Focused Feasibility Study for Operable Unit 2

East Helena Superfund Site

East Helena, MT

January 11, 2024

U.S. EPA Region 8
Helena, Montana

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Acronyms/Definitions

AOC	Administrative Order-on-Consent
ARARs	Applicable or Relevant and Appropriate Requirements
ASARCO	American Smelting and Refining Company
bgs	below ground surface
bioavailability	measurement of the amount of a substance, which enters the body, that is able to have an active effect
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	conceptual site model
COCs	contaminants of concern
DU	Decision Unit
Site	East Helena Superfund Site
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Difference
ET	Evapotranspirative
FFS	Focused Feasibility Study
GIS	Geographic Information System
ICs	Institutional Controls
ICIAP	Institutional Controls Implementation and Assurance Plan
IEUBK	Integrated Exposure Uptake Biokinetic Model
LCC	Lewis and Clark County
LCPH	Lewis and Clark County Department of Public Health
LEAP	Lead Education and Assistance Program
METG	Montana Environmental Trust Group
O&M	Operations and Maintenance
OU	Operable Unit
ppm	parts per million (same as milligrams per kilogram (mg/kg))
PPC	Prickly Pear Creak

PRG	Preliminary Remediation Goal (400 ppm lead for this document)
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RPM	Remedial Project Manager
Site	East Helena Superfund Site, East Helena, Lewis & Clark County, Montana
Soil Regulations	2020 Regulations Governing Soil Displacement and Disposal in the East Helena Superfund Area in Lewis and Clark County

1.0. Introduction and Purpose

This Focused Feasibility Study (FFS) for Operable Unit 2 (OU2) summarizes residential yard remedial approach alternatives for the East Helena Superfund site (Site) located in East Helena, Montana. This report will support remedial decision making for residential properties within the OU2.

The science of lead and its bioavailability has evolved since the last Human Health Risk Assessment (HHRA) was conducted for the Site in 1995. With the update to the Integrated Exposure Uptake Biokinetic Model (IEUBK) model in 2021, EPA determined a re-evaluation of the residential lead cleanup levels at the Site was warranted. A risk evaluation of the existing residential cleanup levels was conducted in 2023 with bioavailability data from residential soil samples collected in April 2023. The risk evaluation is summarized in the *Lead Risk Memorandum for Residential Soils at the East Helena Superfund Site* (Appendix B). Based on this evaluation and for site consistency, this Focused Feasibility Study was prepared to address remedial approaches for a lower residential yard lead cleanup level.

2.0. Site Background

2.1. Site Description and History

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 American Smelting and Refining Company (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.

The EPA originally identified five operable units (OUs) at the Site: process ponds and fluids; groundwater; surface water, soils, vegetation, livestock, fish, and wildlife; slag pile; and ore storage areas. 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). In 2009, as successor to ASARCO, the Montana Environmental Trust Group (METG), the Custodial Trustee for the Site, assumed responsibility for the corrective action cleanup as dictated in the RCRA Consent Decree. This responsibility also includes all remaining environmental compliance obligations of the OU1 Consent Decree issued in 1990 to address groundwater contamination, site soils, surface water and the slag pile.

Figure 1: East Helena Superfund Site Boundary

Current land use at the former smelter site is limited to RCRA Corrective Action cleanup of remaining contaminant sources and restoring the Site for possible future uses. Land use around the facility includes residential, agricultural, recreational/open space and commercial properties. Public access to the facility is restricted. Reuse continues at parts of the Site outside the facility. There were many property sales by METG in 2018 including, 254-acre property to a developer for a mixed-use development, 35 acres to the East Helena Public Schools for the new high school, which is now open, and 100 acres to a developer for a single-family residential development. Also in 2018, Prickly Pear Elementary School opened on 50 acres of Custodial Trust donated land. In November 2019, the Montana Department of Justice Natural Resource Damage Program (NRDP) allocated funding for construction of a greenway trail system along 322 acres of the realigned PPC, linking East Helena to Montana City, and in December 2020 the property was conveyed to Prickly Pear Land Trust for development of the trail and publicly accessible open space, part of which opened in 2023. Additional parcels south of Highway 12 have been sold by METG for commercial and residential development in 2023.

<u>Residential Response Actions History.</u> Pursuant to the 1991 Administrative Order-on-Consent (AOC), ASARCO contractors implemented non-time critical removal actions at residential properties between 1991 and October 2011; these actions addressed 1,576 properties (Table 1). The OU2 Record of Decision (ROD) for Residential Soils and Undeveloped Lands was finalized in 2009. 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 and is ongoing. A summary of the areas remediated to date is provided in Table 1.

Table 1: 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													

<u>On-site soil repositories.</u> 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.

<u>Institutional Controls (ICs).</u> The Lewis and Clark City-County Board of Health implements institutional controls as required by the OU2 ROD. The institutional control requirements for OU2 include local regulations to prevent or reduce recontamination of cleaned-up areas, coordination of planning and zoning efforts, local use and permitting requirements, management of the soil repository, deed notices, easements, public education, best agricultural management practices (e.g., minimal tilling and burning), and continuation of the Lead Education and Assistance Program (LEAP).

The Lewis and Clark City-County Board of Health established an ordinance as a remedy component for the EPA's ongoing CERCLA work, primarily associated with residential properties and undeveloped lands in OU2, to protect public health and control environmental lead and arsenic contamination within the Lewis and Clark County Administrative Boundary (Figure 1). The regulation applies to all persons engaging in soil displacement more than one cubic yard and requires that they obtain a permit and inspection upon completion of the project. All the former ASARCO properties fall within the Administrative Boundary. Local disposal of small quantities of potentially contaminated soil removed by residents is available in the Institutional Control Program repository located off Smelter Road. The Lewis and Clark City-County Board of Health updated the LEAP Soil Ordinance in 2020.

