PART 2
DECISION SUMMARY

1.0 SITE LOCATION AND DESCRIPTION

The Bunker Hill Mining and Metallurgical Complex Superfund Facility, located in the Coeur d'Alene Basin, was listed on the National Priorities List (NPL) in 1983. The NPL facility has been assigned CERCLIS identification number IDD048340921. The facility includes mining-contaminated areas in the Coeur d'Alene River corridor, adjacent floodplains, downstream waterbodies, tributaries, and fill areas, as well as the 21-square mile Bunker Hill "Box" located in the area surrounding the historic smelting operations.

The United States Environmental Protection Agency (EPA) has identified three operable units (OUs): the populated areas of the Bunker Hill Box (OU 1); the non-populated areas of the Box (OU 2); and mining-related contamination in the broader Coeur d'Alene Basin (OU 3). This ROD is focused largely on the floodplain and river corridor of OU 3, which is also referred to as the Coeur d'Alene Basin (the Basin) in this ROD.

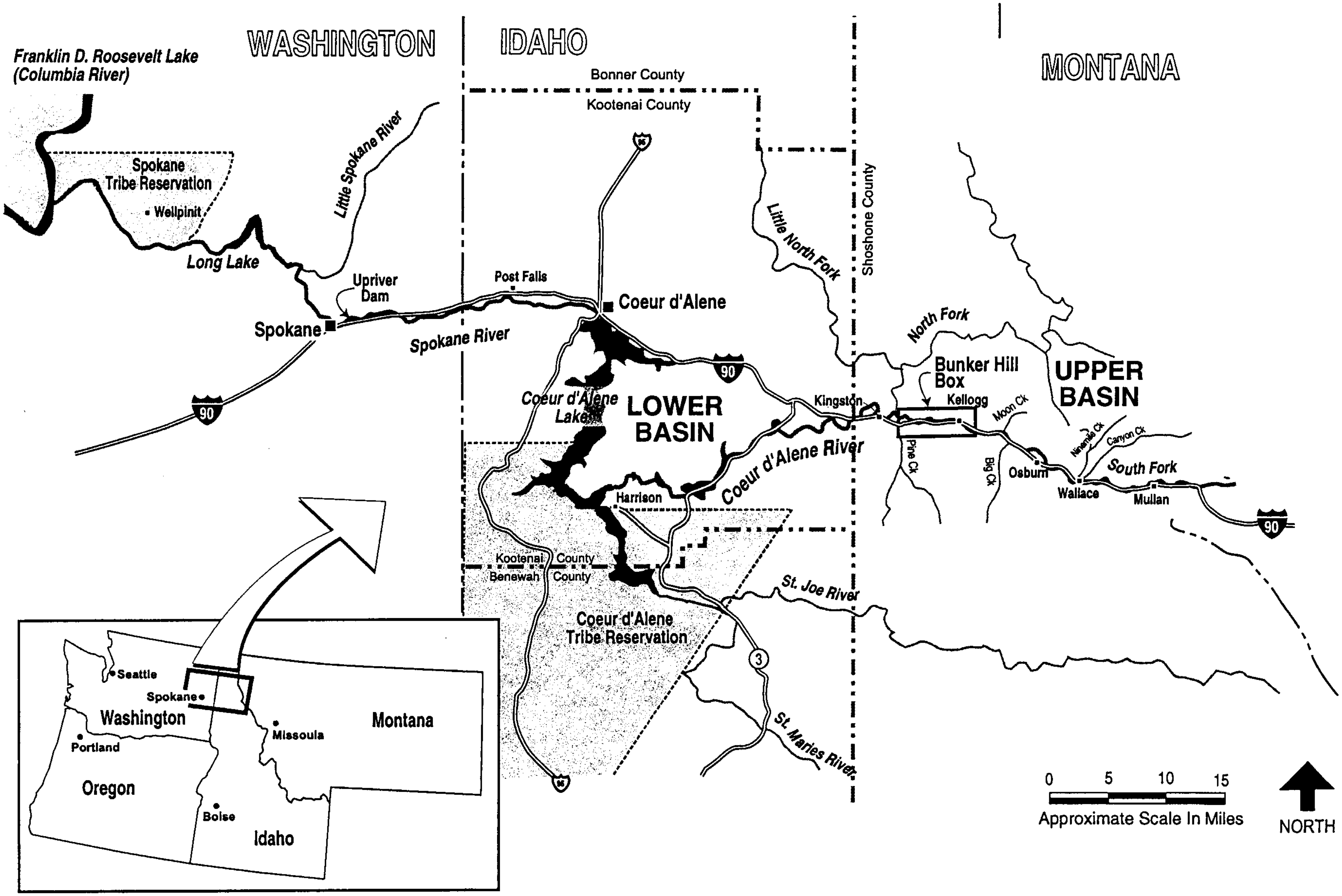
EPA is the lead agency for this decision document. The support agencies for those remedial actions selected within the boundaries of the respective state or tribal jurisdiction are the Idaho Department of Environmental Quality (IDEQ), the State of Washington Department of Ecology and the Coeur d'Alene Tribe. EPA will seek concurrence by the Spokane Tribe of Indians for future remedial actions selected within the boundary of the Spokane Indian Reservation, if any. The Selected Remedy in this decision document was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for the Operable Unit 3.

Within the Basin, historic mining practices, beginning in the late 1880s, have resulted in widespread contamination. This contamination threatens both human health and the environment. The site contaminants are primarily metals, and the metals considered of principal concern include lead and arsenic for protection of human health, and lead, cadmium, and zinc for protection of ecological receptors.

Figure 1.0-1 presents a map of the study area. The study area includes four geographic areas.

- The Upper Basin, the location of former and current mining, milling, and processing activities. (The mining-related waste materials in the Basin were and are released during these activities. The Upper Basin includes the South Fork and the Canyon Creek, Ninemile Creek, Big Creek, Moon Creek, and Pine Creek watersheds.)

- The Lower Basin, which includes the Coeur d'Alene River, adjacent lateral lakes, floodplain, and associated wetlands
- Coeur d'Alene Lake
- Depositional areas of the Spokane River, which flows from Coeur d'Alene Lake



EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RECORD OF DECISION

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Figure 1.0-1
Basin Study Area

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 MINING HISTORY

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 2.1-1 provides an overview of the history of milling and tailings disposal practices in the Basin.

Mining-related activities generated tailings (the part of the ore from which metals cannot be recovered economically, usually 80 to 90 percent of the ore), waste rock (non-ore rock excavated from a mine), concentrates, and smelter emissions. In addition, the water that drains from many abandoned adits contains elevated levels of metals. These are the sources of metals contamination in the Basin.

Until 1968, most tailings were discharged directly into the South Fork or its tributaries. Since 1968, tailings produced have generally been impounded or placed back in the mines. Current mining practices contribute relatively little contamination to the river system compared to the existing contamination resulting from pre-1968 practices. An estimated 62 million tons of tailings were discharged to streams prior to 1968. These tailings contained an estimated 880,000 tons of lead and more than 720,000 tons of zinc. Table 2.1-2 summarizes the quantities of tailings and metals disposed of by various methods.[4]

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 bed, banks, floodplains, and lateral lakes of the Upper Basin and Lower Basin and in Coeur d'Alene Lake. Some fine-grained material washed through the lake and was deposited as sediment within the Spokane River flood channel. The estimated total mass and extent of impacted materials (primarily sediments) exceeds 100 million tons dispersed over thousands of acres.

[4] Minerals are the source of metals (e.g., lead, cadmium, and zinc) released to the environment from historic mining activities. However, although the "mineral form" of these metals may influence their mobility and toxicity (i.e., bioavailability), the metals are hazardous substances under CERCLA. In the context of the CERCLA statute and the NCP regulations that implement CERCLA, "metal" as a hazardous substance generally means "total metals," and does not depend on the mineral it may be associated with.

In addition to transport in water, mining waste accumulated along the railroad lines as a result of spillage of ore and concentrates from railroad cars during transport, was used as fill material for construction of roads, railroads, and structures, and was transported as airborne dust.

2.2 REGULATORY HISTORY

The following is a history of CERCLA-related regulatory actions within the Basin.

- 1983, Bunker Hill Mining and Metallurgical Complex placed on the National Priorities List (NPL).

- 1986, Idaho settles natural resource damages (NRD) claim against the mining companies for $4.5 million.

- 1991, Bunker Hill Mining Company files for Chapter 11 bankruptcy. EPA subsequently resolved its claims against Bunker Hill Mining Company as part of the bankruptcy proceedings.

- 1991, Coeur d'Alene Tribe files a NRD lawsuit against Gulf Resources & Chemical Corporation, Pintlar Corporation, ASARCO, Inc. (ASARCO), Government Gulch Mining Company, Ltd., Federal Mining and Smelting Company, Hecla Mining Company (Hecla), Sunshine Mining Company (Sunshine Mining), Callahan Mining Corporation (Callahan), and Union Pacific Railroad Company (UPRR). That year, the Tribe settled with Callahan (prior to its merger with Coeur d'Alene Mines Corporation).

- July 1992, Bunker Limited Partnership (BLP) files for Chapter 11 bankruptcy. EPA subsequently resolved its claims against BLP as part of the bankruptcy proceedings.

- 1994, Gulf Resources files for Chapter 11 bankruptcy. EPA subsequently resolved its claims against Gulf Resources as part of the bankruptcy proceedings.

- May 1994, EPA and Idaho enter into a consent decree with the Upstream Mining Group (ASARCO, Coeur d'Alene Mines Corporation, Callahan, Hecla, Sunshine Precious Metals, and Sunshine Mining) for remedial work inside the Bunker Hill Box.

- 1995, potential responsible parties (PRPs), including UPRR and Stauffer Chemical, sign consent decree to implement Non-Populated Areas remedial actions, including:
  - Remediation of UPRR right-of-way through the Box (UPRR)
  - Closure of A-4 gypsum pond (Stauffer Chemical)
- March 1996, the Department of Justice (DOJ), on behalf of EPA, U.S. Department of Agriculture, and U.S. Department of the Interior, files a complaint in U.S. District Court for the District of Idaho against the ASARCO, Hecla, Sunshine Mining Company, and Coeur d'Alene Mines Corporation, seeking:
  - Declaration of mining company liability for response costs outside the Bunker Hill Box
  - Payment of natural resource damages inside and outside the Bunker Hill Box
- The case filed by DOJ is consolidated with a pending claim by Coeur d'Alene Tribe.
- September 1997, EPA and ASARCO sign an Administrative Order on Consent (AOC) for an engineering evaluation/cost analysis (EE/CA) to examine use of wetland treatment systems to address mine adit discharge in Canyon Creek.
- 1998, EPA initiates a remedial investigation and feasibility study (RI/FS) for the Coeur d'Alene Basin.
- August 1999, EPA issues a Unilateral Administrative Order for a removal action to address spillage of metal concentrates along the UPRR right-of-way.
- March 2000, EPA, the U.S. Forest Service (USFS), and ASARCO sign an AOC for an EE/CA at the Jack Waite Mine Site in the watershed of the North Fork of Coeur d'Alene River.
- June 2000, 9th Circuit Court of Appeals vacates the decision by U.S. District Court that limited the scope of the NPL facility to the 21-square-mile Bunker Hill Box. The mining companies are given the opportunity, but fail to appeal. The decision confirms that the NPL facility includes all areas of the Coeur d'Alene Basin where mining contamination has come to be located.

- August 2000, U.S. District Court approves the consent decree among Union Pacific, State of Idaho, Coeur d'Alene Tribe, and the United States for the railroad right-of-way. A $30 million settlement will provide for cleanup of mining contamination within the right-of-way and conversion of right-of-way for use as a recreational trail, consistent with the federal Rails-To-Trails Act. The trail will be operated by the State and Tribe, and the cleanup will be maintained in perpetuity by funding from Union Pacific.

- January 2001, U.S. District Court approves the consent decree between Sunshine Mining Company, the United States, and the Coeur d'Alene Tribe.

- May 2001, U.S. District Court approves the Consent Decree between the United States and defendants Coeur and Callahan. Settlement requires payment of $3.8 million plus conduct of removal action on Coeur's property and transfer of the 74-acre parcel.

- Between January and July 2001, the first phase of the trial regarding liability was conducted in district court in Boise, Idaho, with ASARCO and Hecla as principal defendants. The U.S. District Court has not yet ruled on the liability of ASARCO or Hecla.

2.3 PAST REMOVAL ACTIONS IN THE BASIN

Some of the most highly impacted source materials have been contained under CERCLA removal actions, mostly in the Upper Basin, to reduce human health and environmental risks. These removal actions are summarized in this section. In addition, extensive remedial actions have been conducted within the Bunker Hill Box in accordance with the OU 1 and OU 2 RODs. These response actions are described in Section 9.0.

2.3.1 Human Health

Ongoing actions to protect human health have included intervention programs and removal actions. The Lead Health Intervention Program, administered 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.

The strategy for Basin removal actions is consistent with the 1998 clarification (USEPA 1998a) of the 1994 Lead Directive (USEPA 1994a). The response strategy also is consistent with actions taken in the Bunker Hill Box from 1989 through 2001, where intervention and soil cleanup actions have contributed to a 69 percent decline in average blood lead levels among Kellogg children (from 10.8 to 3.4 micrograms per deciliter [μg/dL]). Actions are first targeted at homes where pregnant women reside and homes where families have children 6 years of age and under. Schools, day care facilities, and other common areas typically used by children also are in the first tier of response. Basin removal actions have included both soil removals and treatment of drinking water or municipal hook-up for homes on contaminated private wells.

Basin soil removal actions have been conducted at 91 residential yards, 7 schools and day cares and 6 recreational areas and common-use areas from 1997 through 2001. Drinking water treatment, municipal hook-up, or bottled water have been provided to approximately 28 residences. The residential yard removals represent approximately 10 percent of the estimated total number of yards with lead concentrations greater than 1,000 milligrams per kilogram (mg/kg) in the Basin. In addition, the high-risk yard removals have reduced exposures to a significant percentage of children in the Basin since most of the remediated yards have children in residence. A summary of time-critical removal actions conducted to protect human health is presented in Table 2.3-1.

Union Pacific Railroad is conducting a cleanup within the 72-mile railroad right-of-way for the main line track and related sidings of Union Pacific Railroad's Wallace-Mullan Branch. This line extends from Mullan to Plummer Junction, Idaho. In 1999, UPRR conducted a time-critical removal action to prevent exposures to metal concentrates located within the railroad right-of-way. Current cleanup activities are mandated by a consent decree between the United States, the Coeur d'Alene Tribe, the State of Idaho, and UPRR. This 2000 consent decree followed an extensive engineering evaluation/cost analysis (EE/CA) which was performed under CERCLA removal authority. Considerable soil sampling characterization was performed as part of the EE/CA as well as during implementation of the consent decree. As delineated in the consent decree's statement of work (SOW) and its attachments, the cleanup uses combinations of removals and disposal/consolidation, protective barriers, and institutional controls. The cleanup includes removal of shallow contaminated soil and placement of an asphalt cap over part of the right-of-way for conversion to a recreational trail as part of the federal Rails-To-Trails Act. The trail will be operated by the State of Idaho and Coeur d'Alene Tribe, and the cleanup maintained in perpetuity by UPRR funding.

