1.0 INTRODUCTION

This Coeur d'Alene Basin feasibility study (FS) includes three parts. Part 1 is an overview and summary of Part 2, Human Health Alternatives, and Part 3, Ecological Alternatives. The FS is the feasibility study portion of the Coeur d'Alene Basin remedial investigation/feasibility study (RI/FS).

The Coeur d'Alene Basin site has been defined for the RI/FS to include the Coeur d'Alene River and associated tributaries (the "basin," including portions of the river that run through the Bunker Hill Superfund Site [BHSS]), Coeur d'Alene Lake, and the Spokane River downstream to the Washington State Highway 25 bridge at the Fort Spokane Arm of Lake Roosevelt (Figure 1.0-1). Because it is the subject of an existing RI/FS, the BHSS is not part of this RI/FS, although it is part of the NPL facility. The site has been assigned the CERCLA list (CERCLIS) identification number ID048340921.

The RI/FS has been conducted by the U.S. Environmental Protection Agency (EPA), the lead agency for site activities, in response to historic mining practices in the basin that have resulted in contamination, primarily by metals, of various environmental media, including soils, sediments, groundwater, and surface water. These contaminated media either directly or indirectly threaten human health and the environment. The FS develops and evaluates remedial alternatives to protect human health and the environment and achieve compliance with applicable or relevant and appropriate requirements (ARARs).

EPA has conducted the FS in accordance with the Superfund law—the Comprehensive Environmental Response, Compensation, and Liability Act (or CERCLA, as amended). The FS has also been developed following the EPA regulations that carry out the provisions of CERCLA. These regulations, called the National Oil and Hazardous Substances Pollution Contingency Plan (or NCP), are found in the Code of Federal Regulations, Title 40, Part 300.

In developing the FS, EPA has worked with various stakeholders. These include the Coeur d'Alene Tribe, the Idaho Department of Environmental Quality (IDEQ), the Washington Department of Ecology (Ecology), the U.S. Fish and Wildlife Service (USFWS), and other federal, state, tribal, and local agencies.

The structure of the FS reflects how the remedial alternatives have been developed to date. Because of the complexities associated with developing comprehensive remedial alternatives for the site, including inherent differences between human health and ecological exposure pathways, two concurrent efforts have been used. These efforts have resulted in two complementary sets of remedial alternatives:

- **Alternatives to protect human health**—Human health alternatives for residential and community areas in the Coeur d'Alene River Basin were developed for four environmental media: soil (five alternatives), drinking water (six alternatives), house dust (three alternatives), and aquatic food sources (three alternatives). The human health alternatives for each medium were assembled independently of the other media to allow maximum flexibility in future decisionmaking, including integration with the ecological alternatives, as developed in the second effort. The alternatives are presented in FS Part 2, Human Health Alternatives.

- **Alternatives to protect the environment**—Ecological alternatives were developed considering both human health and the environment, but emphasizing the environmental or ecological component. Reflecting a holistic or systems approach, the ecological alternatives were assembled to deal with both "local" site-specific effects and "global" basin-wide effects. Six alternatives were developed for the Coeur d'Alene River Basin, five separate alternatives were developed for selected sites in Washington along the upper Spokane River and two separate alternatives were developed for Coeur d'Alene Lake. These remedial alternatives are presented in Part 3, Ecological Alternatives.

EPA is currently combining and integrating the human health and ecological alternatives into a "preferred alternative" for the Proposed Plan, as discussed in Section 1.2.

The summary and overview of Parts 2 and 3 that is presented in the six sections of this document include:

- Section 1, the purpose and scope of the FS, the FS process as set forth by CERCLA, and a history of mining and cleanup activities in the basin

- Section 2, key characteristics of the site

- Section 3, a summary of human health and ecological risks

- Section 4, remedial action objectives

- Section 5, summary descriptions and comparisons of the remedial alternatives

- Section 6, key technical issues associated with the remedial alternatives

The details and further background associated with the remedial alternatives are found in Parts 2 and 3 of the FS.

