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Emergency and
Remedial Response

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August 1991

EPA

Superfund
Record of Decision:

Bunker Hill Mining and Metallurgical Complex, ID

50272-101

REPORT DOCUMENTATION PAGE

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16. Abstract (Limit: 200 words)

The Bunker Hill Mining and Metallurgical Complex site is a 21 square-mile area centered around an inactive industrial mining and smelting site, and includes the cities of Kellogg, Smelterville, Wardner, Pinehurst, and Page, in Shoshone County, Idaho. The inactive industrial complex includes the Bunker Hill mine and mill, a lead smelter, a zinc smelter and a phosphoric acid fertilizer plant, all totalling several hundred acres. Furthermore, the site includes the South Fork of the Coeur d'Alene River, an alluvial floodplain bordered by mountains, numerous valleys and gulches, and vegetated residential areas. In 1886, the first mill for processing lead and silver ore was constructed at the site. Operations were expanded in later years with the addition of a lead smelter; a blast furnace; and electrolytic zinc, sulfuric acid, phosphoric acid, and fertilizer plants. Onsite operational and disposal practices have caused the deposition of hazardous substances (e.g., metals) throughout the valley via airborne particulate deposition, alluvial deposition of tailings dumped in the river, and migration from onsite sources. Initially, most of the solid and liquid residue from the complex was discharged into the river. When the river flooded, these materials were deposited onto the valley floor, and have leached into onsite soil and ground

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Bunker Hill Mining and Metallurgical Complex, ID
First Remedial Action
Contaminated Medium: soil
Key Contaminants: metals (arsenic, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 144
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(See ANSI-Z39.18) *See Instructions on Reverse* OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce ract (Continued)

water. Although some of the industrial wastes have been removed and disposed of offsite, thousands of tons of sludge, tailings, flue dust, and other wastes still remain onsite. Contamination at the site is a result of tailings deposition in the floodplain, and airborne deposition from smelter and mill complex emissions. A fire in 1973 severely reduced air pollution control capacity at the lead smelter. A 1974 public health study and concurrent epidemiologic and environmental investigations concluded that atmospheric emissions of particulate lead from the active smelter were the primary sources of elevated blood lead levels in local children. In 1977, two tall stacks were added to disperse contaminants from the complex. The complex ceased smelter operations in 1981, but continued limited mining and milling operations from 1988 to early 1991. In 1989, EPA began a removal program to excavate lead-contaminated soil from affected residential properties. Federal and State agencies have designated a 21-square-mile study area, which has been divided into populated areas and non-populated areas for remediation. This Record of Decision (ROD) addresses contaminated residential soil within the populated areas of the site, and includes four incorporated communities and three unincorporated residential areas as Operable Unit 1 (OU1). The nonpopulated areas of the site as well as all other contaminated media in the populated areas (e.g., house dust, and commercial properties) will be addressed in a future ROD. The primary contaminants of concern affecting residential area soil are metals including arsenic and lead.

The selected remedial action for this site includes soil sampling; excavating taminated soil and sod exceeding 1,000 mg/kg lead on approximately 1,800 residential erties, and replacing it with clean soil and sod; disposing of the contaminated soil and sod at an onsite repository; capping the repository; placing a visual marker if lead levels in soil exceed 1,000 mg/kg below the depth of excavation; revegetating the area; conducting long-term environmental monitoring; and implementing institutional controls including deed and land use restrictions. The estimated present worth cost for this remedial action is $40,600,000, which includes an annual O&M cost of $460,000 for 30 years.

PERFORMANCE STANDARDS OR GOALS: Residential soil with lead concentrations greater than 1,000 mg/kg will be excavated and replaced with clean material resulting in mean soil lead concentrations in residential areas of approximately 200 to 300 mg/kg.

RECORD OF DECISION

Bunker Hill Mining and Metallurgical Complex
Residential Soils Operable Unit
Shoshone County, Idaho

August 1991

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DECLARATION
FOR THE
RECORD OF DECISION

SITE NAME

Bunker Hill Mining and Metallurgical Complex Site
Populated Areas
Residential Soils Operable Unit

LOCATION

Cities of Kellogg, Smelterville, Wardner, Pinehurst, and other residential areas within the site
Shoshone County, Idaho

STATEMENT OF BASIS AND PURPOSE

This decision document presents the remedial action selected by the U.S. Environmental Protection Agency and the Idaho Department of Health and Welfare for the Populated Areas Residential Soils Operable Unit at the Bunker Hill Mining and Metallurgical Complex Site in northern Idaho. The remedy was chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the National Contingency Plan. This decision is based on the Residential Soils Administrative Record file for this site, and the index is attached.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

The Residential Soils Operable Unit is the first unit to be addressed at Bunker Hill. **Exposure to lead in residential soils has been identified as the primary health risk to children and pregnant women within the Populated Areas of the site.** Residential soils are not a "principal threat" at this site (as defined by U.S. EPA--see Glossary), although they represent a significant lead exposure pathway to the local population.

Exposure to interior house dust and consumption of locally grown garden produce have also been identified as significant contaminant exposure pathways to people. Contaminants of concern for garden produce include lead and cadmium.

Remediation of residential soils will break the direct contact exposure pathway between people and those soils. In addition, implementation of the selected remedy will remove a source of metal-contaminated dust to home interiors (residential soils are a source of house dust), and provide safe garden areas.

The residential soils remedy consists of the following:

- Removal of contaminated surficial soil
- Placement of a visual marker if lead in soil concentrations exceed 1,000 ppm below the depth of excavation
- Replacement with clean soil (these soils will function as a barrier between residents and underlying contaminated material)
- Revegetation of yards
- Disposal of contaminated materials
- Dust suppression during remediation
- Institutional controls for barrier management
- Long-term environmental monitoring for evaluation of remedial effectiveness

A Remedial Action Objective is to decrease the concentration of lead such that 95 percent or more of the children in the area have blood lead levels below 10 $\mu g/dL$. This remedial action is expected to achieve community mean soil lead concentrations of approximately 200 to 300 ppm by removal of soils exceeding the threshold level of 1,000 ppm lead. Approximately 1,800 residential properties will be remediated based on this criterion. U.S. EPA and IDHW have determined that residential yards cleaned up in 1989, 1990, and 1991 were done so in a manner consistent with this Record of Decision. These properties will be included in the Institutional Controls Program.

To meet the health based Remedial Action Objectives, contaminated fugitive dust must be controlled and lead concentrations in home interior dust must be reduced. It is expected that there will be at least one other Record of Decision that will address fugitive dust, interior dust, and all other remaining issues for the site.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. However, because treatment of the metal-contaminated residential soils was found to be not practicable, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy. Treatment was determined to be impracticable based upon effectiveness and cost factors.

Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within 5 years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Richard P. Donovan
Director
Idaho Department of Health and Welfare

August 26, 1991
Date

Dana A. Rasmussen
Regional Administrator
U.S. EPA Region 10

August 30, 1991
Date

RECORD OF DECISION SUMMARY

Site Name: Bunker Hill Mining and Metallurgical Complex Site
Populated Areas
Residential Soils Operable Unit

Location: Cities of Kellogg, Smelterville, Wardner, Pinehurst; and other residential areas within site boundaries
Shoshone County, Idaho

1 SITE DESCRIPTION

The Bunker Hill Mining and Metallurgical Complex Superfund Site is located in Shoshone County, in northern Idaho, at 47°5' north latitude and 116°10' west longitude (Figure 1-1). The site lies in the Silver Valley of the South Fork of the Coeur d'Alene River (SFCDR). The Silver Valley is a steep mountain valley that trends from east to west. Interstate Highway 90 crosses through the valley, approximately parallel to the SFCDR. The site includes the town of Pinehurst on the west and the town of Kellogg on the east (Figure 1-2) and is centered on the Bunker Hill industrial complex. The site has been impacted by over 100 years of mining and 65 years of smelting activity. The complex occupies several hundred acres in the center of the site between the towns of Kellogg and Smelterville.

The agencies [U.S. Environmental Protection Agency (U.S. EPA) and Idaho Department of Health and Welfare (IDHW)] have designated a 21-square-mile study area for purposes of conducting the Remedial Investigation/Feasibility Study (RI/FS), which has been divided into Populated Areas and Non-populated Areas. This Record of Decision (ROD) addresses contaminated residential soils within the Populated Areas of the site. Soils throughout the site have been contaminated by heavy metals, to varying degrees, through a combination of airborne particulate deposition, alluvial deposition of tailings dumped into the river by mining activity, and contaminant migration from onsite sources. Onsite sources include the industrial complex, tailings and other waste piles, barren hillsides, and fugitive dust source areas located throughout the site.

The Populated Areas of the site consist of four incorporated communities and three unincorporated residential areas. Except for the eastern portion of Kellogg, all of these communities lie south of U.S. Interstate 90 (I-90), between the highway and steep hillsides to the south. Portions of the residential areas lie within the floodplain of the South Fork of the Coeur d'Alene River.

This ROD addresses currently established residential areas. The city of **Kellogg** (see Figure 1-3) is 6 miles east of the western edge of the site and approximately 1 mile east of the smelter complex. The population is estimated to be 2,600 with about 1,100 residences. The next largest population center is the city of **Pinehurst** (see Figure 1-4) with 700 residences and about 1,700 people. It is located on the western edge of the site, about 1 mile south of I-90. **Smelterville** (see Figure 1-5), with a population of about 450 and 270 residences, is approximately 3 miles east of the western edge of the site and lies along a minor arterial road linking it to Pinehurst and Kellogg. The town is about 1 mile west of the smelter complex. The city of **Wardner** (see Figure 1-6) is contiguous with the southeast portion of Kellogg and is approximately 6 miles east of the western boundary of the site. The population of Wardner is currently about 300 people with 130 residences. The unincorporated community of **Page** (see Figure 1-7) is about 1 mile east of the western edge of the site. Most of the land is owned by American Smelting and Refining Company (ASARCO), while the homes are owned by the residents. Population of Page is estimated to be about 100 to 150 people, and the area includes 65 residences. Two unincorporated residential areas located along the eastern site boundary are **Elizabeth Park** and **Ross Ranch** with populations estimated to be 120 and 50 people, respectively.

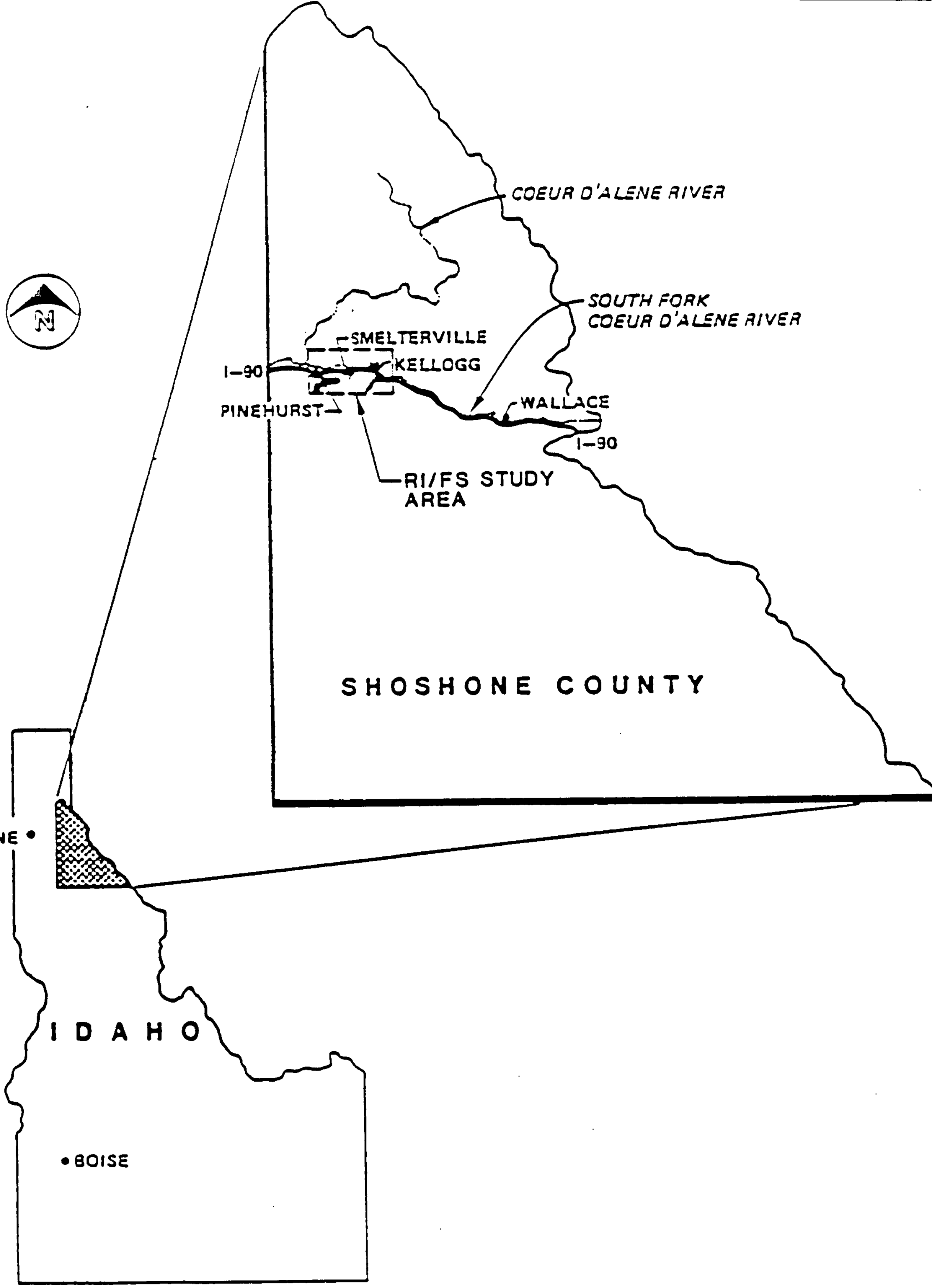

Figure 1-1
BUNKER HILL
RI/FS STUDY AREA

BUNKER HILL POPULATED AREAS RI/FS

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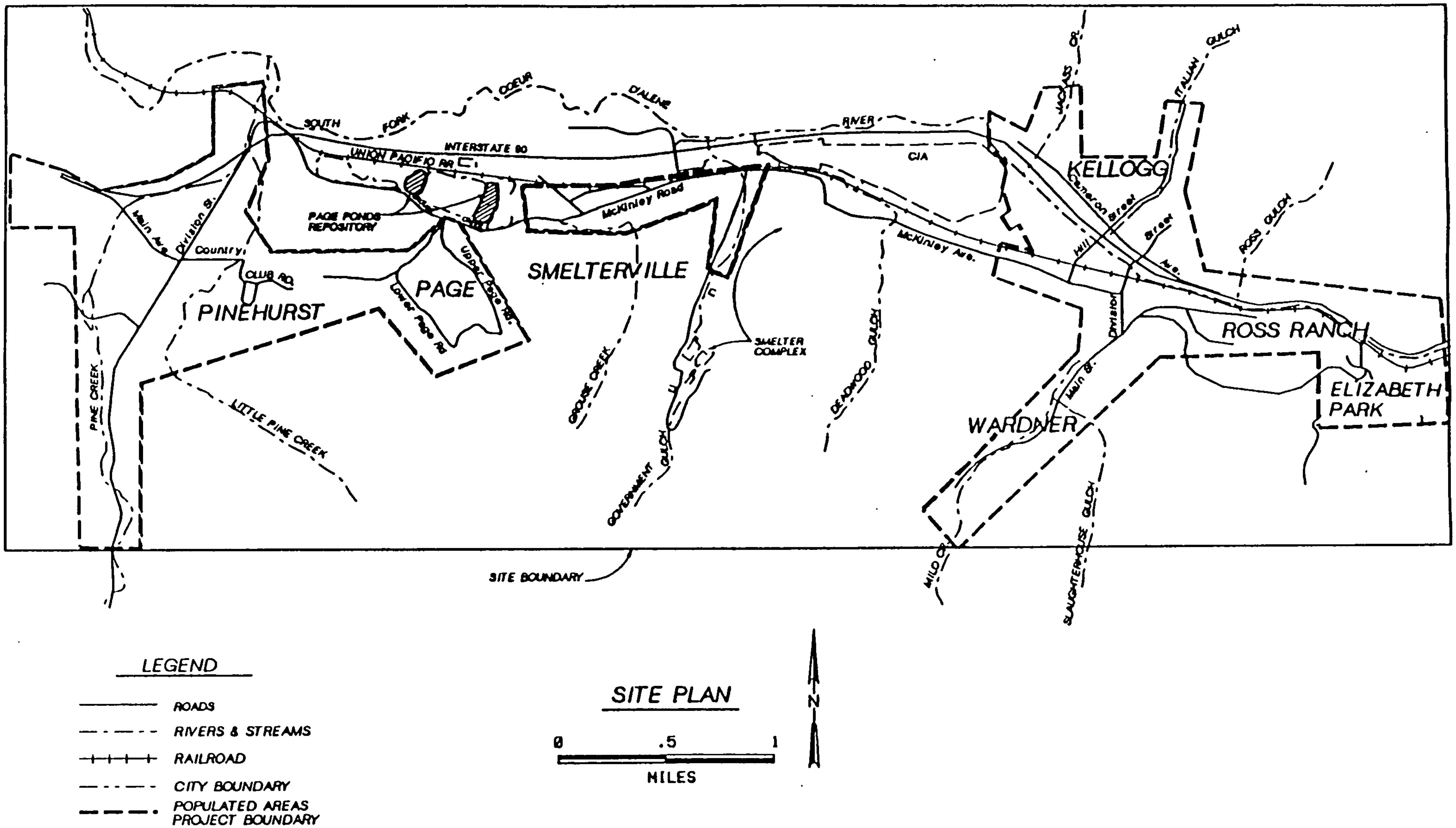


Figure 1-2
POPULATED AND NON-POPULATED AREAS OF THE SITE

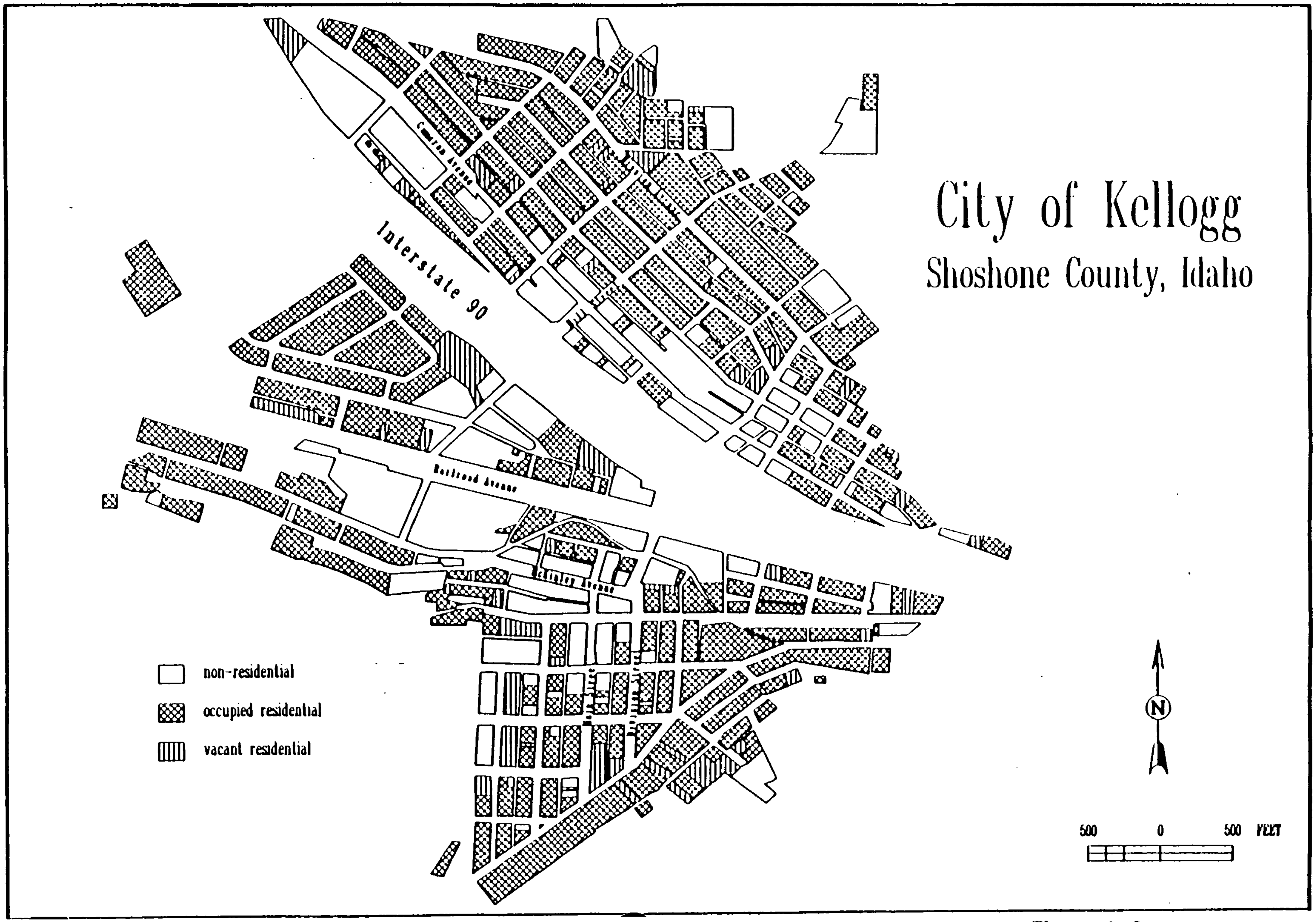


Figure 1-3
POPULATED AS RI/FS
RESIDENTIAL SOIL RECORD

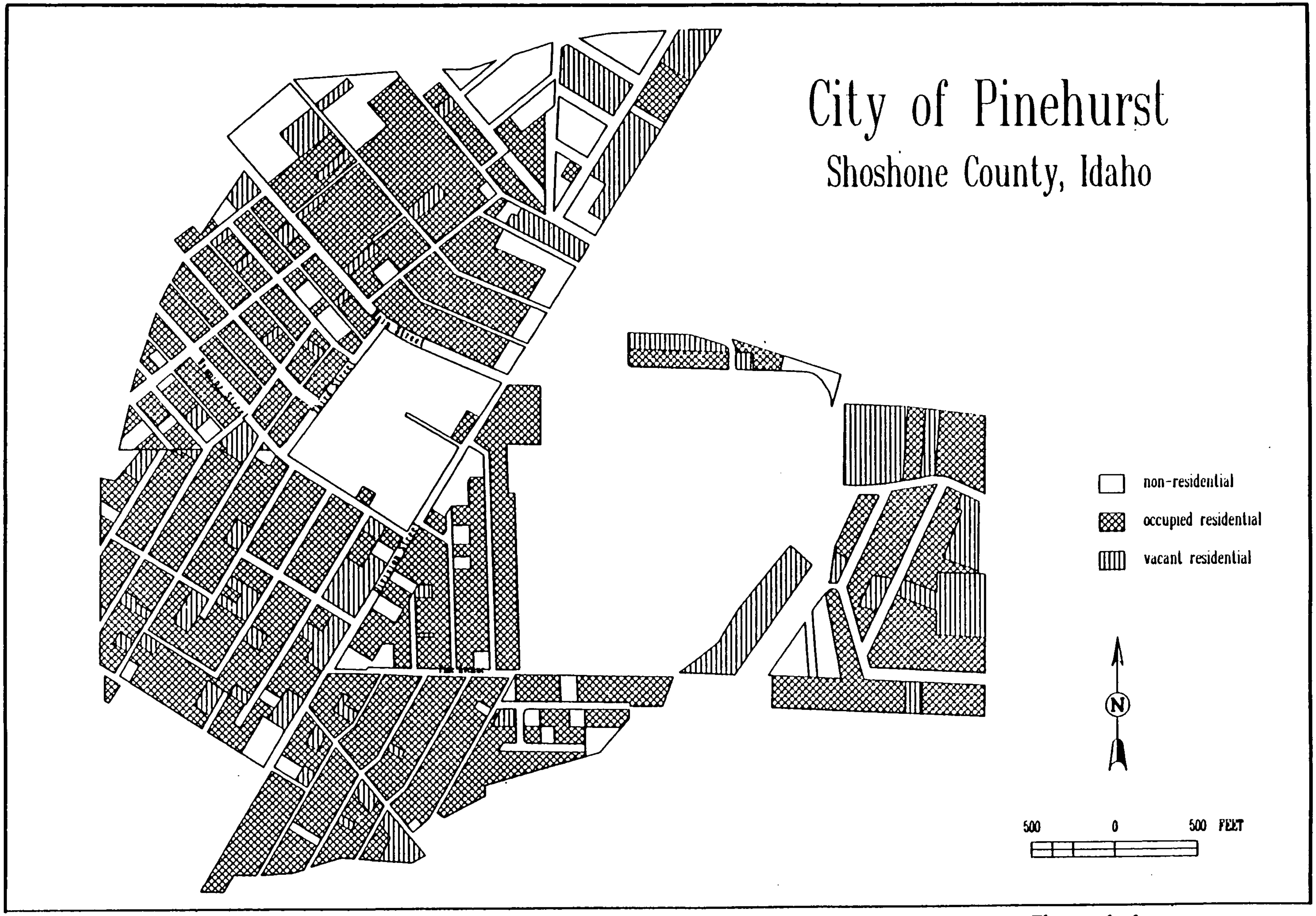


Figure 1-4
POPULATED AREAS RI/FS
RESIDENTIAL SOIL RECORD
OF DECISION

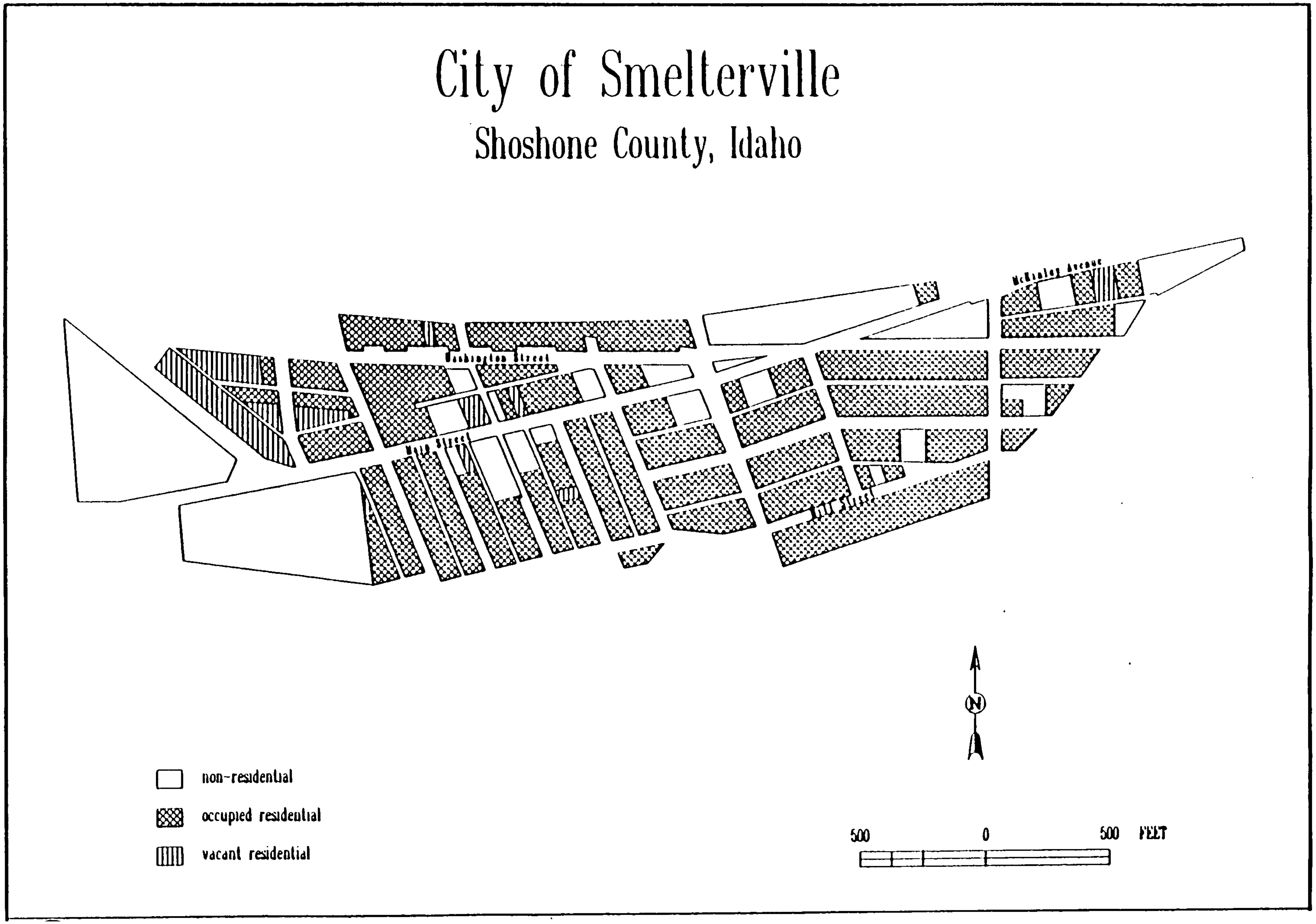


Figure 1-5
POPULATED A   S RI/FS
RESIDENTIAL SOIL RECORD
OF DECISION

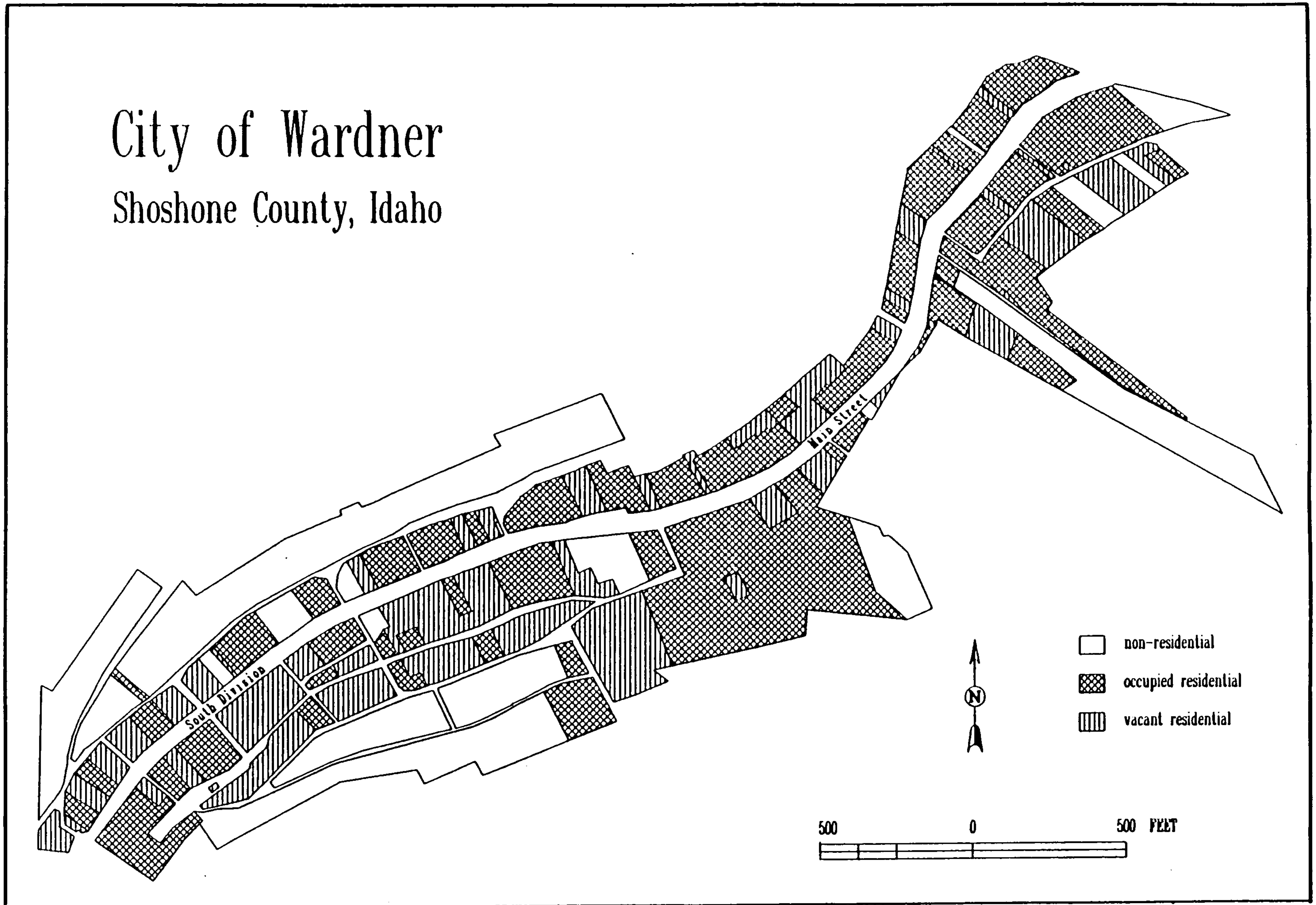


Figure 1-6
POPULATED AREAS RI/FS
RESIDENTIAL SOIL RECORD
OF DECISION

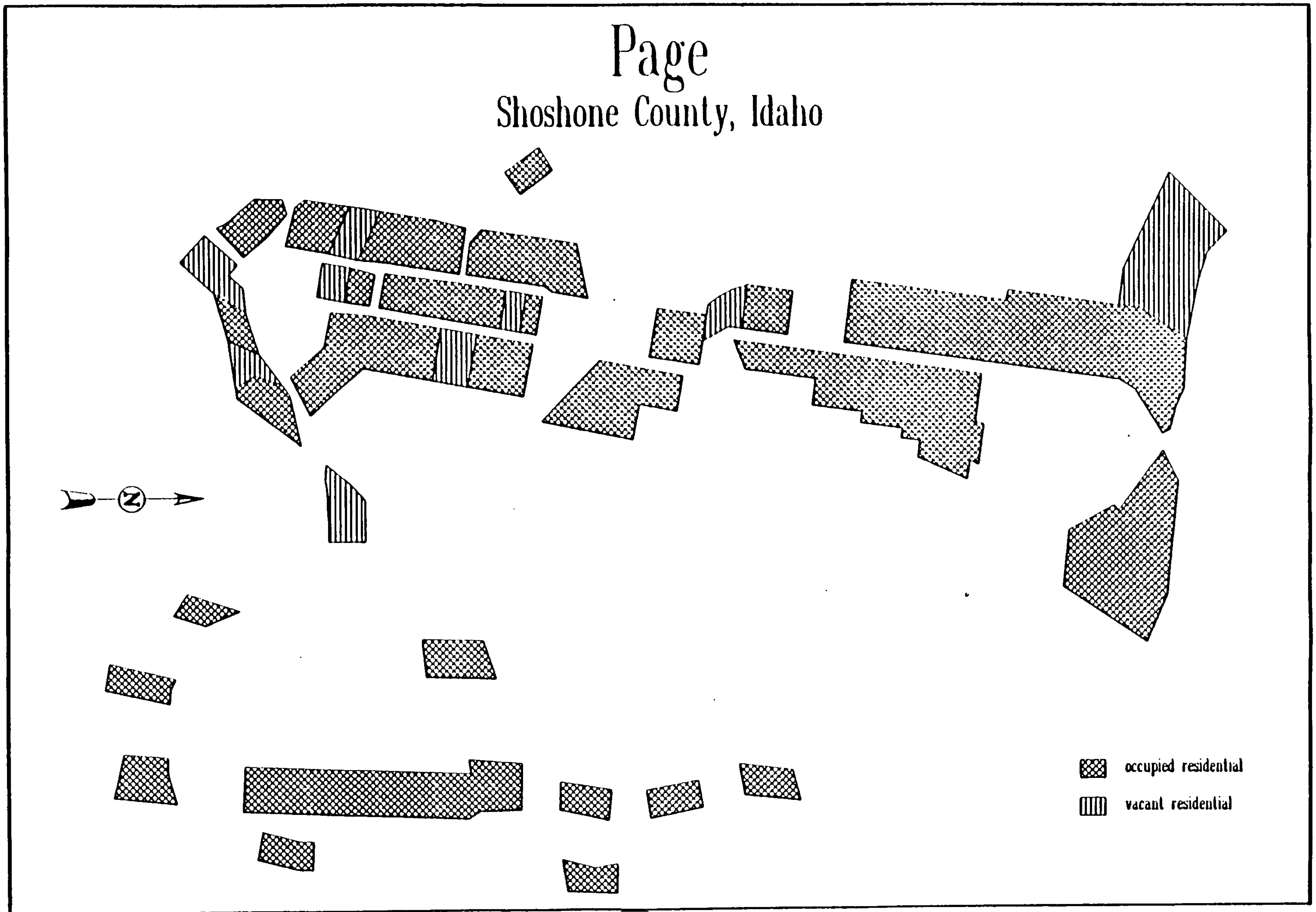


Figure 1-7
POPULATED --EAS RI/FS
RESIDENTIAL SOIL RECORD

2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 SITE HISTORY

The Bunker Hill Superfund Site is part of the Coeur d'Alene Mining District located in northern Idaho and western Montana. Gold was first discovered in the district in 1883. The first mill for processing lead and silver ores at the Bunker Hill site was constructed in 1886 and had a capacity of 100 tons of raw ore per day. Other mills subsequently were built at the site and the milling capacity ultimately reached 2,500 tons per day.