The UPRR cleanup is not designed, in and of itself, to clean up all portions of the right-of-way. EPA recognizes that additional actions may be warranted in portions of the right-of-way, particularly in floodplain areas that are susceptible to recontamination. As cleanup is implemented under the UPRR cleanup and the Selected Remedy, results may indicate additional actions are warranted within portions of the right-of-way. These actions will be conducted using appropriate regulatory authorities.

2.3.2 Ecological

Many cleanup actions have been conducted at source areas and at depositional areas throughout the Basin. These actions have occurred from 1989 to the present and have been conducted by the mining companies, UPRR, various state and federal agencies, and the Coeur d'Alene Tribe. The mining companies and government agencies have worked in concert on many of these actions. For example, the Silver Valley Natural Resource Trustees (SVNRT), a cooperative effort of the IDEQ and the mining companies, has conducted significant cleanup activities. However, given the extensive contamination present, the bulk of the mining-related wastes that are deposited throughout the river and floodplain still remain.

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. A summary of past cleanup actions for ecological protection is presented in Table 2.3-2.

2.4 SITE INVESTIGATION ACTIVITIES

The first comprehensive study of human health effects outside of the Box was conducted in 1996 by the Idaho Department of Health and Welfare (IDHW) and the Agency for Toxic Substances and Disease Registry (IDHW 2000). The study indicated excessive levels of lead absorption by children. Elevated blood lead levels were associated with lead loading in dust mats and bare soil in outdoor play areas (IDHW 2000). In 1997, EPA collected samples of soil, sediment, groundwater, surface water, and other environmental media (e.g., indoor dust, lead-based paint, garden produce) in the Basin. In 1998, EPA began the RI/FS process. To guide field sampling efforts, a generic field sampling plan and quality assurance project plan were prepared that included descriptions of methods that would be used to collect and analyze samples, conduct field measurements, and manage data (USEPA 1997a). Numerous project-specific sampling plans were developed as field sampling plan addenda (FSPAs) to the base plan (USEPA 1999b, USEPA 1999c, USEPA 1999d). Each FSPA was developed to address specific data gaps identified after reviewing available historical data and results of previous field sampling and analysis efforts. FSPAs were developed in general accordance with EPA's data quality objectives process (USEPA 1994b). Detailed descriptions of the investigations are presented in Section 4.2 of Part 1 of the RI (USEPA 2001b).

More than 10,000 samples were collected to support the remedial investigation. These samples, combined with the 7,000 additional samples collected independently by IDEQ, United States Geological Survey (USGS), United States Fish and Wildlife Service (USFWS), the mining companies, EPA under other regulatory programs (e.g., National Pollution Discharge

Elimination System [NPDES]), and others provide a solid basis to support informed risk management decisions for Coeur d'Alene Basin mining waste contamination. However, the large geographic area of the Basin made it impractical to collect all the data needed to fully characterize each source area or watershed. Further data collection will be necessary to support remedial design for areas identified as requiring cleanup. This may include areas where previous cleanup actions have taken place, such as floodplain areas of the UPRR right-of-way (ROW) or other areas where previous removal actions have addressed some, but not all, contamination present.

A human health risk assessment (HHRA) and an ecological risk assessment (EcoRA) were conducted for the Basin. The HHRA and the EcoRA are described in Sections 7.1 and 7.2, respectively. EPA funded the State of Idaho to be the technical lead for preparation of the HHRA, consistent with EPA lead guidance documents, through a Memorandum of Agreement between EPA and IDEQ (USEPA and IDEQ 1999). The lead risks portion of the HHRA was prepared by IDEQ, with oversight provided by EPA staff and a review board appointed by the governor of Idaho. The non-lead risks portion of the HHRA was prepared by EPA.

Table 2.1-1
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 Pinehurst 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 and Osburn breached by flood waters.
1918	Flotation had been adopted at most mills by this time.
mid-1920s	Tailings observed in 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.
1933	Plank dam near Pinehurst breached by flood waters.
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	Tailings produced during this time have generally been impounded or used as stope fill.

Table 2.1-2
Preliminary Estimate of Mill Tailings Produced in the Coeur d'Alene Mining District

Disposal Method[a]	Dates	Tailings (tons)	Metals Contained in Tailings (tons)		
			Silver	Lead	Zinc
To creeks	1884-1967	61,900,000	2,400	880,000[b]	>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.
[b]Bookstrom, et al. (2001) report that an additional 57,000 ±5,500 tons of lead were contained in slimes lost indirectly to the South Fork.

Source: Long (1998)

Table 2.3-1
Removal Actions for Protection of Human Health By Year
(Not Including the Bunker Hill Box)

Actions	1997	1998	1999	2000	2001	Total through 2001
Residential yards	7	11	23	25[a]	25	91
Schools/day cares	1[b]	-	3	2	1	7
Recreational and common-use areas	-[d]	-	4	1	1	6
Educational signage	-	-	9	-	-	9
Bottled water	-	-	10	1	-	11
Start of end-of-tap water treatment[c]	-	-	4	1	-	5
Municipal water hookup	-	-	6	6	-	12
Cubic yards of contaminated soil removed	1,935	1,500	20,000	12,000	6,400	41,835
Cost	$149,000	$249,000	$2,100,000	$2,300,000	$2,300,000	$6,998,000

[a] 2000 yard tally includes 2 homes with exterior lead-based paint that were pressure-washed prior to removal of 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.
[c] Once started, end-of-tap water treatment has been provided each year and will continue until a more permanent solution (e.g., municipal water hookup) is made available.
[d] In 1997, BLM addressed health concerns at the Killarney Lake Boat Ramp (cleanup was not conducted under removal action authorities).

Table 2.3-2
Past Cleanup Actions for Ecological Protection

Site Name	Responsible Agency/Entity	Dates of Action	Description of Action
Upper South Fork			
Morning Mine No. 6	Hecla	1989 and 2000	Adit drainage directed to subsurface flow, rock-bed filter treatment system. Slaughterhouse Gulch was lined to reduce infiltration through the waste rock pile.
Canyon Creek			
Standard Mammoth Facility	ASARCO	1997-1998	Removal of tailings with disposal at Woodland Park Repository. Regraded, stabilized, capped and revegetated waste rock pile. Removed railroad grade and crossing
Canyon Creek from Tamarack to below Gem	SVNRT	1997-1998	Time-critical removal of ~127,000 cy of tailings and contaminated sediment with disposal at the Woodland Park Repository. Soils at removal areas were amended with organic materials, then revegetated. The stream channel of Canyon Creek was stabilized with bioengineering techniques.
Gem Millsite	SVNRT	2000-present	Pilot system (10 gallons per minute (gpm)) for treatment of drainage from the Gem Portal.
Lower Canyon Creek Floodplain	SVNRT	1997-1998	Time-critical removal of 472,000 cy of tailings and contaminated materials with disposal at the Woodland Park Repository. Soils at removal areas were amended with organic materials, then revegetated. The stream channel of Canyon Creek was stabilized with bioengineering techniques.
Woodland Park Repository	SVNRT	1997-1998	Construction of an unlined repository for disposal/consolidation of removals along Canyon Creek. Repository contains approximately 600,000 cy of contaminated materials. Repository capped with native soils and revegetated.
Ninemile Creek			
Interstate Tailings Removal	Hecla	1992-1993	Removal of tailings adjacent to East Fork Ninemile Creek (EFNMC) with consolidation to a nearby uphill area. Installation of straw bales along perimeter of tailings for erosion control.

Table 2.3-2 (Continued)
Past Cleanup Actions for Ecological Protection

Site Name	Responsible Agency/Entity	Dates of Action	Description of Action
Interstate Millsite	SVNRT, IDEQ, Hecla	1998	Non time-critical removal of ~60,000 cy of tailings, mill debris, and contaminated sediments from the mill site and from EFNMC for 1000 feet downstream. Disposal at an on-site repository. EFNMC stabilized with bioengineering structures in removal areas.
Success Mine/Mill Tailings and Waste Rock	EPA, IDEQ	1993	Time-critical removal action included relocation and riprap armoring for ~1,600 feet of EFNMC channel; relocation of streamside tailings; placement of in-stream structures for energy dissipation; capping of tailings pile with 1-foot thick overburden rock; installation of upgradient groundwater and surface water diversions.
Success Mine Site Passive Treatment	IDEQ	2000-present	Contaminated groundwater diverted by a subsurface grout wall (approximately 1,350 feet in length) to a treatment vault. Groundwater treated using apatite.
East Fork Ninemile Creek Floodplain	IDEQ, Hecla	1994	Time-critical removal of ~50,000 cy of flood plain tailings and contaminated sediments with disposal at the Day Rock Repository. Stream reconstruction, riparian stabilization, and revegetation.
Ninemile Creek Floodplain near Blackcloud	SVNRT	1994	Time-critical removal of ~44,000 cy of flood plain tailings and contaminated sediments with disposal at the Day Rock Repository. Stream reconstruction, riparian stabilization, and revegetation.
Day Rock Repository	SVNRT, IDEQ, Hecla	1994	Approximately 94,000 cy of materials from the floodplain removals were placed on top of the existing Day Rock repository and capped with native soils and growth media.
Moon Creek			
Silver Crescent and Charles Dickens	USFS	1998-2000	Non-time-critical removal of ~130,000 cy of tailings, waste rock, contaminated soils, and mill structures, with disposal at an on-site repository. Closure of four adits. Stream relocation and habitat reconstruction along approximately 3,300 feet of Moon Creek, and 10 acres of riparian revegetation.

Table 2.3-2 (Continued)
Past Cleanup Actions for Ecological Protection

Site Name	Responsible Agency/Entity	Dates of Action	Description of Action
Pine Creek			
Constitution Mine and Millsite	BLM	1998-Present	Non-time-critical removal included removal of contaminated soils around the mill with disposal at the Central Impoundment Area (CIA), and realignment of East Fork Pine Creek (EFPC) away from the toe of the tailings pile. Most of the tailings and waste rock dump are on private land and have not been addressed to date.
Denver Cr.	BLM	1996-2000	Time-critical removal of ~5,200 cy of tailings and contaminated soils. No actions have been conducted on the private portion of the pile. Stream channel stabilization.
Douglas Mine and Millsite	EPA	1996-1997	Time-critical removal of two existing tailings impoundments from the flood plain of the EFPC. 25,000 cy of contaminated materials were removed and placed into a temporary repository constructed east of Pine Creek Rd. near the mine.
Highland Creek Floodplain	BLM	1999	Time-critical removal of 8,100 cy major discrete tailings deposits along Highland Creek on public lands.
Highland-Surprise	BLM	1999	Diversion of Highland Cr. to reduce erosion of the lower waste rock dump. Most of the facilities at this site are on private land, thus no other actions have been taken to date.
Sidney (Red Cloud)	BLM	1998-2000	Non-time-critical removal of contaminated soils around the mill foundations with disposal at the CIA; run-on and run-off controls; and improvements to the upstream culvert on Red Cloud Creek to control flow through the site and reduce downstream erosion. Passive treatment of adit drainage with inflow prevention at the Sidney Shaft in Denver Creek. Rock dump regraded and hydroseeded in 2000 to minimize erosion.
Amy-Matchless Millsite	BLM	1996-2000	Time-critical removal of ~9,600 cy of tailings and contaminated soils in 1996 and 1997. In 1998, a non-time-critical removal action removed an additional 420 cy of residual tailings. Disturbed area covered with soil and revegetated. Mine adit was closed by backfilling. Waste rock dump regraded and revegetated.
Liberal King	BLM	1996-2000	Time-critical removal of ~9,400 cy of tailings and contaminated soils in 1998, 99 cy of millsite tailings and mill wastes were removed from the mill area. In 1999, non time-critical removal of an additional 1,800 cy of tailings, regrading backfill of a dry adit, import of growth medium, and revegetation. The 2000 actions included extensive grading and planting of riparian vegetation.

Table 2.3-2 (Continued)
Past Cleanup Actions for Ecological Protection

Site Name	Responsible Agency/Entity	Dates of Action	Description of Action
Nabob	BLM	1994-2000	Soil cover over the tailings pile and a portion of mill area; fence to limit access to the millsite and tailings; channel improvements along Nabob Creek stabilize the channel and prevent erosion of the tailings pile embankment.
South Fork			
South Fork Floodplain Removals	SVNRT	1998	Non-time-critical removals at several areas in the floodplain totaling about 128,000 cy of tailings and contaminated soils.
South Fork above Elizabeth Park	SVNRT	1995	Tailings removal and construction of an armored levee with rock grade-control structures to stabilize bank.
Moon Creek at Mouth (Elk Creek Pond)	SVNRT; USACE, EPA	1994; 2000	Limited tailings removal in 1994. Clean sand was imported for a recreational beach at this swimming hole. Time-critical removal of 28,000 cy of contaminated sediments and tailings in 2000.
Lower Coeur d'Alene River			
Cataldo Mission	CDA Tribe	1995	Removal of ~700 cy of tailings and contaminated soils from traditional campground areas in the vicinity of the Cataldo Mission.
Cataldo Boat Ramp	IDEQ	1996-1997	Placement of cabled log bank protection and brush wattling to reduce erosion and planting of bushes in the vicinity of contaminated soils to discourage human contact with the soils.
Dudley	SVNRT	1999	Pilot bank erosion project to evaluate effectiveness of rock berms in reducing bank erosion cased by piping, or undercutting by boat wake. The project included minor bank regrading and shaping along 750 feet of a straight portion of the river channel near Dudley, with installation of riprap channel bank armoring and rock berms along the overbank.
Medimont	IDEQ/Soils Conservation Service	1994	Placement of four types of bank erosion control: two with hay bales, two with riprap. Subsequent monitoring indicated that the hay-bale methods were not effective in this portion of the river.

Source: Compiled from Tables 1.5-20 through 1.5-26 of the Final Feasibility Study (USEPA 2001c).

3.0 COMMUNITY PARTICIPATION

Throughout EPA's RI/FS activities leading up to this ROD, extensive efforts have been made to inform and involve the public. EPA conducted the activities summarized in this section because the agency believes that community involvement is a key element in developing a successful cleanup plan.

In addition to the many activities discussed below, EPA has complied with the specific requirements for public participation under CERCLA by publishing a Proposed Plan for public comment in October, 2001. The Proposed Plan public comment period ran from October 29, 2001 to February 26, 2002. During the comment period, EPA held four public meetings. Complete transcripts of these public meetings are included in the Administrative Record and are available for public review in local information repositories. A Notice of Availability summarizing the Preferred Alternative was mailed to approximately 1,000 Basin residents. EPA also published newspaper advertisements in the *Coeur d'Alene Press*, the Idaho and Washington editions of the *Spokesman Review*, the *Shoshone News Press*, and the *St. Maries Gazette* announcing the availability of the Proposed Plan, the comment period and the public meetings. The advertisements also briefly described the Preferred Alternative.

EPA released a draft Community Involvement Plan (CIP) for public review in October 1998 and finalized the plan in early 1999. It described how EPA would share information about its activities and how people could become involved and provide input as the cleanup plan was being developed. In response to input from people in the Basin, EPA enhanced its community involvement efforts by adding more information sharing and public input opportunities than originally described in the CIP. A summary of EPA's community involvement activities is provided below.

