

EXPLANATION OF SIGNIFICANT DIFFERENCES

EAST HELENA SUPERFUND SITE

EAST HELENA, MONTANA

January 22, 2024

Introduction

This Explanation of Significant Differences (ESD) presents the details of a change to the residential cleanup level for lead in the remedy selected in the September 2009, Operable Unit 2 Residential Soils and Undeveloped Lands Record of Decision (ROD) for the East Helena Superfund Site (Site).

The East Helena Superfund Site is in East Helena, Lewis and Clark County, Montana, about three miles east of Helena, Montana (Figure 1). The Site includes the City of East Helena, several residential subdivisions and surrounding rural agricultural lands, and the site of a former 140-acre former Asarco lead and zinc smelter that operated from 1888 until it ceased operations in 2001. The smelter has since been demolished and the site it stood on is now covered by an 80-acre evapotranspirative (ET) cover system. The reconstructed Prickly Pear Creek (PPC) floodplain borders the former smelter site on the east, northeast and southeast. State Highway 12 and American Chemet (a metals-based chemical manufacturer) border it to the north.

This ESD selects the change in the selected remedies to allow for the EPA to address residential yards to a cleanup level for lead that factors in variable lead bioavailability and is consistent with the residential cleanup standard established for the Site under the Resource Conservation and Recovery Act (RCRA) for former Asarco- owned undeveloped properties when land use changes. Currently there are approximately 1,517 properties (e.g., residential properties, road aprons, alleys, parks) that remain at or above 400 parts per million (ppm) for lead in soil as part of the earlier sampling actions at the Site. The significant change presented in this ESD is to remove the Site lead action level of 1,000 ppm for residential properties and lower the lead cleanup level to 400 ppm.

Since beginning the work to reassess the residential soil lead cleanup level in 2023, the EPA released updated residential soil lead guidance for CERCLA Sites. This guidance lowers the residential soil lead Regional Screening Level (RSL) to 200 ppm, or 100 ppm if an additional source of lead is identified. The 2024 Updated Residential Soil Lead Guidance is available at <https://www.epa.gov/superfund/updated-soil-lead-guidance-cercla-sites-and-rcra-corrective-action-facilities>.

In the interest of initiating work at the Site to expediently address the risks posed by lead contamination in soil, the EPA is proceeding with this ESD at the 400 ppm lead level, while we concurrently begin the implementation of the 2024 Updated Residential Soil Lead Guidance. Starting in 2024, the EPA will be assessing what this updated guidance means for the East Helena Superfund Site. The EPA anticipates the 400 ppm residential lead cleanup level determined in this ESD being potentially revised based on the updated screening level guidance. It is important to note that implementation of this updated guidance will only expand the number of residential properties qualifying for cleanups and that EPA's whole-yard approach to yard cleanups moving forward will not require multiple cleanups for qualifying properties.

The EPA is the lead agency for oversight of the investigations, feasibility studies, remedial designs, remedial actions and operation and maintenance. The Montana Department of Environmental Quality (DEQ) acts as the consulting agency for this project.

This ESD is issued in accordance with Section 117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, (CERCLA), 42 U.S.C. 9617(c) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Section 300.435(c)(2)(i). The changes described in this ESD significantly change, but do not fundamentally alter, the remedy selected in the ROD with respect to scope, performance, or cost of the selected remedy.

The Final ESD and supporting documentation have been added to the Administrative Record for the Site, as required by NCP Section 300.825(a)(2). All documents making up the Administrative Record, are available for public review at the following website: <https://www.epa.gov/superfund/east-helena>. A notice containing a summary of the action will be published in a local newspaper, as required by NCP Section 300.435(c)(2)(i)(A) & (B).

Figure 1: East Helena Superfund Site Boundary



Site History

A former Asarco lead smelter operated in East Helena from 1888 until 2001. For more than 100 years, lead and zinc smelting operations deposited lead, arsenic, and other heavy metals and hazardous chemicals into the soil, surface water and groundwater of the Helena Valley. The sources of this contamination included the smelter stack, fugitive emissions from plant operations, process ponds and direct surface water discharges. Historically, the mode of transport for the contaminants was air and surface water.

After Asarco, the responsible party, signed a Consent Decree issued by the Department of Justice in 1998, it was determined that the site would be addressed using both the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). For the CERCLA component of the site cleanup, the work is focused on remediation of soils on residential and undeveloped lands (OU2). Areas on the former lead and zinc smelter facility identified in the original OU1 designation that were not remediated under CERCLA before 1998 are being addressed under RCRA Corrective Action authority per the 1998 Consent Decree (modified in 2012).

Residential Response Actions History. Pursuant to a 1991 Administrative Order-on-Consent (AOC), Asarco implemented non-time critical removal actions at residential properties between 1991 and October 2011; these actions addressed 1,576 properties.

The OU2 ROD for Residential Yards and Undeveloped Lands was finalized in 2009. Under the 2009 ROD, the lead action level is 1,000 ppm and residential yards are remediated to 500 ppm lead. The language in the 2009 ROD is as follows:

“Contaminated soil remaining in qualified residential yards and vacant lots will be excavated and disposed of in an EPA-approved soil repository. A lead cleanup level of 1,000/500 milligrams per kilogram (mg/kg) will be applied to residential yards. When any section of a yard is found to have a soil lead concentration greater than 1,000 mg/kg, all portions of the yard with soil lead greater than 500 mg/kg will also be cleaned up. Soil from excavated areas will be replaced with clean topsoil, revegetated and landscaped.