The Kellogg-based Bunker Hill and Sullivan Mining Company, incorporated in 1887, was the original owner and operator of the Bunker Hill complex. In 1956, the name was changed to the Bunker Hill Company and in 1968, Gulf Resources and Chemical Company of Houston, Texas, purchased the company and operated the smelter until it was closed in late 1981. The complex was purchased in 1982 by the Bunker Limited Partnership (BLP), headquartered in Kellogg, Idaho. BLP subsequently sold portions of the complex properties to several related or affiliated entities including:

- Syringa Minerals Corporation
- Crescent Mine
- Bunker Hill Mining Company (U.S.), Inc.
- Minerals Corporation of Idaho

The Bunker Mining Company resumed mining and milling operations in 1988 and subsequently ceased those operations in 1991.

The Bunker Hill and Sullivan Mining Company was originally involved only in mining and milling lead and silver ores from local mines. From 1886 until 1917, the lead and silver concentrates produced at the site were shipped to offsite smelters for processing. Construction of the lead smelter began in 1916 and the first blast furnace went online in 1917. Over the years, the smelter was expanded and modified. At the time of its closure in 1981, the lead smelter had a capacity of over 300 tons of metallic lead per day. An electrolytic zinc plant was put into production at the site in 1928. Two sulfuric acid plants were added to the zinc facilities in 1954 and 1966, and one sulfuric acid plant was added to the lead complex in 1970. When it was closed in 1981, the zinc plant's capacity was approximately 285 tons per day of cast zinc. A phosphoric acid plant was constructed at the site in 1960 and a fertilizer plant was built in 1965. The primary products from these plants were phosphoric acid and pellet-type fertilizers of varying mixtures of nitrogen and phosphorus. The industrial complex ceased operation in 1981 except for limited mining and milling operations mentioned above.

Control of atmospheric emissions, solid waste disposal, and wastewater treatment at the Bunker Hill complex evolved with changing technologies and regulations. Initially, most liquid and solid residue from the complex was discharged into the South Fork of the Coeur d'Alene River and its tributaries. The river periodically flooded and deposited waste material laden with lead, zinc, and other heavy metals onto the valley floor. Operation and disposal practices caused deposition of hazardous substances throughout the valley. Leaching of these deposits through the soil has contributed to heavy metal contamination of the river and groundwater.

A 1973 fire in the baghouse at the lead smelter main stack severely reduced air pollution control capacity. Total particulate emissions of about 15 to 160 tons per month, containing 50 to 70 percent lead, were reported from the time of the fire through November 1974. This compares to emissions of about 10 to 20 tons per month prior to the fire. The immediate effects of increased total lead emissions and high total lead in air content were observed in a 1974 public health study where a significant number of children had elevated blood lead levels. Lead smelter stack emissions following the 1973 baghouse fire are a significant source of current site contamination.

In 1977, tall stacks (>600 feet) were added at both the zinc and lead smelters to more effectively disperse contaminants from the complex. These devices decreased sulfur oxides concentrations in the late 1970s. The smelter and other Bunker Hill Company activities ceased operation in December 1981, and portions of the smelter complex have since been salvaged for various materials, machinery, and scrap.

Although in recent years some wastes have been shipped offsite for disposal in landfills, thousands of tons of sludge, tailings, flue dust, and other wastes remain at the complex. These materials contain high levels of arsenic, lead, and other metals.

2.2 INITIAL INVESTIGATIONS

Contaminated air, soils, and dusts have been identified as contributors to elevated blood lead levels in children living in the Populated Areas of Bunker Hill site. Environmental media concentrations of site contaminants of concern in the Populated Areas are strongly dependent on distance from the smelter facility and industrial complex. Residential areas nearest the smelter complex have shown the greatest air, soil, and dust lead concentrations; the highest childhood blood lead levels; and the greatest incidence of excess absorption in each of the studies conducted in the last decade.

Health effects of environmental contamination were first documented following the smelter baghouse fire and associated smelter emissions in 1973 and 1974. Up to 75 percent of the preschool children tested within several miles of the complex had blood lead levels at that time that exceeded Centers for Disease Control (CDC) criteria. Several local children were diagnosed with clinical lead poisoning and required hospitalization. Lead health surveys conducted throughout the 1970s confirmed that excess blood lead absorption was endemic to this community. Concurrent epidemiologic and environmental investigations concluded that atmospheric emissions of particulate lead from the active smelter were the primary sources of environmental lead that affected children's blood lead levels prior to 1981. Contaminated soils were also found to be a significant, however secondary, source of lead to children in the 1970s.

Following lead poisoning incidents in 1973, a number of activities were instituted to decrease lead exposures and uptakes in the community. In an August 1974 survey, 99 percent of the 1- to 9-year-old children living within 1 mile of the smelter were found to have blood lead levels in excess of 40 µg/dl. The frequency of abnormal lead absorption (defined at the time as greater than or equal to 40 µg/dl) was found to decrease with increasing distance from the smelter. Following the announcement of these results, emergency measures were initiated to reduce the risk of lead intoxication. These measures included: chelation of children with blood lead over 80 µg/dl, purchase and destruction of as many homes as possible within 0.5 mile of the smelter, distribution of "clean" soil and gravel to cover highly contaminated areas, initiation of a hygiene program in the schools, and reduction of ambient air lead levels through reduction of smelter emissions. Street cleaning and watering in dust-producing areas occurred during several periods in the late 1970s. Subsidies were provided by the Bunker Hill Company to residents for the purchase of clean top soil, sand, gravel, grass seed and water, thereby promoting some yard cover in the community.

An analysis of historical exposures to children who were 2 years old in 1973 suggests a high risk to normal childhood development and metal accumulation in bones because of extreme exposures; these exposures could offer a continuing lead body burden in these children because of its long physiologic half life. Females who were 2 years of age during 1973 are now of childbearing age and, even with maximum reduction in current exposure to lead, the fetus may be at risk because of resorption of bone lead stores in the young women.

Following smelter closure in late 1981, airborne lead contamination decreased by a factor of 10, from approximately 5 $\mu g/m^3$ to 0.5 $\mu g/m^3$. A 1983 survey of children's blood lead levels demonstrated a significant decrease in community exposures to lead contamination; however, the survey also found that several children, including some born since 1981, continued to exhibit blood lead levels in excess of recommended public health criteria. Accompanying epidemiological analyses suggested that contaminated soils and dusts represented the most accessible sources of environmental lead in the community.

Childhood mean blood lead levels have continued to decrease since 1983. These decreases are likely related to a nationwide reduction in dietary lead; reduced soil, dust, and air levels in the community; intake reductions achieved through denying access to sources; and the increase in family and personal hygiene practiced in the community. The latter is reflected in the implementation of a comprehensive Community Health Intervention Program in 1984 that encourages improved hygienic (housekeeping) practices, increased vigilance, parental awareness, and special consultation on individual source control practices such as lawn care, removals, and restrictions. The Community Health Intervention Program was initiated specifically to reduce the potential for excess absorptions and minimize total absorption in the population until initiation of remedial activities. Total blood lead absorption among the community's children has been reduced nearly 50 percent since 1983. The incidence of lead toxicity (blood lead > 25 $\mu g/dl$) has fallen from 25 percent to less than 5 percent for children in the highest exposure areas. Recent blood lead monitoring has shown 37 to 56 percent of area children surveyed exceed the blood lead level of 10 $\mu g/dL$.

2.3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

The Bunker Hill site was placed on the National Priorities List (NPL) in September 1983 (48 FR 40658). RI/FS activities were initiated in late 1984 following completion of the 1983 Lead Health Study.

The Bunker Hill Site Characterization Report (SCR) was the first step in the RI process. The objective of the SCR was to describe and analyze existing information. The existing information included files from federal, state, and local agencies, as well as information obtained from past and present owners and operators of the industrial complex. The SCR was then used to identify data gaps and develop work plans for the remedial investigation.

In recognition of the history and complexity of this site, and the continuing need for active health intervention efforts, the EPA and IDHW developed an integrated project structure for RI/FS activities. The site was divided into two principal portions--the Populated Areas and the Non-populated Areas. The Populated Areas include several cities, all residential and commercial properties located within those cities, and other residential properties. The Non-populated Areas include the smelter complex, river floodplain, barren hillsides, groundwater, air pollution, and industrial waste components of the site.

While separate RI/FS efforts were initiated for each portion of the site, U.S. EPA Region 10 retained oversight and risk assessment responsibilities for both. IDHW conducted the Populated Areas RI/FS. The Non-populated Areas RI/FS is being conducted by Gulf Resources & Chemical Corporation under a U.S. EPA Administrative Order on Consent signed by U.S. EPA in May 1987. Table 2-1 lists the major geographic features and investigation emphases.

Table 2-1 Major Features and Investigation Emphasis	
Major Geographic Features	Investigation Emphasis
Populated Areas	
• Pinehurst	• Contaminated Soils and Dust
• Page	• Residential Properties
• Smelterville	• Commercial Properties
• Kellogg	• Roadways/Railways
• Wardner	• Fugitive Dust Sources
• Ross Ranch	• House Dust
• Elizabeth Park	• Airborne Contamination
Non-populated Areas	
• North-Facing Hillsides	• Soil and Surface Materials
• South-Facing Hillsides	• Surface Water
• Denuded Hillsides Near Complex	• Groundwater
• Bunker Hill Smelter Complex Area	• Air/Atmospheric Transport
• Central Impoundment Area (CIA)	• Vegetation
• Smelterville Flats	• Buildings/Process Equipment
• Industrial Corridor	• Waste Piles
• River Channel Area	• Buried Wastes
• East Page Swamp	• Contaminant Migration
• West Page Swamp	
• Pine Creek Channel	
• Page Pond	

2.4 HISTORY OF CERCLA ENFORCEMENT

Several companies have been identified by U.S. EPA as potentially responsible parties (PRPs) for the Bunker Hill Superfund Site. Table 2-2 lists the PRPs for Bunker Hill and the dates they were notified. The PRPs represent a combination of past and present property owners, owners and operators of the various smelting, processing, and production facilities located within the industrial complex, and upstream mining companies that were responsible for tailings discharges into the South Fork of the Coeur d'Alene River that have contributed to the contamination of the site.

Table 2-2 Potentially Responsible Parties Identified for the Bunker Hill Superfund Site	
Name of Company	**Notification Date**
Gulf Resources and Chemical Corporation	10-18-84
Bunker Limited Partnership	10-18-88 and 10-04-89
Minerals Corporation of Idaho	10-04-89
Bunker Hill Mining Company (U.S.), Inc.	10-04-89
BH Properties, Inc.	10-04-89
Syringa Minerals Corporation	10-04-89
Hecla Mining Company	10-04-89
Stauffer Chemical Company	10-04-89
ASARCO, Inc.	02-07-90
Callahan Mining Corporation	02-07-90
Highland Surprise Consolidated-Mining Company	02-07-90
Silver Bowl, Inc.	02-07-90
Sunshine Precious Metals, Inc.	02-07-90
Union Pacific Railroad	02-07-90
Coeur d'Alene Mines Corporation	02-07-90
Sunshine Mining Company	06-07-91

In 1989, U.S. EPA recovered $1.4 million from Gulf Resources & Chemical Corporation in a settlement regarding Superfund money spent during the removal action in 1986. Agency oversight costs associated with the Non-populated RI/FS have been received from Gulf Resources & Chemical Corporation for 1987 through 1989. On May 2, 1990, U.S. EPA filed a civil action for penalties against Bunker Limited Partnership for failure to respond to U.S. EPA's October 1988 request for information. The case is still pending in U.S. District Court in Boise, Idaho.

2.5 REMOVAL ACTIONS

There have been two Superfund-financed removal actions (1986 and 1989 residential soils); one removal action was financed by the PRPs but performed by the agencies (1990 residential soils); and there have been three PRP-performed removal actions (1989 Smelter Complex Stabilization, 1990 hillsides revegetation, and 1991 residential soils, etc.).

In 1986, 16 public properties (parks, playgrounds, and road shoulders) were selected for an immediate removal action because these properties contained high concentrations of lead and were frequented by many area children. The action consisted of placing a barrier between children and the underlying contaminated soil. Six inches of contaminated materials were excavated, and clean soil, sod and/or gravel were imported for replacement. Excavated material was temporarily stored within site boundari at property owned by the Idaho Transportation Department (ITD).

In 1989, the U.S. EPA and IDHW began a residential soil removal program. The program prioritized yards that had a lead concentration greater than or equal to 1,000 ppm and housed either a young child or a pregnant woman. This action consisted of removing 6 to 12 inches of contaminated material from yards and replacing it in kind with clean material. Contaminated soils were again stored at the ITD property within site boundaries. In 1989, yard soil replacement was completed at 81 homes and 2 apartment complexes within the Populated Areas of the site.

An Administrative Unilateral Order was issued October 24, 1989 (U.S. EPA Docket Number 1089-10-21-106), to Bunker Limited Partnership, Minerals Corporation of Idaho, Bunker Hill Mining Company, (U.S.) Inc., and Gulf Resources and Chemical Corporation. The purpose of the order was to implement actions to stabilize several problem areas within the industrial complex. Actions required by the order included immediate cessation of salvaging activities onsite, establishment of site access restrictions, development of a dust control plan, and stabilization and containment of the copper dross flue dust pile.

An Administrative Unilateral Order was issued to all named PRPs on May 15, 1990 (U.S. EPA Docket No. 1090-05-25-106(a)), which required the continuation of the residential soil removal program within the boundaries of the Superfund site. Settlement of this order resulted in an agreement between U.S. EPA and eight of the PRPs (Gulf Resources & Chemical Corporation, Hecla Mining Company, ASARCO, Inc., Stauffer Chemical Company, Callahan Mining Corporation, Coeur d'Alene Mines Corporation, Sunshine Precious Metals, Inc., and Union Pacific Railroad) for payment of $3,180,000 to U.S EPA (U.S. EPA Docket Number 1090-05-35-106) for performance of the 1990 residential soil removal action. Yard soil removal and replacement for an additional 130 yards were performed in 1990. Excavated soils from this removal action were stored at the Page Ponds tailings impoundment.

An Administrative Order on Consent to implement hillside stabilization and revegetation work was entered into between U.S. EPA and Gulf Resources & Chemical Corporation, and Hecla Mining Company, on October 1, 1990 (U.S. EPA Docket No. 1090-10-01-106). The objectives of this Order are to control erosion by reestablishing a native, closed, coniferous forest and understory vegetative cover to approximately 3,200 acres of barren hillsides and to perform terrace repair and construction of detention basins, and repair of the rockslide areas in Wardner and Smelterville. Planting of trees is scheduled to be completed in 1996.

In July of 1991, an Administrative Order on Consent (U.S. EPA Docket No. 1091-06-17-106(a)) was entered into between U.S. EPA and nine PRPs (Gulf Resources & Chemical Corporation, Hecla Mining Company, ASARCO, Inc., Stauffer Chemical Company, Callahan Mining Corporation, Coeur d'Alene Mines Corporation, Sunshine Precious Metals, Inc., Union Pacific Railroad, and Sunshine Mining Company) that required the PRPs to perform the residential soil removal program. It is expected that approximately 80 more properties will be cleaned up this year. As in 1990, excavated soils were stored at the Page Ponds tailings impoundment. Under this Order, the parties have also agreed to undertake sitewide dust control actions; monitor air, groundwater and surface water; enhance the fire fighting capability at the industrial complex; and provide funding to purchase high-efficiency vacuums for loan as part of the Health Intervention Program.

3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

There has been a long history of community relations activities in the Silver Valley. Since discovery of elevated blood leads in children in 1974, the IDHW, Panhandle Health District (PHD), and the CDC have continually worked with area residents to reduce exposures to lead. In 1985 the Shoshone County Commissioners selected a nine-member Task Force to serve as a liaison between the Bunker Hill Superfund Project Team (comprised of representatives of U.S. EPA and IDHW and contractors) and the community. The PHD was contracted by IDHW to perform community relations tasks for the Bunker Hill Superfund Site. A full-time IDHW staff person has also been stationed onsite from mid-1987 to present. Part of their duties is to assist in community relation activities when needed.

The focus of community contact has been the nine-member Silver Valley Task Force. There have been 35 public task force meetings since May of 1985. These meetings consisted of presentations by the Bunker Hill Project Team with time for questions and statements from both the Task Force and the general community. Twenty-three fact sheets have been produced since May 1985 to discuss various aspects of the RI/FS activities at the site. Site records have also been made available to the public through four public information repositories. The community was involved in the selection of activities associated with the residential soil removal actions through a public comment period. This experience, along with the opportunity to observe the cleanup activity over the last 2 years, has helped familiarize the community with the remediation of residential soils.

A series of meetings has been held between the PHD and local planning and zoning commissions, city councils, and county commissioners to help develop the "Evaluation of Institutional Controls for the Bunker Hill Superfund Site." Institutional control development presentations were also made to local business and community groups.

The "Risk Assessment Data Evaluation Report," the "Residential Soils Focused Feasibility Study," the "Proposed Plan for Cleanup of Residential Soil within the Populated Areas of the Bunker Hill Superfund Site," and "An Evaluation of Institutional Controls for the Bunker Hill Superfund Site" were released for public review April 29, 1991. These four documents were made available in the administrative record file, which is located at the Kellogg City Hall, and the four information repositories, which are located at the Kellogg City Hall, Kellogg Public Library, Smelterville City Hall, and Pinehurst/Kingston Library. The notice of availability of the documents was published in the "Shoshone News Press" from April 26 through April 30, 1991. The notice outlined the remedial alternatives evaluated and identified the proposed alternative. A public comment period was established for April 29 to May 31 and was extended to June 30, 1991, after a request to extend the period was received. Extension of the public comment period was published in the "Shoshone News Press" May 24 through 26, 1991. A public hearing was held May 23, 1991, to answer questions and take comments. There were approximately 100 attendees at the meeting. A transcript of questions asked and answers given at the public hearing is included in the Administrative Record. Responses to written comments are included in the Responsiveness Summary, which is part of this Record of Decision.

4 SCOPE AND ROLE OF OPERABLE UNIT

The rationale for separating the Bunker Hill RI/FS into two parts involved both data availability and confidentiality issues associated with an investigation of private residential properties within the Populated Areas. With both environmental data and an abundance of human health related data, collected as part of the epidemiological studies, the agencies believed that the Populated Areas RI/FS could best be completed by government agencies in order to honor confidentiality agreements with individuals and individual property owners.

The RI--Risk Assessment Data Evaluation Report (RADER) for the Populated Areas of the Site--has been completed. The residential soils feasibility study is also complete and is the first unit to be addressed in a Record of Decision. The other units that are related to the Populated Areas investigation that have not been addressed in a decision document include: house dust, commercial properties, and road shoulders and rights-of-way. The agencies originally expected to address these issues in a second ROD in 1992; however, the PRPs have approached U.S. EPA and IDHW with a proposal for a sitewide cleanup that involves all facets of both the Populated and Non-populated Areas. The effort to complete the Residential Soils ROD was maintained, because soils are a primary risk to the residents; however, consolidation of all (see Table 2-1) remaining issues into what is referred to as the expedited FS is ongoing. The expedited FS is expected to support a second ROD for the site that will address all contaminated areas and media not covered in this ROD.

The RADER concluded that subchronic lead absorption among young children is the most significant health risk posed by this site. The greatest risks to young children are associated with ingestion of residential yard soils, house dusts, and locally grown produce. Exposure to residential soils is a primary health risk to area residents, although residential soils are not a "principal threat" as defined by U.S. EPA. The remedial action described in this ROD is intended to minimize direct contact with and ingestion of lead-contaminated residential soils by excavation and replacement of those soils with clean material. While yard soils represent a primary risk to local residents, it is important to recognize that yard soils represent only one component of exposure in these communities. Other sources of contamination within the site must be addressed to prevent additional population exposures and recontamination of residential soil because of contaminant migration. No direct action is being taken for house dust lead reduction at this time; however, it is expected that house dust lead concentrations will decrease as yard soil lead concentrations decrease and fugitive dust sources are controlled. Part of the ongoing Health Intervention Program will be to lend high-efficiency home vacuum cleaners to interested residents. Fugitive dust control efforts undertaken as part of the 1991 removal action will further reduce exposures and the transport of contaminated materials.

Use of a threshold level of 1,000 ppm lead (i.e., remedial action at any yard with a lead concentration of 1,000 ppm or above) will result in residential community mean soil lead concentrations of approximately 200 to 300 ppm. Current community mean soil lead concentrations are approximately 3,000 ppm. The goal is to reduce soil lead concentrations such that mean blood lead levels are below 10 μg/dl and the risk for any individual child to have a blood lead level that exceeds 10 μg/dl is minimized.

Locally grown produce is a potentially significant exposure route for cadmium and lead to pregnant women as well as young children. This action will provide for safe produce gardening areas to ensure that this exposure pathway is minimized. Currently, the Health Intervention Program recommends that produce grown in local gardens not be consumed.

There are approximately 2,700 residential properties onsite. Of those, approximately 50 percent have been sampled. Of the yards sampled, 65 percent have surface soil concentrations of lead greater than or equal to 1,000 ppm. If the unsampled yards show a similar distribution, this action is expected to involve remediation of 65 percent (approximately 1,800) of the residential yards within the site.

5 SITE CHARACTERISTICS

5.1 PHYSICAL SETTING

Topography of the Silver Valley consists of an alluvial floodplain bordered on the north and south by steep mountains. The floodplain ranges in width from about 0.1 mile east of Kellogg to approximately 0.9 mile near Smelterville. The elevation of the valley floor ranges from 2,160 feet above mean sea level at the west end to 2,320 feet at the east end of the project site. The valley floor is nearly level, with slopes typically less than 1 percent. The mountains rising from the valley range from 500 to 2,500 feet above the valley floor. The mountainsides typically exhibit slopes of 45 to 90 percent and at some points exceed 110 percent. Numerous valleys and gulches cut through the mountains and generally trend north to south, intercepting the valley of the South Fork Coeur d'Alene River.

Most residences are located on the valley floor or at the toe of the hillside slopes. Valley floor soils were formed from alluvially deposited materials and have been strongly influenced by mine tailings placed in the river as a result of past mining activity. In general, the alluvial valley-fill deposits are comprised of silty to clayey sand and gravel. Soil parent materials at the toe of the steep slopes are colluvial and mixed colluvial/alluvial and are highly erosive. Residential soils have been modified by typical excavation and backfill practices utilized during home construction.

Vegetation in the residential areas includes conifer and deciduous trees, grass lawns varying in quality with level of maintenance, some vegetable and flower gardens, and native grasses in undeveloped or steeply sloping areas.

The meteorology of the site is dominated by mountain/valley drainage winds related to the local topography. The orientation of the valley effectively channels winds in an east-west direction. Nocturnal winds average 4.5 mph and tend to be from the east. Late morning and afternoon winds are from the west and southwest, averaging approximately 8 mph. The mean precipitation of the area ranges from 30.4 inches at Kellogg to 40.5 inches at the nearby city of Wallace, 10 miles east (upstream) of the site. Data from the National Weather Service collected from 1951 to 1980 show an annual mean temperature in Kellogg of 47.2°F. A record high of 111°F was reached on August 5, 1961, and a record low of -36°F on December 30, 1968. On the average, 28 days per year reach a high temperature of 90°F or greater, and 143 days reach a low of 32°F or less.

5.2 NATURE AND EXTENT OF CONTAMINATION

The scope of the Populated Areas RI included residential soil, fugitive dust source, house dust, and air monitoring studies. Contaminants of concern for residential soils are antimony, arsenic, cadmium, copper, lead, mercury, and zinc. Lead has been identified as the primary contaminant of concern based on health studies.

Residential yard soil concentrations are presented in Table 5-1. The right-hand column of the table presents background mean concentrations for comparison. Data from the residential yards show that metal concentrations in surficial soils are greatly increased over background. Residential soil contaminant concentrations decrease with increasing distance from the mill and smelter complex and result from a variety of historical industrial activities.

Metal contamination to depths as great as 3 feet have been identified in residential soils. Contamination sources at this depth are primarily alluvially deposited tailings.

Table 5-1

SUMMARY OF RESIDENTIAL SOIL METAL CONTAMINATION LEVELS

SMELTERVILLE

Metal	Arith. Mean	Median	Geom. Mean	95%ile	Min.	Max.	N	Background Mean
	Concentration, ppm, dry wt. (ppm)							
As	59	55	52	126	3	254	200	< 10
Cd	41	34	33	101	2	208	200	0.8
Cu	101	88	87	215	11	371	200	28
Hg	6	5	4	18	0.4	50	199	0.1
Pb	3580	3010	2690	10400	202	16100	200	43
Sb	16	12	11	34	1	559	200	1
Zn	914	852	774	2185	134	4220	200	95

KELLOGG*

Metal	Arith. Mean	Median	Geom. Mean	95%ile	Min.	Max.	N	Background Mean
	Concentration, ppm, dry wt. (ppm)							
As	58	53	51	108	4	267	704	< 10
Cd	23	20	20	45	1	113	704	0.8
Cu	83	71	71	166	0.6	1280	704	28
Hg	3.5	2.9	2.7	8	0.12	16	703	0.1
Pb	2701	2330	2147	5830	97.2	17800	704	43
Sb	11	9.5	9	25	1.4	108	704	1
Zn	834	719	714	1810	139	3860	704	95

* Includes Ross Ranch and Elizabeth Park

Table 5-1

SUMMARY OF RESIDENTIAL SOIL METAL CONTAMINATION LEVELS

WARDNER

Metal	Arith. Mean	Median	Geom. Mean	95%ile	Min.	Max.	N	Background Mean
	Concentration, ppm, dry wt. (ppm)							
As	53	47	46	110	14	248	92	< 10
Cd	13	12	11	29	2	33	92	0.8
Cu	79	60	63	167	17	805	92	28
Hg	2	2	2	6	0.2	6	92	0.1
Pb	2040	1500	1450	5710	151	13200	92	43
Sb	17	7	7	27	2	663	92	1
Zn	912	820	773	2030	176	4190	92	95

PAGE

Metal	Arith. Mean	Median	Geom. Mean	95%ile	Min.	Max.	N	Background Mean
	Concentration, ppm, dry wt. (ppm)							
As	28	25	26	50	11	81	50	< 10
Cd	12	11	10	29	1	30	50	0.8
Cu	62	51	51	140	16	238	50	28
Hg	2	1	1	4	0.2	7	50	0.1
Pb	1090	810	808	3220	53	3480	50	43
Sb	7	5	5	16	2	32	50	1
Zn	1060	840	771	3090	107	4050	50	95

Table 5-1

SUMMARY OF RESIDENTIAL SOIL METAL CONTAMINATION LEVELS

PINEHURST

Metal	Arith. Mean	Median	Geom. Mean	95%ile	Min.	Max.	N	Background Mean
	Concentration, ppm, dry wt. (ppm)							
As	30	21	23	73	7	123	100	<10
Cd	6	6	5	13	1	37	100	0.8
Cu	43	40	39	85	17	167	100	28
Hg	0.5	0.4	0.4	1	0.1	4	100	0.1
Pb	683	501	463	1260	63	7990	100	43
Sb	9	7	8	19	5	41	100	1
Zn	474	394	389	1060	99	2300	100	95

Table 5-2 summarizes the percentage and number of properties within each community with yard soil lead concentrations above 1,000 ppm.

Table 5-2
Residential Properties With Lead Concentrations Above 1,000 ppm Lead

Location	Estimated Total Number of Properties	Properties >1,000 ppm Lead (%)	Approximate Number of Properties >1,000 ppm Lead
Kellogg	1,320	89	1,175
Wardner	181	69	125
Smelterville	303	88	267
Page	77	37	28
Pinehurst	837	20	167
TOTAL	2,718	65 (Avg.)	1,762

Notes:

1. The estimated total number of properties to be remediated includes vacant lots within existing residential areas.
2. The approximate number of residential properties were calculated using data for samples collected from approximately 50 percent of the total residences.
3. Information presented in this table was taken from the Risk Assessment Data Evaluation Report (RADER) for the Bunker Hill Populated Areas and TerraGraphics. Two hundred and twenty-one of these residential properties have already been remediated under the 1989/1990 phased cleanup.
4. The number of properties presented for Kellogg includes residences in Ross Ranch and Elizabeth Park.

Soil samples collected from 40 different yards were analyzed for other potential contaminants such as extractable organic compounds, chlorinated pesticides, PCBs, and mercury. Most organic analytes were not detected. However, occasional detections were noted for phthalate esters (plasticizer compounds), some polynuclear aromatic hydrocarbons (i.e., naphthalene, phenanthrene, fluoranthene, pyrene, benzo(b) fluoranthene, and benzo(a)pyrene as constituents of fossil fuels and their combustion products), and polychlorinated biphenyls (PCBs as components of electrical transformer dielectric fluids). Chlorinated pesticides were detected in several samples in each town. For those pesticides observed, the frequencies of detection range from a low of 14 percent for aldrin, lindane, and heptachlor to a high of 100 percent for DDT isomers and metabolites, chlordane, and heptachlor epoxide. Greatest concentrations and frequencies of detection for pesticides in soils were found in Smelterville, Kellogg, and Wardner, with significantly lower levels in Page. Presence of organic and pesticide contaminants in residential soil could not be related to mining and industrial activities associated with the site.

Many residential streets and roads do not have paved curbs and sidewalks. Metals concentrations from samples collected from the surface inch of the road shoulders are shown in Table 5-3. Metals concentrations in roadside samples show considerable variation, both geographically and within towns. Samples from Smelterville ranged from 249 to 60,100 ppm Pb; 3 to 487 ppm Cd; and 19 to 810 ppm As. Samples from the Sunnyside area of Kellogg (north of I-90) averaged 1,935 ppm Pb; 19 ppm Cd; and 71 ppm As. Old Town area (south of I-90) samples averaged 4,497 ppm Pb; 28.6 ppm Cd; and 81 ppm As. Wardner and Pinehurst area samples were notably lower, averaging 1,385 ppm Pb; 15 ppm Cd; and 73 ppm As. Samples of street sweeper dust showed lead contents from 1,560 to 2,230 ppm and zinc levels exceeding 10,000 ppm (1 percent).

In 1988 and 1989, efforts were undertaken to assess recontamination at sites cleaned up in the summer of 1986. Removal actions implemented during 1986 included a 6-inch removal of contaminated soils and replacement with clean materials and sod in parks and playgrounds, and asphalting or gravel cover of roadsides and parking lots. Table 5-4 summarizes the original (preremediation) lead concentrations, remedial material (clean fill) lead concentrations, and the two recontamination assessment efforts.

The few sod samples collected suggest surface recontamination rates of 10 to 100 ppm/yr lead. No recontamination was evident in either the top inch or middle of the soil fill on sodded sites or play fields. Some recontamination was evident at the interface of replaced soils and top of the original cut. Whether this was due to contaminant migration, mixing at the time of placement, or imprecise layering of the sample is unknown. Rudimentary modeling has indicated that upward migration potential exists only in isolated areas where there is shallow groundwater.

Graveled areas, particularly those used as parking lots, showed significant recontamination. Because of the low rates of surface deposition, these increases likely resulted from the continual working of the original soil layers below the replacement materials or tracking of contaminants onto the site by vehicles.

Migration and transport of contaminated solids from the industrial complex and other fugitive dust sources are a major concern in both the Populated and Non-populated Areas of the site. Windblown dusts are potentially significant contributors to contaminant concentrations in human receptor media in the Populated Areas and have been identified as a major source of public complaint. Many of the identified fugitive dust sources are barren soils and impounded wastes and storage piles that can result in significant amounts of reentrained dusts.

Eighteen major barren areas identified as having a potentially significant impact on the residential areas were sampled during remedial investigations in 1986. Table 5-5 identifies the areas sampled, the respective size of each area, the number of samples collected, summary statistics for lead content in the minus 200-mesh portion of the sample, and the average percentage (by weight) that passed the 200-mesh sieve. Antimony, arsenic, cadmium, copper, and zinc were also detected in all samples collected. Locations of the fugitive dust source areas sampled are provided in Figure 5-1.