Community Liaison. In early 1999, EPA hired a full-time community liaison based in Coeur d'Alene. The liaison is an on-scene resource who answers questions, acts as a conduit of information from the community back to EPA staff and managers in Seattle, WA, makes presentations to local organizations about EPA's work in the Basin and provides staff support to the Citizens' Advisory Committee (CAC) RI/FS Task Force.

Comment Periods. Rather than having one public comment period when the Proposed Plan was released, EPA provided four additional public comment periods on drafts of four documents prior to the release of the Proposed Plan. The four documents were the draft HHRA, the draft EcoRA, the draft RI and the draft FS. The comment period for each of these documents was extended beyond 30 days upon request and EPA provided a written response to comments on each of these documents. To make these documents easier for people to understand, EPA also prepared executive summaries for each of these documents.

Progress Report. In April 2001, the governments involved in developing the Basin cleanup plan distributed a progress report that was intended to give the public a sense of the priorities and cleanup approaches that were likely to be included in the Proposed Plan. EPA conducted four public meetings to update the public at the time the progress report was released.

Fact Sheets. During the RI/FS, EPA sent 10 fact sheets that announced major project milestones to a mailing list of approximately 1,000 people. In addition, two fact sheets were included as newspaper inserts in the *Coeur d'Alene Press* and *Shoshone News Press*. EPA also produced and mailed a Notice of Availability that summarized the Preferred Alternative in the Proposed Plan and provided information on the public meetings.

NewsBriefs. Beginning in fall 2000, EPA produced and either mailed or e-mailed 35 monthly *"NewsBriefs"* to more than 200 people each. *NewsBriefs* is now being sent to a longer mailing list of about 1,000 people. *NewsBriefs* provides updates from EPA and the many other state, tribal, and local agencies doing work in the Basin. It also provides a calendar of events for upcoming agency and community group meetings related to the Basin cleanup activities, and lists documents recently added to information repositories.

Briefing Sheets. EPA provided eight "briefing sheets" which described environmental sampling events in the Basin and the results of the sampling.

Resource manual. EPA provided about 100 resource manuals to citizen advisory group members and local elected officials to help them understand the various elements of the cleanup process and keep track of the written material they received from EPA.

Public Meetings, Workshops, Briefings with Elected Officials, and Meetings with Local Organizations. EPA hosted or participated in more than 200 meetings with the general public, elected officials, citizen groups, or community organizations since early 1999 (66 in 1999, 63 in 2000, 55 in 2001, and 15 so far in 2002). These include:

- 16 general public meetings or workshops, including three educational workshops on the HHRA, EcoRA, and FS; and four workshops to preview the Proposed Plan nearly three months prior to its release, in addition to the four formal public meetings on the Proposed Plan
- 41 meetings with local elected officials and congressional staff
- 24 meetings with the CAC RI/FS Task Force and/or the CAC "core" membership
- 16 meetings with the Washington CAC

- EPA's Regional Administrator or EPA officials from Washington D.C. visited the Basin 8 times and participated in 23 separate meetings

RI/FS Task Force. EPA supported the formation of the CAC's RI/FS Task Force and provided staff support to this group for more than two years. This group assisted EPA in making sure people in the Basin were well informed and knew how and when to get involved. The group also provided valuable input during the RI/FS and development of the Proposed Plan.

Washington CAC. EPA worked with the Washington CAC in its effort to provide input on the testing of Spokane River beaches and other elements of the RI/FS and Proposed Plan process.

State of Idaho's Consensus Building Process. EPA participated in and supported the State of Idaho's Consensus Building Process. This intensive six-month process brought diverse interests together to develop a range of common-ground recommendations on the priority areas for cleanup in the Basin.

Information Repositories. EPA established five information repositories in Basin communities where citizens can review detailed information about the cleanup work. The information at the repositories includes documents available for public review and comment and many other technical documents. The repositories were frequently advertised in fact sheets and newspaper notices as well as in *NewsBriefs.*

Basin Website. EPA has maintained a website for the Basin project that allows people to access technical documents, fact sheets, *NewsBriefs,* newspaper clippings and other resources directly from their computers.

Cooperative Agreements. EPA provided more than $100,000 in grant money via two separate cooperative agreements to counties and cities in the Basin. The grants were intended to allow the communities in the Upper Basin and Lower Basin to hire technical experts to help them provide input throughout the RI/FS process.

In addition to the above activities coordinated by EPA's Regional Office in Seattle, WA, during 2001, EPA's Community Involvement and Outreach Center in Washington D.C. hired a contractor to conduct public surveys at several Superfund sites around the country. The Coeur d'Alene Basin was one of the sites chosen to survey. The surveys were intended to gauge the effectiveness of EPA's community involvement programs. Approximately 1,800 Basin residents received the survey and 27 percent of those people returned the survey.

4.0 SCOPE AND ROLE OF THE SELECTED REMEDY

This section describes the scope and role of this Selected Remedy in relation to the overall site cleanup strategy. Section 4.1 describes the relationship of the Coeur d'Alene Basin (OU 3) to the Bunker Hill Box (OUs 1 and 2) and provides a description of each of the three OUs. Section 4.2 describes the relationship of the Selected Remedy to the long-term cleanup needs.

4.1 DESCRIPTIONS OF OPERABLE UNITS

EPA has identified three operable units in the Basin: the populated areas of the Bunker Hill Box (OU 1); the non-populated areas of the Box (OU 2); and mining-related contamination in the broader Coeur d'Alene Basin (OU 3). This ROD is focused on OU 3. Descriptions of the three operable units are provided in this section.

RODs have been signed in 1991 and 1992. The 1991 ROD addressed the residential soils component of OU 1. The 1992 ROD addressed OU 2 and the remaining components of OU 1. In November 2001, an amendment to the OU 2 ROD was signed to address the long-term management of acid mine drainage (AMD) from the Bunker Hill mine. In 1998, EPA initiated an RI/FS for OU 3. A Proposed Plan for OU 3 was released for public comment in October 2001 (USEPA 2001e).

4.1.1 Operable Unit 1 (Populated Areas of the Bunker Hill Box)

The populated areas operable unit of the Bunker Hill Box (OU 1) includes residential and commercial properties, ROWs, and public use areas in the towns of Kellogg, Wardner, Smelterville, Pinehurst, and several smaller unincorporated communities. Cleanup activities began in OU 1 as this was the area of greatest concern for human health exposure. In 1985, a Lead Health Intervention Program (LHIP) was initiated by the Centers for Disease Control and Prevention (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR) to minimize blood lead levels in children through health education, parental awareness, and biological monitoring. This ongoing program is administered by the Panhandle Health District in conjunction with the Idaho Department of Health and Welfare (IDHW).

In 1986, 16 public properties (including city parks and school playgrounds) were cleaned up as part of a CERCLA time-critical removal action. The yard soil removal program was initiated in 1989 as a CERCLA time-critical removal action to replace contaminated soils in yards of young children at highest risk of lead poisoning. Since 1994, the yard soil removal program has been implemented by the PRPs pursuant to the 1991 and 1992 RODs and 1994 Consent Decree. The PRPs are scheduled to remediate at least 200 residential yards each year until all yards, commercial properties, and ROWs with contaminated soils containing greater than or equal to 1,000 mg/kg of lead have been remediated to achieve a community-wide geometric mean of 350 mg/kg lead.

Remediating at least 200 residential yards each year is important because the pace of remediation affects the potential for remediated parcels to be recontaminated by soil and dust from parcels that have not been remediated.

House dust, long recognized as a primary source of lead exposure among children, is being monitored through the LHIP. Should house dust lead levels remain elevated following completion of yard soil remediation, homes with dust lead concentrations greater that 1,000 mg/kg will be evaluated for interior remediation. EPA, the State of Idaho, and the U.S. Army Corps of Engineers are conducting a House Dust Pilot Study. The purpose of the study is to evaluate three methods of cleaning homes to determine the most effective method for reducing contaminated dust in homes. Eighteen homes in Smelterville were cleaned and sampled in 2000 and 2001. The analysis of the study results is ongoing. If cleanup of home interiors is deemed necessary after completion of remediation, the results from the study will be considered when selecting the most effective cleaning method and to estimate cleaning costs (IDEQ 2001).

A five-year review of OU 1 was completed in 2000, which further describes OU 1 cleanup activities.

4.1.2 Operable Unit 2 (Non-Populated Areas of the Bunker Hill Box)

The non-populated areas operable unit of the BHSS (OU 2) includes the former industrial complex and mine operations area, river floodplain, hillsides, various creeks and gulches, surface water and groundwater, the Central Impoundment Area (CIA), and the Bunker Hill Mine and associated acid mine drainage (AMD). Site PRPs performed various removal activities pursuant to several orders prior to the 1992 ROD, including smelter stabilization efforts from 1989 to 1993, and hillsides revegetation and fugitive dust control efforts from 1990 to 1992.

Following completion of the ROD in 1992, PRPs signed a consent decree with EPA to perform cleanup activities in limited areas of OU 2, including the UPRR ROW, and the A-4 gypsum pond. In 1995, EPA and the State of Idaho entered into a State Superfund Contract to perform the remaining site remedial actions. Cleanup actions addressed in the ROD included a series of source removals, surface capping, reconstruction of surface water creeks, demolition of abandoned milling and processing facilities, engineered closures for waste consolidated on site, revegetation efforts, and surface water and groundwater controls in the Bunker Hill Box and treatment in a constructed wetlands treatment system.

There have been two ROD amendments (September 1996 and November 2001) and two Explanation of Significant Differences (January 1996 and April 1998) since the ROD was completed in 1992. A five-year review of OU 2 was completed in 2000. The review document further describes OU 2 cleanup activities.

In the 1995 Bunker Hill State Superfund Contract, EPA and the State of Idaho agreed to a two-phased site implementation strategy. Phase I largely addresses source removals aimed at consolidating extensive contamination from various areas of the site. Phase I cleanup activities were mostly complete in 2001. Phase II will address site surface water and groundwater cleanup and 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.

OU 2 also includes the Bunker Hill Mine and associated AMD. The AMD contains very large loads of metals. The existing central treatment plant (CTP) has not been significantly upgraded since it was built in 1974, is not capable of consistently meeting current water quality standards, and requires repair and replacement to prevent equipment failure.

The 1992 non-populated areas ROD did not select response actions for the mine water. The ROD, therefore, did not address control of AMD from the Bunker Hill Mine or operation of the CTP in any significant way. The ROD briefly addressed the mine water by requiring that it continue to be treated in the CTP prior to discharge to a wetlands treatment system for removal of residual metals. During studies conducted between 1994 and 1996 by the United States Bureau of Mines, the wetlands treatment system was found to be incapable of meeting the treatment levels established in the ROD. The 1992 ROD did not contain or otherwise identify any plans for the control or long-term management of the mine water flows. The ROD also did not address the long-term management of treatment residuals (sludge) from the CTP, which are currently pumped into an unlined pond on the CIA. At current disposal rates it is estimated that the pond will be filled in 3 to 5 years.

Additional remedies for the Bunker Hill AMD were selected in the November 2001 amendment to the OU 2 ROD. These remedies include:

- AMD source control to reduce the quantity of surface water entering the mine and AMD generated within the mine

- Temporary AMD storage in an existing lined surface pond located at the CTP or within the mine (for times when the treatment plant is shut down for maintenance or repairs or when the mine water flow exceeds treatment capacity)

- AMD treatment in an upgraded treatment plant
- Management of treatment residuals (sludge)

4.1.3 Operable Unit 3 (Coeur d'Alene Basin)

At the time the 1992 non-populated areas ROD was written, it was widely recognized that mining-related contamination in the Basin was not limited to the areas within the Bunker Hill Box. Actions selected in the ROD did not address sources of contamination outside of the Box. To address contamination and water quality issues in the broader Coeur d'Alene Basin, EPA, the State of Idaho, the Coeur d'Alene Tribe, and other federal, state and local agencies formed the Coeur d'Alene Basin Restoration Project. The purpose of this project was to integrate water quality improvement programs in the Basin through coordination of the federal regulatory authorities under the Clean Water Act, CERCLA, RCRA, and other state, local, and tribal programs. However, the Coeur d'Alene Basin Restoration Project had limited success as a systematic approach to addressing contamination in the Basin.

The first comprehensive study of human health effects outside of the Box was conducted in 1996 by the IDHW and the ATSDR (IDHW 2000a). The study indicated excessive levels of lead absorption by children.

In September 1996, the United States District Court for the Western District of Washington ordered EPA and the State of Idaho to develop a schedule for completion of total maximum daily loads (TMDLs) for all water-quality impaired streams identified by the state, including the Coeur d'Alene River Basin. TMDL development was initiated in 1998. In August 2000, a TMDL for dissolved cadmium, lead, and zinc in surface waters of the Basin was jointly released by EPA and the State of Idaho.[5] The TMDL establishes waste load allocations for discrete point sources and load allocations for non-discrete sources. It has long been recognized that non-discrete sources are the primary sources of metals in surface water in the Basin. The CERCLA remedial process was identified as the most effective tool to address these non-discrete sources.

Because of the presence of environmental and human health impacts in areas outside of the Box and the limitations of the existing authorities to deal with these impacts, EPA initiated a RI/FS for the Coeur d'Alene Basin in 1998. The final EcoRA was released in May 2001, and the final HHRA was released in July 2001. In October 2001, the final RI and FS were released. Also in October 2001, the Proposed Plan was released for public comment. The public comment period ended on February 26, 2002.

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[5] On September 4, 2001, a district court judge for the State of Idaho invalidated the TMDL on the procedural grounds that the IDEQ had not engaged in formal rulemaking when adopting the Basin TMDL. The impact of this court decision on TMDL implementation is currently unclear, and the final status of the TMDL has not yet been determined.

The Selected Remedy for OU 3 includes remedial actions for 1) protection of human health in the communities and residential areas, including identified recreational areas, of the Basin upstream of Coeur d'Alene Lake (the Upper Basin and Lower Basin), 2) protection of the environment in the Upper Basin and Lower Basin, and 3) protection of human health and the environment in areas of the Spokane River. At present, the risks to persons, including Spokane tribal members, and others who may practice a subsistence lifestyle in the Spokane River area have not been quantified. EPA and the Spokane Tribe are cooperating in planning additional testing and studies that will be implemented to evaluate the potential exposures to subsistence users. The results of those tests and studies will determine appropriate future response actions to be taken, if any.

The Selected Remedy includes a complete remedy for protection of human health in the communities and residential areas, including identified recreational areas, of the Upper Basin and Lower Basin. Certain potential exposures outside of the communities and residential areas of the Upper Basin and Lower Basin are not addressed by this ROD, and will continue to present risks of human exposure to hazardous substances. These potential exposures impacting human health include:

- Recreational use at areas in the Upper Basin and Lower Basin where cleanup actions are not implemented pursuant to this ROD
- Subsistence lifestyles, such as those traditional to the Coeur d'Alene and Spokane Tribes
- Potential future use of groundwater that is presently contaminated with metals.

For environmental protection, the Selected Remedy identifies approximately 30 years of prioritized actions in areas of the Basin upstream of Coeur d'Alene Lake. During this period, EPA will evaluate the effectiveness and protectiveness of these remedial actions as well as the technical practicability of attaining applicable or relevant and appropriate requirements (ARARs), in particular ambient water quality standards for lead, zinc, and cadmium. During the five-year review process and at the end of this approximately 30-year period, EPA will evaluate and decide whether any additional remedial actions are necessary to attain ARARs or to provide for the protection of human health and the environment, and whether any ARAR waivers should be applied.