In June 2021, the EPA Region 8, with support from Lewis and Clark County Department of Public Health (LCPH), prepared an *Institutional Controls Implementation and Assurance Plan (ICIAP)* for OU2. The ICIAP identifies how institutional controls shall be implemented, maintained, enforced, modified, and terminated (when applicable). The implementation and enforcement of institutional controls at the Site is primarily the responsibility of LCPH, with the involvement of the EPA in determining compliance with Superfund requirements. This ICIAP is intended to be a "living" document that will require future revision if or when any of the institutional controls described within the plan are modified. The ICIAP specifies:

- Development of a Geographic Information System (GIS) layer identifying the "area of interest" for soils management, to include the City of East Helena and surrounding portions of Lewis and Clark County
- Web-based public access to property contamination and status information
- Modification of city building permits, zoning policies, and East Helena's growth policy
- One-Call program whereby LEAP receives notification of any excavation plans for all inquiries made within the OU2 Administrative Boundary
- Deed notices
- Best management practices for agricultural land
- Repository management
- Subdivision regulations for the City of East Helena
- Soil displacement permits.

The 2021 ICIAP includes a copy of the 2020 Regulations Governing Soil Displacement and Disposal in the East Helena Superfund Area in Lewis and Clark County (Soil Regulations), which incorporate the administrative area map. The map showing the boundaries of the administrative area, which no longer includes Jefferson County, is presented in Figure 1.

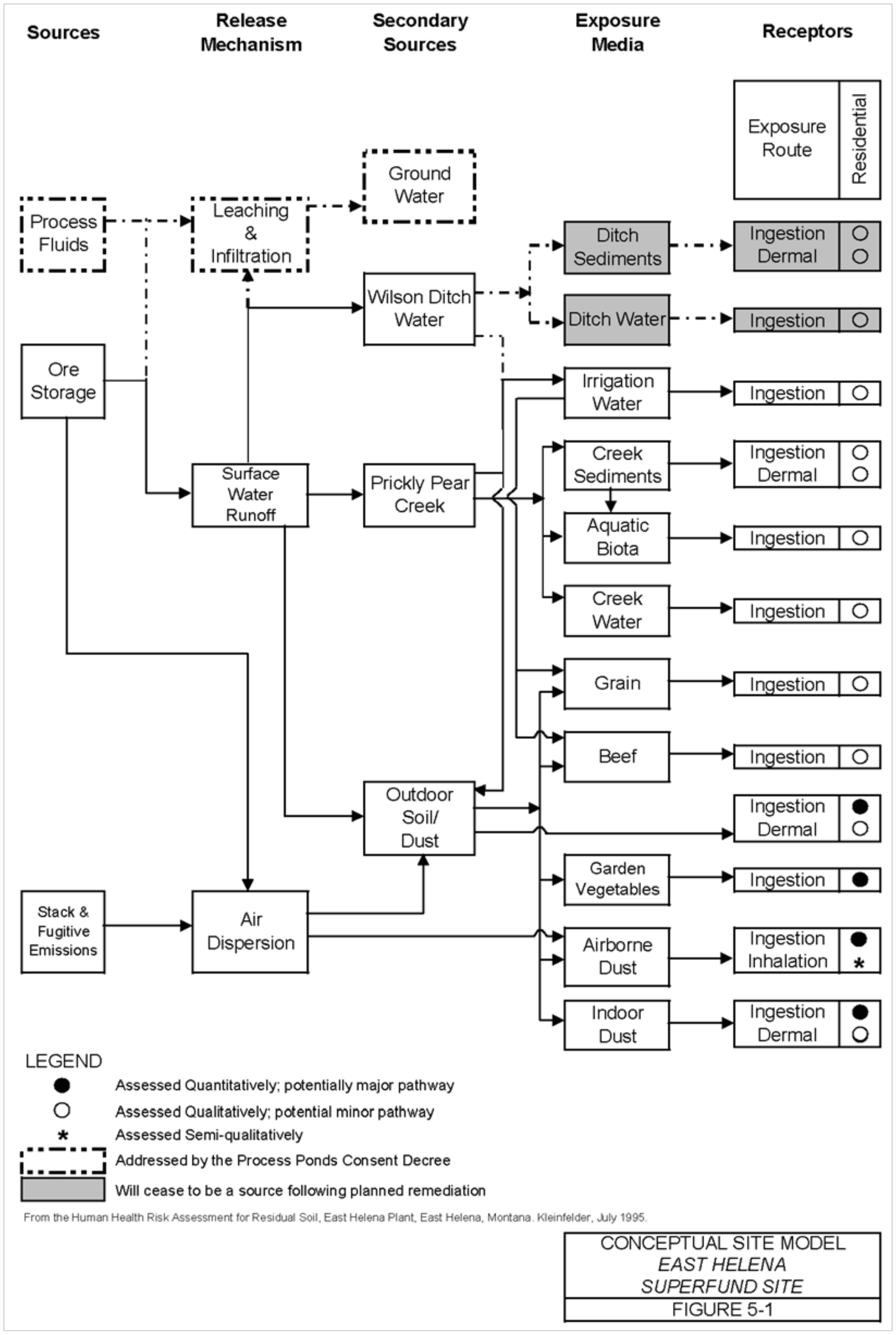
2.2. Nature and Extent of Contamination

Site smelter operations resulted in the release of heavy metals, arsenic, selenium and other hazardous chemicals into the soil, surface water and groundwater of the Helena Valley. The contaminant sources included the smelter stack, fugitive emissions from plant operations, process ponds and direct surface water discharges. Historically, air and surface water transported the contaminants. The Conceptual Site Model (CSM) is depicted in Figure 2.

EPA's risk assessment showed that lead and arsenic are Contaminants of Concern (COCs) for East Helena residents, with lead being the primary COC. Arsenic, although also a COC, poses a relatively low risk.

One of the primary pathways by which humans were exposed to lead and arsenic was by ingesting or inhaling fine particulate dust transported through the air from the smelter. The predominant wind directions in East Helena are towards the east, north, and northeast. However, even with little or no wind, air movement and particulate deposition followed the Prickly Pear Creek watershed. These air patterns deposited the highest concentration of metals in residential areas of East Helena.