Table 5-3
Summary of Road Shoulders and Railroad Right-of-Way Sample Survey

	Sb (ppm)	As (ppm)	Cd (ppm)	Cu (ppm)	Pb (ppm)	Hg (ppm)	Zn (ppm)
Smelterville	9.4	19.4	3	33.9	249	1.3	220
Smelterville	41.7	115	14.2	186	6,970	3.8	2,590
Smelterville	32.7	50.8	26.9	499	2,410	0.06	10,100
Smelterville	40.5	77.7	61.5	274	4,970	0.08	4,770
Smelterville	46.2	267	312	1,950	10,200	2.4	23,600
Smelterville	534	810	487	2,820	60,100	26.2	20,200
Kellogg Sunnyside	8.6	36.2	16.2	106	1,590	0.52	1,560
Kellogg Sunnyside	19.8	103	22.6	297	2,280	0.35	5,360
Kellogg Old Town	34.8	110	31.1	214	7,430	3.8	2,710
Kellogg Old Town	5.9	31.8	28.7	161	1,990	0.94	3,270
Kellogg Old Town	22.6	102	26	305	4,070	0.79	7,210
Wardner	5.2	44.4	12.2	352	1,300	0.16	8,560
Pinehurst	23.2	87.1	11.2	131	1,010	0.24	2,220
Pinehurst	9.4	19.4	9	84.9	725	0.3	1,520
Pinehurst	13.6	47.1	10.5	290	1,020	0.11	6,740
Pinehurst	18.2	85.9	24.5	475	1,580	0.06	9,980
Pinehurst	5.2	41	9	814	425	0.38	18,700
Pinehurst	12.4	149	12	570	735	0.46	12,300
Pinehurst	36.7	85.1	11.2	596	2,110	0.46	10,600
Pinehurst	21.7	96.2	36.2	700	3,560	0.6	10,900
Page	5.2	23.2	9.2	203	480	0.14	4,390
Page	5.2	24.9	11.8	487	595	0.16	11,600
Page	5.2	47.7	65.4	842	1,380	1.3	22,500
Elizabeth Park	7	15.1	5.2	99.9	329	0.28	2,200
Elizabeth Park	9.5	36.4	18.9	631	1,060	0.14	14,700

Table 5-4
1986 "Fast-Track" Removal Efforts and Lead Recontamination Surveys (Page 1 of 2)

Site	1985 U.S. EPA/ IDHW Pre-removal Levels	1986 Removal Action[a]	Recontamination Surveys					
			1988 Sample Results		1989 Sample Results			
City Park Smelterville-S4	8,370 ppm (in playground area)	Playground 6" removal covered with bark chips	Dust from tennis court[b] Playground bark chips	17,800 ppm Pb 792 ppm Pb	Playground Bark Middle Fill Bottom Fill Top of Cut	Core 1 552 ppm 403 ppm 128 ppm 3,510 ppm	Core 2 1,020 ppm 19 ppm 148 ppm 4,910 ppm	Core 3 489 ppm 32 ppm 169 ppm 4,410 ppm
City Park Smelterville-S5		Turnout Asphalted	Turnout dust from asphalt	2,840 ppm Pb	No Sampling			
McKinley Avenue Smelterville-S2	24,000 ppm	6" removal and gravel fill	Road shoulders gravel West End-North West End-South Middle-North Middle-South East End-North East End-South	 1,930 ppm Pb 3,230 ppm Pb 3,480 ppm Pb 2,740 ppm Pb 3,820 ppm Pb 2,620 ppm Pb	No Sampling			
Gold Street Park Kellogg-K10	216 ppm	6" removal replace with pea gravel	Pea Gravel Near fence In disturbed area	 1,320 ppm Pb 438 ppm Pb	No Sampling			
Riverside Park Kellogg-K9	1,205 ppm	6" removal and replace	Soil West Side Monkey bars Slide Swings	 35 ppm Pb 56 ppm Pb 37 ppm Pb 33 ppm Pb	No Sampling			
Station Avenue Kellogg-K2	11,100 ppm	Removal to base and gravel cover	West End-North West End-South East End-North East End-South	514 ppm Pb 408 ppm Pb 317 ppm Pb 339 ppm Pb	No Sampling			

Table 5-4
1986 "Fast-Track" Removal Efforts and Lead Recontamination Surveys (Page 2 of 2)

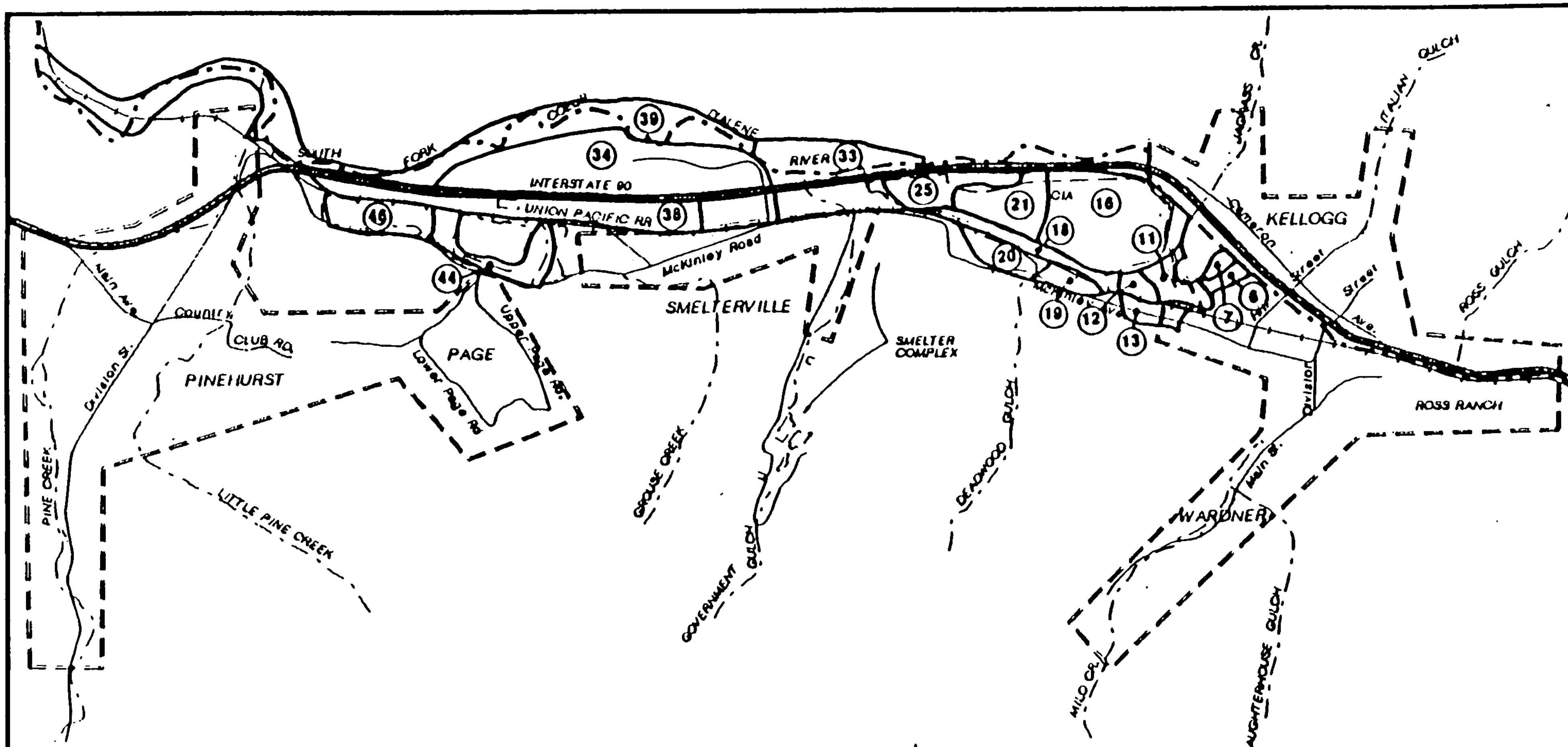
Site	1985 U.S. EPA/ IDHW Pre-removal Levels	1986 Removal Action[a]	Recontamination Surveys					
			1988 Sample Results		1989 Sample Results			
Teeters Field Kellogg-K1	2,863 ppm	6" removal and replacement of infield area	Infield	70 ppm Pb	Infield	Core 1	Core 2	Core 3
			Backstop	306 ppm Pb				
			Duplicate	70 ppm Pb	0-1 Inch	22 ppm	77 ppm	43 ppm
					Middle Fill	34 ppm	52 ppm	9 ppm
					Bottom Fill	120 ppm	188 ppm	373 ppm
					Top of Cut	4,130 ppm	5,500 ppm	8,350 ppm
Memorial Park Kellogg-K4	2,278 ppm	6" removal infield replaced	Infield	138 ppm Pb	Playground	Core 1	Core 2	Core 3
			Road[b]	648 ppm Pb	Area			
			South gravel[b]	8,800 ppm Pb	Litter	-- ppm	173 ppm	-- ppm
			North gravel[b]	450 ppm Pb	0-1 Inch	25 ppm	26 ppm	15 ppm
		Play areas 6" removal and replaced	Playground	80 ppm Pb	Middle Fill	10 ppm	10 ppm	9 ppm
					Bottom Fill	324 ppm	25 ppm	26 ppm
					Top of Cut	1,770 ppm	275 ppm	509 ppm
					Infield			
					0-1 Inch	48 ppm	51 ppm	34 ppm
					Middle Fill	23 ppm	8 ppm	9 ppm
					Bottom Fill	19 ppm	15 ppm	40 ppm
					Top of Cut	921 ppm	2,040 ppm	1,760 ppm

[a] Clean soil lead concentrations 19 to 86 ppm. Clean bark lead concentrations 28 ppm.
[b] Site not remediated.

Table 5-5
Fugitive Dust Source Areas

Map I.D. Number	Site Name	No. of Samples	Area (Acres)	Lead Concentration (µg/gm) Minimum	Mean	Maximum	% of Sample < 200 Mesh
6	Vacant lot west of Mineral Subdivision	8	9	13,400	19,900	26,600	15
7	Undeveloped area near the Junior High School	4	6	1,160	1,810	2,500	26
11	Area near Shoshone Apartments	8	27	30,900	49,100	68,400	28
12	Water treatment plant	4	6	40,000	43,400	48,700	22
13	Parking lot west of Concentrator Building	4	6	212,000	232,000	252,000	30
16	Central Impoundment Area (North Beaches)	20	150	117	5,530	25,300	51
18	Bunker Creek Corridor	12	33	10,300	19,300	42,400	31
19	Old homesite area	8	9	6,560	21,100	47,500	47
20	Old Gypsum Pond	8	29	8,050	62,000	85,800	18
21	New Gypsum Pond	12	61	78	2,160	10,900	30
25	Slag pile	12	26	1,370	10,700	18,200	15
33	Outdoor theater	8	83	2,950	9,190	15,900	18
34	Airport	24	232	11,100	15,500	28,200	29
38	Smelterville Corridor	16	127	11,600	19,800	32,700	33
39	River Channel Flats	12	70	3,970	5,340	6,310	6
44	Page Ponds	12	36	2,560	4,350	6,550	68
46	Page Swamp	4	44	3,850	4,710	6,000	57
	Smelterville	*	*	9,690	15,100	25,400	14

*Specifics of this sample site are confidential, as agreed to in the sampling access agreement with the property owner.



LEGEND:

PROJECT BOUNDARY

I90

RIVERS AND STREAMS

RAILROAD

SITE PLAN

0 .6 1

MILES

N

NOTE:
DESCRIPTIONS FOR SOURCE AREA IDENTIFICATION NUMBERS ARE PRESENTED IN TABLE 5-5.

Figure 5-1
POTENTIAL SOURCE IDENTIFICATION MAP FOR WINDBLOWN DUSTS

Highest metal concentrations among fugitive dust sources were found adjacent to the concentrator building, with the lead concentration averaging about 230,000 ppm (23 percent), and arsenic and cadmium levels each at approximately 10,000 ppm (1 percent). Dust content for this sample was high with 30 percent of the solids passing a 200-mesh sieve. The surrounding areas (11 and 12) also have relatively high metal contaminant levels that may be related to emissions from the concentrator area. Barren areas near Shoshone Apartments (Area 11) and the Water Treatment Plant (Area 12) exhibit approximately 49,000 ppm (4.9 percent) and 43,000 ppm (4.3 percent) lead in surface dust, respectively. The arithmetic mean lead concentration for all fugitive dust source areas is 28,400 ppm (2.8 percent). Source areas near the smelter complex and throughout the river floodplain routinely exhibited levels in excess of 2 percent lead. Percent of sample solids to pass the 200-mesh sieve ranged from 6 to 68 percent, averaging 30 percent for all samples.

Air monitoring was used to investigate air contaminant transport mechanisms. Air monitor locations are shown in Figure 5-2. Total Suspended Particulate (TSP) data are summarized in Table 5-6. Metal content of filters collected on high dust event days (defined as days with TSP>150 $\mu g/m^{3}$) is summarized in Table 5-7. The 19 days in 1987 where blowing dust events were measured account for 43 percent of the Total Suspended Particulates (TSP) loading for the entire 116-day sampling season. The single highest day (September 2, 1987) alone accounted for nearly 10 percent of the total monitoring season loading. In 1989, the peak 10 days accounted for 48 percent of the loading for the 90-day monitoring period.

Metal contaminant levels in house dusts are presented Table 5-8. House dust metal contamination, and especially lead contamination, has decreased markedly since 1974. For example, the mean house dust lead concentration in Smelterville for 1974 was approximately 12,000 ppm (1.2 percent) and has decreased to a mean level in 1988 that is one-tenth the 1974 value (1,200 ppm). Prior to 1981, during smelter operations, the primary route for house dust lead contamination was airborne deposition of smelter lead particulate matter. Since 1981, house dust metals levels have been related to residential soil concentrations. Contaminated dusts reach homes via deposition of windblown dusts or mechanical translocation of contaminated residential soils. Several studies indicate house dust lead levels in urban and smelter communities (exclusive of those impacted by interior leaded paints) are dependent on lead levels in residential soils.

5.3 CONTAMINANT MIGRATION

Soils within the site have been contaminated by heavy metals, to varying degrees, through a combination of airborne particulate deposition, alluvial deposition of tailings dumped into the river by mining activities, and contaminant migration from onsite sources. Onsite sources include the smelter facility, industrial complex, tailings and other waste piles, barren hillsides, and other fugitive dust source areas located throughout the site. Since shutdown of the smelter, contaminant migration pathways of primary concern are fugitive dust, flooding that redeposits tailings into residential areas, water erosion that results in contaminated soil movement off of the hillsides, and human activities that either exacerbate the previous pathways or directly contaminate residential soils.

The current primary contaminant migration mechanism is airborne deposition of contaminated dusts from fugitive dust sources in and adjacent to the mining/smelting complex. Air monitoring information collected during RI/FS activities and summarized in the RADER indicates that airborne dusts transported into the Populated Areas have concentrations ranging from 1,000 to 20,000 ppm lead.

Total dry airborne particulate deposition rates average 2,532 $\mu g/m^2/hr$ and 1,768 $\mu g/m^2/hr$ at the Smelterville Mine Timber and Kellogg Middle School monitoring sites, respectively (Figure 5-2). Wet deposition rates averaged 484 and 487 $\mu g/m^2/hr$ at the Smelterville and Kellogg sites, respectively. More than 80 percent of the total particulate and more than 90 percent of most metals deposition occurs as

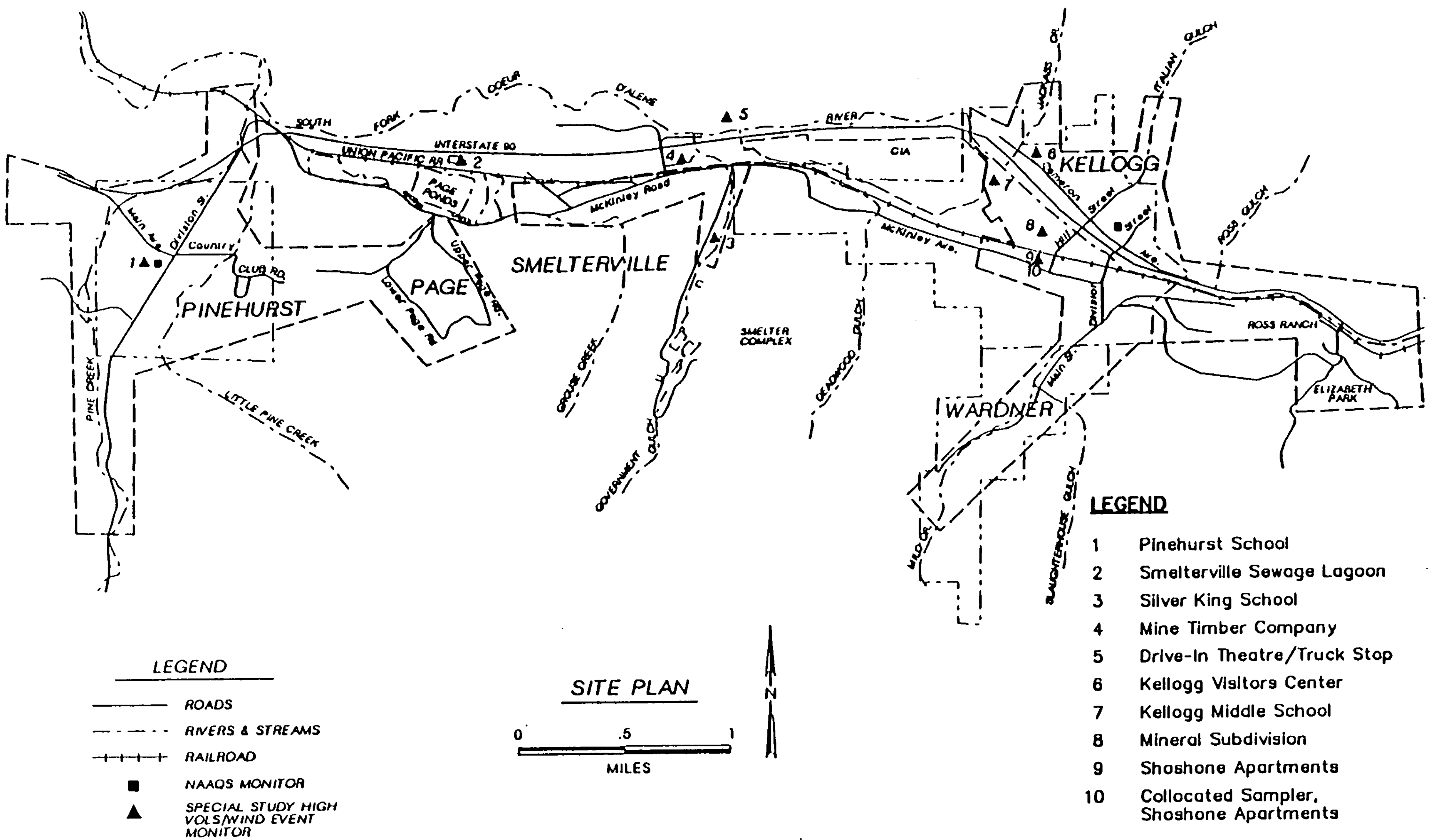


Figure 5-2
AIR MONITORING LOCATIONS
BUNKER HILL POPULATED AREAS RI/FS

Table 5-6
1987 and 1989 Air Monitoring TSP Data ($\mu g/m^3$)

1987		Monitor Number									
		1	2	3	4	5	6	7	8	9	10
Minimum		13	10	8	10	4	11	6	8	5	6
Average		87	76	71	79	71	55	58	68	70	69
Maximum		589	853	821	915	811	722	904	691	690	744
		Frequency Distributions									
Loading Range											
0 - 50	n %	42 36	68 59	70 60	60 52	60 52	84 72	88 76	61 53	58 54	56 55
50 - 100	n %	47 41	39 34	29 25	39 34	37 32	24 21	19 16	42 36	32 30	30 29
100 - 150	n %	18 16	4 3	10 9	6 5	11 9	3 3	4 3	7 6	9 8	8 8
Over 150	n %	9 8	5 4	7 6	11 9	8 7	5 4	5 4	6 5	9 8	8 8

1989		Monitor Number									
		1	2	4	5	5a (PM_{10})	7	7a (PM_{10})	8	9	10
Minimum		10	9	8	6	6	0	2	8	0	20
Average		54	53	54	65	44	43	31	72	66	91
Maximum		309	349	345	683	321	278	127	390	398	341
		Frequency Distributions									
Loading Range											
0 - 50	n %	45 69	36 74	49 71	42 61	39 83	54 78	43 90	38 55	37 56	7 28
50 - 100	n %	15 23	9 18	15 22	19 28	4 9	11 16	2 4	16 23	19 29	11 44
100 - 150	n %	0 0	0 0	0 0	3 4	1 2	0 0	3 6	6 9	6 9	4 16
Over 150	n %	5 8	4 8	5 7	5 7	3 6	4 6	0 0	9 13	4 6	3 12

Table 5-7
Summary of Air Filter Metals Data ($\mu g/m^3$)
1987 and 1989 Event Monitoring

1987 Event Monitoring	Monitor Number									
Analyte: Arsenic	1	2	3	4	5	6	7	8	9	10
Minimum	0.004	0.005	0.004	0.004	0.002	0.003	0.005	0.004	0.003	0.003
Average	0.008	0.022	0.020	0.028	0.021	0.017	0.039	0.052	0.065	0.087
Maximum	0.014	0.176	0.089	0.103	0.095	0.131	0.415	0.287	0.382	0.625
Analyte: Cadmium										
Minimum	0.001	0.001	0.002	0.001	0.002	0.001	0.002	0.001	0.001	0.001
Average	0.002	0.005	0.012	0.008	0.010	0.007	0.015	0.018	0.032	0.039
Maximum	0.002	0.028	0.062	0.033	0.086	0.058	0.151	0.110	0.155	0.237
Analyte: Copper										
Minimum	0.074	0.074	0.056	0.038	0.089	0.017	0.061	0.052	0.044	0.034
Average	0.204	0.169	0.165	0.109	0.144	0.066	0.130	0.145	0.203	0.184
Maximum	0.437	0.233	0.489	0.217	0.259	0.172	0.364	0.490	0.616	0.761
Analyte: Lead										
Minimum	0.041	0.061	0.090	0.047	0.044	0.030	0.033	0.040	0.039	0.031
Average	0.224	0.703	0.997	1.067	1.059	0.382	0.656	1.214	1.799	2.400
Maximum	1.713	3.914	8.591	4.955	4.394	2.874	6.263	7.825	10.007	15.460
1989 Event Monitoring	**Monitor Number**									
Analyte: Arsenic	1	2	4	5	5a (PM_{10})	7	7a (PM_{10})	8	9	10
Minimum	0.004	0.004	0.004	0.004	0.003	0.004	0.003	0.004	0.008	0.012
Average	0.008	0.007	0.010	0.009	0.006	0.010	0.008	0.031	0.022	0.022
Maximum	0.027	0.010	0.032	0.019	0.017	0.028	0.021	0.098	0.059	0.060
Analyte: Cadmium										
Minimum	0.003	0.005	0.003	0.003	0.003	0.003	0.004	0.005	0.005	0.004
Average	0.006	0.006	0.007	0.006	0.005	0.005	0.006	0.015	0.018	0.024
Maximum	0.021	0.010	0.023	0.014	0.008	0.008	0.009	0.053	0.062	0.094
Analyte: Copper										
Minimum	0.064	0.019	0.076	0.048	0.011	0.096	0.019	0.038	0.057	0.092
Average	0.133	0.119	0.132	0.073	0.045	0.354	0.053	0.121	0.176	0.134
Maximum	0.293	0.185	0.257	0.107	0.117	0.712	0.083	0.217	0.317	0.227
Analyte: Lead										
Minimum	0.058	0.053	0.120	0.078	0.045	0.054	0.027	0.139	0.242	0.180
Average	0.091	0.103	0.607	0.542	0.193	0.202	0.124	1.544	1.033	1.179
Maximum	0.189	0.296	3.553	1.611	0.690	0.517	0.437	4.157	2.879	4.013

Table 5-8
Geometric Mean and Extreme House Dust Metal Concentrations
1974, 1975, 1983, and 1988 Lead Health Survey
(ppm)

		As	Cd	Cu	Hg	Pb	Sb	Zn
1974								
Smelterville	Mean (95%ile)	8.0 (28.5)	113.0 (503.0)	•	17.8 (109.0)	10,583 (30,394)	185.0 (409.0)	5,432 (17,154)
Kellogg/Wardner/ Page	Mean (95%ile)	5.7 (40.3)	65.5 (227.0)	•	7.3 (66.6)	6,581 (23,017)	174.0 (844.0)	3,940 (9,575)
Pinehurst	Mean (95%ile)	3.3 (15.9)	29.5 (73.5)	•	3.5 (11.9)	2,006 (5,453)	120.0 (312.0)	2,695 (6,515)
1975								
Smelterville	Mean (95%ile)	•	42.0 (159.0)	•	•	3,533 (21,807)	•	•
Kellogg/Wardner/ Page	Mean (95%ile)	•	44.7 (122.0)	•	•	4,573 (13,521)	•	•
Pinehurst	Mean (95%ile)	•	25.0 (81.5)	•	•	1,749 (6,694)	•	•
1983								
Smelterville	Mean (95%ile)	•	63.3 (125.5)	•	•	3,715 (7,754)	•	2,695 (5,070)
Kellogg/Wardner/ Page	Mean (95%ile)	•	37.6 (93.0)	•	•	2,366 (7,840)	•	2,443 (10,373)
Pinehurst	Mean (95%ile)	•	24.6 (68.3)	•	•	1,155 (3,255)	•	1,578 (3,301)
1988								
Smelterville	Mean (95%ile)	25.7 (80.0)	15.4 (52.0)	177.0 (1,073.0)	1.3 (7.8)	1,203 (4,615)	18.9 (64.0)	1,394 (4,309)
Kellogg/Wardner/ Page	Mean (95%ile)	26.3 (115.0)	15.6 (47.0)	167.0 (963.0)	1.3 (4.6)	1,450 (8,643)	27.9 (147.0)	1,401 (5,143)
Pinehurst	Mean (95%ile)	•	•	•	•	•	•	•

NOTE:

•Data not available. Exposure estimates will employ concentration from most recent measurements. Source: IDHW 1974, 1975, 1983, and 1989.

dry deposition. The maximum dry deposition rate observed was 12,595 $\mu g/m^2/hr$ at the Mine Timber site during the second week of September 1988. Only four metals were observed to have dry deposition rates consistently exceeding 1.0 $\mu g/m^2/hr$. Those were iron, lead, manganese, and zinc with annual average deposition rates at the Mine Timber site of 132, 12.7, 8.6, and 11.3 $\mu g/m^2/hr$, respectively. The maximum weekly lead deposition rate observed was 83.8 $\mu g/m^2/hr$ at the Mine Timber site, also occurring during the second week of September.

The highest deposition rates were observed during the weeks that also included the severe dust event days with Total Suspended Particulates (TSP) >150 $\mu g/m^3$ shown in Table 5-9. The 1988 data confirm that both total solids and contaminant particulate deposition seem to be event-related in a manner similar to the TSP and ambient air metals concentration discussed in the last section. At both sites, more than 25 percent of the total annual solids deposition occurred in four individual weeks in 1988. Those included 1 week in each of May, August, September, and October. The same weeks accounted for 31 percent of total lead, 18 percent of total cadmium, and 29 percent of total arsenic deposition. The 1988 seasonal data also showed a frequency and magnitude of severe dust events (TSP >300 $\mu g/m^3$) similar to that observed in 1987, but absent in 1989.

These results suggest that deposition, similar to TSP, is event-related with the bulk of deposited solids and metals coming as a result of high wind speeds impacting barren dust sources in the vicinity of the monitors.

Water erosion of hillsides near the smelter complex is a migration pathway to residential soil, particularly in yards abutting hill slopes. Mass loading rates are high along these steep barren locations where sheet and rill erosion with gullying are significant. Metals contents on the hillsides average 5,000 ppm lead.

Lead leachability from residential soils was determined by Extraction Procedure (EP) Toxicity and Toxicity Characteristic Leaching Procedure (TCLP) analyses. These tests are used to determine if a material should be considered a hazardous waste pursuant to the Resource Conservation and Recovery Act (RCRA) and, consequently, subject to RCRA storage and disposal requirements. Results showed 3 out of 23 EP Toxicity samples exceeded the RCRA lead threshold level of 5 ppm. Two of the six TCLP samples exceeded the threshold level for lead.

Table 5-9
Individual Filters With TSP >150 $\mu g/m^3$
November 1987 to November 1988

Sample Date	TSP ($\mu g/m^3$)	Cd ($\mu g/m^3$)	Cd (ppm)	Pb ($\mu g/m^3$)	Pb (ppm)
Smelterville Mine Timber					
09-06-88	795.1	0.012	15	3.9	4948
09-03-88	508.4	0.033	65	5.8	1413
08-29-88	357.6	0.006	17	1.9	5180
08-20-88	307.9	0.013	43	3.5	11352
08-25-88	305.3	0.007	24	2.6	8545
09-07-88	253.4	0.006	24	1.5	5985
05-12-88	227.3	0.011	49	1.5	6517
09-09-88	225.6	0.006	28	1.8	7844
07-27-88	214.3	0.005	25	1.5	6943
02-22-88	209.5	0.007	35	0.7	3560
02-24-88	197.9	0.007	34	0.6	3033
02-23-88	190.8	0.007	39	0.7	3826
10-21-88	189.4	0.003	16	0.2	1282
10-03-88	189.2	0.011	59	1.7	9118
04-13-88	185.2	0.017	90	1.6	8894
04-14-88	181.8	0.014	78	1.6	8534
02-25-88	175.2	0.007	41	0.6	3382
07-11-88	170.6	0.001	5	0.2	1210
08-30-88	170.1	0.002	13	1.0	5687
08-01-88	160.9	0.003	18	1.2	7394
09-16-88	160.1	0.004	24	0.4	2654
02-26-88	159.4	0.006	37	0.5	3339
09-15-88	158.9	0.003	21	0.8	5139
10-15-88	158.3	0.000	3	0.0	181
Kellogg Middle School Sites					
09-06-88	594.4	0.068	114	1.5	2568
09-06-88	585.6	0.063	107	1.5	2509
08-29-88	227.6	0.005	21	0.2	852
10-21-88	219.0	0.010	44	0.6	2721
08-19-88	208.8	0.001	5	0.1	380
10-21-88	205.3	0.006	30	0.5	2475
05-12-88	165.0	0.007	42	0.3	1816
09-07-88	154.7	0.011	72	0.3	2008
05-12-88	153.1	0.005	35	0.3	1892
07-11-88	152.6	0.000	3	0.0	215
10-15-88	150.8	0.000	2	0.0	88

6 SUMMARY OF SITE RISKS

6.1 HUMAN HEALTH RISKS

The RADER presents a detailed discussion of the risk assessment for the Populated Areas. In the RADER, both carcinogenic and noncarcinogenic effects of contaminant exposures are evaluated. A Non-populated Areas risk assessment is being conducted in concert with the Non-populated Areas RI/FS.

6.1.1 EXPOSURE ASSESSMENT

The contaminants used in the exposure evaluation and risk assessment are all metals that exhibit: 1) elevated concentrations in residential soils and dusts relative to background concentrations; 2) decreasing concentrations in environmental media with increasing distance from the industrial complex; and 3) potential for human toxicity following incidental and chronic exposures. Contaminants of concern include **antimony, arsenic, cadmium, copper, lead, mercury, and zinc.**

Receptor populations at risk are identified as the current and past residents of the Populated Areas of the site. Three groups have been evaluated in terms of contaminant exposures and consequent risks. These are:

1. A general population of residents that are assumed to live, since birth, under the conditions represented by the contamination levels found since 1983 for a 70-year lifetime (referred to as the current scenario which would also be a future scenario under the No Action Alternative)

2. A general population of residents who were born in 1971 and were 2 years old during the period of maximum exposure onsite and who remain onsite under current conditions for a 70-year lifetime (referred to as the historical scenario)

3. A sensitive subpopulation of children exposed to lead

Historical exposures, since 1971, were evaluated because of documented high contaminant concentrations during 1973-1975. Airborne lead concentrations were approximately 100 times greater during this period than current levels. Consideration of these exposures is critical for evaluating the potential chronic risks of metal contaminants on the population.

Both the current and historical populations (numbers 1 and 2 above) are representative of baseline conditions--those conditions under which no remedial action has been undertaken (the No Action Alternative).

The **principal exposure media** and **associated receptor pathways** characterized for the evaluation of **baseline** human health risk for the typical resident in the Populated Areas of the Bunker Hill site are:

- Ingestion of residential surficial yard soils
- Ingestion of house dusts
- Inhalation of air particulate matter
- Consumption of national market basket variety produce (foodstuffs available on supermarket shelves representing food of average consumers) and water ingestion from

public water supplies (public water is supplied from a surface water source outside site boundaries)

Additional **exposures** that could be experienced by members of the population who engage in potentiall high-risk activities are evaluated as **incremental** exposures. The following incremental exposures were evaluated:

- Consumption of contaminated local groundwater
- Ingestion of other soil/dust at extreme (95th percentile concentration) residential soil and house dust concentrations
- Ingestion of extreme amounts (1 gm/day) of soil and dust during childhood (typical of "pica-type" behavior)
- Consumption of local fish from the Coeur d'Alene area
- Consumption of local vegetable garden produce
- Inhalation of outdoor air particulate matter during episodic, high wind events

To determine an individual's level of risk resulting from participation in potentially high-risk activities, the appropriate incremental risk(s) were added to the baseline estimate. If an individual does not engage in any of the incremental activities evaluated, then the risk to that individual would be the baseline estimate. The incremental exposure analysis can be used to determine the Reasonable Maximum Exposure scenario for the Populated Areas.

Exposures and consequent risks were evaluated for each of the two baseline periods (current and histo cal) in three separate areas (Smelterville, Kellogg/Wardner/Page, and Pinehurst) for the average or typical population. The risk assessment was completed assuming current land uses would continue to be residential.

Lifetime or **chronic** exposures were evaluated for the typical resident by estimating contaminant intakes using average media concentrations (see Table 6-1). For this evaluation, arithmetic mean concentrations for exposure media were used to represent average or typical long-term exposure levels. For residential soil and house dust exposures, geometric mean concentrations were calculated and used for evaluating typical long-term exposures. Geometric mean values for these media are expected to be more representative of average exposures because of the statistical distributions exhibited by soil and house dust metal concentrations.

Chronic exposures at extreme levels are not expected for the typical resident. Therefore, chronic exposures to extreme concentrations of site contaminants are not evaluated in the baseline chronic assessment. Extreme media concentrations represented as 95th percentile levels were evaluated as **incremental and subchronic** exposures.

The traditional approach for risk characterization associated with lead exposure is currently inappropriate because an acceptable Reference Dose (RfD) for lead is not available. Therefore, risk characterization for subchronic lead exposure was accomplished by using observed childhood population blood lead levels and environmental media lead concentrations collected over the last 17 years in an integrated uptake/biokinetic dose-response model. The model was used to relate childhood blood lead levels to contaminated media exposures. Model inputs and criteria were selected and validated using site-specific data as described in the RADER.

Table 6-1 presents a summary of contaminants of concern, exposure routes and sources, and scenarios addressed in the exposure evaluation and risk assessment.

Table 6-1
Contaminants Evaluated, Exposure Routes and Sources, and Exposure Scenarios Addressed in the Risk Assessment

Contaminants Evaluated

Antimony
Arsenic
Cadmium
Copper
Lead
Mercury
Zinc

Exposure Routes and Sources

Chronic

Baseline:

Inhalation--Air/particulates
Ingestion--Soil
Ingestion--House dust
Ingestion--Other soils and dusts
Ingestion--Drinking Water (Municipal Water System)
Ingestion--Market basket produce

Incremental:

Ingestion--Local fish (Lake Coeur d'Alene)
Ingestion--Locally grown garden produce
Ingestion--Drinking Water (onsite groundwater)
Ingestion--Extreme soil/dust consumption rate, "Pica Behavior" (as a child)
Ingestion--Other soils and dusts (maximum estimated exposure)

Subchronic

Dose-Response Modeling for Lead

Exposure Scenarios

Historical--Smelterville
Current--Smelterville
Historical--Kellogg/Page/Wardner
Current--Kellogg/Page/Wardner
Historical--Pinehurst
Current--Pinehurst
Background

6.1.2 TOXICITY ASSESSMENT

A detailed discussion of the toxicity of site contaminants is presented in Section 3.5 of the Protocol Document. Table 6-2 provides a summary of the most sensitive effects for each of the seven site contaminants of concern.

