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EPA Superfund
Record of Decision:

BUNKER HILL MINING & METALLURGICAL COMPLEX
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SMELTERVILLE, ID
09/22/1992

RECORD OF DECISION

Bunker Hill Mining and Metallurgical Complex

Shoshone County, Idaho

September 1992

DECLARATION FOR THE RECORD OF DECISION

SITE NAME

Bunker Hill Mining and Metallurgical Complex Site

LOCATION

The Site is a twenty-one square mile area located in Shoshone County, Idaho. The cities of Kellogg, Smelterville, Wardner and Pinehurst are located within the Site.

STATEMENT OF BASIS AND PURPOSE

This decision document presents the remedial actions selected by the U.S. Environmental Protection Agency (EPA) and the Idaho Department of Health and Welfare (IDHW) for the Non-populated Areas of the Bunker Hill Mining and Metallurgical Complex Site, as well as those aspects of the Populated Areas that were not addressed in the Residential Soils Record of Decision (August, 1991). 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 Bunker Hill Sitewide Administrative Record file for this Site. The Administrative Record Index is available in the EPA Region 10 Records Center and the Kellogg Public Library.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response actions 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 remedial actions described below will eliminate, or reduce to acceptable levels, the exposure pathways at the Site. Together this ROD, and the Residential Soils ROD, prescribe a protective site-wide remedy for the Bunker Hill Mining and Metallurgical Complex Site.

The highlights of the selected remedial actions are presented below by Subarea:

- Hillside Remedial Actions

- Revegetation of Hillside areas with less than 50% cover

- Contour terracing of eroded Hillsides

- Erosion control structures

- Re-establish riparian habitat

! Smelterville Flats

! Mitigation of eroding tailings in the SFCDR floodway

! Consolidation of selected jig tailings into the CIA

! Establish soil barriers in contaminated areas and revegetate

! Central Impoundment Area (CIA)

! Consolidation of jig tailings removed during other remedial actions

! Closure with a low permeability cap

! Remove material accumulations from 1982 Smelter cleanup and consolidate within the Smelter Closure

! Relocate slag pile to either CIA or Smelter Complex

! Collection and treatment of "CIA seeps"
- Page Pond

! Move tailings from West Page Swamp to Page Pond and cap

! Page Pond

! Cap Page Pond benches with residential soils

! Maintain access controls (fencing)

! Channel improvements to Humboldt and Grouse Creeks

! Smelter Complex and Mine Operations Area (MOA)

! Reprocess, recycle or treat all Principal Threat materials

! Removal and recycling of salvageable items

! Demolish structures

! Decontaminate structures not demolished

! Cap Lead Smelter and Zinc Plant with low permeability cap

! Collect and treat Lead Smelter and Zinc Plant closure leachate

! Place contaminated material under caps (phosphoric acid plan debris, boneyard materials, contaminated soils, etc.)

! Treat acid mine drainage from the Bunker Hill Mine in the Central Treatment Plant prior to discharge to Wetlands treatment system

! Recover and treat ground water in Government Gulch

! Relocate A-1 gypsum pond to CIA

! Cap A-4 gypsum pond, or consolidate within the CIA

! Close solid waste landfills

! Rights-of-Way

! Implement access controls, and provide for a barrier consistent with land use or removal/replacement

! Commercial Buildings and Lots

! Barriers, or removals, consistent with land use on all property with lead concentrations over 1000 ppm

! Residential Interiors

! Continue blood lead monitoring

! Residential Interiors

! Continue high efficiency vacuum loan program

! Clean all homes exceeding 1000 ppm lead house dust after remedial actions are completed

! Home interiors of children identified through health screening will be evaluated, and if needed, site specific remediation implemented

! Develop and implement interior dust monitoring program evaluated, and if needed, site specific remediation implemented

! Future Development in Non-populated Areas

! Implement remedial actions based upon current land use

! Through institutional controls, install necessary barrier when land use changes

! Constructed Wetland Treatment Systems

! Collected Water Wetland in Smelterville Flats for treatment of selected surface water sources, CIA seeps, and Government Gulch groundwater, 74 acres in size

! Ground water wetland in Pinehurst narrows for treatment of ground water, 34 acres in size

! Public Water Supply Considerations

! Abandon and close potentially contaminated wells

! Provide an alternative source of water for any well used for drinking water

! Operations and Maintenance Requirements

- water
- Provide for long-term O&M of selected remedial actions
- Institutional Controls
- Environmental Health Code
- Performance standards
- Educational programs
- Testing and monitoring
- Educational programs
- Monitoring
- Air
- Surface water
- Ground water
- Biological Parameters

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, will comply with federal and state requirements that are legally applicable or relevant and appropriate (unless the contingent waiver discussed in Section 10.2 is invoked), and is cost-effective. The selected remedy utilizes alternative treatment and resource recovery technologies to the maximum extent practicable. Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within the fiveyears after commencement of remedial actions to ensure that the remedy continues to provide adequate protection of human health and the environment.

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Location: Shoshone County, Idaho

1 SITE DESCRIPTION

The Bunker Hill Mining and Metallurgical Complex Superfund Site (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 approximately 2,250 feet above mean sea level. Interstate Highway 90 crosses through the valley, approximately parallel to the SFCDR.

The U.S. Environmental Protection Agency (U.S. EPA) and Idaho Department of Health and Welfare (IDHW) (the agencies), have designated a 21square-mile study area as the Site 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 Non-populated Areas of the Site and those aspects of the Populated Areas not covered under the Residential Soil ROD (August 30, 1991). 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.

Soils, surface water, ground water, and air 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, past waste disposal practices, and contaminant migration from onsite sources. Onsite sources include the industrial complex, tailings and other waste piles, material accumulation sites, barren hillsides, and fugitive dust source areas located throughout the Site. Other contaminants include Polychlorinated Biphenyls, PCBs, and Asbestos. The industrial complex consists of:

- The mine, milling, and concentrating operations (This area is designated "A" on Figure 1.3)
- A large tailings impoundment area (B)
- A lead smelter (C)
- A phosphate fertilizer plant (D)
- Three sulfuric acid plants (E)
- An electrolytic zinc plant (F)
- Several large hazardous materials accumulation sites created throughout the Site's history to store both mine and mill tailings, smelter wastes, and by-products

Other onsite sources of contamination will be discussed later in the text.

2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 SITE HISTORY

The Bunker Hill Superfund Site encompasses 21 square miles along Interstate 90 in the Silver Valley area of Northern Idaho (Figure 1-2). The Site encompasses the now inactive Bunker Hill Mining Complex and former metallurgical and smelting facility (the Bunker Hill Complex); the cities of Kellogg, Pinehurst, Smelterville, and Wardner; and the residential areas of Page, Elizabeth Park, and Ross Ranch.

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

Before the widespread use of ponds to contain milling waste products, tailings were often disposed of in local surface waters. The South Fork of the Coeur d'Alene River received tailings in this manner from numerous minesand mills in the Silver Valley both in and upstream of the Site. Dams constructed to retain tailings within the floodplain of the SFCDR, as well as subsequent flooding caused the tailings to be spread throughout the valley floor.

The first tailings impoundments in the Silver Valley were located at the Bunker Hill Complex. The Bunker Hill mine tailings impoundment, known as the Central Impoundment Area (CIA) was originally constructed in 1928. The CIA is contained in a ring dike structure built on mine waste rock and other materials. It is presently 60 to 70 feet high, divided into three major cells, including the east cell, the gypsum pond and the slag pile. A small portion of the east cell is presently in use and receives acid mine drainage from the Bunker Hill mine which is subsequently pumped to the Central Treatment Plant (CTP) for pH adjustment and metals removal prior to discharge to Bunker Creek. In 1926, the 70 acre Page Pond tailings impoundment, located within the Site, began operation. It is currently closed, although a wastewater treatment plant, including four unlined lagoons and a 17 acre stabilization pond, was constructed on the impounded tailings and is in operation. Upstream mines were using tailings ponds by the 1960s.

From 1886 until 1917, the lead and silver concentrates produced at the Bunker Hill Complex were shipped to offsite smelters for processing. Construction of the lead smelter began in 1916 and the first blast furnace went online in 1917 producing lead, cadmium, silver, and alloys of these heavy metals. 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. Smelting operations resulted in fugitive and stack emission of metals and sulfur dioxide which were deposited throughout the Site.

An electrolytic zinc plant was put into production at the Site in 1928. The zinc plant was owned and operated by the Sullivan Mining Company;until 1955, both the Bunker Hill and Sullivan Mining Company and Hecla Mining Company had a 50% interest in the Sullivan Mining Company. By 1956, the zinc plant was wholly owned by Bunker Hill. 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 310 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 pellettype fertilizers composed of varying mixtures of nitrogen and phosphorus. The industrial complex ceased operation in 1981 except for limited mining and milling operations which resumed from 1983 through 1986, and later from 1988 until 1991, as described below.

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 Bunker Hill and Sullivan Mining Company changed its name to the Bunker Hill Company and in 1968, Gulf Resources & Chemical Company (Gulf) of Houston, Texas, merged with the company. Gulf operated the Bunker Hill mine and smelter facilities until late 1981, when it shut down the entire facility.

As a result of damming the river to impound tailings from flowing downstream, the reworking of jig tailings, historic smelter complex waste discharge and runoff as well as the periodic flooding of the river, waste material laden with lead, zinc, cadmium, arsenic and other heavy metals was deposited onto the valley floor. Surface water, ground water, and soils have all been impacted by metals contamination.

By the early 1970s, emissions from the lead smelter and zinc plant, including sulfur dioxide, total suspended particulates, lead and other heavy metals, contributed significantly to contamination of the surrounding area. Although both the lead smelter stacks utilized a baghouse to capture particulates, stack lead emission rates at the facility averaged from 10 tons per month to about 15 tons per month through the 1960s. After a September, 1973 fire in the baghouse at the lead smelter main stack, air pollution control capacity was severely reduced and there was a dramatic increase in emissions. Total particulate emissions of about 25 to over 140 tons per month, containing 50 to 70 percent lead, were reported from the time of the fire through November 1974. During the first three months of 1974, approximately 73 tons of lead per month were emitted into the environment, with airborne lead levels as high as 30 micrograms per cubic meter on a monthly average being reported. The baghouse was reconstructed in mid-1974. (Interim Site Characterization Report, 1986.)

The immediate health effects of increased total lead emissions following the baghouse fire were observed in 1974 and 1975 U.S. EPA-Silver Valley Lead Health Studies. These comprehensive public health studies documented elevated blood lead levels in a significant number of children. Ninety-eight percent of 179 one to nine year old children living in the highest exposure area near the smelter had blood lead levels above 40 micrograms per deciliter (g/dl), while forty percent exceeded 80 g/dl. One of the children tested, who had a blood lead level of 164 g/dl, subsequently sued the Bunker Hill Company in 1977 for lead poisoning and related injuries. Other children with high blood lead levels also were plaintiffs in that lawsuit as well as a later similar action. Ultimately, the cases were settled. In October 1981, Gulf Resources & Chemical Corporation agreed to pay several of these children approximately $8.8 million through an ongoing trust fund. Yoss et al. v. The Bunker Hill Company et al., Civ. No. 77-2030 (D. Idaho, 1981). Blood lead testing has continued at the Site with the results summarized in numerous U.S. EPA and IDHW reports, as described in Section 2.2 below. In 1977, a 715 foot tall stack was constructed at the lead smelter and a 610 foot tall stack was installed at the zinc plant in an effort to disperse contaminants from the complex. The stacks decreased sulfur dioxide concentrations in the late 1970s, although building ventilation and fugitive emissions were estimated to be at least as great as the stack emissions. The smelter and other Bunker Hill Company activities ceased operation in late 1981. At that time, portions of the smelter complex were salvaged for various materials, and scrap.

On November 1, 1982, the Bunker Limited Partnership (BLP) purchased the Bunker Hill Complex and related real property from Gulf. At that time Gulf changed the name of the Bunker Hill Company to the Pintlar Corporation, which remains in existence to this date. Bunker Hill Properties, Inc., a Delaware corporation, is the general partner of BLP. There were originally four limited partners of BLP: H.F. Magnuson, Simplot Development Corporation, HagadoneIdaho, Inc. and Jack W. Kendrick, all of whom also owned varying amounts of stock in Bunker Hill Properties, Inc. Simplot Development Corporation subsequently withdrew from BLP. Since 1984, there have been several transfers of the limited partnership interests in BLP and exchanges of stock in Bunker Hill Properties, Inc. to several newly created corporations of the original limited partners as well as to other related or affiliated entities.

BLP's 1982 acquisition from Gulf included the Bunker Hill mine and related smelter complex facilities, a 50% interest in the Star Unit Area (with Hecla Mining Company controlling the other 50%), the Crescent Silver Mine, approximately 24,500 acres of timberland in Shoshone County and Kootenai County, Idaho and Pend Oreille County, Washington, and approximately 9,500 acres of real property in and around Kellogg, Idaho, including the 350 acre Bunker Hill Complex and mountainous property it leases to the City of Kellogg for the Silver Mt. Ski Area. BLP also took over the former Bunker Hill Companyheadquarters offices in Kellogg.

BLP reopened the Crescent Silver Mine in late 1983, and operated it until mid-1986. BLP incorporated Crescent Silver Mines, Inc. on July 20, 1984, and Syringa Minerals Corporation (Syringa) on March 21, 1986, as wholly-owned subsidiaries. BLP subsequently transferred certain mining and real property holdings to Syringa, including the Bunker Hill Mine, the smelting and refining facilities, concentrator, and wastewater treatment plant. BLP transferred the Crescent Mine to Crescent Silver Mines, Inc. On August 11, 1987, Syringa incorporated Minerals Corporation of Idaho (MCI), a Washington corporation, to which it transferred numerous smelter complex holdings, including but not limited to the lead smelter, zinc plant, silver refinery, cadmium plant, phosphoric acid and phosphate fertilizer plant, sulfuric acid plant, and part of the Central Impoundment Area, while distributing MCI stock to BLP. On December 31, 1987, Crescent Silver Mines, and Syringa merged into the Bunker Hill Mining Company (U.S.), Inc., a wholly-owned subsidiary of the Bunker Hill Mining Company, a Canadian corporation incorporated in British Columbia on June 25, 1987.

The Bunker Hill Mining Company (U.S.), Inc. (BHMC) reopened the Bunker Hill mine in September 1988, with financing obtained through the sale of $7.2 million of public shares of stock sold on the Vancouver Stock Exchange in May 1988. As the price of zinc rose in 1989, BHMC sold additional shares of stock and raised more capital for a planned expansion of the mine. Following a 1990 drop in prices for zinc, silver, and lead, BHMC could no longer meet financial obligations. On January 17, 1991, BHMC filed for relief under Chapter 11 of the U.S. Bankruptcy Code and ceased operations.

BLP filed for Chapter 11 Bankruptcy protection on June 28, 1991. Although BLP continued to control over $20 million in timberlands (in part encumbered by a mortgage of approximately $10 million) and other assets at the Bunker Hill Complex and throughout northern Idaho, it filed for bankruptcy as a result of litigation commenced in 1987 by Gulf Resources & Chemical Corporation over liability for the medical and pension benefits of the former Bunker Hill workers. Pintlar Corporation and Gulf Resources & Chemical Corporation v. Bunker Limited Partnership et al., No. 90976 (Fourth Judicial District of Idaho). On June 13, 1992, Gulf succeeded in obtaining prejudgment attachment liens on 24,500 acres of BLP's timberlands based on its $60 million claim against BLP for workers' pension and medical payments which Gulf alleged BLP was liable for as a result of its breach of the 1982 purchase contract with Gulf. BLP filed for bankruptcy protection shortly thereafter.

BLP and BHMC are presently in the process of liquidating their assets and selling all of their remaining property pursuant to now final Bankruptcy Plans. As described in Section 2.5.3 below, a substantial portion of both BHMC's and BLP's assets are being used for cleanup of the Bunker Hill Complex pursuant to Administrative Orders issued by U.S. EPA.

The Bunker Hill Complex is still largely owned, operated, and controlled by BLP as the debtor in possession along with its general partner BH Properties, Inc. and wholly-owned subsidiary, Minerals Corporation of Idaho, and by BHMC as the debtor in possession of the Bunker Hill mine operating area. BHMC has sold several properties at the mine operations area to various entities and individuals, including the Bunker Hill mine portal. BLP has sold certain other property at the Bunker Hill Complex and in and around Kellogg to various entities and individuals. In addition, certain property of Minerals Corporation was acquired by the Pintlar Corporation pursuant to BLP's confirmed Chapter 11 Bankruptcy Reorganization Plan. BLP has also executed several options with Pintlar Corporation to sell property owned by it and its subsidiaryMinerals Corporation of Idaho, including property surrounding the lead smelter and zinc plant. There are currently no known active mining or other mineral production activities at the Bunker Hill Complex.

Over the past 10 years, BLP, BHMC and their subsidiaries and predecessors have shipped a variety of wastes offsite for salvage, recycling, and disposal. Thousands of tons of sludge, tailings, flue dust, and other wastes remain at the complex.

Contamination at the Site was characterized during Remedial Investigation/Feasibility Studies (RI/FS) conducted from 1987 to 1992. Risks to human health were evaluated through the Risk Assessment Data Evaluation Report (RADER), October 1990, and the Human Health Risk Assessment (HHRA), May 1992. Risks to the environment were evaluated in the Ecological Risk Assessment (ERA), November 1991.

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 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 in 1973 and associated smelter emissions in 1973 and 1974. In an August 1974 survey, 98 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 g/dl. The frequency of abnormal lead absorption (defined at the time as greater than or equal to 40 g/dl) was found to decrease with increasing distance from the smelter. Several local children were diagnosed with clinical lead poisoning and required hospitalization. Lead health surveys conducted throughout the rest of 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, secondary source of lead to children in the 1970s.

Following lead poisoning incidents in 1973-74, a number of activities were instituted to decrease lead exposures and uptakes in the community. Emergency measures were initiated to reduce the risk of lead intoxication. These measures included: chelation of children with blood lead over 80 g/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 two years old in 1973 suggests a high risk to normal childhood development and metal accumulation in bones because of extreme exposures; these exposures could pose a continuing lead body burden in these children because of its long physiologic half life. Females who were two years of age during 1973 are now of childbearing age and, even with maximum reduction in current exposure to lead, the fetusmay be at risk because of resorption of bone lead stores in the young women. ATSDR is currently evaluating the feasibility of reconstructing this cohort of individuals to determine their past health experience. If accomplished this might lead to improved health care through education of both patient and physician.

Following smelter closure in late 1981, airborne lead contamination decreased by a factor of about 10, from approximately 5 g/m[3] to 0.5 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 nation wide 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, parental awareness, and special consultation on individual source control practices such as lawn care. The Community Health Intervention Program was initiated specifically to reduce the potential for excess absorptions and minimize total absorption in the population. 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 g/dl) has fallen from 25 percent to less than 5 percent for children in the highest exposure areas. Recent blood lead monitoring hasshown approximately 20 percent of area children surveyed exceed the blood lead level of 10 g/dl.

2.3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

The 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 U.S. EPA and IDHW developed an integrated project structure for RI/FS activities. The Site was divided into two study areas, the Populated Areas and the Non-populated Areas. The Populated Areas include four cities, residential and commercial properties located within those cities, and other residential properties. The Non-populated Areas include the smelter complex, river floodplain, barren hillsides, ground water, surface water, air, and industrial waste components of the Site.

While separate RI/FS efforts were initiated for each portion of the Site, U.S. EPA retained oversight and risk assessment responsibilities for both portions. IDHW performed the Populated Areas RI/FS. The Non-populate Areas RI/FS was performed by Gulf Resources & Chemical Corporation (Gulf U.S.A. Corporation/Pintlar) under a May 1987 U.S. EPA Administrative Order on Consent (1085-09-09-104). Subsequently, additional PRPs, including: Asarco Incorporated, Callahan Mining Company, Coeur d'Alene Mines Corporation, Hecla Mining Company, Stauffer Management Company, Sunshine Mining Company, Sunshine Precious Metals Company, and Union Pacific Railroad participated in developing deliverables for the FS. Table 2-1 lists the major geographic features and investigation emphases.

In order to thoroughly investigate the contamination of Site wide soils, surface water, ground water, and air, the Non-populated RI/FS Work Plan subdivided the Site into five major areas: Hillside Areas, Smelterville Flats, Page Pond, Central Impoundment Area (CIA), and the Smelter Complex. Based upon a proposal by the PRPs to develop a comprehensive FS, portions of the Populated Areas not covered in the Residential Soil Feasibility Study (RI/FS) prepared by CH2M Hill for the IDHW were addressed in the Non-populated RI/FS. These modifications included: the addition of areas not previously defined as separate areas, including rights-of-way (ROW) within the Populated areas of the Site; currently undeveloped areas which are likely to be developed; commercial buildings and lots; and, residential house interiors. An additional modification was the separation of the Smelter Complex into two areas delineated in the RI/FS Work Plan as the Smelter Complex and the Mine Operations Area (MOA). The identified subareas within the Non-populated areas of the Site include:

1. Hillside Area;
2. Smelterville Flats;
3. Central Impoundment Area;
4. Page Pond;
5. Smelter Complex;
6. Mine Operations Area;
7. ROW within the Non-populated Areas; and,
8. Future Development.

2.4 HISTORY OF CERCLA ENFORCEMENT INVESTIGATIONS

Since the beginning of mining in 1885 and smelting operations in 1917, large quantities of a variety of waste products, including process tailings, flue dust, slag, and airborne emissions have been released into theenvironment at the Site. These wastes contain lead, cadmium, zinc, copper, arsenic, antimony, mercury, silver, and other metal elements. Large quantities of these waste products remain in the environment in and around the Bunker Hill Superfund Site, including in the residential soils within the populated areas of the Site.

U.S. EPA began its CERCLA enforcement investigations at the Site in 1983. Since that time, U.S. EPA has conducted numerous investigations regarding those persons or parties which may be responsible for the payment or response costs pursuant to Section 107(a) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. 9607(a). Several companies have been identified by U.S. EPA as potentially responsible parties (PRPs) for the Site. The U.S. EPA is continuing to investigate additional parties which may be liable for the cleanup costs at the Site. Table 2-2 lists the current PRPs for the Site 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 responsible for discharges of mine and mill tailings into the South Fork of the Coeur d'Alene River that have contributed to the contamination of the Site.

The current upstream mining company PRPs include Asarco, Inc., Hecla Mining Company (also named as a PRP on the basis of 50% interest in the Sullivan Mining Company, which owned and operated the zinc plant), Coeur d'Alene Mines Corporation and Callahan Mining Company (which merged in

1991), Sunshine Mining Company and its wholly-owned subsidiary Sunshine Precious Metals, Inc. (currently in Chapter 11 Bankruptcy reorganization), Silver Bowl, Inc., and Highland Surprise Consolidated-Mining Company.

