 * 10^{-8}$, or 0.084 excess cancer cases per million exposed individuals. Therefore, the estimated theoretical cancer risks for all hikers are below, or well within, the EPA's acceptable cancer risk range. This indicates a very low increased risk of developing cancer from hiking at the Standard Mine site. It is also important to note that the non-cancer health hazards and theoretical cancer risks were estimated based on the conservative assumption of 100% bioavailability of metals in soil at the site.

Recreational Camper Health Implications of Chronic Exposure

The estimated non-cancer ingestion doses for child and adult campers are also below the respective health-based guideline for all surface soil contaminants of potential concern. The highest HQ of 0.4 is for incidental ingestion of arsenic in onsite soil by the future potential child campers, ages 0-6 years (Table A3). Thus, the estimated exposure dose for future potential child campers is over 2 times lower than the health-based guideline for arsenic. The HQ of arsenic for RME child campers is 0.2 and for CTE child campers, the HQ is 0.02. All of the estimated non-cancer HQs are below a level of health concern individually. In addition, the combined HQ (i.e., Hazard Index; HI) for all contaminants of potential concern is either below (for CTE and RME scenarios) or at (for future potential scenario) the level of health concern (i.e. HI =1.0 or below health guidelines)) for child and adult campers (Table A3). This indicates that significant non-cancer health hazards are not likely to occur from exposure to soil while camping at the site.

As mentioned previously, arsenic is the only known oral carcinogen thought to exist in onsite surface soil. The age-adjusted cancer risk equation was also used for the camping scenario (Table A3). For the future potential camper scenario, the estimated theoretical cancer risk is $2.3 * 10^{-5}$ or 23 excess cancer cases per million exposed individuals. For the RME camper scenario, the estimated theoretical cancer risk is $8.7 * 10^{-6}$ or 8.7 excess cancer case per million exposed individuals. For the CTE camper scenario, the estimated theoretical cancer risks are $3.8 * 10^{-7}$ or 0.78 excess cancer cases per million exposed individuals. The estimated theoretical cancer risks are below, or well within, the EPA's acceptable cancer risk range. Therefore, the estimated cancer risks indicate a very low increased risk of developing cancer from exposure to soil while camping at the Standard Mine site. Once again, the non-cancer hazards and cancer risks are based on the conservative assumption of 100% bioavailability of metals in soil.

Recreational ATV Rider Health Implications of Chronic Exposure

As noted in the exposure evaluation section, incidental ingestion of soil and inhalation of fugitive dusts generated by the ATVs are important exposure pathways for ATV riders. Both pathways of exposure occur simultaneously while riding ATVs. So, the exposure doses for both pathways are combined resulting in a total dose while riding ATVs at the site. The estimated exposure doses for ingestion and inhalation pathways are presented separately in Tables A4 and A5, respectively. The combined doses for ATV riders are presented in Table A6 and are briefly discussed below.

As shown in Table A6, the combined ingestion and inhalation non-cancer HQs for ATV riders are below 1 for all COPCs under the CTE and RME scenarios. For the future potential ATV rider, the same is true with the exception of manganese, which has a HQ of 1.6. This is largely due to the inhalation of manganese containing dusts by the future potential child ATV rider. The estimated dose of manganese ingestion for the future potential child ATV rider is approximately 10 times lower than the oral health-based guideline and is not a concern when considered independently of the inhalation exposures experienced by ATV riders. It is, however, important to note that the inhalation dose of manganese (0.0000184 mg/kg/day) for the future potential child ATV rider is significantly below (>1700 times) the benchmark dose level (BMDL) of 0.0317 mg/kg/day (ATSDR 2010). This dose at a 10% response rate ($BMDL_{10}$) was considered equivalent to a No Observed Adverse Effect Level (NOAEL) for neurobehavioral effects such as reaction time, hand-eye coordination, and hand steadiness in workers when deriving the ATSDR chronic inhalation MRL (ATSDR, 2010). This indicates that significant non-cancer adverse health effects are not likely.

In addition, the combined Hazard Index is also below level of health concern (i.e. HI =1.0 or below health guidelines)) for all ATV riders except the future potential child ATV rider, which has an estimated HI of 2.3. Exposure to manganese while riding ATVs is the major risk driver in this case, particularly inhalation of manganese containing dust (HQ= 1.6). Considering the conservative exposure assumptions used in this evaluation, the comparison of inhalation doses with known health effect levels (as noted above), and the reduced bioavailability of metals in soil, the future potential child ATV rider is not likely to experience significant non-cancer adverse health effects. Overall, the estimated non-cancer hazards indicate that significant non-cancer adverse health effects are not likely for children or adults riding ATVs at the Standard Mine site.

Theoretical cancer risks were also evaluated for both inhalation of dusts and ingestion of soil while riding ATVs at the Standard Mine site. Arsenic is the only oral carcinogen identified as a COPC in soils at the site. However, arsenic, cadmium, chromium, and cobalt are all considered carcinogenic through the inhalation pathway by the EPA. The highest total (inhalation and ingestion) theoretical cancer risk is from exposure to arsenic in site soils for the future potential ATV rider, which is $1.6 * 10^{-5}$, or 16 excess cancer cases per million people exposed. This value is well within the EPA acceptable theoretical cancer risk range. Exposure to all carcinogens found in site soils would occur while riding ATVs, so the estimated cancer risks for each COPC was also combined. The combined theoretical cancer risk from exposure to all carcinogens is $2.0 * 10^{-5}$ for the future potential ATV rider, $5.8 * 10^{-6}$ for the RME ATV rider, and $4.0 * 10^{-7}$ for the CTE ATV rider. In each case, the combined theoretical cancer risks are well within or below the EPA acceptable cancer risk range. Overall, the estimated cancer risks under all exposure scenarios indicate a very low increased risk of developing cancer from riding ATVs at the Standard Mine site.

Acute Health Hazards to Recreational Children

Acute exposures to contaminants in soil at the Standard Mine were evaluated over a short period of time (1-day) at higher ingestion rates. The purpose of the acute evaluation is to determine if there are areas where the contaminant concentrations could result in health hazards from a one-time exposure. The acute evaluation is only relevant for children (ages 0-6 years) since adults are not as likely to ingest as large amounts of soil intentionally. It has also been shown that some children intentionally ingest large amounts of soil, which is referred to as pica behavior. Pica is an eating disorder associated with the consumption of large amounts of non-nutritive substances such as soil. ATSDR pica comparison values are based on the consumption of a large amount of soil (5,000 mg/day). However, the prevalence of pica behavior is not known and assuming an ingestion rate of 5,000 milligrams of soil per day may significantly overestimate the non-cancer health risks for recreational children using the Standard Mine site. At this site, a soil ingestion rate of 5,000 mg/day was considered unreasonable for 3 primary reasons: 1) the probability of young children (2-3 years of age), who commonly exhibit pica, visiting the site is low, 2) the chances of coming into contact with the maximum concentration of arsenic and copper and exhibiting pica behavior are extremely low, and (3) evaluation of pica behavior for recreational users at the Standard Mine site is not a likely scenario, especially at the high-end ingestion rate of 5,000 mg/day. Therefore, CCPEHA estimated acute risks with a soil ingestion rate of 400 mg/day and 1,000 mg/day, which appear to be more reasonable assumptions for exposures at the Standard Mine site. The 400 mg/day ingestion rate is the EPA recommended upper percentile soil ingestion rate value based on a short term study (EPA 1997). The 1,000 mg/day ingestion rate is based on the revised Exposure Factor Handbooks (EPA, 2008, 2009).

In the acute evaluation, copper and arsenic were used as indicator chemicals for acute exposures because they were found at high concentrations and acute health guidelines (ATSDR Acute Oral MRL) are available for these contaminants. Acute risks were estimated using the site exposure point concentration that was used in all other exposure dose calculations, as well as the maximum detected concentration of all site soil samples.

Acute exposure to soil contaminants at the Standard Mine site were also evaluated in this health consultation because there are “hot spots” of contaminants that can be acutely toxic and there are some children who enjoy eating and playing in soil, which can also result in acute toxicity. Two different ingestion rates were used to evaluate acute soil exposures to recreational children. The estimated non-cancer health risks are discussed below for acute exposures at each ingestion rate.

At the ingestion rate of 400 mg/day, the estimated acute exposure doses for copper and arsenic are below the acute health-based guidelines when using the site exposure point concentration (Table A7). At the maximum detected concentration, the estimated acute exposure doses are just above the acute health-based guidelines for both arsenic and copper, with an acute Hazard Quotient (HQ) of 1.3 and 1.4, respectively. The estimated acute doses were then compared to observed health effect levels in the scientific literature (i.e., No-Observed-Adverse- Effect- Level and Lowest-Observed-Adverse-Effect-Level). The estimated acute dose of copper and arsenic are well below the acute LOAELs and/or NOAEL values identified for these contaminants. Thus, it was concluded that significant adverse health effects are not likely to occur from acute exposures over a 1-day period to arsenic and copper in site soil at the site exposure point concentration as well as at the maximum concentration based on the assumption of ingesting 400 mg/day of soil.

At the EPA pica ingestion rate of 1,000 mg/day (EPA 2008, 2009), the estimated acute exposure doses for copper and arsenic are lower than the acute health-based guidelines when using the site exposure point concentration (Table A8). At the maximum detected concentration, the estimated acute exposure doses are above the acute health-based guidelines for both arsenic (HQ= 3.4) and copper (HQ= 3.4). The estimated dose of copper at the maximum detected concentration and ingesting 1,000 mg/day is 0.034 mg/kg-day. The acute NOAEL and LOAEL values for copper are 0.0272 mg/kg-day and 0.0731 mg/kg-day, respectively. For the ATSDR MRL derivation, the acute NOAEL value for copper (Cu) is based on a 2-week exposure study conducted by Pizarro et al in 1999. In this study, gastrointestinal symptoms (e.g., nausea, vomiting, and/or abdominal pain) were observed in humans orally exposed to 0.0731 mg Cu/kg-day and 0.124 mg Cu/kg-day of copper sulfate in drinking water, but not at 0.0272 mg Cu/kg-day. In relation to the estimated dose of copper at the maximum detected concentration and an ingestion rate of 1,000 mg/day, the estimated dose slightly exceeds the human NOAEL value (HQ= 1.25) and is less than ½ the LOAEL value (HQ= 0.46). Since the estimated dose under these assumptions is lower than the LOAEL value and the fact that conservative assumptions were used for this exposure scenario, it does not appear likely that significant adverse health effects are likely to occur from coming into contact with copper at the site. For arsenic, a NOAEL value does not exist, but the estimated dose, assuming the maximum detected concentration and 1,000 mg/day soil ingestion, is below the LOAEL value by a factor of 5 (HQ= 0.34) (Table A8). A lack of an acute NOAEL value for arsenic does lead to some uncertainty in the acute evaluation, but it is clear that the estimated dose under these assumptions is well below the level at which adverse health effects are likely to occur. In addition, the actual acute dose of metals is likely to be lower than the estimated acute doses because of the reduced bioavailability of metals in soil. For example, the EPA Region 8 has utilized a default bioavailability factor of 50% for arsenic in soil. If this assumption was used in this evaluation, the health risk would be approximately ½ of what was noted here. Thus, it is concluded that significant adverse health effects are not likely to occur from acute exposures to arsenic and copper in site soil at the site exposure point concentration as well as at the maximum concentration based on the assumption of ingesting 1000 mg/day of soil. Overall, there is a low risk of developing noncancer health effects from acute exposure to copper and arsenic.

Recreational Exposures to Lead in Soil

The method of evaluating risks from exposure to lead differs from the assessment method mentioned previously where exposure doses are calculated and compared to health-based guidelines. To assess the health risks associated with lead exposure, modeling is used to predict the blood lead concentration of those exposed because individuals are exposed to lead from a variety of environmental sources. Lead exposures, and the subsequent health effects, have traditionally been described in terms of blood lead concentrations in the scientific literature. Young children (0-7 years) and the developing fetus are the most sensitive to the toxic effects of lead. Thus, child campers and pregnant women (i.e., the fetus) are the primary receptors of concern for the evaluation of lead exposures at this site.

Blood lead levels as low as 10 micrograms of lead per deciliter of blood (μg/dL), which do not result in obvious symptoms, are associated with decreased intelligence and/or impaired neurobehavioral development (CDC 1991). Blood lead levels of 10 μg/dL or greater is considered elevated, but there is no demonstrated safe level of lead in blood. A growing body of research has shown that there are measurable adverse neurological effects in children at blood lead concentrations as low as 1 μg/dL (EPA 2003a). The EPA has set a goal that there should be no more than a 5% chance that a typical (or hypothetical) child or group of similarly exposed children will exceed a blood lead value of 10 μg/dL. This approach focuses on the risk to a child at the upper bound of the distribution (i.e., 95^{th} percentile). In accordance with ATSDR guidelines, blood lead levels in children are estimated using the EPA's Integrated Exposure Uptake Biokinetic Model (IEUBK). The Adult Lead Model (ALM) is used to estimate the blood lead level in fetuses from the predicted blood lead level of the pregnant mother. These susceptible subpopulations are also considered protective of the general population. Therefore, if the blood lead concentration of young children and the fetus of pregnant women is not a concern at the site, exposures to lead by other recreational users is also not of concern.