Table 6-2 Summary of Most Sensitive Adverse Health Effects of Site Contaminants of Concern				
	Noncarcinogenic Effects		Carcinogenic Effects[a]	
Chemical	Oral	Inhalation	Oral	Inhalation
Antimony	Gastrointestinal irritation	Irregular respiration	Inconclusive (Group D)	Inconclusive (Group D)
Arsenic	Skin lesions, neuropathy, gastrointestinal irritation	Irritation of mucous membranes	Skin cancer (Group A)	Lung cancer (Group A)
Cadmium	Kidney damage	Kidney damage	No evidence of carcinogenicity	Lung cancer (Group B1)
Copper	Gastrointestinal irritation	Metal fume fever; pulmonary fibrosis	Not classified (Group D)	Not classified (Group D)
Lead	Impaired neurobehavioral development; hypertension	Impaired neurobehavioral development; hypertension	Kidney tumor (high dose only, Group B2)	Same as for oral effects
Mercury	Kidney damage, neuropathy	Lung damage	Not classified (Group D)	Not classified (Group D)
Zinc	Hypochromic microcytic anemia	Pulmonary fibrosis	No evidence of carcinogenicity	No evidence of carcinogenicity

[a]U.S. EPA Carcinogen group classification—refers to the strength of the evidence that a substance causes cancer.
Group A, Human carcinogen
Group B, Probable human carcinogen
Group C, Possible human carcinogen
Group D, Not classifiable
Group E, Evidence of noncarcinogenicity

Tables 6-3 and 6-4 summarize the available Cancer Potency Factors (CPFs) and Reference Doses (RfDs) for the site contaminants of concern. These values were obtained from the Health Effects Summa Tables and Integrated Risk Information System.

Table 6-3 Available CPFs for Site Contaminants of Concern $(mg/kg\text{-}day)^{-1}$		
	Oral Exposure	Inhalation Exposure
Arsenic	1.5	50*
Cadmium	-	6.1

*Inhalation slope factor is in terms of absorbed dose. Absorption/deposition of inhaled arsenic is estimated to be 30 percent.

6.1.3 RISK CHARACTERIZATION

6.1.3.1 Carcinogenic Risk

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk of 1×10^{-6} means that if a population of 1 million people were exposed to the baseline condition over a 70-year lifetime, it is expected that there would be one additional cancer above the cancer events due to other causes. The current U.S. cancer rate is one in four. Therefore, in a population of 1 million people, 250,000 cancer events are predicted. Under a 10^{-6} risk scenario, 250,001 cancer events would be predicted.

Table 6-4
Noncarcinogenic Effects and Associated RfDs for Site Contaminants of Concern

Chemical	Exposure Route	Pathology	RfD (mg/kg-day)
Antimony	Oral	GI Irritation	4×10^{-4}
Arsenic	Oral	Skin Lesions	1×10^{-3}
Cadmium	Oral	Renal Dysfunction Food Water	 1×10^{-3} 5×10^{-4}
Copper	Oral	GI Irritation	1.3 mg/L
Lead	Inhalation and Oral	Various, including Renal Dysfunction, Anemia and Neurobehavioral Deficiencies	Unavailable
Mercury	Oral	Renal Dysfunction	3×10^{-4}
Zinc	Oral	Anemia	0.20

Chemicals with common effects include:
- Cadmium, lead, and mercury for renal toxicity.
- Lead and zinc for anemia.
- Antimony and copper for production of gastrointestinal (GI) irritation.

Results of the chronic exposure and risk characterization indicate that excess (above background) **carcinogenic risk** is associated with baseline exposures and consequent intakes for arsenic and cadmium in air. Total baseline (70-year lifetime) risk to lung cancer, due to inhalation of arsenic and cadmium under **current** site conditions, is from 2 to 32 times greater than for offsite background. Under the historical scenario, risk to lung cancer was two to six times **greater than the current** scenario for the same communities. Baseline cancer risk estimates indicate that the typical population exceeds U.S. EPA's acceptable range for cancer risk (10^{-4} to 10^{-6}).

Acceptable levels of risk to lung cancer may never be attained at any future arsenic and cadmium air levels for those individuals who have had considerable historical and cumulative exposures. Tumor registry data support the presence of a disease-causing agent for the increased occurrence of respiratory cancers in the area.

Baseline carcinogenic risk due to site exposures is approximately 30 percent greater than background carcinogenic risk (9.8×10^{-4}). Baseline carcinogenic risk in conjunction with the **consumption of site groundwater** in Smelterville and Kellogg due to arsenic intakes could result in a doubling of the risk associated with background exposures. Excess health risk due to arsenic in groundwater makes this source unsuitable for drinking in many areas of the site. Groundwater is not currently used as a municipal drinking water source.

Table 6-5 presents a summary of the baseline <u>and</u> incremental carcinogenic risk estimates.

Table 6-5
Summary of Baseline and Incremental Carcinogenic Risk Estimates*

Scenario	Location	Contaminant	Baseline	Local Fish	Local Garden Vegetables	Drinking/ Groundwater	Extreme Soil/Dust Ingestion	Other Soil/Dust	Total, All Intakes
Historical	Smelterville	Arsenic	$1.3x10^{-3}$			$6.7x10^{-4}$	$3.3x10^{-5}$	$5.1x10^{-5}$	$2.1x10^{-3}$
		Cadmium	$1.4x10^{-4}$						
		Total	$1.4x10^{-3}$			$6.7x10^{-4}$	$3.3x10^{-5}$	$5.1x10^{-5}$	$2.1x10^{-3}$
	Kellogg/ Wardner/Page	Arsenic	$1.5x10^{-3}$			$1.9x10^{-4}$	$9.5x10^{-5}$	$3.3x10^{-5}$	$1.8x10^{-3}$
		Cadmium	$1.1x10^{-4}$						
		Total	$1.6x10^{-3}$			$1.9x10^{-4}$	$9.5x10^{-5}$	$3.3x10^{-5}$	$1.8x10^{-3}$
	Pinehurst	Arsenic	$1.2x10^{-3}$				$6.4x10^{-5}$	$3.1x10^{-5}$	$1.3x10^{-3}$
		Cadmium	$6.8x10^{-5}$						
		Total	$1.3x10^{-3}$				$6.4x10^{-5}$	$3.1x10^{-5}$	$1.3x10^{-3}$
Current	Smelterville	Arsenic	$1.1x10^{-3}$			$6.7x10^{-4}$	$2.2x10^{-4}$	$3.1x10^{-5}$	$2.0x10^{-3}$
		Cadmium	$5.8x10^{-5}$						
		Total	$1.2x10^{-3}$			$6.7x10^{-4}$	$2.2x10^{-4}$	$3.1x10^{-5}$	$2.0x10^{-3}$
	Kellogg/ Wardner/Page	Arsenic	$1.1x10^{-3}$			$1.9x10^{-4}$	$1.8x10^{-4}$	$2.4x10^{-5}$	$1.5x10^{-3}$
		Cadmium	$1.8x10^{-5}$						
		Total	$1.1x10^{-3}$			$1.9x10^{-4}$	$1.8x10^{-4}$	$2.4x10^{-5}$	$1.5x10^{-3}$
	Pinehurst	Arsenic	$9.8x10^{-4}$				$6.4x10^{-5}$	$3.1x10^{-5}$	$1.1x10^{-3}$
		Cadmium	$1.4x10^{-5}$						
		Total	$9.8x10^{-4}$				$6.4x10^{-5}$	$3.1x10^{-5}$	$1.1x10^{-3}$

* Contaminants and media for which risk is not estimated is due to lack of either an appropriate CPF and/or media concentrations from which intakes can be estimated. CPFs are available only for arsenic (oral and inhalation) and cadmium (inhalation only).

6.1.3.2 Noncarcinogenic Risk

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminants exposures within a single medium or across media. Excess risk is determined to be where the HI is greater than or equal to 1.0.

All estimated **baseline noncarcinogenic** risks for specific toxic endpoints and target organs resulting from oral intakes of site contaminants of concern have been determined to be acceptable (HI <1).

Potential activities that could result in unacceptable risk to noncarcinogenic disease are associated with metal intakes resulting from consumption of site groundwater, excessive soil and dust ingestion by children, and consumption of local garden produce.

Table 6-6 presents the summary of excess risks evaluated in the noncarcinogenic risk assessment.

Table 6-6
Summary of Exposure Routes, Scenarios, and Potentially High-Risk Activities That Could Result in Unacceptable Chronic Risk to Noncarcinogenic Disease

Exposure Scenario	Baseline HI	HI of Baseline Plus
Skin lesions due to arsenic exposures:		
Historical, Smelterville	0.82	Groundwater consumption, HI ≥ 1.3
Current, Smelterville	0.69	Groundwater consumption, HI ≥ 1.1
Anemia due to zinc (and lead[a]) exposures:		
Historical, Smelterville	0.43	Groundwater consumption, HI ≥ 2.1
Historical, Kellogg/Wardner/Page	0.43	Groundwater consumption, HI ≥ 1.5
Current, Smelterville	0.43	Groundwater consumption, HI ≥ 2.1
Current, Kellogg/Wardner/Page	0.43	Groundwater consumption, HI ≥ 1.5
Gastrointestinal irritation due to antimony and copper exposures:		
Historical, Smelterville	0.70	"Pica-type" behavior, HI = 2.3
Historical, Kellogg/Wardner/Page	0.67	"Pica-type" behavior, HI = 2.0
Historical, Pinehurst[b]	0.86	"Pica-type" behavior, HI = 1.8
Renal dysfunction due to cadmium and mercury (and lead[a]) exposures:		
Historical and Current for both Smelterville and Kellogg/Wardner/Page	.75-.81	Local garden produce, HI ≥1.3 to 1.4
Historical and Current for both Smelterville and Kellogg/Wardner/Page	.75-.81	Groundwater consumption, HI ≥3.5 to 19
Historical and Current, Smelterville	.78-.81	"Pica-type" behavior, HI ≥1.1 to 1.3
Historical, Kellogg/Wardner/Page	.75	"Pica-type" behavior, HI ≥1.0

NOTE:

"Pica-type" behavior is associated with extreme soil and dust ingestion rates exhibited by some children of ages 2 through 6 years.

[a]While an RfD is not available for lead, extreme lead exposures can contribute, among other pathologies, to anemia and renal disease.

[b]Antimony in Pinehurst house dusts is represented by 1974 monitoring results and may be in excess of actual current concentrations.

6.1.3.3 Subchronic Exposure

The most recent lead health survey of area children indicates that current blood lead levels for many children exceed levels at which adverse health effects are associated. In 1990, 2 of 362 children had blood lead levels exceeding 25 μg/dL. Fifty percent (50%) of the children within an approximate 2-mile radius of the industrial complex had blood lead levels exceeding 10 μg/dl. Thirty percent (30%) of the children within the 2- to 3-mile radius of the industrial complex had blood lead levels exceeding 10 μg/dL.

CDC's 1985 Health Advisory for Blood Lead Levels states that "a blood lead level in children of 25 μg/dl or above indicates excessive lead absorption and constitutes grounds for medical intervention." Recent information indicates that adverse health effects are associated with blood lead levels at 10 to 15 μg/dl, or possibly lower. CDC is expected to establish 10 μg/dl as the level above which action should be taken. In addition, ATSDR is supportive of the goal of reducing childhood blood lead levels to below 10 μg/dL.

A review of past exposures and health survey data at the Bunker Hill site indicates that during extreme exposures in the early to mid-1970s, up to 80 percent of the children exhibited blood lead levels that are associated with adverse neurobehavioral development that persists into young adulthood. Additional concern for past lead exposures (prior to smelter closure in 1981) is due to the potential release of lead from normal bone resorption during pregnancy and lactation and the resultant pre- and post-natal exposures to children who are born today of mothers who were exposed as children in the 1970s.

Subchronic exposures and consequent intakes could increase health risks in the short term to levels well above those estimated for baseline chronic risks. Ingestion of extreme amounts of soil and dust during childhood (ages 2 to 6 years), characterized as "pica-type" behavior, could yield up to 10 times greater metal intakes than for the typical child. These extreme intakes due to soil/dust ingestion could amount to approximately 2 mg Pb/day, resulting in dangerous blood lead increases in young children. "Pica-type" behavior could present extreme risk to this highly susceptible sub-group of the population, and requires control if observed.

Consumption of local garden produce can yield extreme intakes of cadmium, lead and zinc. Up to 220 times as much lead can be ingested from the consumption of local garden vegetables grown in Smelterville and Kellogg versus that associated with the consumption of national market basket variety produce. Children and pregnant women (as surrogates to the fetus) are most susceptible to the adverse effects associated with consequent lead intakes. Up to 62 times as much cadmium can be consumed in local garden produce versus market basket variety produce, thus presenting unacceptable chronic and subchronic risk to renal disease.

6.1.4 HUMAN HEALTH RISK SUMMARY

In summary, the conclusions of the RADER state that current site conditions present an environment where there are excessive risks associated with several different exposure pathways. These are:

- Carcinogenic risk associated with exposure to:
  - Arsenic via potential groundwater consumption
  - Arsenic and cadmium via inhalation
- Chronic noncarcinogenic risk associated with exposure to:
  - Arsenic, cadmium, and zinc via potential groundwater consumption

- Antimony, cadmium, mercury, and lead via excessive soil and dust ingestion (characterized by "pica-type" behavior)

- Cadmium and lead via local garden produce consumption

- Subchronic noncarcinogenic risk associated with exposure to:

    - Lead via ingestion of soil and dust

    - Cadmium, lead, and zinc via local garden produce consumption

Subchronic lead absorption among young children is the most significant health risk posed by this site. The major routes for lead absorption are:

- Ingestion of contaminated soils in residential yards and other residential environs

- Ingestion of contaminated house dusts that are resultant from tracking of residential soils and deposition of airborne particulate

- Inhalation and ingestion of airborne particulate matter derived from fugitive dust sources throughout the site

6.1.5 THE 1,000 PPM THRESHOLD CLEANUP LEVEL

A remedial action objective for this operable unit is to decrease the exposure to lead-contaminated residential soils such that 95 percent or more of the children in the area have blood lead levels below 10 μg/dl and that less than 1 percent have blood leads greater than 15 μg/dL. The 1,000 ppm lead cleanup threshold level selected for yard soil remediation at Bunker Hill is a site-specific and media-specific value chosen to meet these objectives. This level is not a target exposure concentration. Rather, it is the maximum soil lead level that any child may be exposed to in his or her home yard. This should not be construed to suggest that this level is health protective for soils at other sites, or other soil and dust media at the Bunker Hill site. A child living on an unremediated yard of 1,000 ppm is estimated to have a 0.1 to 2.5 percent (depending on various assumptions) chance of exceeding 15 μg/dl blood lead in the Bunker Hill post-remediation environment. The following are several reasons why this solution applies only for residential yard soils and only at this particular site:

<u>Response Rate</u>: The response rate value for this site was arrived at after extensive review of epidemiologic and environmental data collected at the site for more than 15 years. Analyses of those data suggest that the dose-response relationship between contaminated soils and dusts and resultant blood lead levels in children is about half that observed at other lead-contaminated sites. Whether the lesser response rate is due to reduced intake (lower soils and dust ingestion rates) or reduced uptakes (lesser absorption of ingested lead in soils) cannot be discerned from the data. The selection of the 1,000 ppm threshold level assumes the latter (i.e., reduced absorption rates at this site).

<u>Total Lead Intake</u>: Predicted blood lead levels resultant from remedial activities are based on total lead intake from all media. The four principal pathways are lead in diet, drinking water, air, and soils and dusts. The effectiveness of the 1,000 ppm threshold level for yard soils is dependent on several assumptions regarding reduced intakes along other pathways. Some of those assumptions are based on assessments of other remedial activities on the site and substantial reductions in dietary intake achieved from nationwide lead reduction initiatives. Those assumptions may not apply to other sites.

Composite Soil/Dust Lead Concentrations: Analyses presented in the RADER suggest that the composite concentrations of lead in all the soils and dusts ingested by children must be reduced to 700 to 1,200 ppm at this site to meet the remedial action objective of less than 5 percent of children having a blood lead of greater than 10 μg/dL. There are several contributing sources to this overall soil and dust loading. Those include yard soils, house dusts, road dusts, play area soils, fugitive dust sources, and other soils in the community where children may congregate. Residential yard soils are an important component of the overall soil and dust loading. A substantial portion of children's exposure results from direct contact in the yard. A substantial portion of house dust loading results from yard soils transported into the home and additional children's exposure results from visits to yards other than their own home. Yard soils may also be a source of contaminated dusts circulating through the community via air, water, and mechanical pathways. Removing all yard soils greater than 1,000 ppm will have positive effects along all these pathways and routes of exposure. However, achieving the remedial action objectives will require additional activities among the soil and dust sources other than yard soils. Those actions are specific to this site and may not be applicable to other locales.

Distribution of Yard Soil Lead Concentration: The effectiveness of the cleanup strategy in meeting remedial action objectives depends on the post-remediation distribution of contaminant levels. That distribution will be site-specific and, likely, inapplicable to other locations. The imposition of the 1,000 ppm cleanup threshold at the Bunker Hill site will result in remediation of more than 75 percent of the yards in most residential areas. The mean yard soil lead concentrations in area communities will be reduced from nearly 3,000 ppm to less than 200 to 300 ppm. This represents a tremendous reduction in total environmental lead loading in the community and should have positive effects in other media as well. Substantial benefit will result in the form of reduced exposure from several sources.

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

6.2 ENVIRONMENTAL RISKS

This Record of Decision addresses the remediation of residential soils within the Populated Areas of the Bunker Hill Superfund Site. There are no critical habitats or endangered species or habitats affected by residential soils contamination or anticipated effects caused by future remediation. An ecological risk assessment is being conducted as part of the Non-populated Areas RI/FS.

The urban component of the ecosystem at Bunker Hill has been impacted by historical mining and smelting activities. The average heavy metal concentrations in residential soils and community road shoulders are higher than on the hillsides portion of the site. Many of the residential soils have metal concentrations capable of inducing toxicological effects on soil micro-organisms, invertebrates, and plants. Comparative concentrations in various other soil types have resulted in reduced productivity, yields, decomposition, and nutrient cycling rates. Other animals that inhabit the urban areas such as field mice and squirrels, as well as cats and dogs, are susceptible to ingestion of residential soils with an increased risk of chemical stress.

Management of soil and vegetation at Bunker Hill can facilitate natural and favorable conditions within the urban ecosystem by reducing the mobility of contaminants and their potential for inducing chemical stress. The replacement of residential soils and vegetation is expected to enhance the micro-habitat niches for the flora and fauna that use them.

7 DETAILED DESCRIPTION OF ALTERNATIVES

This proposed cleanup action involves residential yards, an area that is typically used for many different activities and purposes. While it is important that the cleanup action block the routes by which people come in contact with contaminants in the soil, it is also important that the cleanup action allow residents to use their yards for their many purposes. For example, while a concrete or asphalt layer would block the pathway between the contamination and residents, it would make it impossible for residents to use their yards for typical activities, such as planting and gardening. Therefore, except for the No Action Alternative, all of the alternatives are designed to reduce human exposure to contamination, while maintaining the integrity of the individual yards.

7.1 ALTERNATIVE 1--NO ACTION

The No Action Alternative provides a baseline for comparing against other alternatives. The site would be left in its current condition. Existing institutional controls, such as the Health Intervention Program, would be discontinued. Because no remedial activities would be implemented with the No Action Alternative, long-term human health and environmental risks from residential soils at the site would be essentially the same as those identified in the RADER:

- Significant health risks to young children associated with exposure to ingestion of contaminated soil, ingestion of contaminated house dusts, and inhalation and ingestion of airborne particulate matter would maintain currently unacceptable health conditions and could result in dangerous blood lead increases in young children.
- Excessive soil and dust ingestion by "pica-type" children could result in toxic effects due to antimony, cadmium, and lead.
- Consumption of local produce can increase intakes of cadmium, lead, and zinc, resulting in neurological and renal disease.

Unacceptable high blood lead concentrations in some children would probably continue and the potential for increases in blood lead concentrations could increase because of the termination of the health intervention program.

Environmental monitoring would be conducted under the No Action Alternative. The purpose of the monitoring would be to detect changes in environmental conditions over time. Environmental monitoring would occur for the following media:

Media	Parameters
Air	Suspended particulates, Pb and As concentrations
Residential Soils	Contaminant metals concentrations

Sampling locations would be consistent with previous sample collection sites to provide a basis for historic comparisons. In addition to monitoring environmental media, it is expected that childrens' blood would continue to be screened for lead.

7.2 COMMON COMPONENTS OF ALTERNATIVES 3--VARIABLE CUT/REMOVE/FILL/DISPOSAL; 5--SOD REMOVAL/SOD REPLACEMENT/DISPOSAL; 6--DEEP REMOVAL/FILL/DISPOSAL; AND 8--VARIABLE CUT/REMOVE/FILL/TREAT/DISPOSAL

All of the remaining alternatives have components in common (use of institutional controls, revegetation, dust suppression, excavation/backfill, extent of remediation, disposal, and monitoring). Although the description of these components is not repeated in the discussions for each alternative, differences in their planned implementation are identified where appropriate. ARARs for all alternatives are similar and are discussed in Section 10. Each of these common components is discussed below.

7.2.1 INSTITUTIONAL CONTROLS

Institutional controls would be implemented to a certain degree with each alternative. The reliance on institutional controls is dependent on the remedial action technologies employed and their long-term effectiveness in protecting human health and the environment. The detailed evaluation of the proposed institutional controls are included in the document entitled *An Evaluation of Institutional Controls for the Populated Areas of the Bunker Hill Superfund Site*, which is part of the Residential Soils Administrative Record.

The range of institutional controls consists of the following components:

- Deed notices
- Public education
- Excavation regulations and permits
- Health intervention program
- Contaminated soil collection system
- Clean soil supply system
- Post-cleanup administration and evaluation
- Sod maintenance ordinances
- Lawn maintenance contracting

7.2.2 REVEGETATION

Revegetation of residential yards is a component of each alternative. The lawn areas of remediated yards would generally be revegetated with sod. Steep hillsides and other remediated areas not currently planted with lawns (such as vacant lots) would be stabilized and hydroseeded with native grasses. Native grasses require less maintenance and are more tolerant of the local climatic conditions. If preferred by a property owner, hydroseeding with native grasses could be substituted for the sod. To the extent practicable, all yard landscaping would be returned to its original condition.

7.2.3 DUST SUPPRESSION DURING REMEDIATION

Dust suppression measures would be implemented throughout the remediation process to reduce exposure of workers and residents to airborne contaminants. Dust suppression would include:

- Watering of residential yard areas prior to excavation activities

- Continued watering during excavation, as necessary

- Placement of tarps or covers over excavated materials

- Use of tarps or covers over truck beds to reduce blowing dust and spillage during transportation to the waste repository

- Daily cleanup of all spilled or tracked soils from sidewalks, roadways, etc.

Appropriate air monitoring would be conducted to identify the occurrence of contaminant migration during remedial activities. Any exceedances of the standards would result in immediate implementation of additional dust suppression measures or a shutdown of construction activities.

7.2.4 EXCAVATION/BACKFILL/COVER

For all alternatives, remediation of residential yards would be completed by either covering with a layer of uncontaminated soil or by removing and replacing contaminated soil or sod with uncontaminated materials.

A range of alternatives was developed to provide decisionmakers with several options. Alternative 5 is an option with minimal soil removal and replacement. A 12-inch removal and replacement is presented in Alternative 3. A 6-inch soil barrier was considered during the development of Alternative 3. However, it was concluded that a 6-inch depth is insufficient to provide a viable option as a barrier technology in a residential area, if the underlying material is contaminated. This is because a 6-inch barrier could be penetrated by such common occurrences as a digging dog, a homeowner planting bulbs, or children's play activities. To complete the range of alternatives, Alternative 6 was developed to evaluate deep removal of contaminated materials.

7.2.5 EXTENT OF REMEDIATION

For all of the alternatives, the areal extent of remediation would be consistent. For each residential yard, the exact nature of the remediation (e.g., how much sod to replace, which bushes to remove, etc.) would have to be considered on a case-by-case basis. However, for consistency, the following areas would generally be remediated within each yard:

- Sod areas
- Roadway shoulders (if curb and gutter is not present) to the extension of the lot lines
- Alleys (if unpaved) to the extension of the lot lines
- Planters and other landscaped areas
- Garden areas
- Unpaved driveways
- Garages with dirt floors
- Storage areas

In short, remediation would occur in any area within and adjacent to the residential yard where children could play and could potentially come in contact with contaminated soils. Areas that currently provide a barrier from the underlying soils (such as paved sidewalks and driveways) would not require remediation.

7.2.6 DISPOSAL

The proposed site for disposal of contaminated residential soils for all alternatives is the Page Ponds tailings impoundment. Page Ponds is an old tailings impoundment that is currently the site of the South Fork Coeur d'Alene Sewer District treatment facility. On either side of the sewage lagoons are "benches" that are primarily tailings, denuded of vegetation, and consequently are a source of windblown dust to the valley. The benches (east and west dikes) is the area recommended for the residential soils repository. Consolidation of residential soil and sod onto the Page benches will contribute to reducing fugitive windblown dust throughout the valley.

Since the volume of material requiring disposal will vary with the selected alternative, the volume of soil wastes may exceed the capacity of the Page benches. In that case, an additional disposal site will need to be used to supplement the disposal capacity of Page Ponds since the approximate capacity of Page Pon is 360,000 cubic yards.

The disposal site will have an impermeable cap or cover (i.e., one that is designed to minimize migration of contaminants) placed during closure. The long-term management of the area will include maintenance of the cover and groundwater monitoring. In addition, access restrictions and land use restrictions and/or notices will be used to ensure that future use of the property is not incompatible with a residential soils repository.

7.2.7 ENVIRONMENTAL MONITORING

Regardless of the alternative selected, contaminated materials will remain within the residential areas of the site. Alternative 6, which requires deep excavation to remove materials, will most likely not remove all contaminated material. Therefore, environmental monitoring will be continued at the site for an indefinite period. It is estimated that environmental monitoring of fugitive dust and residential soil and litter would continue. Monitoring will occur at previous sampling locations to provide a basis for historical comparisons. It is expected that blood lead levels would also be monitored. For cost estimating purposes, it is assumed that a greater extent and frequency of sampling will be required in Alternative 5 than the other alternatives, since it would place only a sod layer barrier between the contaminants and the residents.

7.3 ALTERNATIVE 3--VARIABLE CUT/REMOVE/FILL/DISPOSAL

Alternative 3 consists of the following options:

- A 2-inch gravel barrier and 10-inch cover without soil excavation

- A 2-inch gravel barrier installation, and a 10-inch soil replacement after excavation and removal of up to 12 inches of soil (yards would be above grade for excavations less than 12 inches)

Both options are similar in that each incorporates a combination of a visual barrier and a separate soil cover. They differ in where they can be applied to a residential yard because of drainage and homeowner considerations. Whatever the excavation depth, this alternative will result in the placement of a minimum of 12 inches of clean material.

The option of a gravel/soil cover barrier without additional soil excavation is preferred because it minimizes the volume of contaminated soil requiring disposal. A 2-inch clean gravel layer with a 10-inch soil cover would be selected for implementation at residences in which the foundation is high enough in relation to existing grade to allow its use, where permission is granted by the respective property owner, and at residences where drainage is not a problem.

The cover would consist of 2 inches of clean gravel overlain by 10 inches of clean topsoil from an offsite borrow source. The gravel layer would provide a visual and physical barrier indicating to the landowner that the bottom of the remediated soils had been reached, isolating the underlying contaminants from inadvertent exposure. Also, the gravel layer would act to some degree as a capillary barrier to the subsurface migration of metals. Clean fill would be revegetated by sodding. To the extent practicable, the yard landscaping would be returned to its original condition.

A 24-inch layer of topsoil would be placed in established garden areas since some plant roots and tubers extend below 12 inches, but generally less than 24 inches. Future activities that penetrate the 12-inch cover, such as utility line installation, planting of larger trees and shrubs, and basement or foundation excavation, would be controlled through ordinances regulating excavation, as detailed under Section 7.2.1, Institutional Controls.

For those residences in which a simple gravel barrier/soil covering cannot be implemented, contaminated soils would be excavated and replaced with a clean gravel/topsoil barrier. Various depths of excavation and fill would be necessary based on site conditions:

- Excavate 12 inches; replace with 2 inches of gravel and 10 inches of soil.
- Excavate less than 12 inches; replace with 2 inches of gravel and 10 inches of soil (finished grade would be above existing grades).
- Excavate 24 inches, replace with 2 inches of gravel and 22 inches of soil (for established garden areas).

The choice of excavating to less than 12 inches is dependent upon the yard grade in relation to the house floor grade and depth of contamination. Under most circumstances, building codes do not allow yard grades to be higher than house floor grades. The next step to implementing this alternative would be to excavate soils to the selected depth below the ground surface. All sod or other surface coverings, except for pavements, would be removed and disposed of along with the soil. Large trees (4-inch diameter and larger) and shrubs (taller than 3 feet) would be saved, if possible. Trees and shrubs left in place would be trimmed back and contaminated soil would be removed by hand from around the roots. The "clean" soil used to replace the excavated soil would meet borrow source and landscaping specifications. Backfilled areas that were previously lawn areas would generally be revegetated with sod. In some backfilled areas it may be more appropriate to revegetate using hydroseeding with native grasses (steep hillsides, vacant lots, etc.) To the extent practicable, however, the yard landscaping would be returned to its original condition.

The volume of material to be disposed is estimated to be 640,000 cubic yards.

Regardless of the option employed under Alternative 3, environmental monitoring of fugitive dust, residential soils, house dusts, and periodic blood lead analyses of residents would be continued. Monitoring would occur at previous sampling locations to provide a basis for historical comparison.

7.4 ALTERNATIVE 5--SOD REMOVAL/SOD REPLACEMENT/DISPOSAL

Alternative 5 consists of contaminated sod removal and replacement.

Residential yards would be cleared and grubbed, which includes removal of sod, brush, and stumps. Alternative 5 would not include any removal of contaminated soils or replacement with clean soils in grassed areas. The clean sod would be placed over the top of contaminated soils. To the extent practicable, the yard landscaping would be returned to its original condition.

All areas not to be covered with new sod would be remediated using excavate/replace/dispose techniques. Areas such as planters and graveled areas would be excavated to 6 inches. Garden areas would be excavated to 24 inches and backfilled with clean soil, similar to Alternative 3. Contaminated materials would be disposed of in the Page Ponds Repository. The estimated volume for disposal would be

203,500 cubic yards. Clean fill from an offsite borrow source would be used to replace the excavated materials.

Future activities that penetrate the clean sod layer, such as utility line installation, planting of trees an shrubs, and basement or foundation excavation, would be controlled through ordinances regulating excavation, as detailed under Section 7.2.1, Institutional Controls. Additional institutional controls would have to be implemented with Alternative 5 to maintain the long-term viability of the sod layer. These controls would include ordinances requiring homeowners to water and maintain the replacement sod to an acceptable level. Additional inspection would be required by the various government entities to ensure that the sod maintenance ordinances were effectively enforced. A professional lawn maintenance company would be retained to advise and assist the homeowners with proper sod maintenance. The lawn maintenance company would also provide and apply the necessary fertilizers and chemicals to ensure the health and vigor of the sod barrier. Environmental monitoring after remediation would be continued.

7.5 ALTERNATIVE 6--DEEP REMOVAL/FILL/DISPOSAL

Alternative 6 includes removal of contaminated soil to a depth of 7 feet and replacement with clean material. Although this is a deep removal, there may be contaminants left in place in some areas.

The institutional controls requirement with this alternative would be considerably reduced. Since contaminated residential soils would be removed to a depth of 7 feet, future institutional controls for residential yards would be minimized. The public information and health intervention programs would be required, but at a reduced level. Environmental monitoring would be continued.

For residential yards, all contaminated soils would be excavated and replaced with clean soil. The depth of excavation would be determined on a site-by-site basis. The excavation would extend to a depth a which the threshold level was reached or to approximately 7 feet.

Prior to excavation activities, the depth and concentration of lead contamination would be determined in areas to be remediated. Selection of sampling strategy and depth of soil removal would be a function of the remedial design/remedial action process.

Once excavation and fill depths are selected, the next step to implement this alternative would be to excavate soils to the selected depth below the ground surface. All sod or other surface coverings would be removed and disposed of along with the soil. The need to remove and replace pavements and sidewalks would be determined on a case-by-case basis. All trees and shrubs would be removed. The soil used to replace the excavated soil would consist of clean soil from an offsite borrow source. Backfilled areas would be revegetated. To the extent practicable, the yard landscaping would be returned to its original condition.

Soil, sod, and other materials that are removed would be disposed at an appropriate disposal site. It is estimated that Alternative 6 would generate 4.45 million cubic yards of wastes. Preliminary estimates indicate that approximately 860,000 cubic yards of wastes could be disposed of at the Page Ponds Repository. This means that approximately 3.6 million cubic yards of wastes would have to be disposed of at another site, if Alternative 6 is implemented.

Special care would have to be taken when excavating near foundations, basements, and utilities to avoid damage to existing structures and facilities. Temporary shoring and supports may be required. It may be advantageous to remove and replace utility lines, rather than shore and support them during construction.

Because of the inconvenience to the residents and potential liabilities associated with this alternative, the residents would be temporarily relocated during construction. The relocation would be to local motels or hotels and would be expected to last 2 to 3 weeks for an average residential yard remediation.

7.6 ALTERNATIVE 8--VARIABLE CUT/REMOVE/FILL/TREAT/DISPOSAL

Alternative 8 is identical to Alternative 3 except that the excavated soil would be treated with pozzolanic agents prior to disposal.

In Alternative 8, excavated soils would be mixed with pozzolanic agents in a pug mill prior to disposal. The addition of pozzolanic agents will tend to solidify contaminated soils and may reduce contaminant mobility. If this alternative is chosen, treatability studies would be conducted to determine if these soils are amenable to pozzolanic fixation, and if pozzolanic fixation will adequately reduce contaminant mobility. Environmental monitoring would be continued at predetermined intervals. The volume of material to be disposed would increase approximately 50 percent from 640,000 cubic yards to 960,000 cubic yards as a result of pozzolanic treatment.

8 COMPARATIVE ANALYSIS OF ALTERNATIVES

A comparative analysis of alternatives using each of the nine evaluation criteria, as required by federal regulation, is presented in this section. The purpose of this analysis is to identify the advantages and disadvantages of each alternative relative to the other alternatives. A separate evaluation of the alternatives is presented under the heading of each criterion.

8.1 PROTECTION OF HUMAN HEALTH AND ENVIRONMENT

Protection of human health and the environment is addressed to varying degrees by the five proposed alternatives. Alternative 1 is the No Action Alternative. As proposed, it would have no effect on the site; therefore, it does not address any of the identified concerns. Indeed, an increase in blood lead concentrations over time could occur.

Alternative 3, 6, and 8 provide protection of human health through installation of a soil and sod barrier between residents and underlying contaminated materials. All three address the concerns of exposure through direct contact with soil contaminants or tracking contaminated residential soil into homes as a source of house dust. Alternative 5 addresses these concerns, but to a lesser extent than the others because of the requirement for rigorous maintenance. All alternatives address the exposure pathway of local garden produce.

None of the alternatives would alter the toxicity or persistence of the soil contaminants. Alternative 8 does include a treatment plan for excavated soils that would solidify the soils once they are removed from the site and may reduce mobility.