U.S. EPA is also continuing to investigate a number of other mining companies which previously conducted mining activities upstream of, or within, the Bunker Hill Site. In addition to investigating the potential liability of these companies, U.S. EPA is investigating the potential liability of other owners, operators and generators at the Site.

U.S. EPA has determined that selection or initiation of remedial action for the Site should not be delayed pending an investigation of additional PRPs.

2.5 REMOVAL AND RESPONSE ACTIONS

The presence of elevated levels of metals, such as lead, zinc, cadmium, and arsenic in the soil, ground water, and surface water, is a result of the historic mining, milling, and smelting activities in the valley. In order to minimize or eliminate contaminant exposures and uptakes. U.S. EPA has developed and implemented several removal and emergency response actions for the community within the Site.

Pursuant to U.S. EPA's removal action authority under Sections 104 and 106(a) of CERCLA. 42 U.S.C. 9604 and 9606(a), U.S. EPA has performed, required, and overseen the performance of five residential area removal actions, including removal of contaminates soils from residential yards and dust control in the residential areas of the Site. U.S. EPA also issued two Administrative Orders, pursuant to Section 106(a) of CERCLA, 42 U.S.C. 9606(a), in 1989 and 1991, to several of the Bunker Hill PRPs for performance of removal activities at the Bunker Hill Complex.

2.5.1 Residential Area Removal Actions

U.S. EPA performed two removal actions at the Site, in 1986 and 1989. In 1990, 1991, and 1992, the PRPs jointly funded additional residential area removal actions, with U.S. EPA and IDHW performing oversight activities.

In 1986, 16 public properties (parks, playgrounds, and roadshoulders) were selected for an immediate removal action because these properties contained high concentrations of lead and were frequented by many area children. This action, conducted by U.S. EPA, 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 boundaries at property owned by the Idaho Transportation Department (ITD).

In 1989, U.S. EPA and IDHW conducted the first residential soil removal action at the Site, beginning a program of four consecutive years of residential soil removal actions performed during the summer months each year. 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 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.

In 1990, U.S. EPA began discussions with a number of the PRPs for continuation of the residential soil removal program and related response actions. U.S. EPA requested that the PRPs jointly fund and perform the removal action under U.S. EPA and IDHW oversight. Though negotiations continued for several months, no agreement was reached. On May 15, 1990, U.S. EPA issued the PRPs an Administrative Order (U.S. EPA Docket No. 1090-05-25-106), which ordered the PRPs to perform this work. U.S. EPA subsequently negotiated an Administrative Order on Consent (U.S. EPA Docket Number 1090-05-35-106) with 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 approximately three million dollars to U.S. EPA 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.

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., Sunshine Mining Company, and Union Pacific Railroad) that required the PRPs to perform the residential soil removal program. Approximately 100 yards were cleaned up under the Order during the summer and fall of 1991, and the PRPs also agreed to undertake Site wide dust control actions; monitor air, ground water 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. As in 1990, excavated soils were stored at the Page Ponds tailings impoundment.

On July 29, 1992, U.S. EPA entered into a Administrative Order on Consent (U.S. EPA Docket No. 1092-04-14-106) with the same nine PRPs, requiring these PRPs to perform the fourth consecutive residential soil removal action at the Site. This Order also requires the PRPs to remove and relocate contaminated soil temporarily stored on ITD property from previous removal actions to the Page Pond Tailings impoundment, undertake dust control activities, perform monitoring activities, provide up to $20,000.00 to fund the Panhandle Health District's lead intervention program, conduct repair work at properties cleaned up under the July 1991 OAC, and provide disposal and transportation services (and replacement soil) for contaminated soil excavated from residentialand commercial properties within the Site.

2.5.2 Non-populated Area Response Actions

On October 24, 1989, U.S. EPA issued an Administrative Unilateral Order (U.S. EPA Docket Number 1089-10-21-106) pursuant to CERCLA S 106(a) against Bunker Limited Partnership, Minerals Corporation of Idaho, Bunker Hill Mining Co. (U.S.), Inc., and Gulf Resources & Chemical Corporation. U.S. EPA ordered these parties to immediately respond to releases and threats of releases of hazardous substances at the Bunker Hill Complex which the U.S. EPA determined were required to protect the public health or welfare or the environment, and to address risks to the public health or welfare or environment which the Agency for Toxic Substances and Disease Registry had identified from its investigation of the Site. 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 and other hazardous substances at the Bunker Hill Complex.

On October 1, 1990, U.S. EPA entered into an Administrative Order on Consent with Gulf Resources & Chemical Corporation, and Hecla Mining Company (U.S. EPA Docket No. 1090-10-01-106) for the performance of hillside stabilization and revegetation work. The Order requires erosion control by reestablishing a native, 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 eroding hillside areas in Wardner and Smelterville.

To control contaminated sediment transport from the hillside areas, and to facilitate establishing vegetation, over forty miles of terraces have been constructed to date. A total of one half million trees have beenplanted on barren hillside slopes during 1991 and 1992. Approximately 350,000 trees are scheduled to be planted in 1993.

17,000 square yards of geotextile blankets have been installed along the Smelterville Slopes and 6,000 square yards along the Wardner slopes. The blankets help stabilize the soil and slows erosion. A number of large detention basins have been constructed in Deadwood Gulch, Magnet Gulch, Government Gulch, and the Page Mine area to control erosion and sediment loadings from those areas to SFCDR.

Several abandoned mine dumps in the hillside area have been regraded and planted with adapted vegetation. In June, 1992, work to recontour and revegetate the Silver Bowl area was completed. Approximately 40 acres of barren hillside were revegetated with grass, trees and shrubs. Approximately 60% of the Page Mine Area was revegetated with grass and approximately 10,000 trees were planted. The remainder of the Page Mine area will be revegetated during the 1993 planting season.

To protect certain residential properties from erosion a 2,600 foot rock-lined diversion channel and 600 feet of sediment retention structures have been constructed in the Smelterville area. Cribbing walls and other sediment retention structures have also been installed in Wardner and Kellogg.

On September 27, 1991, U.S. EPA issued an Administrative Unilateral Order to the Bunker Limited Partnership, Minerals Corporation of Idaho, and Bunker Hill Mining Co. (U.S.), Inc. (U.S. EPA Docket No. 1092-09-15-106) which directed immediate actions to cleanup and prevent releases of hazardous substances at the Bunker Hill Complex, including the copper dross flue dust pile, mercury sludge and acid tanks, PCB-contaminated electrical transformers, acid mine drainage, lead tailings and dust, and other waters continuing to be released at the complex. The Order also prohibits salvage activities, responsible for a serious fire on September 23, 1991, which destroyed the mine rock house and concentrator conveyor system and damaged other mine buildings.

Work under this Order has proceeded with funding coming primarily from the bankruptcy estates of the Bunker Limited Partnership (BLP) and Bunker Hill Mining (BHM)(U.S.). In addition, certain portions of the work at the Bunker Hill Complex are being funded or performed by Pintlar and Gulf. To date, approximately 935,500 pounds of mercury acid sludge were removed from a large storage tank while about 360 drums containing such materials were also removed and taken to a hazardous waste landfill in Arlington, Oregon.

Approximately 130 transformer carcasses that had been stored in the phosphate plant were recently taken to an approved facility for disposal. Transformers and electrical equipment containing PCB oil were removed from the Bunker Hill mine in the spring of 1991, prior to shut down and flooding of the mine. The transformers were drained and properly disposed of. In addition, 40 drums of PCB oil stored in the company warehouse were removed and incinerated at an offsite facility.

Work to relocate 25,000 cubic yards of Copper Dross Flue Dust (CDFD) from Magnet Gulch to an area in the Smelter Complex protected from runoff commenced in April 1992, and was completed in June, 1992. The machine shop at the lead smelter was demolished and the CDFD was moved to the machine shop's concrete pad. The CDFD contains about 40% lead, 11% arsenic and 9% zinc, and will undergo further treatment and stabilization before final disposal. Treatability studies are being performed on the CDFD in order to determine an appropriate cement based stabilization mixture for treatment.

Following removal of the CDFD from Magnet Gulch, temporary pipes were installed on the east side of Magnet Gulch to carry runoff from the A-1 Gypsum Pond to a diversion ditch and into Deadwood

Gulch.

Actions taken to control contaminated windblown dust include thirty-six acres stabilized with rock surface armoring and 142 acres stabilized by chemical polymer sealing, including portions of the CIA. Other areas have received approximately 6 inches of organic amendments to promote revegetation efforts.

2.5.3 U.S. EPA CERCLA Cost-Recovery and Enforcement Litigation

As discussed above, U.S. EPA has undertaken a variety of investigatory, response, and enforcement actions regarding the release of hazardous substances at the Bunker Hill Superfund Site. Although certain response actions have been funded by the PRPs, U.S. EPA has incurred approximately $21 million in response costs through August 1992. U.S. EPA has recovered over $6.27 million from the PRPs as follows: $1.44 million from a 1989 Partial Consent Decree with Gulf and from Gulf's repayment of over $1.65 million of U.S. EPA's RI/FS oversight costs. In addition, U.S. EPA received $3.18 million as a cashout payment from eight PRPs pursuant to the 1990 Administrative Order on Consent discussed previously.

In 1989, U.S. EPA recovered $1.44 million (included in the totals above) from Gulf for the Agency's performance of the 1986 Fast Track removal action to remove and replace lead contaminated soil from public playgrounds, road shoulders and other public areas accessible to young children. These funds were recovered through a Partial Consent Decree entered on December 5, 1989, in a cost recovery action filed in the United States District Court for the District of Idaho. United States v. Gulf Resources & Chemical Corporation et al., Civil No. 89-3067 (D. Idaho).

U.S. EPA also receives yearly oversight payments from Gulf under the 1987 Administrative Order on Consent issued by U.S. EPA for performance of the remedial investigation and feasibility study (RI/FS) for the Non-populated Areas of the Site. Through February 1992, these payments have amounted to $1.65 million (included in the totals above). The Non-populated Areas RI/FS was completed in May 1992, and U.S. EPA issued the Proposed Plan for remedial action of the Non-populated Areas on June 12, 1992. The Populated Area RI and the Residential Soils FS were completed in 1991. U.S. EPA issued a ROD in August 1991 which set forth the selected remedial action for cleanup of residential yard soils, at an estimated cost of $40 million.

On July 2, 1990, the U.S. District Court in Idaho granted U.S. EPA's December 1988 petition to unseal the court files in Yoss v. Bunker Hill Company et al., Civ. No. 77-2030 (D. Idaho). See In the Matter of a Petition by the United States of America to Unseal The File in Yoss v. Bunker Hill Company et al., Civ. No. 77-2030 (D. Idaho, Case No. MS-3505, July 2, 1990). U.S. EPA subsequently copied and reviewed the files in this 1977 child lead poisoning case, which contain a variety of documents and materials pertaining to the September 1973 bag house fire at the Bunker Hill lead smelter. U.S. EPA also subsequently obtained the parties' trial exhibits from this case, discovery materials and other relevant documents, which U.S. EPA has used in developing a variety of reports and documents pertaining to the Site.

From January to March, 1991, U.S. EPA filed liens on properties owned by BLP and MCI within the Site, to help secure U.S. EPA's claims against these companies for past cleanup costs. The liens were filed pursuant to Section 107(1) of CERCLA, 42 U.S.C. S 9607(1).

On July 13, 1992, the U.S. Bankruptcy Court in Spokane entered an Order confirming the Bunker Limited Partnership's (BLP) Chapter 11 Reorganization Plan. In Re Bunker Limited Partnership, No. 91-02087K11 (Spokane, Wa). The final Plan required BLP to deposit additional funds (approximately $5 million) into its "EPA Remediation Account" to bring the total in the account to $7 million. In January 1992, the Bankruptcy Court ordered BLP to deposit $2 million into this account. These funds will be used by BLP to perform cleanup activities pursuant to the September 27, 1991, Administrative Order issued by U.S. EPA. After payments to certain other creditors, BLP is required to deposit an additional $6 million into the account as part of U.S. EPA's post-confirmation claim.

The Chapter 11 Reorganization Plan also requires BLP to liquidate its remaining assets, including 3,700 acres of timberland not yet sold, 9,500 acres of land in and around Kellogg, Idaho, 6,000 acres of which are within the Site, and upon which U.S. EPA previously filed liens. From the proceeds of these future sales, BLP is required to deposit $6 million into the U.S. EPA Remediation Account (in addition to the $7 million) to be used to perform response actions at the Site. To the extent the liquidation of BLP's estate generates additional funds, there will be a pro rata distribution to the unsecured creditors, of which U.S. EPA is the largest creditor ($100 million Allowed Unsecured Claim).

U.S. EPA is currently overseeing BLP's cleanup activities pursuant to the September 27, 1991, Administrative Order. Several million dollars have been spent since January 1992 from BLP's U.S. EPA Remediation Account. As described in Section 2.5.2 above, these funds have been used for relocation of a large copper dross flue dust pile in Magnet Gulch, removal of mercury sludge barrels, treatment of acid mine drainage, disposal of acid wastes and contaminated equipment at the Bunker Hill complex, and dust suppression work.

U.S. EPA also issued the September 1991 Section 106 Order to the Bunker Hill Mining Company (U.S.), Inc. (BHMC), owner and operator of the Bunker Hill and Crescent Mines. After BHMC declared bankruptcy, U.S. EPA negotiated the removal of PCB transformers from the mine before it flooded when power to the dewatering pumps was turned off. BHMC's Liquidation Plan was confirmed by the Idaho Federal District Bankruptcy Court in August 1991. Bunker HillMining Company (U.S.), Inc., (Chapter 11 Bankruptcy, Civ. No. 91-00161, Coeur d'Alene, Idaho).

BHMC's Liquidation Plan provides that, after payment of taxes, all proceeds will go as an administrative expense toward response actions performed by U.S. EPA for the Site. Although there are few valuable assets in BHMC's bankruptcy estate, U.S. EPA is continuing to receive a portion of the proceeds from the sale of BHMC's property. BHMC has thus far generated over $100,000 from the sale of assets that will be used to fund U.S. EPA cleanup activities at the mine complex. Additional funds will be generated as BHMC continues to sell its assets. As a result of several recent sales, including the sale of the mine portal, rock house, and ore concentrator, BHMC is funding the disposal of PCB oil and equipment and dust control activities.

Sunshine Precious Metals, Inc. (SPMI), also filed for bankruptcy protection on March 20, 1992. SPMI, one of the PRPs for the Site, is currently in Chapter 11 Bankruptcy and is seeking confirmation of its Reorganization Plan. This Plan, as currently drafted for court approval, provides that U.S. EPA's claim will not be discharged. Although SPMI disputes U.S. EPA's claim, it has agreed that U.S. EPA's claim will not be impaired and will survive confirmation with whatever rights existed prior to March 20, 1992. This will enable U.S. EPA to reach a settlement with SPMI regarding its liability for the Site, or if necessary, litigate such claims in court.

U.S. EPA will continue to oversee BLP's and BHMC's cleanup activities with funds obtained pursuant to the two final Bankruptcy Plans. U.S. EPA is continuing to closely monitor the various bankruptcy proceedings and prepare for other necessary enforcement actions at the Site, including consent decree settlement negotiations with the PRPs for the performance of remedial actions and reimbursement of past and future costs incurred by U.S. EPA.

3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The specific requirements for public participation at the Site include releasing the RI/FS and Proposed Plan to the public. This was done on June 15, 1992. Both documents were placed in the Administrative Record and information repositories. Notices of the availability of these documents, a public meeting on the Proposed Plan and a public comment period was published in the Spokesman-Review and Shoshone News Press on June 13, 1992; reminders of the public meeting were placed in the Shoshone News Press on June 20, 21, 23, 24, and 25, 1992. The initial public comment period was from June 15 to July 15, 1992; it was extended to August 14, 1992 after a July 10 citizen request to extend the comment period was received. A public meeting was held on June 25, 1992. Comments from the public were taken and are summarized in the Responsiveness Summary portion of this document along with all written comments that were submitted during the comment period.

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 citizen's advisory group to the Bunker Hill Superfund Project Team (comprised of representatives of U.S. EPA and IDHW and contractors). The PHD was contracted by IDHW to perform community relations tasks for the Site. A full time IDHW staff person has also been stationed onsite from mid 1987 to present. Part of the Task Force's duties is to assist in community relation activities when needed.

Community relations activities have focussed on maintaining effective communication between the citizens living on the Site and the agencies. Actions taken have been tailored to meet community needs and are consistent with the requirements of the federal law. They have provided an on going forum for citizen involvement in reaching the remedial action decisions prescribed in this ROD.

Between May 1985, and July 1991, the following meetings and community outreach activities were conducted:

Description	Count
Task Force Meetings	37
Meetings with Groups/ Civic Organizations	79
Meetings with Fair Share/ICN	18
Fact Sheets	25
Health Intervention Program Screenings	9

Information repositories have been created for the public to have access to minutes of task force meetings, all major project documents, fact sheets, orders, and other pertinent information. These repositories are located at the Kellogg Public Library, Kellogg City Hall, Pinehurst/Kingston Public Library, and Smelterville City Hall.

Generally, meetings were well attended. Task force meetings typically were composed of 20 - 50 community members. Proposed plan meetings were attended by over 150 citizens. Smaller group meetings were intended to get information to interested groups.

Specific Community Relations Activities at the Site are listed below. For those activities prior to May 1991, only the dates have been listed. For further details on these activities, refer to the Record of Decision on the Residential Soils (August 1991).

July 15, 16,17, 1992	Notice ran in the Shoshone News Press announcing the extension of the Public Comment Period,
July 10, 1992	U.S. EPA released a Public Comment Period extension notice to people on the mailing list.
June 25, 1992	U.S. EPA conducted the Proposed Plan Public Meeting
June 20, 21, 23, 24, 25, 1992	A reminder of the public meeting ran in the Shoshone News Press.
June 13, 1992	Ad ran in the Shoshone News Press and the Spokesman Review, announcing the date and time of the public meeting and the public comment dates. The ad also briefly described the preferred alternative and encouraged comments on all alternatives from the proposed plan. Also explained where people could pick up copies of the entire plan.
June 13, 1992	The Agencies distributed the Proposed Plan fact sheet door to door in Smelterville, Wardner, Kellogg, Pinehurst, and the rest of the Superfund Site.
June 13, 1992	U.S. EPA mailed the Proposed Plan to the mail list and provided additional copies to the following locations: Superfund Project Office, Kellogg Library, Panhandle Health District Office, Pinehurst/Kingston Library, Kellogg City Hall, and Smelterville City Hall.
June 4, 1992	Regional Administrator and other representatives of U.S. EPA met with several community groups including the Task Force and the Kellogg Chamber of Commerce.
May 28, 1992	Task Force Meeting to discuss institutional control and interior dust remediation alternatives.
May 1992	Newspaper article ran in the Silver Valley Voice, which explained in detail the alternatives that were being considered for the Site.
April 30, 1992	Task Force Meeting to discuss the cleanup alternatives proposed for ground water and surface water.

March 19, 1992	Task Force Meeting to discuss CIA, Smelter complex, MOA and Smelterville Flats cleanup alternatives.
February 26, 1992	Door to door distribution by the Agencies of a fact sheet, which outlined the project accomplishments from 1991 and announced the activities expected to occur over the spring and summer and project accomplishments that had taken place in 1991.
September 5, 1991	Door to door distribution by the agencies of a Fact Sheet announcing the cleanup plan for Residential Soils.
August 12, 1991	Door to door distribution by the Agencies of an updated Fact Sheet on the Hillsides Project.
May 23, 1991	Proposed Plan Public Meeting on Residential Soils Cleanup
April 26, 1991	The proposed Plan for Cleanup of the Residential Soils Within the Site
February 28, 1991	Door to door distribution by the agencies of a Fact Sheet Update.
February 21, 1991	Task Force Public Meeting.
January 18, 1991	Fact Sheet explaining the 1990 accomplishments.
October 25, 1990	Task Force Public Meeting and Summary of Findings Risk Assessment/Data Evaluation Report (RADER) Populated Areas.
October 2, 1990	Fact Sheet released by U.S. EPA which discussed the Hillside Stabilization and Revegetation Order.
September 1990	U.S. EPA released a fact sheet which explained the CERCLA Process at Bunker Hill.
July 24, 1990	U.S. EPA released a general update on activities at the Site.
July 19, 1990	Task Force Public Meeting.
April 12, 1990	Task Force Public Meeting.
March 19, 1990	U.S. EPA released a fact sheet update on the proposed Page Pond disposal
February 26, 1990	Bunker Hill Superfund Site Fact Sheet
December 1989	Bunker Hill Superfund Site Fact Sheet
November 16, 1989	Task Force Public Meeting.
September 1989	Bunker Hill 1989 Residential Soil Removal Action Cost Summary through 9/29/89

August 24, 1989	Task Force Public Meeting.
May 18, 1989	Task Force Public Meeting.
March 1989	Panhandle Health District 1: Notice of Engineering Evaluation for Phased Clean-up comment.
February 16, 1989	Task Force Public Meeting.
December 15, 1988	Task Force Public Meeting.
October 19, 1988	Task Force Public Meeting.
September 8, 1988	Task Force Public Meeting.
September 1988	Bunker Hill Superfund Fact Sheet
July 28, 1988	Task Force Public Meeting.
July 1988	Bunker Hill Superfund Project Update
June 30, 1988	Task Force Public Meeting.
May 12, 1988	Task Force Public Meeting.
February 26, 1988	Letter to Silver Valley Task Force chairman concerning how U.S. and IDHW will proceed with the RI/FS process.
December 10, 1987	Task Force Public Meeting.
December 1987	Bunker Hill Superfund Project Update.
August 13, 1987	Task Force Public Meeting.
August 11, 1987	Letter to Interested Parties regarding RI/FS Bunker Hill Superfund Site
June 1987	Memo to Silver Valley Bunker Hill Superfund Task Force
June 18, 1987	Task Force Public Meeting.
May 1987	Status Report: Bunker Hill Superfund Project
April 16, 1987	Task Force Public Meeting.
March 9, 1987	Task Force Public Meeting.
March 1987	Bunker Hill Superfund Site Update
February 5, 1987	Task Force Public Meeting.
January 1987	U.S. EPA released a fact sheet explaining the Superfund Process.

December 11, 1986	Task Force Public Meeting.
September 18, 1986	Task Force Public Meeting.
August 7, 1986	Task Force Public Meeting.
July 1986	Memo to Silver Valley Superfund Task Force regarding Silver Valley Superfund Project
May 29, 1986	Task Force Public Meeting.
April 10, 1986	Task Force Public Meeting.
March 20, 1986	Task Force Public Meeting.
February 13, 1986	Task Force Public Meeting.
January 9, 1986	Task Force Public Meeting.
December 5, 1985	Task Force Public Meeting.
October 24, 1985	Task Force Public Meeting.
September 19, 1985	Task Force Public Meeting.
August 1, 1985	Task Force Public Meeting.
June 27, 1985	Task Force Public Meeting.
May 16, 1985	Task Force Public Meeting.