1.1 FS PURPOSE AND SCOPE

Under CERCLA, the FS serves as the mechanism to develop and evaluate remedial action alternatives. The FS has been developed following EPA's CERCLA guidance, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final* (USEPA 1988). Under CERCLA, the FS must accomplish the following tasks, which define its scope:

- Integrate and interpret information from the remedial investigation report (RI) (URSG and CH2M HILL 2001a), the human health risk assessment (TerraGraphics and URSG 2001), and the ecological risk assessment (URSG and CH2M HILL 2001b) to determine whether and where remedial actions may be necessary to protect human health and the environment

- Identify applicable or relevant and appropriate requirements (ARARs)

- Propose remedial action objectives (RAOs) and preliminary remediation goals (PRGs)

- Develop remedial action alternatives that are protective of human health and the environment and could achieve the RAOs and PRGs and be ARAR compliant

- Evaluate the alternatives against seven of the nine CERCLA criteria

The seven CERCLA evaluation criteria (USEPA 1988) include overall protection of human health and the environment, compliance with ARARs, long-term and short-term effectiveness, treatment preferences (for reduction of toxicity, mobility, or volume), implementability, and cost. The remaining two CERCLA criteria, state acceptance and community acceptance, are addressed as part of the remedy selection process in the Proposed Plan and Record of Decision (ROD), which are discussed in the following section.

1.2 FS PROCESS

Consistent with EPA's RI/FS guidance (USEPA 1988), the CERCLA FS process was used to develop and evaluate remedial alternatives, as summarized in Figure 1.2-1. After identifying ARARs and developing RAOs and PRGs, remedial technologies were identified, screened, and in some cases eliminated, based on effectiveness, implementability, and relative cost. It may be noted that various differences inherent in the exposure pathways, scales of application, and objectives of the human health alternatives and the ecological alternatives are reflected in the specific differences in the screening of remedial technologies and process options used for the two sets of alternatives. Based on the screening results, remedial alternatives were developed and then analyzed and compared using the seven CERCLA evaluation criteria. Details are presented in Parts 2 and 3 of the FS.

Under CERCLA, the FS develops and evaluates a range of remedial alternatives that provide information needed by risk management decisionmakers to help formulate a Proposed Plan. The Proposed Plan includes a "preferred alternative." Following public and stakeholder review and input on the Proposed Plan, a remedy is selected and documented in a ROD. The selected remedy documented in the ROD then forms the basis for remedial design and subsequent remedy construction, termed remedial action. Since the FS only supports the remedy selection process, it neither recommends nor chooses a preferred alternative nor selects or designs a remedy. The FS process and its relationship to the Proposed Plan and ROD are illustrated in Figure 1.2-1.

The alternatives developed in the FS are not mutually exclusive choices and do not limit the choice of a remedy. A preferred alternative, as developed in the Proposed Plan, or, subsequently, the selected remedy, as developed in the ROD, can combine elements of the various alternatives developed in the FS, refine or modify those elements, or add to them. Although the FS supplies information for helping select a remedy, information supplementing the FS may be incorporated into the remedy selection process at any time.

In the process of developing Parts 2 and 3, early drafts were submitted to regulatory and other stakeholders and the public with the goal of getting their input early and often. Stakeholder and public review and feedback have been incorporated into this final FS and will subsequently be incorporated in the Proposed Plan and the ROD.

1.3 SITE HISTORY

This section presents an overview of the mining activities conducted within the basin. It also summarizes both past and ongoing site investigations and contaminant removals. Figure 1.0-1 shows the greater Coeur d'Alene Basin and identifies specific segments as the upper basin (designated as CSM Units 1 and 2), the lower basin (CSM Unit 3), Coeur d'Alene Lake (CSM

Unit 4), and the Spokane River (CSM Unit 5). "CSM" stands for conceptual site model and denotes the study units that were developed in the early phases of the remedial investigation of the basin (CH2M HILL 1998).

The history of mining activities and mining-related impacts in the basin cannot be completely separated from the activities conducted within the Bunker Hill Superfund Site (BHSS), a 21-square-mile rectangular area adjacent to the South Fork Coeur d'Alene River between Kellogg and the confluence of the North and South Forks. This was the site of some of the most intensive mining and processing operations in the basin. An RI/FS (MFG 1992a, 1992b) and two RODs (USEPA 1991, 1992) for the site were completed by September 1992. Because it is the subject of an existing RI/FS, the BHSS is not part of the study area evaluated in this FS.

1.3.1 History of Mining Activity

Mining within the Coeur d'Alene Basin began more than 100 years ago. The basin has been one of the leading silver, lead, and zinc-producing areas in the world, with production of approximately 1.2 billion ounces of silver, 8 million tons of lead, and 3.2 million tons of zinc (Long 1998). The region surrounding the South Fork has produced over 97 percent of the ore mined in the basin (SAIC 1993). The Bureau of Land Management (BLM) has identified nearly 900 mining or milling-related features in the region surrounding the South Fork (BLM 1999). Table 1.3-1 summarizes the history of milling and tailings disposal practices in the basin.

