U.S. Environmental Protection Agency

Focused Feasibility Study; Lead in Residential Soils and Lead and Arsenic in Residential Dust; Community Soils Operable Unit, Anaconda Smelter NPL Site

February 2012

Final Report

Executive Summary

This focused feasibility study (FFS) report for the Community Soils Operable Unit (OU) of the Anaconda Smelter National Priorities List (NPL) site has been prepared to analyze additional cleanup alternatives to address residual[1] lead concentrations in residential soils and residual arsenic and lead concentrations in dust within the city of Anaconda and surrounding areas. The purpose of this FFS is to present cleanup alternatives for residential soils and interior dust impacted by elevated concentrations of lead (Pb), and arsenic (As) concentrations in interior dust above the established 250 mg/kg residential use action level.

The Anaconda Smelter NPL Site was placed on the NPL in 1983, and the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number is MTD 093291656. This FFS builds upon analyses conducted in the 1996 Community Soils OU Feasibility Study (FS) (ARCO 1996), which was used as the basis for the Selected Remedy presented in the 1996 Record of Decision (ROD) document. That remedy required the cleanup of all residential soils within the site that exceeded the residential action level of 250 mg/kg arsenic concentration in soils. Interior dust was not addressed in the 1996 ROD because indoor dust arsenic concentrations were much lower than soil concentrations. Currently, indoor dust and attic dust are addressed by Atlantic Richfield Company (Atlantic Richfield) upon request from residents through a sampling and abatement program and permit system.

In 2002, the U.S. Environmental Protection Agency (EPA) and the Montana Department of Environmental Quality (DEQ) approved the Residential Soils Remedial Action Work Plan/Final Design Report for the Community Soils Operable Unit (OU) of the Anaconda Smelter Superfund Site. Since then, Atlantic Richfield has sampled approximately 1,740 residences in Anaconda and the surrounding rural areas, and has cleaned up approximately 350 yards where the area-weighted average arsenic concentration exceeded the 250 mg/kg action level. Remedial design and other analytical data collected during the course of this remedial action has identified the following concerns about residual lead concentrations in unremediated residential yards and indoor dust:

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[1] The term "residual" is used to denote concentrations of contaminants in soils after the 2002-2008 residential soils remedial action was conducted, which removed soils containing arsenic in concentrations above the 250 mg/kg residential use action level.

- The remedial action surficial soils data set has median lead concentrations which are higher than the remedial investigation surficial soils data set used in the baseline HHRA.

- Following the ROD, indoor dust analyses identified higher lead concentrations in living spaces of homes than had been projected in the baseline risk assessment.

In response to these findings, this Focused Feasibility Study (FFS) has been completed by EPA to evaluate further remedial action alternatives to address residual lead contamination that may be present in unremediated residential properties within the Community Soils OU. The FFS contains the following components:

- Summary of available data that were used to evaluate human health risk since the 1996 ROD, and a discussion of the 2003 Superfund Lead Handbook which was developed to provide a consistent decision-making process for assessing and managing risks associated with lead-contaminated residential soils across the nation.

- A technical memorandum summarizing the range of selected lead preliminary remedial goals (PRGs) that are applicable to the site, and the selection of three specific values in that range used for cost comparisons in the FFS.

- A discussion of the likely presence of deteriorated lead-based paint on exterior and interior surfaces, and EPA's plan to minimize the risk of post-remediation recontamination.

- Analysis of alternatives for removal of residential soils and abatement of interior dust contaminated with lead, and a comparison between existing institutional controls required by the Community Soils OU ROD and modifications of those controls. These analyses include the No Further Action alternative.

- A detailed description of three alternatives that combine portions of the three design components (lead, dust, and institutional controls) selected for detailed analysis and comparison to the nine National Contingency Plan (NCP) criteria.

Alternative 1, the No Further Action alternative, consists of no changes to the 1996 Community Soils OU remedy that would provide for the completion of residential soils cleanup under the 2001 remedial action work plan. Alternative 2 provides for cleanup of lead "hot spots" to 12 inches, cleanup of lead above a selected lead PRG to 2 inches, and institutional controls including a multipathways program to address both Superfund and non-Superfund sources of lead (note that non-Superfund sources of lead are excluded from the FFS cost analyses). Alternative 3 provides for complete cleanup of all residual lead exceeding the lead PRG to 12 inches in soils and abatement of accessible indoor dust at residences.

In accordance with the NCP, the relative performance of the three alternatives is evaluated using the nine criteria (40 CFR Section 300.430 (e)(9)(iii)) of the NCP as a

basis for comparison. The evaluation indicates that Alternative 1 is not protective in terms of risk to human health from exposure to lead; Alternative 2 is protective, is less costly, but allows residential soils with elevated lead concentrations to remain in the community over a long period; and Alternative 3 is the most protective, but also the most costly.

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Acronyms

ADLC	Anaconda-Deer Lodge County
Agencies	EPA and DEQ
ARARs	Relevant and Appropriate Requirements
ARWW&S	Anaconda Regional Water, Waste, & Soils
Atlantic Richfield	Atlantic Richfield Company
As	arsenic
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFRSSI	Clark Fork River Superfund Site Investigation
COC	contaminant of concern
CPMP	community protective measures program
DEQ	Montana Department of Environmental Quality
DIAR	data interpretation and analysis report
DPS	Development Permit System
EPA	U.S. Environmental Protection Agency
FFS	focused feasibility study
IEUBK	Integrated Exposure Uptake Biokinetic Model
HHRA	Human Health Risk Assessment
ICs	institutional controls
mg/cm^2	milligrams per centimeters squared
mg/kg	milligrams per kilogram
µg/dL	micrograms per deciliter
NPL	National Priorities List
NCP	national contingency plan
NTE	not to exceed
OU	operable unit
Pb	lead
ppm	parts per million
PRG	preliminary remedial goal
PRP	potentially responsible party
PTI	PTI Environmental Services
RA	remedial action
RAWP/FDR	remedial action work plan/final design report
RD	remedial design
RD/RA	remedial design/remedial action
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	record of decision
SAP	sampling and analysis plan
SOP	standard operating procedure
TCRA	time-critical removal action

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Section 1 Introduction

This Focused Feasibility Study (FFS) report for the Community Soils Operable Unit (OU) of the Anaconda Smelter National Priorities List (NPL) site was prepared for the U. S. Environmental Protection Agency (EPA) Region 8 by CDM Federal Programs Corporation (CDM) for Work Assignment No. 202-NGNG-0818 under EPA Remedial Action (RA) Contract (RAC) No. EP-W-05-049. The purpose of this FFS is to present cleanup alternatives for residential soils and interior dust impacted by elevated concentrations of lead (Pb). Since the RA Work Plan/Final Design Report was approved in 2002, significant quantities of new data regarding arsenic (As) and Pb concentrations in residential soils and dust have been collected under the RA. EPA and Montana Department of Environmental Quality (DEQ) (the Agencies) have reviewed these data, and have concerns that some data depart significantly from the remedial investigation (RI) characterization that was used to develop the Selected Remedy presented in the 1996 Community Soils OU Record of Decision (ROD).

This FFS has been prepared to evaluate a limited number of new remedial alternatives. These include proposed modifications to address additional risks identified from the new data to the Remedial Investigation (RI) characterization with respect to the current Selected Remedy.

1.1 Background

The 1996 Selected Remedy of the Community Soils ROD (EPA and DEQ 1996) specified the approach to address residential soils posing a risk to human health:

> *Clean up all current residential soils within the Anaconda Smelter NPL Site that exceed the residential action level of 250 ppm soil arsenic concentration, through removal and replacement with clean soil and a vegetative (e.g., new sod or seed) or other protective barrier (e.g., asphalt pavement, concrete sidewalks)*

The Agencies approved the Residential Soils Remedial Action Work Plan in 2002 and the primary potentially responsible party (PRP), the Atlantic Richfield Company (Atlantic Richfield), has been implementing the work pursuant to Administrative Order EPA Docket No. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-08-2002-08. As of 2009, approximately 1,450 residences have been sampled, and more than 300 residences have been cleaned up in Anaconda. Outside of Anaconda, 290 residences have been sampled, and approximately 47 residences have been cleaned up. Collectively, the remedial design (RD) data collection effort represents over 6,000 discrete samples, more than 15 times the number of samples collected by the 1992 Bornschein Study (Bornschein 1994) that was used to complete the baseline human health risk assessment (CDM Federal Programs Corporation [CDM] 1996).

The 1996 Community Soils OU ROD identified a focus area for RA in East Anaconda consisting of 18 city blocks. Based on kriging geostatistical analyses used to identify the focus area, the ROD estimated that 50 yards would be remediated under the Community Soils OU RA. The results of remedial design/remedial action (RD/RA) investigations conducted since the ROD was issued have led the Agencies to expand the focus area to include all residential portions of Anaconda east of Main Street (Figure 1-1).

The increase in the number of yard cleanups in Anaconda prompted the Agencies to complete an analysis of the residential soils and dust analytical data to re-examine the magnitude and extent of arsenic and lead contamination in soils and dust at Anaconda and Regional residences. The 2008 Residential Soils Data Interpretation and Analysis Report (DIAR) compared remedial design data (including subsurface soil data collected by EPA to investigate residual subsurface arsenic and lead concentrations) to the RI data (which includes the Bornschein Data). The DIAR also analyzed household dust data collected by Atlantic Richfield under a limited investigation to examine interior, exterior and attic dust As and Pb concentrations. Atlantic Richfield submitted technical comments on the DIAR and EPA's proposed action level for cleanup of lead in soils and interior dust on March 4, 2009. Based on consideration of these comments, the significant findings of the DIAR pertaining to lead in soils and dust are as follows:

- The RA surficial soils data set has median lead concentrations significantly higher than the RI surficial soils data set used in the baseline Human Health Risk Assessment (HHRA).

- For 147 unremediated yards sampled for lead under RA Phase 1, 63% of yard components have lead concentrations that exceed 400 milligrams per kilogram (mg/kg) in surficial soils and 66% (of 142 yards included in CDM's PRG analysis) have average yard concentrations exceeding 400 mg/kg. Approximately 20% of yard components have lead concentrations exceeding 800 mg/kg, while only 10% have average yard concentrations exceeding 800 mg/kg. Approximately 8% of yard components have lead concentrations exceeding 1,200 mg/kg, while only 1% have average yard concentrations exceeding 1,200 mg/kg.

- Similar to arsenic, increased lead concentrations at the surface significantly correlates to increased lead concentrations in the subsurface; however, lead concentrations decline significantly with increasing depth.

- Arsenic and lead concentrations in individual yard components surficial soils show a statistically significant correlation.

- Subsurface soils from 2 to 6 inches, 6 to 12 inches, and 12 to 18 inches also show a statistically significant correlation between arsenic and lead. However, interpretations for subsurface soils are based on a smaller data set and should be used with caution.

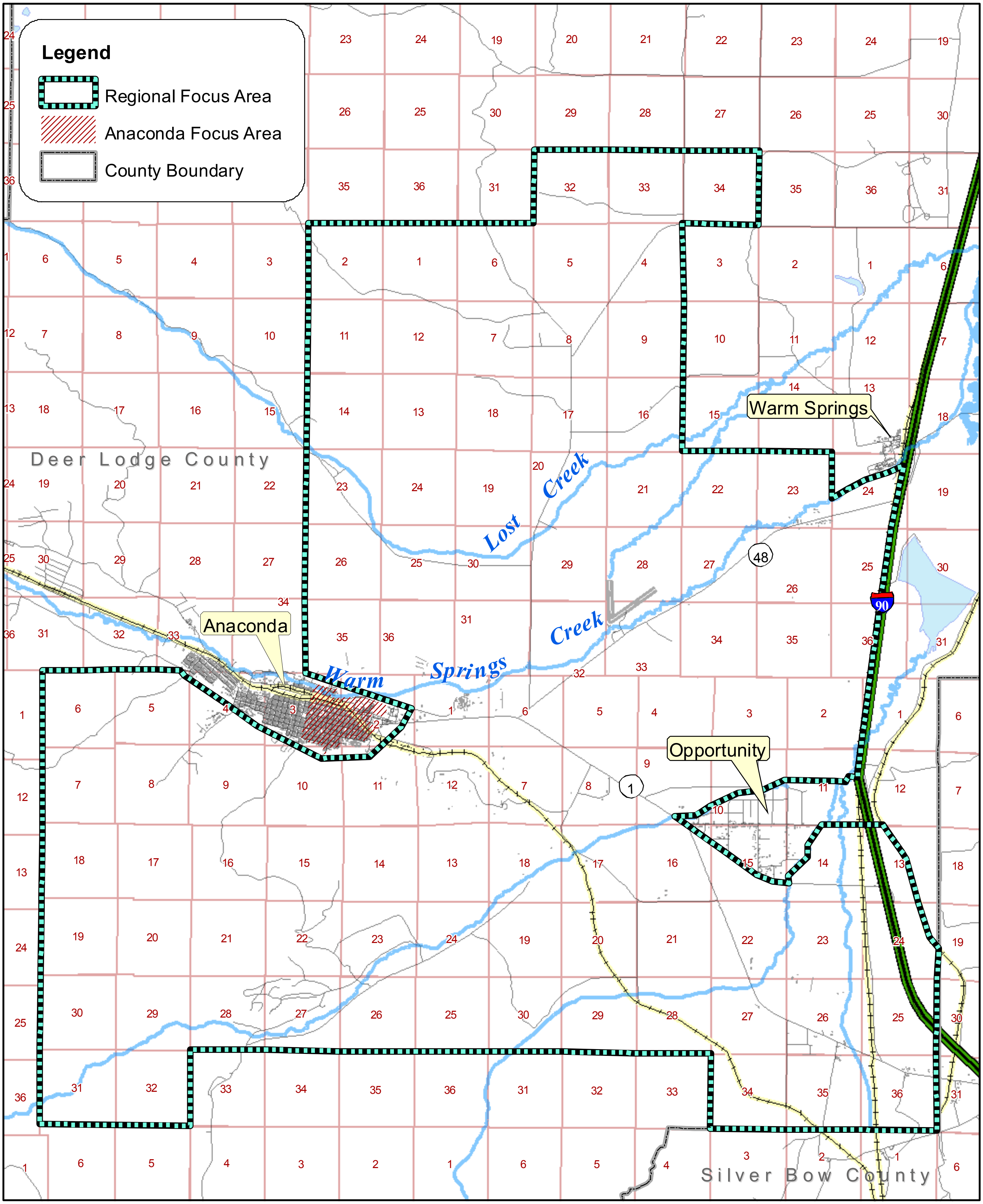

Figure 1-1
Anaconda Smelter Site
Location Map and
Residential Soils
Focus Areas

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- Arsenic and lead concentrations in dust do not correlate with their concentrations in surficial soils.

- While interior and exterior dust concentrations were similar for all areas sampled, attic dust arsenic and lead concentrations in Anaconda east of Main Street were significantly higher than attic dust concentrations in Anaconda west of Main Street, Opportunity, and rural areas suggesting that attic dust is not influencing indoor dust.

- The potential fluvial tailings deposition area in the South Opportunity/ Crackerville region is equally likely to have higher subsurface arsenic and lead concentrations compared to corresponding surface concentrations. Elsewhere in the rural areas, this occurrence is rare, suggesting smelter emissions as the only site-related source of contamination model holds true in rural areas.

In consideration of these findings, the following conclusions were drawn from the data analysis presented in the DIAR and analyses and comments to the DIAR provided by Atlantic Richfield:

- The ROD assumed that smelter emission fallout is the primary source of arsenic and lead contamination within the community of Anaconda; consequently, contaminant distribution should be spatially dependent and decrease from the surface downward. The data, however, indicate factors such as property owner development, impacts from peeling lead-based paint, possible use of smelting and mining wastes within Anaconda as fill materials, and historical import by residents of soil of unknown origin may have contributed to elevated lead and arsenic concentrations at depth, although on average, lead and arsenic concentrations decline with increasing depth.

- Likewise, the spatially-dependent data assumption used to predict the "Focus Area" was shown to be too limited during the RA, and the Focus Area has already been expanded to include all residential areas east of Main Street. The current data set would also indicate that west of Main Street has lower arsenic concentrations compared to east of Main Street; however, there is insufficient data available at depth to determine if the "top down" model of smelter emissions deposition holds true in this area.

- Given that a majority of the yard components sampled under RA Phase 1 in unremediated yards have lead concentrations that exceed the Lead Handbook lower range of 400 mg/kg, it may be appropriate to develop action levels for lead.

- Given that lead concentrations in interior dust are higher than those projected in the baseline risk assessment, it may be appropriate to develop RA protocols to address indoor dust in living spaces of homes.

Subsequent to the DIAR, in spring 2009 Atlantic Richfield collected several soil samples for lead bioavailability analysis. These data were used by the Agencies in the development of preliminary remedial goals (PRGs) for lead, as discussed in Section 2 of this report.

1.2 Scope

The 1996 Feasibility Study (ARCO 1996) formed the basis of the Selected Remedy presented in the 1996 Community Soils Record of Decision (EPA and DEQ 1996). The 1996 Feasibility Study presented several evaluation steps, such as the screening of potential remedial technologies and process options, which are not repeated in this document.

This FFS is limited solely to addressing residual lead contamination due to smelter and mining activities in soils and dust. Other components of the Community Soils OU remedy, such as the cleanup of abandoned railroad beds within Anaconda, and residual arsenic concentrations in subsurface soils and dust, have been excluded from the scope of this FFS. Analysis of lead data for the site indicates potential contributions of lead-based paint to elevated concentrations of lead in soil. Although CERCLA has limited authority to address other types of media (e.g., interior paint, exterior paint, potable water, etc.) that are not site-related, sampling of these types of media to differentiate site-related sources of lead from other residential lead sources is important to determine overall risk when such sources are suspected (EPA 2003). Furthermore, EPA (2003) directs that every effort should be made to ensure lead paint abatement prior to yard soil cleanups in order to avoid recontamination.

1.3 Report Organization

This FFS is organized as follows:

- Section 1 provides an introduction; including objectives, scope, purpose, and document organization.
- Section 2 presents a summary of data collected during the RI, RD, and RA that led to newly-identified potential human health risks from lead in surficial and subsurface soils, and in interior dust.
- Section 3 summarizes the remedial technologies and a process option retained in the 1996 FS, and develops alternatives from these retained technologies and process options to address the newly identified human health risk. Section 3 also presents preliminary screening of these alternatives using the CERCLA criteria of effectiveness, implementability, and cost.
- Section 4 evaluates and compares alternatives retained from the preliminary screening in Section 3 to the threshold and balancing criteria mandated by CERCLA.
- Section 5 discusses and summarizes the next steps in the CERCLA process after the issuance of this FFS.

- Section 6 lists references identified in this FFS.

Section 2 Summary of Existing Data and Human Health Risk

This section summarizes RI data; the 1996 Human Health Risk Assessment; the 1996 Community Soils OU Record of Decision; Pre-Design Data Collection (1997-2000), 2002-2010 Soils RA, 2007 EPA Subsurface Soils Characterization, Interior Dust Characterization; and Residential Soils DIAR. It also discusses the Lead Handbook (EPA 2003) guidance document.

2.1 Existing Data

This section discusses the available data sets used to evaluate lead risk in this FFS. This includes RI data that was used to complete the Baseline Human Health Risk Assessment (CDM 1996) and the Community Soils OU Record of Decision, RD data used to complete the Residential Soils RA Work Plan/Final Design Report (Atlantic Richfield 2002), and RA data that provide the basis for considering additional RAs to address lead risk.

2.1.1 Remedial Investigation

Approximately 21 soil investigations were conducted between 1985 and 1995 at the Anaconda Smelter NPL Site. As described in the Community Soils OU Remedial Investigation/Feasibility Study (RI/FS), the following investigations provided the bulk of the data used in the RI:

- Anaconda Soils Investigation - Phase I (PTI Environmental Services (PTI) 1992)
- Anaconda Soils Investigation - Phase II (PTI 1993)
- The Anaconda Study (Bornschein 1994)
- Smelter Hill RI/FS Phase I and II Investigations (PTI 1991)

The Smelter Hill RI/FS investigations primarily focused on the Smelter Hill Subarea, which is now part of the Anaconda Regional Water, Waste, & Soils (ARWW&S) OU. However, data were collected during these investigations from the Regional Area of the Community Soils OU, and subsequently were incorporated into the Community Soils OU RI/FS database. The other three investigations targeted the Community Soils OU specifically.