The two-part residential cleanup action level adopted for East Helena (1,000/500 ppm lead) is uniquely suited to the variability of lead concentrations in residential soils, and provides a protective, yet cost-effective remedy. The selected cleanup action level overcomes the inherent variability and ensures that this response action will result in no soils remaining with lead concentrations above 1,000 ppm. The cleanup action level for lead is expected to achieve a community-wide post-cleanup average lead concentration that is substantially less than 500 ppm. The result will be protective of human health.”

With this 1,000/500 ppm lead cleanup level, there are a significant number of properties with soil lead concentrations between 500-1,000 ppm. Based on previous soil sampling, primarily from the 1990s, there are at least 250 residential properties with at least one section above 500 ppm.

The Remedial Action Objectives (RAOs) and Remedy Components per the 2009 ROD are as follows in Table 1.

Table 1: OU2 Contaminated Soil RAOs and Remedy Components for the Site

RAOs	Remedy Components
<ul style="list-style-type: none"> Continue to have no child in the East Helena area exhibit a blood lead concentration greater than 10 micrograms per deciliter (µg/dL). Continue the Lead Education and Assistance Program (LEAP) and continue to seek ways to improve its effectiveness and outreach. For the Lead Education and Abatement Program: Maintain 95% or more of the children at or below 4 µg/dL blood lead and the average blood lead concentration for area children at a level less than the national average for children less than 7 years old. Prevent direct contact/ingestion with soil having contaminant concentrations above cleanup levels in existing residential areas. Prevent recontamination of areas already cleaned up from undeveloped areas that have not been cleaned up or from buried soils or remodeling debris with residual lead levels above risk-based concentrations. Minimize wind-borne migration of lead into residential areas. Minimize lead and arsenic exposures to livestock and wildlife. Prevent direct contact/ingestion by workers (farmer, rancher, irrigator, commercial retailer, etc.) or recreational visitors with soil exceeding cleanup levels. Ensure that lead and arsenic concentrations in soil do not exceed established cleanup levels in undeveloped areas proposed for future residential development. 	<ul style="list-style-type: none"> Excavate contaminated soil remaining in qualified residential yards, vacant lots, unpaved streets, aprons, alleys, historic irrigation ditches and drainage channels, and portions of the railroad rights-of-way and dispose of it in an EPA-approved soil repository. Institutional controls to protect the integrity of the completed actions. Continue the county-administered, community-wide education program. Immediate remedial action of a residential yard whenever blood tests of children and a follow-up environmental assessment by a health professional demonstrate that exposure to lead in yard soils is responsible for a blood lead level in a child above 10 µg/dL, regardless of the yard's soil- lead concentration.

From 2013 to 2020, the EPA completed remedial design activities for contaminated soils at remaining developed lands (qualified residential yards, flood channels and road aprons that were in existence prior to 2009). Remedial

action began in 2014. Approximately twelve properties with soil lead above the action level set in the ROD remain unaddressed because access was never granted to EPA to complete remedial action. A summary of the areas remediated to date is provided in Table 2.

Table 2: Summary of OU2 Response Actions Completed by Land Use Category

Year	Total Properties Remediated by Year	Residential	Commercial	Church/School	Park/Public Area	Vacant Lots	Parking Lots	Road Aprons	Alley	Roadway	Flood Channels	Flood Ditches	Railroad Right of Way
Removal Actions													
1991-2011	1,576	786	50	4	11	38	4	373	75	14	141	80	
Remedial Actions													
2015	5	1						4					
2016	26							19			7		
2017	5							5					
2018	20												20
2019	7												7
2020	6	1			1			2				2	
Total Remedial	69	2			1			30			7	2	27
Grand Total	1,645	788	50	4	12	38	4	403	75	14	148	82	27
Notes:													
Bold = cumulative sum of all years													

On-site soil repositories. There are two historical repositories opened by Asarco within the Site, the West Field and East Field Repositories. The West Field Repository was closed by Asarco prior to their bankruptcy in 2007. The East Field Repository was open for residential and commercial soils until 2023 when the Smelter Road Repository located south of the former smelter site was opened. The Smelter Road Repository will be used moving forward for disposal of residential soils.

Basis for this ESD

The Fifth Five-Year Review report was signed on July 21, 2021. This review found that the remedy is protective of human health and the environment. However, the Fifth Five-Year Review was conducted prior to the finalization of the most recent Integrated Exposure Uptake Biokinetic (IEUBK) model in 2021. The IEUBK model factors in the bioavailability of lead in soil. Until 2017, an inexpensive, validated method to determine site-specific bioavailability of lead in soil or dust was not available. Because of the advancement in science on bioavailability, East Helena residential soil samples were collected to obtain site-specific lead bioavailability and the risk was reevaluated using the updated IEUBK model for exposure to lead in East Helena residential soils.

Soil samples from 50 residential properties were collected in April 2023 and analyzed for lead bioavailability and is summarized in the *2023 Lead Risk Memorandum for Residential Soils at the East Helena Superfund Site* (Appendix A). Not all lead present in soil is in a form that can harm humans or animals. Certain forms of lead are not fully available or absorbed by the human body. The amount that is absorbed is referred to as “bioavailable,” meaning it is in a form that can enter the bloodstream and affect human health. In East Helena the soil-lead Relative Bioavailability (%RBA) varied greatly, ranging from 52.5% to 85% with a mean of 64%.