EPA expressly recognizes that after the selected remedial actions are implemented, conditions in the Upper and Lower Basin may differ substantially from EPA's current forecast of those future conditions, which is solely based on present knowledge. The tremendous amount of additional knowledge that will be gained by the end of this period through long-term monitoring and five-year review processes may provide bases for future ARAR waivers. In addition, this new information and advances in science and technology may allow for additional actions to achieve ARARs and protect human health and the environment in a more cost-effective manner.

The Selected Remedy does not include remedial actions for Coeur d'Alene Lake. State, tribal, federal, and local governments are currently in the process of implementing a lake management plan outside of the Superfund process using separate regulatory authorities.

For the Spokane River, the Selected Remedy includes a complete remedy for protection of human health upstream of Upriver Dam and a complete remedy for protection of the environment between Upriver Dam and the Washington/Idaho border.

4.2 SITE CLEANUP STRATEGY

The remedy for OU 3 selected in this ROD is consistent with the overall cleanup strategy for the Basin. Cleanup activities began in OU 1, the area of the most imminent public health threats. The second priority for cleanup was OU 2. Cleanup activities in OU 2 are being implemented in two phases. Phase I addresses consolidating extensive contamination from various areas of the site. Phase II will address site surface water and groundwater cleanup.

This ROD extends the cleanup into the broader Basin (OU 3) and selects priority cleanup actions that will take approximately 30 years to implement. EPA recognizes that the State of Idaho has not concurred in the selection of any remedial action beyond those selected in this ROD. Furthermore, after implementation of the remedies selected by this ROD, EPA commits not to take or select any additional remedial actions in the Upper Basin or Lower Basin without first consulting with the State of Idaho. EPA will continue to work with the regulatory stakeholder group, which was instrumental in developing the actions selected in this ROD.

State legislation under the Basin Environmental Improvement Act established the process for the formation of the Basin Environmental Improvement Project Commission. The Commission includes federal, state, tribal, and local governmental involvement. EPA anticipates working as a member of the Commission. Actions selected in this ROD will be integrated with those selected in the Box to effectively clean up the Coeur d'Alene Basin.

5.0 SITE CHARACTERISTICS

This section describes the geography, topography, and nature and extent of contamination in the Coeur d'Alene Basin.

5.1 GEOGRAPHY AND TOPOGRAPHY

The Coeur d'Alene Basin RI/FS study area includes the Coeur d'Alene River Basin, Coeur d'Alene Lake, and the Spokane River. The contamination is mostly limited to floodplain areas, discrete mine and mill sites, and fill areas.

Based on the results of the RI (USEPA 2001b), the HHRA (IDHW 2001a), and the EcoRA (USEPA 2001a), the FS study area focused on the areas with the greatest human health and ecological risks. The study areas for development of human health and ecological alternatives are organized differently and are defined in the following sections.

5.1.1 Geographical Organization of the Human Health Alternatives

For development of the human health alternatives, eight major areas were identified based on projected human exposure scenarios and public use patterns. These specific areas are defined in the HHRA. For the purposes of this ROD, these areas have been consolidated into two principal geographic areas where the selected human health remedy will be implemented: the Upper Basin and the Lower Basin.

The Upper Basin generally includes mining-contaminated areas within the South Fork of the Coeur d'Alene River and its tributaries east of Cataldo.

The Lower Basin includes all of the Coeur d'Alene River west of Cataldo to Harrison, at the mouth of Lake Coeur d'Alene.

5.1.2 Geographical Organization of the Ecological Alternatives for the Upper Basin and Lower Basin

For development of ecological alternatives, two areas of the Basin upstream of Coeur d'Alene Lake were identified based on geomorphology, habitats, types of waste sources, mechanisms of release and transport of waste, and the natural resources affected by the release of wastes: the Upper Basin and the Lower Basin.

The Upper Basin encompasses the steep mountain canyons of the South Fork and its tributary gulches. The Upper Basin is the source area for most of the mining-related waste materials and includes the Canyon Creek, Ninemile Creek, Big Creek, Moon Creek, and Pine Creek tributary watersheds. The Upper Basin drains an area of 300 square miles. The channel and riparian zone of the South Fork and certain of its tributaries have undergone extensive channelization and other alterations as a result of mining-related activities and other anthropogenic activities, including the construction of the I-90 freeway.

The Lower Basin includes the lower Coeur d'Alene River, the lateral lakes, and extensive floodplain wetlands. Below Cataldo, the river flows into a broad, flat valley and takes on a meandering, depositional character with a fine sediment bottom. From Rose Lake downstream, the river surface elevation is controlled by Post Falls Dam on the Spokane River near the outlet from Coeur d'Alene Lake. Much of the tailings released to streams in the Upper Basin were transported to and deposited within the river channel and floodplains in the Lower Basin, largely during flood events.

For the purposes of the RI/FS, the Upper Basin and Lower Basin were further subdivided into one or more segments based on geomorphology, habitats, types of waste sources, mechanisms of release and transport of waste, and the natural resources affected by the release of wastes. Individual mining-related source areas in the Upper Basin were also identified based on mapping conducted by the BLM.

5.1.3 Coeur d'Alene Lake

Coeur d'Alene Lake encompasses 49.8 square miles at its normal full-pool elevation (2,128 feet above sea level), with a maximum water depth of 209 feet. The 2,128-feet elevation is the level defined by Avista's FERC license as the maximum permitted lake level. Its principal tributaries are the St. Joe's River and the Coeur d'Alene River. The lake has a drainage area of 3,741 square miles. The discharge from the lake forms the Spokane River. Coeur d'Alene Lake is a natural lake, but its elevation is controlled by the Post Falls Dam. The lake is classified as oligotrophic. A large volume of metals-contaminated sediment has been deposited on the lake bottom.

5.1.4 Spokane River

The Spokane River flows from Coeur d'Alene Lake and is dammed at six locations above its terminus at Lake Roosevelt. The river bed primarily consists of coarse gravel and cobbles, and the floodplain and riparian zone are relatively narrow. Metals contamination is present in depositional areas within the river's floodway. Priority depositional areas have been identified by the Washington Department of Ecology between the Washington-Idaho state line and Upriver Dam for environmental protection and upstream of Upriver Dam to the lake for human health protection.

At present, the risks to persons, including Spokane tribal members, and others who may practice a subsistence lifestyle in the Spokane River area have not been quantified. EPA and the Spokane Tribe are cooperating in planning additional testing and studies that will be implemented to evaluate the potential exposures to subsistence users. The results of those tests and studies will determine appropriate future response actions to be taken, if any.

5.2 NATURE AND EXTENT OF CONTAMINATION

Metals related to mining, milling, and smelting activities are present in soil, sediment, surface water, groundwater, and vegetation in the Basin. Sections 5.2.1 through 5.2.4 describe the nature and extent of contamination in the community and residential areas of the Upper Basin and Lower Basin, in non-community areas of the Upper Basin and Lower Basin, in Coeur d'Alene Lake, and in the Spokane River floodway upstream of the Spokane Indian Reservation.

5.2.1 Nature and Extent of Contamination Affecting Human Health in the Community and Residential Areas of the Upper Basin and Lower Basin

The primary media of concern for human health are:

- Contaminated soil where it occurs in residential yards, street rights-of-way, commercial and undeveloped properties, and common areas, and airborne dust generated at these locations
- Contaminated house dust, originating primarily from contaminated soil; interior house paint is also a potential source of lead
- Drinking water from local wells or surface water
- Contaminated aquatic food sources (e.g., fish)
- Contaminated homegrown vegetables
- Contaminated floodplain soil, sediments, and vegetation

People in the Basin can be exposed to chemicals of potential concern (COPCs) by ingesting soil, breathing dust, drinking water, and eating contaminated fish or homegrown vegetables. The COPCs for protection of human health are:

- Seven metals in soil: antimony, arsenic, cadmium, iron, lead, manganese, and zinc

- Seven metals in house dust: antimony, arsenic, cadmium, iron, lead, manganese, and zinc
- Five metals in groundwater: antimony, arsenic, cadmium, lead, and zinc
- Five metals in surface water: arsenic, cadmium, lead, manganese, and mercury
- Two metals in tap water: lead and arsenic

Although fish and vegetables were not screened for COPCs, indicator metals were selected for these based on toxicity and presence in the Basin. The selected indicator metals for fish consumption were cadmium, lead, and mercury; and for vegetable consumption were arsenic, cadmium, and lead. Although not considered a primary medium of concern in the HHRA, interior and exterior lead-based paint contributes to lead concentrations in yard soil and house dust. These are potentially important sources that are addressed on a case-by-case basis.

Exposures to lead in soil and dust from the home and surrounding communities are the primary human health concerns in the Basin. Table 5.2-1 shows geometric mean, arithmetic mean, minimum, and maximum lead concentrations in sampled yard soil and house dust in the Upper Basin and Lower Basin. Tables 5.2-2 and 5.2-3 present minimum, maximum, arithmetic mean, and geometric mean results for the seven COPCs in soil and house dust, respectively.

The identification of chemicals of concern (COCs) for protection of human health is described in Section 7.1. Minimum, maximum, and exposure point COC concentrations for various exposure scenarios and exposure points are also summarized in Section 7.1.

Drinking water obtained from private, unregulated sources is a potential exposure route. Table 5.2-4 presents the results of first-draw and flushed-line samples collected from private, unregulated drinking water sources in the Basin. Although groundwater contamination is observed in the Basin, an insufficient number of monitoring wells have been installed to fully characterize the nature and extent of groundwater contamination.

Soil, sediment, and surface water are impacted at beaches and recreational areas. Figure 5.2-1 shows graphically the widespread distribution of lead concentrations above EPA's emergency action level (2,000 mg/kg) for protection of human health in soil and sediment samples in the Basin. The figure shows four concentration ranges:

- 0 to 175 mg/kg (175 mg/kg equals the 90th percentile of the Upper Basin background soil lead concentration [Gott and Cathrall 1980].)
- 175 mg/kg to 500 mg/kg

- 500 mg/kg to 2,000 mg/kg

- Greater than 2,000 mg/kg

Figure 5.2-2 shows average metal concentrations in surface soil and sediment and average metal loads and concentrations in surface water in the Upper Basin and Lower Basin.

5.2.2 Nature and Extent of Contamination Affecting Ecological Receptors in the Upper Basin and Lower Basin

Contaminated media that potentially affect ecological receptors are surface water, soil, and sediment. In addition, groundwater is important as a pathway for migration of metals to surface water. The chemicals of ecological concern (COECs) for ecological protection are:

- Cadmium, copper, lead, and zinc in surface water
- Arsenic, cadmium, copper, lead, and zinc in soil
- Arsenic, cadmium, copper, lead, mercury, silver, and zinc in sediment

The identification and concentrations of COECs for protection of ecological receptors are described in Section 7.2. Cadmium, lead, and zinc are pervasive in all environmental media and generally present higher risks to ecological receptors than arsenic, copper, mercury, and silver. Therefore, cadmium, lead, and zinc are the focus of the discussion of the nature and extent of contamination presented in this section of the ROD.

To help characterize the nature and extent of contamination and to develop remedial alternatives, the contaminated media were grouped by “source type” in the FS. These source types are based on the mining-related primary sources (tailings, waste rock, and adit drainage) and the secondary sources, or impacted media (floodplain sediments, river banks and beds, wetlands, lateral lakes, dredge spoils, and lake bottom sediments) present in the Basin. Table 5.2-5 presents an overview of the quantities of impacted materials by source type in the Basin.

Upper Basin

The Upper Basin is the primary source of dissolved metals in the river system. Tables 5.2-6 and 5.2-7 show estimated average (expected) values of concentrations and loads (the amount of metal transported in a stream, in pounds per day), respectively, for dissolved cadmium, total lead, and dissolved zinc at sampling locations in the Basin. The estimated average values were calculated from surface water data collected during the period of 1991 to 1999 (USEPA 2001c).[6] The estimated average dissolved zinc load in the South Fork just above the confluence with the North

[6] At each sampling location, the metals concentrations and loads vary in time. A coefficient of variation (CV) is used to measure that variability. A high CV indicates relatively high variability relative to sampling mean.

Fork (South Fork at Pinehurst) is about 79 percent of the load that discharges to the lake (Lower Coeur d'Alene River at Harrison). Figure 5.2-3 shows the estimated average concentrations and loads of dissolved zinc in the river and tributaries in the Basin. The figure shows that zinc concentrations are substantially greater than 10 times the AWQC[7] in parts of the South Fork and some of its major tributaries.

The estimated average concentrations of dissolved cadmium, total lead, and dissolved zinc in the South Fork at Pinehurst are 9.1 µg/L, 56 µg/L, and 1,430 µg/L, respectively. Based on the estimated average values, about 1,550 pounds per day of dissolved zinc (53 percent of the total Upper Basin load) comes from sources inside the Bunker Hill Box and about 1,370 pounds per day of dissolved zinc (47 percent of the total Upper Basin load) comes from sources in the Upper Basin outside of the Bunker Hill Box.

Impacted sediments and associated groundwater in the valley fill aquifers of the Upper Basin are the largest sources of dissolved metals loading in the river and streams. Figure 5.2-4 shows the estimated proportions of the dissolved zinc load in the South Fork at Pinehurst (not including sources within the Bunker Hill Box) that are derived from impacted sediments and associated groundwater, tailings, waste rock, and adit drainage.[8] An estimated 71 percent of the load is derived from impacted sediments and associated groundwater. Surface water and groundwater percolates through the tailings-impacted sediments and dissolves metals. The water discharges into the streams and rivers, carrying the dissolved metal load with it. Metals loading is enhanced by the relatively large degree of surface water/groundwater interaction that occurs in some parts of the Upper Basin. In areas where the valley floor widens, streams lose water to the valley fill aquifer ("losing reach"). In areas where the valley floor constricts, groundwater discharges back into the streams ("gaining reach"), carrying additional metals load. The USGS studied the surface water/groundwater interaction (Barton 2000). Figure 5.2-5 shows the results of the study in lower Canyon Creek in September 1999. These studies show that most of the dissolved zinc load in the study areas was discharged to the streams in the gaining reaches.

An estimated 7 million cubic yards (cy) of tailings-impacted sediments are present in the Upper Basin (CSM Units 1 and 2), including an estimated 3 million cy of sediments that potentially cannot be accessed for excavation because they are beneath the I-90 embankment, other roads, or residential or commercial structures. In addition to the estimated 7 million cy of sediments directly impacted by tailings, analysis of deeper sediments samples indicates metals

[7] The national recommended water quality criteria, or ambient water quality criteria (AWQC), were used in the RI/FS as metrics to quantify existing surface water quality characteristics and the effectiveness of remedial actions for surface water. The values of AWQC used in the RI/FS are the EPA-approved Idaho and Washington water quality standards (Tables 8.2-2, 8.2-3, and 8.2-4). The national recommended water quality criteria have been updated for zinc (in 1999) and cadmium (in 1999 and 2000).

[8] Percentages of dissolved zinc load were estimated by combining the estimated volumes of source materials with the relative loading potentials of the source materials, as described in USEPA 2001f, *Probabilistic Analysis of Post-Remediation Metal Loading*.

concentrations generally exceed background concentrations to depths of 10 to 30 feet. These deeper sediments are potentially an important secondary source of metals.