2.1.1.1 Anaconda Soils Investigation – Phases I and II

Under the first phase of the Anaconda Soils Investigation, soil samples were collected from within the community of Anaconda from boulevard areas. As described by the field sampling notes, a particular composite sample was formed from five discrete samples. One sample was located in the center point of the boulevard area, and the remaining four components were collected approximately

100 feet north, south, east and west away from the central sampling component (which was usually located at a block corner. Samples collected during the Phase I Anaconda soils investigation from the Regional Area included composite samples typically collected in residential yards and properties from regional communities, samples collected on farm pastures, rangeland, alfalfa fields, or mountain foothills in the near-community stations, and disturbed and undisturbed areas of agricultural land or rangeland.

Similar sampling protocols were followed for the Phase II investigation. Community, near-community, and regionally targeted surface soil sampling locations that were determined to have arsenic concentrations in excess of a predetermined level in Phase I were sampled in the Regional Area.

2.1.1.2 Bornschein Study

The Anaconda Study, also referred to as the Urinary Arsenic Study, was a community exposure study conducted by researchers from the University of Cincinnati in the Anaconda, Opportunity, and Regional Areas (Bornschein 1994). Soil samples collected from the Bornschein study were composite samples of 12 soil cores collected from a depth of 0-2 centimeters from play areas, garden areas, bare yard areas, and the house perimeter one meter from the house drip line (Hwang 1994). The house perimeter composite included three samples per side of the house for a total of 12 core samples.

Bornschein data were the primary input into the Anaconda Community database used to complete kriging of surficial soil data for characterization of arsenic contamination in the remedial investigation. A mean of these results was obtained for an overall concentration in one yard. This mean concentration was used in the kriging.

2.1.1.3 Baseline Human Health Risk Assessment

Bornschein data were also used in the 1996 HHRA (CDM 1996). Arsenic and lead were selected as contaminants of potential concern, and were evaluated quantitatively in the risk assessment. Risks from lead were determined to be within EPA's acceptable range even for young children in residential situations. Risks due to arsenic in soils and indoor dust were deemed unacceptable, and therefore arsenic was identified as the sole contaminant of concern (COC) from a human health risk perspective.

As stated in the 1996 ROD:

> *EPA generally considers risk from exposure to lead unacceptable if more than 5% of the children have blood-lead levels in excess of 10 micrograms per deciliters (µg/dL) (EPA 1994c). Modeling predicted that 5.3% of the children in Subarea E may have blood-lead levels in excess of 10 µg/dL. Although risk from lead exposure would be considered marginally unacceptable for exposure in Subarea E, use of conservative default assumptions in the Integrated Exposure Uptake Biokinetic Model (IEUBK)*

model have likely overestimated this risk. Thus, EPA will not address risks to lead at the Community Soils OU.

Thus, action levels for arsenic for residential, commercial/industrial, and recreational/open space/agricultural land use were established in the 1996 ROD. No action levels were set for lead.

2.1.2 Remedial Action

This section describes the four principal RA data sets that were analyzed in the 2008 DIAR.

2.1.2.1 Residential Soils RA Soil Sampling and Analysis

Atlantic Richfield began sampling under the Community Soils OU Residential Soils RA Work Plan/Final Design Report (Atlantic Richfield 2002) in 2002, and continued through 2010. The data were made available to the Agencies for analysis under the 2008 DIAR and included samples collected through 2006. This data set includes 4449 samples collected from 1110 residences in Anaconda and 990 yard components collected from 277 residences in the Regional Area.

2.1.2.2 2006 Residual Lead in Residential Soils Database

At the request of the Agencies, in 2006 Atlantic Richfield analyzed a random sampling of archived soil samples from unremediated residential yards in Anaconda (e.g., where the area-weighted arsenic concentration was less than 250 mg/kg) for Pb concentrations. The purpose of this exercise was to evaluate residual Pb concentrations within the community of Anaconda. The random sampling consisted of 554 subarea samples collected from 147 yards in Anaconda. This represents approximately 17% of the 862 yards that had area-weighted average arsenic concentrations below 250 mg/kg. Table 2-1 summarizes the number of yard components analyzed for lead (Atlantic Richfield 2007).

Table 2-1
Number of Yard Subarea Samples by Surface Soil Lead Concentration Range

Lead Concentration Range (mg/kg)	Back Yard	Bare Area & Play Area	Boulevard	Earthen Driveway	Front Yard	Garden	Total
0-400	44	5	37	50	39	32	207
400-800	70	3	48	23	56	38	238
800-1200	13		16	6	22	9	66
>1200	4		2	2	14	21	43
Total	131	8	103	81	131	100	554

For these yards, 63% of yard components have lead concentrations that exceed 400 mg/kg in surficial soils. This compares to 66% (of the 142 yards included in the PRG analysis) that have average yard concentrations exceeding 400 mg/kg.

Approximately 20% of yard components from Table 2-1 have lead concentrations exceeding 800 mg/kg, while 10% have average yard concentrations exceeding 800 mg/kg. Approximately 8% of yard components (Table 2-1) have lead concentrations exceeding 1,200 mg/kg, while 1% have average yard concentrations exceeding 1,200 mg/kg.

In analyzing these data Atlantic Richfield (2007) identified three critical points suggesting a significant concern for lead-based paint as a contributing source for the elevated lead concentrations in soil.

- House ages are all consistent with high probability of lead paint presence. All of the houses with soil lead concentrations in excess of 1,200 mg/kg were built at times when paint containing lead was prevalent. Thirty of the houses were built from 1898 to 1925, three were built in the 1930s and one was built in 1949. According to a national survey, 90% of houses built before 1940 have paint containing more than 1 milligrams per centimeter squared (mg/cm$^{2)}$ of lead (which is the statutory definition of lead-based paint), while 75% have greater than 2 mg/cm^2 (Clickner, et al. 1995).

- Examination of the lot maps indicates most yard components with lead over 1200 ppm were collected from small areas adjacent to building foundations or along lot lines, both of which are very likely to contain paint chips from painted houses or fences.

- While there was little or no correlation between lead and arsenic concentrations for 34 yards with one component over 1200 parts per million (ppm) lead, the correlation was much higher when 113 yards with no component over 1200 ppm.

Substantial photographic documentation is available of deteriorating paint on houses, garages and fences surrounding many properties, demonstrating that any yard remediation is unlikely to provide long term protection of residents from lead exposures if lead-based paint is not first abated.

2.1.2.3 2007 Subsurface Soils Study

In addition to the RA sampling data collected by Atlantic Richfield, in 2007 EPA collected 221 subsurface soil samples at 108 residences in Anaconda (CDM 2007). This sampling was initiated based on concerns that construction and landscaping activities over the years might have buried contaminated surface soils, creating higher concentrations of arsenic in some subsurface soils compared to the surficial soils now present in yards. Initial review of the residential soils RA data indicated that over one-third of the subsurface soil samples (2 to 6 inch depth interval) had higher arsenic concentrations than the overlying surficial soil sample (0 to 2 inch depth interval).

To better evaluate subsurface soil arsenic concentrations in the community of Anaconda, subsurface soil samples were collected at selected locations from residential yards previously sampled, where the weighted average arsenic

concentration was determined to be less than 250 mg/kg. Samples were also collected from a number of previously sampled and remediated properties where unremediated yard components remained that had surficial arsenic concentrations below 250 mg/kg.

A stratified random sampling design was devised by which subsurface soils from approximately 10% of the Anaconda yards initially sampled by Atlantic Richfield were collected. Random yard components were selected from properties that fell into designated arsenic level categories. These categories are not specifically germane to the lead data and are not described further in this section of the report. Subsurface soils were collected, following the procedures found in the sampling and analysis plan (SAP) document, from randomly selected yard components from the following depths:

- 2 to 6 inches – front and back yards, gardens, driveways, boulevards, and bare areas
- 6 to 12 inches – front yards, back yards, gardens, and bare areas
- 12 to 18 inches – gardens and bare areas

Data for surface soil (0 to 2 inch depth increment) lead concentrations from designated yards and yard components were culled from Atlantic Richfield-provided data sets, while subsurface soils lead levels were those in this study. It is noted only 17 surface soil samples could be matched to their subsurface soils. Descriptive statistics are exhibited in Table 2-2.

Table 2-2
Descriptive Statistics for Lead Concentrations in Surface and Subsurface Soils Collected for Yards in Anaconda, Montana

Statistic	Surface Soil (0 to 2 inches)	Depth Soil (2 to 6 inches)	Depth Soil (6-12 inches)	Depth Soil (12-18 inches)
Number of samples	17	107	79	19
Mean (mg/kg)	884	542	344	277
Standard deviation (mg/kg)	735	733	330	451
Median (mg/kg)	684*	337	250	87.4
Minimum (mg/kg)	105	13.7	21.1	14.5
Maximum (mg/kg)	3400	5250	1670	1650

* Median lead value for surface soils is statistically greater (P = 0.001) than median concentrations at depth

Statistical analysis of these data indicated that, similar to arsenic, increased lead concentrations at the surface statistically significantly correlates to increased lead concentrations in the subsurface; however, lead concentrations decline significantly with increasing depth. Of these 147 yards, 34 yards included at least one yard component with a surface soil lead concentration above 1,200 mg/kg (Atlantic Richfield 2007). For these 34 properties, almost no correlation (r^2 = 0.03) between

lead and arsenic concentrations in surface soil was observed based on regression analyses of the maximum surface soil lead and arsenic concentrations. A higher correlation coefficient (r^2 = 0.35) was observed when the same analysis was conducted for all subsamples from the other 113 yards with no surface soil lead greater than 1,200 mg/kg (Atlantic Richfield 2007). Collectively, these analyses suggest sources of elevated lead in surface soil (distinct from the predominant arsenic source) have had a disproportionate effect on surface soil lead concentrations (Atlantic Richfield 2007).

2.1.2.4 2010 Residual Lead in Residential Soils Database

The data analysis presented above was presented in the Draft Final FFS that was provided to Atlantic Richfield and Anaconda Deer Lodge County (ADLC) for comment and further input. In response, in 2010 Atlantic Richfield made available the full set of lead analytical data for every soil sample conducted under RA sampling. This database included both remediated (where the original area-weighted average arsenic concentration of surface (0 to 2 inches) soil samples taken from the yard exceeded the residential use action level of 250 mg/kg) and residential yards where no action was determined based on the sampling results for arsenic.

Table 2-3 presents a summary of the 2010 database with respect to a range of Pb preliminary remedial goals (PRGs) which are further discussed below in Section 2.3.1. This analysis is limited to the 779 yards that were sampled but where no action was taken because the area-weighted average arsenic concentration of surface (0 to 2 inches) soil samples taken from the various yard components was below the residential use action level of 250 mg/kg. Table 2-3 identifies the number of yard components that exceed each of the four PRGs discussed in Section 2.3.1 for lead concentration in the 0-2 inch surface sample. The table also identifies the number of yards whose area-weighted average lead concentration in the 0-2 inch surface soil sample exceeds each of the PRG range values.

Table 2-3
Yard Components and Yards that exceed Lead PRG Ranges in Residential Yards in Anaconda, Montana
N = 779 yards

	>400 mg/kg	>500 mg/kg	>700 mg/kg	>1200 mg/kg
Number of Yard Components* that Exceed the Lead PRG	720	668	495	189
Number of Yards where the area-weighted average exceeds the Lead PRG	560	444	175	27

* May include multiple yard components for one yard.

2.1.2.5 Interior/Exterior/Attic Dust Characterization Study

Because of concerns over higher-than-anticipated arsenic concentrations in residential soils, and high attic dust concentrations of lead and arsenic detected in

the nearby Walkerville community, beginning in 2004 Atlantic Richfield conducted a limited characterization of interior, exterior, and attic dusts to evaluate arsenic and lead concentrations in 52 homes in the Anaconda and Regional areas of concern. The results of this study were provided in the *Draft Final Community Soils Interior and Attic Dust Characterization Study Data Summary Report (DSR)* (Atlantic Richfield 2008).

Samples were collected from interior dust and attics. Analytical results from these samples were compared to data collected during the Bornschein investigation (Bornschein 1994). Although interior dust concentrations were generally below the arsenic residential action level and lead screening level, the attic dust data confirmed the presence of elevated arsenic and lead concentrations. These concentrations were generally greater in magnitude than those found during the Bornschein study.

2.2 Superfund Lead-Contaminated Residential Sites Handbook

In 2003, seven years after the Baseline Human Health Risk Assessment was completed and the Community Soils OU ROD was issued, EPA issued a guidance document to assess and manage risks associated with lead-contaminated residential sites across the country. The *Superfund Lead-Contaminated Residential Sites Handbook* (EPA 2003) was developed to provide a nationally consistent decision making process for cleanups of sites contaminated with lead. It applies a range of concentrations and an assessment of sensitive populations to prioritize cleanup. As stated in Section 5.1 of the Handbook:

- *Tier 1 properties have both sensitive populations (children up to 7 years old or pregnant women) and soil concentrations in the surface soils (0–1 inch depth) at or above 1,200 ppm (EPA, 1997b, 1997c). Also, Tier 1 sites can be identified based upon a demonstration of children's blood lead levels at or above 10 µg/dL. Generally, TCRAs would be taken at Tier 1 properties.*

- *Tier 2 properties have either sensitive populations and soil lead concentrations in surface soils between 400 ppm and 1,200 ppm, or no sensitive populations and surface soil lead concentrations above 1,200 ppm, but not both. Tier 2 properties can be addressed through time-critical removal action (TCRA)s, or non-time-critical removal actions (NTCRAs), or long-term RAs.*

- *Tier 3 properties have surface soil concentrations below 1,200 ppm, but above 400 ppm, and no sensitive populations present. Tier 3 sites would typically be addressed through long-term RAs or NTCRAs.*

Tier 1 should be the highest priority for immediate action and Tier 3 should be the lowest priority for immediate action. Residential properties can move into a different tier if conditions change (e.g., small children or pregnant women move into a house). A typical residential lead site will contain a combination of properties that fit into different tiers.

Although the handbook uses soil lead concentrations of 400 mg/kg and 1,200 mg/kg to define tiers for prioritizing early, interim response actions, it clarifies that these concentrations should not be confused with cleanup values, which are based IEUBK-estimated PRGs and include an analysis of the nine criteria listed in the national contingency plan (NCP) (EPA 1990).

The handbook also presents recommended site characterization procedures. A comparison between the handbook's recommendations for site characterization, and characterization procedures followed under the 2000 Residential Soil Remedial Action Work Plan/Final Design Report (RAWP/FDR) is provided in Section 3 of this FFS.

2.3 Risk Assessment

The 1996 Baseline Human Health Risk Assessment used an estimate of the upper 95% confidence level lead concentration for the ten Bornschein areas. Current methods for evaluating lead risks to young children do not involve calculation of exposure point concentrations for large site areas. Instead, the recommended approach examines lead risks on a yard-by-yard basis. Specifically, the handbook (EPA 2003) states: "The overall goals of the sampling effort are to estimate an average soil lead concentration for risk assessment purposes and to provide information to determine the scope of any required clean-up actions." Additionally, for risk assessments conducted at lead-contaminated residential sites, EPA recommends that the individual residence be used as the primary exposure unit of concern ([1998 OSWER Directive 9200.4-27P ('Clarification')]).

As discussed above in Section 2.1.3.2 and shown in Table 2-1, of the sampled but unremediated residential yards within Anaconda that were analyzed for lead (17% of the sampled but unremediated residential yards), 347 of 554 (or 63%) yard components were found to have surficial soil lead concentrations that exceed 400 mg/kg. Of those 347 samples, 43 samples (or 8% of yard components from sampled but unremediated residential yards) had surficial soil lead concentrations that exceed 1200 mg/kg. These comparisons do not reflect yard-average soil lead concentrations for use in lead risk assessment per the handbook. However, as discussed below, such comparisons are available based on a recent screening risk analysis for the Anaconda Smelter area (Appendix A) that was conducted at the request of EPA.

The dataset used in the IEUBK model consisted of 174 area-weighted average lead concentrations from 142 yards in Anaconda and an additional 32 yards in Opportunity/Crackerville. All of the data included in the dataset corresponded to unremediated residential yards where area-weighted average arsenic concentrations are below 250 mg/kg. These data were used in batch mode in the IEUBK model to estimate the impact of residual lead in residential yards in the Anaconda area. Within the dataset, 94 of the 174 yards (55%) had area-weighted average lead concentrations in surface soils greater than 400 mg/kg. Only 2 of the 174 yards (1%) had area-weighted average lead concentrations in surface soils greater than 1,200

mg/kg. Of the properties where area-weighted average lead concentrations were greater than 400 mg/kg, all but one was in Anaconda. An area-weighted average soil lead of 520.7 mg/kg corresponded to the sole exceedance of the 400 mg/kg screening value for properties outside of Anaconda. Both of the 2 properties where area-weighted average lead concentrations exceeded 1,200 mg/kg were in Anaconda. Based on Anaconda properties alone, 66% of the area-weighted average lead concentrations from the dataset exceeded 400 mg/kg and 1% exceeded 1,200 mg/kg. The IEUBK model results for these data obtained during RA suggest that lead risks would be unacceptable for some fraction of yards.

2.3.1 Lead Preliminary Remedial Goals

Appendix A to this FFS is a technical memorandum that derives lead preliminary remedial goals (PRGs) using the Integrated Exposure Uptake Biokinetic (IEUBK) model. The IEUBK model addresses risk for young children from exposure to lead. A range of PRGs was developed from runs of the IEUBK model using different input parameters. Selection of input parameters is discussed in Appendix A.

As shown in Table 1 of Appendix A, the range of lead PRGs calculated using the IEUBK model for the Anaconda site range from 418 to 1941 mg/kg. The PRG of 418 mg/kg does not incorporate site-specific data. The three PRGs that incorporate various site-specific data are 449 mg/kg, 548 mg/kg and 1,941 mg/kg. Based on these PRGs, and the residential soils lead cleanup levels used at other Montana Superfund sites impacted by mining and smelting activities, this FFS will use 400, 500, 700 and 1200 mg/kg as example residential cleanup levels for evaluating remedial alternatives. 1200 mg/kg was chosen as the upper end because relatively few yard components exceed that value, and represents a Not to Exceed (NTE) value to be used in the FFS evaluation. Final selection of a residential cleanup level for lead will identified by EPA and DEQ in a Proposed Plan for a Community Soils ROD Amendment.

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Section 3 Development and Screening of Remedial and Institutional Control Alternatives

Based on data collected during the course of the Residential Soils Remedial Acton as discussed in Section 2, and ongoing discussions with Atlantic Richfield, Anaconda – Deer Lodge County, and Montana DEQ, EPA directed the completion of this FFS to analyze potential alternatives to completing additional work.

3.1 Identification, Screening, and Evaluation of Technology Types and Process Options

As a focused feasibility study, this FFS does not repeat the identification, screening and evaluation of technology types and process options that were presented in the 1996 Community Soils OU Feasibility Study (ARCO 1996). The alternatives for residential soils presented in the feasibility study were: (1) No Action; (2) Institutional Controls (ICs); (3) In Situ Treatment, Capping, and ICs; and (4) Excavation and Disposal of Contaminated Soils and ICs.

The No Action alternative did not include any engineered controls or new ICs. The ICs alternative primarily consisted of a new Community Protective Measures Program combined with the existing Development Permit System. Both of these alternatives were determined to be not protective of human health and the environment in the 1996 Feasibility Study. The third alternative consisted of tilling soils to a depth up to 18 inches to dilute arsenic concentrations below action levels. The 1996 Feasibility Study determined that this alternative was protective of human health and the environment; however, as shown in Section 2.1.3.3, the number of subsurface arsenic concentrations that exceed corresponding surface soil arsenic concentrations as determined during RA is higher than the previous RI characterization indicated. Consequently, it is unlikely that tillage would reduce arsenic concentrations below the residential action level in a significant percentage of residential soils in Anaconda, especially since the Feasibility Study cost estimate assumed an average 6 inch tillage depth.