Using the newly collected Site lead bioavailability data and the most recent IEUBK Model (2021), a Preliminary Remediation Goal (PRG) estimate of 588 ppm lead was determined to be most appropriate using 10 µg/dl blood lead level as a benchmark for children in East Helena. However, due to the highly variable bioavailability found at the Site, a more conservative residential lead cleanup of 400 ppm is selected. A lead cleanup level of 400 ppm is also consistent with the residential cleanup standard at the Site established under RCRA for former Asarco-owned undeveloped properties when land use changes.

As mentioned in the Introduction, on January 17, 2024, the EPA released updated residential soil lead guidance for CERCLA Sites. This guidance lowers the residential soil lead Regional Screening Level (RSL) to 200 ppm, or 100 ppm if an additional source of lead is identified. In the interest of initiating work at the Site to expediently address the risks posed by lead contamination in soil, the EPA is proceeding with this ESD at the 400 ppm lead level, while we concurrently begin the implementation of the updated soil lead guidance. The EPA anticipates the 400 ppm residential lead cleanup level determined in this ESD being potentially revised based on the updated screening level guidance. It is important to note that implementation of this updated guidance will only expand the number of residential properties qualifying for cleanups and that EPA’s whole-yard approach to yard cleanups moving forward will not require multiple cleanups for qualifying properties.

Description of Significant Differences

This ESD documents the decision to change the selected remedies to allow for the EPA to address residential yards to a cleanup level for lead that accounts for variability in lead bioavailability. The significant difference for residential properties presented in this ESD is to remove the Site lead action level of 1,000 ppm and lower the lead cleanup level from 500 ppm to 400 ppm. No change is currently proposed for the non-residential area cleanup numbers. Residential properties will be investigated and cleaned up following the

methodologies found in the OU2 ROD, the 2023 Focused Feasibility Study for OU2, and the widely used EPA Superfund Lead- Contaminated Residential Sites Handbook (EPA, 2003).

This ESD does not amend or change the applicable or relevant and appropriate federal and state requirements (ARARs) in the OU2 ROD because the ESD does not identify a new component to the remedy. Therefore, as there is no modification of ARARs in the ESD, there is not an analysis of ARARs specific to the ESD.

The capital cost of this ESD is estimated to be \$50,000,000.

Support Agency Comments

The State of Montana concurs with this ESD.

Statutory Determinations

In accordance with CERCLA Section 121, 42 U.S.C. § 9621, the EPA believes that this action is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action. This ESD makes no changes to the remedy's use of permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

Because this action will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will continue to be conducted within five years after the remedial action to ensure that the remedy is, or will be, protective of human health and the environment. The most recent five-year review was completed on July 21, 2021.

Public Participation Requirements

This ESD and its supporting documentation will be available for public review at these locations and a notice containing a brief summary of the action will be published in a local newspaper, as required by NCP Section 300.435(c)(2)(i)(A) & (B). The public participation requirements set out in NCP section 300.435(c)(2)(i)(A)&(B) have been met.

AUTHORIZING SIGNATURE

This Explanation of Significant Differences (ESD) documents the first modification to the 2009 Record of Decision for the OU2 ROD at the East Helena Superfund Site.

The following authorized official at EPA Region 8 approves the modification as described in this ESD.

Becker, Kathleen
Digitally signed by Becker,
Kathleen
Date: 2024.01.24 08:54:31 -07'00'

KC Becker, Regional Administrator
U.S EPA, Region 8

Date

This Explanation of Significant Differences (ESD) documents the first modification to the 2009 Record of Decision for the OU2 ROD at the East Helena Superfund Site.

The following authorized official at the State of Montana concurs with the modification as described in this ESD.



Christopher Dorrington, Director
Montana Department of Environmental Quality

1/23/2024

Date

*Appendix A: Lead Risk Memorandum for Residential Soils at the East
Helena Superfund Site*

**FINAL LEAD RISK MEMORANDUM FOR RESIDENTIAL SOILS
AT THE EAST HELENA SUPERFUND SITE
EAST HELENA, MONTANA
SEPTEMBER 2023**

1.0 OVERVIEW

In 1995, a human health risk assessment (HHRA) was completed for the East Helena Superfund site that evaluated risks to human health due to metals in residential soil near the former Asarco East Helena Plant (lead smelter) in East Helena, Montana (Asarco, 1995). Lead was identified as the chemical of greatest health concern for residential soil, based on the Environmental Protection Agency (EPA) risk reduction goal at that time of having no more than 5 percent (%) probability of exceeding a blood lead level of 10 micrograms per deciliter ($\mu\text{g}/\text{dL}$) in children. Since that time, EPA has conducted numerous remedial actions in East Helena, including the removal of contaminated soil for those properties exceeding 1,000 parts per million (ppm) lead with a cleanup level of 500 ppm as established in the 2009 Operable Unit (OU) 2 Record of Decision (ROD).¹ Lead toxicology and risk assessment have evolved in the intervening years. Recognizing those changes, EPA has resampled soil from 50 residential yards in East Helena, analyzed the samples for lead and in vitro bioaccessibility (IVBA), and evaluated those sampling results based on current lead risk assessment methodologies. This document provides an overview of the changes in lead risk assessment methodologies, summarizes the results of the 2023 residential soil sampling, and updates the risk calculations based on those methodologies. In addition, the updated risk results are presented in comparison to the 1995 Asarco HHRA risk results.