Relatively little of the dissolved metals in the river system comes from discrete sources. Discrete sources include NPDES-permitted discharges (including the treatment plant for the Bunker Hill mine-water discharge) and unpermitted discrete discharges (adit and seep discharges). As shown in Figure 5.2-6, the estimated loads from the discrete discharges account for only about 8 percent of the estimated dissolved zinc load in the South Fork at Pinehurst.

Based on mapping conducted by BLM (BLM 1999), approximately 2,850 acres of land have been disturbed by mining-related activities or deposition of mining-related wastes in the Upper Basin (not including areas within the Bunker Hill Box). Approximately 295 acres of disturbed area were identified by BLM as riparian. Approximately 1,200 acres of other impacted floodplain areas were identified by BLM.

Lower Basin

In the Lower Basin, erosion of river banks and beds is a major source of metals, particularly lead, entering the Coeur d'Alene River. There are an estimated 1.8 million cy of impacted bank materials and an estimated 20.6 million cy of impacted bed sediments (including an estimated 3 million cy of bed sediments in the river delta downstream of Harrison) subject to erosion. The average concentration of lead in over 2,000 non-random sediment samples within the floodplain collected in the Lower Basin is 3,100 mg/kg.

The increase in total lead load below the confluence of the North Fork and South Fork is about 1,040 pounds per day, or about 69 percent of the load that discharges to the lake (Figure 5.2-7). Lead tends to bind more strongly to soil particles than does zinc, and the lead load is largely due to erosion of soil and sediment, particularly during high-flow periods. As a result, the total lead loads display a large variability with time. During low-flow periods, total lead loads as low as 30 pounds per day have been measured in the Coeur d'Alene River at Harrison. By contrast, during the 100-year flood event in February 1996, an estimated 1,400,000 pounds of lead were discharged to Coeur d'Alene Lake in a single day. The estimated average concentrations of dissolved cadmium, total lead, and dissolved zinc in the Coeur d'Alene River at Harrison, calculated from surface water data collected during the period of 1991 to 1999, are 1.9 µg/L, 52 µg/L, and 344 µg/L, respectively.

Lower Basin wetlands, 100-year floodplains, and lateral lake sediments are the major sources of metals ingested by waterfowl and other animals. Based on geostatistical analysis, there are about 18,300 acres of floodplain sediments that contain more than 530 mg/kg of lead in the surficial sediments, the lowest observed adverse effects level (LOAEL) for waterfowl. The area containing more than 530 mg/kg of lead represents an estimated 95 percent of the 19,200 acres of floodplain habitat present in the Lower Basin. There are about 15,400 acres of floodplain sediments that contain more than 1,800 mg/kg of lead, the mortality threshold concentration for waterfowl. The area containing more than 1,800 mg/kg of lead represents an estimated 80 percent of the 19,200 acres of floodplain habitat present in the Lower Basin. Table 5.2-8 shows the total areas and lead-impacted areas of wetland, lake, and riparian habitat in 27 wetland units identified by the USFWS in the Lower Basin.

The Lower Basin includes the Cataldo/Mission Flats area, where tailings were dredged from the river and placed within the 100-year floodplain from 1932 to 1967. An estimated 13 million cy of tailings-impacted dredge spoils cover about 680 acres at this location.

5.2.3 Nature and Extent of Contamination in Coeur d'Alene Lake

The beaches and wading areas adjacent to Coeur d'Alene Lake were sampled in 1998 and were found to be safe; i.e., concentrations of metals did not exceed risk-based levels for recreation. The only exception is Harrison Beach, which has been remediated as part of the UPRR removal action. Based on existing information, EPA has no reason to believe that mining contamination is present in the residential and commercial areas in the cities of Coeur d'Alene, Post Falls, and Harrison.

The water in Coeur d'Alene Lake meets the safe drinking water standards for metals, except when discharge from the Coeur d'Alene River is high (e.g., during high spring run-off or during flood events), which causes short-term lead concentrations that exceed the drinking water standard. The water in the lake exceeds the water quality standards for protection of aquatic life, which are more stringent than the drinking water standards, for cadmium and zinc and intermittently for lead.

A large volume of metals-impacted sediment has been deposited in Coeur d'Alene Lake. There are an estimated 44 to 50 million cy of contaminated sediments at the bottom of the lake. Studies by the USGS suggest that, under current lake conditions, there may be some movement of the metals from the sediment into the water column in the dissolved phase. The rate of release of metals in the sediments into the water column could increase if the lake water quality deteriorates due to nutrient enrichment. Currently, however, more metals enter the lake annually from the Coeur d'Alene River than flow out of the lake into the Spokane River. Table 5.2-9 shows the net retention of metals in the lake, where retention is the difference between the metal load into the lake and the load out of the lake, expressed as a percentage of the load into the lake. Cadmium retention ranged from 47 to 56 percent and averaged 52 percent. Lead retention ranged from 82 to 92 percent and averaged 89 percent. Zinc retention ranged from 31 to 43 percent and averaged 38 percent.

5.2.4 Nature and Extent of Contamination in the Spokane River Upstream of the Spokane Indian Reservation

Contaminated media that potentially affect humans are soil and sediment at shoreline and sediment depositional areas. The COCs for protection of human health are arsenic and lead. The identification and concentrations of COCs for protection of human health are described in Section 7.1.

The beaches and wading areas adjacent to the Idaho portion of the Spokane River were sampled in 1998 and were found to be safe; i.e., concentrations of metals did not exceed risk-based levels for recreation. Sediment depositional areas in the State of Washington portion of the Spokane River were sampled in 1998 and 1999 (Groisbois 1999), summer/fall 1999 (USEPA 2000d), and August/September 2000 (USEPA 2001i). Several depositional areas were found to contain lead and/or zinc at concentrations exceeding the risk-based levels. These areas are discussed in Section 7.1.3.

The water in the Spokane River meets the safe drinking water standards for metals.

Contaminated media that potentially affect ecological receptors are surface water, soil, and sediment. The COPECs for protection of ecological receptors are:

- Cadmium, copper, lead, and zinc in surface water
- Arsenic, cadmium, copper, lead, and zinc in soil
- Arsenic, cadmium, copper, lead, mercury, silver, and zinc in sediment

The identification of COECs for protection of ecological receptors is described in Section 7.2.

Figures 5.2-8, 5.2-9, and 5.2-10 present concentrations of cadmium, lead, and zinc, respectively, measured in 63 Spokane River sediment samples. Based on these data, about 25 percent of samples contained cadmium above the upper background concentration, about 82 percent of samples contained lead above the upper background concentration, and about 90 percent of samples contained zinc above the upper background concentration.[9] The average concentration of lead in 265 sediment samples collected in the Spokane River floodway between Coeur d'Alene Lake and Long Lake is 400 mg/kg.

Because there are relatively few depositional areas along the Spokane River, the volume of contaminated sediments is small compared to the Upper Basin and Lower Basin. An estimated volume of 260,000 cy of contaminated sediments are present upstream of Upriver Dam.

[9] 90th percentile upper background concentrations were estimated by Ecology using the 2 millimeter and finer fraction of upland soil samples (WDOE 1994).

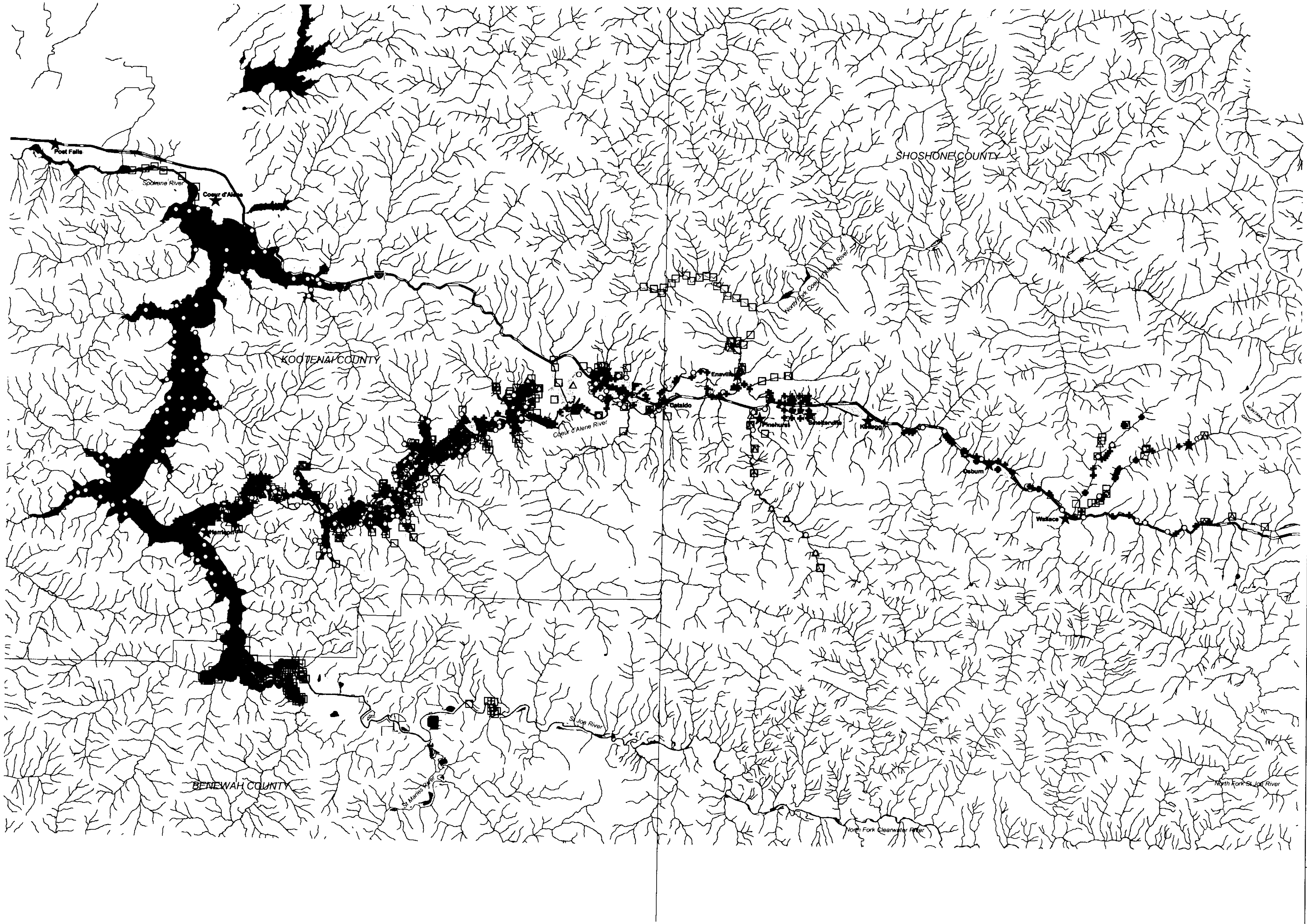
Additional contaminated sediments are present downstream of Upriver Dam, but have not been quantified.

Surface water in the Spokane River has been impacted by metals including particulate lead transported into the Spokane River, particularly during winter storm events and spring runoff. In total metals analysis of samples from the Spokane River analyzed for the RI, 21 percent contained cadmium exceeding a screening level of 0.9 µg/L, 48 percent contained lead exceeding a screening level of 0.66 µg/L, and 68 percent contained zinc exceeding a screening level of 30 µg/L.[10] The estimated average concentrations of total lead and dissolved zinc in the Spokane River at Post Falls, calculated from surface water data collected during the period of 1991 to 1999, are 2.1 µg/L, and 58 µg/L, respectively. Dissolved cadmium was not detected.

Transport of particulate lead into the Spokane River, particularly during winter storm events and spring runoff, has resulted in deposition of lead-contaminated sediments in shoreline and subaqueous depositional areas and periodic exceedances of lead AWQC.

[10] The screening levels for lead and cadmium are equal to the federal AWQC for these metals for a hardness equal to 30 mg $CaCO_3$/L. The screening level for zinc is a risk-based concentration for protection of aquatic plants.

Figure 5.2-1
Range of Lead Concentrations in Surface Soils and Sediments in the Coeur d'Alene River Basin



Legend

- ★ CITIES
- STREAMS
- RIVERS/LAKES
- FLOOD PLAIN

Lead Concentration Ranges (in ppm)

- □ 0 - 175
- △ 175 - 500
- ○ 500 - 2000
- ✚ >2000

Idaho

Location Map

Notes:

1) Base map coverages obtained from the Bureau of Land Management (BLM) and The Coeur d' Alene Indian Tribe.

2) Lead concentrations obtained from the following sources:

McCully Frick and Gilman
RCG Hagler, Bailly Sampling Data
URS Greiner Woodward Clyde
USGS
USFW

N

SCALE: 1:300000

0 5 Miles

027-RI-C9-102Q
Coeur d' Alene Basin RI/FS
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EPA REGION 10

Document Control Number: 4162500.07099.05.a
EPA No. 2.9
Project: n:\projects\rod\rod-01_03.apr
VIEW: Pb sediments
LAYOUT: Fig 5.2-4B-Size
05/02/02