The Community Soils OU ROD (EPA and DEQ 1996) selected the fourth alternative, Excavation and Disposal of Contaminated Soils and ICs, as the Selected Remedy for residential soils. Variations of this alternative will be evaluated in this FFS.

3.2 Development of Alternatives

This section presents alternatives for the following:

- Lead in Surface and Subsurface Soils
- Lead and Arsenic in Interior and Attic Dust

- Institutional Controls

Each of these issues is discussed in the following sections. A comprehensive list of alternatives for these issues was analyzed. From the results of this screening, detailed alternatives combining specific alternatives from the three components was developed for full analysis in Section 4.

3.2.1 Lead in Surface and Subsurface Soils

Table 3-1 identifies possible remedial alternatives developed and screened for remediating lead in soils at Anaconda and Regional (including Opportunity) residences. Alternative 1, the No Further Action alternative, is required by the NCP ((40 CFR) §300.430(e)(6)). Based on the analysis conducted in the Calculation of Preliminary Remedial Goals (PRGs) for Lead in Soils, as summarized in Section 2.3, 71% of the unremediated yards in and around Anaconda have area-weighted average surface soil lead concentrations greater than 400 mg/kg, while 57% and 22% of these yards have area-weighted average surface soil lead concentrations greater than 500, and 700 mg/kg, respectively. Consequently, the No Further Action alternative may not be adequately protective of human health.

As shown in Table 3-1, one subalternative requires re-sampling of all unremediated yards to conform to Lead Handbook sampling protocols. This would be an extensive effort. To evaluate whether this would be necessary, Table 3-2 compares sampling protocols recommended by the Lead Handbook (EPA 2003) to the Clark Fork River Superfund Site Investigations (CFRSSI) standard operating procedures (ARCO 1992).

Table 3-1
Screening of
Potentially Applicable Remedial Alternatives
Lead in Residential Soils

Alternative	*Description of Option/Subalternatives*	*Advantages*	*Disadvantages*	*Retained*
LS1. No Further Action	No additional remedial actions to address lead (Pb) in soils would be taken.	Consistent with1996 remedy. Minimal disruption to the community through continued yard removals. Pb cleanup level currently undetermined. Yards where Pb exceeds the Butte cleanup level of 1200 mg/kg.	It is estimated that 23% of unremediated yards in Anaconda would have lead concentrations >1200 mg/kg, and 88% of those yards would have lead concentrations >400 mg/kg, May not be protective of human health.	Yes[1]
LS2. Cleanup Pb >1200 mg/kg	These options would address yards that have been sampled under the 2002 Community Soils OU Residential Soils RAWP, that has yard components that were not remediated (includes previously remediated yards and unremediated yards where the AWA As < 250 mg/kg). A cleanup level of 1200 mg/kg would be used.			
	LS2.1 .Analyze all 0-2 "archived samples for Pb. Collect depth samples (2-6" and 6-12") from all yards where yard Pb > 1200. Cleanup all those yards to 12" if yard Pb >1,200 mg/kg in 6-12" depth interval. Address any additional lead cleanup through the DPS.	All yards with yard Pb exceeding 1,200 mg/kg in the 6-12" depth interval would be remediated to 12". Protectiveness would be consistent with Butte, and would fall within the range of the Pb PRG document. Minimal amount of additional cleanup would result in less obtrusiveness to the community	Lead in subsurface soils (>2" bgs) may remain at yards where surface soil (0-2") yard Pb is less than 1,200 mg/kg, requiring DPS.	No
	LS2.2. In addition to LS2.1, Collect depth samples from all unremediated yard components (2-6" and 6-12"). Remediate all Pb greater than 1200 mg/kg to a depth of 12 inches.	All previously unremediated yards would be completely remediated to 12 inches	Extensive sampling and remediation.	Yes
	LS2.3. Do not analyze archived samples. Re-sample all yards to 12 inches in accordance with Pb handbook (quadrant sampling instead of CFRSSI protocols).	Consistent with Pb Handbook.	Costly, ignores previously completed work and available data.	No
LS3. Cleanup Pb >700 mg/kg	These options would address yards that have been sampled under the 2002 Community Soils OU Residential Soils RAWP, that have yard components that were not remediated (includes previously remediated yards and unremediated yards where the AWA yard As concentrations < 250 mg/kg). A cleanup level of 700 mg/kg would be used.			
	LS3.1 .Analyze all 0-2 "archived samples for Pb. Collect depth samples (2-6" and 6-12") from all yards where yard Pb > 700. Cleanup all those yards to 12" if yard Pb >700 mg/kg in 6-12" depth interval. Address any additional	All yards with AWA yard Pb exceeding 700 mg/kg in the 6-12" depth interval would be remediated to 12". Protectiveness would be consistent with Butte, and would fall within the	Lead in subsurface soils (>2" bgs) may remain at yards where surface soil (0-2") yard Pb is less than 700 mg/kg, requiring DPS.	Yes

Alternative	*Description of Option/Subalternatives*	*Advantages*	*Disadvantages*	*Retained*
	lead cleanup through the DPS.	range of the Pb PRG document. Minimal amount of additional cleanup would result in less obtrusiveness to the community		
	LS3.2. In addition to LS3.1, Collect depth samples from all unremediated yard components (2-6" and 6-12") regardless of yard Pb in 0-2" depth interval. Remediate all Pb greater than 700 mg/kg to a depth of 12 inches.	All previously unremediated yards with yard Pb > 700 mg/kg in any depth interval to 12" would be completely remediated.	Extensive sampling and remediation.	Yes
	LS3.3. Do not analyze archived samples. Re-sample all yards to 12 inches in accordance with Pb handbook (quadrant sampling instead of CFRSSI protocols).	Consistent with Pb Handbook.	Costly, ignores previously completed work and available data.	No
LS4. Cleanup Pb >500 mg/kg	These options would address yards that have been sampled under the 2002 Community Soils OU Residential Soils RAWP, that have yard components that were not remediated (includes previously remediated yards and unremediated yards where the AWA yard As concentrations < 250 mg/kg). A cleanup level of 500 mg/kg would be used.			
	LS4.1 .Analyze all 0-2 "archived samples for Pb. Collect depth samples (2-6" and 6-12") from all yards where yard Pb > 500. Cleanup all those yards to 12" if yard Pb >500 mg/kg in 6-12" depth interval. Address any additional lead cleanup through the DPS.	All yards with AWA yard Pb exceeding 500 mg/kg in the 6-12" depth interval would be remediated to 12". Protectiveness would be consistent with Butte, and would fall within the range of the Pb PRG document. Minimal amount of additional cleanup would result in less obtrusiveness to the community	Lead in subsurface soils (>2" bgs) may remain at yards where surface soil (0-2") yard Pb is less than 500 mg/kg, requiring DPS.	Yes
	LS4.2. In addition to LS3.1, Collect depth samples from all unremediated yard components (2-6" and 6-12") regardless of yard Pb in 0-2" depth interval. Remediate all Pb greater than 500 mg/kg to a depth of 12 inches.	All previously unremediated yards with yard Pb > 500 mg/kg in any depth interval to 12" would be completely remediated.	Extensive sampling and remediation.	Yes
	LS4.3. Do not analyze archived samples. Re-sample all yards to 12 inches in accordance with Pb handbook (quadrant sampling instead of CFRSSI protocols).	Consistent with Pb Handbook.	Costly, ignores previously completed work and available data.	No

Alternative	*Description of Option/Subalternatives*	*Advantages*	*Disadvantages*	*Retained*
LS5. Cleanup Pb >400 mg/kg	These options would address yards that have been sampled under the 2002 Community Soils OU Residential Soils RAWP, that has yard components that were not remediated (includes previously remediated yards and unremediated yards where the AWA As < 250 mg/kg). A cleanup level applied of 400 mg/kg, is used.			
	LS5.1 .Analyze all 0-2 "archived samples for Pb. Collect depth samples from all yard components where Pb > 400, and cleanup all those components. Address any additional lead cleanup through the DPS.	All surficial components exceeding 400 mg/kg Pb would be remediated.	Lead in subsurface soils likely to remain, requiring DPS.	No
	LS5.2. In addition to LS5.1, Collect depth samples from all unremediated yard components (2-6" and 6-12"). Remediate all Pb greater than 400 mg/kg to a depth of 12 inches.	All previously unremediated yards would be completely remediated to 12 inches	Extensive sampling and remediation.	Yes
	LS5.3 Do not analyze archived samples. Re-sample all yards to 12 inches in accordance with Pb handbook (quadrant sampling instead of CFRSSI protocols).	Consistent with Pb Handbook.	Costly, ignores previously completed work and available data.	No

Notes. CERCLA Guidance requires that the No Action alternative be carried forth through the final analysis.

Table 3-2
Comparison of Lead Handbook to CFRSSI Standard Operating Procedures for Residential Yard Sampling

Sampling Component	Lead Handbook	CFFSSI SOP
Maximum Sample Area	5000 square feet (SF)	5000 SF
Number of Subsamples	5 per 5000 SF If yard > 5000 SF, divide into quadrants	1 per 625 SF. Minimum of 2, no more than 8, per yard component.
Drip Lines	Separate composite of 4 subsamples	Include in yard component sample. Sampling biased to include drip lines.
Play Areas, Gardens, and Driveways	Separate samples (distinct yard component)	Separate samples (distinct yard component)
Sampling Depth and Depth of Removal	0 - 6", 6 - 12", 12 - 18". 0 - 1" for risk assessment. Soils removed to a depth of 12 inches.	0 - 2", subsurface intervals not specified except for gardens (12"). 2-6" and 6-12" used for current action, 12 -18 assumed to be contaminated if 6-12" exceeds action level, per Residential Soils RA Work Plan.

A review of Table 3-2 shows that the most significant difference between the Lead Handbook and the CFRSSI standard operating procedure (SOP) sampling procedures is, the Lead Handbook specifies sampling of drip lines (areas below the edges of roofs), where the current CFRSSI SOP does not. However, the current RA SAP requires that subsamples be biased to include drip lines. Given the little difference in sampling procedures, and that re-sampling of yards would be extremely costly and time consuming, this subalternative was not retained for detailed analysis.

Several other alternatives identified in Table 3-1 consist of evaluating the range of lead PRGs (400, 500, and 700 mg/kg), as discussed in Section 2.3. A review of Atlantic Richfield's data for the unremediated yard components that were sampled, which was conducted as part of this FFS, determined that, of 779 yards sampled with an area-weighted arsenic concentration below 250 mg/kg in the 0 to 2 inch depth interval:

- 720 of the 779 yards (92%) evaluated revealed surface soil lead concentrations in at least one yard component greater than the 400 mg/kg lead PRG.
- 668 of the 779 yards (86%) evaluated revealed surface soil lead concentrations in at least one yard component greater than the 500 mg/kg lead PRG.
- 495 of the 779 yards (64%) evaluated revealed surface soil lead concentrations in at least one yard component greater than the 700 mg/kg lead PRG.

The next consideration in the screening process is selection of the sampling approach to determine where and to what depth RAs would occur. As discussed in Section 1.1, the arsenic in soils cleanup approach used in the current residential soils RA assumed a "top down" cleanup approach based on a conceptual model of smelter emissions that assumed a decrease in contamination from the surface downward. While this model is generally correct, a number of factors have led to instances of

elevated concentrations at depth. Continuous property improvements by homeowners led to the importation of clean soil placed on earlier smelter-impacted soils, as well as the use of mining and smelting waste for driveways and other property improvements. However, for lead, sources of elevated lead in surface soil distinct from the predominant arsenic source have had a disproportionate effect on surface soil lead concentrations (Atlantic Richfield 2007). Additionally, it is anticipated that exposure to deeper soils with higher concentrations will be mitigated by mixing as soils are excavated or moved. The Lead Handbook recommends depth sampling and subsequent remediation to 12 inches for exceedances in lead cleanup levels within the 6-12 inch depth interval. Alternatives LS2.1, LS3.1, LS4.1 and LS5.1 apply the "top down" approach to remediation

EPA recognizes the importance of lead-based paint abatement prior to the implementation of any remedial alternatives for lead. A program should be (if possible) developed to ensure that lead-based paint abatement will occur prior to yard remediation.

3.2.2 Arsenic and Lead in Residential Home Dust

The 1996 Community Soils OU remedy did not address remediation of dust in residential homes. At that time, it was presumed remediating residential soils (the major source of household dust) would result in the remediation of interior dust, and that attic dust did not present a significant exposure pathway for residents. The premise of the ROD's focus on soil remediation rather than remediation of interior dust was the demonstration that interior dust arsenic concentrations were much lower than soil concentrations and that yard soil arsenic had limited influence on arsenic concentrations in interior dust. Data collected since the ROD was issued continue to support this assessment, but also identified some homes with elevated lead concentrations in indoor dust and attic dust.

Since 1996, activities at both Anaconda and the nearby Butte Priority Soils OU (Silver Bow Creek/Butte Area NPL Site) have led the Agencies to re-evaluate the risk from exposure to attic dust. In the fall-winter of 1999, Atlantic Richfield and EPA began sampling attic dust and vapor sampling at the Walkerville neighborhood of the Butte Priority Soils NPL site. This activity began when a homeowner, remodeling his home, knocked down the ceiling, causing large quantities of black soot to fall into the living area. The source of this black soot was believed be from the numerous smelters (10-20) in Butte that operated in the late 1800s - early 1900s. Testing showed that this soot contained high levels of arsenic, lead and mercury. Subsequent testing of homes in the Walkerville area indicated that contaminated attic dust is widespread. In Walkerville, EPA manages attic dust by means of institutional controls in the form of a permit system for remodeling projects that might disturb attic dust. EPA concluded that in the absence of such disturbance, attic dust in attics not used as living spaces did not pose a complete exposure pathway for residents. In light of the Walkerville findings, EPA has decided to re-evaluate the potential for exposure to contaminated attic dust at the Anaconda Smelter NPL site.

Atlantic Richfield currently has an interior and attic dust abatement program in place for arsenic that could be adapted to include consideration of lead.

Table 3-3 presents remedial alternatives to address lead in household dust. The three options considered and retained for detailed analysis include a no RA option that includes maintenance only of the existing Atlantic Richfield program and permit system that is initiated by resident requests and address indoor (living space) and attic (non-living space) dust concentrations above the arsenic action level through sampling and abatement on a case-by-case basis. Alternative 2.1 includes revision of the existing Atlantic Richfield program and permit system to address indoor and attic dusts with arsenic and/or lead above respective action levels. For Alternative 2.1, a revised development permit system (DPS) is also proposed that would require a permit for proposed renovations that would result in exposure to attic dust and provide a mechanism for the community protective measures program (CPMP) to inform tradesmen and the public of potential exposure to arsenic and lead in dust. Alternative 2.2 considers sampling and abatement of interior dust and accessible attic dust, with inaccessible attic dust addressed by the permit system and CPMP.

The only alternative rejected from detailed analysis is the sampling and removal of inaccessible dust in attics and walls. This alternative consists of drilling holes into interior walls (typically at 16 inch spacings between studs) to vacuum sample dust that may be located between the interior and exterior of a house. This alternative is very expensive, there is no way of verifying whether all contaminated dust has been removed, and it will not provide a significant health benefit.

The alternatives listed in Table 3-3 address direct cleanup of Superfund-caused dust contamination only. Alternatives that address other lead sources, or are combined with other programs such as lead paint, are addressed below in the Institutional Controls section. EPA recognizes that prior to the implementation of any remedial alternatives for lead, a program must be developed to ensure that lead-based paint abatement will occur prior to dust abatement.

3.2.3 Institutional Controls

Table 3-4 identifies several alternatives for additional institutional controls that address residual soil and dust contamination. The No Further Action alternative consists of existing Community Soils OU institutional controls (DPS and CPMP) that are specified in the Community Soils and ARWW&S OUs RODs. The additional ICs alternatives identified in Table 3-4 include Alternative IC2 to add a medical monitoring program, and Alternative IC3 which consists of a multi-pathways program to address lead from additional sources.

Table 3-3
Screening of
Potentially Applicable Remedial Alternatives
Arsenic and Lead in Household Dust

Alternative	*Description of Option/Subalternatives*	*Advantages*	*Disadvantages*	*Retained*
ALD1. No Further Action	No remedial actions to address dust (interior, exterior, and attic) would be taken. Attic dust would be addressed through institutional controls (the DPS would require a permit for proposed renovations that would result in exposure to attic dust and the CPMP would inform tradesmen and the public of potential exposure to arsenic and lead in dust).	Consistent with1996 remedy, which required source removal (soil cleanup) to address interior dust issue. To date, no interior dust contamination has been identified (out of 16 sampled houses). Attic dust could be addressed under the CPMP and DPS, to ensure that the remedy is protective of human health.	As and Pb concentrations in several sampled attics exceed removal and cleanup level criteria/PRGs.	Yes
ALD2. Cleanup As > 250 mg/kg and Pb > 400 mg/kg in accessible household dusts.	These options would address interior, exterior, and accessible attic dust. Sampling of these areas would be conducted under an approved Dust Sampling and Analysis Plan. Potential recontamination of cleaned homes would be avoided by deferring interior dust remedial actions until sources (i.e., lead-based paint) that could affect the integrity of the remediation are addressed.			
	ALD2.1. Sample and remediate interior dust, and attic dusts where there is an established exposure pathway to the attic.	Dust exceeding 250 As and 400 Pb mg/kg would be removed. This dust is most accessible to human exposure, especially for small children. Relatively inexpensive. Protective of human health.	Differentiating lead from smelter operations and lead from lead-based paint. Some minor disruption to residents from sampling and cleanup activities. Cleanup in some instance may be very difficult due to the presence of insulating materials	Yes
	ALD2.2. Sample and remediate interior, and attic dusts where there is a potential exposure pathway to the attic.	In addition to the accessible interior and exterior dust exceeding 250 As and 400 Pb mg/kg, attic dust would also be removed. Attic dust may represent a potential source to interior dust.	Some attics where potential exposure pathways exist may be inaccessible, and attic cleanup would significantly increase costs. For others, cleanup would be very difficult due to the presence of insulating materials.	Yes

Table 3-3 (Continued)
Screening of
Potentially Applicable Remedial Alternatives
Arsenic and Lead in Household Dust

Alternative	*Description of Option/Subalternatives*	*Advantages*	*Disadvantages*	*Retained*
ALD3. Cleanup As > 250 mg/kg and Pb > 400 mg/kg in accessible and inaccessible household dusts.	This option would address all dust (accessible and inaccessible) in residences in the OU. Dust samples would be collected from accessible and inaccessible interiors, exteriors, and attics. Accessible dust would be remediated following Alternative LD2.2. In addition, inaccessible dust would include dust within walls. Holes would be drilled between wall studs to allow vacuum sampling. Exceedances (As > 250 mg/kg and Pb >400 mg/kg) would be trigger cleanup through vacuum methods (holes would be patched after sampling and remediation is complete. Insulating materials capable of retaining dust in attics would be removed and replaced if exceedances were identified during sampling.	All dust with As and Pb above action and PRG levels would be moved from residences.	Extremely costly. Additional cost does not provide significant benefit in terms of protectiveness, since the additional dust that would be removed does not have a direct pathway to humans.	No

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Table 3-4
Screening of
Potentially Applicable Remedial Alternatives
Additional Institutional Controls

Alternative	*Description of Option/Subalternatives*	*Advantages*	*Disadvantages*	*Retained*
IC1. No Further Action	Existing institutional controls identified in the Community Soils and the ARWW&S OU Records of Decision will be unmodified and fully implemented. These include the DPS to address soils and dust contamination from arsenic, and the CPMP would inform contractors and the public of potential exposure to arsenic through renovations, and provide contacts to get permits and other information.	Consistent with1996 remedy, which would allow cleanup to end. The CPMP and DPS would ensure that the remedy remains protective of human health.	Does not address lead contamination in soils.	Yes
IC2. Expand ICs to include blood lead testing program for children	Same as No Further Action alternative, but includes a new blood lead testing program.	If no lead action level is adopted at this time, then blood lead data could be used by EPA during future 5 year reviews to determine whether the remedy is protective or whether remedial action needs to be implemented. Blood lead exposure from lead-based paint could be used by other programs to complete non-Superfund cleanup.	If elevated blood levels are found and are determined to be from smelter-related lead, then exposure after the opportunity to have cleanup completed will be documented. Currently no funding is available to implement such a program.	Yes
IC3. Multi-Pathways Residential Metals Abatement Program	This would be structured similarly to the program being implemented at the Butte Priority Soils OU by Butte Silver Bow County and Atlantic Richfield. It would address mining and non-mining related contaminated soils and dust. Residential soils; interior, exterior, an attic dust; and potential lead-based paint would be sampled under this program. Other components include a long-term tracking and data management program, an education and outreach plan, and a medical monitoring program.	Cleans up all sources of lead contamination. Addresses most sensitive populations first. Less obtrusive to the community.	Requires an agreement for funding between ADLC and Atlantic Richfield.	Yes

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The medical monitoring program would be a voluntary program primarily for women, infants, and children, although it would be available to all potentially affected residents within the area of concern. The program would include blood lead and urinary arsenic screening, and would be conducted in consultation with the Agency for Toxic Substances and Disease Registry. The data would be compiled and analyzed in a comprehensive health study report prior to the next five year review.