In general, permanence of remedial actions is greatest for Alternative 6 with its essentially complete removal of contaminated soils. Alternatives 3 and 8 provide a degree of permanence through removal of surficial layers of contaminants, requiring less implementation time and effort, but they rely on a greater need for institutional controls. Alternative 5 provides the least amount of protection on a permanent level because of its reliance on institutional controls and the susceptibility of the sod layer to withstand normal human activities and inconsistencies in maintenance.

8.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

With the exception of Alternative 1, the No Action Alternative, all alternatives meet federal and State of Idaho ARARs. A further discussion of compliance with federal and state ARARs is included in Chapter 10.

8.3 LONG-TERM EFFECTIVENESS

The residual risk (the risk remaining after implementation) increases from lowest to highest in the following order of alternatives: 6, 3 and 8, 5, and 1 (No Action Alternative). Alternative 6 would result in the least amount of residual risk because of the volume of contaminated soils that would be removed to ensure that future exposure to onsite residential soil sources does not occur. Although Alternatives 3 and 8 do not reduce residual risk to the same level as Alternative 6, they would protect the communities in the long term if institutional control measures were implemented and followed. Alternative 5 provides the least long-term protection since the sod barrier may be easily breached.

Maintenance requirements for all alternatives would be fairly similar. Each alternative incorporates a sod or grass cover and similar institutional controls. However, the level of the requirement varies with the alternative. Alternative 5 is more sensitive to maintenance requirements because a layer of sod the only barrier between residents and the underlying contaminated soils. Alternatives 3 and 8 follow with a layer of clean fill of at least 12 inches under the sod layer. Alternative 6 requires the least amount of maintenance as a result of the extensive layer of fill (up to 7 feet) needed to return residential yards to their original grade.

Environmental monitoring would vary according to the degree of protectiveness incorporated within the remedial alternatives. Alternative 5 would require the greatest amount of monitoring to ensure that the sod barrier remains effective. This would entail frequent soil and litter metals analyses and blood lead analyses. Alternatives 3 and 8 would require periodic monitoring of the surficial soil layer to check for airborne recontamination and periodic monitoring of the remediated soil profile to check for disruption and recontamination of the soil barrier. Alternatives 3 and 8 would also require periodic blood lead analyses. Alternative 6 would require periodic monitoring of the surficial soil layer and periodic blood lead analyses. Alternative 1 would include environmental monitoring to check for changes in contaminant levels with time. Blood lead screening would be discontinued when warranted.

The disposal recommendation for residential soil is consistent for all alternatives except for Alternative 8, which includes the addition of pozzolanic agents prior to disposal. The long-term effectiveness of the disposal recommendation is ensured through appropriate closure requirements and management by institutional controls.

8.4 REDUCTION OF TOXICITY, MOBILITY, VOLUME, AND PERSISTENCE THROUGH TREATMENT

Each alternative, with the exception of the No Action Alternative, requires varying degrees of contam nated soil removal and placement of a "clean" fill cover to create a barrier between underlying soil contaminants and the residential population. Alternative 8 is the only alternative to incorporate treatment as part of the remedial action. This treatment would solidify the excavated soil and would likely reduce the metals mobility from soils at the disposal area. The additional decrease in mobility by pozzolanic treatment is not known.

All alternatives would increase volume of soil remaining within the Superfund boundaries through bulking (10 to 15 percent of the in-place volume). The volume would increase by approximately 50 percent as a result of the pozzolanic treatment in Alternative 8 as compared to Alternative 3. None of the alternatives proposes to change the toxicity or persistence of the contaminants.

8.5 SHORT-TERM EFFECTIVENESS

Most of the remedial actions are similar in the technologies proposed for implementation. The extent of the remedial action varies considerably among alternatives. Alternatives 3, 5, and 8 are generally equivalent in the amount of short-term risk they pose to the community. Each requires the removal of the top vegetative layer and varying amounts of underlying soil. Each alternative would include continuing to prioritize residential yards on the basis of sensitive subpopulations. Completion of these alternatives would require 4 to 6 years. Alternative 6 would require considerably more time to complete because of its soil removal requirements. Exposure to fugitive dust generated by the remedial activities is the common risk shared by each alternative. Localized releases of metals-laden dust would likely occur during excavation, but such releases would be minimized by dust control techniques. However, none of the action alternatives is expected to substantially affect the communities during remediation.

Alternative 6 would create a slightly higher risk to workers and residents than the other alternatives, mainly because of the volumes of materials to be excavated and moved and the duration of time needed to accomplish Alternative 6. The greater excavation volume would be associated with increased noise and greater annoyance of residents from more construction activity. Heavy equipment traffic would also increase on local roads with implementation of Alternative 6.

Construction contractors would need protection against dermal and respiratory exposure to the dust while working in contaminated areas. Protective clothing and respirators or dust masks would help control this risk. These risks are inherent to all alternatives.

8.6 IMPLEMENTABILITY, RELIABILITY, AND CONSTRUCTIBILITY

In general, there is not a great difference among alternatives in the types of remedial activities proposed. The extent or degree to which the remediation is applied does vary significantly between alternatives. Most of the activities proposed as part of the alternatives including disposal are well-developed technologies. All of these activities are technically feasible, but the level of effort associated with each is different.

Alternative 5 is the most easily implemented alternative proposed, requiring only the removal and replacement of a sod and grass layer. However, Alternative 5 was judged to be the least reliable because of lack of durability and difficulty in implementing and enforcing the extensive associated institutional controls requirements. Alternative 6, however, is the most difficult to construct, requiring removal of up to 7 feet of soil around each residence, and resulting in potential complications associated with exposed structure footings, utility lines, and pipes. Because of this, Alternative 6 has the greatest potential to impact the community through construction delays resulting from complications. Alternatives 3 and 8 are implementable, reliable, and constructible and require slightly more complex activities than Alternative 5, involving the removal of up to 12 inches of soil and the vegetation layer with subsequent replacement of at least 12 inches of "clean" soil and a new sod layer.

8.7 COST

The cost comparisons are straightforward. Comparing present worth costs, Alternative 6 is the most expensive and Alternative 5 is the least expensive of the action alternatives. The costs of the action alternatives, including present worth, are listed in Table 8-1.

Table 8-1 Summary of Estimated Costs			
Alternative	Capital Cost	Annual Operations & Maintenance Cost	Present Worth Cost
Alternative 3 12-inch removal/ replacement	$ 34,200,000	$460,000	$ 41,300,000
Alternative 5 Sod layer removal/ replacement	14,400,000	792,000	28,600,000
Alternative 6 Deep excavation/ replacement	189,000,000	257,000	193,000,000
Alternative 8 12-inch removal/ replacement and pozzolanic treatment	48,900,000	460,000	56,000,000

8.8 STATE ACCEPTANCE

This decision document presents the remedial action selected by the U.S. EPA and IDHW for th Populated Areas Residential Soils Operable Unit at the Bunker Hill Mining and Metallurgical Complex Site in northern Idaho.

8.9 COMMUNITY ACCEPTANCE

U.S. EPA and IDHW solicited input from the community on the cleanup methods proposed for residential soils. Public comments, in general, indicated support for the recommendation of Alternative 3 in the proposed plan and urged an expeditious implementation of the plan. Public comments are specifically addressed in the Responsiveness Summary section of this document and some have been incorporated into the selected remedy.

9 THE SELECTED REMEDY

9.1 INTRODUCTION

IDHW and U.S. EPA have selected Alternative 3 (as modified by public comments) as the remedy for contaminated residential soils at the Bunker Hill site. This selection is based on the Administrative Record for the site. This remedy addresses surficial residential soils only in currently established residential areas. Because of the extent of contamination, both areal and at-depth, this remedy does not focus on complete removal of contamination from residential yards, but focuses on creating a barrier between contaminants and residents. The remedy employs both engineering and institutional controls to create and maintain the barrier.

9.2 RESIDENTIAL SOILS REMEDY

This remedy is made up of the following components:

SOIL SAMPLING

Approximately 60 percent of residential properties have been sampled at the 0- to 1-inch interval. Prior to commencement of remedial action on a specific yard, sampling will be required at the 0- to 1-, 1- to 6-, 6- to 12-, and 12- to 18-inch intervals. The sampling will be conducted in accordance with established sampling procedures for this site including analysis of soil passing an 80-mesh screen for determination of the 1,000 ppm threshold level.

REMOVAL/REPLACEMENT OF SOILS

The removal of contaminated soil and sod and consequent replacement with compacted clean material will be conducted as follows:

> If the 0- to 1-inch **or** 1- to 6-inch-depth intervals exceed the threshold level, 6 inches of contaminated material will be excavated and replaced. In addition, if the 6- to 12-inch interval exceeds the threshold level, another 6 inches (total of 12 inches) will be removed and replaced. If the 6- to 12-inch interval does not exceed the threshold level, the property will have a 6-inch excavation and replacement.
>
> In the case where the 6- to 12-inch-depth interval exceeds the threshold level but the 0- to 1-inch and 1- to 6-inch intervals do not, 12 inches of material will be excavated and replaced.
>
> If the 0- to 1-inch **and** the 1- to 6-inch **and** the 6- to 12-inch intervals do not exceed the threshold level, the property will not be remediated.

All produce garden areas in **every** yard will receive 24 inches of clean material. Clean soil for produce gardens will be made available to residents whose yards do not require remediation.

If existing property grades permit, it is possible that no excavation of residential soils would be necessary and the cover material could be placed and revegetated without exceeding the height of the foundation. However, it is more likely that some cut and removal of existing soil will be required to properly accommodate the clean cover and new sod.

For each residential yard, the exact nature of the remediation (i.e., how much sod to replace, which bushes to remove, etc.) would have to be considered on a case-by-case basis. However, for consistency, the following areas would generally be remediated within each yard:

- Sod areas
- Roadway shoulders (if curb and gutter are not present) to asphalt or pavement and to the lateral extension of property lines
- Alleys (if unpaved) to the extension of the lot lines
- Landscaped areas
- Garden areas
- Unpaved driveways
- Garages with dirt floors
- Storage areas

Areas immediately associated with the residential properties (i.e., road shoulders and alleys) will not require top soil, but will require replacement will clean material in kind or a permanent cover. Any steep hillside areas located immediately adjacent to yards and with a soil lead concentration greater than the threshold level will be stabilized as part of this action to prevent runoff and recontamination. The final remedy for the hillsides will be addressed in a subsequent ROD.

Based on dose response modeling, a threshold level of 1,000 ppm lead in residential soil was determin to be the threshold cleanup level most appropriate for this site. The results of the threshold assessmen , and the assumptions used, are summarized in Table 9-1.

Requirements for removal and replacement of soils on areas adjacent to residential lots, such as vacant residential lots, within the Populated Areas will be the same as for occupied properties.

VISUAL MARKER

For residential yards that require excavation to 12 inches, if the results of sampling in the 12- to 18-inch interval exceed the threshold level, a visual marker (such as erosion control fabric or other suitable material) will be placed prior to backfilling with clean fill.

REVEGETATION

During the excavation process, all existing sod and soil coverings will be removed and disposed of along with the soil. Larger trees and shrubs will be left in place but subject to pruning. After spreading, compaction, and grading, clean fill will be revegetated. The lawn areas of remediated yards will generally be revegetated with sod. Steep hillsides and other remediated areas not currently planted with lawns (such as vacant lots) will be stabilized and hydroseeded with native grasses. If preferred by a property owner, hydroseeding with native grasses could be substituted for the sod. Vacant lots will be hydroseeded with native grasses after remediation. To the extent practicable, all yard landscaping will be returned to its original condition.

Table 9-1
Risk Range for a Threshold Level of 1,000 ppm

1,000 ppm Threshold Scenarios		No. of Homes Remediated	Post Remediation Predicted Mean				% of Children Predicted to Exceed		
			Yard Soil	House Dust	Blood Lead Level µg/dl				
			Pb Conc ppm	Pb Conc ppm	1-3 yrs	1-10 yrs	10 µg/dl	15 µg/dl	25 µg/dl
Kellogg	1	958	121	1,450	7.5	7.0	15-24	2-7.8	<1-1.0
	2	958	121	121	2.8	2.7	<1-1.6	<1	<1
	3	958	121	143	2.9	2.8	<1-1.6	<1	<1
Smelterville	1	238	122	1,203	6.6	6.1	9-18	1.3-5.1	<1
	2	238	122	122	2.8	2.7	<1-1.6	<1	<1
	3	238	122	145	2.9	2.8	<1-1.6	<1	<1
Wardner	1	90	174	1,450	7.4	6.9	16-25	1.9-8.0	<1-1.0
	2	90	174	174	3.4	3.2	1.5-3.8	<1	<1
	3	90	174	255	3.6	3.4	1.5-4	<1	<1
Page	1	24	278	1,330	7.4	6.9	16-25	1.9-8.0	<1-1.0
	2	24	278	278	3.9	3.8	1.8-5.5	<1-1.3	<1
	3	24	278	440	4.2	4.0	1.8-6.0	<1-1.4	<1
Pinehurst	1	143	275	747	5.1	4.8	2.5-9.0	<1-2.0	<1
	2	143	275	275	3.8	2.6	1.5-4.7	<1-1.0	<1
	3	143	275	356	4.0	3.8	1.5-5.0	<1-1.0	<1

Notes: This remedial scenario assumes replacement of all yards with soil lead concentration exceeding 1,000 ppm cleanup threshold. The total number of homes is estimated to be 1,453. Three alternate scenarios assuming a 1,000 ppm threshold cleanup level were evaluated under the following assumptions:

Threshold Scenario

1. Yard Soil Concentration--All yards with levels of >1,000 ppm lead replaced with soils of 100 ppm Pb.
   House Dust Concentration--As observed in 1988.
   Indoor;Outdoor Partition--70%:30%.
2. Yard Soil Concentration--All yards with levels of >1,000 ppm lead replaced with soils of 100 ppm Pb.
   House Dust Concentration--Equal to soil concentration on individual home basis.
   Indoor:Outdoor Partition--70%:30%.
3. Yard Soil Concentration--All yards with levels of 1,000 ppm lead replaced with soils of 100 ppm Pb.
   House Dust Concentration--Equal to community mean yard soil level at remediated homes, equal to yard soil at nonremediated homes.
   Indoor:Outdoor Partition--70%:30%.

DUST SUPPRESSION

Dust suppression measures will be implemented throughout the remediation process to reduce exposur of workers and residents to airborne contaminants. Dust suppression will include, but not be limited tc

- Watering of residential yard areas prior to excavation activities
- Continued watering during excavation, as necessary
- Placement of tarps or covers over excavated materials
- Use of tarps or covers over truck beds to reduce blowing dust and spillage during transportation to the waste repository
- Daily cleanup of all spilled or tracked soils from sidewalks, roadways, etc.

DISPOSAL OF CONTAMINATED MATERIALS

The analysis of Applicable or Relevant and Appropriate Requirements associated with the disposal of contaminated residential soils assumed that the soils repository would be located within the Bunker Hill site. It is recommended that Page Ponds be used for the disposal repository because it has adequate volume, is within the Bunker Hill site, and the action will reduce the contaminated windblown dust originating from the Page Ponds area.

The use of Page Ponds as the repository will require that it be capped to minimize airborne contaminant migration and reduce the threat of direct contact exposure. The cap surface area will be compacted and graded to prevent ponding and minimize infiltration; it will also be vegetated for stabilization and moisture absorption. Access to the area will be restricted by fencing, locked gates, and warning si Future use of the repository will be limited and subject to institutional controls.

If Page Ponds is not used as the residential soil repository, the chosen repository site will be subject to agency evaluation and public notification.

INSTITUTIONAL CONTROLS

The goal of the institutional controls program is to develop a flexible system that builds on existing administrative structures and programs rather than create a new layer of bureaucracy. Institutional controls regulation will be uniform throughout the Bunker Hill site, irrespective of jurisdictional boundaries. The institutional controls associated with this ROD are designed for the maintenance of residential soil barriers only. These controls are necessary and are an integral part of the selected remedy.

<u>**Physical Program Requirements**</u>

Planning, Zoning, Subdivision and Building Permit Regulations: Implementation of planning, zoning, and subdivision controls through local ordinances, designed to protect and maintain barriers when development or any action that would breach a barrier takes place.

Disposal of Unearthed Contaminants: When a barrier is broken, contaminated soils that are removed must be handled to minimize exposure, collected for disposal, and transported to a proper disposal site. A means for disposal of incidental contaminated soils will be provided to residents.

Provision of Clean Soil: A program will be implemented to provide a centrally located supply of clean replacement soil (both fill and topsoil) to facilitate barrier repair, maintenance, and establishment of produce garden areas.

Administrative Program Requirements

Coordination of Public Institutions: Effective administration of a uniform Institutional Controls Program will require shared authority and resources. The four cities and Shoshone County will play an important role through already established permitting procedures. It has been recommended that the Panhandle Health District will administer the effort with permitting, inspection, records maintenance, and enactment of regulations, where necessary, across jurisdictional boundaries.

Deed Notices: These are a method to notify new owners of their barrier system and their responsibility for participation in that system.

Educational Programs: Educational programs will be developed to keep information about the barrier system in the public eye and to help the public recognize when disruption of the barrier systems requires attention or caution. Distribution of information should be provided through pamphleting, brochures, and general media exposure.

Permitting and Inspection Procedures: Permit issuance and recordkeeping procedures should be tailored to minimize inconvenience to permit applicants. A permit system that integrates with existing permit routines will be implemented.

Monitoring and Health Surveillance Programs: Monitoring will be required to assure both program performance and effectiveness. Health intervention efforts will be required to document and assess success in achieving remedial goals and objectives.

An Evaluation of Institutional Controls for the Populated Areas of the Bunker Hill Superfund Site outlines the various options associated with each of the institutional control requirements and will be used in the remedial design phase to guide implementation of the program. The implementation phase, referred to as Phase II, will include passing local ordinances, setting up an administrative system to oversee and run the program, and documentation of detailed procedures for each of the program components.

MONITORING

The effectiveness of the institutional controls program will be evaluated periodically. Appropriate air monitoring will be conducted to identify the occurrence of contaminant migration during remedial activities. Any exceedances of the standards will result in immediate implementation of additional dust suppression measures or a shutdown of construction activities.

Since contaminated material will be left onsite, both in Populated and Non-populated Areas, ongoing monitoring of fugitive dust and residential yards is necessary to ensure that the clean barrier is maintained.

9.3 CHANGES TO PROPOSED PLAN

During the public comment period, several issues were raised concerning the preferred alternative in the Proposed Plan; consequently, several minor modifications have been incorporated into the selected remedy in response to those concerns. The following is a list of those modifications:

- Depth of excavation may be variable (less than 12 inches) depending on depth of contamination.

- For those properties requiring a visual marker, it will be a material that can be easily seen during digging or excavation activities. The visual marker does not have to be a 2-inch gravel layer.

- Requirements for disposal site closure included an impermeable cap to protect ground-water. ARARs associated with groundwater and surface water protection will be addressed in a subsequent FS and ROD.

- The scope of the institutional controls program will be reevaluated periodically because the requirements of a program of this nature may change with time.

- Soil will be provided for homeowners who have a soil lead level less than 1,000 but who want a garden.

9.4 COST

Cost evaluations, including the assumptions used, are presented in the Feasibility Study. A summary of the capital costs associated with the selected alternative is shown in Table 9-2. The costs are order-of-magnitude (+50 percent to -30 percent) estimates. Capital costs are those required to initiate and construct the remedial action. Typical capital costs include construction equipment, labor and materials expenditures, engineering, and construction management. Bid and scope contingencies are also included in the total capital cost. Projected annual operation and maintenance costs for the selected remedy are also presented in Table 9-2. These costs are necessary to ensure the continued effectiveness of a remedial action. Included are such items as labor and materials; monitoring and the institutional con trols program; and insurance, taxes, etc.

The feasibility level cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented here.

Present worth costs are calculated using a 5 percent discount rate and a 30-year estimated project life. The present worth cost for the selected remedy is $40.6 million (Table 9-2). Capital costs and long-term annual operations and maintenance (O&M) costs are included in the total present worth cost. Long-term O&M costs are those associated with maintaining an alternative after implementation is complete.

Costs presented in Table 9-2 are lower than those presented in the Residential Soil Feasibility Study or the Proposed Plan. The reduction in cost is associated with changes to the Proposed Plan as presented in Section 9.3. Specifically, removing the requirement for an impermeable cap accounts for the cost reduction.

9.5 PERFORMANCE REQUIREMENTS

A remedial action objective for this operable unit is to decrease the exposure to lead-contaminated residential soils such that 95 percent or more of the children in the area have blood lead levels below 10 $\mu g/dl$ and that less than 1 percent have blood leads greater than 15 $\mu g/dl$. The former is projected to be achieved by reducing the overall soil and dust loading concentration to 700 to 1,200 ppm. Th

Table 9-2
Summary of Estimated Costs for Selected Remedy

Item	Capital Cost ($)	Annual O&M Cost ($)
Occupied Lots Remediation Total	18,502,000	0
Vacant Lots Remediation Total	3,665,223	0
Disposal Cap	599,078	0
Operations and Maintenance	0	400,209
Health and Safety (10%)	2,276,630	0
Division 1 Costs (8%)	1,821,304	0
Engineering Services (10%)	2,276,630	0
Subtotal	29,140,865	400,209
15% Contingency	4,371,130	60,031
Total Capital Cost	33,500,000	460,000
Total O&M Present Worth	7,100,000	
Total Present Worth	40,600,000	

Notes:

1. Division 1 costs include the costs for general conditions, mobilization, permits, bond, and insurance.
2. The "Occupied Lots Remediation Total" is based on remediation of 1,273 residences.
3. The "Vacant Lots Remediation Total" is based on remediation of 268 vacant residential lots.
4. The present worth was calculated using a discount rate of 5% for 30 years, then rounded to three significant figures.
5. Institutional control costs include personnel, benefits, contractual services, supplies and materials, capital equipment, health intervention program, soil collection program, and material supply program required for annual maintenance of remedial actions.
6. The disposal cap was assumed to be a 1-foot soil cap.
7. Total costs were rounded to three significant figures.

1,000 ppm yard soil threshold cleanup level will reduce mean yard soil concentrations to approximately 200 to 300 ppm in residential areas. In combination with other remedial measures and the positive effects likely to be seen in other media, it is expected that this objective will be met. Achieving t latter objective of less than 1 percent of area children with blood lead concentrations below 15 µg/dl less dependent on the mean soil/dust concentrations than on the soil concentration left in an unremediated yard. A child living on an unremediated yard of 1,000 ppm is estimated to have a 0.1 to 2.5 percent (depending on various assumptions) chance of exceeding 15 µg/dl blood lead in the Bunker Hill post-remediation environment. Any higher threshold cleanup level would result in unacceptable risk to that child. It is expected that this goal will be achieved by replacing all residential yards with a lead concentration greater than 1,000 ppm lead with clean material (less than 100 ppm). This expectation assumes that fugitive dust sources will be controlled and house dust concentrations will consequently decrease and that remediated yards will not be recontaminated.

This remedy mitigates the risks associated with the following pathways identified in the risk assessment:

- Inhalation/Ingestion of Contaminated Residential Soil
- Ingestion of Locally Grown Produce

This remedy does not directly address the risks associated with the following pathways identified in the risk assessment:

- Consumption of Contaminated Groundwater
- Inhalation/Ingestion of Windblown Dust
- Inhalation/Ingestion of Contaminated House Dust

Actions are being taken now to address these risks. The final remediation with respect to these risks will be addressed in a subsequent feasibility study.

10 STATUTORY DETERMINATIONS

The selected remedy for residential soils is protective of human health and the environment, will comply with federal and state requirements that are legally applicable or relevant and appropriate, and is cost-effective. The selected remedy does utilize alternative treatment and resource recovery technologies to the maximum extent practicable. However, since no treatment and resource recovery technologies were found to be practicable, none were incorporated into the remedy. Because this remedy will result in hazardous substances remaining onsite above health-based levels, the 5-year review provisions of CERCLA Section 121c will apply to this action. The following sections discuss how the selected remedy meets the statutory requirements.

10.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Lead absorption among young children is the most significant health risk posed by this site. Residential soils were identified in the RADER to be one of the primary contributors to risk associated with sub-chronic lead absorption. In order to reduce blood lead exposures, the selected remedy replaces metal-contaminated residential soils with uncontaminated soil, thereby breaking the exposure pathway between soils and children. Post-remediation modeling scenarios show that the soil cleanup level of 1,000 ppm will result in a sitewide mean blood lead level of 2.7 to 3.9 μg/dl. Only 1 to 3 percent of the children living onsite are predicted to have blood lead levels in excess of 15 μg/dl. It is expected that at least 95 percent will have a blood lead level less than 10 μg/dl.

Inclusion of produce garden area remediation to a depth of 24 inches will also reduce the exposure to cadmium, lead, and zinc associated with consumption of local garden produce.

The remedy selection will also effectively mitigate chronic noncarcinogenic risks associated with ingestion of antimony, cadmium, and mercury via soil ingestion. Carcinogenic risks associated with arsenic and cadmium exposure through fugitive dust will be addressed under a separate operable unit.

Contaminated residential soils will be consolidated in a permanent repository. All consolidation areas will be protected from erosion and surface infiltration by a revegetated topsoil cap and contouring. Experience with residential soil removal actions during 1989 and 1990 indicate that with appropriate precautions there will be no unacceptable short-term risks or cross-media impacts associated with the implementation of the selected remedy.

The institutional controls program will ensure the maintenance of physical and institutional barriers that protect against metal exposure. Continued blood lead and residential soils monitoring will measure the long-term success of the selected remedy.

House dust has also been identified as a significant lead exposure pathway. Residential soils are a contaminant source to house dust. Thus, remediating residential soils will reduce a contamination pathway to home interiors. Fugitive dust will need to be controlled and monitored concomitant with residential soil remediation to minimize soil recontamination. The RADER discusses the rate of soil recontamination from airborne fugitive dust and recommends that airborne dust be reduced substantially. Control of fugitive dust will also eliminate direct exposure to highly concentrated dusts, reduce accumulation of metals in homes, and prevent excessive deposition on homegrown produce in local gardens. Dust control measures have been taken on the site in the past 2 years. These measures include irrigation of the Central Impoundment Area (CIA), revegetation of some of the Bureau of Land Management (BLM) property on Smelterville Flats, placement of large rocks on barren areas north of the Kellogg Middle School, and spreading of sawdust on the Smelterville Flats area. Control of fugitive dust from barren hillsides is being addressed in the hillside revegetation order previously discussed. Additional dust control measures will be implemented by the potentially responsible parties (PRPs) under the July 1991 Administrative Order on Consent (see Section 2.5).

The analysis presented in the RADER and the FS shows that the remedy selected for residential soils will break the significant exposure pathways associated with soil. Once residential soil removal is completed, waste soils will be consolidated within the area of contamination of the Bunker Hill site, and an institutional controls program is implemented, risks associated with metal-contaminated residential soils will be mitigated. Therefore, IDHW and U.S. EPA have concluded that the selected remedy for residential soils will be protective of public health and the environment.

10.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Pursuant to SARA Section 121(d), remedial actions shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and control of further release which, at a minimum, assures protection of human health and the environment. In addition, remedial actions shall, upon their completion, reach a level or standard of control for such hazardous substances, pollutants, or contaminants which at least attains legally applicable or relevant and appropriate federal standards, requirements, criteria, or limitations, or any promulgated standards, requirements, criteria, or limitations under a state environmental or facility siting law that is more stringent than any federal standard (ARARs). All ARARs would be met by the selected remedy.

The federal and state ARARs identified by U.S. EPA and IDHW, respectively, for residential soil removal are presented in Tables 10-1 through 10-6. An evaluation of chemical, location, and action-specific ARARs is presented in Section 2 of the Residential Soils Focused Feasibility Study. Additional discussion of chemical-specific ARARs and other requirements to be considered (TBCs) is presented in Section 3 of the RADER.

There are currently no promulgated laws or standards for lead in soil. However, a site-specific threshold level of 1,000 ppm lead in residential soil, that is expected to result in a community average of 200 to 300 ppm, has been developed for protection of human health.

For the Bunker Hill residential soils action, contaminated residential soil will be consolidated from yards throughout the site into a single location. Since some residential soils did demonstrate RCRA hazardous characteristics for lead and pesticides (chlordane), an analysis of the applicability or relevance and appropriateness of the RCRA hazardous waste regulations is required:

> For RCRA to be applicable, the material must demonstrate hazardous characteristics, and the proposed action must involve either treatment, storage, or disposal of the material as defined by RCRA. As the Remedial Investigation sampling and analysis has shown, residential properties and all other areas within the Bunker Hill Superfund Site are contaminated to various degrees with lead and other heavy metals. Contamination is contiguous throughout the site and the site is considered a single "area of contamination" (AOC). As described in the preamble to the final NCP, movement of wastes and soil within an AOC at a Superfund site does not constitute disposal or "placement" and therefore does not trigger RCRA, Subtitle C, disposal requirements. For this action, all soil consolidation and movement will be within a single AOC; thus, the RCRA requirements are not applicable.
>
> For RCRA to be relevant and appropriate, the RCRA requirements must address problems or situations that are similar to the action being taken and the requirements must be well suited to the site. U.S. EPA has determined that portions of the RCRA closure requirements are relevant and appropriate for this action.

Table 10-1 (Page 1 of 2) Federal Chemical-Specific ARARs			
Chemical-Specific	**Citation**	**Prerequisite**	**Requirement**
I. Air			
A. Applicable Requirement			
1. Clean Air Act National Ambient Air Quality Standards (NAAQS)	42 U.S.C. Section 7401 et seq; 40 CFR Part 50	Establishes ambient air quality standards for emissions of chemicals and particulate matter.	Emissions of particulates and chemicals which occur during remedial activities will meet the applicable NAAQS which are as follows. Particulate Matter: 150 $\mu g/m^3$ 24-hour average concentration, 50 $\mu g/m^3$ annual arithmetic mean. Lead: 1.5 μg Pb/m^3 (.5 μg Pb/m^3 is proposed)
B. Relevant and Appropriate Requirement	None		
C. To Be Considered Materials	None		
II. Soil and Dust			
A. Applicable Requirements	None		
B. Relevant and Appropriate Requirement	None		
C. To Be Considered Materials			
1. Risk Assessment Data Evaluation Report (RADER) for the Populated Areas of the Bunker Hill Superfund Site	Technical Enforcement Contract Work Assignment C10002 Prepared by: Jacobs Engineering Group, Inc. and TerraGraphics, Inc.	Evaluates baseline health risk due to current site exposures and establishes contaminant levels in environmental media at the site for the protection of public health.	The ARARs for soils may not provide adequate protection to human health; therefore a risk assessment approach using these guidances should be used in determining cleanup levels.
2. Soil/Dust Lead Contamination Advisory	Centers for Disease Control's statement on childhood blood lead levels, 1985.	Removal of contaminated soils.	Lead in soil/dust appears to be responsible for blood lead levels in children increasing above background levels when the concentrations in the soil/dust exceed 500-1,000 ppm. This concentration is based upon the established CDC blood lead level of 25 μg Pb/dl in children. When soil/dust lead concentrations exceed 500-1,000 ppm, blood lead levels in children are found to exceed 25 μg Pb/dl.

Table 10-1 (Page 2 of 2) Federal Chemical-Specific ARARs			
Chemical-Specific	**Citation**	**Prerequisite**	**Requirement**
3. EPA Interim Guidance Concerning Soil Lead Cleanup Levels at Superfund Sites	Office of Solid Waste and Emergency Response (OSWER) Directive #9355.4-02, September 1989.	Establishes an interim soil cleanup level for total lead in residential settings.	This guidance adopts the recom-mendation contained in the 1985 CDC statement on childhood lead poisoning (an interim soil cleanup level for residential settings of 500-1,000 ppm total lead), and is to be followed when the current or predicted land use of contaminated areas is residential.
4. EPA Strategy for Reducing Lead Exposures	Environmental Protection Agency October 3, 1990	Presents a strategy to reduce lead exposure, particularly to young children.	The strategy was developed to reduce lead exposures to the greatest extent possible. Goals of the strategy are to: 1) significantly reduce blood lead incidence above 10 µg Pb/dl in children; and 2) reduce the amount of lead introduced into the environment.

Table 10-2 (Page 1 of 2) Federal Location-Specific ARARs			
Location-Specific	**Citation**	**Prerequisite**	**Requirement**
I. Federal			
A. Applicable Requirement			
1. Historic project owned or controlled by a Federal Agency	National Historic Preservation Act; 16 U.S.C. 470 et seq.; 40 CFR 6.301(b); 36 CFR Part 800.	Property within the residential areas of the site is included in or eligible for the National Register of Historic Places.	The remedial action will be designed to minimize the effect on historic properties and historic landmarks.
2. Site within an area where action may cause irreparable harm, loss, or destruction of artifacts.	Archeological and Historic Preservation Act; 16 U.S.C. 469; 40 CFR 6.301(c).	Property within the residential area of the site contains historical and archeological data.	The remedial action will be designed to minimize the effect on historical and archeological data.
3. Site located in area of critical habitat upon which endangered or threatened species depend.	Endangered Species Act of 1973; 16 U.S.C. 1531-1543; 50 CFR Parts 17, 401; 40 CFR 6.302(h).	Determination of presence of endangered or threatened species.	The remedial action will be designed to conserve endangered or threatened species and their habitat, including consultation with the Department of Interior if such areas are affected.
4. Site located within a floodplain.	Protection of Floodplains, Executive Order 11988; 40 CFR 6, Appendix A.	Remedial action will take place within a 100-year floodplain.	The remedial action will be designed to avoid adversely impacting the floodplain wherever possible to ensure that the action's planning and budget reflects consideration of the flood hazards and floodplain management.
5. Wetlands located in and around the site.	Protection of Wetlands; Executive Order 11990; 40 CFR 6, Appendix A.	Remedial actions may affect wetlands.	The remedial action will be designed to avoid adversely impacting wetlands wherever possible, including minimizing wetlands destruction and preserving wetland values.

Table 10-2 (Page 2 of 2)
Federal Location-Specific ARARs

Location-Specific	Citation	Prerequisite	Requirement
6. Waters in and around the site.	Clean Water Act (Section 404)—Dredge or Fill Requirements; 33 U.S.C. 1251-1376; 40 CFR 230, 231.	Capping, dike stabilization, construction of berms and levees, and disposal of contaminated soil, waste material or dredged material are examples of activities that may involve a discharge of dredged or fill material.	The four conditions that must be satisfied before dredge and fill is an allowable alternative are: - There must be no practical alternative. - Discharge of dredged or fill material must not cause a violation of State water quality standards, violate any applicable toxic effluent standards, jeopardize threatened or endangered species, or injure a marine sanctuary. - No discharge shall be permitted that will cause or contribute to significant degradation of the water. - Appropriate steps to minimize adverse effects must be taken. Determine long- and short-term effects on physical, chemical, and biological components of the aquatic ecosystem.
7. Area containing fish and wildlife habitat.	Fish and Wildlife Conservation Act of 1980; 16 U.S.C. 2901; 50 CFR Part 83.	Activity affecting wildlife and non-game fish.	Remedial action will conserve and promote conservation of non-game fish and wildlife and their habitats.
8. 100-year floodplain.	Location Standard for Hazardous Waste Facilities - RCRA; 42 U.S.C. 6901; 40 CFR 264.18(b).	RCRA hazardous waste treatment storage and disposal.	Facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any 100-year floodplain.
B. Relevant and Appropriate Requirement	None		
C. To Be Considered	None		

Table 10-3 (Page 1 of 4) Federal Action-Specific ARARs			
Action-Specific	**Citation**	**Prerequisite**	**Requirement**
A. Applicable Requirement			
1. Disposal of Solid Waste	RCRA 42 U.S.C. §6901 <u>et seq.</u>; 40 CFR 257	Maintenance of a facility at which solid wastes are disposed of.	- Facility or practices in floodplains will not restrict flow of basic flood, reduce the temporary water storage capacity of the floodplain or otherwise result in a wash-out of solid waste. - Facility or practices shall not cause or contribute to taking of any endangered or threatened species. - Facility or practices shall not result in the destruction or abuse of critical habitat. - Facility or practice shall not cause discharge of pollutants into waters of the U.S. in violation of a NPDES permit. - Facility or practices shall not cause discharge of dredged or fill material into waters of the U.S.. - Facility or practices shall not contaminate underground drinking source beyond facilities boundary. - The concentration of explosive gases generated at the facility shall not exceed: (1) 25% of the lower explosive limit for the gases in facility structures; (2) the lower explosive limit for the gases at the boundary.
1. Disposal of Solid Waste (Continued)			- Facility or practice shall not pose a hazard to the safety of persons or property from fire. - Facility or practices shall not allow uncontrolled public access so as to expose the public to potential health and safety hazards.