Mining, milling, and smelting practices have resulted in substantial portions of the basin containing elevated concentrations of hazardous substances. "Hazardous substances" are chemicals that may be hazardous to human health and the environment [Section 101(14) of CERLCA]. Within the FS study area, the elevated concentrations of metals resulted primarily from the discharge or erosion of mill tailings and other mine-generated waste into rivers and streams. The metals considered of principal concern include lead and arsenic for human health and lead, cadmium, and zinc for protection of ecological receptors.

Until 1968, tailings tended to be discharged directly into the South Fork or its tributaries. Most of the tailings were transported downstream, particularly during high flow events, and deposited as lenses of tailings or as tailings/sediment mixtures in the following areas:

- Bed, banks, and floodplain areas of CSM Units 1, 2, and 3
- Lateral lakes in CSM Unit 3
- Coeur d'Alene Lake (CSM Unit 4)
- The Spokane River (CSM Unit 5)

Since 1968, mill tailings have been placed in impoundments or returned to the mines as stope fill. Descriptions of past milling and tailings disposal practices are presented in the literature (Box, Bookstrom, and Kelly 1999; Stratus 2000; Gearheart et al. 1999).

An estimated 62 million tons of tailings were discharged to streams from the beginning of ore processing in 1884 until discharge to streams was discontinued in 1968. The tailings contained an estimated 880,000 tons of lead and more than 720,000 tons of zinc (Long 1998). Table 1.3-2 summarizes the quantities of tailings and metals disposed by various methods.

In addition to tailings, mining activities resulted in the generation of large volumes of waste rock and the discharge of water containing high concentrations of metals from mine openings (adits). The waste rock and adit discharges continue to be sources of metals contamination in the basin. Estimated quantities of mining-related source material, including tailings, tailings-impacted sediments, waste rock, and adit discharges generated by mining activities are summarized in Section 2.5.3.

In addition to tailings, waste rock, and adit discharges, very small particles (particulates) were released to the air from smelting operations conducted within the BHSS between 1917 and 1981, and these too contained high concentrations of metals. The particulates were transported by the wind and were deposited primarily within the BHSS. However, some of the particulates were deposited elsewhere in the basin.

Other processing facilities were constructed in the Bunker Hill area at various times, including an electrolytic zinc plant (1928), three sulfuric acid plants (1954, 1966, and 1970), a phosphoric acid plant (1960), and a fertilizer plant (1965).

In 1973, a fire in a portion of a lead smelter at Bunker Hill severely reduced the smelter's ability to control the metals levels released in air emissions. A significant increase in particulate emissions of lead resulted. Control measures were implemented in 1977 to reduce these emissions.

1.3.2 History of Investigation and Removal Actions

Many investigations have been conducted within the basin and the BHSS by the EPA, mining companies, agency trustees of natural resources, and others to characterize the extent of mining-related contamination and its potential impacts on human health and the environment. A portion of the most highly impacted primary source materials have been contained under CERCLA to reduce health and environmental risks. Termed "removal actions," these activities have taken place primarily in the upper basin. A summary of removal actions conducted in areas outside the

BHSS to protect human health is presented in Table 1.3-3. Additional extensive remedial actions have been conducted within the BHSS in accordance with the RODs for that area.

1.3.2.1 Within the Basin Study Area

1.3.2.1.1 Past and Ongoing Investigations. The Coeur d'Alene Basin RI/FS was developed based on historical data collected by the EPA, U.S. Geological Survey (USGS), the U.S. Fish and Wildlife Service (USFWS), the mining companies, IDEQ, the University of Idaho (U of I), and others. Historical data used in this evaluation were selected from available data sources based on their representativeness to the current conditions of the study area. The RI report (URSG and CH2M HILL 2001a) presents additional information on historical data in Part 1, Section 4.1. The RI report also includes a comprehensive list of site characterization studies performed within the basin in Appendix H.

Beginning in 1997, EPA has collected additional samples of soil, sediment, groundwater, and surface water to support the work of the RI/FS. These investigations are described in Section 2.3.