The multi-pathways program is based on a similar program currently being implemented by Butte – Silver Bow County for the Butte Priority Soils OU of the Silver Bow Creek/Butte Area NPL Site. This program, the Residential Metals Abatement Program, addresses both mining and non-mining contamination. Non-mining contamination includes lead-based paint, lead solder, and lead pipes. While this FFS can only consider mining contamination, it cannot be implemented until EPA has created a program to ensure that remediated properties are not recontaminated. EPA envisions that the multi-pathways program will provide flexibility for settling parties to address non-mining contamination.

Section 4 Detailed Evaluation of Retained Alternatives to CERCLA Criteria

In this section, detailed alternatives have been formulated from the screened alternatives for the three remedial categories (lead in soils, interior dust, and institutional controls) presented in Section 3. One alternative from each of the three remedial categories is grouped with two others that appear to be most logical in terms of cleanup approach.

4.1 Description of Detailed Alternatives

On September 15, 2011, representatives from EPA, DEQ, ADLC, and Atlantic Richfield conducted a scoping meeting for alternatives for this FFS. Based on input received at this meeting, EPA has selected the following three alternatives for detailed analysis:

Alternative 1: No Further Action. This alternative consists of the current remedy described under the 1996 ROD, as partially implemented under the 2001 Residential Soils FDR/RAWP (implementation of the Institutional Controls portions of the remedy has not been fully implemented; it is expected to be implemented under the final Institutional Controls Management Plan (ICMP).

This alternative provides for the conclusion of the current Residential Soils RA (completed in 2010); the DPS to manage future development of unremediated properties (both undeveloped and developed), in the event that arsenic-contaminated soils are excavated and exposed during future development (including additions to developed property). It provides for the continued development of the CPMP as described in the 1996 Community Soils OU ROD and 1998 ARWW&S OU ROD, including dissemination of information to homeowners, realtors, and developers. No additional cleanup of lead in soils or dust would be triggered under this alternative.

Alternative 2: Limited Remediation With Expanded ICs. This alternative consists of three primary components: (1) soil lead remedy; (2) household dust remedy; and (3) ICs (revised CPMP/multipathway program/attic dust DPS). Each component is described as follows:

- *Soil Lead Remedy*. Surficial soils exceeding the lead PRG would be removed from the 0 – 2 inch interval if the area-weighted average lead concentration in the yard exceeds the lead PRG. In addition, all yard components having soil lead concentrations greater than 1200 mg/kg Pb will be removed and replaced to a maximum depth of 12 inches, regardless of depth. Subsurface soils (2 – 12 inches) that exceed the lead PRG but are below the lead NTE would remain in place.

- *Household Dust Remedy*. Interior (accessible) dust would be sampled and remediated if the lead PRG and/or the arsenic cleanup level are exceeded. Accessible dust would include attic dust if there is a demonstrated exposure pathway, or a proposed remodeling project.

- *Institutional Controls*. Alternative 2 includes components from the ICs program identified in the Community Soils ROD that are related to providing protectiveness against exposure to lead from mining sources. Generally ICs under Alternative 2 would follow the existing program for arsenic with the addition of: 1) a requirement to obtain a permit for proposed renovations that could result in exposure to attic dust; and 2) a CPMP mechanism to inform tradesmen and the public of potential exposure to lead in dust.

  In addition, to prevent recontamination of the Superfund remedy, under this alternative a multipathway program would be developed to assess and address non-mining lead contamination in advance of cleanup of mining-related lead contamination. The CERCLA statute limits EPA's authority to respond to certain sources such as interior lead-based paint and plumbing. In cases where CERCLA authority is limited, EPA may work with other interested parties and authorities to identify potential funding sources and mechanisms to address these other sources of lead exposure. Similar to the program being implemented in BPSOU the multipathway program will address lead-based paint, lead solder and lead pipes but would have a separate, non-Superfund source of funding. The multipathway program would also include a voluntary community blood lead monitoring program that would enable the community to identify and address multiple additional sources of lead exposure.

Note that this FFS does not address non-Superfund cleanup in the cost analyses or the NCP criteria evaluation.

Alternative 3: Complete Remediation with Current ICs: This alternative specifies the cleanup of all yard components in sampled but unremediated properties where lead concentrations exceed the lead PRG. The existing 0 to 2 inch lead data would be used in RD. Additional sampling from 2 to 12 inches would be conducted on all unremediated properties and unremediated yard components of previously remediated (under the arsenic-driven residential soils RA) properties.

Recognizing that the deterioration of exterior lead-based paint is a significant potential source to recontaminate yards, an assessment of the exterior paint condition would be performed concurrently with the sampling effort. Homeowners having deteriorating exteriors with lead paint would be encouraged to address this condition prior to remediation. However, as noted in Alternative 2, EPA lacks CERCLA authority to require homeowners to mitigate lead paint prior to cleanup.

Concurrently with the soils cleanup, interior dust would be sampled and remediated if lead concentrations are above the PRG and arsenic is above the cleanup level. Cleanup would be limited to accessible dust (interiors and accessible attics).

Existing institutional controls prescribed under the 1996 Community Soils ROD would be amended to address lead. As described in Alternative 2, the CPMP would be amended to notify tradesmen and the public of potential exposure to lead in dust. Additionally, the DPS would be amended to include attic dust sampling in the event of remodeling.

4.2 Detailed Analysis of Alternatives

The NCP (Section 300.430 (e)(9)(iii)) requires that the alternatives be compared with one another using the nine CERCLA remedial evaluation criteria. The purpose of the comparison is to identify the relative advantages and disadvantages of the alternatives in terms of these CERCLA criteria. These nine criteria are divided into subcategories: Threshold Criteria, Balancing Criteria, and Modifying Criteria, as follows:

Threshold Criteria:

1. Overall protection of human health and the environment
2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Alternatives that do not protect human health and the environment or do not comply with ARARs are eliminated from further analysis.

Balancing Criteria:

3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost

Each alternative is evaluated against these criteria in a detailed analysis prior to a comparative analysis.

Modifying Criteria:

8. State Acceptance
9. Community Acceptance

These criteria will be addressed in the Proposed Plan that will be provided for public review and comment.

4.2.1 Threshold Criteria

Alternative 1 may not be protective of human health, as it would allow yards with high lead concentrations (above PRGs and NTE values) to remain in place. Alternatives 2 and 3 are protective of human health. Alternative 2 remediates yards with high concentrations of lead above the NTE value to 12 inches, and yards with moderate concentrations above the PRG to 2 inches, while providing for ICs to manage future risk and evaluate current protectiveness. Alternative 3 is the most protective, as it cleans up all yards over the lead PRG to a depth of 12 inches, thus reducing the need for more comprehensive ICs. All three alternatives comply with ARARs.

4.2.2 Balancing Criteria

Alternative 3 ranks as the highest alternative in terms of long-term effectiveness and performance, because 12 inches of soil removal would be conducted immediately. Alternative 2 ranks lower than Alternative 3 because it relies more on ICs to protect a thin (2-inch) protective layer over soils which may exceed the lead PRG. Both alternatives have the same dust remedy. Alternative 2 ranks higher than Alternative 1 in the comparison conducted for this criterion, as it would result in more removal of contaminated soil and dust.

None of the three alternatives utilize treatment, so each rank low for reducing toxicity, mobility and volume through treatment. Alternatives 2 and 3 use removal to address potential exposure pathways.

Alternative 2 and Alternative 3 rank equally in terms of short-term effectiveness, as both can be implemented in about the same time frame.

In terms of implementability, Alternative 1, the No Further Action Alternative, ranks highest, as institutional controls described in Section 3.4 are currently being implemented. The construction portion of the remedies for Alternatives 2 and 3 are equal, however, adding non-CERCLA components to Alternative 2 for ICs would require additional non-CERCLA funding (e.g., from an agreement between the PRP (Atlantic Richfield) and ADLC). Therefore, Alternative 3 ranks higher in terms of implementability than Alternative 2.

Table 4-1 presents a cost comparison between the three alternatives. Unit costs are based on costs reported by Atlantic Richfield from conducting the previous arsenic RA. The No Further Action alternative has no additional costs associated with it, as all of the described RAs and institutional controls (e.g., DPS and CPMP) have been identified under the existing 1996 Community Soils OU ROD. Similarly, no costs for the DPS and CPMP are assumed for Alternatives 2 and 3.

Table 4-1
Detailed Alternatives Cost Comparison
Additional Residential Soils and Dust Remedial Actions
Community Soils Operable Unit, Anaconda Smelter NPL Site

Description	Alternative 1 No Further Action	Alternative 2 Limited Remediation With Expanded ICs	Alternative 3 Cleanup with Limited ICs
Estimated Time to Complete Remediation	0	2 - 4 years	3 - 6 years
Capital Costs	$0	$2,280,000 - $4,040,000	$2,990,000 - $4,470,000
Annual Costs (ICs and Monitoring)	$0	$7,800	$7,800
5 Year Medical Monitoring Program	$0	$330,000	$0
TOTAL COST (Net Present Value)	**$0**	**$2,920,000 - $4,670,000**	**$3,290,000 - $4,960,000**

As previously discussed in Section 3, the cost estimates use a range of 400 mg/kg, 500 mg/kg, and 700 mg/kg for Pb PRGs for Alternatives 2 and 3, and a NTE level of 1200 mg/kg for Alternative 2. The present value analysis uses a real value discount rate of 1% (which is based on a 4% rate of return on investment minus a 3% inflation factor), and a project life of 50 years. The 1% rate and the 50 year project life were based on similar cost analyses performed by EPA in the last two years, reflecting current economic conditions. The annual costs for remediating residential soils and dusts are based on the average costs reported by Atlantic Richfield. The number of residential yards and interior and attic dust cleanups are projected from the existing data sets, and adjusted for the size of Anaconda compared to Butte. Similar assumptions for average costs and number of residences identified for RA were used to estimate costs for Alternative 3.

The result of the cost analysis presented in Table 4-1 is that Alternative 2 is slightly lower in cost than Alternative 3 in terms of net present value. However, Alternative 2 does not include costs for the multipathways program, which cannot be considered in this FFS as it requires actions that are outside of CERCLA authority.

4.2.3 Modifying Criteria

The final two CERCLA criteria, state and community acceptance, would be addressed after a Proposed Plan for a Community Soils OU ROD Amendment has been provided for public comment.

4.3 Summary

Table 4-2 summarizes the result of this evaluation of the three alternatives compared to the nine CERCLA criteria.

Table 4-2
Comparison of Alternatives to NCP Evaluation Criteria
Additional Residential Soils and Dust Remedial Actions
Community Soils Operable Unit, Anaconda Smelter NPL Site

	Alternative 1 No Further Action	Alternative 2 Clean High Levels of Lead and IC Program	Alternative 3 Clean Low Levels of Land and Arsenic. Limited ICs
Threshold Criteria			
Protective of Human Health and Environment	No	Yes	Yes
Compliance with ARARs	Yes	Yes	Yes
Balancing Criteria			
Long Term Effectiveness	◑	◑	●
Reduction of Toxicity, Mobility, and Volumes through Treatment	○	○	○
Short Term Protection	◔	◑	●
Implementability	●	◑	◕
Cost	●	◑	◑
Modifying Criteria			
State Acceptance	TBD	TBD	TBD
Community Acceptance	TBD	TBD	TBD

LEGEND

●	Meets or exceeds criteria
◕	Meets criteria, with few stipulations
◑	Meets criteria, with some stipulations
◔	May not attain criteria
○	Does not attain criteria
TBD	To be determined

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Section 5 Next Step

EPA and DEQ will select a preferred alternative. The preferred alternative may be one of the alternatives evaluated in Section 4, a modification of one of these alternatives, or an entirely new alternative based on discussion and evaluation. The Preferred Alternative would be identified in a Proposed Plan for an amendment to the 1996 Community Soils OU Record of Decision, which would be distributed for public comment. A public meeting would be held by EPA in Anaconda to explain the Proposed Plan and solicit input from the public.

Following a 45 day public comment period, EPA, in consultation with DEQ, would complete an amendment to the Community Soils OU Record of Decision. The Preferred Alternative identified in the Proposed Plan may be modified in the ROD amendment based on the provided comments. All comments received during this comment period would be addressed in the Responsiveness Summary to the ROD amendment.

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Appendix A
Calculation of Preliminary Remedial Goals (PRGs) for Lead in Soils

Memorandum

To: *Charlie Coleman, EPA Remedial Project Manager*
Susan Griffin, EPA Regional Toxicologist

From: *James Lavelle, CDM*
Marjorie Norman, CDM

Date: *November 8, 2010*

Subject: *Calculation of Preliminary Remedial Goals (PRGs) for Lead in Soils*
Community Soils Operable Unit
Anaconda Smelter National Priorities List Site

In 2002, the U.S. Environmental Protection Agency (EPA) and the Montana Department of Environmental Quality (MDEQ) approved the Remedial Action Work Plan and Final Design Report for the Community Soils Operable Unit of the Anaconda Smelter National Priorities List (NPL) Site. The goal of this plan was to implement the cleanup of residential soils within the NPL site that exceeded a residential action level of 250 mg/kg arsenic. As the implementation of the remedial action progressed, a significant quantity of new data regarding arsenic, and additionally lead, in residential soils and dust was collected. These data showed a majority of yard component soils analyzed had lead concentrations exceeding the 400 mg/kg level used in the Superfund Lead-Contaminated Residential Sites Handbook to define properties requiring cleanup under a long-term remedial action or non-time critical removal action (EPA 2003). Furthermore, many of these samples were taken from yard components not currently scheduled for remediation.

As a result of these findings, EPA issued a Scope of Work (SOW) in April 2009 tasking CDM to assist with the development of a preliminary remediation goal (PRG) for lead. PRGs for lead for residential land use are developed using the Integrated Exposure Uptake Biokinetic (IEUBK) model, which addresses risk for young children from exposure to lead. A critical aspect of developing the PRGs is, therefore, the identification of appropriate input parameters to be used in the IEUBK model. As requested in the SOW, CDM reviewed data from past investigations and summarized information pertinent to the identification of four key model parameters, namely the bioavailability of lead in soils and house dust, the transfer factor relating soil in residential yards to indoor dust, the variability of blood lead concentrations in children with similar exposure conditions as defined by a Geometric Standard Deviation (GSD), and the rate of incidental soil and dust ingestion. Additionally, Atlantic Richfield

Company, a potentially responsible party at the site, reviewed the EPA SOW and provided their comments and suggestions for inputs for the key parameters (Atlantic Richfield 2009).

In August 2009, EPA, MDEQ, Atlantic Richfield and their consultants met to discuss the approach to be used for the development of lead PRGs for residential soils at the Anaconda Smelter Site and more specifically to explore default and site-specific inputs to be used in the IEUBK model. As a result of this meeting, EPA directed CDM to proceed with developing PRGs for lead in soils using several combinations of default, region-specific and site-specific inputs to the IEUBK model to calculate a range of PRG estimates.

A draft of this memorandum that presented a range of site specific PRGs for lead was prepared for agency review in October 2009. In response to comments on this draft, the memorandum was revised. The current document still addresses range of possible PRGs, but considers fewer combinations of IEUBK model inputs. In particular, the memorandum no longer considers alternatives to the default geometric standard deviation (GSD) of 1.6. The IEUBK model (Windows Version 1.1, Build 11 (EPA 2010)) was used to estimate PRGs using the follow four sets of input parameters. Parameters not specifically mentioned below were left at model defaults.

- Default parameters only
- Site-specific parameters for bioavailability of lead in soil and dust, and for soil-to-dust transfer (MSD)
- Site- specific parameters for bioavailability of lead in soil and dust and for MSD, and soil ingestion rates from EPA (2008)
- Site- specific parameters for bioavailability of lead in soil and dust and for MSD, and soil ingestion rates from Stanek et al. (2001)

This document presents and justifies inputs to the IEUBK model and provides results from PRG calculations. PRGs are presented along with an explanation of associated uncertainties. Also presented are suggestions for appropriate interpretation of these estimates in terms of setting remediation targets for Anaconda residential areas. Specifically, Section 1 discusses input parameters used in IEUBK model runs; Section 2 presents results of the calculations, Section 3 discusses uncertainties associated with the range of possible lead PRGs, and Section 4 provides suggestions for interpretation.

1.0 Methods for Calculating PRGs

The IEUBK (Integrated Exposure Uptake Biokinetic) model (EPA2010) was used for developing PRGs for Anaconda residential areas. Parameters used for developing PRGs for

these areas are discussed in the following sections. Sections 1.1 though 1.3 discuss bioavailability of lead from soils and dust, soil to indoor dust transfer, and site-specific soil ingestion rates, respectively.

1.1 Bioavailability of Lead from Soils and Dust

The default relative bioavailability (RBA) estimate used in the IEUBK model is 0.6 (60%) for lead in soil or dust. That is, absorption of lead from soil and dust is assumed to 60% of that assumed for soluble lead in water. Absorption of lead from water is assumed to be 50%, so the default absolute bioavailability of lead soil and dust is 30%. This default value is used in the absence of site-specific bioavailability information. As discussed below, a site-specific estimate of RBA of 0.69 is available, which equates to an absolute bioavailability of 34.5%.

EPA notes that its default value is intended to reflect central tendency rather than an upper bound, and bioavailability of lead at a given site could be higher or lower than this default. Existing Agency risk assessment guidance (USEPA 1989, 1994), in recognition of this fact, indicates that "use of default values should not substitute for site-specific assessments of bioavailability, where such assessments are deemed feasible and valuable for improving the characterization of risk at the site." To support site-specific measurement of bioavailability, EPA has issued a document entitled "Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Health Risk Assessment" to provide guidance to Regional risk assessors on how to assess site-specific oral bioavailability of metals in soils or dust for use in risk assessments (EPA 2007a). The document provides a framework for evaluating and incorporating site-specific bioavailability information. In addition, EPA prepared a memorandum on "Estimation of Relative Bioavailability of Lead in Soil and Soil-like Materials Using In Vivo and In Vitro Methods" which explains animal and laboratory assays that are scientifically sound and indicates that Regional staff should consider valid methods suitable for quantitative use in site-specific risk assessment (EPA 2007b).

Atlantic Richfield (2009) submitted a site-specific evaluation of the bioavailability of lead in soils at Anaconda. No data were available to provide a separate estimate of bioavailability of lead in indoor dust. For setting PRGs, extrapolation of bioavailability of lead in soil to indoor dust is reasonable. Contributions for other sources (e.g. indoor lead-based paint) cannot be reasonably addressed by clean-up of outdoor soil. Thus, a PRG set to only consider the component of indoor dust derived from soil is appropriate. An assumption that bioavailability does not change after transfer of soil to dust seems reasonable.

The Atlantic Richfield memorandum presents estimated relative lead bioavailability values for three groups of samples from the Anaconda site. All of the samples for this study were submitted to the Laboratory for Environmental and Geological Sciences at the University of Colorado at Boulder for analysis of lead bioaccessibility by the in vitro extraction method of Drexler and Brattin (2007). Lead bioaccessibility results were converted to estimated relative

lead bioavailability values using the in vitro and in vivo correlation presented in Drexler and Brattin (2007) and EPA's Estimation of Relative Bioavailability of Lead in Soil and Soil-like Materials Using In Vivo and In Vitro Methods (USEPA 2007b). All of the quality assurance/quality control sample analyses specified in USEPA (2007b) were performed and met control limits. The resulting estimate for RBA of 0.69 is an acceptable site-specific value. Absolute bioavailability used as an input to the IEUBK was 34.5% (50% times 0.69). Uncertainties in the use of this value are discussed in Section 3.1.