2.0 UPDATES TO LEAD RISK ASSESSMENT METHODOLOGY

The updates to lead risk assessment methodologies include changes in sampling soil as well as changes in modeling lead risk. The major changes in lead risk assessment methodologies since the 1995 Asarco HHRA include the following:

1. Incremental composite samples were collected from residential yards to characterize the variance in soil lead concentration over the exposure area (ITRC, 2020).
2. Prior to analysis for lead concentration, surface soil samples were sieved to less than (<) 150 micrometers (μm) particle size fraction to yield the soil particles that adhere to skin. This fraction represents the soil fraction available for incidental ingestion (EPA, 2016).

¹ OU2 consists of non-smelter property surface soils in residential areas, irrigation ditches, rural developments, and surrounding undeveloped land.

3. Soil lead bioavailability was determined for the residential soil samples and considered quantitatively in lead risk calculations (EPA, 2007, 2021a).
4. Updates to the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK Model Version 2, build 1.72) were used for all risk calculations. The changes to the IEUBK model since 1995 primarily effect default exposure factors. These updates are consistent with current EPA risk assessment guidance (<https://www.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals>).
5. In addition to 10 µg/dL, lower target blood lead concentrations were evaluated (i.e., 3.5 and 5 µg/dL) for the lead risk assessment which is consistent with current EPA guidance and practice (EPA, 2013, 2020, 2021b).

3.0 RESIDENTIAL SOIL DATA

The residential soil lead information available in the 1995 Asarco HHRA and from the 2023 sampling that was used for this risk assessment update are discussed below.

3.1 Soil Lead Concentration

Lead concentration data for historical samples were extracted from EPA's Scribe database for the East Helena Site. Data queried from the Scribe database for use in this evaluation focused on lead results for soil samples collected from the 0 to 1 inch (0-1") depth at the 50 properties that were sampled in 2023. Historical data were available in the Scribe database for 1991 through 2016. Data were extracted corresponding to the date range of data used in the 1995 Asarco HHRA (1991-1993) and for the interim period 1994-2016. Soil data used in the 1995 Asarco HHRA were collected from residential properties throughout East Helena from August 1991 through the fall of 1993 (Asarco, 1995). As described in the 1995 Asarco HHRA, these data represented five-point composite samples collected within each quadrant of a residential yard to yield four separate composite yard samples. Lead concentrations were analyzed by X-ray fluorescence (XRF) with a subset of samples subsequently analyzed in the laboratory for confirmational wet chemistry analysis. Analysis information was not available in Scribe to determine which lead concentration data for the 1991-1993 sampling period correspond to laboratory analysis versus XRF. The data in Scribe for the sampling period 1994-2016 were presumed to have not been collected under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and are of unknown quality. They are presented in this evaluation for completeness.

EPA obtained access to conduct soil sampling at 50 residential properties in East Helena in April 2023. This soil sampling was conducted under the EPA-approved Quality Assurance Project Plan (QAPP) (EPA, 2023) using incremental sampling methodology (ISM) in each yard. Each

ISM sample was composed of 30 increments collected from the 0-1" depth interval following ITRC technical guidance (2012, 2020). Replicate (three) ISM samples were collected from the unpaved areas of each of the 50 properties and sent to the laboratory to be sieved to <149 µm. This particle size fraction represents the fraction expected to adhere to skin via dermal contact (Ruby and Lowney, 2012) and is the soil particle size fraction recommended for lead risk assessment (EPA, 2016). All ISM samples were submitted to the laboratory for wet chemistry analysis.

Table 1 summarizes the average lead concentrations for each of the 50 properties included in this evaluation for the sampling periods 1991-1993 (referred to as "1995 Asarco HHRA"), 1994-2016, and 2023.

3.2 Relative Bioavailability (RBA)

3.2.1 Relative Bioavailability (RBA) for Data from 1991-2016

In the 1995 Asarco HHRA, the default assumption for soil lead bioavailability (60% RBA) was used in the risk calculations. The difference between 1991-2016 and 2023 average soil lead concentrations for many of the properties is more than 50 ppm, this suggests that the difference is unlikely due to sampling and analytical variability. Therefore, the RBA value from the 1995 HHRA was retained for the 1991-2016 data set. For each property, the average soil lead concentration from sampling in 1991-2016 was used with the IEUBK model default soil lead RBA (60%) to derive an RBA-adjusted exposure point concentration (RBA-adjusted EPC) as the input to the IEUBK model (EPA, 2020) (see Table 1).

3.2.2 Relative Bioavailability (RBA) for Data from 2023

The 2023 sampling included collection of samples for IVBA measurement to inform relative bioavailability of lead in soil. Lead RBA is predicted from IVBA using the following regression model (EPA, 2007, 2020): $\text{lead RBA (\%)} = 0.878 \times \text{IVBA (\%)} - 2.8$. The 2023 IVBA results and calculated RBA are shown in Table 1 and summary statistics for the RBA data are shown in Table 2. The 2023 RBA information for each yard was plotted on a map (see Figure 1). No spatial trends are apparent based on the 2023 RBA information, so property-specific RBA adjustment was selected as the most appropriate estimate of soil lead RBA for risk calculations using the 2023 data. For each property, the average soil lead concentration was used with the average property-specific soil lead RBA to derive an RBA-adjusted EPC (EPA, 2020) (see Table 1).