The concentration of lead in surface soil at the Standard Mine site is highly variable with a range of 73.5 - 14,600 ppm. The median and average concentration of lead in site soils is 867.5 and 2100 ppm, respectively. The comparison value (CV) for residential exposures is 400 ppm, so lead was carried on as a COPC. In fact, over 70% of the surface soil samples collected in 2009 from the Standard Mine exceeded the residential CV for lead.

It should be noted that the IEUBK and ALM is intended for exposures where the concentration of lead in blood reaches a quasi steady-state. The Technical Review Workgroup (TRW) for lead has recommended that 12 days (weekly exposure over a period of three months) should be the minimum exposure frequency used in the IEUBK and ALM lead models (EPA OSWER #9285.7-76). Thus, slightly different exposure frequencies were used to evaluate lead exposures than were used to evaluate exposure to non-lead contaminants of concern. Average CTE (12 days) and above average RME (20 days) were selected based on the land-use survey described above. In addition, the potential future heavy-use (52 days) scenario was selected based on the default assumption for recreational use. The heavy-use scenario is considered a future potential exposure pathway since there is no evidence that pregnant women and children are currently visiting the site this frequently. In addition, there is some uncertainty regarding how often young children and pregnant women actually frequent the site because of the steep nature of the area. However, the heavy-use scenario was included in this evaluation as a conservative assumption because in the future, once the remedial activity is complete, individuals could visit the site more often.

The blood lead results are presented in Appendix C. The IEUBK model results did not indicate that the blood lead levels in children would exceed the 10 μg/dL cutoff from exposure to surface soil at the Standard Mine site under the average (CTE) and above-average (RME) use scenarios (Table C2).

As seen in Appendix Tables C4 and C5, the results of the Adult Lead Model (ALM) indicated a less than 5% probability (i.e. 0.8 – 3.6%) of blood lead levels in the fetus exceeding a level of health concern under the average (CTE) and above-average (RME) use scenarios.

Overall, exposure to lead in surface soil at the Standard Mine site by young children (age 0-6 years) camping with their parents and pregnant women is not expected to harm the health of all current recreational users.

It is important to note that the child and adult lead models rely on many input parameters to estimate blood lead levels as discussed in Appendix C. The EPA developed default values for all parameters to allow the model to be used without performing costly and time-consuming site-specific studies. Several of these parameters can be measured more accurately on a site-specific basis. In the absence of site-specific data, this evaluation used the default values. These default values could result in an over- or under estimation of the actual blood lead levels in any child or fetus.

Uncertainty Discussion

In general, the uncertainties associated with any risk-based health consultation are likely to over- or underestimate environmental exposures and the associated health hazards because all aspects of the exposure are typically unknown. This section of the discussion is not intended to be an in-depth description of all the uncertainties associated with this evaluation. Rather, the focus is to highlight the major assumptions and limitations that are specific to this evaluation and result in uncertainty.

- The evaluation of a potential future heavy-use exposure scenario of 52 days/year is associated with a large uncertainty because it seems to be unrealistic based on the current site conditions. This scenario is evaluated to address the future potential scenario based on the hypothetical change in land use.

- The estimated cancer and non-cancer risks from the dust inhalation pathway could be over- or underestimated because site-specific data is not available for airborne dust concentrations. These concentrations were estimated by using EPA's screening-level soil-to-air transfer model (i.e., adopted from SRC 2009).

- The overall cancer and non-cancer risks from ingestion pathway are overestimated because of the assumption of 100% metal bioavailability based on what is known of the reduced bioavailability of metals in soils.

- The assumption of additivity to estimate cumulative cancer and non-cancer risks is likely to over- or under-estimate risk due to synergistic and antagonistic interactions. However, non-cancer risk is contributed mainly by manganese and cancer risk is contributed mainly by arsenic. Therefore, interaction between chemicals of potential concern is unlikely to be a source of significant uncertainty.

- For lead risk evaluation, without site-specific data, there is uncertainty about how well the risk estimates predicted by modeling based on the default parameters reflect the true conditions at a site. For example, lead risks may be over- or underestimated based on the unavailable site-specific relative bioavailability of lead from soil.

Child Health Considerations

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

The potential for recreational children experiencing health effects from exposure to soil at the Standard Mine site was considered in this evaluation. Exposures to both lead and non-lead contaminants of potential concern were considered for child campers (age 0-6 years). In all cases, the estimated health risks were below a level of concern for all contaminants. Therefore acute and chronic exposures to soil at the Standard Mine site are not likely to result in any significant adverse health effects in children.

Conclusions

CCPEHA and ATSDR have reached the following one conclusion regarding current and future exposures to soil based on the current land use at the Standard Mine site:

Recreational acute (arsenic and copper) and chronic exposures (aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, and manganese) to surface soil at the Standard Mine site are not expected to harm people's health. This conclusion was reached because the estimated theoretical lifetime excess cancer risks are below or within the EPA acceptable cancer risk range (i.e., one in a million to hundred in a million) and the estimated acute and chronic non-cancer exposure doses are below levels of health concern. Overall, the estimated theoretical cancer risks and non-cancer hazards are associated with a very low increased risk

Recommendations

Based upon CCPEHA's review of the environmental data, exposure pathways, and potential public health implications of exposure to soil contaminants at the Standard Mine site, the following actions are appropriate and protective of current and future residents:

- As a precaution, individuals should take appropriate measures to reduce exposure to soil contaminants found at the Standard Mine site. This includes: washing hands when leaving the site or arriving at home, dusting off clothes prior to entering home, and reducing hand to mouth activity until hands and body are clean.

- In the future, if and when there is a possibility of heavy-use scenario, a land use survey should be repeated by CCPEHA to determine the appropriateness of using the extremely conservative exposure frequency of 52 days/year in this evaluation.

Public Health Action Plan

The public health action plan for the site contains a description of actions that have been or will be taken by CCPEHA and other governmental agencies at the site. The purpose of the public health action plan is to ensure that this public health consultation both identifies public health hazards and provides a plan of action designed to mitigate and prevent harmful human health effects resulting from breathing, drinking, eating, or touching hazardous substances in the environment. Included is a commitment on the part of CCPEHA to follow up on this plan to be sure that it is implemented.

Public health actions that will be implemented include:

- As necessary, CCPEHA will review any additional data collected from the Standard Mine site and evaluate the public health implications of the new data.

- Upon request, CCPEHA will provide assistance to State and Local environmental officials on sampling plans and analysis.

- CCPEHA will provide the appropriate level of health education on the findings of this health consultation to stakeholders and the community.

Report Preparation

This Health Consultation for the Standard Mines Site was prepared by the Colorado Department of Public Health and Environment (CDPHE) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved agency methodology and procedures existing at the time the health consultation was initiated. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this health consultation and concurs with its findings based on the information presented in this report. ATSDR's approval of this document has been captured in an electronic database, and the approving reviewers are listed below.

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Appendix A: Additional Tables and Figures

Table A1. Standard Mine Surface Soil Data Comparison (page 1 of 2)

Contaminant	Year	Maximum (mg/kg)	Minimum (mg/kg)	Mean (mg/kg)	Detection Frequency	Number of Samples	Comparison Value[a] (mg/kg)	COPC	Comparison Value Source
Aluminum	2006	18000	966	7068	100%	190	7600	X	EPA PRG
	2009	21500	3880	12466	100%	58	5000	X	ATSDR Child Chronic EMEG
Antimony	2006	28.8	0.8	6.6	32.6%	190	3.1	X	EPA RSL
	2009	7.5	0.65	2.7	37.9%	58	2	X	ATSDR Child Chronic RMEG
Arsenic	2006	680	4.6	75.5	100%	190	0.39	X	EPA RSL
	2009	252	6.6	47.8	100%	58	0.39	X	EPA RSL
Barium	2006	580	24.3	118.9	100%	190	540	X	EPA PRG
	2009	181	51.4	116.9	100%	58	1000		ATSDR Child Chronic EMEG
Beryllium	2006	6.1	0.02	0.8	95.3%	190	15		EPA PRG
	2009	2.7	0.4	0.9	100%	58	10		ATSDR Child Chronic EMEG
Cadmium	2006	107	0.26	7.8	93.7%	190	3.7	X	EPA RSL
	2009	33.8	0.1	4.7	93.1%	58	0.5	X	ATSDR Child Chronic EMEG
Calcium	2006	16100	99.9	1908.1	100%	190	NA		N/a
	2009	145000	229	7764	100%	58	NA		N/a
Chromium	2006	93.2	0.71	6.9	100%	190	3	X	EPA PRG
	2009	14.8	2.6	7.6	100%	58	0.29*	X	EPA RSL
Cobalt	2006	35.1	0.065	7.6	98.4%	190	90		EPA PRG
	2009	30.2	2.9	8.0	100%	58	2.3	X	EPA RSL
Copper	2006	2730	6	243.5	100%	190	310	X	EPA PRG
	2009	510	9.1	115.7	100%	58	50	X	ATSDR Intermediate Child EMEG
Iron	2006	195999	5600	32635	100%	190	2300	X	EPA PRG
	2009	69000	11200	26795	100%	58	5500	X	EPA RSL
Lead	2006	63500	28.4	3658	99.5%	190	40	X	EPA OSWER CV
	2009	14600	73.5	2100	100%	58	40	X	EPA OSWER CV
Magnesium	2006	3060	120	1503	100%	190	NA		N/a
	2009	25800	515	3246	100%	58	NA		N/a
Manganese	2006	12200	185	2248	100%	190	180	X	EPA PRG
	2009	11000	413	1999	100%	58	300	X	ATSDR Child Chronic RMEG

Table A1. Standard Mine Surface Soil Data Comparison (Continued page 2 of 2)

Contaminant	Year	Maximum (mg/kg)	Minimum (mg/kg)	Mean (mg/kg)	Detection Frequency	Number of Samples	Comparison Value (mg/kg)	COPC	Comparison Value Source
Mercury	2006	0.33	0.0095	0.067	79.5%	190	2.3		EPA RSL
	2009	0.47	0.051	0.11	46.6%	58	2.3		EPA RSL
Nickel	2006	20	0.041	6.1	98.4%	190	160		EPA PRG
	2009	10.9	2.2	6.4	100%	58	100		ATSDR Child Chronic RMEG
Potassium	2006	2550	663	1354	100%	190	NA		N/a
	2009	3110	1760	2393	100%	58	NA		N/a
Selenium	2006	66.3	0.99	12.6	50%	190	39	X	EPA PRG
	2009	14.8	0.26	2.2	63.8%	58	30		ATSDR Child Chronic EMEG
Silver	2006	106	0.36	11.8	98.4%	190	39	X	EPA PRG
	2009	29.7	0.065	4.4	96.6%	58	30		ATSDR Child Chronic RMEG
Sodium	2006	1060	0.42	100.3	92.1%	190	NA		N/a
	2009	226	55.8	120.2	100%	58	NA		N/a
Thallium	2006	6.5	1.0	2.5	5.8%	190	0.52	X	EPA PRG
	2009	6.8	0.68	2.5	32.8%	58	NA		N/a
Vanadium	2006	31	3.0	13.4	100%	190	7.8	X	EPA PRG
	2009	31.3	11.2	18.0	100%	58	39		EPA RSL

NOTE: [a] The comparison value used in this evaluation is 1/10th of the screening value selected to account for multiple chemical exposures, mg/kg: milligram contaminant per kilogram soil, COPC: Contaminant of Potential Concern, 09BG: Background data collected in 2009 (for comparison purposes only), ATSDR = Agency for Toxic Substances and Disease Registry, EPA = Environmental Protection Agency, PRG = Preliminary Remediation Goal, EMEG = Environmental Media Evaluation Guide, RMEG = Reference Dose Media Evaluation Guide, RSL = Regional Screening Level, OSWER = Office of Solid Waste and Emergency Response