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

Date of Plot: May 02, 2002

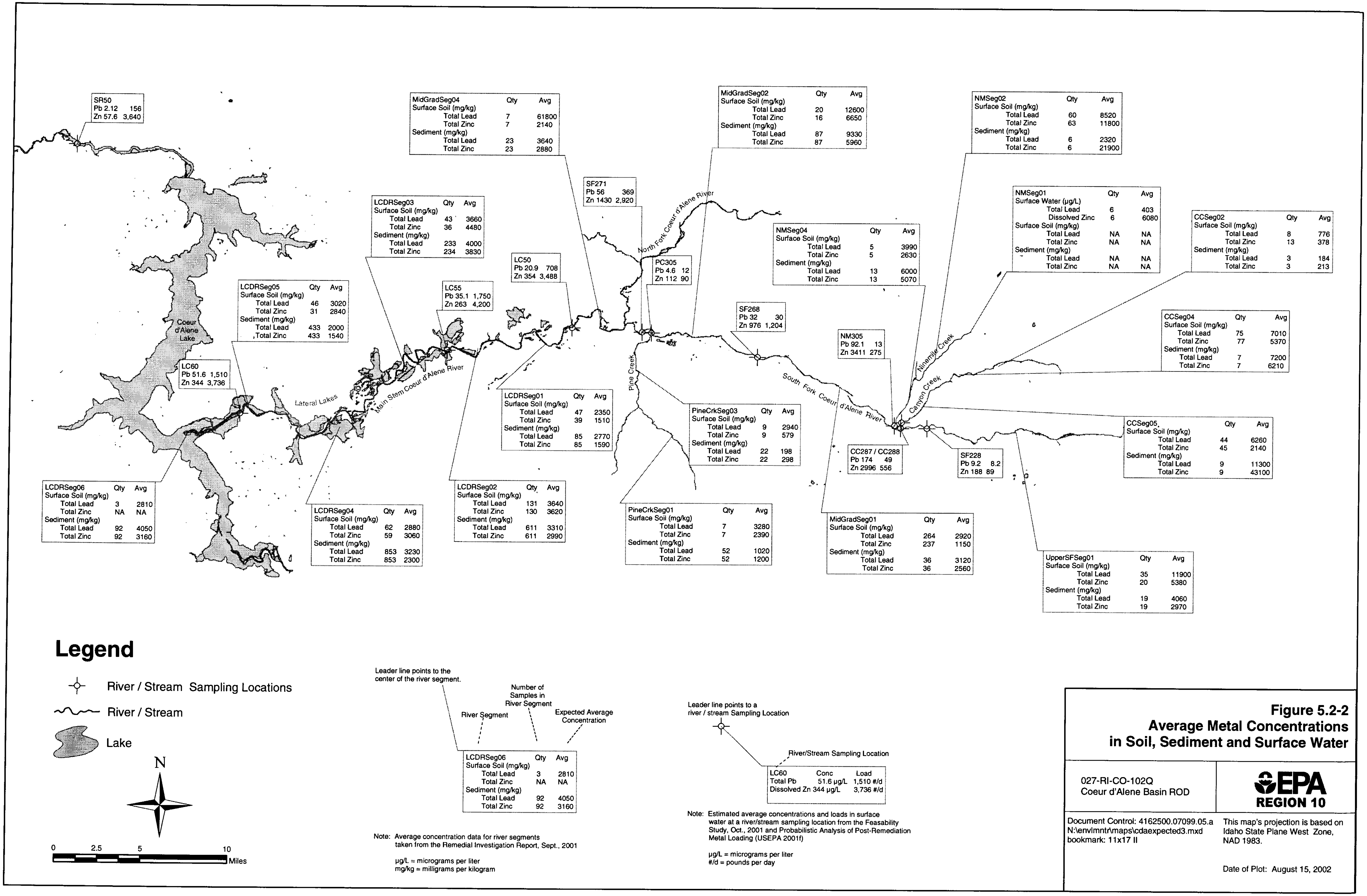
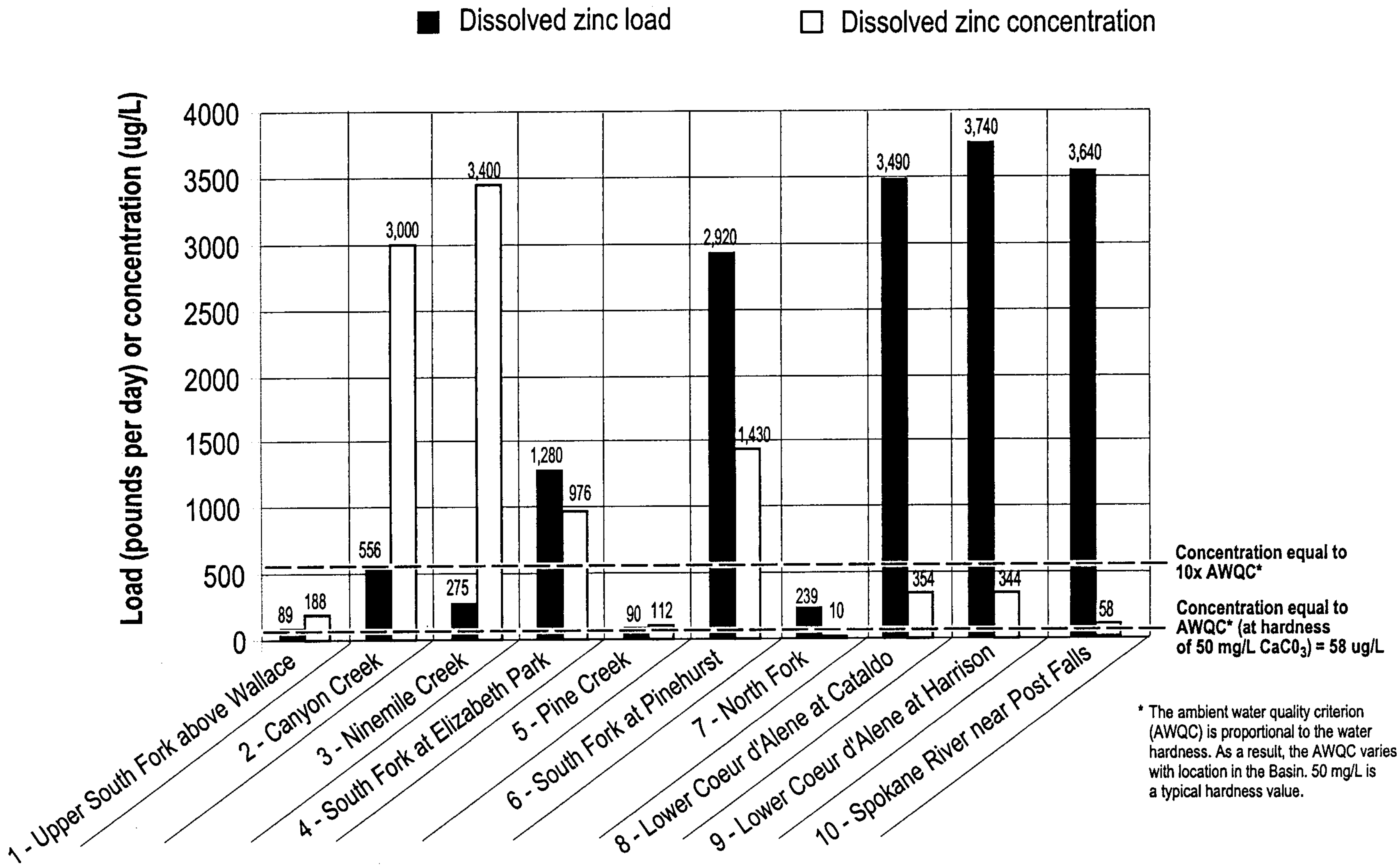


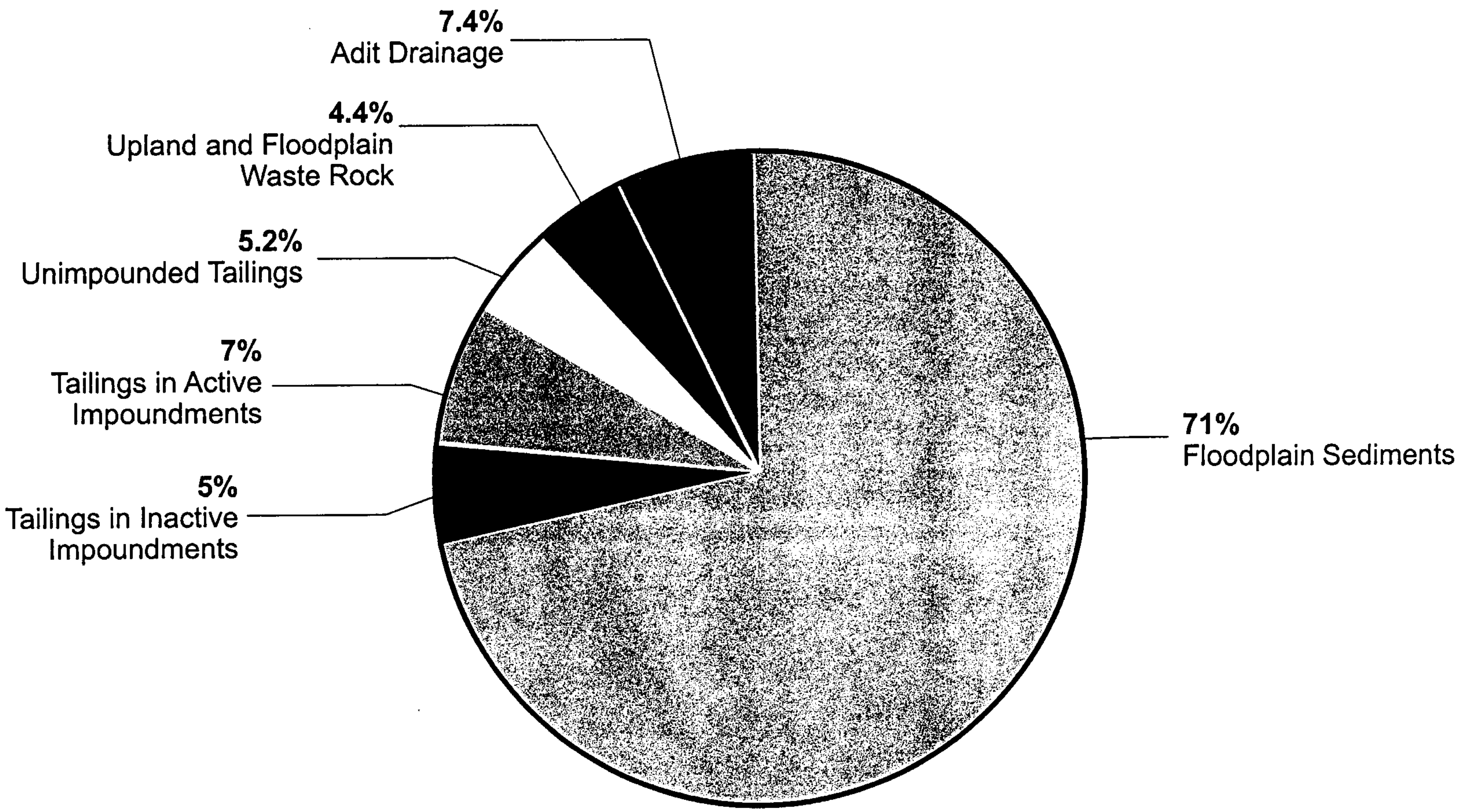
Figure 5.2-2
Average Metal Concentrations in Soil, Sediment and Surface Water



* The ambient water quality criterion (AWQC) is proportional to the water hardness. As a result, the AWQC varies with location in the Basin. 50 mg/L is a typical hardness value.

Note: Estimates based on analysis of available data from 1991 - 1999

EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RECORD OF DECISION	Doc. Control: 4162500.07099.05.a EPA No. 2.9	**Figure 5.2-3** **Estimated Average Values of Dissolved Zinc Loads and Concentrations (1991-1999 Data)**



Note: Percentages of dissolved zinc load were estimated by combining the estimated volumes of source materials with the relative loading potentials of the source materials, as described in USEPA 2001f, "Probabilistic Analysis of Post-Remediation Metal Loading"

EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RECORD OF DECISION	Doc. Control: 4162500.07099.05.a EPA No. 2.9	Figure 5.2-4 Estimated Sources of Dissolved Zinc Load in the Upper Basin (not including the Bunker Hill Box)