4.0 HUMAN HEALTH RISK ASSESSMENT FOR LEAD

The IEUBK model predicts the likely range of blood lead levels in a population of young children (aged 0–84 months; the 12–72 month age group is used for Superfund sites [EPA, 2017]) exposed to a specified set of environmental lead levels. This model requires input data on the concentrations of lead in soil, dust, water, air, and diet at a location, as well as the amount of these media ingested or inhaled by a child. Consistent with EPA guidance, all inputs to the IEUBK model are central tendency estimates (CTEs). These point estimates are used to calculate an estimate of the central tendency (the geometric mean) of the distribution of blood lead values that might occur in a population of children exposed to the specified conditions. Assuming the distribution of blood lead values in a population of similarly exposed children is lognormal and given an estimate of the variability between different children (this is specified by the geometric standard deviation), the IEUBK model calculates the expected distribution of blood lead values in the population of similarly exposed children and estimates the probability that any random child might have a blood lead value over the target blood lead level (EPA, 1994a, 1994b, 1998).

EPA is in the process of reevaluating target blood lead level recommendations at Superfund sites. EPA (2013) reported that the range of cognitive effects in children were substantiated to occur in populations or groups of children with mean blood lead levels between 2 and 8 $\mu\text{g}/\text{dL}$. The IEUBK model cannot be used with a risk benchmark below 3 $\mu\text{g}/\text{dL}$ because the risk goal would be exceeded even if the soil lead concentration were 0 milligrams per kilogram (mg/kg ; primarily due to dietary lead exposure). For these reasons, target blood lead levels of 3.5, 5, and 10 $\mu\text{g}/\text{dL}$ were selected for this Site. Target blood lead levels of 3.5 and 5 $\mu\text{g}/\text{dL}$ were selected to quantitatively evaluate the lower and middle risk range of child blood lead levels associated with adverse health effects, and 10 $\mu\text{g}/\text{dL}$ was selected because it was used in the 1995 Asarco HHRA. Thus, the risk results below are based on the criteria that there is no more than 5% probability that mean child blood lead values may exceed 3.5 $\mu\text{g}/\text{dL}$ (referred to as P3.5), 5 $\mu\text{g}/\text{dL}$ (referred to as P5), or 10 $\mu\text{g}/\text{dL}$ (referred to as P10).

Tables 3 and 4 present the IEUBK model input parameters (age-independent and age-dependent parameters, respectively) used in the risk calculations. All input parameters were set equal to IEUBK Version 2 defaults, except for residential yard soil lead concentration.² Site-specific data were available for these model inputs based on 2023 sampling results as described in Sections 3.1 and 3.2, respectively.

² The input to the IEUBK model was the RBA-adjusted EPC, so the default bioavailability estimate was used in the IEUBK model.

5.0 COMPARISON OF 1995 TO 2023: SAMPLING INFORMATION AND RISK RESULTS

Table 1 shows the sampling data and risk results for the residential properties in East Helena where residential soil was sampled for the 1995 Asarco HHRA, between 1994-2016, and in 2023. For the 50 properties sampled in 2023, average soil lead concentrations (not adjusted for RBA) ranged from 147 to 923 mg/kg. RBA-adjusted average soil lead concentrations, based on site-specific measured IVBA, ranged from 128 to 1,064 mg/kg, with 22 properties exceeding the OU2 cleanup level from the 2009 ROD of 500 mg/kg RBA-adjusted lead in soil. Based on risk calculations performed using the IEUBK model and the 2023 RBA-adjusted soil lead concentrations, all 50 properties exceeded the P3.5 target risk level, 47 properties exceeded P5, and 7 properties exceeded P10. Twenty of these residential properties were evaluated in the 1995 Asarco HHRA, and their soil lead concentrations (adjusted for RBA using a default of 60%) ranged from 246 to 760 mg/kg. Of these 20 properties evaluated in the 1995 Asarco HHRA, all exceeded target lead risk benchmarks of P3.5 and P5, and 3 exceeded P10. For some residential yards, there are differences in soil lead concentrations and risk estimates between 2023 and earlier results. Table 5 presents the relative percent difference (RPD) for each property. The 2023 results reflect the best available science on assessing lead exposure and risk and are reflective of current human exposures.

6.0 UNCERTAINTIES

Quantification of risks to humans from exposures to lead is subject to a number of data limitations and uncertainties. The main source of uncertainty in lead exposure is the amount of soil ingested by human receptors: the soil and dust ingestion rates used in the IEUBK model do not incorporate variability in consumption patterns, nor do they reflect pica behavior. Additionally, the mean lead concentration in each environmental medium (measured soil concentrations and default water, air, and diet concentrations) is used in the exposure and risk calculations in the IEUBK model. However, there is uncertainty in the true average concentration of lead in each environmental medium. Finally, even if the amount of lead ingested at the Site was known with confidence, the effect on blood lead would still be uncertain. This is because the rate and extent of blood lead absorption is a highly complex physiological process and can best be approximated by a mathematical model. Thus, the blood lead values predicted in children by the IEUBK model should be understood to be uncertain, and because of a general preference to use realistic or slightly health-protective values, are more likely to be high than low.

6.1 Soil Lead RBA Estimate

In addition to consideration of property-specific soil lead RBA when no spatial pattern was seen in the RBA information, use of a site-wide RBA was evaluated. As shown in Table 2, the mean, geometric mean, and 95UCL (Student's t) resulted in approximately the same estimate of soil lead RBA (i.e., ~64%). Because the 2023 sampling was complete in that all properties had an IVBA estimate, the property-specific RBA estimate was considered the most applicable RBA estimate for the risk calculations (avoiding the possibility of over- or underestimating risk).