Table A2. Hiker Soil Ingestion Hazard Quotients and Theoretical Cancer Risks

COPC	Child Hiker Hazard Quotient			Adult Hiker Hazard Quotient			Age-adjusted Hiker Cancer Risk		
	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use
Aluminum	2.20E-04	2.20E-03	5.71E-03	5.18E-05	5.18E-04	1.35E-03	NA	NA	NA
Antimony	9.13E-05	9.13E-04	2.37E-03	2.15E-05	2.15E-04	5.60E-04	NA	NA	NA
Arsenic	3.59E-03	3.59E-02	9.34E-02	8.47E-04	8.47E-03	2.20E-02	8.38E-08	5.38E-06	6.99E-06
Cadmium	1.30E-03	1.30E-02	3.37E-02	3.05E-04	3.05E-03	7.94E-03	NA	NA	NA
Chromium	1.34E-04	1.34E-03	3.50E-03	3.17E-05	3.17E-04	8.24E-04	NA	NA	NA
Cobalt	4.93E-04	4.93E-03	1.28E-02	1.16E-04	1.16E-03	3.02E-03	NA	NA	NA
Copper	6.00E-05	6.00E-04	1.56E-03	1.41E-05	1.41E-04	3.68E-04	NA	NA	NA
Iron	7.09E-04	7.09E-03	1.84E-02	1.67E-04	1.67E-03	4.34E-03	NA	NA	NA
Manganese	2.08E-03	2.08E-02	5.42E-02	4.91E-04	4.91E-03	1.28E-02	NA	NA	NA
Hazard Index	8.68E-03	8.68E-02	2.26E-01	2.05E-03	2.05E-02	5.32E-02	NA	NA	NA

NOTE: Hazard Quotients (HQs) are the calculated by dividing the non-cancer exposure dose by the health-based guideline for the COPC. HQs greater than 1 indicate that the health-based guideline has been exceeded. The Hazard Index is the sum of all HQs. CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure

Table A3. Camper Soil Ingestion Hazard Quotients and Theoretical Cancer Risks

COPC	Child Camper Hazard Quotient			Adult Camper Hazard Quotient			Age-adjusted Camper Cancer Risk		
	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use
Aluminum	1.21E-03	9.66E-03	2.51E-02	1.29E-04	1.04E-03	2.69E-03	NA	NA	NA
Antimony	5.02E-04	4.02E-03	1.04E-02	5.38E-05	4.31E-04	1.12E-03	NA	NA	NA
Arsenic	1.98E-02	1.58E-01	4.11E-01	2.12E-03	1.69E-02	4.40E-02	3.75E-07	8.71E-06	2.26E-05
Cadmium	7.12E-03	5.70E-02	1.48E-01	7.63E-04	6.11E-03	1.59E-02	NA	NA	NA
Chromium	7.40E-04	5.92E-03	1.54E-02	7.93E-05	6.34E-04	1.65E-03	NA	NA	NA
Cobalt	2.71E-03	2.17E-02	5.64E-02	2.90E-04	2.32E-03	6.04E-03	NA	NA	NA
Copper	3.30E-04	2.64E-03	6.86E-03	3.53E-05	2.83E-04	7.35E-04	NA	NA	NA
Iron	3.90E-03	3.12E-02	8.11E-02	4.18E-04	3.34E-03	8.69E-03	NA	NA	NA
Manganese	1.15E-02	9.17E-02	2.38E-01	1.23E-03	9.82E-03	2.55E-02	NA	NA	NA
Hazard Index	4.77E-02	3.82E-01	9.93E-01	5.11E-03	4.09E-02	1.06E-01	NA	NA	NA

NOTE: Hazard Quotients (HQs) are the calculated by dividing the non-cancer exposure dose by the health-based guideline for the COPC. HQs greater than 1 indicate that the health-based guideline has been exceeded. The Hazard Index is the sum of all HQs. CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure

Table A4. ATV Rider Soil Ingestion Hazard Quotients and Theoretical Cancer Risks

COPC	Child ATV Rider Hazard Quotient			Adult ATV Rider Hazard Quotient			Age-adjusted ATV Rider Cancer Risk		
	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use
Aluminum	5.49E-04	1.32E-02	1.14E-02	1.29E-04	3.45E-03	2.69E-03	NA	NA	NA
Antimony	2.28E-04	5.48E-03	4.75E-03	5.38E-05	1.44E-03	1.12E-03	NA	NA	NA
Arsenic	8.98E-03	2.16E-01	1.87E-01	2.12E-03	5.64E-02	4.40E-02	2.11E-07	5.38E-06	1.40E-05
Cadmium	3.24E-03	7.77E-02	6.73E-02	7.63E-04	2.04E-02	1.59E-02	NA	NA	NA
Chromium	3.36E-04	8.07E-03	6.99E-03	7.93E-05	2.11E-03	1.65E-03	NA	NA	NA
Cobalt	1.23E-03	2.96E-02	2.56E-02	2.90E-04	7.74E-03	6.04E-03	NA	NA	NA
Copper	1.50E-04	3.60E-03	3.12E-03	3.53E-05	9.43E-04	7.35E-04	NA	NA	NA
Iron	1.77E-03	4.25E-02	3.68E-02	4.18E-04	1.11E-02	8.69E-03	NA	NA	NA
Manganese	5.21E-03	1.25E-01	1.08E-01	1.23E-03	3.27E-02	2.55E-02	NA	NA	NA
Hazard Index	2.17E-02	5.21E-01	4.51E-01	5.11E-03	1.36E-01	1.06E-01	NA	NA	NA

NOTE: Hazard Quotients (HQs) are the calculated by dividing the non-cancer exposure dose by the health-based guideline for the COPC. HQs greater than 1 indicate that the health-based guideline has been exceeded. The Hazard Index is the sum of all HQs. CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure

Table A5. ATV Rider Particulate Inhalation Hazard Quotients and Theoretical Cancer Risks

COPC	Child ATV Rider Hazard Quotient			Adult ATV Rider Hazard Quotient			Age-adjusted ATV Rider Cancer Risk		
	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use
Aluminum	5.44E-03	2.18E-02	5.66E-02	1.90E-03	3.04E-02	6.16E-02	NA	NA	NA
Antimony	2.26E-05	9.05E-05	2.35E-04	1.42E-05	5.69E-05	1.48E-04	NA	NA	NA
Arsenic	8.90E-03	3.56E-02	9.25E-02	5.59E-03	2.24E-02	5.82E-02	6.29E-08	2.52E-07	2.13E-06
Cadmium	1.60E-03	6.42E-03	1.67E-02	1.01E-03	4.03E-03	1.05E-02	3.18E-09	1.27E-08	1.07E-07
Chromium	1.67E-04	6.66E-04	1.73E-03	1.05E-04	4.19E-04	1.09E-03	2.20E-08	8.79E-08	7.43E-07
Cobalt	3.05E-03	1.22E-02	3.17E-02	1.92E-03	7.67E-03	1.99E-02	1.81E-08	7.25E-08	6.12E-07
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	1.55E-01	6.19E-01	**1.61E+00**	9.73E-02	3.89E-01	**1.01E+00**	NA	NA	NA
Hazard Index/Total Cancer Risk	1.74E-01	6.96E-01	**1.81E+00**	1.08E-01	4.54E-01	**1.16E+00**	1.06E-07	4.25E-07	3.59E-06

NOTE for Table A5: Hazard Quotients (HQs) are the calculated by dividing the non-cancer exposure dose by the health-based guideline for the COPC. HQs greater than 1 indicate that the health-based guideline has been exceeded. The Hazard Index is the sum of all HQs. The values bolded in red denote HQs greater than 1. CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure

Table A6. ATV Rider Combined Hazard Quotients and Theoretical Cancer Risks

COPC	Child ATV Rider Hazard Quotient			Adult ATV Rider Hazard Quotient			Age-adjusted ATV Rider Cancer Risk		
	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use
Aluminum	5.99E-03	3.49E-02	6.80E-02	2.03E-03	3.38E-02	6.43E-02	NA	NA	NA
Antimony	2.51E-04	5.57E-03	4.98E-03	6.80E-05	1.49E-03	1.27E-03	NA	NA	NA
Arsenic	1.79E-02	2.51E-01	2.79E-01	7.71E-03	7.88E-02	1.02E-01	2.74E-07	5.63E-06	1.61E-05
Cadmium	4.84E-03	8.41E-02	8.40E-02	1.77E-03	2.44E-02	2.64E-02	9.07E-09	9.07E-09	3.07E-07
Chromium	5.03E-04	8.74E-03	8.73E-03	1.84E-04	2.53E-03	2.74E-03	6.28E-08	6.28E-08	2.12E-06
Cobalt	4.28E-03	4.18E-02	5.73E-02	2.21E-03	1.54E-02	2.60E-02	5.18E-08	5.18E-08	1.75E-06
Copper	1.50E-04	3.60E-03	3.12E-03	3.53E-05	9.43E-04	7.35E-04	NA	NA	NA
Iron	1.77E-03	4.25E-02	3.68E-02	4.18E-04	1.11E-02	8.69E-03	NA	NA	NA
Manganese	1.60E-01	7.44E-01	**1.72E+00**	9.86E-02	4.22E-01	**1.04E+00**	NA	NA	NA
Hazard Index/Total Cancer Risks	1.96E-01	**1.22E+00**	**2.26E+00**	1.13E-01	5.91E-01	**1.27E+00**	3.98E-07	5.76E-06	2.03E-05

NOTE for Table A6: Hazard Quotients (HQs) are the calculated by dividing the non-cancer exposure dose by the health-based guideline for the COPC. HQs greater than 1 indicate that the health-based guideline has been exceeded. The Hazard Index is the sum of all HQs. The values bolded in red denote HQs greater than 1. CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure

Table A7. Evaluation of Acute Soil Exposures to Arsenic and Copper for Children (Ingestion rate = 400 mg/day)

COPC	Concentration (mg/kg)	Exposure Dose (mg/kg-day)	Health-based Guideline	Health-based Guideline Hazard Quotient	NOAEL based Hazard Quotient	LOAEL based Hazard Quotient
Acute Risks with calculated site Exposure Point Concentration						
Arsenic	64.9	1.73E-03	5.0E-03	3.46E-01	NA	3.46E-02
Copper	144.5	3.85E-03	1.0E-02	3.85E-01	1.42E-01	5.27E-02
Acute Risks with maximum detected concentration (hot spot evaluation)						
Arsenic	252	6.72E-03	5.0E-03	**1.34E+00**	NA	1.34E-01
Copper	510	1.36E-02	1.0E-02	**1.36E+00**	5.00E-01	1.86E-01

[a] *Exposure dose* = Soil Concentration (mg/kg) x Soil intake rate (mg/day) x EF x CF/ Child Body weight (kg) x AT; Where: Soil intake rate = 400 mg/day; EF= 1 day; CF = 0.000001 kg/mg, AT = 1 day, Body weight = 15 kg.

[b] No acute NOAEL value for arsenic was identified. An acute NOAEL value for copper of 0.0272 mg/kg/day was selected by ATSDR for the MRL derivation.

[c] Arsenic Acute LOAEL for ATSDR MRL = 0.05 mg/kg/day based on serious neurological, gastrointestinal and cardiovascular effects. Copper acute LOAEL for ATSDR MRL = 0.0731 mg/kg/day

[d] ATSDR Acute Oral MRL

[e] ATSDR Acute Oral MRL

NA- not applicable because NOAEL is not available or health guideline based HQ is less than or equal to 1.0.

Table A8. Evaluation of Acute Soil Exposures to Arsenic and Copper for Children (Ingestion rate = 1000mg/day)

COPC	Concentration (mg/kg)	Exposure Dose (mg/kg-day)	Health-based Guideline	Health-based Guideline Hazard Quotient	NOAEL based Hazard Quotient	LOAEL based Hazard Quotient
Acute Risks with calculated site Exposure Point Concentration						
Arsenic	64.9	4.33E-03	5.00E-03	8.65E-01	NA	8.65E-02
Copper	144.5	9.63E-03	1.00E-02	9.63E-01	3.54E-01	1.32E-01
Acute Risks with maximum detected concentration (hot spot exposure evaluation)						
Arsenic	252	1.68E-02	5.00E-03	**3.36E+00**	NA	3.36E-01
Copper	510	3.40E-02	1.00E-02	**3.40E+00**	**1.25E+00**	4.65E-01

[a] *Exposure dose* = Soil Concentration (mg/kg) x Soil intake rate (mg/day) x EF x CF/ Child Body weight (kg) x AT; Where: Soil intake rate = 1,000 mg/day; EF= 1 day; CF = 0.000001 kg/mg, AT = 1 day, Body weight = 15 kg.

[b] No acute NOAEL value for arsenic was identified. An acute NOAEL value for copper of 0.0272 mg/kg/day was selected by ATSDR for the MRL derivation.