Federal Action-Specific ARARs

Action-Specific	Citation	Prerequisite	Requirement
B. Relevant and Appropriate Requirement			
1. Removal of contaminated soils	Surface Mining Control and Reclamation Act of 1977; 25 U.S.C. §§1201 et seq.; 30 CFR Parts 816.11, .95, .97, .100, .102, .107, .111, .113, .114, .116	Removal of contaminated surface soils.	.11-Posting signs and markers for reclamation, including top soil markers and perimeter markers. .95-Stabilization of all exposed surface areas to effectively control erosion and air pollution attendant to erosion. .97-Use of best technology currently available to minimize disturbances and adverse impacts on fish, wildlife, and related environmental values and achieve enhancement of such if possible; conduct no activity which would jeopardize continued existence of endangered species or like to destroy or adversely modify their critical habitat; avoid disturbances to, enhance where practicable, restore or replace, wetlands, riparian vegetation, and habitats for fish and wildlife.
1. Removal of contaminated soils (continued)			.100-Contemporaneous reclamation including, but not limited to backfilling, regrading, topsoil replacements and revegetation. Achieve approximate original contours, eliminate all highwalls, spoil piles, and depressions; .102-achieve a post action slope not exceeding angle of repose or such lesser slope as is necessary to achieve a minimum long-term static safety factor of 1.3 and to prevent slides.
2. Threshold Limit Values (TLVs)	Established by American Conference of Governmental Industrial Hygienists (ACGIH).	Releases of airborne contaminants during remedial activities.	TLVs are based on the development of a time weighted average (TWA) exposure to an airborne contaminant over an 8-hour work day or a 40-hour work week. TLVs identify levels of airborne contaminants at which health risks may be associated. Since there are no ARARs for several of the contaminants of concern--arsenic, antimony, copper, cadmium, mercury, and zinc--the TLVs should be considered for remedial activities which will cause airborne emission of such chemicals. The TLVs for the contaminants of concern are as follows: Antimony 500 $\mu g/m^3$ Arsenic 200 $\mu g/m^3$ Cadmium 50 $\mu g/m^3$ Copper fume=200 $\mu g/m^3$ dust=1,000 $\mu g/m^3$

Table 10-3 (Page 3 of 4)
Federal Action-Specific ARARs

Action-Specific	Citation	Prerequisite	Requirement
2. Threshold Limit Values (TLVs) (Continued)			Lead 150 $\mu g/m^3$ Mercury alkyl = 10 $\mu g/m^3$ Except Alkyl: vapor = 50 $\mu g/m^3$ inorganic = 100 $\mu g/m^3$ Zinc ZnCl = 1,000 $\mu g/m^3$ Zinc Oxide: fume = 5,000 $\mu g/m^3$ dust = 10,000 $\mu g/m^3$
3. Treatment, Storage, or Disposal of Wastes	40 CFR 264.13, .14	The treatment, storage or disposal of RCRA regulated wastes.	Prevent unknowing entry and minimize the possibility of unauthorized entry of persons or livestock to the active portion of the facility. Includes: - artificial or natural barrier completely surrounding the active area - a means to control entry - a sign stating *'Danger, Unauthorized Personnel Keep Out.'*
C. To Be Considered Materials			
1. Estimated Limit Values (ELVs)	Established by American Conference of Governmental Industrial Hygienists (ACGIH).	Releases of airborne contaminants during remedial activities.	ELVs are based on Threshold Limit Values (TLVs) and converted to reflect exposure to contaminants on a 24-hour/day basis. The calculation of an ELV does not take into consideration the additive and synergistic effects of contaminants and additional exposures from media other than air. ELVs are not expected to be completely protective of the potential effects of exposures to contaminants; however, they do provide some indication of airborne contaminant levels at which adverse health effects could occur. Since there are no ARARs for several of the contaminants of concern--arsenic, antimony, copper, cadmium, mercury, and zinc--the ELVs should be considered for remedial activities which will cause airborne emission of such chemicals. The ELVs for the contaminants of concern are as follows:

Table 10-3 (Page 4 of 4) Federal Action-Specific ARARs			
Action-Specific	**Citation**	**Prerequisite**	**Requirement**
1. Estimated Limit Values (ELVs) (continued)			Antimony 10.0 $\mu g/m^3$ Arsenic 5.0 $\mu g/m^3$ Cadmium 1.0 $\mu g/m^3$ Copper fume=5.0 $\mu g/m^3$ dust=20.0 $\mu g/m^3$ Lead 4.0 $\mu g/m^3$ Mercury alkyl=0.2 $\mu g/m^3$ Except Alkyl: vapor=1.0 $\mu g/m^3$ inorganic= 2.0 $\mu g/m^3$ Zinc ZnCl=20.0 $\mu g/m^3$ Zinc Oxide: fume=120 $\mu g/m^3$ dust=200 $\mu g/m^3$

Table 10-4
State of Idaho Chemical-Specific ARARs

Chemical-Specific	Citation	Prerequisite	Requirement
I. Air			
A. Applicable Requirement			
1. Toxic Substances	IDAPA §16.01.1011,01	Emission of air contaminants that are toxic to human health, animal life, or vegetation.	Emissions of air contaminants which occur during remedial activities will not be in such quantities or concentrations as to alone, or in combination with other contaminants, injure or unreasonably affect human health, animal life or vegetation
B. Relevant and Appropriate	None		
C. To Be Considered	None		
II. Soil	None		

Table 10-5
State of Idaho Location-Specific ARARs

Location-Specific	Citation	Prerequisite	Requirement
I. Air	None		
II. Soil			
A. Applicable Requirement			
1. Areas Adjacent to or in the Vicinity of State Waters	IDAPA §16.01.2300	Storage or disposal of hazardous or deleterious materials in the vicinity of, or adjacent to, state waters.	The remedial action will be designed with adequate measures and controls to ensure stored or disposed contaminated soils will not enter state waters as a result of high water, precipitation, runoff, wind, facility failure, accidents or third-party activities.
B. Relevant and Appropriate Requirement			
1. Siting of Hazardous Waste Disposal Facility	I.C. §§39-5801 et seq.	Siting of a hazardous waste disposal facility.	The remedial action will be designed to satisfy some of the technical criteria in the Idaho Hazardous Waste Siting Management Plan as adopted by the Idaho Legislature. Consideration will be given in remedy design to general considerations referenced by the Hazardous Waste Facility Siting Act. However, a siting license for an onsite hazardous waste disposal facility is not required.

Table 10-6
State of Idaho Action-Specific ARARs

Action-Specific	Citation	Prerequisite	Requirement
I. Air			
A. Applicable Requirement			
1. Fugitive Dust	IDAPA §16.01.1251-16.01.1252	Emission of airborne particulate matter.	The remedial action will be designed to take all reasonable precautions to prevent particulate matter from becoming airborne including but not limited to, as appropriate, the use of water or chemicals as dust suppressants, the covering of trucks and the prompt removal and handling of excavated materials.
II. Soil			
A. Applicable Requirement			
1. Management of Solid Waste	IDAPA §§16.01.5000 et seq.	Management of solid waste including storage, collection, transfer, transport, processing, separation, treatment and disposal.	The remedial action will be designed to manage solid waste to prevent health hazards, public nuisances and pollution to the environment in accordance with the applicable solid waste management requirements. No permit is required for onsite actions.
2. Activities Generating Non-point Discharges to Surface Waters	IDAPA §§16.01.2050,06 and 16.01.2300,04	Construction and other activities which may lead to non-point source discharges to surface waters.	The remedial action will be designed to utilize best management practices or knowledgeable and reasonable efforts in construction activities to minimize adverse water quality impacts and provide full protection or maintenance of beneficial uses of surface waters.
B. Relevant and Appropriate			
1. Management of Hazardous Waste	I.C. §§39-4401 et seq., IDAPA §§16.01.5000 et seq.	Generation, transportation, storage or disposal of hazardous waste.	The remedial action will be designed to manage any hazardous waste that may be generated by the remedial action in accordance with the relevant and appropriate generation, transportation, storage and disposal requirements for such waste. Onsite actions are exempt from some requirements, and permits are not required for onsite activities.
C. To Be Considered	None		

Closure requirements address what actions are necessary to protect public health and the environment when the disposal action is complete. For this action, the relevant and appropriate closure requirements include: 1) capping to minimize airborne contaminant migration and reduce the threat of direct contact exposure; 2) long-term management of the disposal site, including cover maintenance and groundwater monitoring; and 3) institutional controls such as access restrictions, land use restrictions, and/or deed notices.

Closure requirements and landfill design and operating requirements with respect to groundwater and surface water protection will be addressed in a subsequent ROD.

RCRA minimum technology requirements are not appropriate for this action because the residential soils do not present hazards that warrant secure disposal.

Requirements of the Land Disposal Restrictions are not appropriate for this remedial action because the material will be moved within the AOC. Placement, as defined by RCRA, will not occur.

If Page Ponds is not used as the residential soils repository, the agencies will conduct an evaluation of ARARs specific to the repository site chosen.

IDHW and U.S. EPA have determined that all state and federal ARARs for residential soils removal and replacement will be met by the selected remedy. The agencies have not determined the ARARs with respect to groundwater and surface water protection as part of this operable unit ROD. That determination will be made in a subsequent ROD.

10.3 COST-EFFECTIVENESS

IDHW and U.S. EPA believe the selected remedy is cost-effective in mitigating the risk posed by contaminated residential soils. Section 300.430(f)(ii)(D) of the National Contingency Plan (NCP) requires an evaluation of cost-effectiveness by comparing all the alternatives that meet the threshold criteria (protection of human health and the environment) against three additional balancing criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness). The selected remedy meets these criteria and provides overall effectiveness in proportion to its cost.

The selected remedy includes removing and replacing contaminated soils (or placing a soil cap, where appropriate), installing visual barriers (where applicable), revegetating, suppressing dust during remediation, disposing of contaminated materials, and monitoring for metals in soil. Institutional controls will ensure long-term maintenance of physical and institutional barriers that protect against metals exposure. This alternative is attractive because of the relatively low cost (approximately $41.3 million present worth) and expected effectiveness, as compared with other alternatives.

The principal difference between the selected remedy and two of the other alternatives is excavation depth. One alternative involves sod excavation and replacement without removal of underlying contaminated soils. Although less expensive than the selected remedy, sod removal and replacement would provide a less effective means of protecting human health and the environment. Another alternative, which required a 7-foot excavation depth, was considered excessive. Although an excavation depth of 7 feet would effectively remove the contaminated residential soils, the associated cost of $193 million was substantially higher than that for the selected remedy. The added remedial effectiveness would be marginal with respect to the additional cost.

An alternative with a pozzolanic treatment prior to disposal was also evaluated. Pozzolanic treatment would be intended to reduce the mobility of contaminants, as compared with untreated contaminated soil. However, the reduction in contaminant mobility is expected to be marginal with respect to the additional cost of $14.7 million. Contaminants in untreated soils would be adequately immobilized when disposed in a revegetated and properly contoured landfill. The selected alternative was therefore determined to be more cost-effective.

10.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

IDHW and U.S. EPA believe the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for residential soils at the Bunker Hill site. Of the alternatives protective of human health and the environment and that comply with ARARs, the selected remedy provides the best balance in terms of long-term effectiveness and permanence; reduction of toxicity, mobility, volume, and persistence; short-term effectiveness; implementability; and cost. Also, the selected remedy considers the statutory preference for treatment as a principal element and considers community acceptance.

Long-term effectiveness was the primary reason for selecting Alternative 3 over Alternative 5. Twelve inches of soil and sod provide a much more permanent physical barrier to potential exposure than simply a sod barrier. The institutional controls associated with Alternative 3 improved community acceptance because the controls are less intrusive compared to Alternative 5. The cost of removing soils to a depth of 7 feet in Alternative 6 was too high compared to Alternative 3, considering the associated incremental improvement in permanence.

The selected remedy does utilize alternative treatment and resource recovery technologies to the maximum extent practicable. Treatment of residential soils was not found to be practicable; therefore, this remedy does not satisfy the statutory preference for treatment as a principal element. The combination of high soil volume, the nature of metal contamination, and the need to excavate soils from yards prior to application of a treatment technology like soil washing made the costs of any known treatment technology, whether proven or unproven, prohibitive. An *in situ* soil treatment process would have eliminated the soil handling requirement. However, fixation or pozzolanic treatments are not consistent with the uses of a residential yard. There are no other *in situ* treatment technologies known to be effective in removing metals from soil.

10.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

For the reasons described above, the selected remedy does not satisfy the statutory preference for treatment as a principal element. However, this engineering control/containment remedy is consistent with the Superfund program expectations stated in the NCP (40 CFR 430(a)(1)(iii)(B)).

RESPONSIVENESS SUMMARY FOR THE RESIDENTIAL SOIL OPERABLE UNIT

POPULATED AREAS OF THE BUNKER HILL SUPERFUND SITE

SHOSHONE COUNTY, IDAHO

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1 OVERVIEW

Contaminated residential soils are the first operable unit to be addressed through a Record of Decision (ROD) at the Bunker Hill Superfund Site. A proposed plan for residential soils remediation was issued to the public April 29, 1991. A 60-day public comment period began on that day and continued through June 30, 1991. The Proposed Plan recommended removal of 12 inches of soil and replacement with clean material at all residential yards that have soil lead concentrations exceeding 1,000 parts per million (ppm). The Proposed Plan also required placement of a 2-inch gravel visual marker between the clean backfill and any contaminated residual soil. Yards would be revegetated once the area is returned to appropriate grade with clean replacement soil. The Proposed Plan stated that excavated contaminated soils would be disposed at the Page Ponds facility. Upon completion of all soil removal, the disposal site would be stabilized to prevent contaminant migration by wind and water erosion and closed with an impermeable cap. One purpose of the cap was to block the leaching through the highly contaminated underlying tailings. An institutional controls program consisting of permitting requirements and education and health intervention programs would be implemented to maintain the integrity of the residential soil barriers.

Based on public comment, it appears that the public in general favored the proposed remedy. The concern raised most often was that remediation should begin as soon as possible. There was public comment relating to the potentially high cost associated with the gravel barrier. The Potentially Responsible Parties (PRPs) expressed concern at the requirement to excavate 12 inches in all yards when in many cases contamination was present in only the top 6 inches of soil. The PRPs also questioned the use of the 1,000 ppm threshold level and the application of some parameters used to calculate the value. Additionally, the PRPs did not believe that it was appropriate to propose an impermeable cap at the Page Ponds disposal site to address groundwater contamination without performing a comprehensive and integrated analysis of the groundwater contamination issue. They believed that it would be more appropriate to address groundwater contamination in a subsequent Feasibility Study (FS).

The selected remedial alternative, as presented in the Residential Soils Record of Decision, has been modified in response to comments received. The recommended remedy no longer requires use of a 2-inch gravel layer as the visual marker. The marker is still required, but different materials may be used. Less than 12 inches of soil may be removed if sampling shows that contamination does not exceed the 1,000 ppm threshold level at depths between 6 and 12 inches. In any case, a 12-inch clean soil barrier is required over any remaining residential soils that exceed 1,000 ppm. In addition, an impermeable cap was required at the Page Ponds Residential Soil Repository to protect groundwater. However, the ARARs to protect groundwater **and surface water** will be evaluated in a subsequent FS and ROD.

A complete listing of all comments received from the public and PRPs and the agencies' response is included herein.

2 SITE HISTORY AND BACKGROUND ON COMMUNITY INVOLVEMENT

The Bunker Hill Superfund Study area is approximately 7 miles long and 3 miles wide, covering a 21-square-mile area encompassing the cities of Kellogg, Wardner, Smelterville, and Pinehurst and surrounding residential areas. In the center of the site is the Bunker Hill mining, milling, and smelting complex. The primary materials produced were lead, zinc, cadmium, silver, gold, and their alloys. The lead smelter operated from 1917 to 1982 and its zinc plant from 1928 to 1982. During this period, particulates containing lead and other heavy metals were discharged through stacks and from throughout the facilities and dispersed over the project area. Disposal of mill tailings into the river from mining activities also contributed to metal contamination of the site.

In 1974, two cases of excessive lead absorption in children from Kellogg were reported. Detailed epidemiological studies were subsequently conducted on children in the valley, and it was determined that significant numbers of children had elevated lead levels in their blood. Numerous environmental samples were collected from their home environments including soil and vegetation from yards and play areas, interior dust from the home, interior and exterior paint, and garden vegetables. In addition to biological and environmental sampling, a questionnaire was administered to participants to gain socioeconomic and historical information.

Following the 1974 survey, an intensive effort was made to educate the community about the lead health issue and the measures that could be taken to lower blood lead levels. Blood lead screenings were a part of a community Health Intervention Program and have continued to the present.

Since the discovery of the blood lead problem in 1974, IDHW, Panhandle Health District (PHD), and the federal Centers for Disease Control (CDC) have continuously worked with the area residents to reduce exposures to lead. Public meetings have been held in Kellogg to explain blood survey results and to discuss public questions and concerns. Radio talk shows and news releases have also been used as a public forum to address the lead health issues. The PHD has served as a local source of information and education regarding lead and how exposures may be reduced.

Concerns expressed by the community over the years have been documented in the Community Relations Plans for 1987 and 1990. Some specific concerns documented during interviews with local citizens are described below with an explanation of how these concerns were addressed. Concerns expressed in the interviews are representative of the statements and questions asked by individuals during public meetings.

There was concern about the potential impact of the area's Superfund status on the local economy and property values. The U.S. EPA has worked with the Department of Housing and Urban Development to ensure that lenders in the valley will not prevent or delay sales of property due to the Superfund designation. The U.S. EPA and PHD have also worked to help educate lenders about lender liability issues. Hiring of local workers for any Superfund work was encouraged within the framework of fair hiring practice regulations. The U.S. EPA has also signed a "covenant not to sue" agreement to facilitate construction of the Silver Mountain gondola. The gondola project is expected to help enhance the local tourism industry.

Questions about the amount of time it is taking to clean up the site were asked in several different forums. To address this concern, the agencies split the site into smaller operable units so that the work can be initiated as study of each unit is completed. For example, studies for the Residential Soils operable unit were completed before the studies for other units which allowed the agencies to select the cleanup remedy for residential soils before the completion of other studies.

Inquiries about the participation of the PRPs were received on several different occasions. The agencies have worked with a PRP in completion of the Non-populated Areas Remedial Investigation Study. A consortium of PRPs has come together to propose a cleanup plan for the entire site. This plan is being evaluated through the Superfund RI/FS process. The agencies are working with the PRPs to complete the RI/FS and develop a plan to address remaining issues.

Concerns about blowing dust have been expressed over the years. Specific concerns are the health impacts from exposure to dust and recontamination of areas that have been remediated through the 1986, 1989, and 1990 removal actions. Owners of dust source properties were asked by the agencies to control dust throughout the project. In addition, specific orders were issued to require the PRPs to control dust on at least a temporary basis until a final remedy for dust control in specific areas is selected.

Impacts on land use of the residential soil cleanup and cleanup of the rest of the site is a concern that was voiced by community leaders and local citizens. The agencies are working closely with the communities through the PHD to develop an institutional control system that minimizes impacts on an individual's land use.

There was concern about the continued health risks for children and adults living in the valley. The agencies have worked closely with the Agency for Toxic Substance and Disease Registry (ATSDR) and the CDC to address community health concerns. Workshops and public meetings have been held to discuss the risks associated with living in residential areas onsite and how these risks can be minimized. Several specific health questions were presented by the state in response to community concerns at a public meeting and were answered by ATSDR. The Community Health Intervention Program has also been ongoing to help address health concerns. Homes of young children and pregnant women were considered a priority for soils removal.

To facilitate community involvement, the Shoshone County Commissioners selected a nine-member tas force to serve as a liaison committee between the community and the Bunker Hill Superfund Project Team made up of U.S. EPA, IDHW, and PHD staff and contractors. Four public information repositories were also established onsite. Table 1 includes: locations of the repositories; a summary of the number of task force meetings, and meetings held with other community groups; the number of fact sheets and other information; and identification of local contacts. Tables 2 and 3 list the public meetings held with the task force and the fact sheets and other information distributed door to door to every residence within the site, respectively.

Table 1
Summary of Community Relations Activities at the Bunker Hill Superfund Site
May 1985 to July 1991

Public Information Repositories

Kellogg City Hall
323 Main Street
Kellogg, ID 83837
208/786-9131

Kellogg Public Library
16 W. Market Street
Kellogg, ID 83837
208/786-7231

Smelterville City Hall
Smelterville, ID 83868
208/786-3351

Pinehurst-Kingston Library
107 Main Avenue
Pinehurst, ID 83850
208/682-3483

Task Force Members (Nine representatives from the local communities)

Public Task Force Meetings (35)

1985 (6); 1986 (8); 1987 (6); 1988 (6); 1989 (4); 1990 (3); 1991 (2)

Meetings With Groups/Civic Organizations (84)

1985 (5); 1986 (13); 1987 (10); 1988 (14); 1989 (11); 1990 (12); 1991 (19)

Includes meetings with:

Elected Officials	Kiwanis
Idaho Citizens Network	Board of Realtors
Lions Club	KEA
School District	Gondola Committee
Sewer District	North Idaho Pensioners
Chamber of Commerce	Clutch
American Association of Mining Engineers	Clean Lakes Coordinating Council
Project Uplift	Industry
Homeowners	

Meetings With Fair Share/Idaho Citizens Network (18)

Fact Sheets and Other Information (Distributed Door to Door) (25)

Local Contacts (2)

Jerry Cobb	Scott Peterson
Panhandle Health District	IDHW Project Office
P.O. Box 108	10 E. Station Avenue
Silverton, ID 83867	Kellogg, ID 83837
208/752-1235	208/783-5781

3 SUMMARY OF PUBLIC COMMENTS AND AGENCY RESPONSES ON THE PROPOSED PLAN FOR CLEANUP OF RESIDENTIAL SOILS WITHIN THE POPULATED AREAS OF THE BUNKER HILL SUPERFUND SITE

This responsiveness summary addresses the comments received by U.S. EPA and IDHW concerning the Proposed Plan for Cleanup of Residential Soil within the Populated Areas of the Bunker Hill Superfund Site. Comments and questions raised during the public comment period are summarized below. Several of the comments addressed similar concerns and have been grouped accordingly. The summary of comments has been organized into three sections for clarity:

1. Comments received from the public at large

2. Comments received from the Potentially Responsible Parties (PRPs)

3. Public officials' comments on the Institutional Controls Program

Copies of the transcript for the meeting and comment letters received are available in the Residential Soils Administrative Record located at the Kellogg Public Library.

3.1 WRITTEN AND VERBAL COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD

3.1.1 WRITTEN COMMENTS RECEIVED FROM AREA RESIDENTS DURING THE PUBLIC COMMENT PERIOD

Comment: One commenter believed that the inclusion of a gravel layer as a visual marker was excessive based on its cost and the impact that cost would have on the Potentially Responsible Parties.

Response: The purpose of the gravel barrier is to provide a visual indication to homeowners who, during normal activities such as installing a fence or remodeling a home, may encounter buried contaminated soils. The selected alternative will include some type of visual barrier. It is anticipated that the cost of the barrier will be reduced by considering alternative materials to gravel. This will alleviate the concern regarding cost while still providing a visual barrier.

Comment: One commenter stated that there should be variable excavation depths rather than a set depth for all properties.

Response: An allowance for a variable removal depth has been included in the Record of Decision. The depth of removal will be based on a specific sampling and analysis plan. Regardless of the depth of removal, there will be a 12-inch soil column in place in each yard with a soil lead concentration less than 1,000 ppm at any interval.

Comment: One commenter stated that the No Action Alternative should be selected. Decreasing blood lead levels were proof to the commenter that further expenditure of funds is unnecessary.

Response: Although blood lead levels have been decreasing over time, they are currently at unacceptably high levels. Further reduction through environmental remediation is therefore required. The agencies believe that selection of the No Action Alternative would no be protective of human health and the environment.

Comment: One commenter asked that the residents who had lived in the area the longest be given priority for yard remediation rather than the younger children who might have recently moved into the valley but fit the age criteria for yard remediation.

Response: Residential soil removal activities in the past were prioritized based on sensitive subpopulations (young children and pregnant women). Future actions will be based on the goal of obtaining a communitywide soil lead concentration of 200 to 300 ppm lead in soil with an action level of 1,000 ppm rather than sensitive subpopulations. The sequencing of the residential yards to be remediated will be determined in the next phase, the remedial design portion of the project. However, sensitive populations will continue to be prioritized.

Comment: One commenter wants asphalt installed on road shoulders between paved roads and residential yards since gravel shoulders could wash away, exposing contaminated material.

Response: A 12-inch layer of soil will be removed from road shoulders where appropriate and will be replaced with material as required by local and state government regulations.

Comment: One commenter would like a lined landfill designed and constructed on the old Bunker Hill site to serve as the county landfill.

Response: It is anticipated that a repository for residential yard soil will be created onsite However, it is not anticipated that it will be able to accept municipal solid waste fro the area residents. The design and operational standards for a municipal landfill are different than those required for a residential soil repository. Also, the addition of municipal solid waste into the soil repository may exacerbate metals migration through the production of leachate which is generated when water runs through waste material and picks up contaminants which may then enter groundwater.

Comment: One commenter was concerned that the feasibility study and proposed plan did not address the groundwater. Without considering the groundwater, the commenter notes, the long-term effectiveness of the remediation is in question. The commenter stated that Applicable or Relevant and Appropriate Requirements should have been considered for groundwater.

Response: The feasibility study and the proposed plan specifically stated that a groundwater remedy was not being considered in the documents supporting the residential soil operable unit. Groundwater issues are being considered on a larger sitewide basis in order to address the many potential sources of contamination. Groundwater will be addressed in a separate ROD at a later date.

3.1.2 VERBAL COMMENTS FROM THE PUBLIC HEARING

Comment: Four commenters expressed their support for the Preferred Alternative and a strong desire to move forward with the remedial portions of the project and not let it drag on for many years.

Response: Initially, the site was split into two separate RI/FS efforts in order to, among other things, expedite the RI/FS process in the Populated Areas of the site.

The agencies believe that there is community acceptance for the Preferred Alternative as indicated in the Proposed Plan. The agencies are committed to remedial action as soon as possible in the residential areas of the Bunker Hill Superfund Site.

Comment: One commenter wants residential yards put back to equivalent or better condition than when cleanup action was initiated.

Response: It has always been a goal during residential soil remediation to restore yards to an equivalent or better condition than before cleanup. This will continue to be a goal in the future and, as the remedial activities progress, construction requirements to achieve this goal will be improved.

Comment: One commenter wants to see the Health Intervention Program continued and a trust fund established for health prevention in the community.

Response: It is anticipated that the Health Intervention Program will be continued as part of the institutional controls program. Issues of health effects related to past exposures have been referred to ATSDR for consideration.

Comment: One commenter would like the priority for jobs during the remedial action to be given to local residents to help defray the high unemployment in the valley.

Response: The agencies have always encouraged and hired local citizens to assist with the Superfund process where it is appropriate. In the event that private companies are responsible for carrying out remedial activities, the agencies will encourage them to hire local citizens. However, hiring decisions will be the prerogative of the private companies.

Comment: One commenter wants the feasibility studies completed as soon as possible so that public comment can take place and the remedial decisions can be made part of the final Master Plan. In a similar comment, another commenter wanted the residential soil removal to be conducive to the Master Cleanup Plan.

Response: The feasibility study and proposed plan for the residential soils in the Populated Areas is complete. The remediation of residential soils will take place as soon as possible. The agencies currently intend to integrate residential soil remediation with other remedial activities onsite.

Comment: One commenter recommended and stressed that all concerned parties work together.

Response: The agencies continue to work with all interested parties and welcome input from those parties. Public participation has occurred throughout the RI/FS process and will continue in the future.

Comment: One commenter was concerned about the Superfund designation hurting investment opportunity and wanted the U.S. EPA and the PRPs to start the actual cleanup of the lead smelter, zinc plant, and Central Impoundment Area (CIA).

Response: The cleanup of the areas specifically addressed in the comment are separate from the residential soils within the Populated Areas of the Bunker Hill Superfund Site. These areas are being addressed in the Non-populated Areas RI/FS.

Comment: One commenter expressed support for the 1,000 ppm action level.

Response: Based on the Risk Assessment Data Evaluation Report (RADER), the agencies believe that the selection of the 1,000 ppm action level for residential soil remediation will protect human health.

3.2 COMMENTS SUBMITTED BY THE POTENTIALLY RESPONSIBLE PARTIES (PRPs)

Comments were received during the public comment period from three potentially responsible parties: ASARCO Incorporated, Gulf Resources & Chemical Corporation, and HECLA Mining Company on U.S. EPA's proposed plan for cleanup of residential soil within the Populated Areas of the Bunker Hill Superfund Site. Comments were received in a document organized in the following format:

I. The FS Supports at Most Selection of Alternative 5

II. EPA's Designation of 1,000 ppm Soil Cleanup Level is Not Consistent with Sound Science or This Record

- A. EPA's Establishment of a 10 µg/dl Remedial Action Objective is Unjustified
- B. EPA Employed Several Inappropriate Values in Applying the Biokinetic Model
- C. EPA Employed an Overly Conservative Geometric Standard Deviation in Analyzing the Biokinetic Model's Output
- D. When Appropriate Values are Employed, the Biokinetic Model Supports a 1,900-ppm Soil Lead Cleanup Level

III. To the Extent an Excavation Remedy is Adopted, Several Aspects of Alternative 3 Should be Eliminated or Revised

- A. Universal 12-Inch Soil Excavation is Unjustified
- B. The Proposed Gravel Layer is Unnecessary
- C. The FS Improperly Addresses the Page Ponds Disposal Site

IV. The Proposed Institutional Controls Program Must be Revised

- A. The Scope of the Institutional Controls Program Should be Limited
- B. A More Cautious Approach to Program Implementation is Required

V. Miscellaneous Other Comments

In order to easily correlate responses to comments, the above-ordered format of the comments has been maintained as much as possible. In many cases there was supporting text for each comment. Responses have been developed for the general comments and the supporting text as much as possible.

COMMENT I: **The FS Supports at Most Selection of Alternative 5**; "There are nine criteria for evaluation of remedial alternatives: ...Properly explained by EPA, Alternative 5 appears to meet them all. The only significant reservation EPA has expressed about Alternative 5 is that sod would not hold up over time, or would not be well maintained. ...The record is devoid of information, however, to suggest that, when properly maintained, sod replacement would not provide long-term remediation at the site. Nor does it raise substantial doubts that sod can be maintained."

Response: The commenter is correct that there are nine criteria against which each remedial action alternative is judged. However, the commenter is incorrect is stating that Alternative 5 meets all of them. The last criterion is Community Acceptance. Public comments have been received in the past regarding the potential burden of the Institutional Controls Program. Since the residents of the site prefer the least burdensome institutional controls program, the agencies support Alternative 3 rather than Alternative 5 since it is judged to have a less burdensome institutional controls program. Comments were received during the public comment period in favor of Alternative 3 while no comments, with the exception of those from the Potentially Responsible Parties, were received in support of Alternative 5. Therefore, there is greater community acceptance of Alternative 3.

Also, the long-term effectiveness of Alternative 5 is questionable. The FS states: "Although Alternative 5 constitutes a reliable short-term solution, it requires a labor- and enforcement-intensive effort for long-term success. The permanence of Alternative 5 is directly related to maintenance of the protective cover. Alternative 5 has the lowest long-term effectiveness of all alternatives (with the exception of the No Action Alternative.)

The agencies are not suggesting that a properly maintained sod barrier would not meet the long-term effectiveness criteria. However, the agencies do have reservations, and these are significant reservations as suggested by the commenter, that the maintenance of the sod barrier over a long time period would be extremely difficult. The long-term effectiveness of Alternative 5 was judged to be the least with the exception of the No Action Alternative.

The comment states that the FS is "devoid of information" that the sod layer would not be an effective long-term alternative. It should also be pointed out that the commenters presented no supporting information regarding the efficacy of a sod layer as an effective long-term remedial alternative. In short, there is little information regarding long-term effectiveness of a remedial alternative instituted on such a large scale. Therefore, the agencies believe it is appropriate to select an alternative (Alternative 3) which logic suggests has greater long-term effectiveness, has more state and community acceptance, and has a less stringent institutional controls program.

Alternative 5 is the easiest to implement and the least costly of all alternatives considered, with the exception of the No Action Alternative. The agencies do not consider Alternative 5 to have the long-term effectiveness of Alternatives 3, 6, or 8. The criterion of long-term effectiveness was judged to be significant enough to not select Alternative 5 as the Preferred Alternative. Based on these comments, the agencies' selection of Alternative 3 is judged to provide greater protection of human health and the environment.

COMMENT II: EPA'S Designation of a 1,000 ppm Soil Cleanup Level is Not Consistent With Sound Science on This Record

Response: The U.S. Department of Health and Human Services' "*Strategic Plan for the Elimination of Childhood Lead Poisoning*" (February 1991) has identified adverse health effects associated with 10 μg/dl blood lead and have proposed 10 μg/dl as the definition of lead poisoning in children.

U.S. EPA and IDHW have identified 10 μg Pb/dl blood as the appropriate Remedial Action Objective for this site.

The agencies disagree with the commenter's assertion that the remedial action objective is unsupported and unnecessarily conservative. This is a conclusion drawn by the commenters and appears to be based on the comments found under II.A. through II.D. (as follows). The agencies are responding to a situation at the Bunker Hill site where imminent and substantial endangerment exists for area residents. The agencies believe that while the attainment of natural background contaminant levels in soils and dusts in the Silver Valley would offer the most protection to the community relative to heavy exposures, it is less than practical. Therefore, U.S. EPA and IDHW have identified as a remedial goal the reduction of heavy metal exposures to levels that would minimize (but not necessarily eliminate) adverse effects to sensitive populations in the study area.