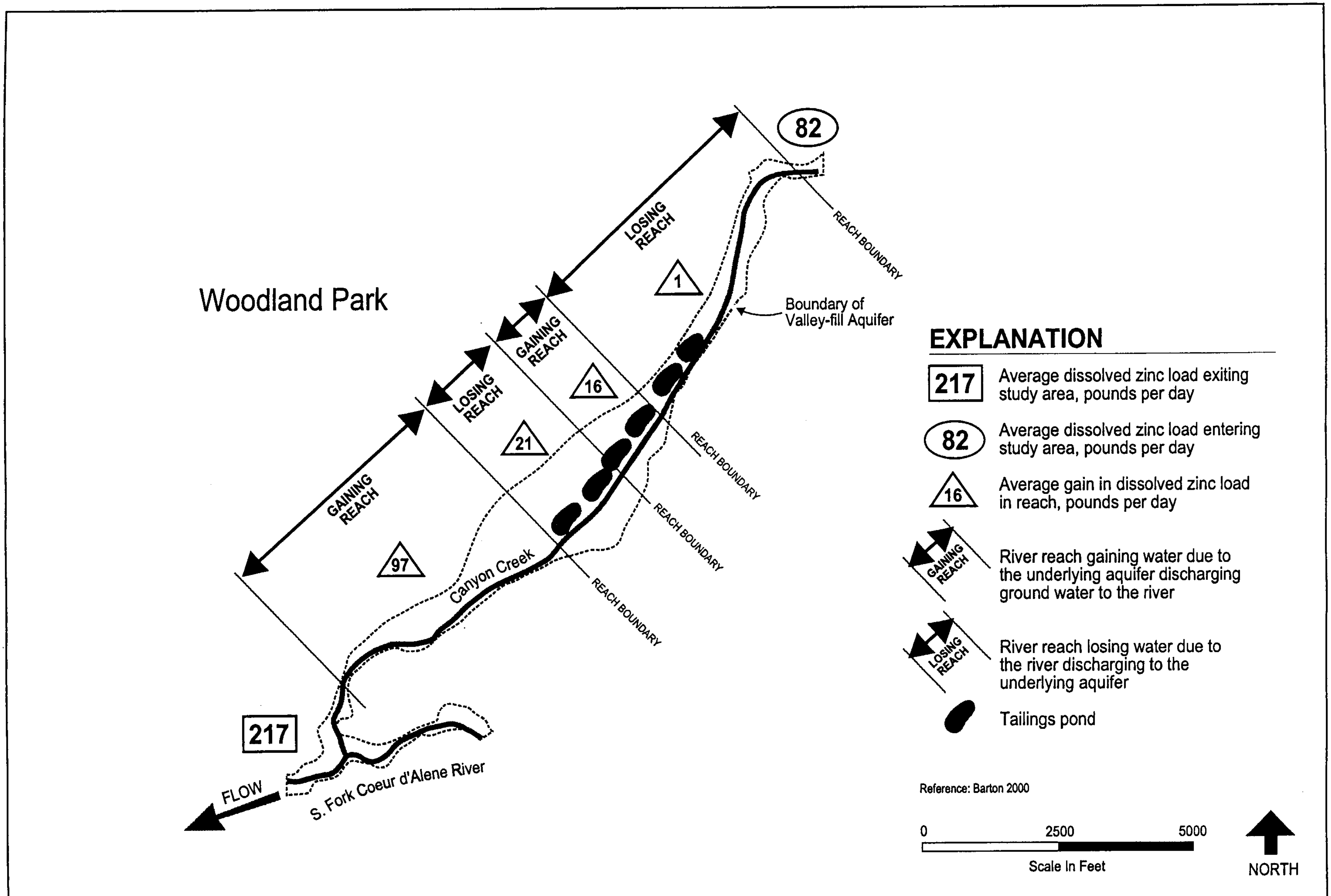


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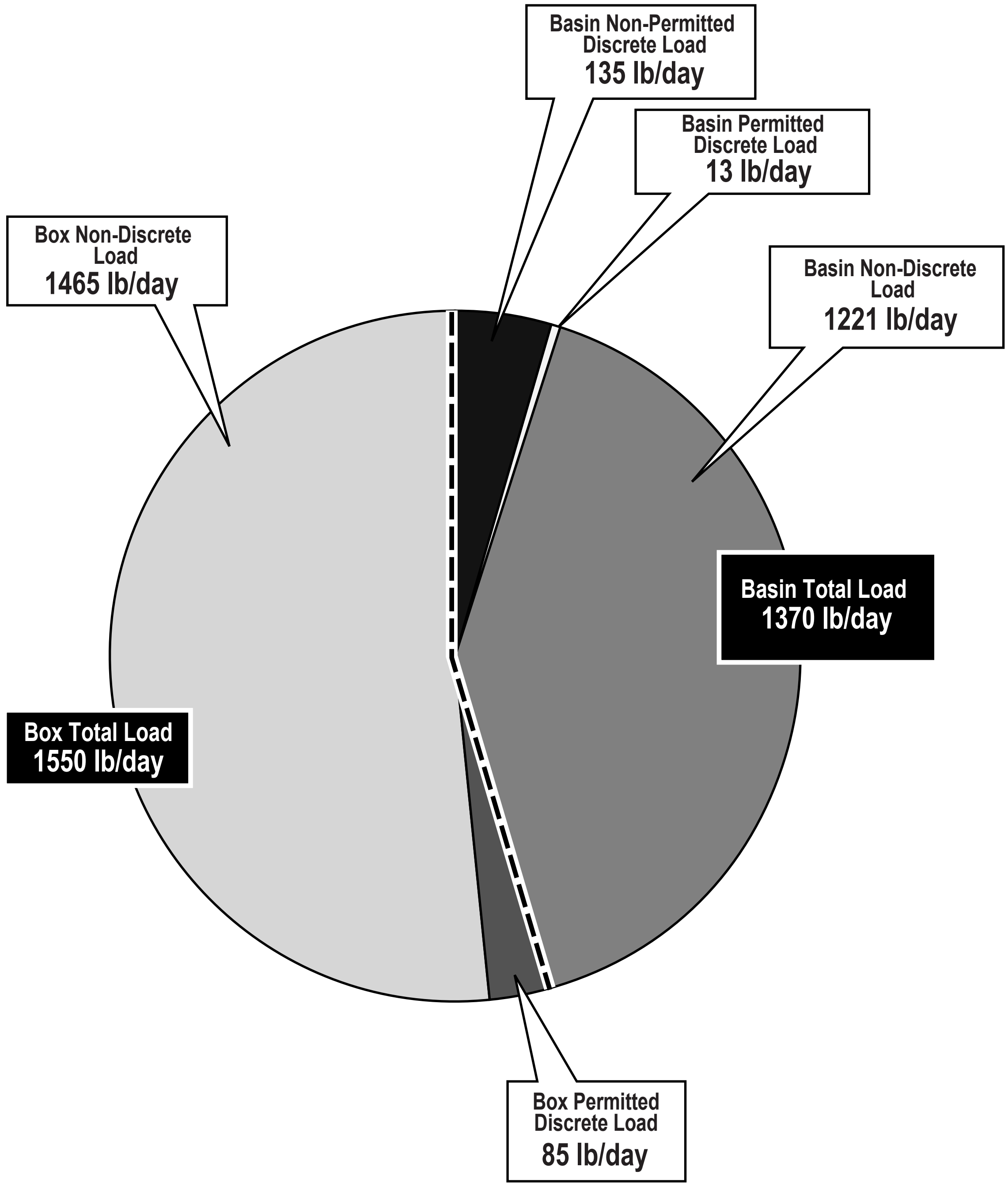
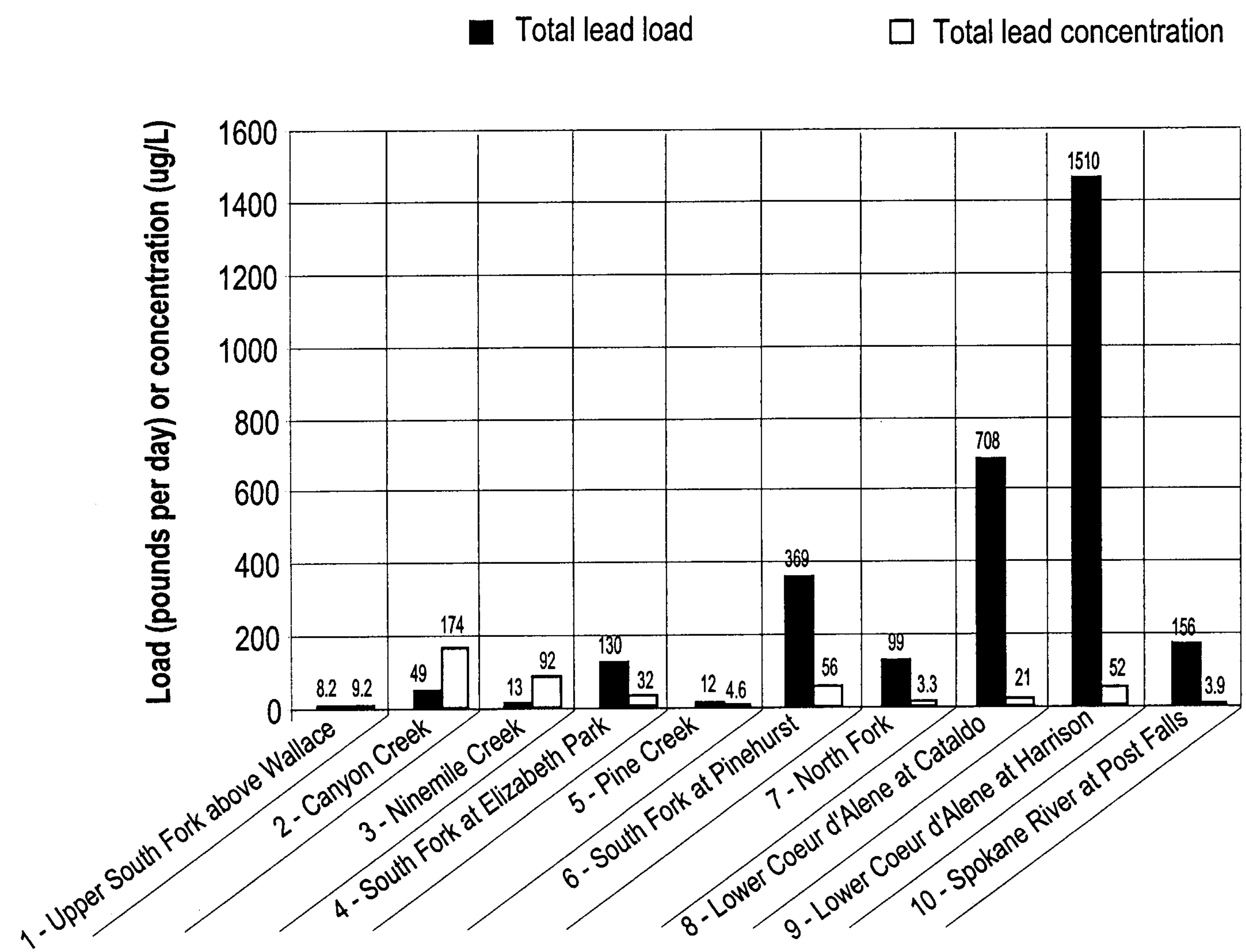
Figure 5.2-5
Dissolved Zinc Loads in Canyon Creek at Woodland Park, September 17, 18, and 19, 1999



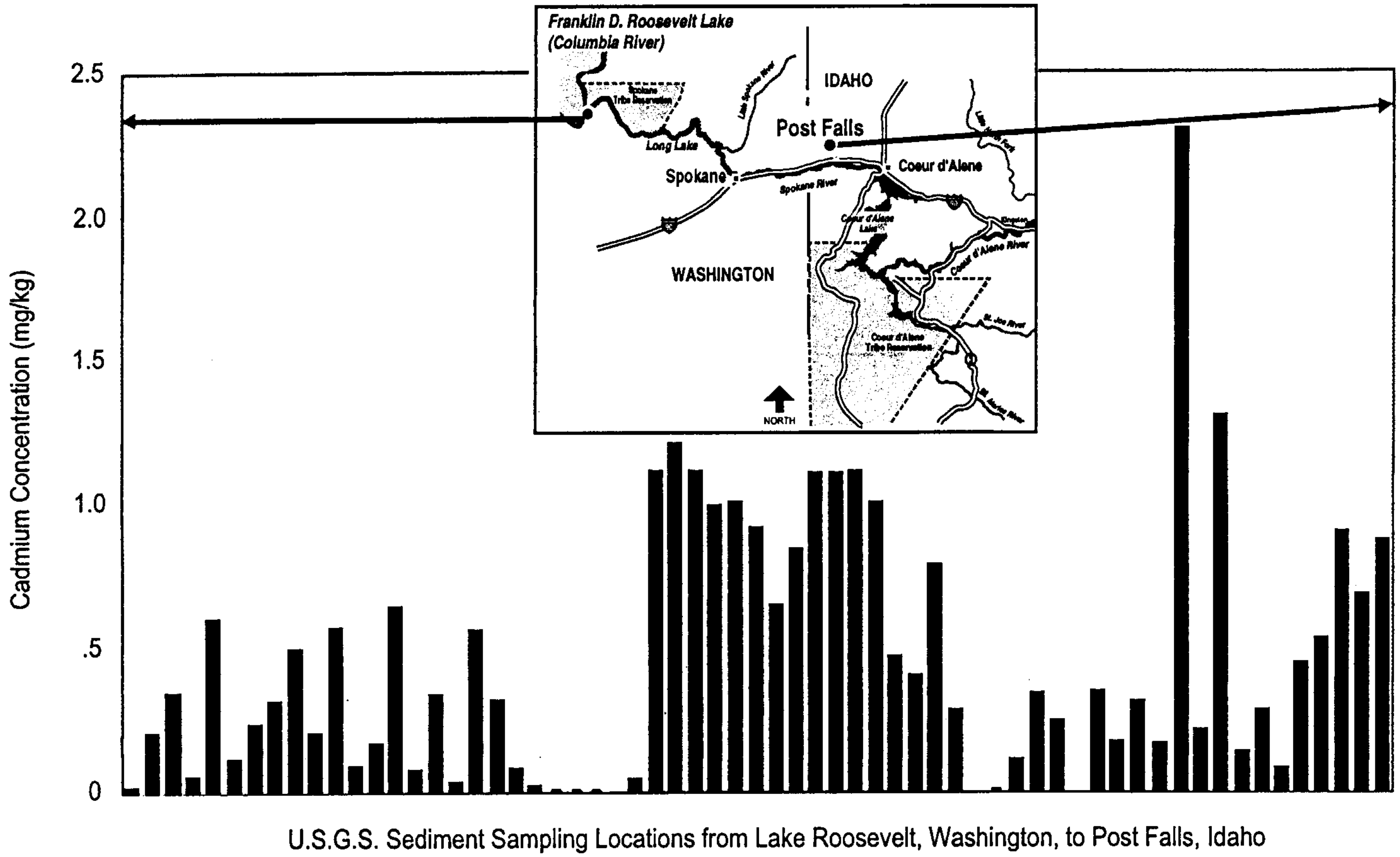
Notes:

1. Non-discrete loads include waste piles and nonpoint sources (mining wastes that were disposed directly into the receiving water in the past).
2. Total dissolved zinc loads in Basin and Box equal to estimated average loads based on 1991 to 1999 data (USEPA 2001c). Loads from the Box are expected to decrease with time as a result of capping of the CIA, source removals in Smelterville Flats and the gulches (2.0 million cy), discontinuation of discharge of mine water on the CIA, and other actions. Monitoring will be conducted to evaluate the effectiveness of these actions.
3. Permitted loads based on data provided by EPA Office of Water (USEPA 2000c)
4. Basin non-permitted discrete loads from Feasibility Study (USEPA 2001c), Part 3, Appendix D, Table D-26)



Note: Estimates based on analysis of available data from 1991 - 1999

EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RECORD OF DECISION	Doc. Control: 4162500.07099.05.a EPA No. 2.9	**Figure 5.2-7** **Estimated Average Values of Total Lead Loads and Concentrations (1991-1999 Data)**



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RECORD OF DECISION	Doc. Control: 4162500.07099.05.a EPA No. 2.9	**Figure 5.2-8** **Total Cadmium Concentrations in Spokane River Sediments**