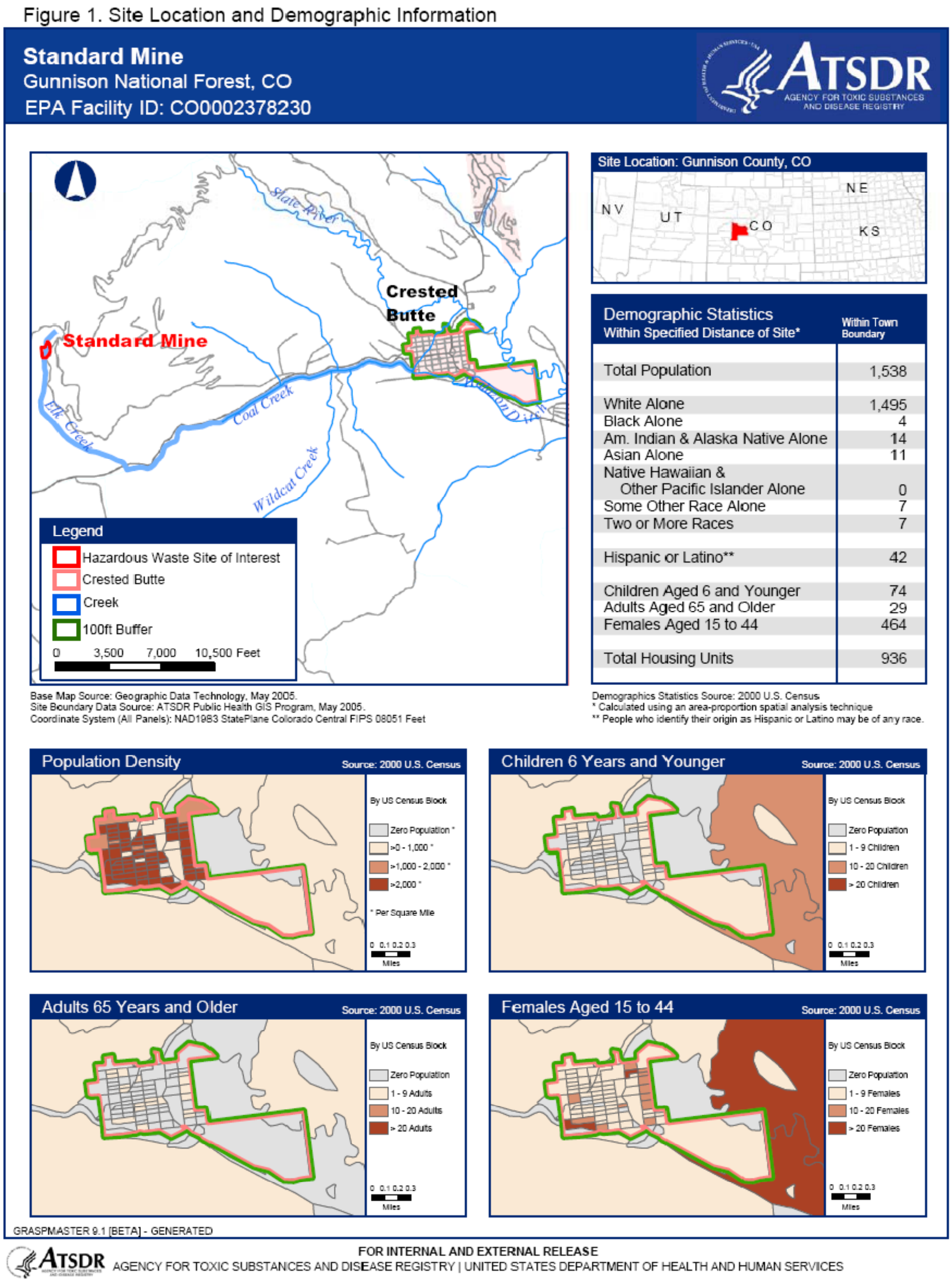
[c] Arsenic Acute LOAEL for ATSDR MRL = 0.05 mg/kg/day based on serious neurological, gastrointestinal and cardiovascular effects. Copper acute LOAEL for ATSDR MRL = 0.0731 mg/kg/day

[d] ATSDR Acute Oral MRL

[e] ATSDR Acute Oral MRL

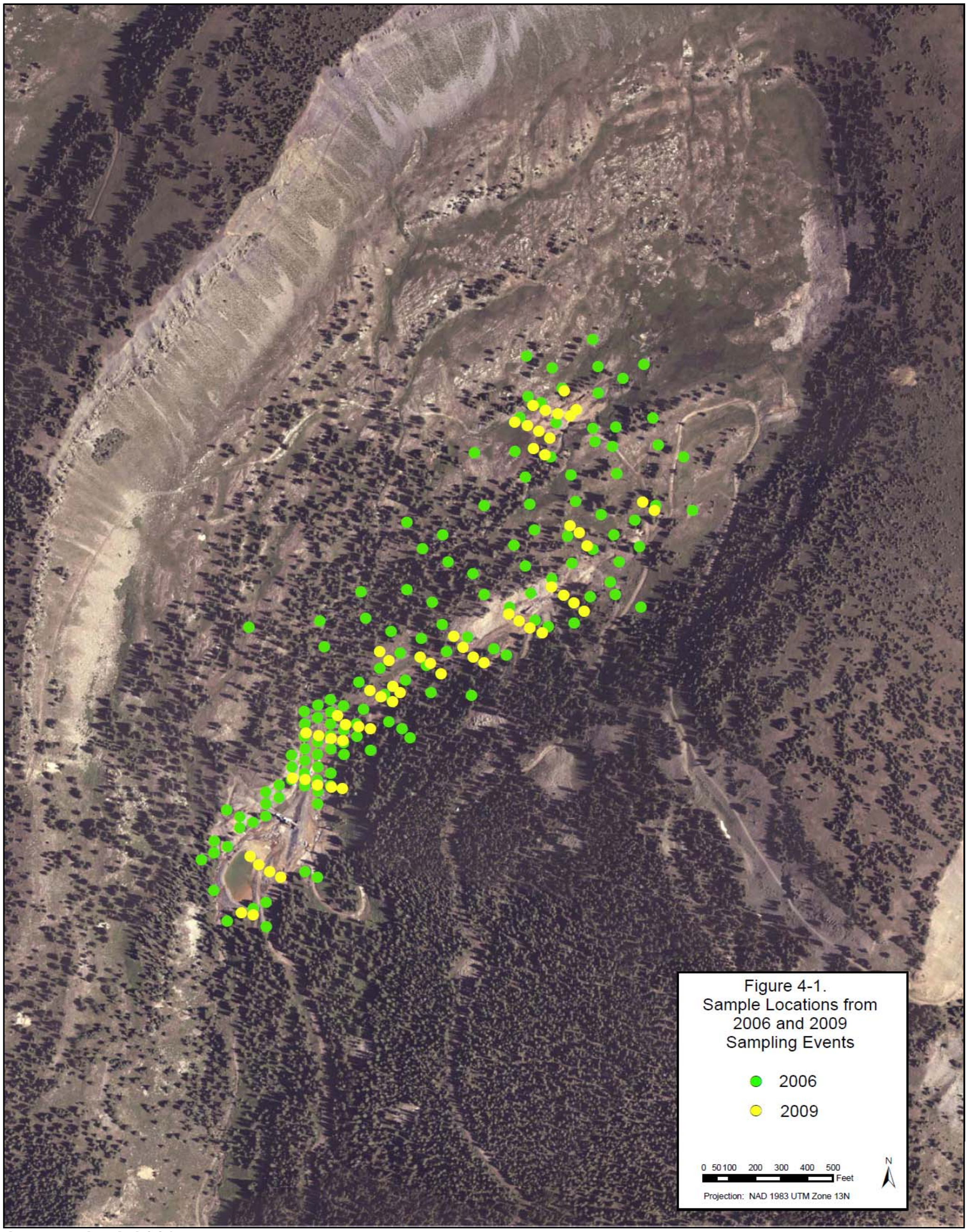
NA- not applicable because NOAEL is not available or health guideline based HQ is less than or equal to 1.0.

Figure A1. Site Location and Demographic Information (from ATSDR 2006)



Source: ATSDR 2006

Figure A2. 2006 and 2009 Surface Soil Sampling Locations



Source: SRC 2009

Appendix B. Additional Exposure Dose Information

This section provides additional information on the exposure assumptions and exposure doses that were used to evaluate the public health implications of surface soil exposures at the Standard Mine site. .

Three potential exposure pathways were evaluated in this health consultation:

- Recreation Hikers
- Recreational Campers
- ATV Riders

The potential exposure pathways were selected based on results from a community survey conducted by the EPA and CDPHE in 2006 (Attached as Appendix F).

Table B1. Surface Soil Exposure Point Concentration Comparison

COPC	2006 Data EPC[1] (mg/kg)	2009 Data EPC[2] (mg/kg)	ProUCL 4.00.05 Recommended Statistical Method	2009 Bkgd Data EPC[2] (mg/kg)
Aluminum	7423	13225	95% Student's-t	16283
Antimony	3.3	2.2	95% KM (% Bootstrap	NS
Arsenic	123.4	64.9	95% H-UCL	8.7
Barium	126.9	NS	N/a	NS
Cadmium	11.4	7.8	95% KM (Chebyshev)	0.3
Chromium	9.5	8.1	95% Approximate Gamma	9.1
Cobalt	NS	8.9	95% Modified-t UCL	5.8
Copper	418.6	144.5	95% Approximate Gamma	NS
Iron	41599	29875	95% Modified-t UCL	14840
Lead	6746	3629	95% H	150.3
Manganese	2888	3012	95% Chebyshev (Mean,Sd)	803.8
Selenium	8.2	NS	N/a	NS
Silver	17.5	NS	N/a	NS
Thallium	1.2	NS	N/a	NS
Vanadium	14.0	NS	N/a	NS
Zinc	2413	NS	N/a	NS

NS = Not Selected as a contaminant of concern; N/a = Not Applicable

[1] As calculated by ProUCL Version 4

[2] As calculated by ProUCL Version 4.00.005

Recreational Hiker Exposures

The recreational hiker exposure scenario is most likely to represent current and future surface soil exposures at the Standard Mine site. Individuals do hike up the Standard Mine site either by mistake on their way to Copley Lake or to visit the historic site for various other purposes including inspections, recreation, and/or sight-seeing. According to the community survey conducted in 2007, the frequency of visits to the site varies dramatically. It was assumed that child and adult hikers will visit the site. However, children are considered ages 7-12 years since it is likely too difficult for younger children (0-6 years) to manage the steep terrain surrounding the site.

The central tendency exposure aims to represent typical exposures at the Standard Mine site. It was assumed that children and adults will visit the site 5 times a year over a period of 2 years for children and 9 years as adult. The exposure frequency was selected from the information gathered during the community survey and the exposure duration is the default value for EPA central tendency exposures (EPA 1993). The majority of respondents felt that people would only be passing through the site and not hanging around the site itself. Therefore, default values for daily soil ingestion were used in this evaluation, but the soil ingestion values were adjusted to account for the fraction of soil a hiker is likely to ingest from the site. The resulting soil ingestion values for CTE are 40 milligrams of soil per hike for children and 20 mg soil per hike for adults. All assumptions used for the hiker evaluation are listed below in Table B2.

Table B2. Recreational Hiker Exposure Parameters

Exposure Pathway	Exposure Parameter	Units	Receptor					
			Child			Adult		
			CTE	RME	Future Potential	CTE	RME	Future Potential
General	Body Weight (BW)	kg	33[a]	33[a]	33[a]	70[b]	70[b]	70[b]
	Exposure Frequency (EF)	days/yr	5[c]	20[c]	52[d]	5[c]	20[c]	52[c]
	Exposure Duration$_{NC}$ (ED_{NC})	years	2[b]	6[b]	6[b]	9[b]	30[b]	30[b]
	Exposure Duration$_{C}$ (ED_{C})	years	N/a	N/a	N/a	9*	30*	30*
	Averaging Time$_{N C}$ (AT_{NC})	days	730[e]	2190[e]	2190[e]	3285[e]	10950[e]	10950[e]
	Averaging Time$_{C}$ (AT_{C})	days	N/a	N/a	N/a	25550[f]	25550[f]	25550[f]
Incidental Ingestion of Soil	Conversion Factor (CF)	kg/mg	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06
	Ingestion Rate$_{NC}$ (IRS_{NC})	mg/day	100[b]	200[b]	200[b]	50[b]	100[b]	100[b]
	Ingestion Rate$_{ADJ}$ (IRS_{ADJ})	(mg-yr)/ (kg-day)	N/a	N/a	N/a	4.1*	35.3*	35.3*
	Fraction Ingested from Contaminated Source (FI)	unitless	0.4[c]	0.5[c]	0.5 [c]	0.4 [c]	0.5 [c]	0.5 [c]

NOTE: CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure, N/a = Not applicable (age-adjusted equation was used)
[a] EPA, Exposure Factors Handbook (1997)
[b] EPA, Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure (1993)
[c] Professional judgment based on site-specific information from the community survey (Appendix E)
[d] CDPHE, standard default exposure frequency for recreational users
[e] ATSDR, Public Health Assessment Guidance Manual (2005)
[f] EPA, Risk Assessment Guidance for Superfund (1989)
* Age-adjusted equation was used to calculate theoretical cancer doses. The age-adjusted calculation accounts for exposure over two years of ages 7-12 years and 7 years as an adult for the CTE hiker and 6 years of ages 7-12 years and 24 years as adult for the RME and future potential hiker.