4 SCOPE AND ROLE OF OPERABLE UNIT

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

The residential soil component of the Populated Areas was the first operable unit to be addressed in a ROD (August 1989). The other components related to the Populated Areas investigation that have not been addressed in a decision document include: residential interiors, commercial properties, and rights-of-way. The agencies originally expected to address these issues in a second ROD in 1992; however, the Potentially Responsible Parties (PRPs) proposed to the U.S. EPA and IDHW a Site Wide cleanup plan that comprehensively addresses concerns in both the Populated and Non-populated Areas. Subsequently, the Agencies decided to complete the Residential Soils ROD as scheduled, because soils are a primary risk to the residents; however, all remaining issues (see Table 2-1) were consolidated into a comprehensive FS performed by the PRPs with U.S. EPA oversight representing a second Operable Unit for the Site. That FS supports this second ROD for the Site.

Elements addressed in this ROD include:

- Hillsides
- Smelterville Flats
- Central Impoundment Area
- Page Pond
- Smelter Complex and Mine Operations Area
- Rights-of-Way
- Commercial Buildings and Lots
- Residential Interiors
- Future Development in Non-populated Areas
- Constructed Wetland Treatment Systems
- Public Water Supply Considerations
- Soil Action Levels
- Institutional Controls
- Monitoring
- Operations and Maintenance

The consolidation of these elements for investigative and remedy selection purposes recognizes the interrelationships among the geographic areas of the Site, transport media considerations, and the need to develop an integrated remedial action for the Site. Throughout the FS process, every effort was made to consider how remedial actions for each area would impact an overall remedial action for the Site. Development of the FS by the cooperating PRPs involved considerable dialogue with the agencies. Numerous meetings were held to focus technical evaluations of site contamination and evaluate cleanup options.

This ROD considers both the interrelated nature of the various Non-populated Areas, and the need to integrate residential areas into a site wide remedial action. For example the decision in the Residential Soils ROD to utilize removal and replacement of contaminated residential soils to a depth of one foot has impacts on site ground water that must be considered in evaluating that resource in subsequent investigations. The residential soils ROD also sets the stage for the utilization of institutional controls as a component of site wide remedial actions and appropriate remedies for onsite disposal of contaminated residential soils. Actions selected in this ROD complement the remedial actions selected in the Residential Soils ROD. Together this ROD and the Residential Soils ROD serve to prescribe a protective site wide remedy for the Bunker Hill Site. Studies conducted during the Residential Soils RI/FS, including the RADER, were factored into the decisions in this ROD. Response actions required by the existing U.S. EPA Orders for the Site are components of this ROD and are hereby incorporated into this ROD.

Actions selected in this Record of Decision do not address sources of contamination upgradient of the Bunker Hill Superfund Site, and while onsite actions are expected to have significant benefits to downgradient SFCDR water quality conditions over time, active remediation of the SFCDR is beyond the scope of actions specified in this ROD. The NCP gives U.S. EPA broad discretion to use not only CERCLA but also other appropriate authorities, to address releases of hazardous substances in the Coeur d'Alene Basin. Recently U.S. EPA, the State of Idaho, the Coeur d'Alene Tribe of Idaho and other federal, state and local agencies have initiated efforts to integrate water quality improvement programs in the Coeur d'Alene Basin. The Coeur d'Alene Basin Restoration Project efforts are expected to complement actions selected in this ROD in improving overall water quality conditions in the Basin. The Coeur d'Alene Basin Project is being designed to integrate and coordinate the activities within the Coeur d'Alene Basin which are being undertaken by the local landowners, local governments, state agencies, the Coeur d'Alene Tribe, the Federal Trustees and U.S. EPA. This includes coordination of regulatory authorities under the Clean Water Act (CWA), CERCLA, and RCRA. Other state, local and Tribal programs will also be integrated into thisProject. The Clean Water Act provides a mechanism for developing water quality standards, evaluating discharge permits and establishing nonpoint source controls within the Coeur d'Alene Basin. CERCLA provides a mechanism for investigation and controlling the release of hazardous substances through the exercise of removal authorities.

5 SITE CHARACTERISTICS

5.1 PHYSICAL SETTING

The Bunker Hill Superfund Site consists of a seven-mile by three mile section of the east-to-west trending valley of the South Fork of the Coeur d'Alene River (SFCDR). The topography of the valley, known as the Silver Valley, consists of an alluvial floodplain bordered on the north and south by steep mountains or hillsides. Floodplain width varies from about 0.1 mile east of Kellogg to approximately 0.9 miles near Smelterville. The elevation of the valley floor ranges from 2,160 feet above mean sea level at the west end of the Site to 2,320 feet at the eastern end of the Site. Typically, the valley floor is nearly level, with most slopes less than one percent. 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 (SFCDR). The major drainages of the Site are on the south side of the Valley. These include Milo, Deadwood, and Government Gulches.

SOILS

Soils within the Site vary from poorly developed native colluvium and slope-wash materials on the hillsides to largely alluvial soils on the SFCDR valley floor.

Hillside area soils with slopes greater than 35 percent were generally formed in volcanic ash and metasedimentary rocks. Surface layers are typically 14 to 16 inches of gravelly silt loam with very cobbly loam subsoils extending more than 60 inches to weathered bedrock. In the Smelter Complex area, terrace deposits occur near the base of the hillsides and are formed in glacial and alluvial deposits. These soils typically have exposed subsoils consisting of silt loam and heavy silt loam underlain by very cobbly or very gravelly heavy silt loam and silty clay loam.

Hillsides in the immediate vicinity of the Smelter Complex are generally devoid of vegetation, resulting in conditions favorable to sheet, rill, and gully erosion. This erosion has resulted in substantial loss of material from the upper soil horizons.

Soils and surface materials on the SFCDR valley floor (including Smelterville Flats) vary in their physical characteristics and genesis from those on the hillsides, with some evidence of regional loess contribution. The valley floor soils and surface materials were impacted by the construction of a plank and pile dam at the west end of Smelterville Flats in the early 1910s which retained sediments, including tailings, until its failure in the 1930's. The tailings have been reworked and redistributed by the river since that time. Flooding of the SFCDR together with excavation of the tailings/alluvial mixture (jig tailings) for reprocessing has redistributed jig tailings and smelter emissions throughout most of the valley flood plain.

SURFACE WATER

The SFCDR below Wallace, located 12 miles east of Kellogg, is a relatively shallow stream with a gradient of about 30 feet per mile. Since mining activities in the area began, the SFCDR and some tributary streams in the Site vicinity or the Site, as well as upstream, and downstream areas, have received a sediment load which included mine/mill tailings.

Flow variations of the SFCDR are affected by spring snowpack melt. In a typical year, peak average monthly flows occur in April, May, and June, tapering off in later summer and early fall. In winter, flows are low unless an early snow melt or a large rainfall event occurs.

The drainage network of the Coeur d'Alene River (CDR) Basin includes Canyon Creek, above Wallace; Big Creek (including its east and west forks), between Osburn and Kellogg; Montgomery Creek; and, Pine Creek (including its east, middle, and west forks), near Pinehurst. There has been extensive mining activity in many of the tributaries upstream of the Site, in particular Canyon Creek, Nine Mile Gulch, and Big Creek. Tributaries within the Superfund Site include Milo, Italian, Jackass, Portal, Deadwood, Magnet, Government, Humboldt, Grouse, and Pine Creek Gulches.

GROUND WATER

Water bearing materials in the Site include: upper, confining, and lower zones. This system is important because of its hydraulic linkage with the SFCDR, relatively large ground water discharge rates and flow velocities, and potential to receive contaminants from overlying and integrated sources as well as upstream areas. Ground water is also known to be present, at least seasonally, in colluvial/alluvial deposits in tributary valleys and locally in terrace deposits along the south wall of the SFCDR Valley. Ground water systems are probably present in the hillsides along the bedrock/soil interface, particularly after precipitation and snow melt events. It is probable that a fracture-flow dominated ground water system exists within the bedrock underlying the Site (RI, 1992).

Major tributary valleys at the Site include Milo, Jackass, Italian, Deadwood, Magnet, Government, Grouse, Humboldt, and Pine Creek Gulches. Ground water in these gulches probably occurs in shallow, unconfined systems with steep hydraulic gradients; an exception to this is the Pine Creek drainage, which is relatively large with a flat floor. Potential recharge sources to these ground water systems include infiltration of precipitation and snow melt, leakage from streams, leakage from surface impoundments, and potential contribution from bedrock sources. Discharge from the tributary gulch ground water systems primarily enters the upper zone of the valley fill aquifer system.

From an environmental impact perspective, Government Gulch is one of the more important tributaries entering the SFCDR Valley because of numerous contaminant sources resulting from the Zinc and Phosphoric Acid Plants. Water levels in Government Gulch are typically highest in April and lowest in January and October. Although water levels varied by as much as seven feet, the horizontal hydraulic gradient tends to be relatively constant, indicating that water level fluctuations are fairly uniform within the Gulch. Relatively constant ground water flow gradients are expected in other tributary gulches. The estimated ground water gradient in Government Gulch is about nine times that noted in the upper zone of the SFCDR Valley.

VEGETATION

Forests in the Bunker Hill Superfund Site area are characteristic of the northern region of the Rocky Mountains, extending from southern Montana and Idaho to Jasper National Park in Alberta. Typical forest area species in the Site area include: western hemlock, western red cedar, mountain hemlock, and subalpine larch which are interspersed among ponderosa pine, lodgepole pine, douglas-fir, and subalpine fir.

Much of the Site vegetation has been modified by past disturbances and, consequently, forests on the Site are typically restricted to the upper elevations of the hillsides and areas near the perimeter of the Site (Pinehurst, Elizabeth Park, etc.). In general, vegetative cover increases with increasing distance from the Smelter Complex. The present site area includes barren areas (near the Smelter Complex), sparsely vegetated shrub land (peripheral to barren areas), natural forested areas (upper hillsides near the boundaries), swamps (southwestern portion of Smelterville Flats), plantations of young conifers (areas planted by the Bunker Hill Company), and urban vegetation (residential areas).

CLIMATE

The meteorology of the Site is dominated by mountain/valley drainage winds related to the local topography. Wind patterns in the SFCDR Valley generally follow a daily recurring upvalley/downvalley (easterly/westerly) flow regime. Typically, night cooling of the ground layer leads to a surfacebased atmospheric temperature inversion, producing a down-valley flow of air. After sunrise, heating of the valley floor and hillsides causes a reversal of the earlier wind pattern, although not as strong. During the transition period between the two wind directions, winds are generally calm in the valley. At other times, because of the sheltering effects of the SFCDR Valley location, wind speeds are typically lower in the valley than more exposed areas such as hillsides. Construction of a wind frequency distribution/magnitude plot shows the influence of strong regional west to east winds (see Figure 331 of RI, Volume 1).

The Bunker Hill Site receives some of the highest levels of precipitation in Idaho. Normal annual precipitation in the SFCDR valley floor area (Kellogg) is approximately 30.4 inches. Total annual precipitation at Kellogg typically has a relatively small range of 20 to 40 inches, with extremes of 47.6 inches in water year 1974 to 17.4 inches in water year 1973. Mean annual snowfall for the period of record in Kellogg was 69.9 inches. Average annual precipitation at higher hillside elevations can exceed 50 inches (RI, 1992). An average of 70 percent of the annual precipitation at Kellogg occurs from October to April, mainly as snowfall.

At higher elevations, snow normally persists from late fall to late spring. The Bunker Hill Site area is positioned to receive straight zonal flow of warm Pacific moisture from the west. Resulting precipitation from this system in combination with a melting snowpack have produced some of the largest floods in the SFCDR Basin; these have occurred during the winter months.

The Bunker Hill Site is in the climate region termed "highland climates", and is dominated by mountain-valley climate characteristics such as upvalley/downvalley wind regimes. This is accompanied by considerable variation in snowfall with elevation and location. The mean annual temperature for the period 1951 to 1980 was 47.2 F. The record extreme temperatures were 111 F (August 5, 1961) and -36 F (December 30, 1968). On the average, 28 days per year reach a maximum temperature of 90 F or greater, and 143 days reach a minimum of 32 F or lower (RI, 1992).

CULTURAL SETTING

The Bunker Hill Superfund Site encompasses four incorporated cities (Kellogg, Pinehurst, Smelterville, and Wardner) and three communities (Elizabeth Park, Page, and Ross Ranch). About 5,000 residents live within the Site. Settlement of the valley was associated with the development and growth of the metal mining and smelting industries. Homes and business were constructed throughout the valley floor and side gulches. As a result, local populations live to varying degrees in close proximity to contaminated media and sometimes contaminant sources. For example, many valley floor residences have been constructed on tailings, resulting in contaminated yard soil. Smelter emissions also caused widespread contaminant dispersion, resulting in contaminated yard soils and interior dusts. The pervasive nature of Site contamination and the close association of the resident population requires remedial actions that retain the integrity of the residential community while addressing contaminant exposure pathways.

5.2 NATURE AND EXTENT OF CONTAMINATION

5.2.1 Contaminants of Concern

Adverse environmental impacts have and continue to occur from heavy metals and other contaminants associated with mining, milling, and mineral beneficiation and processing activities. The Site Characterization Report (SCR) listed thirteen contaminants of concern based on preliminary investigations including the following:

- Antimony
- Arsenic
- Beryllium
- Cadmium
- Cobalt
- Mercury
- Selenium
- Silver
- Zinc
- Asbestos
- Copper
- Lead
- Polychlorinated Biphenyls (PCBs)

Work conducted subsequent to the SCR and as proposed by the Nonpopulated RI/FS Work Plan addressed these principal contaminants along with an extensive screening program for the presence of other contaminants of concern, including organic compounds. Task 0 of the RI sampled for the priority pollutant list and 10 other constituents. Task 0 activities entailed collection of solid and liquid samples for broad-spectrum contaminant screening at the onset of the RI. Evaluation of the analytical results was completed in conjunction with a review of field records, historical records, and process, product, and byproduct material information. During the RI, no additional contaminants of concern were identified. Manganese is listed as a contaminant of concern in the Ecological Risk Assessment (ERA) because of the potential impact to small mammals from localized soils; additionally, manganese was identified in the Risk Assessment Data Evaluation Report (RADER) as exceeding Secondary Drinking Water Standards (DWS) in some instances. Some contaminants of concern were not detected in surface or ground water during the screening process and thus were eliminated from further water analyses. Beryllium, PCBs, and asbestos analyses were not routinely conducted on surface or ground water samples, and antimony and copper analyses were not routinely conducted on ground water samples since screening determined these constituents to be below levels of concern.

5.2.2 Contaminant Sources

The presence of contaminants at the Site was traced to the following contaminant sources and source areas identified during the RI:

! Jig Tailings - In the early years of operation, mills within the Site and, for a longer period, mills upstream of the Site, released tailings, a waste product from the ore concentrating process, which were deposited on the valley floor. During flood events, these and, for a longer period, mills upstream of the Site, released deposited on the flood plain. The valley floor throughout the Site is currently mantled with a mixture of jig tailings, flotation tailings, and alluvium, as well as air dispersed contaminants from the Smelter Complex. The mixture is referred to as "jig tailings" for the purpose of the RI/FS. Jig tailings were identified as a source of Site wide metals contamination in soil, air, surface water, and ground water.

! Flotation Tailings - Crude flotation ore concentration methods were used at the Site as early as 1913. Froth flotation was the predominant method of ore concentration after approximately 1930. The byproducts of this ore concentration process are called flotation tailings. The release of tailings from the Page Mill to the Page tailings impoundment began in 1926. Flotation tailings for the Bunker Hill Mill were deposited on the valley floor until the West Mill began discharging to the Central Impoundment Area (CIA) in 1928. Uncontrolled releases of flotation tailings in upstream areas continued until as late as 1968; these tailings comprise a portion of the alluvium/tailings mixture (jig tailings) on the SFCDR Valley floor. Flotation tailings impounded in the CIA and Page Pond were recognized as sources of metals contamination in air, surface water, and ground water.

! Inflow of Contaminants at the Upstream Site Boundary Mining and milling operations were conducted upstream of the eastern site boundary during the same period as those conducted within the Site. The RI documented the degradation of surface and ground water quality upgradient of the Site, and identified the influxes of metals in surface and ground water at the eastern Site boundary as sources of contamination within the Site.

! Air Emissions - The Lead Smelter began operations in 1917, and Zinc Plant production began in 1928. Particulate controls were employed to capture and recycle the Lead Smelter and Zinc Plant flue dusts, but sulfur dioxide emissions were not directly addresseduntil sulfuric acid plants were constructed in 1954 and 1965 (Zinc Plant) and 1970 (Lead Smelter). Emission controls were not consistently effective, and operational upsets occurred, in particular after the 1973 baghouse fire. Smelter Complex air emissions, including fugitive emissions, were identified as sources of lowered pH and heavy-metal concentrations in soils throughout the Site, and contributed to vegetation damage and erosion on hillside slopes.

- Smelter Complex Materials and Residuals - Ores, concentrates, flue dusts, sinter and calcine (products of roasting concentrates), lead residues, slag, gypsum, other materials, and wastes were stored, transported, and occasionally spilled in and around the Smelter Complex. Material accumulations and residual materials within the complex were identified as sources of air, surface water, and ground water contamination. The Smelter Complex had the highest concentrations of contaminants of any area within the Site.

- Gypsum and Slag - Gypsum generated during phosphoric acid production was disposed in three impoundments that were identified as sources of blowing dusts and inorganic nonmetal contaminants in surface and ground water. Large quantities of granulated slag were deposited in the CIA west cell. The granulated slag was produced by the zinc fuming process wherein most of the zinc was removed as zinc oxide. Small quantities of ungranulated slag were deposited adjacent to the lead smelter. The ungranulated slag was not subjected to the zinc fuming process and therefore contains a greater abundance of zinc than the granulated slag. The remaining metals in the granulated and ungranulated slag are relatively immobile in their current state due to their incorporation in a silicate matrix.

- Acid Mine Drainage - Dewatering of the Bunker Hill Mine has contributed acidic, metals-laden mine water to the east cell of the CIA. Most dewatering was curtailed in early 1991; however, it is likely that full scale dewatering will resume in the future. Seepage from the east cell was identified as the largest source of metals loading to Site ground water during the RI.

Full-scale smelting operations at the Site ceased in 1981, although salvage efforts, including sporadic open-pot smelting, were reported in the mid-1980s. Mining and milling operations have operated at the Site intermittently since 1981, but were curtailed in early 1991. Therefore, new contaminants are no longer being generated onsite with the exception of continued mine discharge. However, contaminants continue to enter ground water and surface water at the upstream Site boundary. Additional contaminants will be generated onsite and will increase if dewatering of the Bunker Hill Mine is resumed or when water flows naturally from the mine. The redistribution of contaminants from existing sources by air, surface water, ground water and anthropogenic activities continues to impact onsite and offsite areas.

A description of the nature and extent of contamination by media and current contaminant transport pathways as characterized during the RI are provided in the following sections.

SOILS AND SURFICIAL MATERIALS

Soil contamination exists in most areas of the Site. Contaminant concentrations in Site soils are generally highest in and adjacent to the Smelter Complex. Table 5-1 summarizes maximum soil metals concentrations exhibited within the Bunker Hill Superfund Site. Soil metals concentrations were compared with background levels established for the Coeur d'Alene Mining District by the U.S. Geological Survey (Gott and Cathrall, 1980). "Threshold levels" were established as a basis for locating ore deposits.

HILLSIDES

Metal concentrations in undisturbed hillside soils throughout the Site were generally elevated above the threshold levels. The highest metals concentrations in the hillside soils occurred in the uppermost few inches of soil profile; metals concentrations generally decreased sharply with depth. Table 5-2 summarizes average metal concentrations for all zones at 0-1" depth in the Hillsides and the vicinity around the Smelter Complex area. Sources of hillside soil contaminants included historical Lead Smelter and Zinc Plant air emissions, wind-mobilization and subsequent deposition of fugitive dust from material accumulations and residuals in the Smelter Complex, and deposition of wind-blown tailings. Erosion of contaminated soils was identified as a contaminant transport mechanism during the RI and has resulted in a reduction of surface soil concentrations in some areas.

SMELTERVILLE FLATS

Jig tailings were widely distributed on the valley floor throughout the Site; these deposits contain elevated metals concentrations compared to threshold levels. The largest accumulation of jig tailings within the project area is on Smelterville Flats, where contamination ranges to depths of three to seven feet, with local accumulations approaching ten feet in thickness. Jig tailings also underlie the CIA and portions of the Page Swamps. In general, concentrations in the jig tailings are dependent on the relative quantities of tailings and alluvium in the mixture. Maximum concentrations of 504 mg/kg arsenic, 78.2 mg/kg cadmium, 30,000 mg/kg lead, and 15,600 mg/kg zinc were measured in valley floor jig tailings samples.

TAILINGS IMPOUNDMENTS

The CIA and the Page Pond tailings impoundments contain a total ofapproximately 18 million cubic yards of flotation tailings. For the CIA flotation tailings, maximum measured arsenic and cadmium concentrations (692 mg/kg and 45.2 mg/kg, respectively) occurred in surficial dust samples. Maximum measured lead and zinc concentrations (7,760 mg/kg and 7,990 mg/kg, respectively) occurred in composite core samples. IDHW characterized Page Pond as a dust source by averaging concentrations from individual dust samples. Averages of measured concentrations from Page Pond surface samples were 202 mg/kg arsenic, 38.7 mg/kg cadmium, 4,350 mg/kg lead, and 4,260 mg/kg zinc.

GYPSUM

Gypsum (calcium sulfate) generated during the production of phosphoric acid was disposed in impoundments in upper Magnet Gulch, on the valley floor near the mouth of Magnet Gulch, and in the CIA middle cell. The gypsum contains relatively low metals concentrations but was found to be readily soluble and was identified as a source of sulfates, fluoride, and other inorganic non-metal constituents (Table 5-3). The A-4 and A-5 Gypsum ponds are potential source areas for fluoride although it was not analyzed during the RI.

SLAG

Granulated slag in the CIA west cell contains highly elevated concentrations of metals. However, these metals are generally regarded as being immobile and unavailable for transport due to their incorporation in a silicate matrix, which limits leaching, and the relatively large particle size of the slag, which limits wind transport. Maximum metals concentrations measured in the granulated slag were 172 mg/kg arsenic, 51.8 mg/kg cadmium, 5,850 mg/kg lead, and 23,650 mg/kg zinc.

MATERIAL ACCUMULATIONS

Discrete accumulations of various high-concentration products, byproducts, residues, and wastes are present in indoor and outdoor areas within the Smelter Complex. Indoor accumulations are sheltered and subject to limited dispersal, except where structures are in poor condition. Outdoor material accumulation sites have contributed to soil, surface water, and ground water contamination. Soil contamination is generally greatest adjacent to and underlying the various sites and may extend to depths of several feet where infiltration and earthwork have occurred.