6.2 Addition of Soil or Sod to Yards Since 1991

Surface soil for the 50 residential properties sampled in 2023 were sampled using incremental composite sampling (IRTC, 2020), whereby the top inch of soil, underneath any organic layer present, was sampled for laboratory analysis. In some of the yards, the sampling team noticed what appeared to be sod cover in some of the yards. It is unknown the extent to which sod and soil from offsite had been applied to the residential yards (if at all) in the past; however, if sod or soil was applied to the yard between 1991 and 2023 that would likely alter the soil lead concentration and/or the lead bioavailability, and ultimately the RBA-adjusted EPC.

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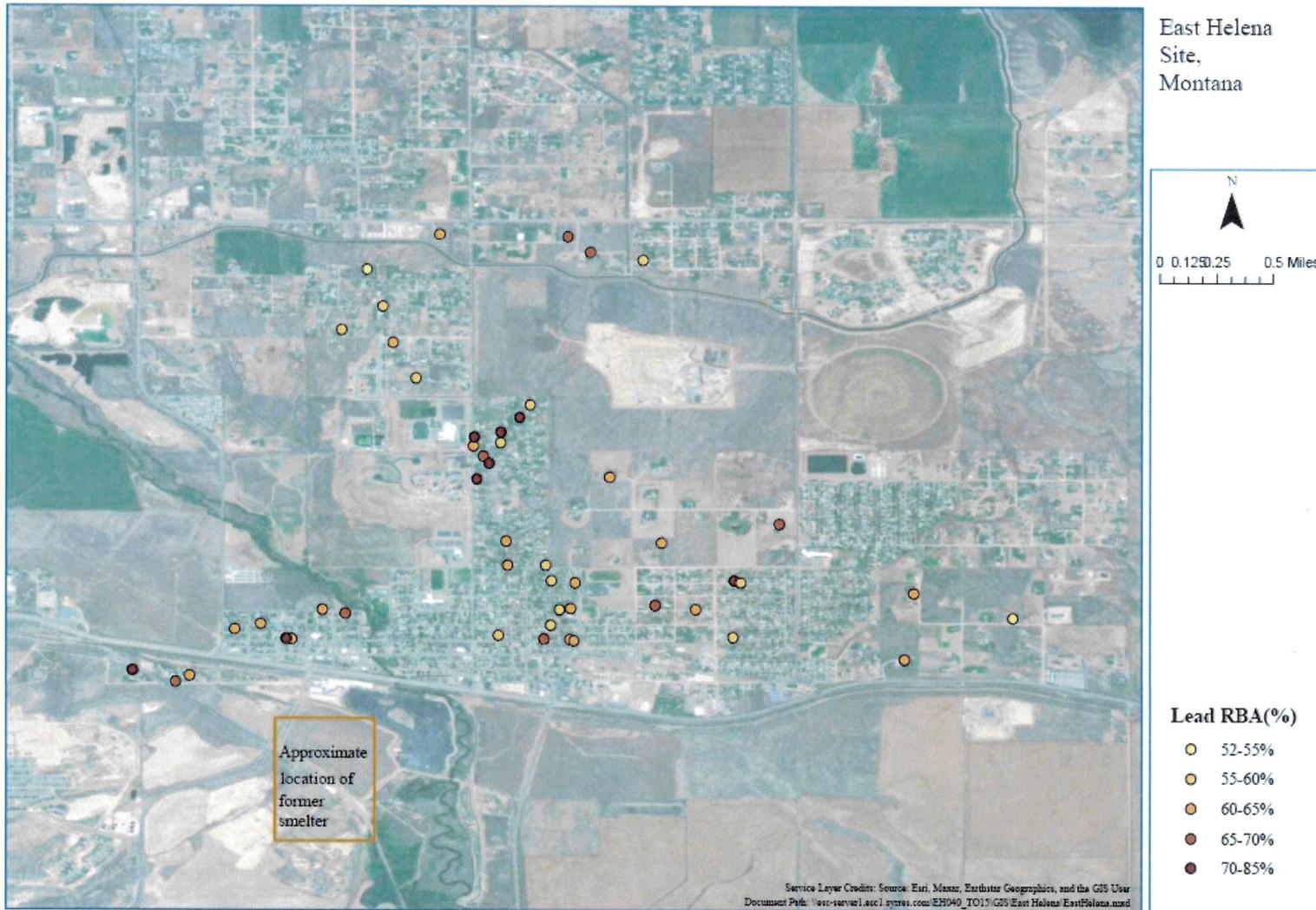
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Figure 1. Soil Lead RBA based on 2023 Residential Soil Sampling



Defense > Environment > Intelligence



Table 1. Summary of 1995 Asarco HHRA, 1994-2016, and 2023 residential soil lead sampling information and risk results for 50 residential properties in East Helena, MT