The soil ingestion exposure doses were calculated using the non-cancer dose equation and an age-adjusted cancer dose equation as shown below.

Equation 1. Non-Cancer Soil Ingestion Dose

$$\textbf{Non-Cancer Dose} = (C_s * IRS * FI * CF * EF * ED) / (BW * AT_{NC})$$

Where:
C_s = Chemical Concentration in Soil (in mg/kg or milligrams contaminant per kilogram of soil)
IRS = Ingestion Rate of Soil (in milligrams of soil per day)
FI = Fraction of soil ingested from contaminated source
CF = Conversion Factor (in kilograms per milligram)
EF = Exposure Frequency (in days per year)
ED = Exposure Duration (in years)
BW = Body Weight (in kilograms)
AT_{NC} = Non-Cancer Averaging Time (in days)

Example: Non-cancer CTE adult hiker ingestion dose of Arsenic (Table B3) =>
(64.9 mg/kg * 50 mg/day * 0.4 * 10^{-6} kg/mg * 5 days per year * 9 years) / (70 kg. * 3,285 days)
= **2.54 * 10^{-7} mg/kg-day**

Equation 2. Age-adjusted Cancer Soil Ingestion Dose

$$\textbf{Cancer Dose} = (C_s * CF * IRS_{adj} * EF) / (AT_C)$$

Where:
C_s = Chemical Concentration in Soil (in mg/kg or millgrams contaminant per kilogram of soil)
CF = Conversion Factor (in kilograms per milligram)
IRS_{adj} = Age-adjusted Soil Ingestion Rate (in milligrams of soil-year per kilogram body weight)
EF = Exposure Frequency (in days per year)
ED = Exposure Duration (in years)
AT_C = Cancer Averaging Time (in days)

Example: Theoretical Cancer Dose of Arsenic for the CTE adult hiker (Table B3) =>

(64.9 mg/kg * 10^{-6} kg/mg * 4.1 mg-year/kg * 0.4* 5 days/year) / (25,550 days)

= 5.21 * 10^{-8} mg/kg/day

Table B3. Recreational Hiker Surface Soil Ingestion Doses

COPC	Non-cancer Child Hiker Dose (in mg/kg-day)			Non-cancer Adult Hiker Dose (in mg/kg-day)			Theoretical Cancer Dose for the Age-adjusted Hiker (in mg/kg-day)		
	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use
Aluminum	2.20E-04	2.20E-03	5.71E-03	5.18E-05	5.18E-04	1.35E-03	NA	NA	NA
Antimony	3.65E-08	3.65E-07	9.50E-07	8.61E-09	8.61E-08	2.24E-07	NA	NA	NA
Arsenic	1.08E-06	1.08E-05	2.80E-05	2.54E-07	2.54E-06	6.60E-06	5.59E-08	3.59E-06	4.66E-06
Cadmium	1.30E-07	1.30E-06	3.37E-06	3.05E-08	3.05E-07	7.94E-07	NA	NA	NA
Chromium	1.34E-07	1.34E-06	3.50E-06	3.17E-08	3.17E-07	8.24E-07	NA	NA	NA
Cobalt	1.48E-07	1.48E-06	3.84E-06	3.48E-08	3.48E-07	9.06E-07	NA	NA	NA
Copper	2.40E-06	2.40E-05	6.24E-05	5.66E-07	5.66E-06	1.47E-05	NA	NA	NA
Iron	4.96E-04	4.96E-03	1.29E-02	1.17E-04	1.17E-03	3.04E-03	NA	NA	NA
Manganese	5.00E-05	5.00E-04	1.30E-03	1.18E-05	1.18E-04	3.07E-04	NA	NA	NA

NOTE: COPC = Contaminant of Potential Concern, CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure, NA = Not applicable, mg/kg-day = milligram of contaminant per kilogram body weight per day

Recreational Camper Exposures

Camping was also selected as a potential exposure scenario based on the community survey. It was assumed that children and adults could use the site for camping; however, in this case, children ages 0-6 years old were selected since it is possible that they could be transported to the site by other means than hiking. Frequency and duration of exposure for CTE, RME, and future potential use are the same for camping and hiking. The CTE camping scenario is the most likely to represent current and future camping exposures at the Standard Mine site. The RME camper is an above-average user and the future potential camper is a future (post remediation), heavy user. The daily soil ingestion rates were not adjusted for the camping scenario since it was assumed that campers would be spending more time at the site. Equations 1 and 2 (shown above) are the same equations used to calculate the exposure dose estimations for the camping scenario.

Table B4. Camper Exposure Assumptions

Exposure Pathway	Exposure Parameter	Units	Receptor					
			Child			Adult		
			CTE	RME	Future Potential	CTE	RME	Future Potential
General	Body Weight (BW)	kg	15[a]	15[a]	15[a]	70[e]	70[e]	70[e]
	Exposure Frequency (EF)	days/yr	5[c]	20[c]	52[d]	5[c]	20[c]	52[d]
	Exposure Duration$_{Non\text{-}cancer}$ (ED_{NC})	years	2[b]	6[b]	6[b]	9[b]	30[b]	30[b]
	Exposure Duration$_{Cancer}$ (ED_C)	years	N/a	N/a	N/a	9*	30*	30*
	Averaging Time$_{Non\text{-}cancer}$ (AT_{NC})	days	730[e]	2190[e]	2190[e]	3285[e]	10950[e]	10950[e]
	Averaging Time$_{Cancer}$ (AT_C)	days	N/a	N/a	N/a	25550[f]	25550[f]	25550[f]
Incidental Ingestion of Soil	Ingestion Rate$_{Non\text{-}cancer}$ (IR_{NC})	mg/day	100[b]	200[b]	200[b]	50[b]	100[b]	100[b]
	Ingestion Rate$_{Age\text{-}adjusted}$ (IR_{ADJ})	(mg-yr)/(kg-day)	N/a	N/a	N/a	19.7*	114.3*	114.3*
	Fraction Ingested (FI)	unitless	1.0[e]	1.0[e]	1.0[e]	1.0[e]	1.0[e]	1.0[e]

NOTE: CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure

[a] EPA, Exposure Factors Handbook (1997)

[b] EPA, Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure (1993)

[c] Professional judgment based on site-specific information from the community survey (Appendix E)

[d] CDPHE, standard default exposure frequency for recreational users

[e] ATSDR, Public Health Assessment Guidance Manual (2005)

[f] EPA, Risk Assessment Guidance for Superfund (1989)

[g] Professional Judgment

* Age-adjusted equation was used to calculate theoretical cancer doses. The age-adjusted calculation accounts for exposure over two years of ages 7-12 years and 7 years as an adult for the CTE hiker and 6 years of ages 7-12 years and 24 years as adult for the RME and future potential hiker.

Table B5. Child and Adult Camper Surface Soil Ingestion Doses

COPC	Non-cancer Child Camper Dose (in mg/kg-day)			Non-cancer Adult Camper Dose (in mg/kg-day)			Theoretical Cancer Dose for the Age-adjusted Camper (in mg/kg-day)		
	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use
Aluminum	1.21E-03	9.66E-03	2.51E-02	1.29E-04	1.04E-03	2.69E-03	NA	NA	NA
Antimony	2.01E-07	1.61E-06	4.18E-06	2.15E-08	1.72E-07	4.48E-07	NA	NA	NA
Arsenic	5.93E-06	4.74E-05	1.23E-04	6.35E-07	5.08E-06	1.32E-05	2.50E-07	5.81E-06	1.51E-05
Cadmium	7.12E-07	5.70E-06	1.48E-05	7.63E-08	6.11E-07	1.59E-06	NA	NA	NA
Chromium	7.40E-07	5.92E-06	1.54E-05	7.93E-08	6.34E-07	1.65E-06	NA	NA	NA
Cobalt	8.13E-07	6.50E-06	1.69E-05	8.71E-08	6.97E-07	1.81E-06	NA	NA	NA
Copper	1.32E-05	1.06E-04	2.74E-04	1.41E-06	1.13E-05	2.94E-05	NA	NA	NA
Iron	2.73E-03	2.18E-02	5.67E-02	2.92E-04	2.34E-03	6.08E-03	NA	NA	NA
Manganese	2.75E-04	2.20E-03	5.72E-03	2.95E-05	2.36E-04	6.13E-04	NA	NA	NA

NOTE: COPC = Contaminant of Potential Concern, CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure, NA = Not applicable, mg/kg-day = milligram of contaminant per kilogram body weight per day

Recreational All-terrain Vehicle Riders

Based on information gathered in the community survey, it was assumed that ATV riders could visit the site around 5 times per year for CTE and 20 times per year at the RME level. Two primary routes of exposure to site-related contaminants in surface soil are likely to occur while riding ATVs onsite: 1) inhalation of particulates generated by ATVs disturbance of the soil and 2) ingestion of surface soil. For total ATV rider exposure, exposure doses from both pathways were combined. The Equations 1 & 2 (shown above) were used to calculate the estimated non-cancer and cancer doses from incidental ingestion of soil while riding ATVs. Equations 3 & 4 below were used to calculate inhalation of metal laden dusts at the site. Please note that dose for the inhalation of dust particles was estimated per ATSDR methodology by using an inhalation rate, body weight, and inhalation cancer slope factor (ATSDR 2005).

Table B6. Child and Adult ATV rider Exposure Assumptions

Exposure Pathway	Exposure Parameter	Units	Receptor					
			Child			Adult		
			CTE	RME	Future Potential	CTE	RME	Future Potential
General	Body Weight (BW)	kg	33[a]	33[a]	33[a]	70[b]	70[b]	70[b]
	Exposure Frequency (EF)	days/yr	5[c]	20[c]	52[d]	[c]	20[c]	52[c]
	Exposure Duration Non-cancer (ED_{NC})	years	2[b]	[b]	[b]	[b]	30[b]	30[b]
	Exposure Duration Cancer (ED_C)	years	N/a	N/a	N/a	9*	30*	30*
	Averaging Time Non-cancer (AT_{NC})	days	730[e]	2190[e]	2190[e]	3285[e]	10950[e]	10950[e]
	Averaging Time Cancer (AT_C)	days	N/a	N/a	N/a	25550[f]	25550[f]	25550[f]
	Conversion Factor (CF)	kg/mg	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06
Incidental Ingestion of Soil	Ingestion Rate Non-cancer (IRS)	mg/day	100[b]	200[b]	200[b]	50[b]	100[b]	100[b]
	Ingestion Rate Cancer (IRS_{adj})	(mg-yr)/(kg-day)	N/a	N/a	N/a	11.1*	70.6*	70.6*
	Fraction Ingested from Contaminated Source (FI)	unitless	1.0[e]	1.0[e]	1.0[e]	1.0[e]	1.0[e]	1.0[e]
Inhalation of Particulates	Inhalation Rate	m3/hour	1.2[a]	1.2[a]	1.2[a]	1.6[a]	1.6[a]	1.6[a]
	Exposure Time (ET)	Hours/day	1	1	1	1	1	1

NOTE: CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure

[a] EPA, Exposure Factors Handbook (1997)

[b] EPA, Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure (1993)

[c] Professional judgment based on site-specific information from the community survey (Appendix E)

[d] CDPHE, standard default exposure frequency for recreational users

[e] ATSDR, Public Health Assessment Guidance Manual (2005)

[f] EPA, Risk Assessment Guidance for Superfund (1989)

[g] Professional Judgment

* Age-adjusted equation was used to calculate theoretical cancer doses. The age-adjusted calculation accounts for exposure over two years of ages 7-12 years and 7 years as an adult for the CTE hiker and 6 years of ages 7-12 years and 24 years as adult for the RME and future potential hiker.