The BLM has mapped mining-related disturbances in the upper basin and in the lower Coeur d'Alene River floodplain to below Cataldo (BLM 1999). These maps and associated data were used as the basis for identifying mining-related sources in the upper basin. Identification of these sources helped in development of the ecological alternatives.

1.3.2.1.2 Cleanup Actions Taken to Date. Many cleanup actions have been conducted at source areas and at depositional areas throughout the Coeur d'Alene Basin. These actions have occurred from 1989 to the present and have been conducted by several of the mining companies (including Asarco and Hecla), Union Pacific Railroad (UPRR), and by various government agencies. The government agencies that have conducted or sponsored cleanup actions have included the Idaho Department of Environmental Quality (IDEQ), the Idaho Department of Fish and Game (IDFG), the Idaho Transportation Department (ITD), the BLM, the EPA, and the U.S. Forest Service (USFS). Cleanup actions have also been conducted by the Coeur d'Alene Tribe. The mining companies and government agencies have worked in concert on many of these actions. For example, significant cleanup activities have been conducted by the Silver Valley Natural Resource Trustees (SVNRT), a cooperative effort of the State of Idaho (IDEQ) and the mining companies.

Most of the cleanup actions have focused on source areas within Canyon Creek, Ninemile Creek, Moon Creek, Pine Creek, and the South Fork Coeur d'Alene River in the Osburn area. Other minor actions have been conducted in the Upper South Fork watershed and in the lower Coeur d'Alene River and lateral lakes areas. Previous actions conducted to date are detailed by watershed in Tables 1.5-20 through 1.5-26 of the FS Part 3.

Other programs have been initiated to address human health issues. The Lead Health Intervention Program, run by the Panhandle Health District (PHD), provides personal health and hygiene information to help reduce exposure to metals. Services include educational programs, health monitoring programs, yard and home sampling, and nursing follow-up services. Blood lead levels in children have declined by 58 percent in Kellogg (from 10.8 to 4.5 micrograms per deciliter) since the inception of remedial activities within the BHSS in 1989. The program is described in more detail in Section 1.6 of the FS Part 2. In addition, soil posing a health risk has been removed at many public areas, including the Mullan Elementary School (USEPA 2000a).

Numerous studies have been conducted in the basin by federal, state, and local agencies to address concerns about the effects of mining-related metals contamination on human health. These studies, along with the health-related programs currently conducted in the basin, are summarized in Section 3.1.

1.3.2.2 Within the BHSS

The Bunker Hill Superfund Site (BHSS) has already been evaluated through the CERCLA process and is the subject of two existing CERCLA RODs. Additional remedial actions or considerations within the BHSS are not included in the alternatives developed for this FS. The following discussion briefly describes the present status of the BHSS cleanup.

Two RODs were developed for the BHSS, one for populated areas and one for non-populated areas (USEPA 1991, 1992). Remedial actions based on these RODs either have been implemented or are in the process of being implemented at the BHSS. Remedial actions that have been implemented include source removals, surface capping, reconstruction of creeks, demolition of abandoned milling, processing and smelting facilities on site, engineered closures for waste consolidated on site, and revegetation. Almost 4.5 million cubic yards of contaminated material, about half of which was from floodplain areas, has been removed and placed in on-site repositories. The remedial actions that are part of the overall BHSS remedy are summarized in Table 1.1-1 of the FS Part 3.

Five-year reviews of Superfund sites, mandated by CERCLA following signing of the ROD, have been conducted for both the populated and non-populated areas. Generally, the purpose of 5-year reviews is to evaluate whether the selected remedial actions continue to be protective of human health and the environment. Additional information about the 5-year review process is presented in the review reports for the BHSS (USEPA 2000b; TerraGraphics 2000) and in Section 1.1.6 of the FS Part 3.