The largest material accumulation pile in the Smelter Complex noted during the RI was the copper dross flue dust pile (CDFDP) in lower Magnet Gulch. The CDFD was sprayed with surface sealant during the RI to reduce its potential as a wind-blown dust source; the CDFD was subsequently relocated to the Lead Smelter during Spring 1992. Salvage of contaminated materials from the Smelter Complex with subsequent transport to offsite areas was identified during the RI as a contaminant dispersal mechanism, as was transport of contaminated dust and mud on vehicles. Imminent threats associated with the Smelter Complex are currently being addressed by the Smelter Complex owners, as required by the September 1991, Administrative Order.

Some isolated occurrences of oil-stained soils in the Smelter Complex contained PCBs in concentrations ranging from non-detectable to as high as 218 mg/kg near the Lead Smelter's water softening building. Numerous pieces of PCB-containing electrical equipment were removed and disposed of from the Bunker Hill Mine. Asbestos containing materials (ACM) were identified in some Smelter Complex buildings and equipment (e.g., insulations, roofing, and siding materials). Most of the loosened and damaged ACM at the Smelter Complex was removed during a 1989 CERCLA removal action.

AIR

Wind-mobilization and redistribution of contaminants from soils and surficial materials was identified as a major site wide transport pathwayimpacting the Populated areas of the Site.

Historical data collected by IDHW indicated that prior to the lead smelter and zinc plant closures, airborne lead was the primary contributor to elevated blood lead levels in human populations at the Site. Construction of the sulfuric acid plants and tall stacks (1977) resulted in significantly decreased sulfur dioxide and lead concentrations in onsite air. Lead and total suspended particulates (TSP) concentrations decreased further, following closure of the Smelter Complex. However, sources of wind-blown contaminants remaining at the Site include the CIA, Smelterville Flats, the Mine Operations Area (MOA), Smelter Complex facilities and properties, Page Pond, parking lots, railroad ROW, and other public and commercial facilities.

RI air quality data were collected from the Smelterville and Kellogg Middle School areas between November 1987 and November 1988. Maximum daily TSP concentrations were measured at the two school stations during a September 1988 dust storm. Weekly TSP concentrations at the two stations averaged 69.5 g/m[3] and 40.8 g/m[3], respectively. Weekly maximum and mean lead concentrations at the Smelterville station were reported at 1.35 and 0.312 g/m[3], respectively; and the weekly maximum and mean lead concentrations at the Kellogg Middle School were reported at 0.310 and 0.095 g/m[3], respectively. In general, higher lead concentrations in air correlate with higher TSP concentrations, and the highest TSP and metal concentrations were occasionally reported during the winter months. The National Ambient Air Quality Standard (NAAQS) for TSP (150 g/m[3]) was occasionally exceeded at the Smelterville and Kellogg Middle School stations during high-wind events. The NAAQS for lead (1.5 g/m[3] and 0.5 g/m[3] proposed) is based on the three-month average of daily lead concentration measurements. This standard was not exceeded at either monitoring station during the RI. Fugitive dust model (FDM) predictions indicate that air transport pathways impact the populated areas of the Site. Dust source data from the summer of 1988 were used to predict the contributions to airborne lead concentrations during wind-blown dust events at six populated area receptor zones from specific sources within the Site. The results of the model simulations are discussed below.

! Smelterville Flats Sources - Receptor sites in Smelterville and lower Government Gulch were predicted to receive 88 percent and 53 percent, respectively, of their airborne lead concentrations from dust sources in Smelterville Flats. Approximately 28 and 23 percent of the lead Government Gulch were predicted to receive 88 percent and 53 percent, respectively, was also attributed to this source area.

- CIA Sources - CIA dust sources were predicted to contribute approximately 21 percent of the airborne lead concentrations in northwest Kellogg and less than 10 percent to other receptor zones within the Site.

- Smelter Complex Sources - Sources in the MOA were predicted to contribute approximately 65 percent of the airborne lead in west and south Kellogg and Wardner. Southeast Kellogg may receive over 30 percent of its airborne lead concentrations from the MOA. The Lead Smelter lead contribution to lower Government Gulch was estimated at approximately 22.5 percent. Other Smelter Complex sources accounted for less than 10 percent of the predicted lead levels at the other receptor zones.

- Hillside Sources - FDM predictions indicated that source areas on hillside slopes contributed approximately 26 percent and 16 percent of the total airborne lead concentrations at receptor sites in southeast and northeast Kellogg, respectively. The hillsides were predicted to contribute less than 10 percent of the total airborne lead in the other receptor zones.

Dusts that are dispersed from the sources described above may ultimately be resuspended and redistributed to other areas of the Site or offsite areas.

Since completion of RI field investigations, an increase in Site vegetative cover has been observed and measures have been taken to reduce potential fugitive dust generation that may result in an overall reduction of wind-blown contaminant transport.

SURFACE WATER

During the RI, baseline and runoff surface water quality samples were collected from stations along the SFCDR, perennial tributary gulches, and other locations throughout the Site. The collected data show that surface water entering the Site is of poor quality and is further degraded by a variety of inputs within the Site boundaries. Comparison of baseline data collected by U.S. EPA during the early and mid-1980s with those collected during the RI indicate an overall improvement in the water quality of the SFCDR within the Site.

The RI surface water data were compared with Federal Primary and Secondary Drinking Water Standards (DWS) and Aquatic Life Criteria (ALC); both Chronic and Acute). Surface water transport pathways were quantified in the RI Report in terms of combined metals loadings (CML) expressed in pounds per day (lb/day). CML was defined as the sum of the reported concentrations of arsenic, cadmium, cobalt, lead, and zinc multiplied by the volumetric flow rate and appropriate unit conversion factors.

The DWS and/or Chronic ALC for lead, cadmium, and zinc were commonly exceeded under baseline flow conditions at stations upgradient and within the Site. Table 5-4 compares ALC to both low flow and high flowconcentrations for zinc, cadmium, and lead at various locations. Maximum baseline cadmium, lead, and zinc concentrations recorded at Elizabeth Park upstream from the Site boundary were 0.015 mg/l, 0.057 mg/l, and 2.22 mg/l, respectively, whereas the maximum concentrations of those metals reported at the downstream Site boundary were 0.017 mg/l, 0.188 mg/l, and 2.76 mg/l, respectively. In general, most constituent concentrations were higher during baseline low-flow conditions in late summer and fall than during higher flow conditions. During storm runoff events, maximum concentrations of total arsenic, cadmium, lead, and zinc in the SFCDR at the western (downstream) Site boundary were 0.045 mg/l, 0.047 mg/l, 0.931 mg/l, and 4.09 mg/l, respectively. Nearly all SFCDR runoff samples exceeded the DWS and Chronic ALC for cadmium, lead, and zinc, while arsenic concentrations were generally below Chronic ALC and DWS levels. Increased metal concentrations in the rising limb of the discharge hydrograph were attributed to the scouring of metal-laden materials from the stream bed and other source areas during the initial phases of runoff events.

Surface water transport was identified as a major migration pathway for contaminants in the dissolved and solid phases within and exiting the Site. Although concentrations of contaminants do not vary greatly between the upgradient and downgradient. Site boundaries, a combination of contaminant contributions and increased flow significantly increase the metal loadings leaving the Site. Baseline CML estimates for the SFCDR at the western (downstream) Site boundary under low-flow conditions (September 1987) and under high-flow conditions (May 1988) were 959 lb/day and 7,200 lb/day, respectively. CML sources to the SFCDR identified during the RI included the following:

- Inflows from upstream of the eastern Site boundary. CML estimates ranged from 633 to 3,420 lb/day;

- Upper zone ground water inflows in gaining reaches of the SFCDR. The estimated net CML from ground water to the river was 657 lb/day in September of 1987; over 400 lb/day of this loading was estimated from seeps in the south bank of the SFCDR near the CIA; estimated net CML from ground water to the river was 657 lb/day in

- Erosion, transport, and dissolution of contaminants in stream-bed and bank materials, contaminated soils, and material accumulations and residuals within the Site; bank materials, contaminated soils, and material accumulations and operations. Estimated CML under baseline conditions were 1.96 to 68.7 lb/day for Milo Creek, 2.46 to 67.7 lb/day for Bunker Creek, 2.02 to 101 lb/day for Government Creek, and 3.52 to 153 lb/day for Pine Creek;

- Discharges from the Page Pond and Smelterville wastewater treatment plants. CML estimates were 2.03 to 6.86 lb/day and 0.045 to 7.15 lb/day, respectively; and

- Stormwater runoff from the Smelter Complex and hillsides was identified as contributing large pulses of contaminants to the surface water system. Some of this runoff is routed to the CIA through drainage pipes and channels; however, a portion of the runoff from Government, Magnet, and Deadwood Gulches, MOA, Lead Smelter, Zinc Plant, and Phosphoric Acid/Fertilizer Plant enters Bunker or Government Creeks and ultimately the SFCDR.

GROUND WATER

A water well inventory indicates that a few residences rely on well water; most of the residences within the Site receive potable water from a municipal supply obtained from areas upgradient of contamination. Therefore, ground water at the Site is generally not used as a source of drinking water, and industrial use of Site ground water currently occurs infrequently. RI data indicate that the Site ground water has been contaminated by the previously described sources. Ground water quality data were compared with Federal Primary and Secondary Drinking Water Standards as a means of interpreting monitoring results and evaluating the impacts of Site contamination to the ground water system. CMLs for ground water were estimated as a means of assessing the relative contributions of specific source areas to the upper zone of the SFCDR Valley ground water system. RI data indicate that the DWS for cadmium and zinc were exceeded in most monitored areas of the upper zone; the cadmium DWS was exceeded near the east Site boundary, indicating an impact from upgradient sources. Exceedances of arsenic and lead in the upper zone were localized in the CIA and Page Pond areas. The DWS for cadmium was exceeded in lower zone ground water in the Kellogg and Smelterville Flats areas. The zinc secondary standard was exceeded in the lower zone in a small area near Portal Gulch and in the area from the mouth of Magnet Gulch to Pinehurst Narrows.

Measured concentrations of arsenic, cadmium, cobalt, lead, and zinc in all monitoring well samples were averaged over four sampling periods. The maximum average values are summarized in Tables 5-5 and 5-6 as follows:

DWS for cadmium, lead, zinc, fluoride, and sulfate were exceeded in one or more monitoring wells in Government Gulch and other wells in the Smelter Complex (See Table 5-7). The poorest ground water quality observed at the Site occurred in upper Government Gulch south of the Zinc Plant and was probably associated with leaching of metals from a former materials storage area.

CMLs for ground water were estimated as a means of assessing the relative contributions of specific source areas to the upper zone of the SFCDR Valley ground water system. The estimated ground water CML at the western (downgradient) Site boundary was approximately 208 lb/day based on September 1987 RI data. The sum of the CMLs entering the SFCDR Valley system from upgradient and from onsite sources was estimated at approximately 986 lb/day. However, the surface and ground water systems in the SFCDR valley are linked by three identified gaining river reaches and two losing reaches. The net effect of these multiple losing and gaining reaches is a CML transfer from the ground water system to the SFCDR; this transfer was estimated at 657 lb/day based on September 1987 data presented in the Task 3 Data Evaluation Report.

Approximately 75.8 lb/day of CML was transported in ground water across the eastern Site boundary from upgradient source areas based on September 1987 data. The largest onsite ground water loading source was seepage from the ponded area of the CIA east cell through flotation tailings; the CML in this seepage was estimated at 683 lb/day. Site wide infiltration through jig tailings deposits was estimated to be the second largest loading source at 168 lb/day. Discharge from the Government Gulch tributary system to the upper and/or lower zones of the valley system was estimated at 14.5 lb/day, and all other sources were each estimated to contribute less than 10 lb/day to the valley fill upper and lower zone aquifers.

6 SUMMARY OF SITE RISKS

6.1 HUMAN HEALTH RISKS

Risks to human health associated with exposures in the Nonpopulated Areas Site media were evaluated in the Human Health Risk Assessment (June 1992) (HHRA). This evaluation was third in a series of risk assessment efforts addressing both the Populated and Non-populated portions of the Site. All exposures for this Site were evaluated either as baseline or incremental. Baselinerefers to exposure resulting from activities common to all members of the resident population. Incremental exposures result from potentially high risk activities by some members of the local population or visitors to the area. Risk associated with baseline activities of the resident population were addressed in the RADER (October 18, 1990). Potential baseline exposures evaluated in the RADER included ingestion of residential surficial yard soils and house dusts, inhalation of particulate matter, and consumption of water from local public supplies. Incremental activities evaluated in the RADER included potential consumption of local ground water, ingestion of soils from severely contaminated areas, extreme ingestion rates of soils/dusts by children (picatypes behavior), consumption of local fish and garden vegetables, and inhalation of outdoor airborne particulate matter during episodic high wind conditions.

Unacceptable risk levels in the populated area were associated with several of these exposures. Actions addressing cleanup of residential soils, house dusts, and fugitive dusts were developed in the Residential Soils ROD and the 1991 and 1992 Administrative Orders.

Risks associated with potential exposures in the Non-populated Areas were evaluated as incremental to assumed post-remedial baseline exposures in the Populated Areas.

Contamination of Site media is extensive throughout the Nonpopulated Areas. Contaminants of concern in all media include antimony, arsenic, cadmium, copper, lead, mercury, and zinc. Additional concerns may be expressed with respect to asbestos, cobalt, (PCB), and particularly mercury compound exposures to workers in the abandoned industrial complex. Potential risks resultant from the latter exposures were not quantified in the HHRA because they were detected only in localized areas within the individual complexes.

Contaminated media in the Non-populated Areas include soils anddusts, sediments, surface water, air, and ground water. The highest contaminant concentrations are noted in residual material accumulation piles, buildings, and process facilities throughout the Smelter Complex.

Ground water and surface water contaminant concentrations exceed drinking water maximum contaminant levels (MCLs) and aquatic life criteria (ALC) throughout many areas of the non-populated areas.

Contaminant migration is ongoing throughout the Non-populated Areas. Airborne, surface and ground water, and mass movement pathways are all active and continue to redistribute residual metals across the Site.

Potential risks were addressed in two major categories including:

! Risks associated with contaminant migration from Nonpopulated Areas sources into the residential portions of the Site where the general population is exposed; and,

! Incremental risks associated with direct contact with contaminated media by members of the population engaged in specific activities.

With respect to human health issues, the most significant contaminant transport phenomena are:

! Airborne dusts that result in excess respiratory cancer risk from arsenic and cadmium, and redistribute particulate lead to residential soils and house dusts that are a source of excess lead absorption in the resident population.

! Contaminated ground water that exceeds MCLs and presents excessive carcinogenic and non-carcinogenic risk through potential ingestion of arsenic, cadmium, manganese, lead, and zinc.

! Surface water transport of dissolved metals and contaminated sediments that can redistribute lead and other metals to areas accessible by the local population.

that can redistribute lead and other metals to areas accessible by the concerns are associated with exposures related to potential land use in the Non-populated Areas. Risk scenarios were evaluated for future residential, recreational, and occupational use of the Non-populated Areas. Both carcinogenic and (chronic and sub-chronic) non-carcinogenic risks were evaluated. The Non-populated Areas were divided into geographic sub-divisions for the HHRA analysis. Those sub-divisions were:

! Hillsides

! Smelterville Flats

! Smelter Complex

! Mine Operations Area

- Page Ponds
- CIA

Table 6-1 summarizes route specific carcinogenic risk for the baseline population. Incremental carcinogenic risks exceeding acceptable criteria were observed for arsenic in ground water, in soils for children exhibiting pica-type behavior in several areas, and for adult occupational scenarios in the industrial complex and other highly contaminated areas of the Site.

Unacceptable Chronic non-carcinogenic risks (i.e., those exceeding Hazard Indices (HI) of 1.0 per U.S. EPA 1989) are summarized in Table 6-2.

Sub-chronic non-carcinogenic risk was evaluated for lead exposures to children and pregnant women. For children a biokinetic modeling methodology was employed. That analysis identified soil lead levels exceeding 1000 mg/kg as a threshold cleanup level for residential soils (CH2M HILL 1991). Geographic sub-units of the Non-populated Areas were evaluated against the criteria as shown in Table 6-3.

Summary risk assessment findings for future use scenarios for the Non-populated Areas sub-units follow:

- With respect to potential residential development, some hillside areas remote from the industrial complex meet the soil lead cleanup criteria established in the Residential Soil ROD. No other areas were suitable for residential development at current contaminant levels. remote from the industrial complex meet the soil lead cleanup criteria

- Any portion of the Non-populated Areas not suitable for residential uses are also considered inappropriate for recreational development that would attract preschool children (e.g., picnic areas or playgrounds).

- Regarding potential recreational activities, the majority of hillsides outside of the immediate vicinity of the Smelter Complex are suitable for unrestricted activities under current conditions. The entire Smelterville Flats, Mine Operations Area, abandoned Smelter Complex, outside of the immediate vicinity of the Smelter Complex are suitable recreational activities for either children or adults. The most significant risks are associated with potential subchronic lead poisoning due to contact with contaminated soils, dusts, and sediments. Chronic non-carcinogenic disease could also result from continued consumption of surface waters during recreational activities.

- With respect to potential occupational uses of the Nonpopulated Areas, women of reproductive age that may become pregnant are the population of concern. Common occupational activities by pregnant women could more than double prenatal exposures to lead in all areas except the general hillsides. Especially severe exposures could occur on a short-term basis within the abandoned complex, theCIA area, or the Mine Operation Areas. Within these latter areas, workers are potentially at-risk for both carcinogenic and chronic non-carcinogenic disease under a 35-year occupational scenario.

- Acute exposures representing an immediate threat to life and health could result from short-term exposures in the Smelter Complex or Mine/Mill Areas. While no specific criteria or thresholds have been identified in the two areas for short-term exposures it is nonetheless prudent to avoid even minimal contact with the high contaminant concentrations exhibited in these locations. In these areas, exceedance of 10,000 mg/kg concentration levels (10 times the Populated areas cleanup level) for lead are common.

Antimony, arsenic, cadmium, and mercury are also highly elevated. Excessive risk of acute toxic effects could also result from heavy metals and arsenic exposure in the CIA Area, the Smelterville Flats, and Hillsides adjacent to the industrial complex. (SAIC, 1992).

6.2 ENVIRONMENTAL RISKS

Soil, sediment, surface water, and ground water within the Site exhibit elevated levels of antimony, arsenic, cadmium, copper, lead, manganese, mercury, silver, and zinc. Lack of vegetative cover over much of the Site has resulted in the loss of wildlife habitat and increased soil erosion. Concentrations of metals over large areas of the Site adversely impact both aquatic and terrestrial biota.

Current levels of cadmium, lead, and zinc in surface water adversely affect resident populations of benthic organisms, fish, and aquatic plant species. Acute and chronic ambient water quality criteria for these metals are substantially exceeded in the SFCDR. Low flow contaminant loading information in the RI indicates that approximately 700 lbs/day of zinc, eight lbs/day of lead, and four lbs/day of cadmium enter the SFCDR from within the Site.

Average cadmium and zinc concentrations in the SFCDR within the Site exceed acute water quality criteria by approximately three and fifteen times, respectively. In addition, cadmium and zinc upstream of the site (SF-2) exceed acute aquatic life criteria by approximately four and twenty-one times, respectively. In the Coeur d'Alene River at Cataldo, approximately ten miles downstream from the Site, cadmium and zinc exceed acute criteria values by about two and eleven times, respectively. Contamination upstream of the Site contributes to excessive metal loadings found in the river and are combined with metal loadings within the Site via surface water runoff and ground water contamination. An environmentally significant threat exists to aquatic populations and trophic diversity in the Coeur d'Alene River as a result of the South Fork water quality.

Although tolerant species of fish and benthic organisms appear to be re-establishing within the Site, toxicity tests on rainbow trout and water fleas conducted during the RI show that lethal conditions for less tolerant species currently exist in the SFCDR. Persistent contamination in the SFCDR and natural processes such as erosion and flooding continue to alter water and sediment quality upstream, within the Site, and in the lower reaches of the Coeur d'Alene River.

Average concentrations of antimony, arsenic, cadmium, copper, lead, mercury, silver, and zinc in hillside soils exceed reference (background) concentrations by as much as 50 times for lead, 25 times for cadmium, and 12 timesfor zinc. These elevated levels are also a source of contamination in the surface water, ground water, and sediments and are potentially toxic to terrestrial biota. The following Table 6-4 shows soil toxicity reference concentrations that may induce toxicological effects on plants, soil invertebrates, and small mammals; it also provides the approximate acreage that may exceed the reference levels.

Estimated intake levels for mice, deer, and waterfowl compared with toxicological reference values indicate that current arsenic and zinc levels in localized areas are likely to cause adverse effects in small mammals. Lead and silver levels are also expected to have sublethal effects on small mammals, while antimony, copper, and manganese concentrations in soil may have sublethal effects on less tolerant individuals. Figure 6-1 shows major Site areas where soil metal concentrations exceed projected toxic levels. Approximately 850 acres in the vicinity of the Lead and Zinc Smelters and 450 acres in Smelterville Flats have soil concentrations capable of inducing adverse toxicological effects on plants, soil invertebrates, and small mammals. Other localized areas of the Site have contaminant levels that could produce long term sublethal effects on such organisms.

Waterfowl are particularly at risk of toxic effects from ingestion of lead in soil and plants; however, waterfowl exposure within the Site is limited by the general lack of attractive habitat. The assessment of lead hazards to waterfowl in the Coeur d'Alene River Basin are complicated by the ingestion of lead shot. Impacts include documented periodic acute poisoning, as well as uncertain chronic effects such as enhanced susceptibility to disease, predation, and reproductive impairment. Tissue analyses detected elevated lead levels in all samples analyzed. Concentrations of metals in soil and sediments in some localized areas of the basin are similar to those found within the Bunker Hill Site; however, major differences exist in their physical characteristics. Habitat differences between the Site and basin also obscure comparisons of similar risks.

Impaired trophic communities and structural habitat exist throughout the Site and are especially evident by the barren and sparsely vegetated areas on the hillsides and flats. Elevated metal concentrations continue to disrupt the interaction and interdependence between soil, plants, and terrestrial fauna, which are integral components in soil stability, wildlife habitat, food chain pathways, and nutrient cycling.

Contamination of localized areas alter species composition and occurrence. Soil structure is deteriorated and the integrity of the organic matter and litter layers are severely reduced. The maintenance of biogeochemical processes and cycles are also altered. Water retention and erosion control by major water sheds are dysfunctional and can not moderate environmental extremes.

Terrestrial and aquatic communities, however, have exhibited some natural succession, and several areas have demonstrated signs of recovery. An evaluation of ecosystem indicators at the Site show a capacity for adjustments and adaptation.