Figure 2: Conceptual Site Model



2.3. Remedial Approach Following 2009 ROD

Per the 2009 OU2 ROD, the current remedy for residential yards for both lead and arsenic is:

> “A lead cleanup level of 1,000/500 [ppm] will be applied to residential yards. When any section of a yard is found to have a soil lead concentration greater than 1,000 [ppm], all portions of the yard with soil lead greater than 500 [ppm] will also be cleaned up.
>
> Yards where the yard-wide average soil arsenic concentration exceeds 100 ppm will be cleaned up regardless of the lead concentration.”

At properties that qualify for cleanup, initial excavation to a 6 inch depth is performed, followed by post-excavation confirmation sampling of the newly exposed soil surface. If the sample results show concentrations of lead above 500 ppm or arsenic above 100 ppm, another 6 inch depth excavation is performed. This continues until the soil left in place has lead and arsenic concentrations below the cleanup levels or the excavation reaches the maximum depth of 18 inches below original ground surface. This excavation and sampling strategy can result in a final excavation depth of 6, 12, or 18 inches at each property, depending on the concentrations of lead and arsenic in the analyses of the post-excavation samples. After excavation, yards were backfilled with clean fill. EPA excavations required clean fill material to contain less than 50 ppm lead.

3.0 Lower Lead Cleanup Level

A risk evaluation of the existing residential cleanup levels was conducted in 2023 with bioavailability data from residential soil samples collected in April 2023. The risk evaluation is summarized in the *Lead Risk Memorandum for Residential Soils at the East Helena Superfund Site* (Appendix B).

Quantification of risks to humans from exposures to lead is subject to a number of data limitations and uncertainties. Representative site-specific data are essential for developing a risk assessment (as well as cleanup goals) that reflect the current or potential future conditions. The most common type of site-specific data is media-specific lead concentration information (air, water, soil, dust). Until recently, an inexpensive, validated method to estimate bioavailability of lead in soil or dust was not available. Receptor data (e.g., age, body weight, breathing rate, or soil ingestion rate) does not typically vary from site to site.

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. Using 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 bioavailibility found at the Site, a 400 ppm PRG was selected.

A PRG of 400 ppm lead is also consistent with the residential cleanup standard established under the Resource Conservation and Recovery Act (RCRA) for former East Helena ASARCO-owned undeveloped properties when land use changes.

4.0. Description of Residential Yard Remedial Approach Alternatives

This section describes the limited alternatives that were considered for the remediation of residential yards. These alternatives are intended to represent the realistic range of remedial options which might be employed to address contamination in residential soils at the site. The risk management soil Preliminary Remediation Goal (PRG) of 400 ppm lead has been used for the comparison of remedial alternatives.

In accordance with EPAs *Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, three alternatives, including the "No Action" alternative, were considered (EPA 1999). The other two alternative approaches to residential yard remediations are "Soil Removal and Replacement Using a Decision Unit (DU) Approach," and "Whole-Yard Removal and Replacement."

Description of properties subject to remediation. Properties subject to remediation include residential properties, parks, schools, churches, and unpaved streets/road aprons/alleys of residential areas. Table 2 identifies the number of residential properties potentially qualifying for cleanup for the DU and Whole-Yard approach alternatives. Table 3 shows the estimated number of soil cleanups proposed under each of the three alternatives.

Because of previous removal and remedial activities, residential properties in the Site that may require remediation can be divided into four categories:

1. Currently Qualify: Properties that currently qualify for remediation under the 2009 OU2 ROD with lead soil concentrations above 1,000 ppm,
2. Previously Sampled, Did Not Qualify: Properties previously sampled properties that did not qualify for remediation and have DUs above the PRG,
3. Not Sampled: An estimation of properties not previously sampled that may have lead concentrations above the PRG, and
4. Remediated: An estimation of properties that were remediated to 500 ppm lead and have DUs not remediated above the PRG.

Table 2: Number of Residential Properties Qualifying for Cleanup Based on Approach Alternative

Property Category	Description PRG = 400 ppm lead	Number of properties	
		DU Approach	Whole-Yard Approach (estimated)
Currently Qualify	Properties that currently qualify for remediation under the 2009 OU2 ROD with lead soil concentrations above 1,000 ppm	12	12
Previously Sampled, Did Not Qualify	Previously sampled properties that did not qualify for remediation and have DUs above the PRG	322	(206)[1]
Not Sampled	An estimation of properties not previously sampled that may have lead concentrations above the PRG	264	(169)[2]
Remediated	An estimation of properties that were previously remediated to 500 ppm lead and have DUs not remediated above the PRG.	262[3]	262
Total Properties		**860**	**649**

Table 3: Estimated Number of Soil Cleanups for the Three Alternative Approaches

Alternatives	**# of Residential Properties**	**Soil Removal**	**# of Unpaved Street Sections, Road Aprons, & Alleys**	**Soil Removal**	**# of Parks**	**Soil Removal**	**# of Schoos**	**Soil Removal**	**Total # of Properties**	**Soil Removal**
No Action	860	0	651	0	5	0	1	0	**1,517**	**0**
Alternative 2	860	860	651	651	5	5	1	1	**1,517**	**1,517**
Alternative 3	860	649	651	651	5	5	1	1	**1,517**	**1,306**

Level of soil removal. This study of approach alternatives focuses on remediation of properties with a full removal of soil down to 18 inches bgs, where lead contamination is present above the PRG. This approach is generally supported by the community, will result in decreased use of ICs, and result in fewer long-term Operations and Maintenance (O&M) resource needs. East Helena residents expressed concerns about changing yard uses during a community listening session hosted by EPA on August 28, 2023. In particular, concerns were expressed about adding and expanding gardens and play areas and residents would like yards remediated for unrestricted use. Full removal down to 18 inches bgs normally allows the remediated yard to return to unrestricted use (EPA 2003).