The administrative record shows that the implementation of a 1,000 ppm Soil Lead Cleanup Threshold yields a maximum soil lead concentration for any individual yard at less than 1,000 ppm with community mean soil lead concentrations of 122 ppm, 121 ppm, 174 ppm, 278 ppm, and 275 ppm for Smelterville, Kellogg, Wardner, Page, and Pinehurst, respectively. House dust lead levels are expected to exhibit a conseque reduction because of residential yard soil remediation. The administrative record, sp cifically the RADER, presents the methodologies and associated data used for evaluating and determining the soil lead cleanup threshold identified in the remedial plan for residential yard soils. These reductions in environmental lead levels and implementation of an institutional controls program are components of a comprehensive plan designed to achieve the remedial objective by reducing environmental exposures to sensitive populations.

Several factors were considered in the agencies' selection of the 1,000 ppm Soil Lead Cleanup Threshold. The agencies believe all were consistent with sound science and the project record. The selected cleanup threshold is based to a large degree on analyses of the site-specific data base available for this population. This data base has accumulated over 17 years of epidemiological data following the identification of community childhood lead poisoning.

Input parameters used in the dose-response modeling, as it has been applied at the Bunker Hill site, are site-specific and may not be appropriate for other sites. Input parameters have been validated for preremedial conditions using the site's epidemiological data base. Use of the model for determination of threshold soil and dust lead cleanup levels has not incorporated any uncertainly or safety factors for the establishment of remedial goals. The agencies believe that the dose-response modeling has been balanced, based on site-specific observations, and does not incorporate the margin of safety usually applied in evaluations where less epidemiologic data and more uncertainty are found.

Comment II.A.: **EPA'S Establishment of a 10 μg/dl Remedial Action Objective is Unjustified**

Response: In order to evaluate unnecessary and adverse exposures of sensitive populations to lead, U.S. EPA and IDHW have reviewed and considered most of the available scientific, technical, and health/toxicological literature, as well as consulted with knowledgeable health authorities (see Sections 3.5.1.5 and 5 in the Protocol Document and Section 6.2.2 in the RADER). This evaluation is required to support a cleanup plan that is protective of public health. While the uncertainties identified with (the subtle and chronic) health effects described in low-level lead exposure studies are recognized by the agencies as well as the commenters, the remedial plan, nevertheless, must consider those uncertainties and make assumptions that err on the side of both individual and community protectiveness. (Federal agencies, including ATSDR and EPA, have identified a blood lead threshold of 10 μg/dl for sensitive populations for the protection of community health.) Specifically, U.S. EPA and IDHW have established a community blood lead remedial action objective of ≤10 μg/dl blood for greater than 95 percent of the childhood population with not more than 1 percent of the population exceeding 15 μg/dl. This objective is consistent with the Clean Air Scientific Advisory Committee's finding that blood lead levels in the range of 10 to 15 μg/dl warrant avoidance. In addition, the committee concluded that there was likely no blood lead threshold level at which adverse health effects did not occur and that all practical steps should be taken to minimize childhood lead exposures. The agencies are also aware that the childhood blood lead level of concern has been decreasing and that further reductions are likely.

Comment II.B.: **EPA Employed Several Inappropriate Values in Applying the Biokinetic Model**

Response: The use of a 42 percent respiratory absorption/deposition value for lead in air is justified and based on earlier studies as cited in both the RADER and Protocol Document. A lower value, such as 32 percent used as the default value in the LEAD4 model, does not significantly affect the model results and would only increase slightly the lead contribution from ingested soils and dusts. The use of a lower respiratory adsorption/deposition value would result in a greater soil/dust lead dose coefficient and thus a lower soil lead cleanup threshold (<1,000 ppm) for remediation.

U.S. EPA assumed a 100 ppm lead in replacement soils rather than a lower value in order to allow some minimal recontamination of the soils used for replacement (typically, 60 ppm lead). Soil recontamination rates in some parts of the site have been observed to range from 10 to 100 ppm/yr. The use of 100 ppm soil lead for a replacement value in the site model allows for approximately 2 to 10 years for completion of the comprehensive plan. Any longer than 2 years requires the use of a greater value for replacement soils and the need for a lower (<1,000 ppm) soil lead cleanup threshold for remediation.

An air lead level in remediated areas of 0.14 $\mu g/m^3$ (which is the current annual mean air lead level) was assumed since the comprehensive remedial plan for dust control has not been finalized, nor has a site-specific air lead control value been established. It should be noted that post-remedial air lead level greater than 0.14 $\mu g/m^3$ is expected to result in unacceptable environmental exposures for sensitive members of the community. Allowing the air lead concentration to approach the current federal legal limit of 1.5 $\mu g/m^3$ is unacceptable for the site, since the soil lead cleanup threshold was determined using an air lead limit of 0.14 $\mu g/m^3$. It has been suggested that the federal limit as an enforcement standard would have been an appropriate model input parameter for determining the soil lead cleanup threshold (which would have resulted in a soil lead cleanup threshold <1,000 ppm).

Comment II.C.: EPA Employed An Overly Conservative Geometric Standard Deviation in Analyzing the Biokinetic Model's Output

Response: Communitywide childhood blood lead variability, expressed in terms of the geometric standard deviation (GSD), has ranged from 1.65 to 1.77 during 1988 through 1990. Town/city childhood blood lead GSDs for the same period ranged from 1.59 to 1.85; the childhood population in Page (a minimally impacted community in the site) exhibited a GSD ranging from 1.62 to 1.85. Lower GSDs, including a GSD of 1.42, appear to be reasonable for describing population blood lead variability in areas exhibiting high uniformity and consistency in environmental lead contamination due to limited point source contributions. While mean blood lead levels at this site have decreased since the early to mid-1970s, the variance relative to the mean (or range) has increased during the same period. This suggests that multiple and various sources of lead contamination exist and have been unmasked in the residential areas following the elimination of primary point source emitters. The elimination of remaining contaminated media and sources throughout the site, including those found in the Non-populated Areas, may be expected to lower the post-remedial blood lead variability in the residential areas. However, without being able to address the post-remedial conditions in the Non-populated Areas at this time, the evaluation of post-remedial blood lead response was accomplished using a range of GSDs, 1.42 through 1.71. Higher GSDs are recommended if any potential exists for post-remedial increases in environmental lead concentrations resulting from transport of contaminated dusts and soils to residential areas from Non-populated Areas or other contaminated sources. Use of higher GSDs are warranted if the effectiveness of the long-term remedy for the entire site compromised, and if significant change and diversity in population behavior characteristics for future populations occur at the site. In addition, use of the higher GSDs could offer some margin of safety in the event any of the assumptions applied in the model were not appropriate for the post-remedial environment. For example, if the "low" soil/dust lead dose coefficients observed historically for the site fail to continue under post-remedial conditions, the 1,000 ppm cleanup threshold may not be sufficient to meet the remedial objective. In this case, the application of the more conservative, or higher, GSDs would help offset any excess exposures.

Post-remedial response and variability in the residential areas are expected to approach the community responses recently exhibited in the least impacted portions of the residential areas of the Bunker Hill site, such as Page and Pinehurst. Perimeter communities of the site with mean lead concentrations in soil and dust less than 1,000 ppm (where 20 to 37 percent of residential soils are greater than 1,000 ppm) exhibit childhood blood lead GSDs ranging from 1.59 to 1.85.

Comment II.D.: When Appropriate Values are Employed, the Biokinetic Model Supports a 1,900-ppm Soil Lead Cleanup Level

Response: Contrary to the recommendations of the commenters, the 1,000 ppm soil lead threshold is not "overly conservative." U.S. EPA and IDHW believe the PRP assertion is incorrect, and a soil lead cleanup threshold of 1,900 ppm for this community would result in a >30 percent likelihood of an individual child exceeding a blood lead level of 10 μg/dl and a 5 to 25 percent likelihood of exceeding 15 μg/dl. Both risks are unnecessarily high and considered unacceptable. A soil lead cleanup threshold of 1,000 ppm is expected to protect 95 percent of the children to a blood concentrati less than 10 mg/dl. In Smelterville and Kellogg, implementation of the 1,000 ppm lead threshold requires remediation for approximately 90 percent of the residential soils, which are some of the highest lead-contaminated soils in the Populated Areas. Seven to nine percent of the soils in this area (Smelterville and Kellogg) are between 500 and 1,000 ppm. Following the completion of remedial efforts, from 91 to 93 percent of the soil lead concentrations in Smelterville and Kellogg will be less than 500 ppm.

The identified threshold level of 1,000 ppm for lead in soils and dusts, in some parts of the community and for some childhood behaviors, may not be sufficiently protective. If children frequent areas with soil lead levels much greater than mean levels (approximately 200 to 300 ppm) established in the residential areas of the site following remediation, then blood lead levels could exceed the criterion established as the goal under the remediated plan. Higher offsite exposures to children would require considering lowering the residential soil lead threshold in order to offset excess offsite exposures. The 1,000 soil lead threshold in Smelterville, Kellogg, and Wardner is sufficiently protective of health if children remain in the residential areas and do not become unnecessarily exposed to high lead levels in the nonresidential portions of the site.

In Page and Pinehurst, where implementation of the 1,000 ppm lead threshold requires cleanup of approximately 37 percent and 20 percent, respectively, of the residential soils, a reduction in community blood lead levels is not expected to be as significant as in other portions of the residential area. This is due primarily to two factors: 1) after cleanup, community mean lead concentration for soils will be greater than in Smelterville, Kellogg, and Wardner; and 2) the soil/dust lead dose coefficient is approximately twice that found in most of the other residential portions of the site. Following the completion of remedial efforts, from 64 to 70 percent of the soil lead concentrations in Page and Pinehurst will be less than 500 ppm (as compared to ~92 percent in Smelterville and Kellogg). The remedial plan calls for post-remedial follow-up and monitoring as a component of the institutional controls program in order to ensure that health-based remedial goals have been achieved throughout the site.

U.S. EPA's analyses of environmental lead effects have undergone extensive sensitivity analyses for determination of reasonableness, and in almost all cases represent mean values for possible ranges in uptakes and blood lead response distributions. Several of the model input parameter values that were used for the determination of the soil lead cleanup threshold, such as the soil/dust lead dose coefficient and the post-remedial daily dietary lead intake, are lower than the values recommended in LEAD4. This results in a soil lead cleanup threshold that is higher than that estimated using default values found in the LEAD4 model. The remedial threshold for soil lead levels determined for this site is site-specific. While it is not projected to be 100 percent protective, it is expected to be protective for most (at least 95 percent) of the sensitive population. People who continue to have high blood lead concentrations after cleanup may require additional intervention efforts as part of the Institutional Controls Program.

In summary, the input parameters applied in the IU/BK model for the establishment of a soil/dust lead remedial threshold were for a population and environmental conditions that have typically exhibited a relatively low blood lead response. The current characteristics of the site and its population may not be representative of conditions after cleanup. Factors that support an evaluation of remedial effectiveness as remedial efforts proceed are: 1) public awareness and perception of the hazards associated with post-remedial environmental contamination are not expected to be as keen as prior to remediation; 2) the soil/dust lead dose coefficient for some portions of the community (especially in the perimeter areas of the site) are greater than the mean determined in the central portions of the site; and 3) there is the lack of a safety or uncertainty factor for establishment of a remedial threshold for lead-contaminated soils and dusts.

COMMENT III: **To the Extent An Excavation Remedy is Adopted, Several Aspects of Alternative Should Be Eliminated or Revised**

Comment III. A.: Universal 12-Inch Soil Excavation is Unjustified; Even if EPA could justify a 12-inch protective soil cover where excessive lead concentrations remain at lower soil profiles, there is no logical reason why the soil could not be tested at a 6-inch depth, and soil removal limited if the soil does not exceed the action level at that point.

Response: The agencies agree that if contamination greater than the threshold level does not exist below 6 inches, a 6-inch excavation depth would be acceptable.

Comment III. B.: The Proposed Gravel Layer is Unnecessary; To the extent a visual barrier is valuable, there are significantly simpler, less expensive, and equally effective ways to designate the cut/fill line.

Response: The primary purpose of the gravel barrier is to provide an easily identifiable interface between remediated and nonremediated soils. The agencies do not believe that the barrier should be eliminated since it is an important part of the institutional controls program. Also, the agencies do not agree with the commenters' assertion that it "generally will be readily apparent to any person digging at a remediated property where "new" fill ends and native materials begin."

Although the agencies believe that a physical barrier is necessary, the construction materials used for the barrier will be determined in the Remedial Design phase of the project. A gravel barrier was evaluated in the Feasibility Study since it is a readily available and commonly used construction material.

Comment III. C.: The FS Improperly Addresses the Page Ponds Disposal Site; Commenters believe that the use of Page Ponds as a final disposal site is not appropriate if the site would then be subject to regulation as a hazardous waste facility.

Response: When evaluating Applicable or Relevant and Appropriate Requirements (ARARs) for the site, RCRA must be considered. However, RCRA in its entirety is never "automatically" applied. Indeed, only portions of RCRA may be considered as ARARs.

The agencies agree that the ARARs associated with groundwater (and surface water) will be evaluated in a subsequent FS and ROD. The requirements associated with the Page Ponds repository for this ROD focus on airborne migration, direct contact, and maintenance.

COMMENT IV: **The Proposed Institutional Controls Program Must Be Revised**

General Response: The remedy selected for Residential Soils within the Populated Areas of the Bunker Hill Superfund Site includes both engineered and nonengineered controls. The goal of this cleanup action is to break the pathway between contaminants in residential soils and the people living on those properties. It is not feasible to remove or treat all the contamination associated with residential yards because of the depth of contamination at some residential properties. However, the agencies believe it will be protective of human health to provide a barrier between the at-depth contamination and residents, provided that the integrity of the barrier is maintained. One of the purposes of the ICP is to ensure the maintenance of barriers placed during the residential soils remediatio

Section III of this Responsiveness Summary outlines the extensive community involvement activities the agencies employed in scoping, evaluating, and choosing an Institutional Controls Program that: 1) minimizes inconvenience and loss of land use; 2) utilizes existing entities (does not create an additional bureaucracy); and 3) is self-sustaining while not imposing additional costs on local government, residents, or property owners.

The purpose of the report titled *An Evaluation of Institutional Controls for the Populated Areas of the Bunker Hill Superfund Site* was to evaluate various ICP options designed to provide a perpetual maintenance program for the installation, management, and replacement of barriers established during the cleanup of the Bunker Hill Superfund Site. While some of the ICP requirements evaluated in the above-mentioned document focus directly on maintenance of barriers established in residential yards, the report went further in assuming that there may be ICP requirements associated with the cleanup of other parts of the site. Therefore, there are pieces of the ICP that were evaluated, but are not being required as part of this Record of Decision (ROD), because this ROD focuses only on creating barriers in residential yards and the institutional controls associated with those barriers. The ICP associated with this ROD is intended to protect the integrity of the current and any future, barriers placed in service, update and maintain the community awareness/education effort, and provide monitoring and enforcement functions.

It is expected that once sitewide cleanup decisions are made, the ICP will need to be expanded to include any additional requirements associated with those decisions.

Comment IV.A.: The Scope of the ICP Should Be Limited; The commenters state that properties with a soil lead concentration less than the threshold level should be treated differently than those with concentrations above the threshold level. "Fully excavated" yards should not be subject to a special disposal system or be provided with "clean dirt services."

Response: The ICP associated with this ROD is structured to be a comprehensive and integrated program. In addition to the program being designed to maintain clean barriers, it is also intended to: 1) maintain records of which properties are clean, partially remediated, scheduled for remediation, unremediated, or under construction; 2) track various activities and ensure that a system is maintained whereby contaminated soils are not intermixed with clean soils; and 3) monitor activities or processes whereby a "clean" parcel may be contaminated from outside sources such as unauthorized dumping or erosion. The agencies agree that a "clean" yard may not need to be subject to the same requirements as a yard that is not fully "clean"; however, it is necessary for all yards to be tracked by a sitewide Institutional Controls Program.

The agencies believe that it may not be necessary to subject property owners with contaminant levels below the threshold level to special disposal requirements. However, until there is a system to sample, monitor, and document the "cleanness" of a specific property (both at the surface and at-depth), it is impossible to delineate between which properties should be subject to the special disposal requirements. The ROD requires implementation of an ICP that meets the physical and administrative needs outlined in Section 9 of the ROD. Part of the implementation or design of the ICP must include prescribing procedures for delineation of properties with respect to contaminant concentrations (i.e., development of a data base).

The requirement for provision of "clean dirt" is intended to ensure maintenance of barriers and provide a safe medium for gardening. There may be properties that do not meet the requirements for remediation but have owners that are interested in growing their own produce. "Clean dirt" will be made available to any residential property owner for the purpose of establishing a produce garden.

Comment: The ICP must recognize that in some areas and for some uses the terms of sale and existing development standards will result in "remediation" at many properties. The same controls that apply to developed property should not necessarily apply to undeveloped property.

Response: The agencies recognize that there is potential for "remediation" to occur as a requirement of a real estate sales contract or as part of normal development requirements imposed by local flood plain ordinances and construction requirements associated with performance standards required by local land use ordinances. However, for this ROD, the ICP focuses on implementation, management, and maintenance of residential soils barriers only (i.e., barriers placed in residential yards in current residential areas). If the ICP is expanded as part of another ROD to include areas with development potential, requirements associated with development will be specified at that time. While such properties are not specifically included among the residential properties subject to remediation under this ROD, these properties may also be subject to institutional controls.

The ROD does include some undeveloped properties (see Figures 1-3 through 1-7 in the ROD) in and around current residential areas that will be included in the residential soils remedial effort. These properties become informal play and activity areas for children, and the agencies believe they require a protective barrier. The barrier at undeveloped properties will be no different than those at developed properties.

Comment IV.B.: A More Cautious Approach to Program Implementation is Required; The commente do not believe the feasibility study analysis, specifically estimates of costs, is sufficiently substantiated to support reasoned and lawful decisionmaking. An interim program could be implemented for 5 to 7 years while "other remedial activities" proceed that would allow for identification of ICP needs and realistic cost estimates. Commenters suggest that during the "remediation period," the disposal/clean dirt system might be supplied by a group of potentially responsible parties, if they are implementing the program.

Response: The agencies believe that the institutional control evaluation entitled "*An Evaluation of Institutional Controls for the Populated Areas of the Bunker Hill Superfund Site,*" which is part of the Residential Soils Feasibility Study, and is included as part of the Administrative Record for the Residential Soils ROD is sufficient to support the Residential Soils Institutional Controls Program (ICP). At this time, the agencies have estimated the cost of the ICP; however, funding mechanisms for implementing the program will be determined by the agencies in the design phase of the remedial action process.

The ICP must be implemented concurrently with the residential soils remedial action because lack of such controls could jeopardize the effectiveness of the selected remedy.

The ROD outlines the components of an ICP for residential soils (i.e., a comprehensive management program to include permitting, community education, and soils services), but the actual implementation of the program will require at least the adoption of local ordinances, setting up an administrative system to oversee and run the program, and documentation of detailed procedures for each of the program components. This implementation phase has been referred to as "Phase II" (see page 1-3 of *An Evaluation* *of Institutional Controls for the Populated Areas of the Bunker Hill Superfund Site*) and will involve a high degree of community participation.

In addition, the protectiveness of yard soil barriers is dependent on the success of the ICP, and the ICP will only be successful if it is not unduly burdensome, confusing, and/or restrictive for property owners and local government. The agencies believe that a lengthy period of essentially trial and error experience prior to developing final program elements would create unnecessary confusion and frustration.

Since contamination will be left in place with respect to the remedy described in the Residential Soils ROD, the agencies will periodically review the residential soils action to ensure its protectiveness. Part of this review will focus on the ICP and its effectiveness. If the ICP is determined to be inappropriate, changes to the program can be made through the review process.

The agencies agree that it is not necessary for a public entity to provide these services; however, it is essential that such services are perpetually integrated into the overall ICP.

Implementation, funding, and work required by the ICP for residential soils will be the subject of RD/RA and consent decree negotiations between the agencies and responsible parties.

COMMENT V. Miscellaneous Other Comments

Comment V.A.: "FS Table E-1 (p. ES-4) sets forth a summary of estimated present worth costs of the remedial alternatives evaluated in the FS. As its footnote 2 indicates, however, that analysis does not include re-remediation of 221 residential yards addressed during prior summer activities. Commenters support the conclusion, implicit in the analysis underlying this chart, that regardless of the remedial approach adopted for residential yards that have not yet been subject to removal activities, there is no basis for EPA to require re-remediation of soils which previously have been excavated in prior removal actions. Among other factors, the community impacts that would be associated with such reexcavation activities simply cannot be justified."

Response: The purpose of the footnote in Table E-1 is for informational purposes only. By not considering the already remediated properties in the cost estimates for each alternative, the same number of homes for potential remedial action is consistent from alternative to alternative.

The footnote does not in any way indicate a decision by the agencies to eliminate these homes from consideration of re-remediation. However, the selected remedy is consistent with the method in which these yards were addressed and the agencies do not intend to redo this work. If those properties become recontaminated in the future, they will be considered for re-remediation.

Comment V.B.: "The background information presented in Chapter 1 of the FS contains several errors of fact. The nonpopulated areas FS, referred to at page 1-1, is being conducted by Gulf Resources and Chemical Corporation and Pintlar Corporation, not Gulf Resources, Inc. Other nonpopulated areas activities are being co-sponsored by Gulf and others."

Response: Comment noted.

Comment V.C.: "In discussing the history of the site the FS incorrectly states that "for most of its operating life, the Bunker Hill complex had few or no controls on atmospheric emissions, solid waste disposal, or waste water treatment." FS at p. 1-17. This is incorrect. A variety of pollution control devices were installed over the years. For example, tailings were impounded at the Bunker Hill complex beginning in 1928 and atmospheric emission controls were put in place from the time the processin facilities were constructed in 1917 and repeatedly improved over the years. Further, the paragraph on page 1-18 characterizing the effects of the 1973 "baghouse fire" prejudicially states disputed facts and conclusions that have no bearing on the FS. To avoid inaccuracy, this entire section should be deleted."

Response: Comment noted.

Comment V.D.: "The FS says that the current primary contaminant migration mechanism is airborne deposition of contaminated dust from fugitive dust sources "in and adjacent to the mining/smelting complex." Commenters agree that major dust sources are the properties owned by the Bunker Limited Partnership and its affiliated entities."

Response: Comment noted.

Comment V.E.: "FS Figure 1-5 purports to show general residential soil remediation pathways. Among those portrayed is an upward movement of metals, apparently from groundwater. In light of the FS's discounting of concerns for capillary action, and the data set forth in the McCulley, Frick & Gilman, Inc. memorandum attached as Exhibit C to these comments, those arrows should be eliminated. There also would appear to be no basis to include an arrow from the South Fork of the Coeur d'Alene River."

Response: The arrows in the referenced figure were placed to indicate potential pathways of migration to residential soil. Since the FS discounts the effect of capillary action on soil recontamination, the arrow was shaded to indicate that it is not a significant pathway. For further information, please see the response to Exhibit C comments.

The agencies believe that flooding and consequent deposition of solids from the Sout Fork of the Coeur d'Alene River is a potential source of recontamination and the arrow was appropriately placed on the figure.

Comment V.F.: "FS Table 2-1 sets forth Federal chemical-specific ARARs. It states that .5 μg/dl of lead per cubic meter of air is a proposed standard. This is incorrect. No such standard has been proposed nor, in the expectation of the Commenters, is likely to be proposed."

Response: *See "U.S. EPA. Report of the Clean Air Scientific Advisory Committee on its Review of the National Ambient Air Quality Standards for Lead", EPA-SAB-EC90-001. December 1989.*

Please note that the comment should use the units of $\mu g\ Pb/m^3$.

Comment V.G.: "FS Table 2-1 also describes among To Be Considered ("TBC") materials EPA's strategy document for reducing lead exposure. That document is not properly a TBC document. Rather, it is a document describing how EPA intends to implement various future rule-making activities. It has no independent scientific or regulatory importance."

Response: U.S. EPA and IDHW are considering this document a TBC for this site.

Comment V.H.: "At p. 6-23, the FS states that risks to human health and the environment would be likely to increase over time if left unmitigated. This is questionable. It is more likely that renewed growth of vegetation in the area would gradually mitigate the amount of contaminated dust and soil transported by winds and erosion. Replacement of residential site soils per se is going to have a very limited effect as far as containing contaminated soil and dust from high winds and surface water runoff from the Superfund site."

Response: The statement as found in the FS (p. 6-33) is accurate. Continued transport of highly contaminated solids by both water and wind erosion to residential areas results in unnecessary and excess exposures to the community. Monitoring and modeling results presented in the RADER have shown that rates of lead deposition in some parts of the residential areas (up to 1 lb/acre/yr) have resulted in the accumulation of approximately 100 ppm/yr for lead in litter. Within the residential areas, yard soil concentrations for lead range from 53 to 17,800 ppm (1.78 percent Pb in soil). Any transport of highly contaminated solids within the site would result in an increase of community exposures and consequent health effects.

Mobilization of highly contaminated soils also increases its hazard potential since it is likely to be converted or introduced to media exhibiting high community exposure frequency, such as house dust. Soil transport and incorporation to house dusts is a major concern at the site since small soil particles exhibiting high metals content accumulate as dusts in homes and present high contact potential to sensitive populations. Any deterioration of current site conditions or reduction of effort towards mitigation or health intervention are likely to result in increased health risk to the community. The prospective for continued success of the Lead Health Intervention Program is not assured. Childhood blood lead levels at the site are doubtless reduced as a result of the aggressive monitoring and follow-up program currently instituted. It is doubtful that the 90+ percent level of participation exhibited by the community could be continued indefinitely. Those children currently protected by the program could be at great risk if the program were compromised.

Comment V.I.: "Re: Proposed Plan, p. 5: What is the explanation for the fact that children in Page have a blood lead average above 10 μg/dl Pb, whereas children in Smelterville, Kellogg, and Wardner average less than 10 μg/dl Pb, even though soil lead levels in those communities are double or triple the levels found in Page? Does this not suggest that there may be an entirely different source involved rather than lead in soil? Also, does it not raise a serious doubt as to the rationality of the 1,000 μg/g Pb [ppm lead] criteria?"

Response: Page and Pinehurst blood lead responses are approximately equivalent to those observed in other studies, and it is the response in Smelterville, Kellogg, and Wardner that is considered atypical. There is greater uncertainty that the 1,000 ppm soil lead cleanup threshold is protective in Page and Pinehurst than for the remainder of the site. Children in some portions of the residential community tend to exhibit mean blood lead responses to contaminated soils and dusts greater than the overall community mean. Children in Page and Pinehurst exhibit mean **soil/dust lead dose coefficients** that are approximately twice those observed in Smelterville, Kellogg, and Wardner. These higher soil/dust lead dose coefficients are typical of a more "common" response that has been observed at East Helena, Montana, and similar to the response described in version 4.0 of U.S. EPA's Integrated Uptake/Biokinetic (IUBK) Dose-Response Lead Model (LEAD4) using default input parameters. Site-specific factors that control physiologic response to environmental lead exposures and "effective" lead absorption are:

1. Site climate and meteorological conditions

2. Contaminated dust loadings

3. Form and chemical species of lead-contaminated solids (issues related to the relative proportions of ore, slag, tailings, concentrate, and lead oxide dusts that comprise contaminated solids)

4. Presence of other associated metals competing with lead absorption (physiologic absorption)

5. Total daily lead intake (lead absorption rate is dependent on intake rates; high daily intakes can result in lower GIT absorption coefficients)

6. General population socioeconomic and nutritional status

7. An effective exposure and health intervention program that potentially reduces total soil intake and subsequent absorption through awareness, hygiene, and nutrition programs

Those specific factors that could yield an increase in the total absorption of lead in Page and Pinehurst relative to the rest of the community are related to factors 3, 4, 5, and 7. Reduced lead absorption (in lower response areas) could be a result of proportionately higher levels of ore, slag, and tailings comprising contaminated solids in the flood plain of the South Fork of the Coeur d'Alene River. Considerably higher concentrations of lead and other metals are found in Smelterville, Kellogg, and Wardner soils and dusts, which yields a lower GIT (gastrointestinal tract) absorption rate for lead in the three towns. Also, less community health intervention has been practiced in Page and Pinehurst, while considerably more effort has gone towards exposure intervention and education in Smelterville, Kellogg, and Wardner, again yielding a lower uptake rate (either as soil/dust ingestion of lead absorption rate, or both) for lead in the three towns. Any one or all of these factors in combination would yield an apparent (rel' tive) increase in the rate of lead uptake in Page and Pinehurst.

Observed differences in physiologic response to environmental lead exposures, quantified in terms of the soil/dust lead dose coefficient, between Smelterville/Kellogg/Wardner and Page/Pinehurst suggest that post-remedial physiologic response in Smelterville, Kellogg, and Wardner could approach the "common" response (as defined above). A reduction of total metals exposures and the cessation of the community Health Intervention Program in Smelterville, Kellogg, and Wardner could result in an increase in the soil/dust lead dose coefficient to those values observed in Page, Pinehurst, and East Helena (Montana).

Comment VJ.: "Re: Proposed Plan, p. 6: Sources of contamination to residential soil other than tailings and airborne smelter emissions are not addressed. Other possible sources are windblown deposition of dust from the mining-smelter complex; exhaust emissions from internal combustion engines; lead-based paint; lead piping and lead solder in water piping; and use of smelter slag, both as a traction agent and soil modifier."

Response: The administrative record, specifically the Protocol Document and RADER, have compared offsite background environmental contaminant levels for all exposure media to onsite levels. An evaluation of health risk associated with environmental contamination found onsite for seven metals of concern in various exposure media are summarized in Tables 7.22 through 7.26 of the Protocol Document. Chronic lead intakes, for example, are estimated to be 2.1 to 7.7 times greater onsite than for an offsite population. The RADER identifies those sources and mechanisms responsible for environmental media contamination in the residential areas. Exhaust emissions from internal combustion engines, lead-based paint, lead piping, and lead solder in water piping are considered small contributors to the total lead uptake for members of the residential populations at the Bunker Hill site.

Comment V.K.: "Re: Proposed Plan, p. 5. The phrase "To ensure protection from adverse health effects associated with exposure to lead, EPA and IDHW has determined that it is necessary to clean up any residential property within the Bunker Hill site with a lead concentration of 1,000 parts per million.", seems to express an unjustified level of confidence that soil replacement will eliminate all blood lead problems, especially when the cause of the problems may not be fully defined."

Response: Remediation of contaminated soils in the residential areas of the site is one component of a comprehensive plan to reduce sensitive populations' exposure to metals. House dusts, fugitive dust sources, air, surface and ground water, materials and waste piles, etc. will also be addressed in the comprehensive plan. The agencies are confident that all contaminant sources and media of health significance have been characterized during RI activities and appropriate remediation will occur as part of the final plan. If the commenters believe that any exposure routes and/or media have been overlooked, they should have been identified during remedial investigations. Identification of additional concerns should be made at this time. Any media or transport processes that still require remediation following implementation of the final plan should be detected during followup site monitoring and health surveys.

Comment V.L.: "Re: Proposed Plan, p. 9. The difficulty and the prospect of serious structural damage under Alternative 6 is underemphasized. Considering the condition of many of the structures in the Superfund Site, removal of surrounding soil to a 7-inch depth could prove disastrous."

Response: Although it is feasible to remediate to a depth of 7 feet, the agencies agree that the difficulty and cost of such a program would be extreme. Therefore, Alternative 6 has not been selected. (The agencies believe the comment should have stated "7-foot" rather than "7-inch-depth".)

Comment V.M.: "Re: Proposed Plan, pp. 7 and 10: It should be emphasized that "garden areas" refers to vegetable and fruit gardens and not flower gardens.

Response: Comment noted. Garden areas are referred to as "produce gardens" in the Record of Decision for the Residential Soil Operable Unit.

EXHIBIT A: Comments on EPA's Proposed Cleanup Goals for the Populated Areas of the Bunker Hill Site

Responses to the comments presented in this exhibit have been addressed in the responses to Comment II.

EXHIBIT B: Residential Soil Sample Variations; Exhibit "B" of the document submitted by the PRPs during the public comment period discusses the differences between results obtained by IDHW/U.S. EPA, using a modified laboratory analytical technique for metals analysis, and a nonmodified technique, as used by a representative of the PRPs, American Energy and Environment (AEEE). The difference between the two techniques is that for the modified technique the sample is dried and then sieved through an 80-mesh screen. Only the portion passing the 80-mesh screen is analyzed. The nonmodified technique does not dry the sample and does not sieve the sample before analysis.

AEEE compared the 0- to 1-inch sample analysis results for samples collected in May 1991 using the two techniques. It was found that the modified technique had lead concentrations approximately 1.5 times higher than the nonmodified technique.

To further evaluate this difference, AEEE had nine samples analyzed that were taken from another sampling event, conducted by the PRPs, using both techniques. The results of these analyses did not indicate a bias between the techniques. AEEE concluded that the analytical techniques themselves (i.e., the sieving of the sample) were not responsible for the bias in the first set of data. It was assumed that the sample collection or sample preparation were responsible for the high bias of the modified technique that was employed by IDHW/U.S. EPA.

Several comments were provided by the PRPs as to the actual cause of the bias.

Comment 1: The samples were gathered by CH2M HILL and split in the field. The moisture content, soil consistency, and the technicians' splitting technique could all contribute to an uneven splitting of the solid sample.

Response: All soil samples collected in May 1991 were split in the field following the techniques specified in "*Field Sampling Plan (FSP) for the Phase II RI Sampling and Analysis Plan Bunker Hill CERCLA Site Populated Areas RI/FS Document No. BHPA-FSP89-F-RO-050489.*" The soil samples obtained in May 1991 were not overly wet, and adequate mixing was performed prior to splitting to ensure that the two portions of the sample were homogeneous.

It is also unclear how an unbiased sampling error (i.e., incomplete mixing or uneven splitting) would result in a biased analytical result (i.e., all of the IDHW/U.S. EPA samples being higher than the AEEE results).

Comment 2: [It was] noted on a visual inspection of the soil samples in the soil sample collection bags that there were some samples that had not been well mixed. (See Attachment C to Exhibit B.) This would make it more difficult to obtain a representative sample for digestion.

Response: All samples taken during May 1991 were completely broken up and composited as required in the previously referenced FSP. Based on the information contained in the comment, it is unclear what samples were observed.

Again, it is not clear how these actions, even if they were done, could lead to the biased results observed between the two analytical techniques.

Comment 3: The modified CLP788 procedure includes a drying step in which the sample is dried at 60 degrees C overnight, and then screened through a -80 mesh screen. Variabilities could arise in this step due to differences in screening technique. [It was] noticed that two different technicians performing the screening step on similar soil samples resulted in very different final samples that would be used for analysis. One of the technician's meshing and screening step resulted in about 75 percent of the soil remaining in the plus 80 fraction that is archived and not analyzed, and the remaining 25 percent of the sample was then used for analysis. The other technician, by comparison, screened a similar sample and all of the soil went into the minus 80 fraction used for analysis.

Response: Eleven (11) AEEE samples containing the +80 fraction were selected at random and sieved through an 80 mesh screen. The mean of -80 remaining in these samples was 1.38 percent. The standard deviation of -80 remaining was 1.08 percent. At the 95 percent confidence interval, this equates to a maximum intersample variation of

2.16 percent. While not insignificant, these figures represent a relatively minor source of method intersample variation.

Comment 4: Variabilities could have arisen by cross contamination. The screening process included a cleaning step in which the screen [i]s cleaned by blowing compressed air over it. It was noted that the technician used inconsistent and careless cleaning in this step.

Response: Considering the volume of sample containing most AEEE samples and the high lead concentrations in these samples, any cross contamination due to micron-size particles (i.e., dust) being left on the screen after blowing off with high pressure air would be unmeasurable or insignificant at best.