1.2 Soil to Dust Transfer Factor

The default mass fraction of soil in indoor dust (MSD) in the IEUBK model is 0.7. Site-specific data are, however, available to support a value of 0.43. This value was used as an input to the Multiple Source Analysis module in the IEUBK model.

The IEUBK model default value for MSD is based on analysis of soil and dust concentrations measured in residential communities across the nation (USEPA 1994). This value addresses only direct soil-to-dust transfer, for example, via tracking on shoes and pets. The Multiple Source Analysis adds a small increment to this transfer to account for airborne dust that might enter a home.

EPA guidance regarding the MSD recommends that measurements of lead concentrations in soil and dust, if available, be used as inputs to the IEUBK model when conducting residential lead risk assessments (EPA 1998). A site-specific MSD of 0.43 was previously developed for use in the baseline risk assessment for Anaconda residential areas prepared in 1996 (CDM 1996). This MSD was based on a multiple regression analysis of arsenic concentrations from more than 300 paired soil and dust samples (Bornschein 1994). The empirical derivation of this estimate would include any component from airborne dust.

Alternatively, a possible MSD of 0.34 was suggested by Integral in their memorandum entitled "Site-Specific Lead Action Levels for Anaconda Community Soils" (Atlantic Richfield 2009). This value was based on an analysis of lead concentrations in paired soil and interior dust samples from 26 homes in the Anaconda area. These data directly address soil-to-dust transfer of lead. However, data pairs for this data set were not collected at the same time, the dataset is rather small, soil/dust ratios are quite variable, and the evaluation yields a result similar to that used in the BHHRA (CDM1996). The arsenic dataset offers a value that is more robust statistically, and arsenic is not subject to the same confounders, such as lead in indoor and outdoor paint, that makes evaluation of lead data sets difficult.

Thus, a value of 0.43 was used in the development of PRGs. When this value was used, the contribution of airborne lead to indoor dust concentrations was turned off in the IEUBK model. As indicated above, the empirical relationship between soil and indoor dust lead would include contributions of all sources.

1.3 Site-Specific Soil Ingestion Rates

Default soil ingestion rates recommended by EPA (listed below) along with ingestion rates recommended in the Children's Exposure Factors Handbook were used in developing the range of PRGs. In addition, site-specific soil ingestion rates, developed in a study conducted in Anaconda in 1992, were used for developing the PRG for one of the four scenarios listed above.

EPA's default soil ingestion rates were used in conducting the Baseline Risk Assessment for the Anaconda site (CDM 1996). These rates are still the default values for soil ingestion in the latest version of the IEUBK model. By age bracket, default soil ingestion rates are: 0.085 g/day for 0-1 year olds, 0.135 g/day for 1-4 year olds, 0.100 g/day for 4-5 year olds, 0.090 g/day for 5-6 year olds, and 0.085 g/day for 6-7 year olds.

For purposes of calculating a reasonable range of PRG estimates for comparison, ingestion rates from the Child Exposure Factors Handbook (EPA 2008) were also used. This guidance recommends lower intake rates for children in 0-1 and 1-4 year age brackets and a slightly higher estimate for children 5 to 6 years of age. Ingestion rates based on this guidance, as used in IEUBK model runs were: 0.06 g/day for 0-1 year olds, 0.1 g/day for 1-6 year olds, and 0.085 g/day for 6-7 year olds.

In 1992, Stanek and Calabrese conducted a short-term (7-day) investigation of soil ingestion using a sample of 64 children aged 1 to 4 living in Anaconda. In 2000 and 2001, the authors published reevaluations of the original study and suggested a mean soil ingestion rate of 0.031 g/day (Stanek and Calabrese 2000, Stanek et al. 2001). Although the study investigated only children ages 1 to 4, these site-specific results were incorporated into the development of PRGs for the Anaconda site using a ratio approach to develop estimates for other age groups. Specifically, 0.031 g/day was used for 1-4 year olds, and EPA default values for 0-1, 4-5, 5-6 and 6-7 were multiplied by a ratio of 31/135 to obtain rates of 0.020, 0.023, 0.021, and 0.020 g/day, respectively.

2.0 Results of PRG Calculations

This section presents results of the IEUBK model runs, using parameters identified in Section 1, to develop PRGs for Anaconda residential areas (in particular, Community Soils OU). These PRGs are listed in Table 1. For each combination of scenarios, the IEUBK model "Find" module was used to estimate a PRG for soil. In each run, the PRG was based on a target

blood lead concentration of 10 ug/dL, a geometric standard deviation (GSD) of 1.6[1], and a target probability of a child's blood lead concentration exceeding 10 ug/dL of 5 percent. All model output files are provided in Attachment 1.

Table 1. Lead PRGs for Anaconda Residential Area

RBA	MSD	Soil Ingestion	PRG (mg/kg)
0.60	0.70	Default	418
0.69	0.43	Default	449
0.69	0.43	Child EFH (2008)	548
0.69	0.43	Stanek et al. (2001)	1941

3.0 Uncertainties of Calculated PRGs

Uncertainties associated with input parameters used for developing PRGs for Anaconda residential areas are discussed in the following sections.

3.1 Bioavailability of Lead from Soils and Dust

The overall uncertainty surrounding the bioavailability of lead from Anaconda residential soils is low. In developing the site-specific bioavailability factor, 15 samples from residential soils from the town of Anaconda were collected. Estimated relative lead bioavailability values in these samples ranged from 62 to 73 percent with an average of 69%. The measurements were consistent and reproducible. Initially, some concern about the identity of materials and the lack of samples at depth was voiced; however, it was decided that materials at depth were likely to be less bioavailable than surface soil as represented by the samples evaluated. Materials at depth would not be subject to oxidation to the extent that surface materials would be. Oxidation typically leads to more available lead forms. Thus, sampling was considered representative for lead bioavailability of in residential yards within the Community Soils OU.

3.2 Soil to Dust Transfer Factor

The uncertainty surrounding the soil to dust transfer factor is moderate. In developing the site-specific factor, a robust data set of over 300 paired soil/dust arsenic concentrations was evaluated. The MSD for lead is extrapolated from these data. This approach appears reasonable as a significant correlation was found between surface soil concentrations of arsenic and lead, and one might anticipate that arsenic and lead would move in a similar fashion from soil to dust, given that transport depends mainly on physical characteristics of

[1] The IEUBK model estimates a geometric mean blood lead concentration, then applies a GSD to estimate the distribution of blood lead concentrations, along with probability of a blood lead concentrations exceeding 10 ug/dL

soil particles rather than their chemical composition. However, waste from different sources may have both different particle size distributions and different arsenic and lead concentrations. If such sources contribute differently to total arsenic and total lead concentrations in the community, differences in transport of arsenic and lead into homes could occur.

Considering this possibility, if lead was transported very efficiently into homes, soil and dust concentrations might in the worst theoretical case be equal (in several studies no suggestion that soil contaminants might be concentrated in dust was reported). Such an occurrence would suggest an underestimation of lead transport of no more than a factor of about 2. Conversely, if transport was very inefficient, little or no lead in soil would be transported into homes. In such case, PRGs could be overly conservative, but still protective. Studies at several sites across the country suggest that neither of the above extreme alternatives is at all likely, implying that the maximum influence different sources might have on dust concentrations would be relatively small. For example, the range of MSDs from several western mining sites spanned a range of 0.15 to 0.43 (USEPA 2003). The highest of these values is from the study conducted in Anaconda.

Results included in this memorandum indicate the IEUBK model is moderately sensitive to this parameter. A change of the MSD from the default of 0.7 to the site-specific value of 0.43, while holding all other inputs at default values, resulted in a 23% increase in the calculated PRG (418 versus 516 ppm). Therefore, while some uncertainty exists regarding the MSD for lead in Anaconda residential areas, impacts on PRG estimates is likely to be relatively small.

3.3 Site-Specific Soil Ingestion Rates

The uncertainty surrounding the soil ingestion rate is high, as evidenced by the large changes in PRG estimates associated with some changes in ingestion rate inputs. The IEUBK model is sensitive to changes in this parameter, and ingestion rates within the plausible range have a significant impact on PRG estimates. Changing soil ingestion rates from EPA default values to site-specific values of Stanek et al. (2001), and holding all other inputs constant at default values, resulted in a 4.4 fold increase in the PRG (418 to 1839 ppm). Data from Stanek and Calabrese were collected in the early '90s from 64 children residing in the Community Soils OU, and are the only site-specific soil ingestion available.

Changing the EPA default values to rates consistent with the Children's Exposure Factor Handbook, and again holding all other inputs constant, increased the calculated PRG by 1.22 from 418 to 512 ppm. This increase is similar to the change observed in the PRG estimate when changing the input for MSD to 0.43.

At this time, knowledge of soil and dust ingestion patterns within the United States is limited (USEPA 2008). While USEPA and the Child's Exposure Factors Handbook recommend

generic values applicable to children, confidence in the recommendations are medium to low. Furthermore, these generic recommendations may not reflect exposure conditions for Anaconda.

The data collected by Stanek and Calabrese in their study of children in Anaconda conducted in 1992 may better reflect the Anaconda community, and the reevaluation of the data published in 2001 may provide more certain estimates of the amount of soil ingested. The study is one of the few that uses a mass-balance approach, accounts for non-soil sources of trace element concentrations, characterizes tracer and intra-child variability, uses a study population from the Western U.S., and is based on analytical data from soil samples sieved to <250 microns. The latter is the size fraction expected to adhere to skin, and thus would be ingested following hand-to-mouth activity. However, soil ingestion was negative for some children on some days of the study, likely due to the large amount of noise in the data. Estimating total intake of non-absorbed inorganic tracers is difficult, and small amounts of such tracers in soil are only detected against significant background.

4.0 Screening Risk Analysis for the Anaconda Smelter Area

A sense of the importance of lead for remediation of residential yards in and around the former smelter can be ascertained by examining lead concentrations in yards that have and will not be remediated on the basis of arsenic concentrations in soil – that is, for yards where arsenic concentrations are below 250 mg/kg.

Data for lead in unremediated residential yards was received from ARCO via Mr. Dennis Neuman of Reclamation Research Group. This data set consisted of area-weighted average lead concentrations from 142 yards in Anaconda and an additional 42 yards in Opportunity/Crackerville. These data were entered were used in batch mode in the IEUBK model to estimate the impact of residual lead in residential yards in the Anaconda area.

For these calculations, relative bioavailability of lead in soil was assumed to be 0.69 (69%), and the contribution of outdoor soil to indoor dust (MSD) was assumed to be 0.43. Thus, the calculations are consistent with the IEUBK model input used to estimate the second PRG in the above table (449 mg/kg). As recommended by the EPA technical work group, input for the age variable for the batch file was 50 months for all residences. All other inputs to the IEUBK model were kept as defaults. The batch file used in the calculations is provided in Attachment 2.

IEUBK model results are summarized in Figure 1, and IEUBK model output is provided in Attachment 2. For 86 residential yards, the probability of a child's blood lead concentration (PbB) exceeding 10 ug/dL was less than 5 percent suggesting that lead risks for young children would not be unacceptable. For the remaining 88 yards, the probability was greater than 5 percent, suggesting unacceptable risks from exposure to lead. All but one of these

yards is located in Anaconda. A single yard with a lead concentration of 520 mg/kg located in the Opportunity/Crackerville area was associated with risk above 5 percent of exceeding 10 ug/dL PbB.

Overall, slightly more than half of all yards in the data set may present unacceptable risk to young children. If only the yards from Anaconda are considered, the percentage rises to just over 60 percent. For 14 yards in Anaconda, the probability of a child's blood lead exceeding 10 ug/dL might range from more than 25 to about 82 percent. In the two yards with the highest soil concentrations, geometric mean PbB might exceed the target of 10 ug/dL PbB.

The above results should not be considered a complete assessment of current risks associated with lead exposure for the Anaconda Smelter site. A number of issues, such as site-specific soil ingestion rates, lead in drinking water, data (if any) for blood lead concentrations in children in Anaconda, contributions of lead-based paint (interior or exterior), and numbers of young children living in the area, were not addressed. The results do provide some indication of the possible impact of lead in soil in Anaconda under one set of exposure assumptions. Additional discussion of some uncertainties and interpretation of risk results and PRG estimates is provided in the following section.

5.0 Suggestions for Interpretation of Results

PRGs calculated for lead in soil in residential areas in Anaconda span a large range – from 418 to 1941 mg/kg. All of these estimates have a reasonable technical basis. However, all values should probably not be considered as equally likely candidates for establishment of clean up targets. The following brief discussion is intended to marry PRG calculations, results of risk screening and the discussions of uncertainties in order to assist the risk manager in applying the results of the analysis to soil remediation in Anaconda.

Uncertainties associated with site-specific estimates for bioavailability of lead in soils and for transfer of lead in soil to indoor dust are relatively low. Site data are robust and appear to be clearly preferable to generic data for development of PRGs. For this reason, the PRG (418 ppm) based on default assumptions is not likely to be the best choice as a clean-up target. EPA recommends use of site-specific data whereever possible.

The two PRGs (449 and 548 ppm) that are based on site-specific estimates of MSD and bioavailability, but use default/generic inputs for soil ingestion rates seem consistent with clean-up targets at other sites where bioavailability of lead in soil is high. These PRGs are technically defensible choices for clean-up targets for residential soils at Anaconda. Risk estimates based on the same inputs to the IEUBK model, while still uncertain, are also likely to be technically defensible.

The final PRG, 1941 ppm, uses site-specific inputs for all three key parameters – MSD, bioavailability and soil ingestion. Soil ingestion rates from Stanek and Calabrese are substantially lower than any generic rates that are typically used to estimate childhood exposure. However, these data have been considered sufficient for use in human health risk assessment at some other sites in the US. At the moment, the low soil ingestion rates from Stanek and Calabrese are not used widely, however, and they have been criticized by EPA's TRW for lead and asbestos. Given the high bioavailability of lead in residential soils (about 15% higher than the default of 30 percent), and the hesitation in many regulatory circles to accept the soil ingestion rates from the Anaconda study, the highest PRG, though plausible, is subject to greater uncertainty.

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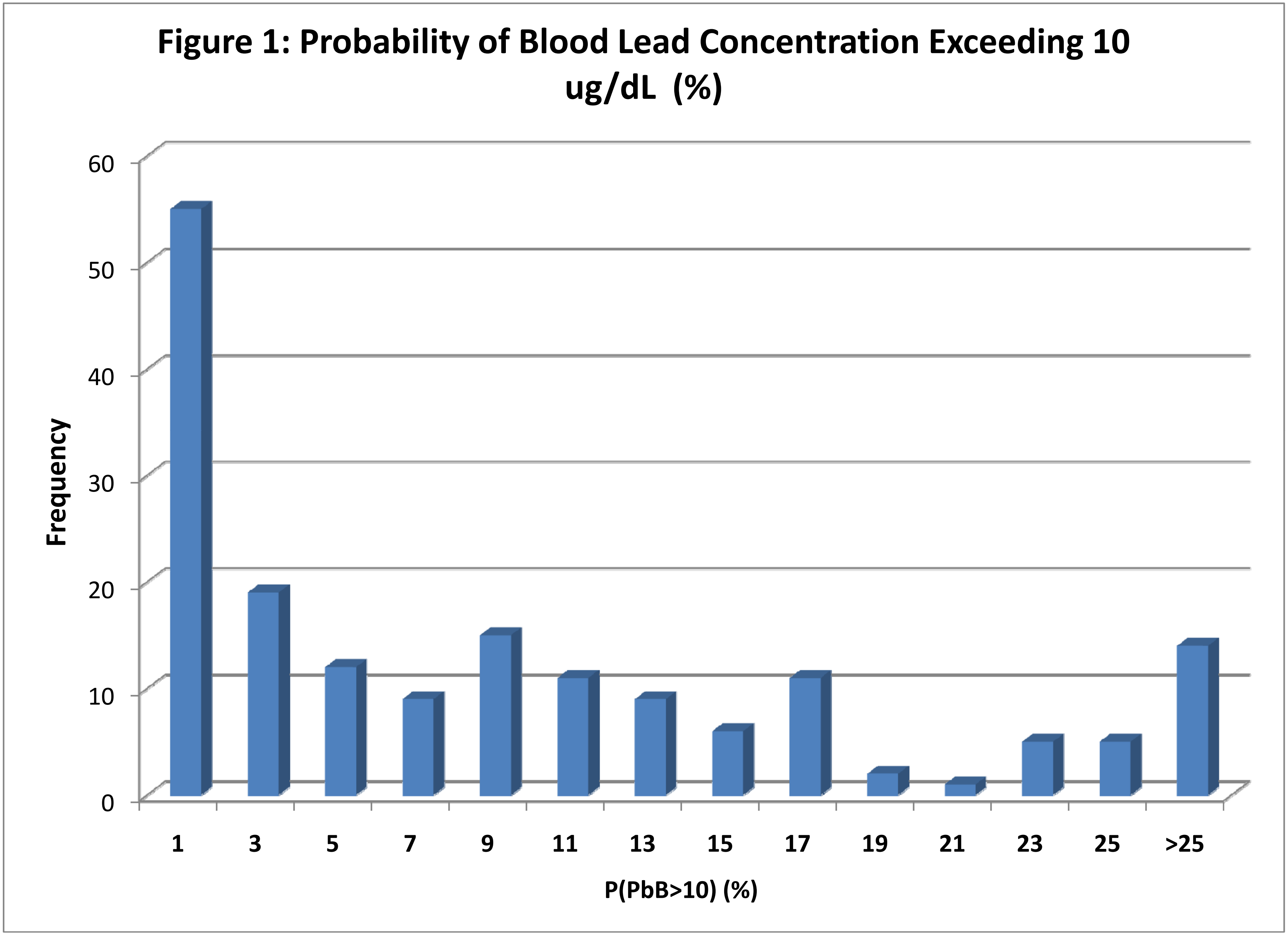

Figure 1: Probability of Blood Lead Concentration Exceeding 10 ug/dL (%)
Frequency
60
50
40
30
20
10
0
1
3
5
7
9
11
13
15
17
19
21
23
25
>25
P(PbB>10) (%)

Attachment 1

LEAD MODEL FOR WINDOWS Version 1.1

==
Model Version: 1.1 Build11
User Name: Jim LaVelle
Date: 10/15/2010
Site Name: Anaconda Smelter NPL Site
Operable Unit: Community Soils
Run Mode: Site Risk Assessment

Soil/Dust Data
Entered Soil PRG for Default Parameters
==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 302.600 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	418.000	302.600
1-2	418.000	302.600
2-3	418.000	302.600
3-4	418.000	302.600
4-5	418.000	302.600
5-6	418.000	302.600
6-7	418.000	302.600

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.013	0.000	0.359
1-2	0.034	0.863	0.000	0.880
2-3	0.062	0.953	0.000	0.931
3-4	0.067	0.927	0.000	0.963
4-5	0.067	0.913	0.000	1.030
5-6	0.093	0.971	0.000	1.099
6-7	0.093	1.058	0.000	1.124

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	8.107	9.500	5.1
1-2	12.637	14.414	5.9
2-3	12.851	14.797	5.5
3-4	13.047	15.004	5.2
4-5	9.962	11.972	4.3
5-6	9.067	11.230	3.6
6-7	8.615	10.891	3.2

LEAD MODEL FOR WINDOWS Version 1.1

==
Model Version: 1.1 Build11
User Name: Jim LaVelle
Date: 10/15/2010
Site Name: Anaconda Smelter NPL Site
Operable Unit: Community Soils
Run Mode: Site Risk Assessment

Soil/Dust Data
Entered Soil PRG for Default Parameters
GI Values + Bioavailability Data
Entered Site-Specific Bioavailability for Soil and Dust
Multiple Source Analysis Data
Entered Site-Specific MSD