[1] Estimation assumes 64% of these properties would have a whole-yard lead average of 400 ppm or greater.

[2] Estimation assumes 50% of the properties not previously sampled would have at least one DU above 400 ppm (264 properties) and 64% of these properties would have a whole-yard lead average of 400 ppm or greater (169 properties).

[3] Previously remediated properties were evaluated for DUs above 400 ppm. At least 524 properties were only partially remediated, and it was estimated that 50% of them would contain DUs above 400 ppm.

4.1. Alternative 1: No Action

This alternative is included as a baseline for comparison to other alternatives. Under the no action alternative, no steps would be taken to remediate residential soils within the Site. Approximately 29.3% of the 4,275 properties in the site boundary are likely to have concentrations of lead in soil exceeding the PRG. Looking only at results from the 50 properties sampled in April 2023, selection of this alternative would leave lead in soil exceeding the PRG at 32 of these properties. Selection of this alternative could be expected to leave lead in soil exceeding the PRG in 860 yards; 651 unpaved street sections, road aprons, and alleys; 5 parks; and 1 school.

This alternative is readily implementable and cost effective. However, the no action alternative is not protective.

4.2. Alternative 2: Soil Removal and Replacement Using a Decision Unit Approach

This alternative consists of yard remediation based on quadrant or decision unit (DU) sampling. Any DU exceeding the PRG is remediated to 18 inches bgs and DUs below the PRG are not remediated. Of the total number of properties all would be remediated, however, DUs below the PRG would remain and additional remediation of most properties may be necessary if EPA lead policy changes.

4.3. Alternative 3: Whole-Yard Removal and Replacement

This alternative consists of whole-yard remediation to 18 inches below ground surface based on area-wide sampling for residential properties averaging greater than or equal to the PRG. This approach may result in high lead concentrations being left in place on properties that do not qualify for remediation.

Determining cleanup eligibility for residential yards

The initial step is to determine area-wide lead averages for residential properties. Determining area-wide lead averages will be different depending on the property category, as described below. Properties where the area-wide lead average is above the PRG would qualify for remediation.

For properties that do not qualify for whole-yard removal and replacement, additional sampling of gardens, play areas, and other high exposure areas could qualify those specific areas for remediation to 24" bgs if above the PRG, thereby reducing exposure to soils with high lead concentrations for these properties and ensuring long-term protectiveness.

Description of residential property categories

1. Currently Qualify: Properties that currently qualify for remediation under the 2009 OU2 ROD with lead soil concentrations above 1,000 ppm. An area-wide lead average for DUs for these properties would be determined with a whole-yard area-weighted average of the existing DU lead concentrations. See flowchart in Figure 3.

2. Previously Sampled, Did Not Qualify: Properties previously sampled that did not qualify for remediation and have DUs above the PRG. An area-wide lead average for DUs for these properties would be determined with a whole-yard area-weighted average of the existing DU lead

concentrations, except for the 50 properties sampled in April 2023 where the area-wide lead average was determined using incremental sampling.[4] See flowchart in Figure 3.

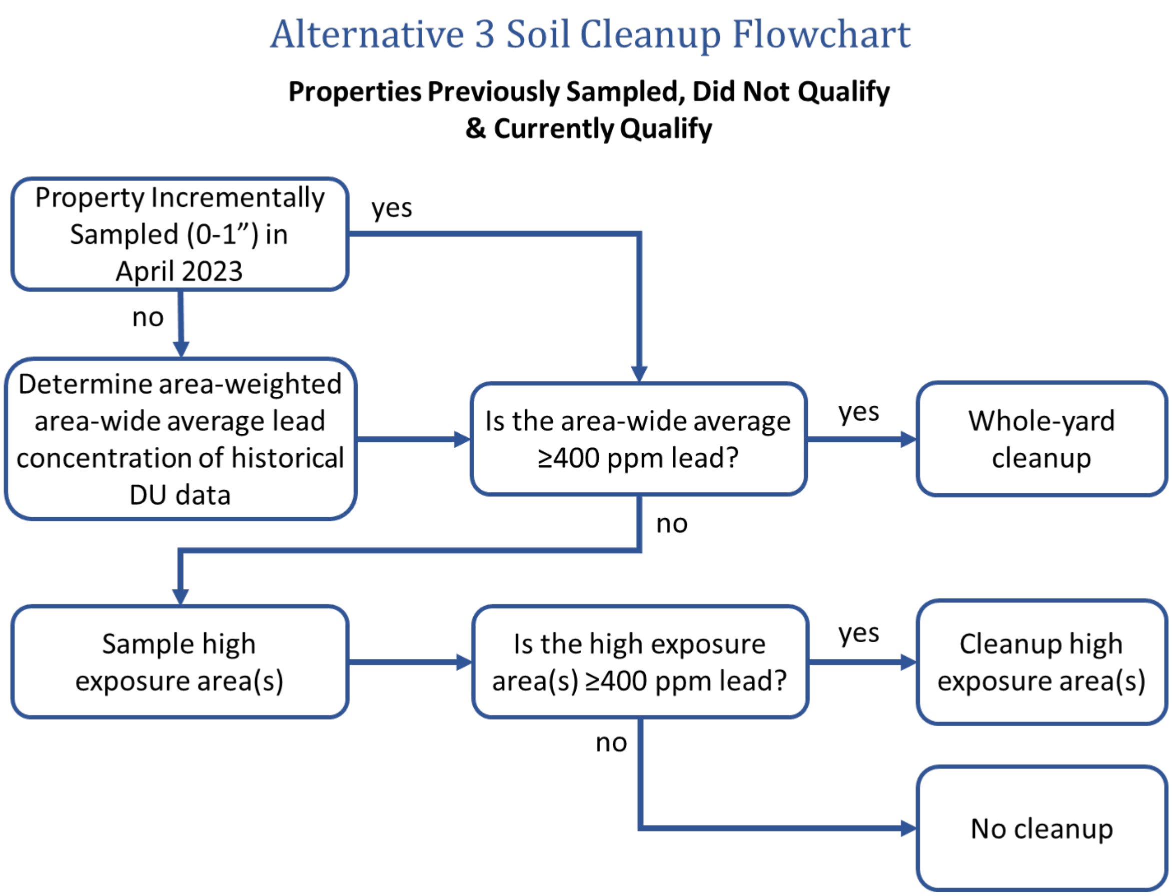
3. Not Sampled: An estimation of properties not previously sampled that may have lead concentrations above the PRG. These properties would be sampled using an incremental sampling method to obtain the area-wide lead average. See flowchart in Figure 4.