Comment 5: There was a possibility of cross contamination in the digestion procedure also. It was observed that in bulking the samples to their final 200 ml volume, the same graduated cylinder was used without careful rinsing between samples.

Response: Silver Valley Laboratories' (SVL) procedure is to rinse graduated cylinders three (3) times with deionized water between samples during the digestate bulking process. This procedure was followed for the AEEE samples.

Comment 6: The possibility of error also exists in the data generation. In the reporting of the data there is a step that incorporates a percent solids test to correct for the moisture fraction found in the soils that have not been dried. This percent solids value was calculated in the standard CLP788 method utilized by AEEE. It was noted that this test was also applied to the IDHW/EPA modified CLP788 method. If inadvertently the percent solids were used to calculated the final results of the IDHW/EPA samples it would lead to an error comparable to what [is] seen in Table 1, columns 3 and 4.

Response: Four IDHW data packages selected at random were reviewed. The modified CLP method followed by SVL for the IDHW did not include a percent solids adjustment of the final results. Samples were dried and sieved before analysis; therefore, no percent solids correction was necessary.

Summary Comment: Based on these results, EPA should evaluate variability in data from their past and current sample collection and analysis procedures. Based on their reevaluation, EPA/IDHW may wish to reanalyze some or all yards.

Response: The agencies believe that the above responses adequately address any concerns regarding data variability and there is no need to reevaluate the data base or reanalyze some or all yard samples.

EXHIBIT C: Review of EPA Study on Upward Movement of Lead in Yard Soils; "The conclusions in Appendix B (of the Residential Soil Feasibility Study) clearly state that there is little empirical evidence to suggest that upward migration of lead is occurring on site in residential soil. ...there are compelling hydrologic and chemical precepts that indicate that such upward migration is not expected to be a significant process in the past, present or future. Consequently, we see no utility or justification for the specification of a capillarity barrier for yard remediation."

Response: The CERCLA process requires that the agencies "select a remedial action that is protective of human health and the environment, that is cost-effective, and that utilizes *permanent solutions*" (emphasis added) "and alternative treatment technologies or resource recovery technologies to the maximum extent practicable."[1] Upward migration of inorganics is a documented phenomenon and, therefore, a potential migratio pathway that, if not evaluated and considered, could adversely affect the permanence the selected remedial alternative.

Appendix B of the Residential Soils Focused Feasibility Study is a worst-case evaluation of the potential for upward migration. The conclusions of the appendix agree with the basic comment above in that "there is no empirical evidence to suggest that lead upward migration is occurring onsite in residential soils."

SUMMARY OF SPECIFIC COMMENTS

Comment 1: "The modeling approach does not consider the effects of recharge, which would transport water downward... Additionally, the author [of the upward migration technical memorandum] cites the occurrence of caliche layers as evidence of upward flow from a shallow water table. We did not find any notation of caliche layers in the RI/FS boring logs."

Response: Indeed the modeling approach does not consider the effects of recharge. This provides a more conservative estimate of the potential for upward migration of contaminants. The summary section of the appendix explains that "the objective was to perform a worst-case analysis using a simplified model."

The introductory sentence of the technical memorandum states that the existence of "caliche" or "hardpan" layers are evidence of the upward flow of inorganic constituents through the soil profile. This introductory sentence presents the idea of upward migration to the reader who may not be familiar with soil chemistry. It is presumed that caliche or hardpan layers are a familiar occurrence to most readers of the documen The absence of these layers does not dismiss the occurrence of the phenomenon. Th memorandum does not state that there are caliche or hardpan layers at the Bunker Hill Superfund site.

Comment 2: "The stratigraphy between ground surface and the water table is known to be heterogeneous, not homogeneous as assumed in the report. Stratified layers... represent textural discontinuities that would have profound influence on the vertical migration of soil water."

Comment 3: "The modeling process considers only evaporation not evapotranspiration. ...the assumption that solutes will accumulate only in the upper 1 inch as a result of evaporation is unfounded."

Comment 4: "The range of pH values assumed for ground water are about one pH unit lower than the actual range typically measured in water from the RI/FS wells. The system is not as acidic as assumed, which affects the speciation and mobility of lead.

Comment 5: "...the modeling assumption that concentrations in soil water are equal to the observed concentrations in ground water has not been honored."

Comment 6: "The correlation of soil water Pb concentrations to distribution coefficients and measured soil Pb concentrations probably does not accurately represent a soil water system with significant Pb

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[1]Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Section 121(b)(1).

controls exerted by precipitation of sparingly soluble Pb compounds.... ...will probably overestimate the aqueous lead in the subsurface."

Comment 7: "The rates of lead accumulation in the surficial soils depicted in Figures 4, 5, and 6 [from the upward migration technical memorandum] assume that the lead concentrations in soil water are accurate and that all of the dissolved lead will migrate to the upper one inch of soil.... ...such assumptions are not valid...."

Response to Comments 2 through 7: Each of these comments concerns the validity of the assumptions made for modeling the upward migration of lead in residential soil. The assumptions were made to produce a worst-case estimate of the upward migration of contaminants to the upper one inch of soil. The memorandum clearly states these assumptions and indicates that this is a simplified modeling effort based on worst-case assumptions.

EXHIBIT D: **Depth of Contamination in Residential Yards, Bunker Hill Superfund Site;** "This alternative [Alternative 3] is internally inconsistent because lead contamination does not exist to depths of at least 12 inches in all residential areas. Chemical data documenting the decrease in concentration of contaminants with depth include two different sets of data collected by the PRPs during 1990."

"A core sampling program could determine the vertical profile of lead concentration, and allow the remediation effort at an individual residence to concern only those soil intervals that threaten human health."

Response: The agencies agree that a core sampling program could determine the vertical profile of lead concentration and a sampling program is being required as part of this ROD. As stated earlier, if contamination above the threshold level does not exist below 6 inches, a 6-inch excavation will be acceptable.

3.3 SUMMARY OF INSTITUTIONAL CONTROLS MEETINGS

The purpose of this section of the Responsiveness Summary is to describe local government and community involvement in the development of the Institutional Controls Program (ICP) and to respond to comments raised by local officials during the comment period.

The agencies understand that the success of an ICP is dependent on the communities' and local governments' involvement and support. Development of the ICP occurred over a 4-year period. Information was gathered and concerns were defined through many meetings, presentations, and discussions with local government and citizen representatives. Comments and concerns associated with an ICP were solicited both before and after the report entitled *An Evaluation of Institutional Controls for the Populated Areas of the Bunker Hill Superfund Site* was completed.

3.3.1 MEETINGS HELD PRIOR TO REPORT COMPLETION

During development of the ICP report, the agencies met with the Task Force (public meeting), local government officials (both elected and appointed representatives of affected cities and the county), and other interested groups. Comments received during these discussions were particularly important in determining the scope of a locally acceptable ICP.

The preevaluation meetings focused on conceptual development of an ICP that could operate within the context of current authorities. In general, the response was favorable with the following provisions:

1. Institutional controls should minimize inconvenience and loss of land use options to local governments and residents.

2. Institutional controls should use, to the maximum extent practicable, existing contro mechanisms and local agencies.

3. Institutional controls should be self-sustaining and impose no additional cost on local governments, residents, or property owners.

These concerns were used as guidelines in producing the *Draft Evaluation of Institutional Controls for the Populated Areas of the Bunker Hill Superfund Site.*

3.3.2 MEETINGS HELD AFTER REPORT COMPLETION

The evaluation document was completed in January 1991 and mailed to elected officials in all the cities within the Superfund site as well as Shoshone County. It was also available for public comment from April 29 through June 30, 1991, and was described as part of the Proposed Plan. Following the mailing, meetings were held in March through May 1991 to discuss the document with elected officials from the cities and county, the Task Force (public meeting), and other interested or potentially affected parties. Concerns and questions noted at those meetings and the agencies' responses follow. Comments and responses have been organized by subject for clarity.

IMPLEMENTATION/MANAGEMENT

Comment: One commenter was concerned about being sure everyone who needed to, adhered to program requirements.

Response: The ICP will be presented in a positive manner, to be used by the homeowner durin land transactions. A high level of community awareness and education will be maintained and, if all else fails, the penalties associated with breaking local laws and ordinances would be invoked.

Comment: Another commenter requested that proposed deed notices serve as an educational tool and not as a restriction to land use.

Response: Deed notices are intended to notify potential purchasers of real estate about the condition of the property being considered. It is not anticipated that these notices will restrict land use; rather, they are informational in nature.

Comment: A commenter from Pinehurst wanted to know if the ICP was going to be instituted in Pinehurst.

Response: Some or all of the ICP elements will be utilized in Pinehurst depending upon the extent of remediation and the amount of contamination that remains in yards after the cleanup has been completed.

Comment: Several commenters representing the various cities were not interested in providing project management and emphasized that the cities do not have the funds to ensure perpetual management of an ICP.

Response: The agencies have considered this comment and do not anticipate that the cities will be required to fund or manage the program in perpetuity. Funding for the program as well as the management of the program will be determined as part of the design of this remedial action.

Comment: When would the cities be asked to "sign-on" to the program?

Response: Development of the ICP has followed the public comment period on the proposed plan. The cities will be asked to "sign-on" prior to initiation of remedial design for the residential soils action.

Comment: The City of Wardner is currently rewriting its comprehensive plan and zoning ordinances and wanted to know if they needed to factor in the proposed ICP.

Response: It is suggested that the city stay in contact with the agencies developing the ICP in order to incorporate as much information from the ICP as possible. It was also noted that if portions of the ICP developed at a later date would require amendments to city plans, assistance would be provided.

Comment: How enforceable is the ICP?

Response: The ICP is expected to be incorporated into city and county ordinances and regulations that have the weight of law.

Comment: What would be done with partially remediated yards?

Response: There will be no partially remediated yards. If sampling and analysis indicates soil concentrations exceeding 1,000 ppm lead, the entire yard will be remediated.

Comment: What would be required of a homeowner whose paved/driveway deteriorated to the point that it would need to be replaced?

Response: The homeowner would have a variety of options under the proposed ICP. Included in those options would be repaving or replacement and capping if soil lead levels warranted it.

Comment: Would the ICP be in conflict with Federal Flood Plain Ordinances?

Response: The ICP and Flood Plain Ordinances will not be in conflict.

PUBLIC INVOLVEMENT

Comment: One commenter wanted to know what would happen if, after the ICP was designed and approved by local elected officials, the public did not like it.

Response: The plan was subject to public comment for 60 days. The agencies did not receive adverse comments from members of the community. The concerns raised during the comment period came primarily from the PRPs (see Section II of the Responsiveness Summary). Ongoing public education regarding the institutional controls program is integral to the program's success.

Comment: Why should Pinehurst have to participate in the ICP?

Response: The ICP is needed in Pinehurst to ensure barrier maintenance. The ICP will apply to all residential properties within the site.

COST/FUNDING

Comment: One commenter requested additional information on the cost of administering the ICP.

Response: The cost estimates for the ICP are included in both *An Evaluation of Institutional Controls for the Populated Areas of the Bunker Hill Superfund Site* and the *Residential Soil Feasibility Study*.

Comment: How will the ICP be funded?

Response: Funding of the ICP will be determined during remedial design.

DEVELOPMENT/DISTURBANCES

Comment: One commenter wanted to know if realtors should be "digging in" sales signs.

Response: It was suggested that for now, small signs that negate the need for deep holes should be used.

Comment: Using the ICP to facilitate land transactions and future development made the program worthwhile.

Response: Comment noted.

Comment: How would someone go about developing a lot? And, if soil testing was necessary, wh would pay for it?

Response: There are currently no special Superfund requirements for property development, but anyone wishing to begin a project should contact the Kellogg Superfund Project Office for information. Mechanisms for addressing property development with respect to contamination outside the residential areas will be addressed in the Non-populated Areas RI/FS.

Comment: What would be done for homeowners wanting to put in a vegetable garden?

Response: People wishing to grow produce gardens should do so in 24 inches of clean soil. For those homes exceeding the threshold level and requiring remediation, 24 inches of clean material will be provided during cleanup. For others whose yards are not cleaned up, clean soil will be made available for developing produce garden areas.

PERMITS

Comment: One commenter wanted to know if homeowners would be charged for permits associated with the ICP.

Response: Funding mechanisms for the program will be determined as part of the design of the remedial action, but it is anticipated that homeowners will not be required to pay for permits.

Comment: Where would a homeowner go to obtain a permit to dig? Could they be obtained over the phone?

Response: While the complete program has not been developed, permits would most likely be available at each city hall through an existing governmental department such as the Building Department or the Department of Public Works. Permit availability will be determined in remedial design.

Comment: The ICP appeared to be fairly aggressive in requiring permits and managing barriers and, as proposed, it provides a complete approach to the challenge of managing barriers and future development.

Response: Comment noted.

Comment: Another concern was in regard to how the decision will be made as to what is hazardous and what soil cleanup level would be used.

Response: A soil lead concentration of 1,000 ppm is the threshold level for cleanup of residential surficial soils. Procedures for determining soil concentrations below clean barriers will be developed during remedial design.

Comment: How did Pinehurst end up in the Superfund site, if no elevated blood lead levels were noted in Pinehurst children? What were the soil lead levels in Pinehurst?

Response: Sampling and analysis indicate some soil lead levels throughout the city exceed the threshold level of 1,000 ppm lead and approximately 30 percent of the children tested have blood lead concentrations greater than 10 μg/dl. Soil lead concentrations varied between approximately 60 and 8,000 ppm with an average of 460 ppm.

Comment: Has any thought been given to controlling movement of metals up or down through the soil column?

Response: Yes, a discussion of this issue is presented as part of the feasibility study for residential soil. It was determined that the probability of this mechanism affecting remediation at this site is very low.

Comment: What is a barrier and will different types of barriers be used at the Bunker site?

Response: In general, a barrier is a physical cap or layer of materials that prevents exposure of people to contaminants beneath the barrier. Different types of barriers may be used at the site, depending on differing land uses. The barrier required for residential soil is determined in this ROD. The specific type of barriers required for other types of land use will be determined as part of other cleanup decisions.

Comment: Are institutional controls being considered at other Superfund sites?

Response: Yes, institutional controls are being considered at other Superfund sites both for residential and other uses.

Table 2
Public Meetings Summary
Residential Soils Operable Unit
Bunker Hill Superfund Site

Date	Description (Subjects Discussed)
May 23, 1991	Proposed Plan: Residential Soils Cleanup Public Comment Meeting Other Sitewide Activities
February 21, 1991	Status Report on Residential Soil Feasibility Study Institutional Controls Program Status of PRP Sitewide Cleanup Proposal
October 25, 1990	Update on Hillside Revegetation Order Results of 1990 Blood Lead Screening Risk Assessment Data Evaluation Report Summary and Conclusion Agency for Toxic Substance and Disease Registry (ATSDR) Response to Task Force/IDHW Questions on Lead Health Issues
July 19, 1990	Risk Assessment Data Evaluation Report Smelter Order/Plans Fugitive Dust Event Air Monitors Update on 1990 Residential Soil Removal Program ATSDR Answers to Task Force Health Questions 1990 Blood Lead Screening Program
April 12, 1990	Negotiations with PRPs Smelter Complex/Unilateral Order Page Pond/Residential Soil Disposal 1990 Residential Soil Removal Homeowner Meetings Contractor Workshops Emergency Removal vs. Remedial Interior House Dust Update on 1989 Blood Lead Screening
November 16, 1989	Status Report on Bunker Complex U.S. EPA Order Buried Waste Status Report on 1989 Residential Soil Removal Report on August 1989 Lead Screening Update on Interior House Dust Miscellaneous Topics U.S. EPA/IDHW--PRP Negotiations Slag December Fact Sheet Technical Assistance Grant
August 24, 1989	Update on Negotiations Status Report on Soil Removal Project Discussion of Slag Issue Update on Fugitive Dust Status Report on August Lead Screening
May 18, 1989	Discussion of Community Comments on Proposed Removal Activities Update on 1989 Summer Removal Action

Table 2
Public Meetings Summary
Residential Soils Operable Unit
Bunker Hill Superfund Site

Date	Description (Subjects Discussed)

February 16, 1989	Status on Negotiations with Gulf Resources & Chemical Corporation
	Update on Activities on Non-populated Areas of the Site
	Update on Health Issues
	Summer 1989 Cleanup
	    Plans for Cleanup
	    Schedules

December 15, 1988	Update on Populated Remedial Investigations Update on Non-populated Remedial Investigation Negotiations with Gulf Resources & Chemical Corporation Status of 1989 Removal Plans

October 19, 1988	Why Do We Need a Cleanup
	    Health Risk
	    Summary: 1988 Health Intervention Program
	Getting to Cleanup
	Homeowners Letter
	    Explanation of Letter
	    Maps
	Summer 1989 Cleanup
	    Selecting Properties
	    Cleanup Alternatives

September 8, 1988	Continued Discussion of Health Issues
	Introduction to Risk Assessment
	    Pathways
	    Health Criteria
	    Cleanup Limits

July 28, 1988	Overview of Historic Lead Health Issues Environmental Toxicology Health Effects of Local Contaminants 1988 Summer Lead Screening

June 30, 1988	IDHW
	    Final RI/FS Work Plan (Populated Areas)
	    1988 Summer Sampling Events
	    Status on Previous Sampling and Analysis
	U.S. EPA
	    Status on Gulf RI/FS Oversight
	    Status on Gulf Focused Feasibility Studies
	    Status on Gulf FOIA Request
	Gulf/Pintlar
	    Status on RI/FS Activities on Non-populated Areas
	Technical Assistance Grant Update
	Introduction to U.S. EPA Health Risk Assessment Process
	    Endangerment Assessment
	    Approach to Phased Cleanup

Table 2
Public Meetings Summary
Residential Soils Operable Unit
Bunker Hill Superfund Site

Date	Description (Subjects Discussed)

May 12, 1988	Introduction: Activities in the Past 6 Months
	Project Overview
	Project Status
	    Gulf/Pintlar
	    U.S. EPA
	    IDHW
	    Introduction to Endangerment
	    Upcoming Activities

December 10, 1987	Populated Areas
	    Progress in 1987
	    Future Activities
	Non-populated Areas
	    Progress Status
	    Update of Gulf Activities
	    Oversight Activities
	    Contractor Transition
	    Feasibility Studies
	    Future Activities

August 13, 1987	Upcoming Non-populated Areas--RI/FS Field Activities 1986-87 Residential Soil Sampling Results Review Outline for RI/FS Work Plan for Populated Areas

June 18, 1987	Status of U.S. EPA Activities
	    Gulf Resources Involvement
	    Field Activities in Non-populated Areas
	    U.S. EPA Oversight
	Status of State of Idaho Activities
	    Progress to Date
	    Project Plan
	    Silver Valley Laboratories

April 16, 1987	RI/FS in Non-populated Areas
	    Gulf Resources Involvement
	    Work Plan
	    Proposed Consent Order
	    Schedule
	Windblown Dust
	    State Activities
	    U.S. EPA Activities
	    Schedule
	RI/FS Study in Populated Areas

March 9, 1987	Status of Gulf Involvement in RI/FS Activities
	Status of IDHW Activities
	    Contractor Selection
	    Cooperative Agreement
	    Silver Valley Laboratories
	Proposed Consent Order with Gulf

Table 2
Public Meetings Summary
Residential Soils Operable Unit
Bunker Hill Superfund Site

Date	Description (Subjects Discussed)
February 5, 1987	Orientation of Work Plan to Potential Remedies Schedule Tasks 1 through 10, Feasibility Study, and Proposal

December 11, 1986	Reauthorization/Superfund
	Site Characterization Report
	Gulf Involvement in RI/FS
	Fall Sampling Activities
	    Residential Soil Sampling
	    Windblown Dust Monitoring Program
	Project Schedule
	    Short-Term Remedies
	    RI/FS

September 18, 1986	Update on 1986 Blood Lead Screening
	Status Report on Residential Soil Sampling
	Status Report on Fugitive Dust Monitoring Program
	RI/FS Status
	    Schedule
	    Reauthorization of Superfund
	    Involvement of Gulf Resources
	    Site Characterization Report

August 7, 1986	Status Report of Blood Lead Screening
	Fast-Track Summary
	Summary of Changes and Additions to Site Characterization Report
	Project Organization
	    Overview
	    Residential Property
	    Windblown Dust

May 29, 1986	Interim Remedial Measures Update
	    Construction
	RI/FS Project Status Update
	    Site Characterization Report
	    Fugitive Dust Monitoring
	    Soils Verification
	    Work Plan

Table 2
Public Meetings Summary
Residential Soils Operable Unit
Bunker Hill Superfund Site

Date	Description (Subjects Discussed)

April 10, 1986	Interim Remedial Measures Update
	    Public Comment
	    Contract with Local Officials
	    Contractual-Administrative Update
	    Contracts with Gulf
	    Selected Actions
	Schedule for Interim Remedial Measures Implementation
	    State Activities
	    U.S. EPA Activities
	RI/FS Project Status
	    Superfund Reauthorization
	    Site Characterization Report Status
	    Recontamination--Surface/Subsurface

March 20, 1986	Interim Remedial Measures Update State Natural Resource Suit
February 13, 1986	Interim Remedial Measures Update Interim Remedial Measures Recommendations--Workshop

January 9, 1986	Status Report of Lead Health Project
	    Results of 1985 Blood Lead Screening
	    Winter Screening
	Status Report on Public Interim Remedial Measure Sites
	    Engineering Alternatives
	    Remedial Costs for Representative Sites
	Update of State's Natural Resource Suit
	Bunker Hill Complex Issues

December 5, 1985	Status Report on Site Tour Status Report on Site Characterization Report

October 24, 1985	Status Report on Blood Lead Sampling
	Site Characterization Report
	    Status of Site Visit
	    Comments Received on Site Characterization Report
	    Schedule for Completion of Site Characterization Report
	Fast-Track--Interim Remedial Measures Update
	    Status Report
	    Ranking Process--Public Sites
	    Potential Remedies
	    Schedule for Proceeding

Table 2
Public Meetings Summary
Residential Soils Operable Unit
Bunker Hill Superfund Site

Date	Description (Subjects Discussed)

September 19, 1985	Status Report on Blood Lead Screening
	Status Report on Fast-Track Program
	    Review of Sampling Locations
	    Sampling Results
	    Future Activities
	Site Characterization Report
	    Purpose and Use of Site Characterization Report
	    Overview of Site Characterization Report
	        Where Site Characterization Report Fits in Cleanup Process
	        Summary of Conclusions
	        Additional Data Requirements

August 1, 1985	Status Report on Health Screening
	Revised Community Relations Plan
	Areas of Task Force Involvement
	    Community Relations
	    Update on Status of Consent Requests
	Status Report on Site Characterization
	Status Report on Soils Characterization
	Update on Fast-Track Program

June 27, 1985	Status Report of Data Review
	    System Overview
	    Organizations Visited
	    Information Available to Date
	    Information Exchange
	Lead Health Issue
	    Historical Overview
	    Emissions and Air Monitoring Data
	    Overview of 1974 Lead Health Survey
	    Overview of 1983 Lead Health Survey
	    Current Status of Lead Health Program
	Status Report on Soils Characterization
	Fast-Track Sampling Program
	    Overview of Fast-Track Program
	    Status Report on Sampling Program
	    Future Fast-Track Activities and Needs
	Overview of Community Relations Plan

May 16, 1985	Superfund Overview
	Cooperative Agreement
	Elements of the Investigation
	    PRPs/Liability
	    Technical/Remedial Activities
	    Health and Interim Remedial Actions
	    Community Relations
	    Innovative Solutions
	Roles and Responsibilities of Task Force

Table 3
Fact Sheets and Other Information Distributed Door to Door
Residential Soils Operable Unit
Bunker Hill Superfund Site

Date	Description
August 12, 1991	Superfund Progress Report. Bunker Hill–Hillsides Project
April 26, 1991	The Proposed Plan for Cleanup of the Residential Soils Within the Bunker Hill Superfund Site
February 28, 1991	Project Update: Bunker Hill Superfund Site, Shoshone County, Idaho
January 18, 1991	Bunker Hill Superfund Project, Kellogg, Idaho; Summary of 1990 Accomplishments
October 25, 1990	Summary of Findings Risk Assessment/Data Evaluation Report (RADER) Populated Areas
October 2, 1990	Bunker Hill Superfund Site, Kellogg, Idaho; Hillside Stabilization and Revegetation Order Signed
September 1990	The Superfund Process at Bunker Hill
July 24, 1990	Superfund Fact Sheet; Bunker Hill Superfund Site, Kellogg, Idaho
July 11, 1990	Bunker Hill Superfund Site, Kellogg, Idaho; Invitation to Superfund Task Force Meeting (July 19)
April 9, 1990	Bunker Hill Superfund Site, Kellogg, Idaho; Invitation to Superfund Task Force Meeting (April 12)
March 19, 1990	Bunker Hill Superfund Site Project Update, Kellogg, Idaho; Proposed Page Pond Landfill
February 26, 1990	Bunker Hill Superfund Site Fact Sheet, Kellogg, Idaho
December 1989	Bunker Hill Superfund Site Fact Sheet, Kellogg, Idaho
September 1989	Bunker Hill 1989 Residential Soil Removal Action Cost Summary through 9/29/89
March 1989	Panhandle Health District 1: Notice
September 1988	Bunker Hill Superfund Fact Sheet
July 1988	Bunker Hill Superfund Project Update
February 26, 1988	Letter to Silver Valley Task Force chairman concerning how U.S. EPA and IDHW will proceed with the RI/FS process
December 1987	Bunker Hill Superfund Project Progress Update
August 11, 1987	Letter to Interested Parties regarding Remedial Investigation/Feasibility Studies--Bunker Hill Superfund Site
June 1987	Memo to Silver Valley Bunker Hill Superfund Task Force
May 1987	Status Report: Bunker Hill Superfund Project
March 1987	Bunker Hill Superfund Site Update

Table 3
Fact Sheets and Other Information Distributed Door to Door
Residential Soils Operable Unit
Bunker Hill Superfund Site

Date	Description
January 1987	Fact Sheet: The Bunker Hill Superfund Site Process
July 1986	Memo to Silver Valley Superfund Task Force regarding Silver Valley Superfund Project

GLOSSARY AND LIST OF ACRONYMS AND ABBREVIATIONS

GLOSSARY

Acceptable Daily Intake. The amount of toxicant, in ppm body weight/day, that will not cause adverse effects after chronic exposure to the general human population.

Acceptable Intake for Chronic Exposure. The highest human intake of a chemical, expressed as ppm/day, that does not cause adverse effects when exposure is long term (lifetime). The AIC is usually based on chronic animal studies.

Acceptable Intake for Subchronic Exposure. The highest human intake of a chemical, expressed ppm/day, that does not cause adverse effects when exposure is short term (but not acute). The AIS is usually based on subchronic animal studies.

Ambient. Environmental or surrounding conditions.

ARARs. Applicable or Relevant and Appropriate Requirements.

Background Exposure. Exposure under conditions offsite and in unimpacted areas.

Baseline Exposure. Exposure under onsite conditions with no remediation (no-action scenario.)

Cancer. A disease characterized by the rapid and uncontrolled growth of aberrant cells into malignant tumors.

Carcinogen. A chemical that causes or induces cancer.

Chronic. Occurring over a long period of time, either continuously or intermittently; used to describe ongoing exposures and effects that develop only after a long exposure.

Chronic Daily Intake. The projected human intake of a chemical averaged over a long time period, up to 70 years, and expressed as ppm/day. The CDI is calculated by multiplying long-term by the concentration human intake factor, and it is used for chronic risk characterization.

Chronic Exposure. Long-term, low-level exposure to a toxic chemical.

Concomitant. To accompany or to be concurrent.

Dermal Exposure. Contact between a chemical and the skin.

Dermal. Of the skin; through or by the skin.

Dose-Response Assessment. The second step in the toxicity assessment process that involves defining the relationship between the exposure level (dose) of a chemical and the incidence of the adverse effect (response) in the exposed populations.

Dust. Airborne solid particles, generated by physical processes such as handling, crushing, grinding of solids, ranging in size from 0.1 to 25 microns.

Endangerment Assessment. A site-specific assessment of the actual or potential danger to public health, welfare, or the environment from the threatened or actual release of a hazardous substance or waste from a site. The endangerment assessment document is prepared in support of an enforcement action under CERCLA or RCRA.

Environmental Fate. The destiny of a chemical after release to the environment; involves considerations such as transport through air, soil and water, bioconcentration, degradation, etc.

Etiologic Agent. An agent responsible for causing disease.

Exposure Assessment. One of the components of the endangerment assessment process. The exposure assessment is a four-step process to identify actual or potential routes of exposure, characterize populations exposed, and determine the extent of the exposure.

Exposure Scenario. A set of conditions or assumptions about sources, exposure pathways, concentrations of toxic chemicals, and populations (numbers, characteristics and habits) that aid the investigator in evaluating and quantifying exposure in a given situation.

Fugitive Releases. Emissions that occur as a result of normal plant operations due to thermal and mechanical stress. Fugitive dusts may result from vehicle reentrainment, soil movement by earth-moving equipment, or wind erosion of contaminated surfaces.

Hazardous Waste. Hazardous waste, as defined in Title 40 of the Code of Federal Regulations, is a legal rather than a scientific term. To be considered hazardous, a waste must be on the list of specific hazardous waste streams or chemicals, or it must exhibit one or more of certain specific characteristics including ignitability, corrosivity, reactivity, and toxicity. The definition excludes household waste, agricultural waste returned to the soil, and mining overburden returned to the mine site. It also excludes all wastewater discharged directly or indirectly to surface waters.

High-Risk Child. Those children possessing several of the following risk co-factors observed to influence blood lead levels. Soil/dust ingestion rates are 90 to 100 mg/day for this group. Associated risk co-factors for classification are: a) chewing of fingernails and mouthing of objects; b) nonvegetated uncovered outdoor play area; c) poor quality housekeeping or high indoor dust levels; d) lack of dieta vitamin supplements; e) smoking parent in home; f) <$10,000 per year home income; and g) parents possess less than a secondary level of education.

Low-Level Threat Wastes. Those source materials that generally can be reliably managed with little likelihood of migration and that present a low risk in the event of exposure. They include source materials that exhibit low mobility in the environment or are above protective levels but are not considered to be significantly above protective levels for toxic compounds.

Mean. A statistical estimate of central tendency. Two different means are employed here: arithmetic mean and geometric mean. Arithmetic means approximate data centroids when data is normally distributed. Geometric means approximate data centroids when data is log-normally distributed. Arithmetic Mean $\geq$ Geometric Mean for the same data population.

National Market Basket Variety Produce. Vegetable, fruit, and meat produce distributed nationally and available on supermarket shelves, which constitutes the source of food for the average consumer.

Pathway. A history of the flow of a pollutant from source to receptor, including qualitative descriptions of emission type, transport, medium, and exposure route.

Pica. Refers to both normal mouthing and subsequent ingestion of nonfood items, which is quite common among children at certain ages, and the unnatural craving for and habitual ingestion of nonfood items. The latter is an uncommon condition that is generally associated with medical conditions such as malnutrition, certain neurobehavioral disorders, and iron deficiency anemia or, less often, with a particular cultural background.

Plume. Term used to describe the distribution of contaminants.

Population at Risk. A population subgroup that is more likely to be exposed to a chemical, or is more sensitive to a chemical, than is the general population.

Principal Threat Wastes. Those source materials considered to be highly toxic or highly mobile that generally cannot be reliably controlled and that present a significant risk to human health or the environment. They include liquids, highly mobile materials (e.g., solvents), or high concentrations of toxic compounds.

Risk Assessment. A qualitative or quantitative evaluation of the environmental and/or health risk resulting from exposure to a chemical or physical agent (pollutant); combines exposure assessment results with toxicity assessment results to estimate risk.

Risk Characterization. The final component of the endangerment assessment process that integrates all of the information developed during the exposure and toxicity assessments to yield a complete characterization of the actual or potential risk at a site.

Route of Exposure. The avenue by which a chemical comes into contact with an organisms (e.g., inhalation, ingestion, dermal contact, injection).

Scenario. A set of assumptions describing how exposure takes place. Scenarios are usually constructed in the "Integrated Exposure Analysis" section of an exposure assessment and are usually specific to an exposure setting.

Standard Deviation. A statistical estimate of variability associated with a data population. One standard deviation surrounding the mean includes 68 percent of the data population, and two standard deviations surrounding a mean includes 95 percent of the population.

Subchronic. Of intermediate duration, usually used to describe studies or levels of exposure between 10 and 90 days.

Subchronic Daily Intake. The projected human intake of a chemical averaged over a short time period, expressed as ppm/day. The SDI is calculated by multiplying the short-term concentration by the human intake factor, and it is used for subchronic risk characterization.

Toxicity Assessment. One of the components of the endangerment assessment process, the toxicity assessment is a two-step process to determine the nature and extent of health and environmental hazards associated with exposure to contaminants of concern present at the site. It consists of toxicological evaluations and dose-response assessments for contaminants of concern.

ACRONYMS AND ABBREVIATIONS

Ag	Silver
AIC	Acceptable Intake for Chronic Exposure
ARAR	Applicable or Relevant and Appropriate Requirement
As	Arsenic
ATSDR	Agency for Toxic Substances and Disease Registry
B1-Pb	Blood Lead Level; also as Pb-B
Ca	Calcium
Cd	Cadmium
CDC	Centers for Disease Control
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CIA	Central Impoundment Area
Co	Cobalt
CPF	Cancer Potency Factor
Cr	Chromium
CTV	Critical Toxicity Value
Cu	Copper
DI	Daily Intake
EA	Endangerment Assessment
EECA	Engineering Evaluation and Cost Analysis
EEPC	Engineering Evaluation for Phased Cleanup
EP	Erythrocyte Protoporphyrin
EPTox	Extraction Procedure Toxicity
FDA	U.S. Food and Drug Administration
Fe	Iron
GRC	Gulf Resources & Chemical Corporation
HAD	Health Assessment Document
HEA	Health Effects Assessment
HIF	Human Intake Factor
IDAPA	Idaho Administrative Procedure Act
IDHW	Idaho Department of Health and Welfare
IRIS	Integrated Risk Information System
K	Potassium
Mg	Magnesium
Mn	Manganese
µg/dl	Micrograms per deciliter
$\mu g/m^3$	Micrograms per cubic meter
Na	Sodium
NCP	National Contingency Plan
NHANES	National Health and Nutrition Examination Survey
Ni	Nickel
NPL	National Priority List
OSHA	U.S. Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
Pb	Lead
Pb-B	Blood Lead Level
PHD	Panhandle Health District
PD	Protocol Document=Human Health Risk Assessment Protocol for the Populated Areas of the Bunker Hill Superfund Site (produced by Jacobs Engineering et al., 1989)

Acronyms and Abbreviations (cont.)

ppb	Parts per billion
ppm	Parts per million = $\mu g/gm$ = mg/kg
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery act
RfD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
Sb	Antimony
Se	Selenium
SFCDR	South Fork of the Coeur d'Alene River
SPHEM	Superfund Public Health Evaluation Manual
TBC	To-Be-Considered
TCLP	Toxicity Characteristic Leaching Procedure
Tl	Thallium
TLV-TWA	Threshold Limit Values--Time-Weighted Average
TSCA	Toxic Substance Control Act
TSD	Treatment, Storage and Disposal Facility
U.S. EPA	U.S. Environmental Protection Agency
V	Vanadium
Zn	Zinc