Turned Off Contribution of Outdoor Airborne Lead to Indoor Dust
Soil/Dust Data
Set Model Parameters for Anaconda Scenario 2
Soil/Dust Data
Entered Soil PRG for Anaconda Scenario 2
==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 193.070 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.430
Outdoor airborne lead to indoor household dust lead concentration: 0.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	449.000	193.070
1-2	449.000	193.070
2-3	449.000	193.070
3-4	449.000	193.070
4-5	449.000	193.070
5-6	449.000	193.070
6-7	449.000	193.070

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.013	0.000	0.359
1-2	0.034	0.863	0.000	0.880
2-3	0.062	0.953	0.000	0.931
3-4	0.067	0.927	0.000	0.963
4-5	0.067	0.913	0.000	1.030
5-6	0.093	0.971	0.000	1.099
6-7	0.093	1.058	0.000	1.124

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	8.106	9.499	5.1
1-2	12.635	14.412	5.9
2-3	12.849	14.795	5.5
3-4	13.045	15.002	5.2
4-5	9.960	11.970	4.3
5-6	9.066	11.229	3.6
6-7	8.614	10.889	3.2

LEAD MODEL FOR WINDOWS Version 1.1

==

Model Version: 1.1 Build11
User Name: Jim LaVelle
Date: 10/15/2010
Site Name: Anaconda Smelter NPL Site
Operable Unit: Community Soils
Run Mode: Site Risk Assessment

Soil/Dust Data
Entered Soil PRG for Default Parameters
GI Values + Bioavailability Data
Entered Site-Specific Bioavailability for Soil and Dust
Multiple Source Analysis Data
Entered Site-Specific MSD

Turned Off Contribution of Outdoor Airborne Lead to Indoor Dust
Soil/Dust Data
Set Model Parameters for Anaconda Scenario 2
Soil/Dust Data
Entered Soil PRG for Anaconda Scenario 2
Soil/Dust Data
Set Soil Ingestion Rates for Child EFH Recommendations
Soil/Dust Data
Entered Soil PRG for Anaconda Scenario 3

==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (μg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(μg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 235.640 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.430
Outdoor airborne lead to indoor household dust lead concentration: 0.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	548.000	235.640
1-2	548.000	235.640
2-3	548.000	235.640
3-4	548.000	235.640
4-5	548.000	235.640
5-6	548.000	235.640
6-7	548.000	235.640

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.026	0.000	0.363
1-2	0.034	0.871	0.000	0.889
2-3	0.062	0.961	0.000	0.939
3-4	0.067	0.934	0.000	0.970
4-5	0.067	0.903	0.000	1.019
5-6	0.093	0.957	0.000	1.082
6-7	0.093	1.049	0.000	1.115

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	7.067	8.477	4.6
1-2	11.536	13.330	5.4
2-3	11.717	13.679	5.1
3-4	11.882	13.853	4.8
4-5	12.018	14.007	4.6
5-6	12.112	14.244	4.4
6-7	10.428	12.686	3.8

LEAD MODEL FOR WINDOWS Version 1.1

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Model Version: 1.1 Build11
User Name: Jim LaVelle
Date: 10/15/2010
Site Name: Anaconda Smelter NPL Site
Operable Unit: Community Soils
Run Mode: Site Risk Assessment

Soil/Dust Data
Entered Soil Ingestion Rates for Child EFH Recommendations
Soil/Dust Data
Entered PRG for Uncertainty Analysis -- Impact of Child EFH Recommendations for Soil Ingestion
Soil/Dust Data
Entered Soil Ingestion Rates Recommended by Stanek et a.
Soil/Dust Data
Entered Soil PRG for Uncertainty Analysis -- Imapct of Stanek et al Soil Ingestion Rates
Soil/Dust Data
Soil/Dust Data
Corrected Soil/Dust Intake for 6 to 7 Year Olds
Soil/Dust Data
Revised Soil PRG for Anaconda Scenario 4

==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 834.630 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.430
Outdoor airborne lead to indoor household dust lead concentration: 0.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	1941.000	834.630
1-2	1941.000	834.630
2-3	1941.000	834.630
3-4	1941.000	834.630
4-5	1941.000	834.630
5-6	1941.000	834.630
6-7	1941.000	834.630

****** Alternate Intake ******

Age	Alternate (μg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 μg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.012	0.000	0.358
1-2	0.034	0.863	0.000	0.881
2-3	0.062	0.954	0.000	0.931
3-4	0.067	0.927	0.000	0.964
4-5	0.067	0.913	0.000	1.031
5-6	0.093	0.971	0.000	1.098
6-7	0.093	1.057	0.000	1.124

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	8.233	9.624	5.2
1-2	12.552	14.330	5.9
2-3	12.763	14.711	5.5
3-4	12.957	14.915	5.2
4-5	9.906	11.917	4.3
5-6	9.141	11.303	3.6
6-7	8.756	11.030	3.2

LEAD MODEL FOR WINDOWS Version 1.1

==

Model Version: 1.1 Build11
User Name: Jim LaVelle
Date: 10/15/2010
Site Name: Anaconda Smelter NPL Site
Operable Unit: Community Soils
Run Mode: Site Risk Assessment

\# Soil/Dust Data
Entered Soil Ingestion Rates for Child EFH Recommendations
\# Soil/Dust Data
Entered PRG for Uncertainty Analysis -- Impact of Child EFH Recommendations for Soil Ingestion

==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (μg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 371.200 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	516.000	371.200
1-2	516.000	371.200
2-3	516.000	371.200
3-4	516.000	371.200
4-5	516.000	371.200
5-6	516.000	371.200
6-7	516.000	371.200

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.025	0.000	0.363
1-2	0.034	0.870	0.000	0.888
2-3	0.062	0.961	0.000	0.938
3-4	0.067	0.933	0.000	0.970
4-5	0.067	0.902	0.000	1.018
5-6	0.093	0.956	0.000	1.082
6-7	0.093	1.049	0.000	1.115

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	7.124	8.532	4.6
1-2	11.626	13.419	5.5
2-3	11.809	13.770	5.1
3-4	11.977	13.947	4.9
4-5	12.116	14.103	4.7
5-6	12.210	14.342	4.4
6-7	10.514	12.771	3.8

LEAD MODEL FOR WINDOWS Version 1.1

==

Model Version: 1.1 Build11
User Name: Jim LaVelle
Date: 10/15/2010
Site Name: Anaconda Smelter NPL Site
Operable Unit: Community Soils
Run Mode: Site Risk Assessment

Soil/Dust Data
Entered Soil Ingestion Rates for Child EFH Recommendations
Soil/Dust Data
Entered PRG for Uncertainty Analysis -- Impact of Child EFH Recommendations for Soil Ingestion
Soil/Dust Data
Entered Soil Ingestion Rates Recommended by Stanek et al.
Soil/Dust Data
Entered Soil PRG for Uncertainty Analysis -- Imapct of Stanek et al Soil Ingestion Rates

==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (μg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 1297.300 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	1839.000	1297.300
1-2	1839.000	1297.300
2-3	1839.000	1297.300
3-4	1839.000	1297.300
4-5	1839.000	1297.300
5-6	1839.000	1297.300
6-7	1839.000	1297.300

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.011	0.000	0.358
1-2	0.034	0.863	0.000	0.880
2-3	0.062	0.953	0.000	0.931
3-4	0.067	0.927	0.000	0.963
4-5	0.067	0.913	0.000	1.030
5-6	0.093	0.970	0.000	1.098
6-7	0.093	1.061	0.000	1.128

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	8.275	9.666	5.2
1-2	12.616	14.393	5.9
2-3	12.829	14.776	5.5
3-4	13.025	14.982	5.2
4-5	9.959	11.969	4.3
5-6	9.191	11.352	3.6
6-7	7.954	10.236	3.1

Attachment 2

Anaconda Non-Remediated Yards
RBA = 0.69; MSD = 0.43

CODE	FAM	AREA	AGE	PBS	PbD	PbW	PbAir	ALT	PbB
A-047-B	1	1	50	2136	918.48	4	0.1	.	.
A-252-B	2	2	50	1218	523.74	4	0.1	.	.
A-815-B	3	3	50	1155	496.65	4	0.1	.	.
A-313B	4	4	50	1068	459.24	4	0.1	.	.
A-768B	5	5	50	1045	449.35	4	0.1	.	.
A-531-B	6	6	50	1025	440.75	4	0.1	.	.
A-582-B	7	7	50	971	417.53	4	0.1	.	.
A-626-B	8	8	50	946	406.78	4	0.1	.	.
A-200-B	9	9	50	925	397.75	4	0.1	.	.
A-364-B	10	10	50	881	378.83	4	0.1	.	.
A-1166-B	11	11	50	878	377.54	4	0.1	.	.
A-1298-B	12	12	50	849	365.07	4	0.1	.	.
A-1304-B	13	13	50	817	351.31	4	0.1	.	.
A-1011-B	14	14	50	802	344.86	4	0.1	.	.
A-1375-B	15	15	50	777	334.11	4	0.1	.	.
A-1087-B	16	16	50	771	331.53	4	0.1	.	.
A-1119-B	17	17	50	770	331.1	4	0.1	.	.
A-669-B	18	18	50	765	328.95	4	0.1	.	.
A-385-B	19	19	50	755	324.65	4	0.1	.	.
A-530-B	20	20	50	747	321.21	4	0.1	.	.
A-879-B	21	21	50	745	320.35	4	0.1	.	.
A-1381-B	22	22	50	745	320.35	4	0.1	.	.
A-343-B	23	23	50	734	315.62	4	0.1	.	.
A-756-B	24	24	50	733	315.19	4	0.1	.	.
A-1187-B	25	25	50	719	309.17	4	0.1	.	.
A-1401-B	26	26	50	688	295.84	4	0.1	.	.
A-1047-B	27	27	50	682	293.26	4	0.1	.	.
A-334-B	28	28	50	656	282.08	4	0.1	.	.
A-258-B	29	29	50	654	281.22	4	0.1	.	.
A-311B	30	30	50	653	280.79	4	0.1	.	.
A-410-B	31	31	50	647	278.21	4	0.1	.	.
A-001-B	32	32	50	645	277.35	4	0.1	.	.
A-719-B	33	33	50	643	276.49	4	0.1	.	.
A-535-B	34	34	50	643	276.49	4	0.1	.	.
A-1010-B	35	35	50	642	276.06	4	0.1	.	.
A-1296-B	36	36	50	637	273.91	4	0.1	.	.
A-140B	37	37	50	633	272.19	4	0.1	.	.
A-698-B	38	38	50	630	270.9	4	0.1	.	.
A-752-B	39	39	50	625	268.75	4	0.1	.	.
A-217-B	40	40	50	624	268.32	4	0.1	.	.
A-860-B	41	41	50	623	267.89	4	0.1	.	.
A-664-B	42	42	50	619	266.17	4	0.1	.	.
A-757-B	43	43	50	616	264.88	4	0.1	.	.
A-799B	44	44	50	605	260.15	4	0.1	.	.
A-788B	45	45	50	594	255.42	4	0.1	.	.
A-1092-B	46	46	50	588	252.84	4	0.1	.	.
A-1283-B	47	47	50	587	252.41	4	0.1	.	.
A-1204-B	48	48	50	579	248.97	4	0.1	.	.
A-728B	49	49	50	579	248.97	4	0.1	.	.
A-615-B	50	50	50	576	247.68	4	0.1	.	.
A-666-B	51	51	50	570	245.1	4	0.1	.	.
A-619-B	52	52	50	566	243.38	4	0.1	.	.
A-335-B	53	53	50	565	242.95	4	0.1	.	.
A-765B	54	54	50	561	241.23	4	0.1	.	.
A-1013-B	55	55	50	561	241.23	4	0.1	.	.
A-078B	56	56	50	558	239.94	4	0.1	.	.
A-613-B	57	57	50	554	238.22	4	0.1	.	.
A-169-B	58	58	50	551	236.93	4	0.1	.	.
A-849-B	59	59	50	547	235.21	4	0.1	.	.
A-1248-B	60	60	50	546	234.78	4	0.1	.	.

A-1356-B	61	61	50	539	231.77	4	0.1	.	.
A-552-B	62	62	50	537	230.91	4	0.1	.	.
A-1096-B	63	63	50	527	226.61	4	0.1	.	.
A-1058-B	64	64	50	526	226.18	4	0.1	.	.
A-543-B	65	65	50	517	222.31	4	0.1	.	.
A-415-B	66	66	50	517	222.31	4	0.1	.	.
A-915-B	67	67	50	514	221.02	4	0.1	.	.
A-1104-B	68	68	50	510	219.3	4	0.1	.	.
A-408-B	69	69	50	510	219.3	4	0.1	.	.
A-071B	70	70	50	509	218.87	4	0.1	.	.
A-1261-B	71	71	50	505	217.15	4	0.1	.	.
A-036-B	72	72	50	504	216.72	4	0.1	.	.
A-1367-B	73	73	50	503	216.29	4	0.1	.	.
A-318-B	74	74	50	501	215.43	4	0.1	.	.
A-1136-B	75	75	50	500	215	4	0.1	.	.
A-1332-B	76	76	50	496	213.28	4	0.1	.	.
A-907-B	77	77	50	489	210.27	4	0.1	.	.
A-416-B	78	78	50	485	208.55	4	0.1	.	.
A-288-B	79	79	50	478	205.54	4	0.1	.	.
A-091-B	80	80	50	470	202.1	4	0.1	.	.
A-547-B	81	81	50	469	201.67	4	0.1	.	.
A-796-B	82	82	50	466	200.38	4	0.1	.	.
A-168-B	83	83	50	459	197.37	4	0.1	.	.
A-544-B	84	84	50	448	192.64	4	0.1	.	.
A-592-B	85	85	50	448	192.64	4	0.1	.	.
A-223-B	86	86	50	445	191.35	4	0.1	.	.
A-167-B	87	87	50	442	190.06	4	0.1	.	.
A-1009-B	88	88	50	437	187.91	4	0.1	.	.
A-432-B	89	89	50	429	184.47	4	0.1	.	.
A-441-B	90	90	50	415	178.45	4	0.1	.	.
A-731B	91	91	50	415	178.45	4	0.1	.	.
A-683B	92	92	50	415	178.45	4	0.1	.	.
A-1370-B	93	93	50	414	178.02	4	0.1	.	.
A-1271-B	94	94	50	401	172.43	4	0.1	.	.
A-362-B	95	95	50	399	171.57	4	0.1	.	.
A-606-B	96	96	50	390	167.7	4	0.1	.	.
A-1012-B	97	97	50	386	165.98	4	0.1	.	.
A-1158-B	98	98	50	386	165.98	4	0.1	.	.
A-1222-F	99	99	50	382	164.26	4	0.1	.	.
A-624-B	100	100	50	369	158.67	4	0.1	.	.
A-759-B	101	101	50	368	158.24	4	0.1	.	.
A-061B	102	102	50	367	157.81	4	0.1	.	.
A-916-B	103	103	50	358	153.94	4	0.1	.	.
A-303B	104	104	50	358	153.94	4	0.1	.	.
A-1393-B	105	105	50	347	149.21	4	0.1	.	.
A-309BV	106	106	50	343	147.49	4	0.1	.	.
A-309BV	107	107	50	343	147.49	4	0.1	.	.
A-597-B	108	108	50	338	145.34	4	0.1	.	.
A-908-B	109	109	50	335	144.05	4	0.1	.	.
A-260-B	110	110	50	332	142.76	4	0.1	.	.
A-1043-B	111	111	50	319	137.17	4	0.1	.	.
A-1095-B	112	112	50	315	135.45	4	0.1	.	.
A-060-B	113	113	50	310	133.3	4	0.1	.	.
A-384-B	114	114	50	298	128.14	4	0.1	.	.
A-1135-B	115	115	50	290	124.7	4	0.1	.	.
A-638-B	116	116	50	285	122.55	4	0.1	.	.
A-1052-B	117	117	50	271	116.53	4	0.1	.	.
A-1229-B	118	118	50	270	116.1	4	0.1	.	.
A-784B	119	119	50	268	115.24	4	0.1	.	.
A-081-BV	120	120	50	268	115.24	4	0.1	.	.
A-308-B	121	121	50	261	112.23	4	0.1	.	.
A-305-B	122	122	50	260	111.8	4	0.1	.	.
A-1068-B	123	123	50	242	104.06	4	0.1	.	.

A-652-B	124	124	50	236	101.48	4	0.1	.	.
A-665-B	125	125	50	233	100.19	4	0.1	.	.
A-696-B	126	126	50	220	94.6	4	0.1	.	.
A-1340-E	127	127	50	220	94.6	4	0.1	.	.
A-1334-B	128	128	50	216	92.88	4	0.1	.	.
A-913-B	129	129	50	206	88.58	4	0.1	.	.
A-122B	130	130	50	203	87.29	4	0.1	.	.
A-175-BV	131	131	50	197	84.71	4	0.1	.	.
A-1094-B	132	132	50	176	75.68	4	0.1	.	.
A-115B	133	133	50	170	73.1	4	0.1	.	.
A-1181-B	134	134	50	149	64.07	4	0.1	.	.
A-232B	135	135	50	140	60.2	4	0.1	.	.
A-803-B	136	136	50	136	58.48	4	0.1	.	.
A-1385-B	137	137	50	126	54.18	4	0.1	.	.
A-1349-B	138	138	50	99	42.57	4	0.1	.	.
A-1403-B	139	139	50	96	41.28	4	0.1	.	.
A-1389-B	140	140	50	85	36.55	4	0.1	.	.
A-511-F	141	141	50	40	17.2	4	0.1	.	.
A-507-F	142	142	50	26	11.18	4	0.1	.	.
R-145	143	143	50	202	86.86	4	0.1	.	.
R-149	144	144	50	294.7	126.721	4	0.1	.	.
R-150	145	145	50	260	111.8	4	0.1	.	.
R-153	146	146	50	362.3	155.789	4	0.1	.	.
R-156	147	147	50	520.7	223.901	4	0.1	.	.
R-812	148	148	50	179.5	77.185	4	0.1	.	.
R-206	149	149	50	74.7	32.121	4	0.1	.	.
R-196	150	150	50	107.4	46.182	4	0.1	.	.
R-137	151	151	50	94.9	40.807	4	0.1	.	.
R-138	152	152	50	84.4	36.292	4	0.1	.	.
R-139	153	153	50	66.7	28.681	4	0.1	.	.
R-142	154	154	50	96.3	41.409	4	0.1	.	.
R-132	155	155	50	97.3	41.839	4	0.1	.	.
R-133	156	156	50	94.3	40.549	4	0.1	.	.
R-134	157	157	50	123.1	52.933	4	0.1	.	.
R-135	158	158	50	153.5	66.005	4	0.1	.	.
R-118	159	159	50	146.1	62.823	4	0.1	.	.
R-121	160	160	50	71.8	30.874	4	0.1	.	.
R-119	161	161	50	111	47.73	4	0.1	.	.
R-120	162	162	50	195.7	84.151	4	0.1	.	.
R-123	163	163	50	178.6	76.798	4	0.1	.	.
R-122	164	164	50	88	37.84	4	0.1	.	.
R-125	165	165	50	160.8	69.144	4	0.1	.	.
R-126	166	166	50	168.6	72.498	4	0.1	.	.
R-124	167	167	50	158.2	68.026	4	0.1	.	.
R-128	168	168	50	233.4	100.362	4	0.1	.	.
R-113	169	169	50	146.9	63.167	4	0.1	.	.
R-114	170	170	50	186.9	80.367	4	0.1	.	.
R-116	171	171	50	187	80.41	4	0.1	.	.
R-117	172	172	50	120.5	51.815	4	0.1	.	.
R-161	173	173	50	331.3	142.459	4	0.1	.	.
R-112	174	174	50	204.7	88.021	4	0.1	.	.

LEAD BATCH MODE OUTPUT FILE

Model Version: 1.1 Build11

User Name: LaVelle
Date: 11/8/2010
Site Name: Anaconda Smelter NPL Site
Operable Unit: NA
Run Mode: Screening

*** : signify default values used in place of missing input data.**
 # : signify surrogate values entered (determined) by user.
---: signify missing input data.
PBB & PRED are the observed and predicted blood Pb levels in ug/dL.