Property ID	Soil Lead Concentration ^a (mg/kg)				Soil Lead Relative Bioavailability (%RBA)				RBA-adjusted Soil Lead Exposure Point Concentration (mg/kg) [†]		
	Mean Concentrations			Maximum Concentration Across All Data	1995 Asarco HHRA %RBA ^b	1994-2016 %RBA ^b	2023 %IVBA	2023 %RBA ^c	1995 Asarco HHRA ^b	1994-2016 ^b	2023 ^c
	1995 Asarco HHRA	1994-2016	2023								
CK06	418.75		480.00	537.00	60		75	63.05	418.75		504.40
DB03	578.50		390.00	700.00	60		67	56.03	578.50		364.17
DE10		424.75	200.00	627.00		60	68	56.90		424.75	189.68
DH05	626.88		516.67	858.00	60		72	60.42	626.88		520.25
DK06		770.00	576.67	999.00		60	75	63.05		770.00	605.98
DK08		680.25	546.67	923.00		60	71	59.54		680.25	542.46
EB08	365.25		390.00	645.00	60		74	62.17	365.25		404.12
ED03	478.25		473.33	656.00	60		74	62.17	478.25		490.47
EF08	607.00		456.67	722.00	60		75	63.05	607.00		479.88
EF09	246.00	392.25	760.00	780.00	60	60	92	77.98	246.00	392.25	987.70
FA01	389.75	520.75	463.33	653.00	60	60	76	63.93	389.75	520.75	493.67
FD02	617.00	692.50	923.33	980.00	60	60	82	69.20	617.00	692.50	1064.85
GH05		822.00	800.00	984.00		60	71	59.54		822.00	793.84
HE06	534.00	785.75	513.33	996.00	60	60	71	59.54	534.00	785.75	509.38
HE08		812.00	480.00	893.00		60	80	67.44		812.00	539.52
HF07	333.75	306.75	346.67	533.00	60	60	74	62.17	333.75	306.75	359.22
HI05		896.25	503.33	970.00		60	72	60.42		896.25	506.82
IC09	456.75		286.67	595.00	60		74	62.17	456.75		297.04
IC20	760.20		720.00	910.00	60		81	68.32	760.20		819.82
IC26	395.25		480.00	649.00	60		84	70.95	395.25		567.62
MH05	423.83		363.33	570.00	60		73	61.29	423.83		371.17
MI01		488.00	456.67	828.00		60	79	66.56		488.00	506.61
NA08		582.50	420.00	935.00		60	91	77.10		582.50	539.69
NC05		428.25	170.00	726.00		60	67	56.03		428.25	158.74
NK03		550.50	306.67	557.00		60	70	58.66		550.50	299.82
S4CF15		511.00	490.00	945.00		60	74	62.17		511.00	507.74
S4FIS04		466.25	380.00	694.00		60	72	60.42		466.25	382.63
S4GV01	396.60		216.67	550.00	60		67	56.03	396.60		202.32
S4HOF02		403.13	396.67	510.00		60	71	59.54		403.13	393.61
S4LAN20		364.67	146.67	600.00		60	63	52.51		364.67	128.37

Table 1. Summary of 1995 Asarco HHRA, 1994-2016, and 2023 residential soil lead sampling information and risk results for 50 residential properties in East Helena, MT

Property ID	Soil Lead Concentration ^a (mg/kg)				Soil Lead Relative Bioavailability (%RBA)				RBA-adjusted Soil Lead Exposure Point Concentration (mg/kg) [†]		
	Mean Concentrations			Maximum Concentration Across All Data	1995 Asarco HHRA %RBA ^b	1994-2016 %RBA ^b	2023 %IVBA	2023 %RBA ^c	1995 Asarco HHRA ^b	1994-2016 ^b	2023 ^c
	1995 Asarco HHRA	1994-2016	2023								
S4WV05		495.93	350.00	921.00		60	66	55.15		495.93	321.70
SB01 ^d		516.26	443.33	1420.00		60	72	60.42		516.26	446.41
SR01		442.50	356.67	591.00		60	81	68.32		442.50	406.11
SU01		531.13	566.67	687.00		60	72	60.42		531.13	570.60
TA04		540.58	380.00	838.00		60	87	73.59		540.58	466.04
TA09	485.75	506.43	460.00	741.00	60	60	80	67.44	485.75	506.43	517.04
TA10		564.78	273.33	746.00		60	75	63.05		564.78	287.23
TA12		542.75	540.00	934.00		60	89	75.34		542.75	678.08
TB03		616.33	416.67	966.00		60	95	80.61		616.33	559.79
TC13	434.50	551.57	423.33	859.00	60	60	71	59.54	434.50	551.57	420.07
TD08		410.00	266.67	550.00		60	68	56.90		410.00	252.91
TE03		381.00	236.67	721.00		60	95	80.61		381.00	317.96
TE15	493.83		566.67	945.00	60		100	85.00	493.83		802.78
TJ04	579.00		433.33	819.00	60		74	62.17	579.00		449.02
XA05		448.50	616.67	710.00		60	81	68.32		448.50	702.16
XB07		357.88	383.33	615.00		60	78	65.68		357.88	419.65
XC14		323.00	533.33	596.00		60	71	59.54		323.00	529.23
ZA02		281.08	266.67	573.00		60	72	60.42		281.08	268.52
ZB03		315.79	253.33	824.00		60	65	54.27		315.79	229.14
ZD05		319.28	203.33	507.00		60	76	63.93		319.28	216.64

^a Mean soil concentrations were calculated for each property for each dataset. For completeness, the maximum concentration reported across all data (regardless of dataset) is also shown.

^b The soil lead RBA used was the default value in the IEUBK model (60%).

^c The soil lead RBA used was based on a site-specific (property-specific) estimate calculated from the 2023 residential soil sampling IVBA results.

^d The average result for 1994-2016 for property SB01 is based on 16 samples that includes 1 sample that reported lead as not detected (the reported concentration in Scribe is 1.1 mg/kg).

[†] All properties from all three time periods have soil lead concentrations that exceed P3.5. Bold indicates the soil lead concentration exceeds P5, bold blue italics indicates the soil lead concentration exceeds P10.