Remedial actions at the Site can have a significant beneficial impact on the re-establishment of native terrestrial and aquatic communities within the Site and are expected to contribute to improvements to water quality in lower reaches of the Coeur d'Alene River. Establishment of vegetative cover in areas impacted by past mining, milling, and smelting operations; control of wind and water erosion; and minimization of metals loading to surface and ground water will enhance recovery of the local environment.

However remediation of the Site will not restore the Coeur d'Alene Basin, as a whole, to a condition that existed prior to the advent of mining in the region. Remediation of the Bunker Hill Site is only one component of what will be a basin wide approach to addressing impacts from decades of mining, forestry, agriculture, and development in the Coeur d'Alene Basin.

Recently, federal, state, tribal, and local interests have held discussions to build upon past efforts in understanding basin environmental problems in order to develop a Coeur d'Alene Basin Restoration Project. Successful efforts by these groups, coupled with remedial actions at the Site, have the potential to enhance recovery of many of the environmental features of the Coeur d'Alene Basin that have been compromised over the past 100 years.

7 DETAILED DESCRIPTION OF ALTERNATIVES

This proposed cleanup action involves the Non-populated Areas of the Site and those areas within the Populated areas not covered under the Residential Soils ROD. These are areas that are typically used for many different activities and purposes. While it is important that the cleanup actions block or remove the routes by which people and organisms come in contact with contaminants, it is also important that the remedial actions allow for continued growth of the community.

Remedial actions selected must eliminate, or reduce to acceptable conditions, the routes by which people and environmental receptors come in contact with or are affected by contaminants in soil, dust, and water. It is also important that the remedial action not unduly interfere with resident or community activities during and after the remediation process. The remedial alternatives were developed with these factors in mind and with consideration given to present and anticipated land use activities. Institutional controls that assure the integrity of remedial actions selected for the Site are an important component of all alternatives presented. Continued development of the area will be possible if undertaken consistent with remedial actions specified in this ROD and managed through the Institutional Control Program (ICP). Institutional controls were also an important component of the Residential Soils ROD, (August 1991). Previous public comment on the Residential Soils ROD indicated that the community would only support an ICP if there were no costs to local citizens or governments.

To achieve an acceptable level of protectiveness, the remedial alternatives were designed to attain site wide and sub-area specific Remedial Action Objectives (RAOs). RAOs are general cleanup objectives that are established early in the FS process to guide the development of cleanup alternatives. The selected RAOs reflect consideration of risk management principles and available information identifying contaminants, media of concern and potential exposure pathways. They represent preliminary judgements regarding acceptable exposures to site contaminants, from a variety of routes, that are adequately protective of human health and the environment.

Biological monitoring is an important component of all alternatives with respect to evaluating potential impacts on environmental receptors. While each alternative includes extensive efforts to contain or manage contaminants posing an environmental threat, certain areas of the Site, particularly hillsides adjacent to the smelter complex, may have a potential to impact sensitive species of plants and animals after implementation of remedial actions. No specific soil cleanup goals (ARARs) have been established to evaluate risk to environmental receptors, however, the ecological risk assessment has developed soil toxicity reference concentrations which are intended to serve as an indicator of potential impact.

While residual contamination may pose a potential threat to environmental receptors at the Site the FS determined that remediation of all hillside areas to levels below soil toxicity reference contamination was infeasible. Habitat establishment was, however, determined to be both feasible, and desirable, and is a component of all alternatives presented in the FS. As habitat is established, and environmental receptors are exposed to residual soil contamination, monitoring will be conducted to evaluate actual impacts to resident populations.

RAOs are expected to be attained through achievement of remedial action specific performance standards. The reliance on performance standards for individual remedial actions is intended to provide a realistic measure of success for the specific actions proposed. They have been developed to achieve overall cleanup objectives for the Site. Performance standards for the selected remedial actions are discussed in greater detail in Section 9.2. The performance attributed to other alternatives is discussed in detail in the FS and supporting Technical Memoranda.

General response actions (GRAs) and technologies were selected and evaluated based on effectiveness, implementability, and cost in reaching their respective RAOs. Alternatives, or combinations of remedial technologies, were then developed for each media and subarea. Finally, comprehensive site wide alternatives were developed to address the site wide RAOs for the four principal site media: soil/source materials, ground water, surface water, and air. As a result, the FS Report proposed four site wide remediation alternatives. Except for the No Action Alternative which served as a baseline comparison alternative only, all of the site wide alternatives are able to satisfy, to varying degrees, the nine evaluation criteria, (discussed in detail in Section 8), required by the NCP to be used when comparing various remediation alternatives.

The proposed alternatives have been described in the Proposed Plan as follows: Alternative 1: No-Action Alternative 2: Source and Institutional Controls Alternative 3: Source Controls and Treatment Alternative 4: Removal, Source Controls and Treatment

7.1 ALTERNATIVE 1 NO ACTION

Alternative 1 is the No Action Alternative required for evaluation under the NCP. This alternative incorporates those removal actions and Orders already implemented or underway which were summarized under "Site History". The determinations made in the Residential Soils ROD have also been considered in the development of Site-wide remedial alternatives presented here. As a result of these response actions, transport of contaminants via surface water and air from various onsite sources have been reduced. Additionally, human exposures to soil/source materials have also been reduced in the Hillside, Smelterville Flats, CIA, ROW, and Smelter Complex subareas. Alternative 1 serves as a baseline for comparison and evaluation of the other alternatives.

7.2 ALTERNATIVE 2 SOURCE AND INSTITUTIONAL CONTROLS

Alternative 2, the Source Containment and Institutional Controls Alternative, was developed as a potentially effective solution to address Sitewide RAOs, primarily through the use of containment (barrier) technologies. It is comprised of components that include containment/stabilization, drainage and erosion controls, and institutional controls. As compared to the No Action Alternative, Alternative 2 would further reduce the mobilization of contaminants via surface water and air and prevent human contact. Active ground water controls are not included in this alternative; however, significant ground water and surface water improvements are expected over time due to source containment aspects of this alternative and the considerable efforts being undertaken to establish vegetation on over 3,200 acres of the Site which are currently eroding at excessive rates.

7.3 ALTERNATIVE 3 SOURCE CONTROLS AND TREATMENT

Alternative 3, the Source Controls and Treatment Alternative, addresses the Site wide RAOs by utilizing a combination of: source containment (inplace caps); selective source removal; drainage and erosion controls; innovative treatment of ground water and surface water; treatment of selected source materials; and, institutional controls. Alternative 3 was developed to utilize a combination of innovative and conventional engineering controls and treatment options with respect to ground water and surface water in particular. This alternative will also use cement-based stabilization to treat all Principal Threat materials (defined in Section 9.2.5) before they are contained when they are not recycled or reprocessed. This alternative would reduce and/or eliminate the mobilization of soil/source materials, surface water, ground water, and airborne dusts.

7.4 ALTERNATIVE 4 REMOVAL, SOURCE CONTROLS, AND TREATMENT

Alternative 4 is the Source Controls and Removal Alternative which relies upon: source removals with disposal in engineered repositories; treatment of ground water and surface water; conventional engineering controls; and institutional controls. This alternative is distinguished from Alternative 3 through its reliance on source removal and conventional water treatment technologies instead of innovative treatment technologies. This alternative would significantly decrease the impacts of soil/source material contaminants and further reduce surface water, ground water, and air-borne contaminant transport.

Each of the alternatives (except for the No Action Alternative) has been developed to specifically address human health and environmental concerns and has identified specific remedial actions for soils/source materials, ground water, surface water, and air associated with each of the subareas. Site wide subarea remedial action alternatives are presented in Table 7-1. These tables outline the remedial action components designed to address mediaspecific and subarea contamination individually. They also delineate the combinations of actions comprising each specific site wide remedial alternative proposed. Detailed descriptions of each subarea and site wide remedial action alternative are provided in the Bunker Hill Superfund Site Final Feasibility Study Report (May 1, 1992) and associated Technical Memoranda. These documents are all available as part of the Administrative Record.

8 COMPARATIVE ANALYSIS OF ALTERNATIVES

A comparative analysis of alternatives using each of the nine evaluation criteria, as required by the NCP, is presented in this section. These criteria are set forth in Table 8-1. This analysis has been undertaken in a two-tiered fashion. First, an individual assessment was made of each alternative's ability to meet each of nine evaluation criteria delineated in the NCP. Secondly, a comparative analysis was undertaken to determine the relative performance of the alternatives and to identify major trade-offs (i.e., the relative advantages and disadvantages) among them. The purpose of this analysis is to identify the advantages and disadvantages of each alternative relative to the other alternatives.

8.1 INDIVIDUAL ANALYSES

8.1.1 Alternative 1: No Action

The no action alternative serves as a baseline to evaluate all other alternatives. While it incorporates all previous and planned response actions taken at the Site, the No Action Alternative fails to fully address contaminant pathways on a site wide basis. ARARs and site wide RAOs established to ensure protectiveness of human health and the environment are not met. Therefore, the no action alternative fails to satisfy the regulatory threshold requirements of protection of human health and the environment, and compliance with ARARs. In addition, this alternative fails to utilize permanent and alternative treatment technologies, ranks poorly with regard to long-term effectiveness and permanence in reducing risk, fails to substantially reduce the toxicity, mobility, or volume of hazardous waste associated with the Site, and is not considered short-term effective. Because it provides a baseline for comparison, implementability and cost are not considered.

8.1.2 Alternative 2: Source and Institutional Controls

The combination of engineering, source, and institutional controls proposed under Alternative 2 achieves the threshold criteria of protectiveness of human health and the environment. It is expected that this alternative would meet ARARs and RAOs identified for soils and source materials as well as air. RAOs developed to protect environmental receptors will not be met in all areas of the Site in the near term; however, as discussed in the Ecological Risk Assessment, current wide spread habitat destruction limits actual exposure of environmental receptors to potentially toxic soil conditions. Seepage reduction and control at the CIA, Page Ponds, and the Smelter Complex sources are expected to promote significant improvements to Site wide ground water quality and to substantially achieve ground water RAOs pertaining to onsite sources over time. Also, loadings reductions to surface water expected under this alternative would provide significant water quality improvement in the SFCDR and would substantially achieve surface water RAOs pertaining to onsite sources. Offsite seeps and TABLE 8 -1

COMPARATIVE ANALYSIS OF ALTERNATIVES

These are the evaluation criteria that are required by the NCP to use when comparing the various cleanup alternatives.

1) Overall protection of human health and the environment: Addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2) Compliance with federal and state environmental standards: Addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements (ARARs) of other federal and state environmental statutes and/or provide grounds for requesting a waiver.

3) Long-term effectiveness and permanence: Refers to the magnitude of remaining risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

4) Reduction of toxicity, mobility, and volume: Addresses the anticipated performance of the treatment technologies that may be employed in a remedy in terms of eliminating or controlling risks posed by the toxicity, mobility, or volume of hazardous substances.

5) Short-term effectiveness: Refers to the speed with which the remedy achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment during the construction and implementation period.

6) Implementability: Addresses the technical and administrative feasibility of a remedy including the availability of materials and services needed to implement the chosen solution.

7) Cost: Includes capital costs, operating and maintenance (O&M)costs (including Institutional Controls), and evaluates the cost-effectiveness of each alternative.

8) State acceptance: Indicates whether the state concurs with, opposes, or has no comment on the preferred alternative.

9) Community acceptance: Assessed following a review of public comments, both oral and written, received on the RI/FS and supporting technical memoranda documents.

loadings and the widespread existence of jig tailings onsite may inhibit immediate compliance with certain ground water ARARs in some areas of main valley aquifer. Ultimate attainment of Federal Water Quality Criteria (FWQC) in the SFCDR, and Maximum Contaminant Level (MCL) and Maximum Contaminant Level Goals (MCLGs) promulgated under the Safe Drinking Water Act (SDWA) in portions of the valley aquifer system, will depend on the implementation and effectiveness of offsite programs to reduce or control contaminant transport and on the ability of onsite remedies to meet performance standards over time. Separate offsite programs to restore the Coeur d'Alene River Basin are currently being formulated by a multi-disciplinary group of Federal, State, Tribal, and local governments in an effort to coordinate programs to restore water quality in the Basin to its maximum beneficial use.

A contingent waiver for chemical-specific ARARs within the main valley aquifer system will be granted only after technical impracticability has been demonstrated, consistent with the procedure outlined in Section 10 of this ROD. All alternatives will rely on institutional control of water use to be adequately protective of human health. Five year reviews will be relied upon to evaluate the effectiveness of the selected remedy and compliance with ARARs.

The overall long-term effectiveness of Alternative 2 is rated moderate based on the degree to which site wide RAOs are addressed, the degree to which the Principal Threats are reduced, the reduction of risks to humans, and the need to rely on long-term institutional controls to achieve protectiveness for contaminants remaining onsite. Because Alternative 2 does not propose treatment of Principal Threat materials, it does not meet the statutory preference for remedial actions that employ treatment technologies that significantly reduce the toxicity, mobility, or volume of hazardous waste. However, the removal and onsite containment of source materials contemplated under Alternative 2 would substantially decrease the magnitude of residual risk and provide long-term effectiveness by decreasing the volume of uncontrolled waste sources which can contribute to exposure pathways of concern. Capping and cover requirements contemplated under this alternative would also contribute to a reduction in mobility of contaminants of concern.

Alternative 2 is readily implementable and would not result in excessive risk to workers or the community, if properly implemented; therefore, it is considered short-term effective. Total capital costs are estimated to be $31.3 million, while O&M costs are estimated at $11.5 million. Total costs are significantly less than costs for Alternatives 3 and 4; but, the alternative does not provide comparable site wide improvements.

8.1.3 Alternative 3: Source Controls and Treatment

By combining containment, treatment, and institutional controls, Alternative 3 addresses all onsite pathways and is protective of human health and the environment onsite. In addition, it effectively contributes to improvements in downstream water quality. This alternative provides a high level of protectiveness, would minimize exposure pathways identified for soils, source material, and air, and would attain soil and air RAOs site wide for human health protection. RAOs developed to protect environmental receptors will not be met in all areas of the site in the near term; however, as discussed inthe Ecological Risk Assessment, current wide-spread habitat destruction limits actual exposure of environmental receptors to potentially toxic soil conditions. As habitat onsite is re-established environmental receptors will be monitored to evaluate potential impacts. Actions specified in Alternative 3 are expected to have significant water quality benefits, limit direct exposure to the most contaminated soils onsite, and re-establish vegetative cover over exposed areas of the Site. Although FWQC in the SFCDR are not expected to be met in the near term, Alternative 3 adequately controls onsite sources to the river and substantially improves water quality and aquatic conditions both on and down gradient of the Site. Most Site-wide surface and ground water RAOs are expected to be met under this alternative. However, certain chemicalspecific ground water ARARs in the main valley aquifer may not be achieved by onsite remedial actions.

As noted in Alternative 2, conditions for a contingent waiver for ground water are discussed in Section 10. Alternative 3 is expected to more rapidly achieve surface water and ground water ARARs onsite than Alternative 2, as it is expected to be more effective in controlling major contaminant sources. Action specific ARARs and ARARs dealing with air and soil/source materials will be met with implementation of this alternative. Relevant and appropriate requirements of RCRA Land Disposal Restrictions (LDRs) for cement-based stabilization of Principal Threat waste are expected to be attained. While LDRs for mineral processing wastes have not been promulgated (and therefore are not applicable), U.S. EPA has determined that it is appropriate to seek to achieve the percent reduction goals, and or extract concentration criteria, set forth in the LDRs for immobilization of inorganic compounds. Treatability tests for cement-based solidification of one of the major Principal Threat waste material accumulations onsite (the Copper Dross Flue Dust recently moved from Magnet Gulchto the Smelter Complex) indicates that attainment of percent reduction goals based upon TCLP protocols is likely. However, due to the varying solubilities of contaminants of concerns through a range of pH values U.S. EPA has determined that the acid leaching aspects of the TCLP test protocol are not appropriate for wastes consolidated in the Lead Smelter Closure, and has elected to design a stabilization mixture that will achieve LDR treatment goals at a pH reflective of actual onsite conditions. A rain water leach test has been determined to be more appropriate than an acid leach test.

The overall long-term effectiveness of Alternative 3 is expected to be high based on the degree to which it addresses site wide RAOs and the reliability and permanence of the prescribed controls. Alternative 3 removes, controls, and/or treats significant contaminant sources and effectively addresses site wide RAOs. The toxicity, volume, and mobility of source materials available for transport is effectively reduced. Because Alternative 3 proposes treatment of Principal Threats in soils and source materials, and treats ground and surface waters, it satisfies the statutory preference for treatment of hazardous wastes. Short-term effectiveness is mitigated by moderate, but manageable, human health and environmental risks associated with contaminant removal, transport, and onsite disposal.

Alternative 3 relies primarily on standard technologies which are readily implementable. The constructed wetland system may be considered innovative at this scale of application. However, it is expected to perform effectively with adequate design and management. Management of metals in the wetlands substrate (lower soils) may be required in the future; proper design and O&M of the treatment system should mitigate potential problems. Alternative 3 addresses human health and environmental concerns without significant threats to workers or the community and is considered short-term effective. Totalcapital costs are estimated at $56.6 million; and, O&M costs are estimated at $11.1 million. Alternative 3 provides considerably more improvements in site conditions than Alternative 2 for the increased cost.

8.1.4 Alternative 4: Removal, Source Controls, and Treatment

Alternative 4 addresses all pathways and is protective of human health and the environment. Site wide RAOs and ARARs for soils/source materials and air would be met for human health protection. RAOs developed to protect environmental receptors will not be met in all areas of the Site in the near term; however, as discussed in the Ecological Risk Assessment, current wide spread habitat destruction limits actual exposure of environmental receptors to potentially toxic soil conditions. Although ground water ARARs in the valley aquifer system and FWQC in the SFCDR are not expected to be met in the near term, Alternative 4 adequately controls these pathways onsite and would substantially improve water quality and aquatic conditions both onsite and down gradient of the Site, thus providing the largest practicable improvement in water quality and aquatic conditions of the four alternatives. It relies to a moderate degree on institutional controls to eliminate or reduce ground water and surface water exposures and to ensure the long-term reliability and effectiveness of other treatment and source control measures.

Most Site wide ground water and surface water RAOs are expected to be met under this alternative. However, as was noted in Alternatives 2 and 3 specific conditions for a contingent ARAR waiver in the main valley aquifer are outlined in Section 10. Alternative 4 is expected to be more successful in achieving ARARS onsite than Alternative 2, as it is more effective in controlling sources of ground water and surface water contamination. Action specific ARARs and ARARs for air, soil/source materials will be achieved.

The overall long-term effectiveness of this alternative is expected to be high based on the degree to which it addresses Site-wide RAOs and on the permanence and reliability of the prescribed controls. However, this effectiveness is tempered by the generation of potentially hazardous water treatment sludges over an indefinite time period. RAOs would be addressed and Principal Threats in soil and source material reduced through reliance on removal, containment and conventional water treatment. Loading reductions to ground water, surface water, and air would also be realized. Alternative 4 would significantly reduce the mobility of contaminants across the Site; however, only proposed water treatment remedial actions result in a reduction of volume or toxicity of contaminants.

Due to its reliance on extensive removal actions, Alternative 4 presents a higher level of potential human health and environmental risks and thereby negatively influences short-term effectiveness. These risks can be minimized by appropriate controls, but would require more intensive management compared to other alternatives.

Implementability of this alternative is considered readily feasible based on its utilization of standard technologies. However, implementability concerns do exist because of the large scale removal to be undertaken. Total capital costs are estimated at $90.2 million, while O&M costs are estimated at $87.9 million.

8.2 COMPARATIVE ANALYSIS

The subsequent sections summarize a comparative analysis of each of the nine evaluation criteria (Table 8-1) to determine the relative performance of the alternatives and identify major trade-offs.

8.2.1 Protection of Human Health and Environment

Alternatives 3 and 4 provide superior site wide protection relative to Alternative 2, which provides a relatively large increase in protectiveness over Alternative 1. Specifically, Alternative 2, 3, and 4 would all be protective with regard to soil, source, and air pathways. Alternative 2, however, provides adequate, but comparatively less, protection and improvement of ground and surface water pathways than Alternatives 3 and 4 as it relies more heavily on institutional controls to control potential exposure pathways. Alternatives 3 and 4 provide comparable net improvements and protectiveness site wide. All alternatives rely to various degrees on institutional controls to be protective of Human Health & the Environment both in the near and long term.

8.2.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Alternatives 2, 3, and 4 meet ARARs identified for soils, source materials, and air as well as action specific ARARs. Whether or not any of the alternatives would meet groundwater ARARs throughout the main valley aquifer is uncertain. Contamination attributable to dispersed and largely inaccessible jig tailings throughout the river valley may make attainment of certain of these ARARs impracticable. Section 10 includes a discussion of the basis for making the technically impracticability determination and waiving chemicalspecific ARARs in areas of main valley aquifer system continuing to exceed ARARs after successful implementation of the remedy and contingent measures. Institutional controls will continue to protect against utilization of the aquifer until all Drinking Water Standards are met.

With respect to the attainment of FWQC in site surface water, these ARARs are expected to be achieved in onsite tributaries to the SFCDR upon the successful implementation of remedial actions specified in this ROD. The attainment of FWQC in the SFCDR has been determined to be beyond the scope of this ROD and is therefore not an ARAR for this action. Protection of the SFCDR from FWQC exceedances due to onsite sources, however, continues to be an objective of the remedial actions in this ROD. U.S. EPA is currently working with State, Tribal, and local government, as well as other federal agencies and local interest groups to develop and implement cleanup strategies for the Coeur d'Alene Basin which are expected to significantly improve water quality conditions both upstream and downstream of the Site.

Five year reviews will be relied upon to evaluate the effectiveness of the selected remedy and compliance with ARARs.

RCRA LDRs (40 CFR 268) are not applicable to the utilization of cement-based stabilization of Principal Threat wastes in Alternative 3, since LDRs for mineral processing wastes are not scheduled for promulgation until 1994. However, for the purposes of this action, percent reduction and/or extract concentration criteria goals of the LDRs will be considered to be relevant and appropriate for this treatment component of the remedial action. Treated Principal Threat waste would be consolidated within the Smelter Complex.

8.2.3 Long-Term Effectiveness

Alternatives 2, 3, and 4 are all effective and reliable remedies with respect to risks and conditions associated with onsite sources. However, Alternatives 3 and 4 provide additional improvements through treatment of surface and ground water. The treatment plant proposed in Alternative 4 would require more long-term maintenance than that anticipated under Alternative 3. This may affect effectiveness in the long-run.