4. Remediated: An estimation of properties that were previously remediated to 500 ppm lead and have DUs not remediated above the PRG. These properties would need to be assessed to determine whole-yard area-weighted average of the remaining DUs that were not remediated. See flowchart in Figure 5.

Consideration for larger properties

There are about 100 East Helena properties with sizes between 2-10 acres. For soil removal, a residential yard can be defined as a maximum of 125 feet from the exterior of a residence, unless a property or natural boundary (i.e., fence, hedge, tree line, abrupt change in grade, etc.) is encountered at a distance less than 125 feet. The 125-foot distance is considered a guideline and can be adjusted, as appropriate considering land use by the property owner.

Figure 3: Alternative 3 Previously Sampled, Did Not Qualify and Currently Qualify Flowchart



[4] There are at least 18 properties, and possibly more, where risk management may be used where there are conflicting results with historical data.

Figure 4: Alternative 3 Not Sampled Flowchart

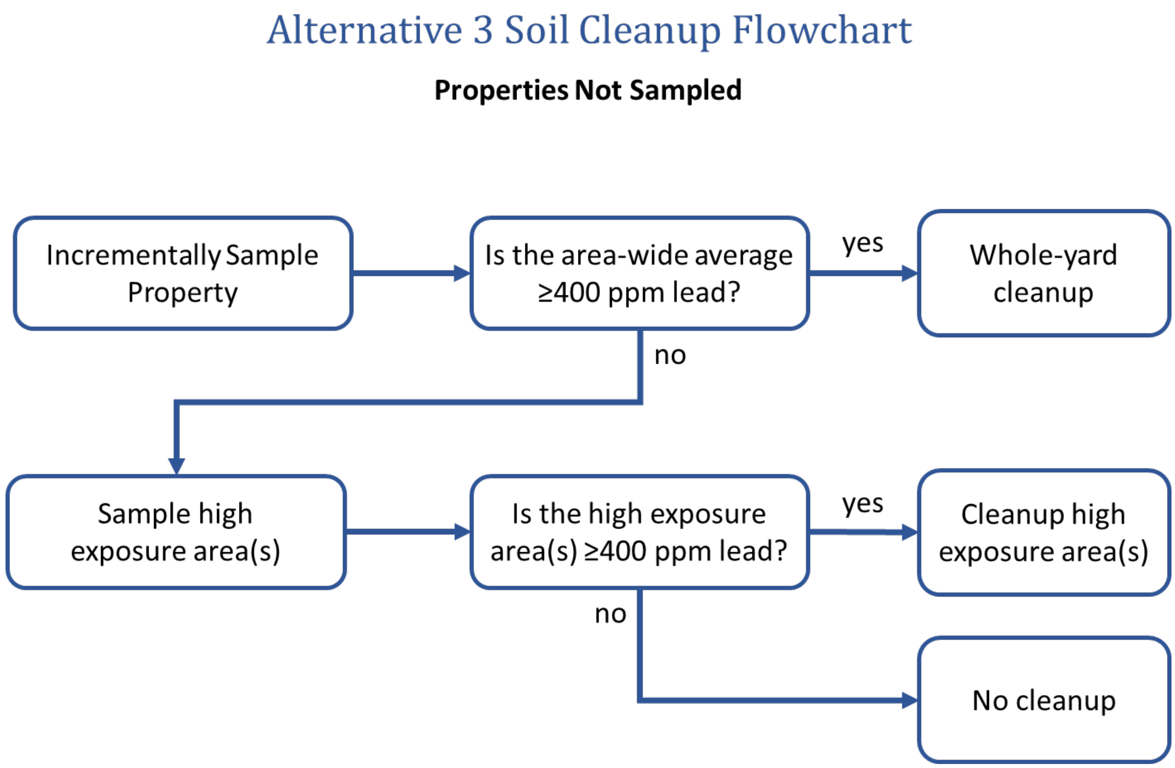
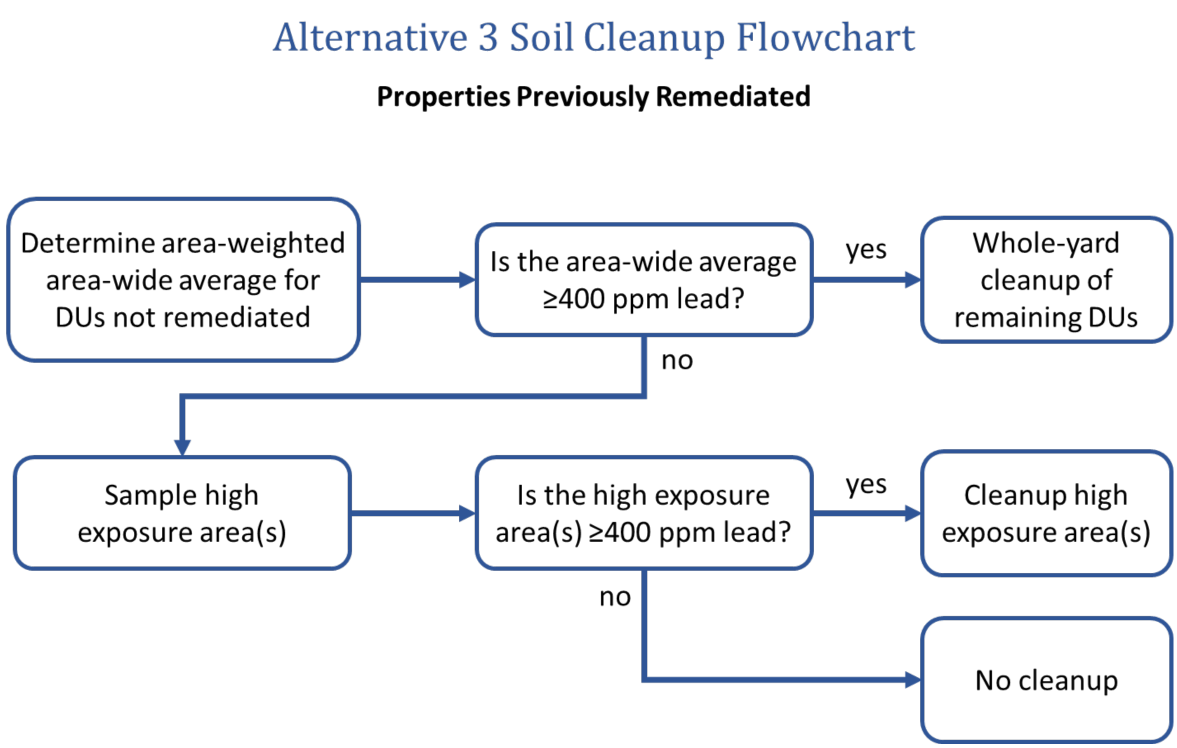