Note: Sample IDs that start with A represent yards in Anaconda; Sample IDs that start with R represent yards in Opportunity/Crackerville
Note: FAM and BLK are "dummy" variables and do not identify specifc homes or areas in the Anconda area

Percent exceedance was calculated using values of GSD and PbB Cutoff as follows:
GSD = 1.6
PbB Cutoff (C) = 10 ug/dL

Input File: BatchPb.dat

Sample (Yard) ID	FAM	BLK	AGE (mon)	SOIL (ug/g)	DUST (ug/g)	WATER (ug/L)	AIR (ug/m^3)	Other (ug/day)	PBB (ug/dL)	PRED (ug/dL)	P(PbB>C) (%)
A-047-B	1	1	50	2136	918.5	4	0.1	0.000*	---	15.61	82.845
A-252-B	2	2	50	1218	523.7	4	0.1	0.000*	---	10.3	52.534
A-815-B	3	3	50	1155	496.6	4	0.1	0.000*	---	9.89	49.074
A-313B	4	4	50	1068	459.2	4	0.1	0.000*	---	9.31	43.964
A-768B	5	5	50	1045	449.4	4	0.1	0.000*	---	9.16	42.552
A-531-B	6	6	50	1025	440.8	4	0.1	0.000*	---	9.02	41.304
A-582-B	7	7	50	971	417.5	4	0.1	0.000*	---	8.65	37.851
A-626-B	8	8	50	946	406.8	4	0.1	0.000*	---	8.47	36.215
A-200-B	9	9	50	925	397.8	4	0.1	0.000*	---	8.32	34.825
A-364-B	10	10	50	881	378.8	4	0.1	0.000*	---	8.01	31.872
A-1166-B	11	11	50	878	377.5	4	0.1	0.000*	---	7.99	31.669
A-1298-B	12	12	50	849	365.1	4	0.1	0.000*	---	7.78	29.699
A-1304-B	13	13	50	817	351.3	4	0.1	0.000*	---	7.55	27.514
A-1011-B	14	14	50	802	344.9	4	0.1	0.000*	---	7.44	26.488
A-1375-B	15	15	50	777	334.1	4	0.1	0.000*	---	7.26	24.78
A-1087-B	16	16	50	771	331.5	4	0.1	0.000*	---	7.22	24.37
A-1119-B	17	17	50	770	331.1	4	0.1	0.000*	---	7.21	24.302
A-669-B	18	18	50	765	329	4	0.1	0.000*	---	7.17	23.962
A-385-B	19	19	50	755	324.6	4	0.1	0.000*	---	7.1	23.281
A-530-B	20	20	50	747	321.2	4	0.1	0.000*	---	7.04	22.738
A-879-B	21	21	50	745	320.4	4	0.1	0.000*	---	7.02	22.603
A-1381-B	22	22	50	745	320.4	4	0.1	0.000*	---	7.02	22.603
A-343-B	23	23	50	734	315.6	4	0.1	0.000*	---	6.94	21.859
A-756-B	24	24	50	733	315.2	4	0.1	0.000*	---	6.93	21.792
A-1187-B	25	25	50	719	309.2	4	0.1	0.000*	---	6.83	20.85
A-1401-B	26	26	50	688	295.8	4	0.1	0.000*	---	6.6	18.79
A-1047-B	27	27	50	682	293.3	4	0.1	0.000*	---	6.55	18.396
A-334-B	28	28	50	656	282.1	4	0.1	0.000*	---	6.35	16.709
A-258-B	29	29	50	654	281.2	4	0.1	0.000*	---	6.34	16.581

All Yards

Blood Lead Concentration	P(PbB>10)
1	55
3	19
5	12
7	9
9	15
11	11
13	9
15	6
17	11
19	2
21	1
23	5
25	5
>25	14
Total	**174**
Total >10	**88**
% > 10	**51%**

Anaconda Yards

Blood Lead Concentration	P(PbB>10)
1	27
3	16
5	12
7	9
9	14
11	11
13	9
15	6

Soil Pb Concentrations

Min	Mean	Max	Count
26	451	2136	174

Percent Rank 449
51%

A-311B	30	30	50	653	280.8	4	0.1	0.000*	---	6.33	16.517
A-410-B	31	31	50	647	278.2	4	0.1	0.000*	---	6.28	16.135
A-001-B	32	32	50	645	277.4	4	0.1	0.000*	---	6.27	16.008
A-719-B	33	33	50	643	276.5	4	0.1	0.000*	---	6.25	15.881
A-535-B	34	34	50	643	276.5	4	0.1	0.000*	---	6.25	15.881
A-1010-B	35	35	50	642	276.1	4	0.1	0.000*	---	6.24	15.818
A-1296-B	36	36	50	637	273.9	4	0.1	0.000*	---	6.21	15.503
A-140B	37	37	50	633	272.2	4	0.1	0.000*	---	6.17	15.252
A-698-B	38	38	50	630	270.9	4	0.1	0.000*	---	6.15	15.064
A-752-B	39	39	50	625	268.8	4	0.1	0.000*	---	6.11	14.753
A-217-B	40	40	50	624	268.3	4	0.1	0.000*	---	6.11	14.691
A-860-B	41	41	50	623	267.9	4	0.1	0.000*	---	6.1	14.63
A-664-B	42	42	50	619	266.2	4	0.1	0.000*	---	6.07	14.383
A-757-B	43	43	50	616	264.9	4	0.1	0.000*	---	6.04	14.199
A-799B	44	44	50	605	260.1	4	0.1	0.000*	---	5.96	13.529
A-788B	45	45	50	594	255.4	4	0.1	0.000*	---	5.87	12.871
A-1092-B	46	46	50	588	252.8	4	0.1	0.000*	---	5.83	12.516
A-1283-B	47	47	50	587	252.4	4	0.1	0.000*	---	5.82	12.457
A-1204-B	48	48	50	579	249	4	0.1	0.000*	---	5.76	11.991
A-728B	49	49	50	579	249	4	0.1	0.000*	---	5.76	11.991
A-615-B	50	50	50	576	247.7	4	0.1	0.000*	---	5.73	11.817
A-666-B	51	51	50	570	245.1	4	0.1	0.000*	---	5.68	11.473
A-619-B	52	52	50	566	243.4	4	0.1	0.000*	---	5.65	11.246
A-335-B	53	53	50	565	242.9	4	0.1	0.000*	---	5.65	11.189
A-765B	54	54	50	561	241.2	4	0.1	0.000*	---	5.61	10.964
A-1013-B	55	55	50	561	241.2	4	0.1	0.000*	---	5.61	10.964
A-078B	56	56	50	558	239.9	4	0.1	0.000*	---	5.59	10.796
A-613-B	57	57	50	554	238.2	4	0.1	0.000*	---	5.56	10.574
A-169-B	58	58	50	551	236.9	4	0.1	0.000*	---	5.53	10.409
A-849-B	59	59	50	547	235.2	4	0.1	0.000*	---	5.5	10.19
A-1248-B	60	60	50	546	234.8	4	0.1	0.000*	---	5.5	10.135
A-1356-B	61	61	50	539	231.8	4	0.1	0.000*	---	5.44	9.757
A-552-B	62	62	50	537	230.9	4	0.1	0.000*	---	5.42	9.65
A-1096-B	63	63	50	527	226.6	4	0.1	0.000*	---	5.34	9.123
A-1058-B	64	64	50	526	226.2	4	0.1	0.000*	---	5.34	9.071
A-543-B	65	65	50	517	222.3	4	0.1	0.000*	---	5.26	8.609
A-415-B	66	66	50	517	222.3	4	0.1	0.000*	---	5.26	8.609
A-915-B	67	67	50	514	221	4	0.1	0.000*	---	5.24	8.457
A-1104-B	68	68	50	510	219.3	4	0.1	0.000*	---	5.21	8.256
A-408-B	69	69	50	510	219.3	4	0.1	0.000*	---	5.21	8.256
A-071B	70	70	50	509	218.9	4	0.1	0.000*	---	5.2	8.206
A-1261-B	71	71	50	505	217.1	4	0.1	0.000*	---	5.17	8.008
A-036-B	72	72	50	504	216.7	4	0.1	0.000*	---	5.16	7.959
A-1367-B	73	73	50	503	216.3	4	0.1	0.000*	---	5.15	7.91
A-318-B	74	74	50	501	215.4	4	0.1	0.000*	---	5.14	7.813
A-1136-B	75	75	50	500	215	4	0.1	0.000*	---	5.13	7.764
A-1332-B	76	76	50	496	213.3	4	0.1	0.000*	---	5.1	7.571
A-907-B	77	77	50	489	210.3	4	0.1	0.000*	---	5.04	7.238
A-416-B	78	78	50	485	208.6	4	0.1	0.000*	---	5.01	7.052
A-288-B	79	79	50	478	205.5	4	0.1	0.000*	---	4.95	6.73
A-091-B	80	80	50	470	202.1	4	0.1	0.000*	---	4.88	6.372
A-547-B	81	81	50	469	201.7	4	0.1	0.000*	---	4.88	6.328
A-796-B	82	82	50	466	200.4	4	0.1	0.000*	---	4.85	6.196
A-168-B	83	83	50	459	197.4	4	0.1	0.000*	---	4.8	5.894
A-544-B	84	84	50	448	192.6	4	0.1	0.000*	---	4.71	5.436

17	11
19	2
21	1
23	5
25	5
>25	14
Total	**142**
Total >10	**87**
% > 10	**61%**

A-592-B	85	85	50	448	192.6	4	0.1	0.000*	---	4.71	5.436
A-223-B	86	86	50	445	191.4	4	0.1	0.000*	---	4.68	5.314
A-167-B	87	87	50	442	190.1	4	0.1	0.000*	---	4.66	5.194
A-1009-B	88	88	50	437	187.9	4	0.1	0.000*	---	4.62	4.996
A-432-B	89	89	50	429	184.5	4	0.1	0.000*	---	4.55	4.689
A-441-B	90	90	50	415	178.4	4	0.1	0.000*	---	4.43	4.176
A-731B	91	91	50	415	178.4	4	0.1	0.000*	---	4.43	4.176
A-683B	92	92	50	415	178.4	4	0.1	0.000*	---	4.43	4.176
A-1370-B	93	93	50	414	178	4	0.1	0.000*	---	4.43	4.141
A-1271-B	94	94	50	401	172.4	4	0.1	0.000*	---	4.32	3.696
A-362-B	95	95	50	399	171.6	4	0.1	0.000*	---	4.3	3.63
A-606-B	96	96	50	390	167.7	4	0.1	0.000*	---	4.23	3.341
A-1012-B	97	97	50	386	166	4	0.1	0.000*	---	4.19	3.217
A-1158-B	98	98	50	386	166	4	0.1	0.000*	---	4.19	3.217
A-1222-F	99	99	50	382	164.3	4	0.1	0.000*	---	4.16	3.096
A-624-B	100	100	50	369	158.7	4	0.1	0.000*	---	4.05	2.721
A-759-B	101	101	50	368	158.2	4	0.1	0.000*	---	4.04	2.693
A-061B	102	102	50	367	157.8	4	0.1	0.000*	---	4.03	2.666
A-916-B	103	103	50	358	153.9	4	0.1	0.000*	---	3.96	2.426
A-303B	104	104	50	358	153.9	4	0.1	0.000*	---	3.96	2.426
A-1393-B	105	105	50	347	149.2	4	0.1	0.000*	---	3.86	2.151
A-309BV	106	106	50	343	147.5	4	0.1	0.000*	---	3.83	2.056
A-309BV	107	107	50	343	147.5	4	0.1	0.000*	---	3.83	2.056
A-597-B	108	108	50	338	145.3	4	0.1	0.000*	---	3.79	1.941
A-908-B	109	109	50	335	144.1	4	0.1	0.000*	---	3.76	1.874
A-260-B	110	110	50	332	142.8	4	0.1	0.000*	---	3.74	1.809
A-1043-B	111	111	50	319	137.2	4	0.1	0.000*	---	3.62	1.542
A-1095-B	112	112	50	315	135.4	4	0.1	0.000*	---	3.59	1.465
A-060-B	113	113	50	310	133.3	4	0.1	0.000*	---	3.55	1.373
A-384-B	114	114	50	298	128.1	4	0.1	0.000*	---	3.44	1.167
A-1135-B	115	115	50	290	124.7	4	0.1	0.000*	---	3.37	1.041
A-638-B	116	116	50	285	122.6	4	0.1	0.000*	---	3.33	0.968
A-1052-B	117	117	50	271	116.5	4	0.1	0.000*	---	3.21	0.781
A-1229-B	118	118	50	270	116.1	4	0.1	0.000*	---	3.2	0.769
A-784B	119	119	50	268	115.2	4	0.1	0.000*	---	3.18	0.744
A-081-BV	120	120	50	268	115.2	4	0.1	0.000*	---	3.18	0.744
A-308-B	121	121	50	261	112.2	4	0.1	0.000*	---	3.12	0.664
A-305-B	122	122	50	260	111.8	4	0.1	0.000*	---	3.11	0.652
A-1068-B	123	123	50	242	104.1	4	0.1	0.000*	---	2.96	0.475
A-652-B	124	124	50	236	101.5	4	0.1	0.000*	---	2.9	0.425
A-665-B	125	125	50	233	100.2	4	0.1	0.000*	---	2.88	0.401
A-696-B	126	126	50	220	94.6	4	0.1	0.000*	---	2.76	0.309
A-1340-E	127	127	50	220	94.6	4	0.1	0.000*	---	2.76	0.309
A-1334-B	128	128	50	216	92.9	4	0.1	0.000*	---	2.73	0.284
A-913-B	129	129	50	206	88.6	4	0.1	0.000*	---	2.64	0.228
A-122B	130	130	50	203	87.3	4	0.1	0.000*	---	2.61	0.213
A-175-BV	131	131	50	197	84.7	4	0.1	0.000*	---	2.56	0.185
A-1094-B	132	132	50	176	75.7	4	0.1	0.000*	---	2.37	0.109
A-115B	133	133	50	170	73.1	4	0.1	0.000*	---	2.31	0.092
A-1181-B	134	134	50	149	64.1	4	0.1	0.000*	---	2.12	0.049
A-232B	135	135	50	140	60.2	4	0.1	0.000*	---	2.04	0.036
A-803-B	136	136	50	136	58.5	4	0.1	0.000*	---	2	0.031
A-1385-B	137	137	50	126	54.2	4	0.1	0.000*	---	1.91	0.022
A-1349-B	138	138	50	99	42.6	4	0.1	0.000*	---	1.66	0.007
A-1403-B	139	139	50	96	41.3	4	0.1	0.000*	---	1.63	0.006

A-1389-B	140	140	50	85	36.5	4	0.1	0.000*	---	1.53	0.003
A-511-F	141	141	50	40	17.2	4	0.1	0.000*	---	1.11	0
A-507-F	142	142	50	26	11.2	4	0.1	0.000*	---	0.97	0
R-145	143	143	50	202	86.9	4	0.1	0.000*	---	2.6	0.208
R-149	144	144	50	294.7	126.7	4	0.1	0.000*	---	3.42	1.114
R-150	145	145	50	260	111.8	4	0.1	0.000*	---	3.11	0.652
R-153	146	146	50	362.3	155.8	4	0.1	0.000*	---	3.99	2.539
R-156	147	147	50	520.7	223.9	4	0.1	0.000*	---	5.29	8.798
R-812	148	148	50	179.5	77.2	4	0.1	0.000*	---	2.4	0.119
R-206	149	149	50	74.7	32.1	4	0.1	0.000*	---	1.44	0.002
R-196	150	150	50	107.4	46.2	4	0.1	0.000*	---	1.74	0.01
R-137	151	151	50	94.9	40.8	4	0.1	0.000*	---	1.62	0.006
R-138	152	152	50	84.4	36.3	4	0.1	0.000*	---	1.53	0.003
R-139	153	153	50	66.7	28.7	4	0.1	0.000*	---	1.36	0.001
R-142	154	154	50	96.3	41.4	4	0.1	0.000*	---	1.64	0.006
R-132	155	155	50	97.3	41.8	4	0.1	0.000*	---	1.65	0.006
R-133	156	156	50	94.3	40.5	4	0.1	0.000*	---	1.62	0.005
R-134	157	157	50	123.1	52.9	4	0.1	0.000*	---	1.89	0.019
R-135	158	158	50	153.5	66	4	0.1	0.000*	---	2.16	0.056
R-118	159	159	50	146.1	62.8	4	0.1	0.000*	---	2.1	0.044
R-121	160	160	50	71.8	30.9	4	0.1	0.000*	---	1.41	0.002
R-119	161	161	50	111	47.7	4	0.1	0.000*	---	1.77	0.012
R-120	162	162	50	195.7	84.2	4	0.1	0.000*	---	2.54	0.18
R-123	163	163	50	178.6	76.8	4	0.1	0.000*	---	2.39	0.117
R-122	164	164	50	88	37.8	4	0.1	0.000*	---	1.56	0.004
R-125	165	165	50	160.8	69.1	4	0.1	0.000*	---	2.23	0.07
R-126	166	166	50	168.6	72.5	4	0.1	0.000*	---	2.3	0.088
R-124	167	167	50	158.2	68	4	0.1	0.000*	---	2.21	0.065
R-128	168	168	50	233.4	100.4	4	0.1	0.000*	---	2.88	0.404
R-113	169	169	50	146.9	63.2	4	0.1	0.000*	---	2.1	0.045
R-114	170	170	50	186.9	80.4	4	0.1	0.000*	---	2.47	0.145
R-116	171	171	50	187	80.4	4	0.1	0.000*	---	2.47	0.145
R-117	172	172	50	120.5	51.8	4	0.1	0.000*	---	1.86	0.017
R-161	173	173	50	331.3	142.5	4	0.1	0.000*	---	3.73	1.794
R-112	174	174	50	204.7	88	4	0.1	0.000*	---	2.62	0.222

Appendix B
Detailed Alternatives Cost Estimates

TABLE B-1: COMMUNITY SOILS OPERABLE UNIT
FOCUSED FEASIBILITY STUDY REMEDIAL ACTION ALTERNATIVE NO. 2 COST ESTIMATE
LEAD AWA ACTION LEVEL = 400 mg/kg (with 1,200 mg/kg Individual Component NTE Value)
MAXIMUM REMOVAL DEPTH = 12 inches

Activity	Quantity	Units	Unit Cost	Total Cost	Comment
Sampling / Data Management					
Sample Yards in **Anaconda (Focus Area)** to depth of 12 inches for lead analyses.	1,300	Yards	$800.00	$1,040,000.00	Number of residential yards within Focus Area based on counting lots East of Main Street in Anaconda.
Develop Individual Site Work Plans (ISWPs) for previously sampled residential yards subject to Remedial Action for soil AWA lead (>400 mg/kg).	563	Yards	$200.00	$112,600.00	Assumes 2.5 hours/ISWP @ $80.00/hour.
Sample Residences in Anaconda (Focus Area) for interior and accessible attic dust for arsenic and lead.	1170	Residences	$400.00	$468,000.00	Assumes 90% of the lots East of Main Street in Anaconda have residences constructed on them.
Develop Individual Site Work Plans (ISWPs) for residences subject to Remedial Action for dustarsenic (>250 mg/kg) and lead (>400 mg/kg).	59	Residences	$200.00	$11,700.00	Assumes 5% of residences will require interior dust remedial action. Assumes 2.5 hours/ISWP @ $80.00/hour.
SUBTOTAL - SAMPLING / DATA MANAGEMENT				$1,632,300.00	
Remedial Action					
Remediate residential soils for lead (>400 mg/kg AWA lead) within **Anaconda (Focus Area)** at 0 - 2 inch depth interval.	1417	Yard Components	$1,125.00	$1,594,125.00	Assumes an average yard component size of 530 SF, and unit cost of $2.12/SF (Extrapolated from AR costs for 6-inch and 12 inch cleanup)
Remediate residential soils for lead (>1,200 mg/kg NTE lead) within **Anaconda (Focus Area)** at 0 - 6 inch depth interval.	151	Yard Components	$1,325.00	$200,075.00	Assumes an average yard component size of 530 SF, and unit cost of $2.50/SF (AR cost estimate)
Remediate residential soils for lead (>1,200 mg/kg NTE lead) within **Anaconda (Focus Area)** at 0 - 12 inch depth interval.	75	Yard Components	$1,625.00	$121,875.00	Assumes an average yard component size of 530 SF, and unit cost of $3.07/SF (AR cost estimate)
Interior Dust Remediation	20	Res	$1,000.00	$19,500.00	
Attic Dust Remediation	39	Res	$4,000.00	$156,000.00	
SUBTOTAL - REMEDIAL ACTION				$2,091,575.00	
ENGINEERING / OVERSIGHT				$313,736.25	Assumes 15% of Construction Cost.
Blood Lead and Arsenic Urinalysis Monitoring					
Monitor Children for blood-lead levels	1	Lump Sum	$329,980.00	$329,980.00	5 year biomonitoring program. Assumes comprehensive PbB and ZPP analysis in venous blood for all children < 7 yrs for Years 1 and 5. Pb/ZPP analysis in capillary blood for all children < 24 months and new resident children < 7 yrs during program Years 2, 3, and 4. Costs assume collaboration with local health dept/hospital staff for collection of samples, managing database, and education & outreach activities. Also includes data anlaysis and reporting after program Year 1 and 5 and home lead assessments for children with PbB > 10 ug/dL. See attached worksheet for backup.
Multi-Pathway Program / Institutional Controls Annual Long Term Costs					
Sample Interior and Attic Dust	5	Res	$400.00	$2,000.00	Assumes 20 residences per year would be sampled for interior/attic dust.
Attic Dust Remediation	1	Res	$4,000.00	$4,000.00	Assumes four residences per year would be identified as requiring attic dust remediation.
Engineering / Oversight Support (for RA and Reporting)	1	Lump Sum	$1,800.00	$1,800.00	Assumes 30% of RA construction cost.
Estimated Annual Cost				$7,800.00	
Present Worth Value of Annual Cost (0.01 Discount Rate, 50 Years)				$305,729.58	
TOTAL ESTIMATED COST				**$4,673,320.83**	