In addition, Alternative 3 provides enhanced effectiveness relative to other Alternatives through treatment of Principal Threat wastes. The removal of all accessible jig tailings in Alternative 4 would increase the longterm effectiveness compared to Alternative 3. Alternative 3 utilizes institutional controls and the constructed wetland ground water system to mitigate the impacts of this contaminant source. 8.2.4 Reduction of Toxicity, Mobility, Volume, and Persistence through Treatment

Other than treatment actions for sediment reduction in tributary sedimentation basins, Alternative 2 does not incorporate treatment as a component of the remedy. It therefore compares poorly with respect to the statutory mandate for treatment. Alternatives 3 and 4 utilize treatment of ground and surface water to the same extent; and, both are considered adequate in utilization of appropriate levels of treatment in this regard. Additionally, Alternative 3 focuses on reprocessing/recycling or treatment of the Principal Threat materials from the Smelter Complex. Alternative 3 therefore goes further toward satisfying the statutory preference for reduction of toxicity.

8.2.5 Short-Term Effectiveness

Alternative 2 would be implemented in a relatively short time frame and would not pose large short-term risks. Alternatives 3 and 4 would take approximately twice as long to implement as Alternative 2. Due to the greater volumes of materials handled, some short-term risks to workers and the community may be associated with excavation under Alternative 3, while substantially greater potential risks, and time, would be associated with the more extensive excavation efforts under Alternative 4. The risk associated with Alternatives 3 and 4 can however, be managed with current construction and hazardous waste handling procedures. An example of these procedures would be dust control measures.

8.2.6 Implementability, Reliability, and Constructability

Alternatives 2, 3, and 4 are implementable using standard construction/remediation techniques. Long term monitoring efforts under Alternatives 2 and 3 may be greater than for Alternative 4. Alternative 4 would involve a sizable loss of developable land along the I-90 corridor due to extensive tailings excavation in Smelterville Flats and would necessitate obtaining onsite or near offsite landfill space to handle a continuing stream of treatment sludge generated by the water treatment plant.

8.2.7 Cost

A summary of estimated capital, O & M, and net present worth costs is provided in Table 8-2. Alternative 2 is significantly lower in capital and net present worth costs, but is also lower in overall long-term effectiveness. Although Alternative 3 is significantly lower in costs than Alternative 4, it provides comparable net protection and provides substantial improvements due to innovative surface and ground water treatment methods and the utilization of reprocessing/recycling technologies.

8.2.8 State Acceptance

IDHW and U.S. EPA have worked together throughout the development of the Bunker Hill Superfund project. The State of Idaho concurs with the selection of Alternative 3 as the remedial action for the Site.

8.2.9 Community Acceptance

The results of the public comment period and the discussion during the Proposed Plan Public Meeting indicate that the majority of the community supports the proposed alternative. The community expressed overwhelming desire to get the cleanup moving as soon as possible. See the Responsiveness Summary for additional details of community response.

8.2.10 Tribal Acceptance

The Coeur d'Alene Tribe has been participating in the Site activities since 1990. The Coeur d'Alene Tribe in their letter of August 1992, to U.S. EPA continues to express concern with the Proposed Plan for the Site. These concerns are addressed in the Responsiveness Summary Section.

Individual concerns about various aspects of the Proposed Plan are responded to in the attached Responsiveness Summary.

9 THE SELECTED REMEDY

9.1 INTRODUCTION

U.S. EPA and IDHW have selected Alternative 3 for cleanup of the Bunker Hill Superfund Site. This selection is based on the Administrative Record for the Site. These actions, coupled with actions required in the Residential Soils ROD and U.S. EPA directed response actions, constitute the Site wide remedial actions selected by the U.S. EPA and IDHW. The remedial actions are developed to address the subareas RAOs as well as media-specific concerns in that subarea.

9.2 REMEDIAL ACTIONS BY SUBAREAS

Remedial actions specified below were presented in Table 7-1; however, this section provides a more thorough discussion of the selected remedy and includes performance standards for remedial actions where appropriate. The discussion is presented in the following sections:

- Hillsides
- Smelterville Flats
- Central Impoundment Area (CIA)
- Page Pond

! Smelter Complex and Mine Operations Area

! Rights-of-Way (ROW)

! Commercial Buildings and Lots

! Residential Interiors

! Future Development in Non-populated Areas

! Constructed Wetland Treatment Systems

! Public Water Supply Considerations

! Soil Action Levels

! Operation and Maintenance

! Institutional Controls

! Monitoring

! Institutional Controls

! General Remedial Design Considerations

9.2.1 Hillside Remedial Actions

U.S. EPA is currently overseeing implementation of an Administrative Order on Consent (AOC) for Revegetation and Stabilization of hillside areas within the Site. This AOC was signed in October, 1990 by U.S. EPA, Gulf Resources & Chemical Co. and Hecla Mining. The AOC calls for the revegetation of 3,200 acres of eroding hillsides having less than 50% cover within the Site, contour terracing of steep slopes to control erosion and increase infiltration, erosion control and sedimentation retention structures, and control of water and wind erosion of selected mine dumps. U.S. EPA approved workplan for Hillsides Stabilization and Revegetation provide for achievement of 85% ground cover on existing barren hillsides within approximately 8 to 12 years.

Zero gradient contour terraces are being constructed on the selected barren and sparsely vegetated hillside to the south, east, and west of the Smelter Complex. Sediment retention treatment basins are being constructed in the major tributaries within the Smelter Complex area for the purpose of reducing the suspended sediment/contaminant loadings in surface runoff to the SFCDR. These detention structures receive storm flows from Deadwood, Magnet, and Government Gulches. Additional details of the work to be performed are found in the AOC work plan which is available in the Administrative Record repository at the Kellogg library. In addition to the revegetation actions specified on approximately 3200 acres in the Hillsides AOC workplan, U.S. EPA is requiring that severely eroding hillside areas having less than 50% cover, within areas of greater cover (50% +), are also revegetated consistent with the methodology outlined in the AOC. The revegetation efforts apply to areas where there is a high potential for contaminant transport and the net impact of planting access is not greater than the benefit. Specific areas to be added to the revegetation efforts will be determined by additional field investigations conducted during the Remedial Design phase; however, the additional acreage is expected to be less than 500 acres. Additional emphasis is also placed on reestablishment of riparian habitat and stream corridor vegetation under this action, although establishment of runoff filtering areas adjacent to stream corridors and drainage ways is an integral component of the Hillsides AOC. In general, efforts will be undertaken to establish a vegetated stream corridor of 100 feet width at a minimum. Specific plans for each stream corridor being remediated will be developed during Remedial Design in conjunction with development of Hillsides AOC workplans. Respondents to the AOC have established Test Plots to determine which revegetation strategies will be most effective on the hillside areas. The results of the test plots will be used to determine the best revegetation applications. Monitoring of the performance and maintenance of erosion control measures and sedimentation structures will continue until revegetation efforts have been successful in controlling erosion and sedimentation of the hillside areas. Future work will be consistent with action taken to date in accordance with the October 1990 AOC. Detailed design and construction documents for hillside actions have been prepared as required by the AOC and are available for review in the Administrative Record. Also included in the AOC work plans are site specific plans for closure of mine rock dumps identified as posing a direct contact or erosion hazard.

In order to minimize contact between Milo Creek surface water and tailings and mine waste rock on the Milo Gulch floor, and reduce contaminant transport to the SFCDR as suspended sediment during runoff events, Milo Creek will be channelized and lined from the Wardner Water System intake to the culvert which directs stream flow beneath Wardner and Kellogg. Lining of Milo Creek may also reduce recharge to the Bunker Hill Mine workings. Operation and Management plans will be developed during remedial design for all hillside actions in order to assure continued effectiveness.

9.2.2 Smelterville Flats

Remedial actions for Smelterville Flats consist of actions to control migration of windblown dust, minimize direct contact risk, and control contaminant migration to surface and ground water. Consistent with other remedial actions to treat contaminated surface and ground water at the Site, over 100 acres of jig tailings-contaminated alluvium will be removed from the northwestern portion of the flats adjacent to the SFCDR for the creation of constructed wetlands for the treatment of surface and ground water; this material will be consolidated in the CIA. Additional details on the conceptual design of this system are provided in the Constructed Wetland Technical Memorandum available at the Administrative Record repository.

Along with the construction of the wetlands, a floodway with a protective dike will be constructed on the south side of the SFCDR. The floodway will be a minimum of 500 feet wide and the dike will be designed to protect Smelterville Flats and the wetlands treatment system from a 100 year, 24 hour storm event. Accessible tailings in those portions of the floodplain of the SFCDR being modified for floodway construction will also be removed and disposed of in the CIA. Additionally, all exposed tailings along the banks of the SFCDR within the Site will be stabilized to prevent erosion, or removed for consolidation within the CIA. Remedial design for any modifications within the floodway, and all bank stabilization measures, will incorporate aquatic habitat considerations. Appropriate State and Federal natural resource agencies will be consulted in developing site specific habitat considerations. For example, stream corridor configuration and revegetation of river banks can be designed to maximize benefits to aquatic resources.

Implementation of these measures will result in improvements to ground water and surface water quality due to the removal of these materials to an area that will be resistant to infiltration and isolated from contact with ground water and surface water.

The jig tailings/alluvium mixture that will remain in Smelterville Flats will be capped with a minimum of six inches of soil to enhance revegetation efforts and minimize direct contact risk. Alternatively, contaminated surfaces will be covered with a more permanent barrier, consistent with current land use (revegetation is the preferred remedial action and will be required unless land use necessitates a more durable barrier). As with other areas of the Site, if land use conversions occur in Smelterville Flats a barrier consistent with the new land use will be required in those locations where lead concentrations in the top foot of soil exceeds 1,000 ppm. This cleanup goal is consistent with the remedial action level in the Residential Soil ROD. An institutional controls system will be the mechanism used to ensure that appropriate barriers are installed and maintained on Smelterville Flats as land use conversions occur. Approximately 500 acres of Smelterville Flats will be removed or capped. Jig tailings/alluvium removed from Smelterville Flats will be placed in the CIA prior to its closure.

Additional remedial actions specified for Smelterville Flats include a system for capturing and treating ground water being discharged to the SFCDR in the areas immediately east of Pinehurst Narrows. This system is discussed in greater detail in section 9.2.10 - Constructed Wetlands Treatment System.

9.2.3 Central Impoundment Area

The remedial actions proposed for the CIA focus on minimizing releases from this source by installation of a cap designed to minimize infiltration through jig tailings and Central Treatment Plant sludges disposed of in this area. The CIA will also serve as a repository for consolidation of jig tailings/alluvium, gypsum and slag removed as a component of other remedial actions. The cap will be designed to have a hydraulic conductivity of less than 10^{-6} cm/sec. After grading of the CIA surface and dikes to promote runoff, the cap will be composed of a minimum of twelve inches of low permeability material overlain by a minimum of six inches of clean soil suitable for revegetation. Other engineering designs meeting these criteria will be considered. Cap design and revegetation requirements will be consistent with potential future land use. Prior to closure of the CIA, material accumulations originating from the 1982 Smelter Complex cleanup will be removed and returned to the Smelter Complex. A determination will be made regarding whether the material will be recycled, reprocessed, or treated via cement based stabilization prior to being capped in the Smelter Closure. The process for making this determination is detailed in Figure 9-1. Surficial soils on the CIA dikes and areas surrounding the CIA will be capped, as appropriate, consistent with current land use. At a minimum, six inches of clean soil will be placed to enhance revegetation. The slag pile on the west end of the CIA will be relocated either to the Smelter Complex or the east cell of the CIA prior to capping.

Included in the CIA closure is installation of a system to recover and treat contaminated ground water surfacing north of the CIA. This recovery system will be designed to maximize the efficient interception of contaminated ground water from the "CIA Seeps". Water collected from the seeps will be conveyed to the constructed wetlands treatment system before release to the SFCDR. The performance standards for the constructed wetland treatment system are discussed in section 9.2.10.

9.2.4 Page Pond

Page Pond is a former tailings disposal area resulting from mineral mining and concentrating activities at the former Page Mine. This area contains tailings that contribute to localized contamination of surface and ground water and serves as a source of windblown dust. The Page Pond currently serves as a repository for soils removed from residential properties as well as the site for the South Fork Sewer District Water Treatment Plant. The remedy for Page Ponds calls for the removal of approximately 40-60 thousand cubic yards of jig tailings accumulations from the West Page Swamp area and the subsequent placement of this material on the Page Pond benches as a sub-base for a vegetated cap. The final extent of material to be removed from West Page Swamp will be determined during Remedial Design and will consider current vegetated status, surficial soil contaminant concentrations, water levels, and habitat. The regrading and capping of Page Tailings Impoundment with residential soils will serve as a barrier to direct contact with tailings within this impoundment and will facilitate revegetation efforts in that area. In addition, the cap will decrease the leachate generation of the Page Pond area by promoting runoff and evapotranspiration compared to current conditions. Impoundment dikes will also be regraded and then vegetated after placement of a minimum of six inches of clean soil. Existing fencing will be maintained to limit access. Wetlands associated with the Page Pond areas will be evaluated for water quality, habitat considerations, and biomonitoring in order to assess environmental conditions resulting from remedial actions. U.S. EPA and IDHW will work with the appropriate state and federal natural resource management agencies to determine appropriate management and operations of the area.

Under this alternative Humboldt and Grouse Creeks will be isolated, to the degree practicable, from contact with Page tailings accumulations by the use of diversions and channel modifications. The objective is to minimize the contamination of these surface streams by preventing contact with jig tailings. Some benefits will also accrue to ground water as the diversion can be designed to minimize surface water contributions to the ground water system underlying Page Ponds. Final configurations of any channel modifications will be determined during Remedial Design and will include habitat considerations. Appropriate State and Federal natural resource management agencies will be consulted in determining the most appropriate design.

9.2.5 Smelter Complex and Mine Operations Area (MOA)

The Smelter Complex and Mine Operations Area include those areas of the Site that comprise the former active mining, milling, and material processing areas of the Site. This area typically contains the most highly contaminated areas of the Site with metal concentrations of material accumulations and soils well into the percentage range in many instances. The Remedial Investigation (RI) Report includes summary tables documenting material accumulations found within the Smelter Complex and MOA. In addition to material accumulations, the Smelter Complex and MOA contain numerous contaminated structures in an advanced state of deterioration. The Smelter Complex and MOA present a continuing threat to the community due to the risk of fire and the threats posed to trespassers on the property. Contaminant migration via wind and water is also a major concern. Acid mine drainage from the Reed and Kellogg tunnels or other mine portals where the drainage from the Bunker Hill Mine is collected will also require collection and treatment.

Remedial actions selected for the Smelter Complex and MOA focus on limiting direct contact with contaminants and controlling migration of contaminants to surface and ground water. Following removal and reprocessing, recycling, or cement-based stabilization of Principal Threat (threshold concentrations provided in the table below) material accumulations and soils within the Smelter Complex and MOA, the Lead Smelter and the Zinc Plant structures will be demolished in place and prepared for capping after removal of salvageable items, such as steel, timber, and equipment. Salvage material will be decontaminated consistent with the proposed rule for Best Demonstrated Available Technology (BDAT) treatment technologies for contaminated debris published in the Federal Register, January 9, 1992. Recycling and reprocessing of material accumulations and demolition debris will be utilized to the extent practicable in order to minimize material in the Smelter closure. MOA structures will be decontaminated consistent with intended use and maintained for future utilization, where feasible, or demolished. Prior to demolition, PCB-containing equipment will be managed consistent with applicable Toxic Substance Control Act (TSCA) regulations. Asbestos containing materials will also be managed consistent with applicable regulations during all closure activities. Demolition of the Lead and Zinc tall stacks are not required as part of this action; however, they must be decontaminated.

The Smelter Complex is composed of three principal areas for the purpose of this discussion; the Lead Smelter, Zinc Plant, and Mine Operations Area. Associated material storage sites and related areas are also considered part of the Smelter Complex. The following discussion focuses on these three principal areas. Materials accumulation sites and associated soils that have been impacted by contamination from mineral processing facilities (e.g., lead smelting, zinc refining, etc.) are slated for removal and consolidation within the Lead Smelter and Zinc Plant closures since these wastes are generally of higher concentration and require a greater level of management in order to insure a protective remedy. A subset of these materials comprises the Principal Threat materials of the Site. The parameters of this subset are outlined in a separate Principal Threat Technical Memorandum which is part of the Administrative Record for the Site. Table 9-1 lists the action levels for the Principal Threat materials. Principal Threat materials will be reprocessed, recycled, or treated via cement-based stabilization under this remedial action to address the statutory preference for treatment of Principal Threat Wastes (Figure 9-1).

Lead Smelter

Other materials within the Smelter Complex to be consolidated in the Lead Smelter closure include:

- contaminated materials and soils from the "boneyard area" south of the Lead Smelter;
- some slag from the west cell of the CIA to aid in preparation of the Lead Smelter;
- residential soils collected during other remedial actions may be consolidated within the smelter closure as needed to facilitate preparation of the Site for capping and revegetation;
- Smelter Complex cleanout material (removed from the Smelter Complex by Gulf in 1982) currently located in the CIA, approximately 31,000 cubic yards; Gulf in 1982) currently located in the CIA, approximately 31,000 cubic including the "boulevard area";
- material accumulations and contaminated soils, including former waste disposal or holding ponds sediments within the Smelter Complex;
- cleanup material from MOA buildings decontaminated to allow for future disposal or holding ponds sediments within the Smelter Complex;
- Magnet Gulch cleanup material accumulations andcontaminated soils; industrial utilization;
- treated Principal Threat material, including the Copper Dross Flue Dust Pile which was recently removed from Magnet Gulch for temporary storage in the Lead Smelter Complex where it awaits cement based stabilization; and,
- other materials/soils determined during Remedial Design to be appropriate to consolidate in this area.

Zinc Plant

The Zinc Plant closure will include material from the Zinc Plant, Phosphoric Acid/Fertilizer Plant areas (excluding the fertilizer warehouse), contaminated soils in the vicinity of the Zinc Plant and upper Government Gulch, and material, debris, and contaminated soils from the fertilizer plant. Any of the materials destined for the Zinc Plant closure could also be placed in the Lead Smelter Closure if the Zinc Plant closure is at capacity.

Mine Operations Area

Surface soils and material accumulations within the MOA will either be removed for consolidation within the lead smelter closure, treated as Principal Threat wastes and consolidated within the lead smelter closure, or capped in place with a barrier consistent with land use. Remediation of the MOA is expected to include considerable removal of material due to high levels of contamination found in this area and the anticipated future land use. In determining whether soils in the MOA and Smelter Complex (outside of the capped area) are removed to be consolidated in the Lead Smelter and Zinc Plant closures, an evaluation of the characteristics of material accumulations will be conducted during Remedial Design. All material accumulations and associated soils will be removed and consolidated in the Lead or Zinc Plant closures if they exhibit concentrations in excess of what would typically be attributed to mine waste rock or tailings. Remedial Design will include a process for determining the extent of excavation in areas impacted by material accumulations. In all cases a minimum of six inches of clean soil or other barrier appropriate to land use, will be applied as a cover where surface concentrations exceed 1,000 ppm lead.

Currently, a portion of the acid mine drainage from the Bunker Hill Mine is conveyed from the Kellogg Tunnel to the CIA for subsequent treatment in the Central Treatment Plant (CTP). All acid mine drainage will be conveyed to the CTP for pre-treatment followed by further treatment in the constructed wetland treatment system to be located in Smelterville Flats. During remedial design the adequacy of the existing CTP to pretreat mine water will be evaluated to determine if modifications to this facility are needed to meet water-quality-based effluent limits which will be imposed on the constructed wetland treatment system outfall. This remedial action is consistent with the requirements of a U.S. EPA Administrative Order issued in 1991. The order requires that a closure plan for the Bunker Hill Mine be developed and implemented which addresses acid mine drainage from the mine as well as other environmental considerations.

Closure Considerations

Upon demolition of the Lead Smelter and Zinc Plant, and consolidation of material accumulations and contaminated soils, including treated Principal Threat materials, both of these facilities will be closed. The Principal Threat materials remaining after recycling and reprocessing options have been implemented will be treated via cement-based stabilization fixation.

The objective of cement-based stabilization/fixation is to reduce the mobility of contaminants. Relevant and appropriate requirements of RCRA Land Disposal Restrictions (LDRs) for cement-based stabilization of Principal Threat waste are expected to be attained. While LDRs for mineral processing wastes have not been promulgated (and therefore are not applicable), U.S. EPA has determined that it is appropriate to achieve the percent reduction and/or extract concentration criteria goals set forth in the LDRs for immobilization of inorganic compounds. Treatability tests for cement-based solidification of one of the major Principal Threat waste material accumulations onsite (the Copper Dross Flue Dust recently moved from Magnet Gulch to the Smelter Complex) indicates that attainment of percent reduction goals based upon TCLP protocols is likely. However, due to the varying solubilities of contaminants of concern through a range of pH values, U.S. EPA has determined that the acid leaching aspects of the TCLP test protocol are not appropriate for wastes consolidated in the Lead Smelter Closure, and has elected to design a stabilization mixture that will achieve LDR percent reduction goals and/or extract concentration criteria at a pH reflective of actual onsite conditions. A rain water leach test which approximates onsite conditions has been determined to be appropriate; a modification of U.S. EPA Method 1320 will be used. Treated Principal Threat materials will be consolidated in concrete substructures (basements, storage bins, etc.) within the Lead Smelter Complex unless other areas are determined to be appropriate by U.S. EPA during Remedial Design.

Closure of the Lead Smelter and Zinc Plant will consist of a minimum of one foot of low permeability material or a soil/geosynthetic cap (or an appropriate combination of the two) that will have an in place hydraulic conductivity of less than or equal to 10[7] cm/sec to minimize water infiltration and subsequent contaminant migration. Other appropriate RCRA 40 CFR Part 264, Subpart G requirements for closure of existing facilities will be incorporated into the closure design, including: leachate collection and treatment, runoff and runon controls, monitoring, and operation and maintenance considerations.

Other Smelter Complex Remedial Actions

The surface water actions selected for the Smelter Complex include channelizing and lining of Government Creek, with diversion and treatment of base flows in the Collected Water Wetland. A cutoff wall will be constructed south of the Zinc Plant in order to divert relatively uncontaminated water around the closed industrial complex. A second cutoff wall will be constructed at the northern end of the gulch to facilitate the collection of contaminated ground water and surface water within the area. This water will be shunted to the constructed wetland treatment system planned for Smelterville Flats under this alternative. The Remedial Design for these components of the remedial action will seek to maximize recovery of base flow contaminated ground water and surface water for treatment and divert uncontaminated surface water and ground water around the closed industrial complex to the SFCDR. Bunker Creek base flows will also be conveyed to the wetland treatment systems if water quality sampling indicates exceedances of FWQC.

The existing storm water drainage system in the MOA will be maintained and the mill settling pond (Concentrator Reservoir) will be closed. Any sludge remaining in the bottom of the mill settling pond will be consolidated in the Lead Smelter closure.