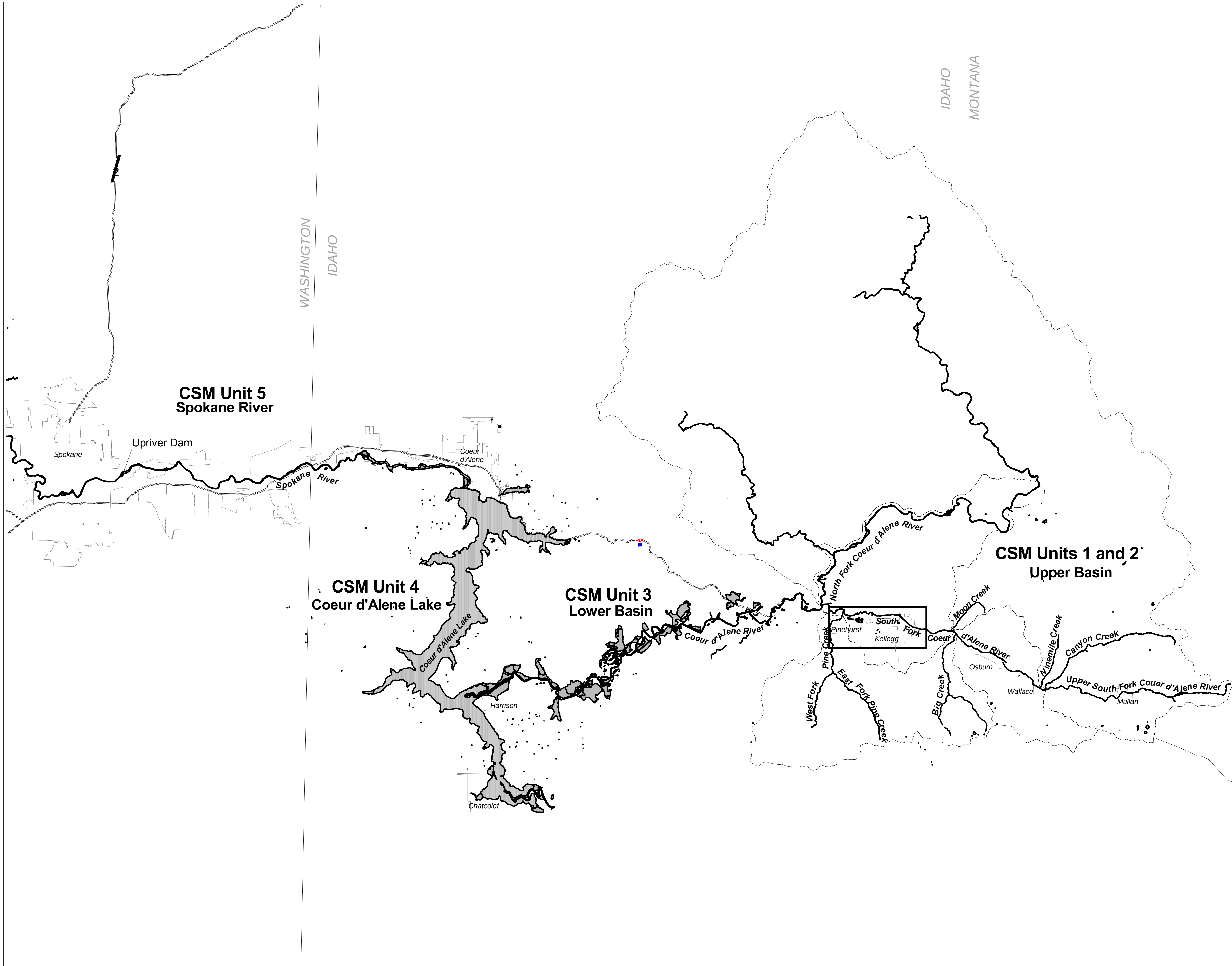
Based on the staged implementation and completion of the BHSS remedial actions, the initial 5-year review was not able to determine the effectiveness of the remedies completed at the BHSS; rather, it is a starting point for ongoing monitoring and evaluation of the overall BHSS remedy. For example, as remedial activities progress and the ability of these activities to achieve water quality improvement objectives for the BHSS becomes clearer, the 5-year reviews will be expanded to include an assessment of the need for further remedial actions. This approach is consistent with the phased implementation strategy presented in the State Superfund Contract discussed below.

In accordance with CERCLA requirements for Superfund remediations led by the federal government, a State Superfund Contract has been agreed to by EPA and the State of Idaho (IDHW 1995). Several documents are appended to the contract that provide a framework for decisionmaking and conducting the BHSS cleanup as well as provide cost-sharing agreements.

One of these documents, the comprehensive cleanup plan, outlines the conceptual approach to implementation of the remedy at the BHSS. The comprehensive cleanup plan defines a two-phase implementation strategy for remediation of the BHSS. These two phases define initial actions followed by reevaluation to confirm that the initial actions meet performance goals. Phase I work includes source removal actions aimed at removing and consolidating extensive contamination from various BHSS areas, demolition of structures, development and implementation of an institutional controls program, guidance for future land use development, and public health response actions. Phase I work also includes support studies for long-term water quality improvement. Phase I was expected to last approximately 8 years (1995 through 2002). The first 5-year review was conducted near the end of Phase I.