TABLE B-2: COMMUNITY SOILS OPERABLE UNIT
FOCUSED FEASIBILITY STUDY REMEDIAL ACTION ALTERNATIVE NO. 2 COST ESTIMATE
LEAD ACTION LEVEL = 500 mg/kg (with 1,200 mg/kg Individual Component NTE Value)
MAXIMUM REMOVAL DEPTH = 12 inches

Activity	Quantity	Units	Unit Cost	Total Cost	Comment
Sampling / Data Management					
Sample Yards in **Anaconda (Focus Area)** to depth of 12 inches for lead analyses.	1,300	Yards	$800.00	$1,040,000.00	Number of residential yards within Focus Area based on counting lots East of Main Street in Anaconda.
Develop Individual Site Work Plans (ISWPs) for previously sampled residential yards subject to Remedial Action for soil lead (≥700 mg/kg).	447	Yards	$200.00	$89,400.00	Assumes 2.5 components per yard subject to RA. Assumes 2.5 hours/ISWP @ $80.00/hour. Assume 25% of the components require remediation to 12 inches.
Sample Residences in Anaconda (Focus Area) for interior and accessible attic dust for arsenic and lead.	1170	Residences	$400.00	$468,000.00	Assumes 90% of the lots East of Main Street in Anaconda have residences constructed on them.
Develop Individual Site Work Plans (ISWPs) for residences subject to Remedial Action for dust arsenic (>250 mg/kg) and lead (≥500 mg/kg).	47	Residences	$200.00	$9,360.00	Assumes 4% of residences will require interior dust remedial action. Assumes 2.5 hours/ISWP @ $80.00/hour.
SUBTOTAL - SAMPLING / DATA MANAGEMENT				$1,606,760.00	
Remedial Action					
Remediate residential soils for lead (≥500 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 2 inch depth interval.	935	Yard Components	$1,200.00	$1,122,000.00	Assumes an average yard component size of 530 SF, and unit cost of $2.12/SF (Extrapolated from AR costs for 6-inch and 12 inch cleanup)
Remediate residential soils for lead (≥1,200 mg/kg NTE lead) within **Anaconda (Focus Area)** at 0 - 6 inch depth interval.	151	Yard Components	$1,325.00	$200,075.00	Assumes an average yard component size of 530 SF, and unit cost of $2.50/SF (AR cost estimate)
Remediate residential soils for lead (≥1,200 mg/kg NTE lead) within **Anaconda (Focus Area)** at 0 - 12 inch depth interval.	75	Yard Components	$1,625.00	$121,875.00	Assumes an average yard component size of 530 SF, and unit cost of $3.07/SF (AR cost estimate)
Interior Dust Remediation	15	Res	$1,000.00	$14,800.00	
Attic Dust Remediation	32	Res	$4,000.00	$128,000.00	
SUBTOTAL - REMEDIAL ACTION				$1,586,750.00	
ENGINEERING / OVERSIGHT				$238,012.50	Assumes 15% of Construction Cost.
Blood Lead and Arsenic Urinalysis Monitoring					
Monitor Children for blood-lead levels	1	Lump Sum	$329,980.00	$329,980.00	5 year biomonitoring program. Assumes comprehensive PbB and ZPP analysis in venous blood for all children < 7 yrs for Years 1 and 5. Pb/ZPP analysis in capillary blood for all children < 24 months and new resident children < 7 yrs during program Years 2, 3, and 4. Costs assume collaboration with local health dept/hospital staff for collection of samples, managing database, and education & outreach activities. Also includes data anlaysis and reporting after program Year 1 and 5 and home lead assessments for children with PbB > 10 ug/dL. See attached worksheet for backup.
Multi-Pathway Program / Institutional Controls Annual Long Term Costs					
Sample Interior and Attic Dust	5	Res	$400.00	$2,000.00	Assumes 20 residences per year would be sampled for interior/attic dust.
Attic Dust Remediation	1	Res	$4,000.00	$4,000.00	Assumes four residences per year would be identified as requiring attic dust remediation.
Engineering / Oversight Support (for RA and Reporting)	1	Lump Sum	$1,800.00	$1,800.00	Assumes 30% of RA construction cost.
Estimated Annual Cost				$7,800.00	
Present Worth Value of Annual Cost (0.01 Discount Rate, 50 Years)				$305,729.58	
TOTAL ESTIMATED COST				**$4,067,232.08**	

TABLE B-3: COMMUNITY SOILS OPERABLE UNIT
FOCUSED FEASIBILITY STUDY REMEDIAL ACTION ALTERNATIVE NO. 2 COST ESTIMATE
LEAD ACTION LEVEL = 700 mg/kg (with 1,200 mg/kg Individual Component NTE Value)
MAXIMUM REMOVAL DEPTH = 12 inches

Activity	Quantity	Units	Unit Cost	Total Cost	Comment
Sampling / Data Management					
Sample Yards in **Anaconda (Focus Area)** to depth of 12 inches for lead analyses.	1,300	Yards	$800.00	$1,040,000.00	Number of residential yards within Focus Area based on counting lots East of Main Street in Anaconda.
Develop Individual Site Work Plans (ISWPs) for previously sampled residential yards subject to Remedial Action for soil lead (>700 mg/kg).	175	Yards	$200.00	$35,000.00	Assumes 2.5 components per yard subject to RA. Assumes 2.5 hours/ISWP @ $80.00/hour.
Sample Residences in Anaconda (Focus Area) for interior and accessible attic dust for arsenic and lead.	1170	Residences	$400.00	$468,000.00	Assumes 90% of the lots East of Main Street in Anaconda have residences constructed on them.
Develop Individual Site Work Plans (ISWPs) for residences subject to Remedial Action for dust arsenic (>250 mg/kg) and lead (>700 mg/kg).	35	Residences	$200.00	$7,020.00	Assumes 3% of residences will require interior dust remedial action. Assumes 2.5 hours/ISWP @ $80.00/hour.
SUBTOTAL - SAMPLING / DATA MANAGEMENT				$1,550,020.00	
Remedial Action					
Remediate residential soils for lead (>700 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 2 inch depth interval.	171	Yard Components	$1,200.00	$205,200.00	Assumes an average yard component size of 530 SF, and unit cost of $2.12/SF (Extrapolated from AR costs for 6-inch and 12 inch cleanup)
Remediate residential soils for lead (>1,200 mg/kg NTE lead) within **Anaconda (Focus Area)** at 0 - 6 inch depth interval.	151	Yard Components	$1,325.00	$200,075.00	Assumes an average yard component size of 530 SF, and unit cost of $2.50/SF (AR cost estimate)
Remediate residential soils for lead (>1,200 mg/kg NTE lead) within **Anaconda (Focus Area)** at 0 - 12 inch depth interval.	75	Yard Components	$1,625.00	$121,875.00	Assumes an average yard component size of 530 SF, and unit cost of $3.07/SF (AR cost estimate)
Interior Dust Remediation	11	Res	$1,000.00	$11,100.00	
Attic Dust Remediation	24	Res	$4,000.00	$96,000.00	
SUBTOTAL - REMEDIAL ACTION				$634,250.00	
ENGINEERING / OVERSIGHT				$95,137.50	Assumes 15% of Construction Cost.
Blood Lead and Arsenic Urinalysis Monitoring					
Monitor Children for blood-lead levels	1	Lump Sum	$329,980.00	$329,980.00	5 year biomonitoring program. Assumes comprehensive PbB and ZPP analysis in venous blood for all children < 7 yrs for Years 1 and 5. Pb/ZPP analysis in capillary blood for all children < 24 months and new resident children < 7 yrs during program Years 2, 3, and 4. Costs assume collaboration with local health dept/hospital staff for collection of samples, managing database, and education & outreach activities. Also includes data anlaysis and reporting after program Year 1 and 5 and home lead assessments for children with PbB > 10 ug/dL. See attached worksheet for backup.
Multi-Pathway Program / Institutional Controls Annual Long Term Costs					
Sample Interior and Attic Dust	5	Res	$400.00	$2,000.00	Assumes 20 residences per year would be sampled for interior/attic dust.
Attic Dust Remediation	1	Res	$4,000.00	$4,000.00	Assumes four residences per year would be identified as requiring attic dust remediation.
Engineering / Oversight Support (for RA and Reporting)	1	Lump Sum	$1,800.00	$1,800.00	Assumes 30% of RA construction cost.
Estimated Annual Cost				$7,800.00	
Present Worth Value of Annual Cost (0.01 Discount Rate, 50 Years)				$305,729.58	
TOTAL ESTIMATED COST				**$2,915,117.08**	

TABLE B-4: COMMUNITY SOILS OPERABLE UNIT
FOCUSED FEASIBILITY STUDY REMEDIAL ACTION ALTERNATIVE NO. 3 COST ESTIMATE
LEAD ACTION LEVEL = 400 mg/kg
MAXIMUM REMOVAL DEPTH = 12 inches

Activity	Quantity	Units	Unit Cost	Total Cost	Comment
Sampling / Data Management					
Sample Yards in **Anaconda (Focus Area)** to depth of 12 inches for lead analyses.	1,300	Yards	$800.00	$1,040,000.00	Number of residential yards within Focus Area based on counting lots East of Main Street in Anaconda.
Develop Individual Site Work Plans (ISWPs) for previously sampled residential yards subject to Remedial Action for soil lead (≥400 mg/kg).	720	Yards	$200.00	$144,000.00	Assumes 2.5 components per yard subject to RA. Assumes 2.5 hours/ISWP @ $80.00/hour.
Sample Residences in Anaconda (Focus Area) for interior and accessible attic dust for arsenic and lead.	1170	Residences	$400.00	$468,000.00	Assumes 90% of the lots East of Main Street in Anaconda have residences constructed on them.
Develop Individual Site Work Plans (ISWPs) for residences subject to Remedial Action for dust arsenic (>250 mg/kg) and lead (≥400 mg/kg).	59	Residences	$200.00	$11,700.00	Assumes 5% of residences will require interior dust remedial action. Assumes 2.5 hours/ISWP @ $80.00/hour.
SUBTOTAL - SAMPLING / DATA MANAGEMENT				$1,663,700.00	
Remedial Action					
Remediate residential soils for lead (≥400 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 2 inch depth interval.	1270	Yard Components	$1,200.00	$1,524,000.00	Assumes an average yard component size of 530 SF, and unit cost of $2.12/SF (Extrapolated from AR costs for 6-inch and 12 inch cleanup)
Remediate residential soils for lead (>400 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 6 inch depth interval.	423	Yard Components	$1,325.00	$560,475.00	Assumes an average yard component size of 530 SF, and unit cost of $2.50/SF (AR cost estimate)
Remediate residential soils for lead (>400 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 12 inch depth interval.	212	Yard Components	$1,625.00	$344,500.00	Assumes an average yard component size of 530 SF, and unit cost of $3.07/SF (AR cost estimate)
Interior Dust Remediation	20	Res	$1,000.00	$19,500.00	
Attic Dust Remediation	39	Res	$4,000.00	$156,000.00	
SUBTOTAL - REMEDIAL ACTION				$2,604,475.00	
ENGINEERING / OVERSIGHT				$390,671.25	Assumes 15% of Construction Cost.
Institutional Controls Annual Long Term Costs					
DPS sampling for Attic Dust	5	Res	$400.00	$2,000.00	Assumes 4 residences per year would be sampled for attic dust.
Attic Dust Remediation	1	Res	$4,000.00	$4,000.00	Assumes one residences per year would be identified as requiring attic dust remediation.
Engineering / Oversight Support (for RA and Reporting)	1	Lump Sum	$1,800.00	$1,800.00	Assumes 30% of Construction Cost.
Estimated Annual Cost				$7,800.00	
Present Worth Value of Annual Cost (0.01 Discount Rate, 50 Years)				$305,729.58	
TOTAL ESTIMATED COST				**$4,964,575.83**	

TABLE B-5: COMMUNITY SOILS OPERABLE UNIT
FOCUSED FEASIBILITY STUDY REMEDIAL ACTION ALTERNATIVE NO. 3 COST ESTIMATE
LEAD ACTION LEVEL = 500 mg/kg
MAXIMUM REMOVAL DEPTH = 12 inches

Activity	Quantity	Units	Unit Cost	Total Cost	Comment
Sampling / Data Management					
Sample Yards in **Anaconda (Focus Area)** to depth of 12 inches for lead analyses.	1,300	Yards	$800.00	$1,040,000.00	Number of residential yards within Focus Area based on counting lots East of Main Street in Anaconda.
Develop Individual Site Work Plans (ISWPs) for previously sampled residential yards subject to Remedial Action for soil lead (>400 mg/kg).	668	Yards	$200.00	$133,600.00	Assumes 2.5 components per yard subject to RA. Assumes 2.5 hours/ISWP @ $80.00/hour.
Sample Residences in Anaconda (Focus Area) for interior and accessible attic dust for arsenic and lead.	1170	Residences	$400.00	$468,000.00	Assumes 90% of the lots East of Main Street in Anaconda have residences constructed on them.
Develop Individual Site Work Plans (ISWPs) for residences subject to Remedial Action for dust arsenic (>250 mg/kg) and lead (>500 mg/kg).	59	Residences	$200.00	$11,700.00	Assumes 5% of residences will require interior dust remedial action. Assumes 2.5 hours/ISWP @ $80.00/hour.
SUBTOTAL - SAMPLING / DATA MANAGEMENT				$1,653,300.00	
Remedial Action					
Remediate residential soils for lead (>500 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 2 inch depth interval.	1039	Yard Components	$1,200.00	$1,246,800.00	Assumes an average yard component size of 530 SF, and unit cost of $2.12/SF (Extrapolated from AR costs for 6-inch and 12 inch cleanup)
Remediate residential soils for lead (>500 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 6 inch depth interval.	347	Yard Components	$1,325.00	$459,775.00	Assumes an average yard component size of 530 SF, and unit cost of $2.50/SF (AR cost estimate)
Remediate residential soils for lead (>500 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 12 inch depth interval.	174	Yard Components	$1,625.00	$282,750.00	Assumes an average yard component size of 530 SF, and unit cost of $3.07/SF (AR cost estimate)
Interior Dust Remediation	20	Res	$1,000.00	$19,500.00	
Attic Dust Remediation	39	Res	$4,000.00	$156,000.00	
SUBTOTAL - REMEDIAL ACTION				$2,164,825.00	
ENGINEERING / OVERSIGHT				$324,723.75	Assumes 15% of Construction Cost.
Institutional Controls Annual Long Term Costs					
DPS sampling for Attic Dust	5	Res	$400.00	$2,000.00	Assumes 4 residences per year would be sampled for attic dust.
Attic Dust Remediation	1	Res	$4,000.00	$4,000.00	Assumes one residences per year would be identified as requiring attic dust remediation.
Engineering / Oversight Support (for RA and Reporting)	1	Lump Sum	$1,800.00	$1,800.00	Assumes 30% of Construction Cost.
Estimated Annual Cost				$7,800.00	
Present Worth Value of Annual Cost (0.01 Discount Rate, 50 Years)				$305,729.58	
TOTAL ESTIMATED COST				**$4,448,578.33**	

TABLE B-6: COMMUNITY SOILS OPERABLE UNIT
FOCUSED FEASIBILITY STUDY REMEDIAL ACTION ALTERNATIVE NO. 3 COST ESTIMATE
LEAD ACTION LEVEL = 700 mg/kg
MAXIMUM REMOVAL DEPTH = 12 inches

Activity	Quantity	Units	Unit Cost	Total Cost	Comment
Sampling / Data Management					
Sample Yards in **Anaconda (Focus Area)** to depth of 12 inches for lead analyses.	1,300	Yards	$800.00	$1,040,000.00	Number of residential yards within Focus Area based on counting lots East of Main Street in Anaconda.
Develop Individual Site Work Plans (ISWPs) for previously sampled residential yards subject to Remedial Action for soil lead (≥400 mg/kg).	405	Yards	$200.00	$81,000.00	Assumes 2.5 components per yard subject to RA. Assumes 2.5 hours/ISWP @ $80.00/hour.
Sample Residences in Anaconda (Focus Area) for interior and accessible attic dust for arsenic and lead.	1170	Residences	$400.00	$468,000.00	Assumes 90% of the lots East of Main Street in Anaconda have residences constructed on them.
Develop Individual Site Work Plans (ISWPs) for residences subject to Remedial Action for dust arsenic (>250 mg/kg) and lead (≥700 mg/kg).	35	Residences	$200.00	$7,020.00	Assumes 3% of residences will require interior dust remedial action. Assumes 2.5 hours/ISWP @ $80.00/hour.
SUBTOTAL - SAMPLING / DATA MANAGEMENT				$1,596,020.00	
Remedial Action					
Remediate residential soils for lead (≥700 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 2 inch depth interval.	576	Yard Components	$1,200.00	$691,200.00	Assumes an average yard component size of 530 SF, and unit cost of $2.12/SF (Extrapolated from AR costs for 6-inch and 12 inch cleanup)
Remediate residential soils for lead (>700 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 6 inch depth interval.	192	Yard Components	$1,325.00	$254,400.00	Assumes an average yard component size of 530 SF, and unit cost of $2.50/SF (AR cost estimate)
Remediate residential soils for lead (>700 mg/kg lead) within **Anaconda (Focus Area)** at 0 - 12 inch depth interval.	96	Yard Components	$1,625.00	$156,000.00	Assumes an average yard component size of 530 SF, and unit cost of $3.07/SF (AR cost estimate)
Interior Dust Remediation	11	Res	$1,000.00	$11,100.00	
Attic Dust Remediation	24	Res	$4,000.00	$96,000.00	
SUBTOTAL - REMEDIAL ACTION				$1,208,700.00	
ENGINEERING / OVERSIGHT				$181,305.00	Assumes 15% of Construction Cost.
Institutional Controls Annual Long Term Costs					
DPS sampling for Attic Dust	5	Res	$400.00	$2,000.00	Assumes 4 residences per year would be sampled for attic dust.
Attic Dust Remediation	1	Res	$4,000.00	$4,000.00	Assumes one residences per year would be identified as requiring attic dust remediation.
Engineering / Oversight Support (for RA and Reporting)	1	Lump Sum	$1,800.00	$1,800.00	Assumes 30% of Construction Cost.
Estimated Annual Cost				$7,800.00	
Present Worth Value of Annual Cost (0.01 Discount Rate, 50 Years)				$305,729.58	
TOTAL ESTIMATED COST				**$3,291,754.58**	