Non-cancer Particulate Inhalation Dose

Non-cancer Dose = (C_a * IRA * ET * EF * ED)/ (BW * AT)

Where:
C_a = Chemical Concentration in Air (in mg/m^3 or milligrams contaminant per cubic meter of air, See Appendix D for more information on calculating the air concentration)
IRA = Inhalation Rate (in m^3/hr. or cubic meters per hour)
ET = Exposure Time (in hours)
EF = Exposure Frequency (in days per year)
ED = Exposure Duration (in years)
BW = Body Weight (in kilograms)
AT_{NC} = Non-Cancer Averaging Time (in days)

Example: Non-cancer CTE Adult ATV Rider Inhalation dose of Manganese (Table B8) =>
(0.00355 mg/m^3 * 1.6 m^3/hr. * 1 hour * 5 days per year * 9 years) / (70 kg. * 3,285 days) = **$1.11 * 10^{-6}$ mg/kg-day**

Age-adjusted Particulate Inhalation Dose

Age-Adjusted Cancer Dose = (C_a * IRA_{adj} * EF) / AT_C

Where: IRA_{adj} = [(ED_c * ET_c * IRA_c) / BW_c] + [(ED_a* ET_a * IRA_a) / BW_a]

C_a = Chemical Concentration in Air (in mg/m^3 or milligrams contaminant per cubic meter of air, See Appendix D for more information on calculating the air concentration)
IRA_{adj} = Age-adjusted Inhalation Rate (in m^3-year/kg. or cubic meter year per kilogram)
EF = Exposure Frequency (in days per year)
ED_c = Exposure Duration Child (in years)
ED_a = Exposure Duration Adult (in years)
ET_c = Exposure Time child (in hours)
ET_a = Exposure Time adult (in hours)
BW_c = Body Weight child (in kilograms)
BW_a = Body Weight adult (in kilograms)
IRA_c = Inhalation Rate child (in m^3/hr. or cubic meters per hour)
IRA_a = Inhalation Rate adult (in m^3/hr. or cubic meters per hour)
AT_C = Cancer Averaging Time (in days)

Example: Theoretical cancer CTE Age-adjusted ATV Rider Inhalation dose of Cadmium (Table B8) =>
IRA_{adj} = (2 years * 1 hour * 1.2 m^3/hr. / 33 kg.) + (7 years * 1 hour * 1.6 m^3/hr. / 70 kg.) = 0.28 m^3-yr./kg

Dose = (9.2 * 10^{-6} mg/m^3 * 0.23 m^3-yr./kg * 5 days per year) / (25550 days) = **5.0 * 10^{-10} mg/kg-day**

B7. Child and Adult ATV Rider Soil Ingestion Doses

COPC	Non-cancer Child ATV Rider Dose (in mg/kg-day)			Non-cancer Adult ATV Rider Dose (in mg/kg-day)			Theoretical Cancer Dose for the Age-adjusted ATV Rider (in mg/kg-day)		
	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use
Aluminum	5.49E-04	1.32E-02	1.14E-02	1.29E-04	3.45E-03	2.69E-03	NA	NA	NA
Antimony	9.13E-08	2.19E-06	1.90E-06	2.15E-08	5.74E-07	4.48E-07	NA	NA	NA
Arsenic	2.69E-06	6.47E-05	5.60E-05	6.35E-07	1.69E-05	1.32E-05	1.41E-07	3.59E-06	9.33E-06
Cadmium	3.24E-07	7.77E-06	6.73E-06	7.63E-08	2.04E-06	1.59E-06	NA	NA	NA
Chromium	3.36E-07	8.07E-06	6.99E-06	7.93E-08	2.11E-06	1.65E-06	NA	NA	NA
Cobalt	3.69E-07	8.87E-06	7.68E-06	8.71E-08	2.32E-06	1.81E-06	NA	NA	NA
Copper	6.00E-06	1.44E-04	1.25E-04	1.41E-06	3.77E-05	2.94E-05	NA	NA	NA
Iron	1.24E-03	2.98E-02	2.58E-02	2.92E-04	7.80E-03	6.08E-03	NA	NA	NA
Manganese	1.25E-04	3.00E-03	2.60E-03	2.95E-05	7.86E-04	6.13E-04	NA	NA	NA

NOTE: COPC = Contaminant of Potential Concern, CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure, NA = Not applicable, mg/kg-day = milligram of contaminant per kilogram body weight per day

Table B8. Child and Adult ATV Rider Inhalation Doses

COPC	Non-cancer Child ATV Rider Dose (in mg/kg-day)			Non-cancer Adult ATV Rider Dose (in mg/kg-day)			Theoretical Cancer Dose for the Age-adjusted ATV Rider (in mg/kg-day)		
	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use
Aluminum	7.77E-06	3.11E-05	8.08E-05	2.71E-06	4.34E-05	8.80E-05	NA	NA	NA
Antimony	1.29E-09	5.17E-09	1.34E-08	8.12E-10	3.25E-09	8.45E-09	NA	NA	NA
Arsenic	3.81E-08	1.53E-07	3.97E-07	2.40E-08	9.59E-08	2.49E-07	4.19E-09	1.68E-08	1.42E-07
Cadmium	4.58E-09	1.83E-08	4.77E-08	2.88E-09	1.15E-08	3.00E-08	5.04E-10	2.02E-09	1.70E-08
Chromium	4.76E-09	1.90E-08	4.95E-08	2.99E-09	1.20E-08	3.11E-08	5.24E-10	2.09E-09	1.77E-08
Cobalt	5.23E-09	2.09E-08	5.44E-08	3.29E-09	1.31E-08	3.42E-08	5.75E-10	2.30E-09	1.94E-08
Copper	8.49E-08	3.40E-07	8.83E-07	5.34E-08	2.13E-07	5.55E-07	NA	NA	NA
Iron	1.76E-05	7.02E-05	1.83E-04	1.10E-05	4.41E-05	1.15E-04	NA	NA	NA
Manganese	1.77E-06	7.08E-06	1.84E-05	1.11E-06	4.45E-06	1.16E-05	NA	NA	NA

NOTE: COPC = Contaminant of Potential Concern, CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure, NA = Not applicable, mg/kg-day = milligram of contaminant per kilogram body weight per day

Table B9. Child and Adult ATV Rider Combined (Ingestion and Inhalation) Doses

COPC	Non-cancer Child ATV Rider Dose (in mg/kg-day)			Non-cancer Adult ATV Rider Dose (in mg/kg-day)			Theoretical Cancer Dose for the Age-adjusted ATV Rider (in mg/kg-day)		
	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use	CTE	RME	Future Potential Use
Aluminum	5.57E-04	1.32E-02	1.15E-02	1.32E-04	3.49E-03	2.78E-03	NA	NA	NA
Antimony	9.26E-08	2.20E-06	1.91E-06	2.23E-08	5.77E-07	4.56E-07	NA	NA	NA
Arsenic	2.73E-06	6.48E-05	5.64E-05	6.59E-07	1.70E-05	1.35E-05	1.45E-07	3.60E-06	9.47E-06
Cadmium	3.28E-07	7.79E-06	6.78E-06	7.92E-08	2.05E-06	1.62E-06	3.18E-09	2.02E-09	1.07E-07
Chromium	3.41E-07	8.09E-06	7.04E-06	8.22E-08	2.13E-06	1.68E-06	2.20E-08	2.09E-09	7.43E-07
Cobalt	3.75E-07	8.89E-06	7.74E-06	9.04E-08	2.34E-06	1.85E-06	1.81E-08	2.30E-09	6.12E-07
Copper	6.08E-06	1.44E-04	1.26E-04	1.47E-06	3.79E-05	3.00E-05	NA	NA	NA
Iron	1.26E-03	2.98E-02	2.60E-02	3.03E-04	7.84E-03	6.19E-03	NA	NA	NA
Manganese	1.27E-04	3.01E-03	2.62E-03	3.06E-05	7.90E-04	6.25E-04	NA	NA	NA

NOTE: COPC = Contaminant of Potential Concern, CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure, NA = Not applicable, mg/kg-day = milligram of contaminant per kilogram body weight per day

Appendix C. Lead Assessment

Lead is naturally occurring element found at low levels in soils. At mining sites, lead is typically released either directly by targeting and removing lead from the mine, or indirectly through acid mine drainage, which has a low pH capable of releasing metals from their naturally bound state. Thus, lead is a common contaminant found at mining sites throughout the state. At the Standard Mine site, lead levels in surface soil ranges between 73.5 ppm and 14,600 ppm. These lead levels and the mean exposure point concentration of 2100 ppm at the Standard Mine are significantly higher than the EPA and CDPHE lead screening level of 400 ppm. Therefore, lead uptake modeling is required for the recreational exposure scenario at the Standard Mine.

Exposure Assessment

Lead exposure can occur via multiple pathways (air inhalation and ingestion of water, food, soil, and dust). Therefore, exposure to lead is assessed based on total exposure through all pathways rather than site-specific exposures. However, a primary human exposure pathway to lead is through ingestion of soil and dust. Current knowledge of lead pharmacokinetics indicates that risk values derived by standard procedures would not truly indicate the potential risk, because of the difficulty in accounting for pre-existing body burdens of lead. Lead bioaccumulates in the body, primarily in the skeleton. Lead body burdens vary significantly with age, health status, nutritional state, maternal body burden during gestation and lactation, etc. For this reason, and because of the continued apparent lack of threshold, it is still inappropriate to develop reference values for lead (CDC, 2004: http://www.cdc.gov/nceh/lead/spotLights/changeBLL.htm, EPA IRIS 2004). Therefore, estimation of exposure and risk from lead in soil also requires assumptions about the level of lead in other media, and also requires use of pharmacokinetic parameters and assumptions that are not needed traditionally. Thus, EPA has adopted a method that entails modeling total lead exposure (uptake/biokinetic) by incorporating input data on the levels of lead in soil, dust, water, air, and diet from multiple sources in addition to site soils. These models are discussed in later sections.

Lead has particularly significant effects in children, well before the usual term of chronic exposure can take place (EPA 2004). Children under 6 years old have a high risk of exposure because of their more frequent hand-to-mouth behavior and they absorb more lead than adults (CDC 1991). Pregnant women and women of child bearing age should also be aware of lead in their environment because lead ingested by a mother can affect the fetus. Thus, the population of most concern is young children for residential and recreational use, and pregnant women for nonresidential use (e.g., occupational and recreational).

Health Effects/Blood Lead Levels of Concern

It is important to note that risks of lead exposure are not based on theoretical calculations and are not extrapolated from data on lab animals or high-dose occupational exposures. Health effects of lead are well known from studies of children. Lead affects virtually every organ and system in the body and exhibits a broad range of health effects. The most sensitive among these are the central nervous system, hematological, and cardiovascular systems, and the kidney. However, it is particularly harmful to the developing brain and nervous system of fetuses and young children (CDC, 1991, ATSDR, 2007). It should be noted that many health effects of lead may occur without overt signs of toxicity: most poisoned children have no symptoms. Extremely high levels of lead in children (BLL of 380 ug/dL) can cause coma, convulsions, and even death. Lower levels of blood lead cause effects on the central nervous system, kidney, and hematopoietic system. Blood lead levels as low as 10 μg/dL, which do not cause distinct symptoms, are associated with decreased intelligence and impaired neurobehavioral development (CDC, 1991). Blood lead levels of 10 μg/dL or greater are considered elevated but there is no demonstrated safe level of lead in blood. A growing body of research has shown that there are measurable adverse neurological effects in children at blood lead concentrations as low as 1 μg/dL (EPA, 2003a). EPA believes that effects may occur at blood levels so low that there is essentially no threshold or "safe" level of lead (EPA IRIS, 2004). Although the concentration of lead in blood is an important indicator of risk, it reflects only current exposures. Lead is also accumulated in bone. Recent research suggests that lead concentrations in bone may be related to adverse health effects in children.

Lead is classified as a probable human carcinogen by the EPA based on sufficient evidence of carcinogenicity in animals and inadequate evidence in humans. However, no toxicity value has been derived for cancer effects and EPA has determined that noncancer effects discussed above provide a more sensitive endpoint than cancer effects to assess health risks from exposure to lead.

Health Risk Assessment

Health risks of exposure to lead are determined using predictive modeling. EPA uses two predictive lead models for risk assessment purposes: the Integrated Exposure Uptake Biokinetic (IEUBK) model for children up to the age of 7 years (EPA, 2002), and the adult lead model; ALM (EPA, 2003b) for adolescents and adults for assessing nonresidential exposures. The ALM model is designed for nonresidential exposures to lead such as female workers and recreationalists. The model is thought to be protective of the fetus, which the EPA considers the most sensitive health endpoint for adults. Whether lead risk is deemed acceptable or unacceptable is determined by comparing the predicted BLLs with target BLLs of 10 μg/dL (for fetuses and young children), established by the CDC (1991). The EPA has set a goal that there should be no more than a 5% chance that a typical (or hypothetical) child or group of similarly exposed children will exceed a blood lead value of 10 μg/dL. This approach focuses on the risk to a child at the upper bound of the distribution (i.e., 95^{th} percentile).