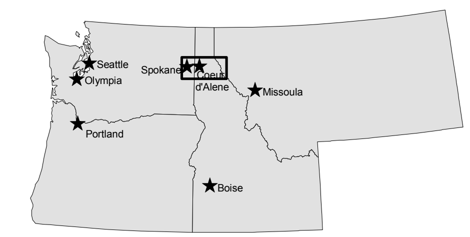
Phase II of the BHSS remedy will be implemented following completion of source control and removal activities and evaluation of the effectiveness of these activities in meeting water quality improvement objectives. This phase will consider any shortcomings encountered in implementing Phase I. It will specifically address long-term water quality, and ecological and environmental management issues.

Figure 1.0-1
Coeur d'Alene Basin RI/FS
Project Location



LEGEND

- Interstate / Highway
- Lakes and Rivers
- City Boundaries
- CSM Boundaries
- Bunker Hill Superfund Site



Location Map

NOTES

1) **Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management**

SCALE 1:440,000

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Coeur d' Alene Basin RI/FS
FINAL FS PART 1

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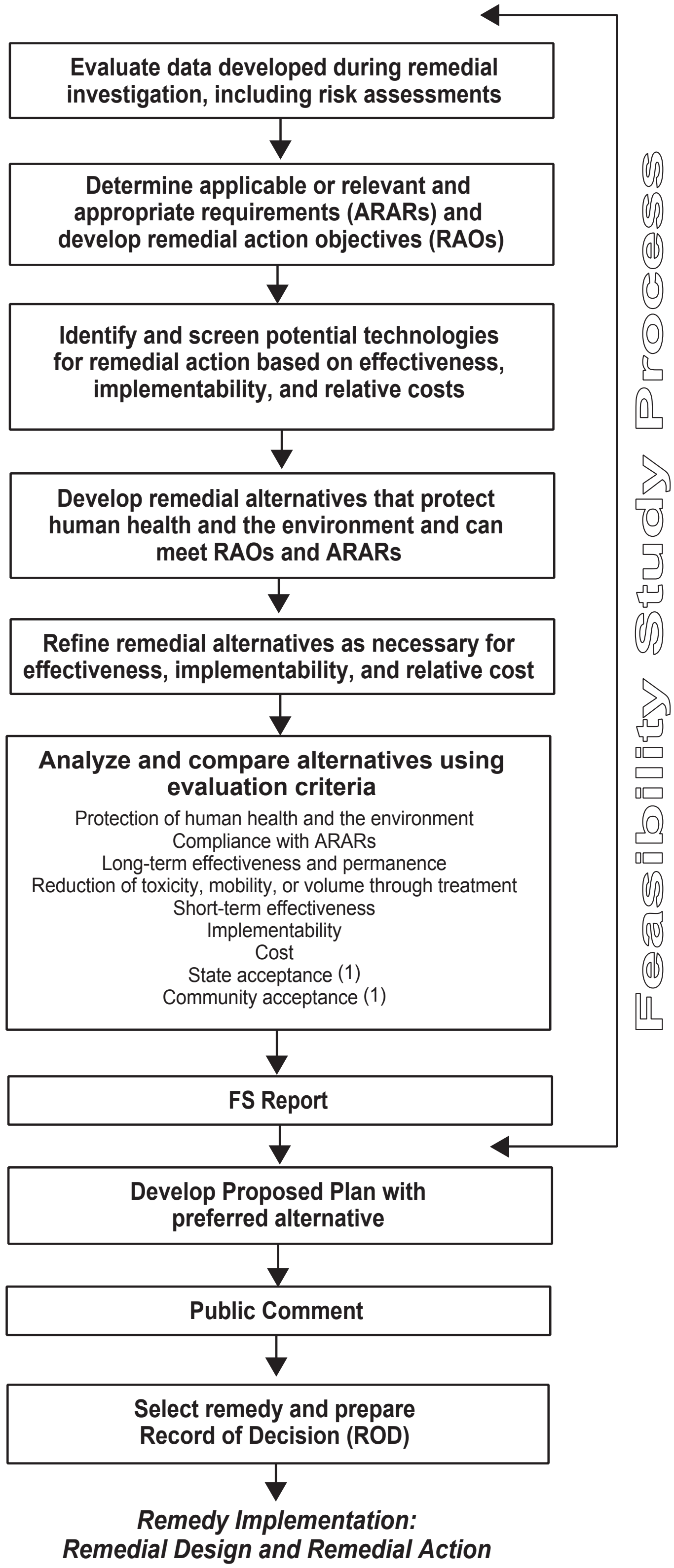
V: watershed bound
E: wa-id
L: Part 1 Fig 1.0-1
09/06/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: September 6, 2001