Table 2. Summary Statistics for 2023 Lead RBA Data

Statistical Parameter	Result
Sample number (n)	50
Minimum	52.51 %
Maximum	85%
Mean	63.98%
Geometric mean	63.6%
Standard deviation	7.28
Skewness	1.12
Coefficient of variation	0.114
25 th percentile (Quartile 1)	59.54%
50 th percentile (Quartile 2)	62.17%
75 th percentile (Quartile 3)	67.44%
95 th percentile	79.42%
99 th percentile	82.85
95% Student's-t UCL	65.71%

Table 3. Age-Independent IEUBK Input Parameter Values

Parameter	Units	Value	Source
Drinking Water Concentration	µg/L	0.9	IEUBK default
Indoor Dust Concentration (C _{dust})	mg/kg	Calculated	$C_{dust} = (0.7 \times C_{soil}) + (100 \times C_{air})$
Outdoor Air Concentration (C _{air})	µg/m ³	0.1	IEUBK default
Indoor Air Concentration	µg/m ³	30% of outdoor	IEUBK default
Absorption Fraction (water)	unitless	0.5	IEUBK default
Absorption Fraction (diet)	unitless	0.5	IEUBK default
Relative Bioavailability	unitless	60%	IEUBK default
Absorption Fraction (soil, dust)	unitless	n/a	RBA-adjusted EPC was used (EPA, 2020)
Absorption Fraction (air)	unitless	0.32	IEUBK default
Fraction of Soil + Dust that is Soil	unitless	0.45	IEUBK default
Geometric Standard Deviation	unitless	1.6	IEUBK default
Maternal Blood Lead Concentration	µg/dL	0.6	NHANES 2009-2014
Target Blood Lead Concentration	µg/dL	3.5	Professional judgment
		5	
		10	

Table 4. Age-Dependent IEUBK Input Parameter Values

Age (months)	Time Outdoors (hours)	Ventilation Rate (m ³ /day)	Dietary Intake (µg/day)	Water Intake (L/day)	Soil-Dust Intake (mg/day)
0 to <12	1.0	3.22	2.66	0.4	86
12 to <24	2.0	4.97	5.03	0.43	94
24 to <36	3.0	6.09	5.21	0.51	67
36 to <48	4.0	6.95	5.38	0.54	63
48 to <60	4.0	7.68	5.64	0.57	67
60 to <72	4.0	8.32	6.04	0.6	52

Values shown in this table correspond to the IEUBK default parameters.

Table 5. Comparison of Historic and Current EPCs

Property ID	RBA-adjusted Soil Lead Exposure Point Concentration (EPC) (mg/kg) ^c			Relative Percent Difference (RPD) of Historic Sampling EPCs and 2023 EPCs (%) ^d
	1995 Asarco HHRA ^a	1994-2016 ^a	2023 ^b	
CK06	418.75		504.40	19
DB03	578.50		364.17	45
DE10		424.75	189.68	77
DH05	626.88		520.25	19
DK06		770.00	605.98	24
DK08		680.25	542.46	23
EB08	365.25		404.12	10
ED03	478.25		490.47	3
EF08	607.00		479.88	23
EF09	246.00	392.25	987.70	120
FA01	389.75	520.75	493.67	24
FD02	617.00	692.50	1064.85	53
GH05		822.00	793.84	3
HE06	534.00	785.75	509.38	5
HE08		812.00	539.52	40
HF07	333.75	306.75	359.22	7
HI05		896.25	506.82	56
IC09	456.75		297.04	42
IC20	760.20		819.82	8
IC26	395.25		567.62	36
MH05	423.83		371.17	13
MI01		488.00	506.61	4
NA08		582.50	539.69	8
NC05		428.25	158.74	92
NK03		550.50	299.82	59
S4CF15		511.00	507.74	1
S4FIS04		466.25	382.63	20
S4GV01	396.60		202.32	65
S4HOF02		403.13	393.61	2
S4LAN20		364.67	128.37	96
S4WV05		495.93	321.70	43
SB01 ^e		516.26	446.41	15
SR01		442.50	406.11	9
SU01		531.13	570.60	7
TA04		540.58	466.04	15
TA09	485.75	506.43	517.04	6
TA10		564.78	287.23	65
TA12		542.75	678.08	22
TB03		616.33	559.79	10
TC13	434.50	551.57	420.07	3
TD08		410.00	252.91	47
TE03		381.00	317.96	18
TE15	493.83		802.78	48
TJ04	579.00		449.02	25
XA05		448.50	702.16	44

Table 5. Comparison of Historic and Current EPCs

Property ID	RBA-adjusted Soil Lead Exposure Point Concentration (EPC) (mg/kg) [†]			Relative Percent Difference (RPD) of Historic Sampling EPCs and 2023 EPCs (%) ^d
	1995 Asarco HHRA ^a	1994-2016 ^a	2023 ^b	
XB07		357.88	419.65	16
XC14		323.00	529.23	48
ZA02		281.08	268.52	5
ZB03		315.79	229.14	32
ZD05		319.28	216.64	38

^a The soil lead RBA used was the default value in the IEUBK model (60%).

^b The soil lead RBA used was based on a site-specific (property-specific) estimate calculated from the 2023 residential soil sampling IVBA results.

^c The average result for 1994-2016 for property SB01 is based on 16 samples that includes 1 sample that reported lead as not detected (the reported concentration in Scribe is 1.1 mg/kg).

^d RPDs compare the 1995 Asarco HHRA data with the 2023 data, unless the property was not sampled in 1995. In those cases the 1994-2016 data were used in the RPD calculations.

[†] All properties from all three time periods have soil lead concentrations that exceed P3.5. Bold indicates the soil lead concentration exceeds P5, bold blue italics indicates the soil lead concentration exceeds *P10*.