The IEUBK Model for Young Children (Age 0-6 years) Camping with Parents

The IEUBK model is designed to estimate the percentage of children that could have elevated blood lead levels as a result of exposure to lead in soil and dust. The model calculates the expected distribution of blood lead and estimates the probability that any random child might have a blood lead value over 10 ug/dL. As shown in Table C1, Blood lead levels were estimated for children exposed under CTE (12 days/year), RME (20 days/year), and future potential exposure scenarios (52 days/year) to the weighted soil lead concentrations of 2622, 1116, 763, 527, or 396 ppm, based on the site EPC of 2100 ppm and the background levels of lead at home (default assumption of 200 ppm). The IEUBK model results did not indicate that the blood lead levels in children would exceed the 10 µg/dL cutoff from exposure to surface soil at the Standard Mine site under all exposure scenarios: the average (CTE), above-average (RME) and the hypothetical future use (Table C2). These findings indicate that exposure to lead in surface soil is "*not expected to harm the health of young children*".

The ALM Model for Outdoor Adults

The ALM model is designed to express the probability that the fetal blood lead concentration will be greater than the target blood lead value of 10 ug/dL. As already noted, based on the Technical Review Workgroup (TRW) recommendation, 3 months of exposure duration (and a minimum EF of 1day/week) is required to achieve a quasi-steady state blood lead concentration. All exposure parameters used for this model are shown in Table C3. As seen in Tables C4 and C5, the results of the Adult Lead Model (ALM) indicated a less than 5% probability (i.e., 0.8 – 3.6%) of blood lead levels in the fetus exceeding a level of health concern under al exposure scenarios: the average (CTE), above-average (RME), and hypothetical future use. These findings indicate that exposure to lead in surface soil is "*not expected to harm the health of the developing fetus*".

Uncertainty in Risks Predicted by the IEUBK and ALM Lead Models

Reliable estimates of exposure and risk using the IEUBK and ALM models depend on site-specific information for a number of key parameters, including lead concentration in outdoor soil (fine fraction) and indoor dust, soil ingestion rate, individual variability in child blood lead concentrations Geometric Standard Deviation (GSD) and the rate and extent of lead absorption from soil. Therefore, uncertainties are discussed qualitatively here. For example, lead risks may be over- or underestimated based on the unavailable site-specific relative bioavailability of lead from soil. In assessing risks from lead exposure, the EPA assumes 60% relative bioavailability of lead in soils, which is a measure of the difference in absorption between different forms of chemical or between different dosing vehicles (e.g., lead in water, or soil). However, in the absence of site-specific data, it is prudent to use the default bioavailability assumption in order to ensure public health protection. In summary, without site-specific data, there will be uncertainty about how well the risk estimates predicted by computer modeling based on the default parameters reflect the true conditions at a site.

In addition, it is important to keep in mind that evidence is growing that there are measurable adverse neurological effects in children at blood lead concentrations as low as 1 ug/dL (EPA, 2003a). This suggests that the target blood lead level of 10 ug/dL in fetuses and young children for the IEUBK model and ALM model may result in underestimation of lead hazards at the Standard Mine site.

Appendix C References

ATSDR (2007). Toxicological Profile for Lead.

CDC (1991). Preventing lead poisoning in young children. Atlanta, GA: US Department of Health and Human Services, PHS, Centers for Disease Control and Prevention. (http://www.cdc.gov/nceh/lead/publications/books/plpyc/contents.htm
Environmental Protection Agency (EPA, 2002).

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Environmental Protection Agency (EPA, 2003a). America's Children and the Environment: Measures of Contaminants, Body Burden and Illnesses, Second Edition.

Environmental Protection Agency (EPA 2003b). Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. EPA-540-R-03-001. USEPA, Technical Review Workgroup, Washington, DC.

Environmental Protection Agency, Integrated Risk Information System (EPA IRIS 2004). *Lead and Compounds*. http://www.epa.gov.iris.

Table C1. Default Input Parameters for the IEUBK Model for exposure to Residential Children

Exposure variable	EPA Default Value
Groundwater concentration (C_{gw})	4.0 μg/L
Dust Fraction	70% (0.70)
Geometric standard deviation (GSD) or interindividual variability	2.1
Soil Concentration (ppm)	Site-specific Time-Weighted
Concentration of Lead in Outdoor Air	0.1 $\mu g/m^3$
FDA dietary parameters	1.95 – 2.26 μg/day
Relative bioavailability	60%

Table C2. The IEUBK Model Estimated Risk to Young Children (0-84 months) from Exposure to Site-Specific Surface Soil and Dust During Seasonal Camping with Parents: Percentage of Children that Exceed the Target Average Blood Lead Level of 10 μg/dL for variable exposure frequency and averaging time, Based on the Default Assumptions.

Exposure Frequency [a] (Days/ Year)	Averaging Time (Days/ Year)	Weighted Site Soil Lead Concentration [b] (PbS_w)	Age Group (Months)	Geometric Mean PbB Concentration (μg/dL)	Percent of Population > 10 μg/dL
52	365	466	0-84	5.0	7.1
20	365	305	0-84	3.7	1.6
12	365	257	0-84	3.2	0.8

Note: Please see Table C1 for details of exposure/input parameters for the IEUBK model. It should be noted that a variable GSD of 1.4 (vs. default of 1.6) did not change the conclusions for different categories of exposure frequency as presented in the last column of %population >10μg /dL (data not shown).

[a] For example, Exposure frequency of 52 days/year = 2.7 days/week for 4 weeks/month over 5 months.

[b] Weighted Site Soil Lead concentration calculated in accordance with the intermittent exposure guidance (EPA, 2003b), based on the site EPC of 2100 ppm and the assumption of home lead concentration of 200 ppm (default for the IEUBK model). For example, lead site concentration of 903 ppm is calculated as follow:

F_{site} = 52 days/140 days = 0.37

F_{home} = 1-0.37 = 0.63

Lead site = 0.37 x 2100 (lead EPC) = 777 ppm

Lead home = 0.63 x 200 ppm (default) = 126 ppm

Lead site weighted (PbS_w) = 777 + 126 = 903 ppm

Table C3. Input Parameters for the ALM Model for Adult Outdoor Recreational Activities

Exposure Variable	Equation[1]		Description of Exposure Variable	Units	Using Equation 1
	1*	2**			GSDi = Hom
PbS	X	X	Soil lead concentration	ug/g or ppm	2100
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	2.1
PbB_0	X	X	Baseline PbB	ug/dL	1.5
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}		X	Mass fraction of soil in dust	--	--
$AF_{S, D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	X	X	Exposure frequency (same for soil and dust)	days/yr	5, 20, or 52 (site-specific)
$AT_{S, D}$	X	X	Averaging time (same for soil and dust)	days/yr	365 (default)

Table C4. The ALM Model Results for Adults Recreational Activities with The <u>High-End Exposure to Soil (100 mg/day)</u>: Probability of Fetal Blood Lead (PbB) >10 μg /dL and the 95th Percentile PbB among Fetuses of Adult Recreationalists

Exposure Frequency [a] (days/year)	**Averaging Time (days/year)**	**95th percentile fetal PbB (μg/dL)**	**Probability of fetal PbB >10 μg/dL**
52	365	9.0	3.6%
20	365	6.3	1.1%
12	365	5.6	0.8%

Note: Please see Table B4 for details of exposure/input parameters for the ALM model.

[a] For example, Exposure frequency of 52 days/year = 2.7 days/week for 4 weeks/month over 5 months.

Table C5. The ALM Model Results for Adults Recreational Activities with The <u>Average Exposure to Soil (50 mg/day)</u>: Probability of Fetal Blood Lead (PbB) >10 μg /dL and the 95th Percentile PbB among Fetuses of Adult Recreationalists

Exposure Frequency [a] (days/year)	**Averaging Time [b] (days/year)**	**95th percentile fetal PbB (μg/dL)**	**Probability of fetal PbB >10 μg/dL**
52	365	6.8	1.5%

Note: Please see Table C3 for details of exposure/input parameters for the ALM model.
[a] Exposure frequency of 52 days/year = 2.7 days/week for 4 weeks/month over 5 months.

Appendix D. Derivation of Particulate Emission Factor for ATV Rider

The calculation for inhalation of fugitive dust while riding ATVs requires that a particulate emission factor (PEF) be estimated, which describes the amount of dust in the air. The amount of dust generated is dependent on a number of factors including, but not limited to, speed, type of vehicle, and the type of soil. Without site-specific sampling data, it is very difficult to determine the actual amount of dust generated by ATVs at the Standard Mine site. Only one source of sampling data was identified by the EPA that could be used to derive the PEF for ATVs. This data set was collected at the former Quincy Smelter Site in Houghton County, Michigan by the USEPA (ATSDR 2006). This dataset was adopted from the EPA Region 8 Human Health Risk Assessment for this site (SRC 2007, 2009). It should be noted that the soils encountered in this study are likely to be different from the soils at the Standard Mine site. However, it was concluded that the use of this data set would most accurately represent the PEF since the data was collected while ATVs were in use.

The dust data used in this evaluation was collected by equipping an ATV with a dust-sampling device while following another ATV up and down a trail over a period of approximately 6 hrs. The total dust concentration ranged from 18.7 $\mu g/m^3$ to 23,359 $\mu g/m^3$ during this time. A number of factors could contribute to the large variation in total dust concentration including distance from the lead ATV, speed, and wind conditions. The mean concentration of the data was utilized to account for this variation. This is a conservative approach since the arithmetic mean is biased high in this case. The mean total dust concentration is 3,375 $\mu g/m^3$. This concentration was converted to kg/m^3 for the dose calculation as shown below.

Another issue with calculating the PEF is the percentage of particulate matter that is considered inhalable in total dust. The inhalable fraction generally refers to particulate matter with a geometric diameter of 10 μm or less (PM_{10}). Larger particles are typically filtered out in the nose and mouth prior to entering the airways and are not inhaled into the deeper sections of the lungs where they can enter the bloodstream. The PM_{10} fraction is largely dependent on soil type, the silt content of the soil, and the soil moisture content (EPA 2006). Again, without site-specific data to determine the concentration of PM_{10} in the total dusts samples, it is impossible to determine the actual fraction of PM_{10}.

In the absence of site-specific measurements of contaminant levels in air due to re-suspended soil particles, EPA's methodology and assumptions used in the Standard Mine risk assessment (SRC 2007, 2009) adopted in this health consultation are noted below:

- The concentration of PM_{10} is equal to 35% of the mean concentration of total dust.
- The concentration of contaminants may be estimated in accordance with EPA (1996, 2000) as noted below.

$C_{air} = C_{soil} \bullet PEF$

where:

C_{air} = Concentration of contaminant in air (mg/m3)
C_{soil} = Concentration of contaminant in soil (mg/kg)
PEF = Soil to air emission factor (kg/m3)

Note the PEF term in this equation is the inverse of the value presented in USEPA (1996, 2002), which has units of m3/kg.

Estimation of PEF

$PEF_{atv} = C_{Total\ Dust} \cdot f_{PM10} \cdot CF$

where:

PEF_{atv} = Particulate emission factor for ATV riding (kg/m3)
f_{PM10} = Fraction of total dust that is PM10 (unitless)
$C_{Total\ Dust}$ = Concentration of total dust (ug/m3)
CF = Conversion Factor (kg/ug)

$PEF_{ATV} = C_{PM10} * 0.35 * CF$

Where $CF = 1 * 10^{-9}$ kg/μg

$C_{PM10} =$ 3,375 $\mu g/m^3$

Thus,
$PEF_{ATV} =$ 1.18E-06kg/m^3

Once the PEF has been calculated, the chemical concentration in air is derived by multiplying the exposure point concentration of surface soil COPCs by the PEF as shown below.

$C_a = C_s * PEF$

Where C_s = Exposure Point Concentration in Surface Soil

For example,
Cs for Mn= 3018 mg/kg
Ca for Mn = 3018 x 1.18E-06kg/ m^3 = 3.565E-03 mg/m^3

USEPA (2006). Office of Air and Radiation. Compilation of Air Pollutant Emission Factors. AP-42 5th Edition Section 13 Unpaved Roads, January 1995. Updated November 2006.

Appendix E. Toxicological Evaluation

The basic objective of a toxicological evaluation is to identify what adverse health effects a chemical causes, and how the appearance of these adverse effects depends on dose. The toxic effects of a chemical also depend on the route of exposure (oral, inhalation, dermal) and the duration of exposure (acute, subchronic, chronic or lifetime). The major contaminants of concern identified in this consultation are lead, manganese, and arsenic.