Figure 5: Alternative 3 Previously Remediated Flowchart



5.0. Individual and Comparative Analysis of Approach Alternatives

The purpose of this section is to present relevant information necessary for decision makers to select a remedy for the Site. To comply with the EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988), the selected alternative should:

- Be protective of human health and the environment,
- Attain Applicable or Relevant and Appropriate Requirements (ARARs) or provide grounds for invoking a waiver,
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable,
- Satisfy the preference for treatment that reduces the mobility, toxicity, or volume of waste as a principal element or provide an explanation in the ROD as to why not,
- Be effective in the short-term,
- Be implementable,
- Cost effective,
- Acceptable to the State,
- Acceptable to the community.

The detailed analysis of alternatives provides the basis for selecting the remedy by evaluating each alternative against these nine criteria. The results of the detailed analysis of alternatives will support the final selection of a remedial action approach.

5.1. Alternative 1: No Action

This alternative is included as a baseline for comparison to other alternatives. Under the no action alternative, no steps would be taken to remediate residential soils within the Site. The no action alternative is not protective of human health and is therefore removed from further consideration.

5.2. Alternative 2: Soil Removal and Replacement Using a Decision Unit Approach

Alternative 2 provides for removal of soil to 18 inches below ground surface from residential yards using a decision unit (DU) sampling approach. While this approach will result in remediation of all properties with sampling results above the PRG, DUs below the PRG would remain. This approach should effectively comply with the EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988), however, a change in the EPA's Lead Policy could result in this approach being less cost effective in the long-term.

This approach can accomplish the Site Remedial Action Objectives (RAOs) and is protective of human health and the environment, satisfying the first threshold criterion. The other threshold criterion considered in the detailed analysis of alternatives is compliance with ARARs. Alternative 2 can be implemented in compliance with ARARs. Long term effectiveness of Alternative 2 is considered moderate to high, because it complies with the Lead Handbook. Although there is some residual risk due to the possibility that lead contamination left in place could present an exposure risk, the risk is considered low. Soil removal and replacement is highly effective in the short term, as the remedy requires relatively little time to implement. However, there will be some dust generation and potential for worker exposure during the activity. Estimated costs for implementation of Alternative 2 are detailed in Table 5.

Community acceptance. Residents with properties that have soils previously sampled with lead concentrations between 500-1,000 ppm lead have expressed concerns about the lead contamination remaining on their properties. They have communicated these concerns to EPA through their Montana State Senator and Representative, during a listening session hosted by EPA on August 28, 2023, and individually to the Site Remedial Project Manager (RPM). They are very supportive of additional yard cleanups and support a lower residential cleanup level. Additionally, residents have expressed concerns about changing property use and would like yards remediated for unrestricted use. Alternative 2 would not result in the option for unrestricted-use designations for yards, provided that designation can be adequately satisfied with respect to areas under decks, sidewalks, trees, etc.

5.3. Alternative 3: Whole-Yard Removal and Replacement

Alternative 3 provides for whole-yard remediation to 18 inches below ground surface based on whole-yard sampling for residential properties averaging greater than or equal to the PRG. This approach will result in approximately 211 fewer yards qualifying for remediation. Properties that are remediated will qualify for unrestricted use designation; properties not remediated will have a low exposure risk based on the area-wide lead average and remediation of high exposure areas (e.g., play areas and gardens).

This approach may result in areas with high lead concentrations being left in place on properties that do not qualify for remediation, however these areas are expected to present low risk due to the exposure assumptions for residential yard use. Monitoring of properties with historical DU sampling data with lead concentrations above the PRG that do not qualify for remediation will continue to ensure long-term protectiveness.

This alternative can accomplish the Site RAOs and is protective of human health and the environment, satisfying the first threshold criterion. The other threshold criterion considered in the detailed analysis of alternatives is compliance with ARARs. Alternative 3 can be implemented in compliance with ARARs. Long term effectiveness of Alternative 3 is considered high. The removal and replacement of contaminated yard soils only partially satisfy the regulatory preference for remedies which reduce the toxicity, mobility, or volume of contaminants through permanent solutions or alternative treatments. Soil removal and replacement is highly effective in the short term, as the remedy requires relatively little time to implement. However, there will be some dust generation and potential for worker exposure during the activity. Estimated costs for implementation of Alternative 3 are detailed in Table 5.