The A-1 Gypsum Pond sediments located in Magnet Gulch will be removed and relocated to the CIA prior to closure of that area. The A-4 Gypsum Pond sediments, located north of McKinley Avenue at the mouth of Magnet Gulch, will either be capped in place or moved to the CIA along with the A-1 Gypsum Pond. The final determination regarding this aspect of the selected remedy will be based upon the engineering feasibility of closing the A-4 Gypsum Pond in place and additional consideration of ground water and surface water hydrology in that area. If a cap is selected it must minimize infiltration through the A-4 Gypsum Pond and be of low maintenance. Relocation the A-4 Gypsum Pond sediments within the CIA closure would have the additional benefit of making an area available in the former A-4 Gypsum Pond location for construction of a sedimentation basin for detention of runoff from the Smelter Complex, Bunker Creek, and Deadwood Gulch.

Other existing solid waste landfills within the Smelter Complex will be closed consistent with appropriate RCRA 40 CFR Part 264 requirements (Subpart N). A low permeability soil cover system will be constructed over the solid waste landfills located on the east side of Deadwood Gulch south of the mine/mill crusher plant in order to reduce surface infiltration through potential source materials. Capping the landfills is expected to reduce potential ground water loadings from these sources. Upon completion of remedial activities, all disturbed areas will be re-vegetated or other appropriate permanent barrier installed.

9.2.6 Rights-of-Way

All rights-of-way (ROW) within the Site will be managed to minimize contaminant migration and direct contact risk. The ROWs remedial action determinations will necessarily be site specific based upon location, utilization, and contaminant concentrations. In general all ROWs will receive one or more of the following treatments: access control, capping (i.e., barrier consistent with land use), or removal/replacement. Capping will be the predominant action utilized in Non-populated Areas; however, in areas within the Smelter Complex/MOA removal and replacement will be favored. Where caps are determined to be appropriate during RD, they will be consistent with land use and will have suitable durability; for example, in the case of overhead power lines the method of remediation will be consistent with the other areas around the ROW. Within residential areas, ROWs adjacent to residential properties will be treated consistent with the remedial action selected in the Residential Soils ROD. In all cases, ROWs contributing to contaminant migration via air or water will be addressed. ROWs include all state, county, local and private roads.

9.2.7 Commercial Buildings and Lots

Commercial buildings and lots include public buildings, parks, churches, as well as commercial properties. Risks posed by commercial buildings and lots are similar to those in residential settings. While the duration of exposure in commercial settings may be less, on the average, than a residential setting, the most sensitive portion of the population must still be protected. Consequently, this action requires remedial actions similar to those for residential areas. In existing commercial settings soils exceeding a lead concentration of 1,000 ppm in the top 1 foot, must receive a protective barrier consistent with land use. Barriers may include a minimum of six inches of clean soils or gravel, or a paved surface. Final decisions regarding barriers performance standards will be developed during Remedial Design or as a component of the institutional control program. Commercial properties used predominantly by sensitive populations will require a 12 inch soil barrier. As new commercial uses are undertaken the same approach to barrier management will be required. The institutional control program planned for the Site will provide specific performance standards for various barrier systems. Proper disposal of material excavated during commercial development is a key component of this remedy. Soils may be consolidated within the Page Pond tailings impoundment, or the Smelter Complex, until closure of Smelter Complex is complete.

With respect to interiors of commercial properties, the institutional controls program will encourage interior cleaning of properties and provide guidelines for replacement of carpets, floors, and insulation of existing structures.

9.2.8 Residential Interiors

The remedial actions presented here are intended to complement actions selected in the Residential Soils ROD issued by U.S. EPA in August of 1991. To provide a protective remedy for Site residents the following components are included:

! Continuation of blood lead monitoring in conjunction with educational programs currently provided by the Panhandle Health District.

! Continuation of the high efficiency vacuum loan program. programs currently provided by the Panhandle Health District.

! Development of institutional control programs for home remodeling activities, including the normal replacement of carpets, floors, and attic insulation.

! All homes with house dust lead concentrations equal to or exceeding 1000 ppm lead will have a one time cleaning of residential interiors after completion of remedial actions that address fugitive dust. If subsequent interior house dust sampling indicates that house dust lead concentrations exceed a site wide average of 500 ppm lead the need for additional cleaning will be evaluated.

! Home interiors of children identified through health screening will be evaluated and if needed site specific remediations will be performed.

- Additional interior dust studies will be developed during remedial evaluated and if needed site specific remediations will be performed. time cleaning.

9.2.9 Future Development in Non-populated Areas

With the exception of certain areas within the Site that are integral components of the remedial actions (e.g., Lead Smelter cap and constructed wetland systems), currently undeveloped areas of the Site may be utilized in the future, consistent with local land use controls.

The institutional controls program will guide the establishment of effective barriers in areas where surficial (top one foot) soil lead concentrations exceed 1,000 ppm lead. In areas where lead concentrations are below 1,000 ppm lead no special considerations will be required beyond those typically required for new developments. The exception to this would be creation of a new residential development in a currently undeveloped area of the Site. Such a development would have an average residential yards lead concentration less than 350 ppm lead, with no property exceeding 1,000 ppm lead, and would need to be effectively isolated from nearby areas that would expose residents to surficial lead soil levels exceeding 1,000 ppm. New developments not meeting these criteria will require remediation prior to residential use as described in the Residential Soils ROD.

Non-populated Areas with the potential for future development will be remediated to address current human health and environmental concerns as discussed in this section. Remediation activities specific to conditions at future land use locations will be implemented, as appropriate, as development occurs via institutional controls (see Section 9.2.14).

9.2.10 Constructed Wetland Treatment Systems

Two constructed wetland treatment systems are selected for the innovative treatment of surface water and ground water. The first system (Collected Water Wetland) will occupy approximately 74 acres in Smelterville Flats and is intended to treat CIA seeps, pre-treated acid mine drainage, contaminated surface and ground water from Government Gulch, leachate from the Lead and Zinc Plant closures, and other selected surface water flows. The U.S. EPA is selecting this system based upon information presented in the FS, supporting Technical Memoranda, an independent review of the literature. The system would operate by adsorption and precipitation of metallic sulfides within an anaerobic wetlands substrate. The contaminants would remain bound in thewetland as long as the substrate remains anaerobic and saturated. This system will bedesigned to maximize removal of contaminants from treated waste streams as early as practicable. After source control remedial actions are in place and the system operation has been optimized, it is U.S. EPA's expectation that the constructed Collected Water Wetland treatment system will treat approximately eight CFS of contaminated water to a minimum of 90% removal efficiency and will meet water-quality-based effluent limits prior to discharge to the SFCDR. Currently the SFCDR is a water quality limited stream segment; however, the IDHW, U.S. EPA, the Coeur d'Alene Tribe, and other interested state federal and local agencies are considering developing a Total Maximum Daily Load (TMDL) for the SFCDR, as required by the Clean Water Act. Discharge limits for the Collected Water Wetland and Ground Water Wetland effluents will be determined as this process evolves as part of the Coeur d'Alene Basin Restoration Project. Should the Collected Wetland Treatment System not meet both 90 percent reduction criteria and water-quality-based effluent limits meeting the substantive requirements of an NPDES permit, pretreatment of influent contaminant streams or modifications to the treatment systems will be required.

The second system, the 34 acre Ground Water Wetland system selected for treatment of ground water is described in greater detail in the FS and supporting Technical Memoranda. In general, this system is intended to treat upper zone ground water flowing towards the SFCDR in the western portion of Smelterville Flats. This system will be designed to maximize the efficiency of contaminated ground water capture in this area and maximize removal of contaminants from ground water early as practicable. After source control remedial actions are in place and the system operation has been optimized, it is U.S. EPA's expectation that the constructed Ground Water Wetland treatment system will treat approximately three CFS of contaminated water toa minimum of 90% removal efficiency and will meet water-quality-based effluent limits prior to discharge to the SFCDR. Should passive collection of ground water for treatment not prove effective, active collection (i.e., pumping) will be required to achieve recovery of contaminated ground water. Modifications to the treatment process will be required if performance standards noted above are not achieved.

For both systems, long term management of wetland substrate and operations and management considerations will be an integral part of the Remedial Design.

9.2.11 Public Water Supply Considerations

The current availability of an offsite potable water supply for most Site residents effectively limits the use of onsite water for domestic purposes; however, adequate supplies of suitable water must continue to be available to minimize exposure to onsite surface and ground water. Should offsite potable water become unavailable, additional actions may be required to assure a safe drinking water supply until onsite sources are restored to a suitable quality. As discussed previously, restoration of onsite water resources is dependent upon control of upgradient sources of contamination to surface and ground water as well as onsite remedial actions.

Except as noted below, all ground water wells within the Site that are in the main valley aquifer, either upper zone, lower zone, or other contaminated wells within the Site will be closed or abandoned according to the State of Idaho requirements. Existing domestic wells selected for closure will be replaced by an existing alternative water supply if the residence is not already serviced by a municipal water system. Industrial wells will be replaced by an alternative water supply as needed. Monitoring and aquifer test wells will not require replacement with an alternative water supply. Monitoring wells will be closed if they are not required for continued monitoring. Approximately 48 domestic wells, 43 industrial wells, and 317 monitoring wells will be closed.

9.2.12 Soil Action Levels

Remedial actions for specific areas of the Bunker Hill Superfund Site are outlined earlier in this Section. Additional details on these remedial actions are provided in the FS description of Alternative 3 and supporting Technical Memoranda. In general, the decision regarding how a particular area of surface contamination is addressed is a function of the area it is within. Areas that are primarily impacted by a mixture of tailings and alluvium (soil) are suitable for capping. These areas represent a high volume, low concentration source that is appropriately managed by a combination of containment technologies and institutional controls. This approach is consistent with U.S. EPA's previously issued Residential Soils ROD.

Areas that have been impacted by contamination from mineral processing facilities (e.g., lead smelting, zinc refining, etc.) are slated for removal since these wastes are generally of higher concentration and require a greater level of management in order to insure a protective remedy.

For the purposes of this ROD, clean replacement soils are considered to contain less than 100 ppm lead, 100 ppm arsenic and 5 ppm cadmium.

9.2.13 Operations and Maintenance Requirements

Specific Operations and Maintenance (O&M) requirements for all remedial actions selected in this Record of Decision will be developed during the Remedial Design process. O & M requirements are an integral component of remedial actions and must be planned and implemented to ensure the long term effectiveness of selected measures. Long term protection of human health and the environment is dependent upon the successful maintenance of barriers, facility closures (i.e., CIA, Smelter Complex), erosion control structures, channel liners,and contaminant treatment systems. O & M requirements must also be designed to complement institutional control and Monitoring programs which are discussed below.

9.2.14 Institutional Controls

Institutional controls, which include a variety of legal restrictions and regulations on the use of land where potentially hazardous levels of contamination will remain after completion of this remedy, are an important component of remedial actions for the Bunker Hill Superfund Site. The Residential Soils ROD issued in 1991 requires the use of institutional controls for maintenance of residential soil barriers to prevent human contact with contaminated soils after removal and replacement of contaminated surficial soil.

This remedy also relies upon institutional controls to assure the protectiveness of selected remedial actions, including certain hillside areas within the Site which have surface soil concentrations that exceed residential soil cleanup goals for lead, and which are likely to be developed in the future. Institutional controls will guide the future development of these areas to ensure that appropriate remedial actions are taken, including the use of protective barriers on contaminated soils, to protect future residents and users of such areas from exposure presenting unacceptable risks. In addition, institutional controls will assist landowners who undertake projects by providing guidance and certification of compliance with the institutional controls regulatory program.

The NCP sets out U.S. EPA's expectation that institutional controls "shall not substitute for active response measures [that actually reduce, minimize, or eliminate contamination] as the sole remedy unless such measures are determined not to be practicable." 40 CFR Part 300.430(a)(1)(iii)(D). Nevertheless, where active remediation is not practicable, institutional controls maybe "the only means available to provide for protection of human health." 55 Fed. Red. 8666, 8706 (March 8, 1990). In addition, institutional controls may be "a necessary supplement where waste is left in place as it is in most response actions." Id.

Accordingly, U.S. EPA has determined that institutional controls are both an acceptable and integral component of remedial actions for both the Residential Soil ROD and this Non-populated Areas ROD. Institutional controls have been identified and evaluated in the Residential Soil Feasibility Study and RADER, and U.S. EPA and IDHW have participated in the development of the Panhandle Health District's evaluation of such controls in the Populated Areas. Institutional controls were also evaluated in the Non-populated Area FS.

The January 25, 1991, Draft "Evaluation of Institutional Controls for the Populated Areas of the Bunker Hill Superfund Site," prepared for the Panhandle Health District outlines the need for and purpose of a comprehensive Institutional Controls Program (ICP) for the Bunker Hill Site. There are four main components of the ICP, including:

1. An Environmental Health Code;
2. Performance Standards for remedial actions (e.g., specifications for barriers);
3. An educational program for residents and contractors to familiarize themselves with ICP requirements;
4. A testing and monitoring program to evaluate the effectiveness of the ICP.

The Panhandle Health District held numerous meetings with local elected officials regarding the development and implementation of the ICP. On February 24, 1992, the Panhandle District Board of Health formally approved the Panhandle Health District's involvement as the management entity for the Institutional Control Program and their commitment to amend the existing Environmental Health Code to include specific Contaminant Management Regulations andperformance standards. In May 1992, the Panhandle Health District completed a draft of an Environmental Health Code, also known as Contamination Management Regulations.

Once finalized and adopted, the Contaminant Management Regulations will be incorporated into the Panhandle Health District's Environmental Health Code, and are expected to govern all excavations, building, development, grading and renovations within the Site and potentially other areas affected by heavy metal contamination within the Panhandle Health District's jurisdiction in Shoshone County.

The Environmental Health Code will also include specific performance standards to regulate and provide guidance for all activities encompassed by the ICP. The performance standards will establish minimum requirements when barriers are to be established or breached and will govern the following activities:

1. Building Interior Construction/Modification
2. Exterior Construction
3. Subdivision Development
4. Transportation
5. Disposal
6. Clean Materials Supply Program

After adoption of the Environmental Health Code and performance standards, the Panhandle Health District will then develop an educational program component of the ICP, based on the final ICP performance standards. The Panhandle Health District will then administer and oversee the testing and monitoring component of the ICP.

In addition, the Health Intervention Program, as described below, will be continued at least through the completion of remedial action. This program identifies children and pregnant women who are being impacted by lead exposures and provide intervention activities to mitigate such exposures.

Blood lead screening should continue as it is currently being performed until the Remedial Action is completed and the blood lead concentrations Remedial Action Objective is met. This RAO requires that blood lead levels decrease until 95% of the children tested-have blood lead levels below 10 ug/dl with less than 1% of children having blood lead levels above 15 ug/dl.

The objective of the screening program will continue to be the identification of children who have elevated blood lead levels and need follow up to reduce lead exposures. The Centers for Disease Control guidelines for follow up activities will be used to determine appropriate intervention response. Outlined below are specific response actions for blood concentration ranges.

ug/dl Follow Up Response

10-14 Provide rescreening and community-wide childhood lead poisoning prevention activities. These prevention activities will be part of the Institutional Control education program.

15-19 Response as listed for 10-14 ug/dl plus home visits by health professional and provide nutritional and educational intervention. If appropriate, recommend a special education evaluation for school age children by the local school district.

20-44 Responses as listed for 15-19 ug/dl plus recommend a visit to a family physician.

Children between the ages of 9 months to 9 years will be included in the program. The program will continue to offer incentives to children for having their blood tested. A house dust sampling program will be continued. Home visits would include environmental evaluations which examine house dust, residential soils, vegetable gardens and paint.

Pregnant women will also be screened. However, no incentives would be provided, as is the case for children. Women with blood lead levels greater than 10 ug/dl would be referred to their physician for medical evaluation. Additionally, a home visit would be conducted and the expectant mother provided with nutritional and intervention information.

Once remedial actions are completed and blood lead levels have decreased to meet the RAO described above, the health intervention program will be scaled back to provide blood lead testing upon request only. The same follow up responses for children and pregnant women with elevated blood lead levels will be activated. However, the number of individuals needing follow up would be low.

The Panhandle Health District has stated that it will only manage and administer the ICP for as long as it is funded, as the Panhandle District Board of Health has not, and will not, authorize funding for any of the Institutional Control Program activities. Community acceptance of the ICP program, as expressed during the public comment period, is also conditioned on such controls being self-sustaining with no additional costs to Site residents or local governments.

9.2.15 Monitoring

Extensive monitoring of soil, water, and air is an important component of the remedial actions outlined in the ROD. Monitoring is required for the following purposes, in addition to those that may be required during Remedial Design.

- To evaluate compliance with ARARs in surface and ground water

- To assess the status of environmental receptors (i.e., biological monitoring)

- To evaluate the performance of specific remedial actions and their respective O & M programs

- To evaluate success in meeting public health protection goals (i.e., continuation of blood lead screening program)

- To evaluate the adequacy of control measures instituted during implementation of remedial actions.

Monitoring programs will be utilized to evaluate the success of remedial actions in protecting human health and the environment and will serve to assist U.S. EPA in determining the adequacy of remedial actions selected in this ROD.

9.2.16 General Remedial Design/Remedial Action Considerations

During remedial actions certain activities will have to be maintained or implemented to protect human health and environment. These activities include; dust control, access control, fire control, and the management of the release of contaminants during remedial construction activities.

During remedial construction activities, dust control measures will be implemented site wide to prevent the transport of contaminated material. The dust control activities can include the use of water to wet down areas or polymeric, chemical, or physical surface sealers for temporary dust control. Some of the areas that will receive temporary dust control include Page Pond and CIA surfaces and dikes, roads in the populated and non-populated ROW, Smelterville Flats, the Smelter Complex, and other source areas that generate fugitive dust. Institutional controls will also be applied to restrict access to potential source areas to control transport of contaminants within the site and exposures to contaminants of concern.

Access control will be maintained in all areas where it currently exists until the remediation in that area is completed. Access controls will also be used to prevent exposures during remedial actions. Access controls will include fencing, signs, and security patrols and guards.

Fire control will be in place until remedial actions are completed in the Smelter Complex and MOA. Fire control will include quarterly inspections of all structures until they are either demolished or decontaminated. The necessary fire protection materials, including the necessary water supplies, will be maintained as long as the potential for release of contaminants through fire exists. This will include coordination with the local fire district to provide the necessary information for safe access should it be necessary to fight a fire. Also included in fire control is the use of fire protection during all activities involving potential ignition sources, such as cutting and welding activities. These activities include wetting down areas prior to these activities, having fire extinguishers at hand, and providing a fire watch for an appropriate period after all ignition sources have been abated.

The management of the release of contaminants during remedial construction activities will also be performed. This will include the management of high flow runoff to minimize sediment transport in surface water. Storm water management during remedy implementation will be consistent with all State and local requirements. Best Management Practices employed during remedial action implementation will include extensive use of storm water detention facilities to minimize impacts from runoff events until monitoring of remedial actions have demonstrated their effectiveness in mitigating contaminant loading from runoff events.

Any repairs required to community infrastructure, such as roads and utilities, due to the implementation of remedial actions required in this ROD, will be implemented as appropriate.

9.3 CHANGES TO PROPOSED PLAN

Residential soils were originally intended to be consolidated on Page Pond or another suitable area onsite. For clarification, it is also appropriate to utilize residential soils as a sub-base material for the closure of the Lead Smelter and Zinc Plant, or as a component of the final cover of these closures if surface concentrations are below 1000 ppm lead and access is controlled.

Language has been added to Section 10 of this ROD to clarify when the contingent waiver of ground water ARARs in the main valley aquifer would become effective based upon technical impracticability. It has been further clarified that, while remedial actions outlined in this ROD seek to limit the impacts of site contaminant sources on the SFCDR, achievement of FWQC in the river is beyond the scope of this ROD and attainment of FWQC in the SFCDR is not an ARAR for this ROD.

Preliminary results of treatability testing of Principal Threat material accumulations indicate that a rain water leach test is more appropriate under the circumstances of this release than the acid leach test typically utilized for design of stabilization mixtures meeting LDR requirements. Therefore, a rain water leach test will be used in lieu of an acid leach test to design the cement-based stabilization mixture for treatment of Principal Threat waste. This test will be a modification of U.S. EPA Method 1320 utilizing water with a pH representing local conditions, rather than acidified water.

9.4 QUANTITY OF MATERIALS REMOVED, CONTAINED, AND TREATED

Table 9-2 provides a summary of quantity of materials removed, capped, and treated.

9.5 COST

Cost evaluations, including the assumptions used, are presented in the Non-populated Areas Feasibility Study (FS) report. A summary of estimated capital, both direct and indirect, and O&M, and net present worth costs associated with the selected remedy is outlined in Table 9-3. Contingency allowances have been included in the estimates, consistent with the extent of the uncertainties. The accuracy of the estimates is expected to fall within the acceptable range of +50 percent to -30 percent, as outlined in the NCP.

Capital costs are those required to initiate and construct the remedial action. Typical capital costs include construction equipment, labor, and material expenditures, engineering, and construction management. The total estimated capital, including direct and indirect costs, is $56.6 million (Table 9-3).

An implementation period of six years for the selected remedy was assumed for cost estimation purposes. The exact duration of initial implementation and corresponding capital cost distribution is dependent on the results of the Remedial Design Phase. The capital cost for each year is converted to 1991 dollars. Using a three, five, and ten percent discount rates and a 30-year estimated project life, the present worth cost for the selected remedy is $57.2, $52.0, and $42.4 million, respectively (Table 9-3). Capital costs and long-term annual O&M costs are included in the total present worth cost.

Estimates for the cost of O&M activities are prepared for operations expected to be performed for the 30-year period following site remediation. Site wide monitoring costs, a contingency fund for unpredicted events, and allowance for periodic site reviews are not included. These costs are necessary to ensure the continued effectiveness of the remedial action.

The feasibility study cost estimates 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. *** The cost estimates as presented in the FS do not include costs for the Hillside work that is required by a 1990 Hillsides AOC or additional cost of revegetation in the 50 - 85% cover class. The costs for commercial buildings and lots, rights-of-way, interior dust remediations, and compliance with National Historic Preservation Act were also not estimated. However, the cost estimate does include the cost of demolishing the two tall stacks which is not a required component of this ROD and the solidification of the copper dross flue dust (CDFD) which has already been relocated to the Lead Smelter in preparation for stabilization as required by a 1991 UAO issued by the U.S. EPA.

In addition to the costs specified in this ROD, site wide cleanup also includes an estimated $40 million dollars to implement the Residential Soils Record of Decision, and approximately $20 million dollars which has been incurred to date for site investigations, removal actions, and oversight of PRP investigations and response actions. To date, approximately 400 residential properties have been remediated and numerous response action have been taken across the Site to protect human health and the environment. These actions are discussed in Section 2 of this ROD.