Lead can affect nearly every system of the body with the main target organ systems being the nervous system. Lead health effects are particularly important for young children and pregnant mothers. Manganese is an essential nutrient, and eating a small amount of it each day is important to stay healthy. The most common health problems in workers exposed to high levels of manganese involve the nervous system. These health effects include behavioral changes and other nervous system effects, which include movements that may become slow and clumsy. This combination of symptoms when sufficiently severe is referred to as “manganism”. Other less severe nervous system effects such as slowed hand movements have been observed in some workers exposed to lower concentrations in the work place. Studies in children have suggested that extremely high levels of manganese exposure may produce undesirable effects on brain development, including changes in behavior and decreases in the ability to learn and remember(ATSDR, 2008). Arsenic is classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC) meaning that it is a known human carcinogen. It is important to note that estimates of human health risks may be based on evidence of health effects in humans and/or animals depending upon the availability of data. The toxicity assessment process is usually divided into two parts: the cancer effects and the non-cancer effects of the chemical.

The USEPA and the ATSDR has established oral reference dose (RfD) and minimal risk levels (MRL) for non-cancer effects. An RfD is the daily dose in humans (with uncertainty spanning perhaps an order of magnitude), including sensitive subpopulations, that is likely to be without an appreciable risk of non-cancer adverse health effects during a lifetime of exposure to a particular contaminated substance. An MRL is the dose of a compound that is an estimate of daily human exposure that is likely to be without an appreciable risk of adverse non-cancer effects of a specified duration of exposure. The acute, intermediate, and chronic MRLs address exposures of 14 days or less, 14 days to 365 days, and 1-year to lifetime, respectively.

The EPA Integrated Risk Information System (IRIS) manganese RfD (0.14 mg/kg-day) includes manganese from all sources, including diet. The author of the IRIS assessment for manganese recommended that the dietary contribution from the normal U.S. diet (an upper limit of 5 mg/day) be subtracted when evaluating non-food (e.g., drinking water or soil) exposures to manganese, leading to a RfD of 0.071 mg/kg-day for non-food items. The explanatory text in IRIS further recommends using a modifying factor of 3 when calculating risks associated with non-food sources due to a number of uncertainties that are discussed in the IRIS file for manganese, leading to a RfD of 0.024 mg/kg-day. This modified RfD has been used in the derivation of some manganese screening levels for soil and water.

The USEPA has also established in the EPA IRIS an oral cancer slope factor of 1.5 per mg/kg/day for lifetime exposures to arsenic. In addition, cadmium and chromium (VI) are considered Class 1 carcinogens by the IARC for inhalation exposures. Estimating the cancer slope factor is often complicated by the fact that observable increases in cancer incidence usually occur only at relatively high doses. Therefore, it is necessary to use mathematical models to extrapolate from the observed high dose data to the desired slope at low dose. In order to account for the uncertainty in this extrapolation process, EPA typically chooses to employ the upper 95th confidence limit of the cancer slope as the Slope Factor. That is, there is a 95% probability that the true cancer potency is lower than the value chosen for the Slope Factor.

The health-based guidelines and cancer slope factors used for this evaluation are listed below.

Table E1. Oral Health-based Guidelines

Contaminant	Health-based Guideline (mg/kg-day)	Source
Aluminum	1.0	ATSDR Chronic MRL
Antimony	0.0004	EPA IRIS (metallic antimony)
Arsenic	0.0003	ATSDR Chronic MRL
Cadmium	0.0001	ATSDR Chronic MRL
Chromium	0.001	ATSDR Chronic MRL (Chromium VI)
Cobalt	0.0003	PPRTV
Copper	0.04	HEAST
Iron	0.7	PPRTV
Manganese	0.024	EPA IRIS (Non-diet)

NOTE: mg/kg-day: milligram contaminant per kilogram body weight per day, ATSDR: Agency for Toxic Substances and Disease Registry, MRL: Minimal Risk Level, EPA: Environmental Protection Agency, IRIS: Integrated Risk Information System, PPRTV: Provisional Peer Reviewed Toxicity Value, HEAST: Health Effects Summary Tables. Please note that when toxicity values were available from multiple sources such as EPA and ATSDR, the most conservative value was selected for this evaluation.

Table E2. Inhalation Health-Based Guidelines

Contaminant	Health-based Guideline (mg/kg-day)	Source
Aluminum	0.0014	PPRTV
Antimony	0.000057	EPA IRIS (antimony trioxide)
Arsenic	0.0000043	California EPA
Cadmium	0.0000029	ATSDR Chronic MRL
Chromium	0.000029	EPA IRIS
Cobalt	0.0000017	PPRTV
Manganese	0.000011	ATSDR Chronic MRL

NOTE: mg/kg-day: milligram contaminant per kilogram body weight per day, PPRTV: Provisional Peer Reviewed Toxicity Value, EPA: Environmental Protection Agency, ATSDR: Agency for Toxic Substances and Disease Registry, MRL: Minimal Risk Level, IRIS: Integrated Risk Information System

Table E3. Cancer Slope Factors

Contaminant	Route of Exposure	Cancer Slope Factor (mg/kg-day^{-1})	Source
Arsenic	Oral	1.5	EPA IRIS
Arsenic	Inhalation	15	EPA IRIS
Cadmium	Inhalation	6.3	EPA IRIS (Diet)
Chromium	Inhalation	41	EPA IRIS
Cobalt	Inhalation	31.5	PPRTV

NOTE: mg/kg-day^{-1}: 1/milligram contaminant per kilogram body weight per day, EPA: Environmental Protection Agency, IRIS: Integrated Risk Information System, PPRTV: Provisional Peer Reviewed Toxicity Value

Appendix F. Community Survey Results

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Community Interviews for Determining
Land Use at the Standard Mine Site

Crested Butte, Colorado – July 27, 2006
Written by Libby Faulk of the EPA (Region 8)

Interview Summary and Area Statistics

Interviews were voluntary and done by phone, email, and in person. There were three public notices in the newspaper and fact sheets posted throughout the town to make the community aware of EPA's interest in information about recreational use at the Standard Mine. The following is a summary of the responses to the 9 questions as well as information on the demographics of those that responded:

Total Adult Responders – 29
20 to 29 – 4
30 to 39 – 2
40 to 49 – 6
50 to 59 – 8
60 to 69 – 1
70 to 69 – 1
No age given – 7

Number of Males responders – 11
Number of Female responders – 18

According to the 2000 U.S. Census, Crested Butte population breakout was the following:

Crested Butte town, Colorado Statistics and Demographics (US Census 2000)

	Number	Percent
Crested Butte Population:	1529	100.00%
Sex and Age		
Male	848	55.46%
Female	681	44.54%
Under 5 years	59	3.86%
5 to 9 years	46	3.01%
10 to 14 years	60	3.92%
15 to 19 years	56	3.66%
20 to 24 years	162	10.6%
25 to 34 years	590	38.59%
35 to 44 years	260	17%
45 to 54 years	207	13.54%
55 to 59 years	43	2.81%
60 to 64 years	17	1.11%
65 to 74 years	22	1.44%
75 to 84 years	7	0.46%
85 years and over	0	0%
Median age (years)	30.6	

Questions and Responses

<u>Current Land Use</u>

What are the current land uses at the Standard Mine Site? (Check all that apply)

-Residential
-Commercial/Industrial
-Recreational
-Other (Please specify)

All 29 responders believed recreational was one of the current land uses taking place at our around the Standard Mine Site. Of the responses received, 6 believed there was some level of commercial activity taking place in the area such as hiking tours. Of the responses received, 4 responders believed there's current residential use in the area.

For those land uses checked above, except residential, what type of activities do people engage in?

-ATV and motorcycle riding
-Hiking, mountain biking
-Camping
-Skiing, Snowmobiling
-Fishing
-Mining
-Other (please specify)

Of the choices above, we received the following response:

ATV and motorcycle riding – 14
Hiking, mountain biking – 28
Camping – 6
Skiing, Snowmobiling – 17
Fishing – 0
Mining – 0
Other (please specify)
horseback riding
rock hounding
biomonitoring
snowboarding
hiking with dog who may be drinking the water
One responder witnessed a jeep in the area.

How often do people engage in the activities checked above? (please specify for all activities checked above)

-Number of hours per event
-Number of days per year
-Number of years

Many responders were not sure how long people spend time in the Standard Mine area but most responders felt that the time spent would be very little. The reason stated for this is because they believed most people would just be passing through the site and not hanging around the site itself. For those that did respond, they responded with the following:

Number of hours per event – under 5 hours per event with the exception of one response that state 10 hours per event and another 24 hours or more. The person that responded with 24 hours or more has property in the area.

Number of days per year

Under 5 days – 11
6 to 10 days – 3
11 to 15 days – 2
16 to 20 days – 0
Over 20 days – 1
* One person that responded stated she was up there 250 to 300 times per year.

Number of years

1 to 5 yrs. – 9
6 to 10 yrs. – 3
11 to 20 yrs. – 3
Over 20 yrs. – 5

General Comments Received:

- The numbers may be increasing because of the interest around the clean-up of the mine and people wanting to see what the ruckus is all about.

- For mountain bikers under an hour and for motorized users maybe more time.

- Some probably just pass right on through or turnaround because they missed the trail head to Copley Lake.

Do you bring your children with you? If so, what are their ages?

Of those that responded to this question, 12 do not have children. For those that have children, 11 of them said they do not take their children with them to that area and one said their child has only been to Copley Lake which is below the Standard Mine, another responder said she took her daughter there once at age 11 but she's now 28, and one responder said that her kids have been up in the area a long time ago but not recently. Her children are now ages 14 and 18. I did not get the ages of the children where the parents stated that they have never taken their children up to the Standard Mine site.

General Comments:

- The area of hiking is too steep for children to hike.
- Don't have any and have never seen any up there when I've been up there. It seems that the hike would be too steep for children.
- Too far up and steep.
- Only up to Copley Lake
- We shouldn't assume that children are not hiking in the area because there are quite a few families that do lots of hiking in the area.
- You'll see kids on ATVs and motorbikes riding around.

If you fish, where do you fish? (Please describe location of where on site fishing is occurring, for example, at the site itself, along Elk Creek below the site, Coal Creek).

No one responded as having fished in the area.

How many fish do you catch each year from this site? Do you eat all of the fish you catch? When you prepare the fish, do you prepare just the fillets or do you include other parts of the fish?

See response to #5 above.

Future Land Use

What do you think are the most likely land uses for the Standard Mine site in the future? (Check all that apply)

-Residential
-Commercial/Industrial
-Recreational
-Other (please specify)

All 29 responders believed that in the future, recreational use would continue to be the main use in and around the Standard Mine area. Of all the responders, 9 of the responders felt that residential development could occur in the area, 7 felt there could be commercial interest such as tours in the area.

For each of the land uses checked above, please explain the basis for your answer. For example, if residential land use is checked, is this based on zoning ordinances, county planning, recent property purchases, development plans, etc.

Many of the responses received to this question were the same from each responder. The comments received were the following:

- Continue to be the same recreational activities as is occurring in the area now.
- There could be an increase in commercial activity for touring in the area.
- The Township of Irwin is close by and growing and so residential development is bound to spill over into the Elk Basin area.
- There's private property in the area so there will probably be an increase in residential development at some point.
- You may see more tours for historical and educational purposes.
- Recreational only - Climate, location and elevation.
- Will depend on road improvements to the area that would make it more accessible.
- Doubts much due to steepness of the area and difficulty in getting to the mine site.

- Recreational only - Location, terrain, and precipitation.
- Recreational only – location, accessibility, and demand.

For those land uses checked above, except residential, what are the most likely activities you think people may engage in?

ATV and motorcycle riding
Hiking, mountain biking
Camping
Skiing, Snowmobiling
Fishing
Mining
Other (please specify)

Of the choices above, we received the following response:

ATV and motorcycle riding – 17
Hiking, mountain biking – 29
Camping – 10
Skiing, Snowmobiling – 19
Fishing – 0
Mining – 0
Other (please specify)
horseback riding
biomonitoring
educational tours (hiking)
Jeeps 4-wheeling
rock hounding
hunting

General Comments Received:

- Camping may increase but probably around Copley Lake and not up at the mine site itself.

- Other general suggestions or comments that responder's mentioned during the interviews or on their interview sheet were:
    - If the U.S.F.S would clearly mark the trail head to Copley Lake, less people would end up at the Standard Mine site.

- Someone should evaluate the risk of hunting wildlife in and around the Standard Mine site because the elk and deer in the area probably drink out of the creek and pond. What would the mean for someone who eventually ate the elk or deer?
- People probably don't typically come across the mine because it's not easy to stumble across.

- There's a lot of private property in the area making it difficult to get to the site without crossing over someone's property.

- There are gates in various areas making it difficult to get to the site.

- We think that somewhere between 175 to 200 mountain bikers visit the Gunsight Pass/Standard Mine/Scarps Ridge area in a summer. If there was a more defined route from the top of Gunsight through the Standard Mine site down Elk Creek to Kebler the area would probably see more use. I think many folks believe there are private property issues through the area.