Community acceptance. Residents with properties that have soils previously sampled with lead concentrations between 500-1,000 ppm lead have expressed concerns about the lead contamination remaining on their properties. They have communicated these concerns to EPA through their Montana State Senator and Representative, during a listening session hosted by EPA on August 28, 2023, and individually to the Site Remedial Project Manager (RPM). They are very supportive of additional yard cleanups and support a lower residential cleanup level. Additionally, residents have expressed concerns about changing property use and would like yards remediated for unrestricted use. Alternative 3 would result in the option for unrestricted-use designations for yards, provided that designation can be adequately satisfied with respect to areas under decks, sidewalks, trees, etc.

5.4. Comparative Analysis

Table 4 presents a summary of the approach alternatives evaluation against the nine criteria. Based on this analysis, the EPA selects Alternative 3, Whole-Yard Removal and Replacement, for the following reasons. The EPA will evaluate how to document this change to the 2009 ROD for the Site.

Rationale for the section of Alternative 3:

- This remedial approach will provide the best long-term protection for human health. Yards will be remediated which may allow for unrestricted use designations for properties where possible. Additionally, yards that do not qualify for whole-yard removal will still have high exposure areas evaluated and remediated if they are above the PRG. This will provide additional protection against lead exposure in the soil to residents.

- Cost comparison: Whole-Yard Removal and Replacement is estimated to be less expensive than the DU approach. See Table 5 for the cost comparison of the alternative approaches.

Table 4: Summary of the Approach Alternatives Evaluation Against the Nine Criteria

	Criterion	Description	Alternative 1 No Action	 2 Decision Unit Approach	 3 Whole-Yard Approach
Threshold Criteria	**Overall protection to human health and the environment**	Does an alternative eliminate, reduce, or control threats to public health and the environment through ICs, engineering controls, or treatment?	Not Protective	Protective	Protective
	Compliance with ARAR's	Does an alternative meet Federal, State, and Tribal envrionmental statutes, regulations, an other requirements relevant to the site, or is a waiver justified?		Complies with ARARs	Complies with ARARs
Balancing Criteria	**Long-term effectiveness and performance**	Does an alternative maintain protection of human health and the environment over time?		Moderately effective	Highly effective
	Reduction of toxicity, mobility, or volume through treatment	Does an alternative use treatment to reduce contaminants harmful effects or ability to move in the environment and the amount of contamination remaining after cleanup?		No	No
	Short-term effectiveness	How much time is needed to implement an alternative and the risk the alternative poses to workers, residents, and the environment during implementation?		Highly effective	Highly effective
	Implementability	What is the technical and administrative feasibility of implementing the alternative, including factors susch as availability of materials and services?		Readily implementable	Readily implementable

Table 5: Comparison of Total Cost of Remedial Approach Alternatives

Site: East Helena Operable Unit 2 **Location:** East Helena, MT **Phase:** Focused Feasibility Study - Comparative Analysis of Remedial Approach Alternatives			Base Year: 2024
DESCRIPTION	**Alternative 1** No Action	**Alternative 2** Soil Removal & Replacement Using a Quadrant or Decision Unit Approach	**Alternative 3** Whole-Yard Removal & Replacement to 18 Inches Below Ground Surface
Duration	0	10 years	10 years
Capital Cost	$0	$49,660,603	$44,715,622
Annual O&M Cost	$0	TBD	TBD
Total Constant Dollar Cost	$0	$49,660,603	$44,715,622
Total Present Value of Alternative (assuming 7% discount factor)	$0	$43,039,802	$38,750,408
Present Value of Alternative Range (assume accuracy of estimate - 30% + 50%)	$0	$30,127,861 to $64,559,703	$27,125,286 to $58,125,612

6.0. References

EPA, 2021. *Institutional Controls Implementation and Assurance Plan (ICIAP) for Residential Soils and Undeveloped Lands Operable Unit 2 East Helena Superfund Site*

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Appendix A: 2009 ROD Remedial Action Objectives (RAOs)

The Remedial Action Objectives (RAOs) and Remedy Components per the 2009 ROD are as follows in Table 6.

Table 6: OU2 Contaminated Soil RAOs and Remedy Components for the Site

RAOs	Remedy Components
• 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.	• 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.

Appendix B: Final Lead Risk Memorandum for Residential Soils at the East Helena Superfund Site – September 2023

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 (µg/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.

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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): lead RBA (%) = 0.878 × 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 µg/dL. The IEUBK model cannot be used with a risk benchmark below 3 µg/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 µg/dL were selected for this Site. Target blood lead levels of 3.5 and 5 µg/dL were selected to quantitatively evaluate the lower and middle risk range of child blood lead levels associated with adverse health effects, and 10 µg/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 µg/dL (referred to as P3.5), 5 µg/dL (referred to as P5), or 10 µg/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.