It is anticipated that although cost estimates presented in the FS and summarized in this ROD do not include a specific itemization of every item of the selected remedial action, as noted above, these omissions are offset by inclusion of other elements in the FS cost estimates that are currently being addressed under U.S. EPA Orders. In any case, the overall cost estimate is expected to be consistent with RI/FS Guidance (U.S. EPA 1988).

9.6 PERFORMANCE REQUIREMENTS

Performance requirements for specific remedial actions are included in Section 9.2 of this ROD, Remedial Actions by Subarea. During remedial design, monitoring programs will be developed to evaluate performance of each remedial action. Additionally, O & M requirements will provide for continued achievement of performance standards over time.

10 STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, will comply with federal and state requirements that are legally applicable or relevant and appropriate (unless the contingent waiver discussed in Section 10.2 of this ROD is invoked), and is cost-effective. The selected remedy utilizes alternative treatment and resource recovery technologies to the maximum extent practicable. Because this remedy will result in hazardous substances remaining onsite above health-based levels, the five-year review provisions of Section 121(c) of CERCLA, 42 U.S.C. S 9621(c), 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

The remedy selected is protective of human health and the environment by inhibiting the significant exposure pathways through removals, containment, and treatment. The transport of contaminants by air and direct exposure to contaminated soils will be controlled by removal of contaminated materials or barriers. Base flow surface water from contaminated onsite tributaries entering the SFCDR will be treated prior to entering the river. Revegetation and erosion control efforts on the hillsides will help control the transport of soils by surface water runoff during storm events. A portion of the ground water that enters the SFCDR in the vicinity of Pinehurst Narrows and the CIA seeps will be collected and treated prior to entering the river, as will theground water in the Government Gulch. Infiltration through the Smelter Complex and CIA caps will be minimized by implementation of effective closure methods, therefore the impact to ground water from these areas will be reduced. Principal Threat soils and source materials will be treated prior to consolidation within the Lead Smelter closure. This will effectively limit the potential of a release of Principal Threat material if the cap is ever breached.

The analysis presented in the FS demonstrates that the remedy selected will reduce the significant exposure pathways. When the remedial actions are completed and the Institutional Controls Program is implemented, the risks associated with metal contamination will be reduced to acceptable levels. Therefore, U.S. EPA has concluded that the selected remedy will be protective of human health and the environment.

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

Pursuant to Section 121(d) of CERCLA, 42 U.S.C. 9621(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). In instances where the remedial actions do not achieve ARARs the basis for a waiver must be provided by U.S. EPA.

The federal and state ARARs for this remedy, identified by U.S. EPA and IDHW, respectively, are presented in Tables 10-1 through 10-6. These tables cite the requirements identified, state whether the requirements are applicable or relevant and appropriate, summarize the substantive standards to be met, and specify where in this ROD the requirements must be met. It is expected that this remedy will satisfy all ARARs identified, except in the instance where the contingencies outlined below for attainment of groundwater ARARs in the main valley aquifer demonstrate the technical impracticability of achieving chemical-specific ARARs for certain areas of the aquifer. Because of the complexity of this remedy, the applicability of certain of the ARARs is discussed below. Additional analyses of ARARs is presented in Section 8 of the Non-populated Feasibility Study and Section 2 of the Residential Soils Feasibility Study.

Ground and Surface Water ARARs

Section 121(d) of CERCLA, 42 U.S.C. S 9621(d), specifically states that remedial actions shall attain a level or standard of control established under the Safe Drinking Water Act (SDWA), where such level or control is applicable or relevant and appropriate to any hazardous substance, pollutant or contaminant that will remain onsite. The enforceable standards under the SDWA are maximum contaminant levels (MCLs) which represent the maximum permissible level of a contaminant which may be delivered to any user of a public water system. Section 121(d) of CERCLA also states that remedial actions shall attain maximum contaminant level goals (MCLGs) where such goals are relevant and appropriate. (MCLGs are health-based goals set at levels at which no adverse health effects may arise, with a margin of safety.)

MCLs are only legally applicable under the SDWA to the quality of drinking water at the tap. Therefore, MCLs are not applicable with regard to remediation of surface or ground water which is not used or intended for drinking water purposes. They are, therefore, not applicable standards with regard to this remedy. In addition, because the riparian surface water onsite is classified by the State for agricultural and non-contact recreational purposes, and not drinking water, MCLs and MCLGs are not relevant and appropriate for remediation of onsite, riparian surface waters. However, MCLs and MCLGs are relevant and appropriate for ground water onsite since it is possible that the aquifer could be used for drinking water purposes in the future.

One goal of site-wide remedial actions is to restore ground water to its maximum beneficial use. Currently, onsite ground water is utilized for domestic consumption only in limited circumstances and primarily in areas outside of the contaminated valley aquifer system. Public water supplies within the Site come from surface water sources that are unimpacted by Site contamination. While domestic use of ground water is limited, there are some wells within the valley aquifer system operated by individuals utilizing ground water for landscaping or other non-consumptive purposes.

Remedial actions specified in this ROD will limit exposure to contaminated ground water by abandoning potentially contaminated wells and connecting additional users to the public water supply system. These actions, in conjunction with the use of institutional controls to limit future utilization of contaminated ground water, provide adequate protection of human health from this exposure pathway.

Notwithstanding the effectiveness of these actions in minimizing exposure of the resident population to contaminated ground water, it is also a goal of this remedial action to improve ground water quality, both for potential use as a water supply, and to ensure that it does not contribute to surface water quality degradation.

Based on information obtained during the Remedial Investigation, and the analysis of remedial alternatives, U.S. EPA and IDHW believe that the selected remedy may be able to achieve the water quality improvement objectives stated above. However, ultimate attainment of federal Drinking Water Standards in the valley aquifer system will in part depend upon the success of upstream water quality improvement initiatives in controlling contaminant loading to the valley aquifer system, as well as onsite actions. Ground water contamination may be especially persistent in the immediate vicinity of contaminant sources, and in portions of the valley aquifer system most strongly influenced by upgradient surface and ground water contamination.

The ability to achieve cleanup goals (DWS ARARs and protection of surface water quality) at all points throughout the valley aquifer system cannot be determined until the remedial actions outlined in this ROD have been effective in meeting their individual performance standards (specified in Section 9), and upgradient efforts to improve water quality have been implemented. If the selected remedy cannot meet DWS throughout the valley aquifer system, notwithstanding upgradient efforts that may be implemented independently of the actions required by this ROD, to improve ground water quality entering the Site, the contingency measures described in this section may replace the selected remedy and ground water cleanup goals. These contingency measures will include refinement of ground water recovery and treatment system components of the remedial action, and continuation of institutional controls.

The selected remedy will include ground water extraction and treatment from the western portion of Smelterville Flats, areas North of the CIA, and Government Gulch for an estimated period of no less than 10 years after the completion of site wide source control remedial actions. Overall system performance will be carefully monitored on a ongoing basis and adjusted as warranted to maximize system efficiency. Modifications may include any or all of the following:

a. augmentation of passive ground water collection at the Smelterville Flats ground water wetland by active recovery of ground water (i.e., pumping) to increase capture efficiency if RAOs for protection of SFCDR water quality due to onsite sources are not met due to ground water contributions to this segment of the river;

b. modifications to the ground water (seep) collection system to be constructed north of the CIA to increase contaminated ground water capture efficiency if RAOs for protection of SFCDR water quality due to onsite sources are not met due to ground water contributions to this segment of the river;

c. active collection and treatment of contaminated ground water in Deadwood Gulch and Magnet Gulch if source control measures in those areas are not successful in controlling the continued release of contaminants of concern to the ground water system at concentrations exceeding ARARs

d. removal, containment, or treatment of discrete ground water contaminant sources when it can be determined that additional benefits to ground water may be achieved by such actions.

If it is determined, based on the successful implementation of the selected remedy (i.e., performance standards are met), and the above specified modifications, that certain areas of the valley aquifer system cannot be expected to meet ARARs, notwithstanding whatever additional efforts which may be made, independently of the actions required by this ROD to improve upgradient ground water quality entering the Site, the following measures involving long-term management may occur, for an indefinite period of time, as a modification to the existing system:

a. a long-term program will be developed and funded to insure the continued operation of containment systems, (such as source control measures and ground water recovery and treatment components of the remedial actions) to limit the continued release or migration of contaminants of concern;

b. chemical-specific ARARs will be waived for those limited portions of the valley aquifer system not meeting drinking water ARARs, based upon the technical impracticability of achieving further contaminant reductions, as demonstrated by implementation of the selected remedy and the modifications discussed above;

c. institutional controls will be continued to restrict access to those portions of the aquifer which remain above remediation goals;

d. monitoring of ground water to evaluate changes in ground water quality and insure the adequacy of institutional controls in limiting exposure to contaminated ground water;

e. periodic review will be performed of the success of upgradient water quality improvement initiatives in enhancing onsite water quality; longterm improvements may influence the requirements of the institutional control system.

The decision to invoke any or all of these measures will occur during periodic reviews of the remedial action, which will occur at least every 5 years, in accordance with CERCLA section 121(c) of CERCLA, 42 U.S.C. S 9621(c).

U.S. EPA has determined that the human health water quality criteria for ingestion of organisms (fish) and the chronic aquatic life water quality criteria (FWQCs) under the Clean Water Act are applicable with regard to onsite tributaries to the SFCDR. With respect to the SFCDR, the RI demonstrates that SFCDR water quality within the Site is substantially controlled by loadings from sources upstream of the Site to a degree that even with total elimination of loadings from onsite sources, the FWQC for cadmium, lead, and zinc would still be exceeded (See Section 5.2 of the Technical Memorandum: Post Remediation Water Quality Projections for Feasibility Study Alternatives 2, 3, and 4). Because this ROD does not address remediation of the SFCDR (exceptfor the contribution from onsite sources), attainment of FWQC in the SFCDR is not an ARAR with respect to this remedial action.

Currently the SFCDR is a water quality limited stream segment; however, IDHW, U.S. EPA, the Coeur d'Alene Tribe, and other interested state federal and local agencies are considering development of a Total Maximum Daily Load (TMDL) for the SFCDR, as required by the Clean Water Act. Discharge limits for the Collected Water Wetland and Ground Water Wetland treatment systems effluents will be determined as this process evolves as part of the Coeur d'Alene Basin Restoration Project. It is also expected that control and abatement of onsite sources of contaminants will be effective in reducing metal loading to both ground and surface water.

Five year reviews, at a minimum, will be relied upon to evaluate the effectiveness of the selected remedy and compliance with ARARs. In addition, until the ARARs can be met, the remedy will rely on the institutional control of water use to be adequately protective of human health.

RCRA ARARs

RCRA imposes a number of requirements on remediation involving the disposal and/or placement of wastes and therefore contains a number of provisions which may be ARAR at a Site. Land Disposal Restrictions (LDRs) place specific restrictions on certain RCRA hazardous wastes prior to their placement in a land disposal unit. Under CERCLA, placement occurs when wastes are moved from one "area of contamination" (AOC) to another. Therefore, wastes left in place or consolidated within one AOC are not subject to the regulations. For purposes of this ROD, the entire Bunker Hill Site has been identified as one AOC. LDRs, therefore, are generally not applicable. In addition, certain wastes produced through the extraction and beneficiation of minerals (and some specifically identified mineral processing wastes) have been excluded from RCRAregulation pursuant to section 3001(b)(3)(A)(ii) of RCRA, 42 U.S.C. S 6901(b)(3)(A)(ii) (these excluded wastes are referred to as "Bevill-exempt"). Further, LDR treatment standards have not been promulgated for mineral processing wastes. Although LDRs are not applicable to any of the actions specified in this ROD, U.S. EPA has determined that certain aspects of RCRA LDRs may be relevant and appropriate for the treatment of Principal Threat soil and material accumulations. As was discussed previously, the relevant and appropriate aspects of LDRs for treatment of Principal Threat waste will be attained through design of a cement-based stabilization mixture that will meet percent reduction goals and/or extract concentration criteria outlined in the RCRA LDRs for inorganic materials using a rain water leach test to simulate onsite conditions. Those percent reduction standards are a minimum of; 90% for arsenic, 90% for mercury; 95% for cadmium, 90% for antimony, 95% for nickel, and 99% for lead. Extraction concentration criteria are 1.0 ppm for arsenic, 0.008 ppm for mercury, 2.0 ppm for cadmium, 0.2 ppm for antimony, 1.0 ppm for nickel, and 3.0 ppm for lead.

RCRA LDRs are not applicable or relevant and appropriate at the Page Pond, CIA, Hillside, mine dump, or Smelterville Flats portions of the Site because wastes in these areas are Bevill-exempt and/or their placement constitutes consolidation within the AOC. While not applicable at the MOA, LDRs are relevant and appropriate there for wastes which will be treated. Finally, LDRs are not applicable or relevant and appropriate at the Wetlands System because wastes there are being consolidated for in situ treatment.

In addition to LDRs, RCRA can impose closure (40 CFR Part 264, Subpart G) and ground water monitoring requirements (40 CFR Part 264 Subpart F). For purposes of this ROD, RCRA 40 CFR Part 264, Subpart G closure requirements are relevant and appropriate to the Smelter Complex. With regard to potential wastes which may remain onsite as treatment residuals at the Wetland Systems,relevant and appropriate aspects of RCRA 40 CFR Part 264, Subpart X will apply. At these areas of the Site, RCRA's substantive closure requirements will be met. In addition, certain provisions of RCRA 40 CFR Part 264, Subpart G are relevant and appropriate at the CIA and Page Pond. Compliance with the substantive requirements for protectiveness under these sections will be achieved through capping and institutional controls as further described in Section 9.2 of this document.

Requirements for ground water monitoring under RCRA 40 CFR Part 264, Subpart F are relevant and appropriate for RCRA wastes located at the Smelter Complex and the Wetlands System. Although not applicable based on Bevillexempt status, RCRA 40 CFR Part 264, Subpart F requirements are relevant and appropriate at the Smelterville Flats, Page Pond, CIA, MOA, and Hillside portions of the Site. The substantive requirements for ground water monitoring will be achieved under the Site wide monitoring program established for the overall remedy.

Asbestos and PCB ARARs

The substantive standards of 40 CFR 61 regarding management and disposal of asbestos and 40 CFR 700 regarding PCB management and disposal are applicable at the Smelter Complex and MOA portions of the Site. Before and during demolition, asbestos and PCB containing materials will be properly managed pursuant to these regulations. Asbestos management during remedial actions will also be consistent with U.S. EPA's policy regarding disposal onsite.

Executive Orders

Executive Order 11990, 40 CFR Part 6, Appendix A, regarding wetlands protection is applicable for the West Page Swamp remedial actions and certain portions of the Smelterville Flats area. These areas will be managed to avoid adverse effects, to minimize harm, and, to the extent practicable, to enhance wetlands in keeping with this Executive Order. In addition, Executive Order11988, 40 CFR Part 6, Appendix A regarding floodplain protection is applicable at the West Page Swamp, Smelterville Flats, and Wetlands System portions of the Site. Pursuant to the terms of this Executive Order, these areas will be evaluated for potential effects from flood hazards.

10.3 COST-EFFECTIVENESS

U.S. EPA believes the selected remedy is cost-effective in mitigating risks posed by contaminated soils, ground water, surface water, and material accumulations at the Bunker Hill Site. Section 300.430(f)(ii)(D) of the 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 source controls and treatment. Institutional controls will ensure long-term maintenance of the physical and institutional barriers that protect against contaminant exposures. This alternative is attractive because of the relatively low cost (approximately $52.0 million net present worth) and expected effectiveness.

The principal difference between the selected remedy and the other two alternatives is the amount of treatment. One alternative relies primarily on source containment. Although less expensive that the selected remedy, source containment would provide a less effective means of protecting human health and the environment since no water treatment, either surface or ground, is included in this alternative. Although Alternative 4 would remove more contaminated materials for consolidation onsite, the associated cost of $120.3 million was substantially higher than that for the selected remedy, the added effectiveness would be marginal with respect to the additional cost. 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

U.S. EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner at the Site. Of the three alternatives protective of human health and the environment and in compliance with ARARs, the selected remedy provides the best balance in terms of long 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 2. The treatment included in the selected remedy provides more permanent controls. The cost of removals in Alternative 4 was too high compared to Alternative 3, considering the associated incremental improvement in performance.

The selected remedy utilizes alternative treatment and resource recovery technologies to the maximum extent practicable. All materials, including Principal Threat materials and demolition debris, will be evaluated for reprocessing or recycling before disposal onsite. Innovative treatment was selected for both ground and surface water in a constructed wetlands treatment systems to remove metals. Principal Threat materials that cannot be reprocessed or recycled will be treated by cement based stabilization. The treatment process will reduce the mobility of the contaminants by stabilizing them in a solid matrix.

10.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy satisfies the statutory preference for treatment as a principal element. The recycling and reprocessing of all materials practicable, cement-based stabilization treatment of remaining Principal Threat materials, and the treatment of both surface and ground water in the wetlands treatment system are all principal elements of the selected remedy. The treatment, along with the engineering controls, is consistent with the Superfund program expectations stated in the NCP (40 CFR 430(a)(1)(iii)(B)).

11 REFERENCES AND ACRONYMS

All references may be found in the Administrative Record for the Site, or otherwise publicly available.

1. Bunker Hill Superfund Site Feasibility Study Report (FS). May 1, 1992. Prepared by McCulley, Frick, and Gilman, Inc. Volumes I, II, III, and associated Technical Memoranda.

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3. CH2M Hill. 1991. Residential Soil Feasibility Study for The Bunker Hill CERCLA Site Populated Areas RI/FS (RI/FS). Document Number BHPA-RSFS-F-RO-041991.

4. Ecological Risk Assessment for The Bunker Hill Superfund Site (ERA). November, 1991. Prepared by Science Applications International Corporation, Technology Service Company (SAIC, 1991). 5. Final Human Health Risk Assessment for The Non-populated Areas of The Bunker Hill NPL Site (HHRA). June 1992. Prepared by Science Applications International Corporation, Technology Services Company (SAIC, 1992).

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7. Record of Decision (ROD). Bunker Hill Mining and Metallurgical Complex Residential Soils Operable Unit. Shoshone County, Idaho. August 1991. Prepared by Idaho Department of Health and Welfare (IDHW).

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9. Technical Memorandum Evaluating Regulatory Requirements for The Bunker Hill Site. June 1992. Document Number: TZ4- C10010-EP-10748.

10. The Revised Final National Contingency Plan (NCP). April 1990.

11. U.S. EPA. 1992.

12. U.S. EPA. 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Interim Final. October 1988. Office of Emergency and Remedial Response.

13. Chapter 11 Bankruptcy Plan of Reorganization, In Re Bunker Limited Partnership, No. 91-02087K11 (July 13, 1992, D. Wash.).

14. Chapter 11 Bankruptcy Plan of Liquidation, In Re Bunker Hill Mining Company (U.S.), Inc., No. 91-00161 (August 22, 1991, D. Idaho).

15. Evaluation of Institutional Controls for the Populated Areas of the Bunker Hill Superfund Site (Draft), January 25, 1991, For Panhandle Health District by Gale Allen and Jerry Mason.

16. Human Health Risk Assessment Protocol For the Populated Areas of the Bunker Hill Superfund Site, U.S. EPA Contract No. 68-01-7351, Jacobs Engineering Group, Inc., ICAIR, Life Systems, Inc., and TerraGraphics, Inc. (September 1989).

17. Interim Site Characterization Report for the Bunker Hill Site, U.S. EPA Contract No. 68-01-6939, Woodward-Clyde Consultants and TerraGraphics (August 4, 1986).

18. In the Matter of a Petition by the United States of America to Unseal The File in Yoss v. Bunker Hill Company et al., Civ. No. 77-2030 (D. Idaho, Case No. MS-3505, July 2, 1990).

ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ACM	Asbestos Containing Materials
ALC	Aquatic Life Criteria
AOC	Area Of Contamination
ARARs	Applicability or Relevant and Appropriate Requirements
As	Arsenic
ATSDR	Agency for Toxic Substances and Disease Registry
BDAT	Best Demonstrated Available Technology
BH	Bunker Hill
BHMC	The Bunker Hill Mining Company (U.S.), Inc.
BLP	Bunker Limited Partnership
Cd	Cadmium
CDC	Center for Disease Control
CDFD	Copper Dross Flue Dust
CDFDP	Copper Dross Flue Dust Pile
CDR	Coeur d'Alene River
CERCLA	Comprehensive Environmental Response, Compensation, and Liability
Act	
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIA	Central Impoundment Area
CMCs	Combined Metal Concentrations
CMLs	Combined Metal Loadings
CPFs	Cancer Potency Factors
CTP	Central Treatment Plant
CWA	Clean Water Act
cy	cubic yard
dl	deciliter
DWS	Drinking Water Standards
ELVs	Estimated Limit Values
ERA	Ecological Risk Assessment
FDM	Fugitive Dust Model
FEMA	Federal Emergency Management Act
FR	Federal Register
FS	Feasibility Study
FWQC	Federal Water Quality Criteria
gm	gram
HEPA	High Efficiency Particulate Analyzer
HHRA	Human Health Risk Assessment
HWMA	Hazardous Waste Management Act

IC	Institutional Controls
ICN	Idaho Citizens Network
ICP	Institutional Control Program
IDAPA	Idaho Administrative Procedures Act
IDHW	Idaho Health and Welfare
IDT	Idaho Department of Transportation
LDRs	Land Disposal Restrictions
Lin. ft.	linear feet
MCI	Minerals Corporation of Idaho
MCLs	Maximum Contaminant Levels
MCLGs	Maximum Contaminant Level Goals
MOA	Mine Operations Area
mg/kg	milligram per kilogram
mg/mg	microgram per milligram
m[3]	cubic meter
MTR	Minimum Technology Requirements
NAAQS	National Ambient Air Quality Standard
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NQ	Not Quantified
OSWER	Office of Solid Waste Emergency Response
Pb	Lead
PCBs	Polychlorinated Biphenyls
PHD	Panhandle Health District
ppm	parts per million
PRP	Potentially Responsible People
PWTP	Page Water Treatment Plant
RADER	Risk Assessment Data Evaluation Report
RAO	Remedial Action Objective
RCRA	Resource Conservation Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
ROW	Rights-of-Way
RSFS	Residential Soils Feasibility Study
SAIC	Science Application International Applications
SARA	Superfund Amendment Reauthorization Act
SCR	Site Characterization Report
SDWA	Safe Drinking Water Act
SFCDR	South Fork of Coeur d'Alene River
SPMI	Sunshine Precious Metals, Inc.
sq.ft.	square feet

TCLP	Toxicity Characteristic Leaching Procedure
TLV	Threshold Limit Value
TMDL	Total Maximum Daily Load
TSCA	Toxic Substance Control Act
TWA	Time Weighted Average
UAO	Unilateral Administrative Order
U.S. EPA	United States Environmental Protection Agency
U.S. FWS	United States Fish and Wildlife Services
U.S.C.	United States Code
Zn	Zinc
ZnCl	Zinc Chloride