(1) Discussed in the Proposed Plan and ROD

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Figure 1.2-1
CERCLA Feasibility Study (FS) Process

Table 1.3-1
History of Tailings Disposal Practices in the Coeur d'Alene Basin

Date	Milestone
1886	Processing of ore initiated using jigging.
1891	Six mills operating, with a total capacity of 2,000 tons per day
1901-1904	Construction of plank dams on Canyon Creek near Woodland Park and on the South Fork near Osburn and Pine Creek to control tailings movement. Large volumes of tailings accumulate behind the dams.
1905	Jig tailings from the Morning mill contained about 8% lead and 7% zinc.
1900-1915	Recovery of zinc initiated during this period. Previously, zinc was not recovered, and mills primarily processed low-zinc ores.
1906	Total milling capacity in the basin was 7,000 tons per day
1910	Flotation introduced in the basin at the Morning mill. Increased metals recoveries were achieved using flotation. Flotation tailings were finer grained than jig tailings and were transported greater distances by streams.
1917	Plank dams at Woodland Park, Pine Creek, and Osburn breached by flood waters.
1918	Flotation had been adopted at most mills by this time.
mid-1920s	Tailings observed in the Spokane River.
1925	Flotation tailings from the Morning mill contained <1% each of lead and zinc.
1926-1928	Bunker Hill mills began placing tailings at Page Pond and the present-day location of the Central Impoundment Area.
1932	Dredging operations initiated in Lower Coeur d'Alene below Cataldo. Dredging continued until 1967. Dredge spoils were placed at Mission Flats.
1940-1942	Addition of 12 new mills with a combined capacity of 2,000 tons per day. Total milling capacity in the basin was 12,000 tons per day.
1940s	A portion of the tailings that had accumulated behind the Osburn and Woodland Park plank dams were reprocessed for metals recovery.
Late 1950s	Reuse of tailings as stope fill initiated.
1960s	Start of I-90 construction. Tailings from Mission Flats and Bunker Hill tailings pond used in embankment construction.
1968 to present	All tailings impounded or used as stope fill.

Table 1.3-2
Preliminary Estimate of Mill Tailings Produced in the Coeur d'Alene Mining District

Disposal Method[a]	Dates	Tailings (ton)	Metals Contained in Tailings (ton)		
			Silver	Lead	Zinc
To creeks	1884-1967	61,900,000	2,400	880,000	>720,000
To dumps	1901-1942	14,600,000	400	220,000	>320,000
Mine backfill	1949-1997	18,000,000	200	39,000	22,000
To impoundments	1928-1997	26,200,000	300	109,000	180,000
Total	1884-1997	120,700,000	3,300	1,248,000	>1,242,000

[a]Long (1998) defines dumps as unsecured stockpiles of tailings. Impoundments are secured by dams or other structures. Many impoundments were built over and from older tailings dumps.

Source: Long (1998)

Table 1.3-3
Removal Actions for Protection of Human Health by Year

Actions	1997	1998	1999	2000	Total to Date
Residential yards	7	10	23	21[a]	61
Schools/daycares	1[b]	-	3	2	6
Recreational areas	-	-	4	1	5
Educational signage	-	-	9	-	9
Bottled water	-	-	10	1	11
End of tap water treatment	-	-	4	1	5
Municipal water hookup	-	-	6	-	6
Cubic yards of contaminated soil removed	1,935	1,500	20,000	12,000	35,465
Cost	$149,000	$187,252	$2,274,243	$1,200,000	$3,800,000

[a] 2000 yard tally includes 20 residential properties and 1 trailer park. Also, 2 homes with exterior lead-based paint were pressure-washed prior to removal of the contaminated soil.
[b] Silver Hills Middle School was started in 1997 and completed in 1998 due to extremely large size and coordination with school schedules.

Note:
Removals within the BHSS are not included in this table.