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

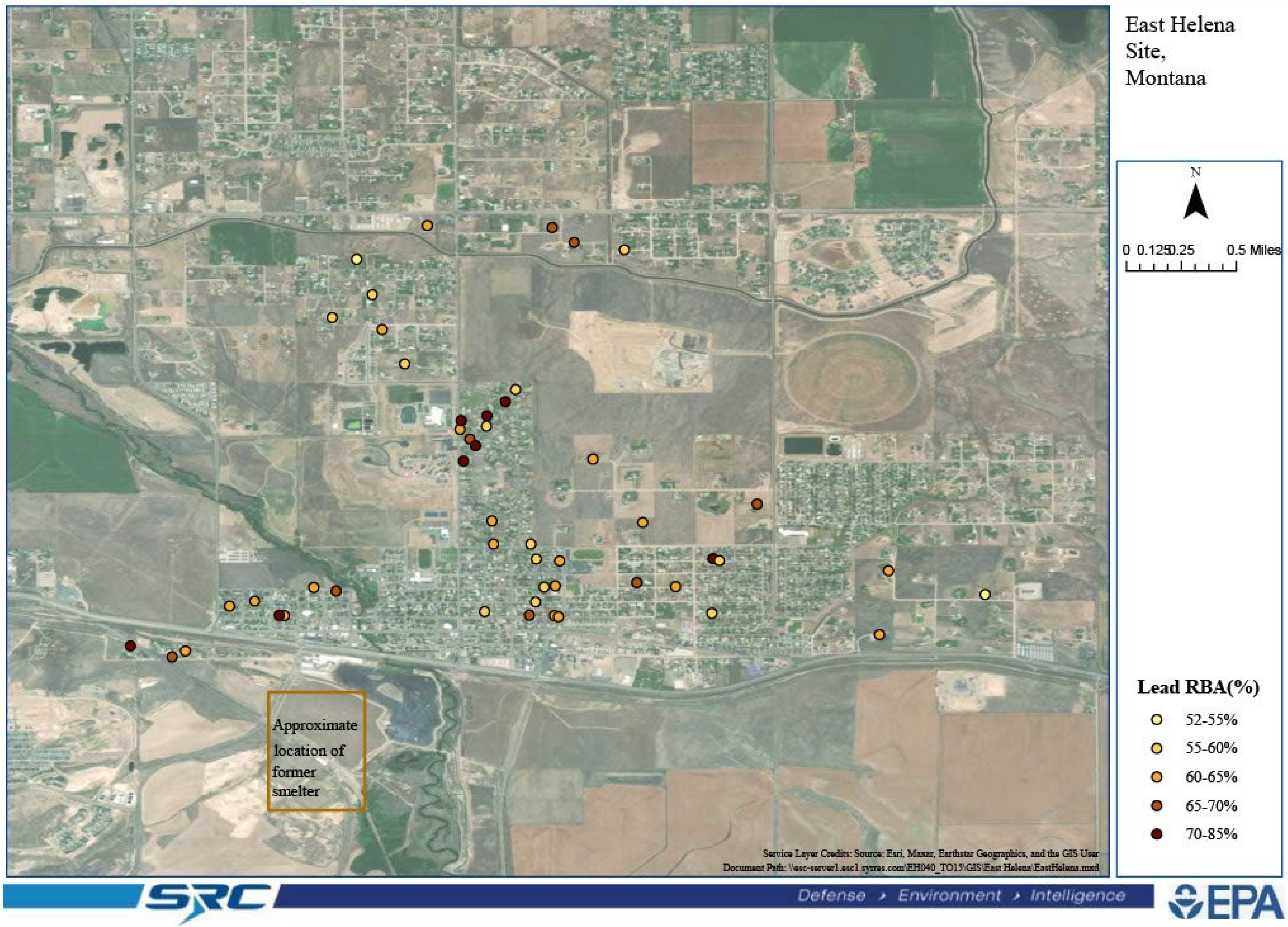

Table 1. Summary of 1995 Asarco HHRA, 1994-2016, and 2023 residential soil lead sampling information and risk results for 50 residential properties in East Helena, MT

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	1994-2016	2023		1995 Asarco HHRA %RBA[b]	1994-2016 %RBA[b]	2023 %IVBA	2023 %RBA[c]	1995 Asarco HHRA[b]	1994-2016 [b]	2023 [c]
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

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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	1994-2016	2023		1995 Asarco HHRA %RBA[b]	1994-2016 %RBA[b]	2023 %IVBA	2023 %RBA[c]	1995 Asarco HHRA[b]	1994-2016 [b]	2023 [c]
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***.

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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
25th percentile (Quartile 1)	59.54%
50th percentile (Quartile 2)	62.17%
75th percentile (Quartile 3)	67.44%
95th percentile	79.42%
99th 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 (Cdust)	mg/kg	Calculated	Cdust = (0.7 x Csoil) + (100 x Cair)
Outdoor Air Concentration (Cair)	µg/m³	0.1	IEUBK default
Indoor Air Concentration	µg/m³	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 5 10	Professional judgment

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.

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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]	
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[c]		**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***.

Appendix C: Identification and Description of Applicable or Relevant and Appropriate Requirements (ARARs) for the Focused Feasibility Study, East Helena Superfund Site, Operable Unit 2

Table 7: Federal and State Applicable or Relevant and Appropriate Requirements

Action	Requirement	Prerequisite	Citation
Stormwater Runoff Control Requirement			
Construction activities causing discharges of storm water	Substantive requirements of a permit for construction activities (General Permit for Storm Water Discharge Associated with Construction Activity, Permit No. MTR100000 (April 16, 2007), generally requiring implementation of best management practices (BMPs) and to take all reasonable steps to minimize or prevent any discharge which has a reasonable likelihood of adversely affecting human health or the environment.	Construction activities causing discharges of storm water, as defined at ARM 17.30.1341(1)(j) - **applicable**	ARM 17.30.1341
Site Preparation, Construction, and Execution			
Activities causing fugitive dust emissions	Measures required to control fugitive dust emissions include, for example, watering, chemically stabilizing, frequently compacting or scraping roads, promptly removing rock, soil or other dust-forming debris from roads, restricting vehicle speeds, stabilizing surface soils, restricting unauthorized vehicle traffic, minimizing area of disturbed land, and promptly revegetating regraded lands (in accordance with MCA 82-4-231)	Excavation, earthmoving, and transportation activities - **relevant and appropriate**	ARM 17.24.761
Activities causing visible air contamination	Emission into the outdoor atmosphere shall not exhibit an opacity of 20% or greater averaged over 6 consecutive minutes	Excavation, earthmoving, and transportation activities - **applicable**	ARM 17.8.304(2)
Activities causing airborne particulate matter	Shall take reasonable precautions to not cause emissions of airborne particulate matter exhibiting an opacity of 20% or great averages over 6 consecutive minutes; shall take reasonable precautions to control emissions of airborne particulate matter from use of street/road.	Handling and transportation, or use of any street/road, or operation of a construction site - **applicable**	ARM 17.8.308(1), (2), & (3)
Transportation of solid waste	Solid waste must be transported in such a manner as to prevent its discharge, dumping, spilling, or leaking from the transport vehicle	Transportation of solid waste - **applicable**	ARM 17.50.523