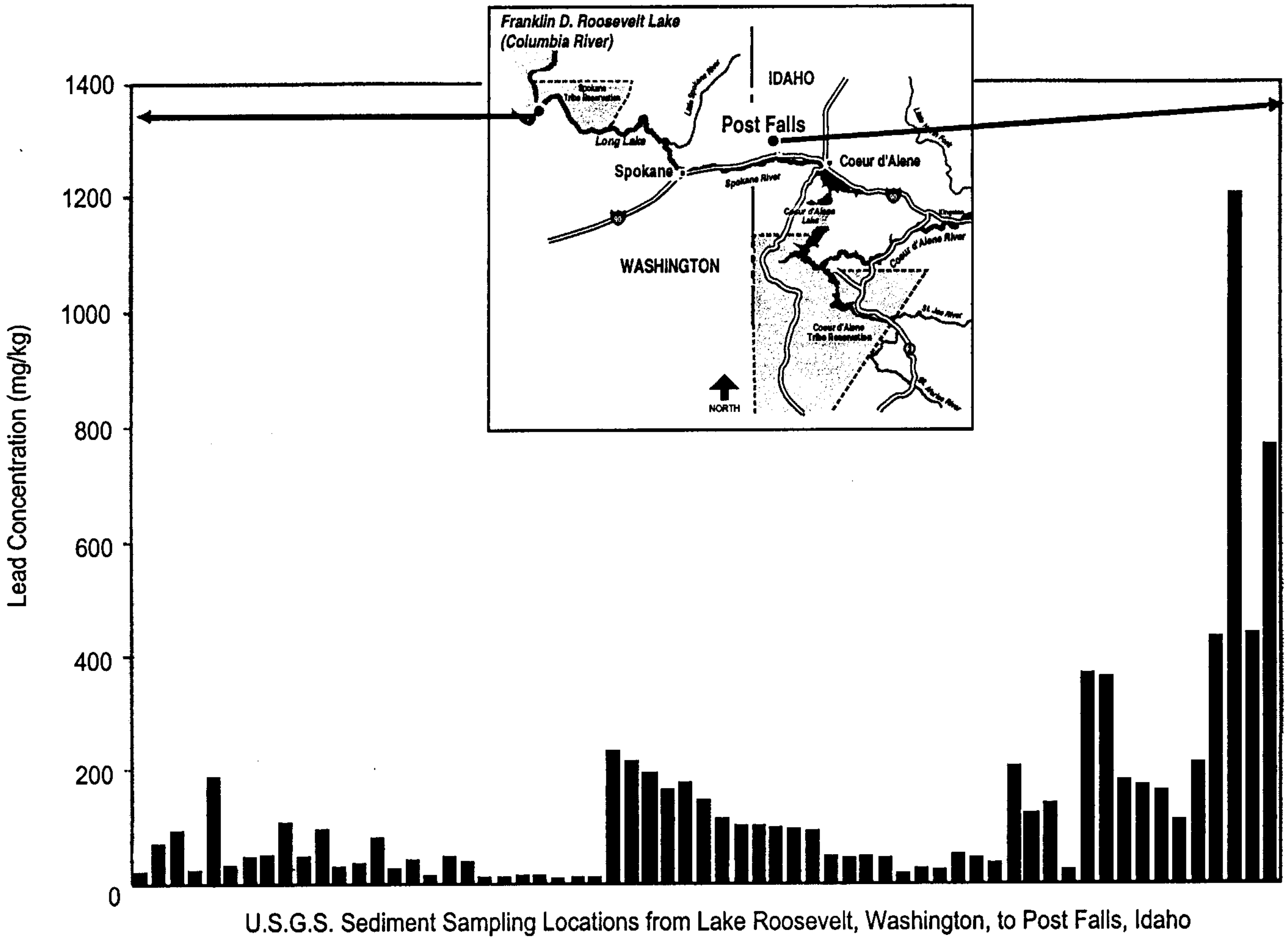


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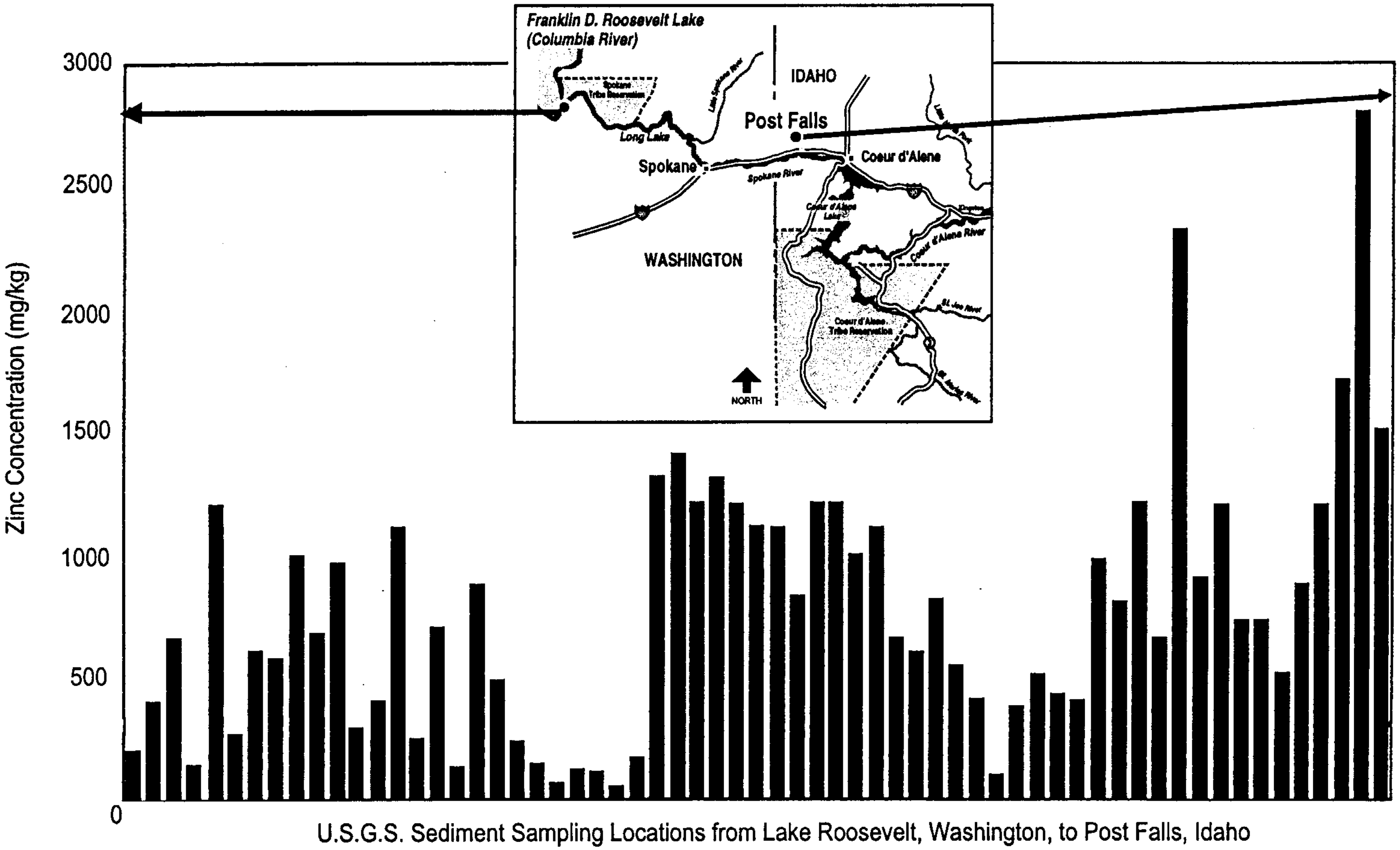
Figure 5.2-9
Lead Concentrations in Spokane River Sediments



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RECORD OF DECISION	Doc. Control: 4162500.07099.05.a EPA No. 2.9	**Figure 5.2-10** **Zinc Concentrations in Spokane River Sediments**

Table 5.2-1
Summary of Lead Concentrations in the Upper and Lower Basin

Medium	No. of Samples	Minimum, mg/kg	Maximum, mg/kg	Arithmetic Mean, mg/kg	Geometric Mean, mg/kg
Lower Basin					
Yard Soil	160	15	7,350	487	110
House Dust	31	49	3,140	512	301
Upper Basin					
Yard Soil	834	22	20,218	821	460
House Dust	268	23	29,725	997	659

Notes:
House dust lead concentrations were measured from vacuum bag samples
Source: Human Health Risk Assessment (IDHW 2001a)

Table 5.2-2
Summary of Analytical Results for Metals in Soil

Chemical	No. of Detections	No. of Samples	Maximum Concentration (mg/kg)	PRG (mg/kg)	No. of Detections Exceeding PRG	Percentage of Samples Exceeding PRG	Background Concen-tration (mg/kg)[b]	No. of Detections Exceeding Background Concentrations
Antimony	2,966	4,029	623	30	313	7.8	5.8	1,239
Arsenic[a]	4,186	4,208	3,610	0.38	4,186	99	22	1,346
Cadmium	3,939	4,208	194	37	184	4.4	2.86	2,290
Iron	3,980	3,980	256,000	22,000	1,527	38	65,000	369
Lead	4,208	4,208	67,100	400	1,336	32	175	3,065
Manganese	4,002	4,002	26,400	3,100	500	12	3,600	450
Zinc	4,208	4,208	25,800	22,000	3	0.07	280	2,806

[a] Carcinogen; PRG are protective of cancer health effects
[b] 90th percentile from Gott and Cathrall (1980).

Notes:
COPC - chemical of potential concern
NA - not available
PRG - preliminary remediation goal (from tables in EPA Web site at http://www.epa.gov/region09/waste/sfund/prg)
SV - screening value (0.1 times EPA PRGs for noncarcinogens and same as PRGs for carcinogens)

Table 5.2-3
Summary of Analytical Results for Metals in House Dust

Chemical	No. of Detections	No. of Samples [b]	Maximum Concentration (mg/kg)	Soil PRG (mg/kg)	No. of Detections Exceeding PRG	Percent Detections Exceeding PRG
Antimony	160	160	318	30	29	18
Arsenic[a]	160	160	635	0.38	160	100
Cadmium	159	160	375	37	5	3.1
Iron	160	160	60,800	22,000	115	72
Lead	160	160	59,500	400	134	84
Manganese	160	160	5,460	3,100	3	1.9
Zinc	160	160	57,500	22,000	2	1.3

[a] Carcinogen; the PRG for arsenic is protective of cancer health effects at a target risk of 1 in 1 million.
[b] Samples collected from vacuum bags and floor mats.

Notes:
There are no background values available for house dust.
COPC - chemical of potential concern
NA - not available
PRG - preliminary remediation goal for residential soil (from tables in EPA Web site at: http://www.epa.gov/region09/waste/sfund/prg)

Table 5.2-4
Summary of Analytical Results for Metals in Drinking Water

Chemical	No. of Detections	No. of Samples	Maximum Concen-tration (µg/L)	PRG (µg/L)	No. of Detections Exceeding PRG	Percentage of Samples Exceeding PRG	MCL (µg/L)	No. of Detections Exceeding MCL
First Draw Samples								
Arsenic[a]	45	102	7.6	0.045	45	44	10	0
Cadmium	45	102	33.6	18	1	1.0	5	5
Lead	101	102	78.5	4	36	35	15	11
Flushed Line Samples								
Arsenic[a]	45	100	9.2	0.045	45	45	10	0
Lead	83	100	9.5	4	2	2.0	15	0

[a] Carcinogen; PRGs are protective of cancer health effects

Notes:
COPC - chemical of potential concern
MCL - Maximum Contaminant Level
PRG - preliminary remediation goal (from tables in EPA Web site at http://www.epa.gov/region09/waste/sfund/prg)

Table 5.2-5
Summary of Estimated Basin Ecological Source Quantities

Source Type	Units	Quantity
Upper Basin		
Floodplain Sediments[a]	cy	7,100,000
Tailings[b]	cy	11,000,000
Waste Rock[c]	cy	11,700,000
Adit Drainage[d]	#Zn/d	101
Lower Basin		
River bed Sediments, including the Harrison Delta[e]	cy	20,600,000
Bank Wedges[e]	cy	1,780,000
Wetland Sediments[e]	cy	5,900,000
Lateral Lake Sediments[e]	cy	5,900,000
Floodplain Sediments[e]	cy	10,200,000
Cataldo/Mission Flats Dredge Spoils	cy	13,600,000
Coeur d'Alene Lake		
Lake Bottom Sediments	cy	44,000,000 to 50,000,000
Spokane River[f]		
Shoreline and River bed Sediments	cy	260,000

[a] Impacted sediment present in the current and historic 100-year floodplain. Total volume does not include either less impacted, generally deeper and more dispersed sediments that are potential source of zinc loading or impacted materials within fills or embankments (e.g., I-90 and UPRR rights-of-way); these additional sediment volumes may be as high as approximately 20,000,000 cy.
[b] Tailings volumes include unimpounded tailings and impounded tailings in both inactive and active facilities.
[c] Waste rock volumes include waste rock in floodplains and uplands, as well as waste rock at active facilities.
[d] Data used to calculate average zinc loading are available for only 53 of 114 discharging adits in the upper basin. Although data are available for the largest loaders, the cumulative average zinc load from all discharging adits may exceed the amount shown in this table.
[e] Volumes estimates for all impacted media in the lower basin, CSM Unit 3, are based on lead concentrations exceeding 1,000 mg/kg. Additional volumes of impacted sediments that are potential sources of zinc loading are not included in these estimates.
[f] Contaminated sediments upstream of Upriver Dam. Additional contaminated sediments are present downstream of Upriver Dam, but have not been quantified.

Notes:
This is a condensed summary with approximate quantities—for a detailed accounting of sources and remedial actions see the FS Part 3, Sections 5 and 6 and appendices as referenced therein (USEPA 2001c). Quantities of source materials within the BHSS are not included in this table.
cy - cubic yards
#Zn/d - pounds of zinc per day

Table 5.2-6
Estimated Average (Expected) Values of Metals Concentrations in Surface Water in the Basin, 1991-1999 Data

Sampling Location	Dissolved Cadmium			Total Lead			Dissolved Zinc		
	Estimated Expected Value in µg/L	CV	Number of Samples	Estimated Expected Value in µg/L	CV	Number of Samples	Estimated Expected Value in µg/L	CV	Number of Samples
South Fork and Tributaries									
SF220 (below Mullan)	0.7	0.55	41	11.1	0.59	41	130	0.68	41
SF228 (below Trowbridge Gulch)	1.1	0.46	46	9.2	0.90	46	188	0.74	47
SF239 (Silverton)	7.2	0.70	56	43	1.13	56	1,080	0.74	56
SF249 (Osburn)	7.45	0.48	37	27	0.66	37	1,110	0.52	37
SF259 (SF at above Big Creek)	8.1	0.45	38	25	0.71	38	1,200	0.48	38
SF268 (near Elizabeth Park)	6.8	0.61	67	32	1.58	67	976	0.59	67
SF270 (Smelterville)	11.3	0.52	45	43	1.26	45	1,674	0.55	45
SF271 (Pinehurst)	9.1	0.63	108	56	1.34	69	1,430	0.63	111
Canyon Creek									
CC2	NA	NA	NA	3.2	1.57	36	26.2	0.43	36
CC276	0.7	0.23	41	11.9	1.53	41	122	1.41	41
CC278	2.5	0.67	38	13.3	0.4	38	378	0.67	38
CC291	3.9	0.51	35	20.4	0.35	35	650	0.65	35
CC282	7.1	0.55	23	114	1.8	23	1,100	0.52	23
CC284	8.4	0.51	42	72.6	1.46	42	1,370	0.56	42
CC285	10.8	0.85	38	213	2.45	39	1,460	0.8	38
CC287 and CC288	21.9	0.74	92	174	1.99	93	2,996	0.71	93
Ninemile Creek									
NM291	1.1	0.48	32	7.7	1.36	32	318	1.56	32
NM293	17.3	0.76	24	24.6	0.69	24	4,670	2.16	23
NM295	15.8	0.68	18	23.2	0.50	18	3,000	0.61	18

Table 5.2-6 (Continued)
Estimated Average (Expected) Values of Metals Concentrations in Surface Water in the Basin, 1991-1999 Data

Sampling Location	Dissolved Cadmium			Total Lead			Dissolved Zinc		
	Estimated Expected Value in µg/L	CV	Number of Samples	Estimated Expected Value in µg/L	CV	Number of Samples	Estimated Expected Value in µg/L	CV	Number of Samples
NM296	33.2	0.55	54	587	7.2	54	6,070	0.53	54
NM298	42.7	0.66	50	234	0.88	50	7,140	0.69	50
NM303	27.7	0.42	42	99.4	0.43	42	4,590	0.8	42
NM305	21.7	0.48	96	92.1	0.80	98	3,411	0.47	96
Pine Creek									
PC307	2.6	0.21	39	4.5	1.19	39	974	0.237	39
PC308	11.7	0.27	33	9.6	0.54	33	4,430	0.269	33
PC305	0.54	2.68	12	4.6	1.3	38	112**	0.45**	38
Big Creek									
BC260 (mouth of Big Creek)	1 (max. detected)*	NA	NA	28 (max. detected)*	NA	NA	6.9 (max. detected)*	NA	NA
Moon Creek									
MC262 (mouth of Moon Creek)	0.68	0.33	58	3.7	1.2	57	121	0.39	58
Main Stem									
LC50 (Cataldo)	3.2	1.3	101	20.9	1.43	44	354	0.61	102
LC55 (Rose Lake)	2.3	1.02	71	35.1	1.34	35	263	0.88	12
LC60 (Harrison)	1.9	0.37	91	51.6	1.08	32	344	0.48	91
Spokane River									
SR50 (Post Falls, ID)	NA	NA	9	2.12	0.87	9	57.6	0.48	10
SR55 (near Otis Orchard, WA)	NA	NA	7	2.31	0.77	7	50.7	0.52	7
SR60 (Greenacres)	NA	NA	7	2.41	0.92	7	51.2	0.47	7
SR65 (near Trentwood)	NA	NA	7	2.41	0.97	7	50.7	0.61	7
SR70 (Spokane)	NA	NA	7	2.21	1.13	7	53.1	1.22	7

Table 5.2-6 (Continued)
Estimated Average (Expected) Values of Metals Concentrations in Surface Water in the Basin, 1991-1999 Data

Sampling Location	Dissolved Cadmium			Total Lead			Dissolved Zinc		
	Estimated Expected Value in µg/L	CV	Number of Samples	Estimated Expected Value in µg/L	CV	Number of Samples	Estimated Expected Value in µg/L	CV	Number of Samples
SR75 (Spokane)	NA	NA	10	2.72	1.02	9	50.1	0.58	9
SR85 (Long Lake)	NA	NA	13	1.45	0.50	8	27.3	1.74	13

Notes:
* Data-based value from USEPA (2001b), Part 2, Big Creek
** Without two outliers

CV - coefficient of variation
NA - not applicable

Table 5.2-7
Estimated Average (Expected) Values of Metals Loads in Surface Water in the Basin, 1991-1999 Data

Sampling Location	Dissolved Cadmium			Total Lead			Dissolved Zinc		
	Estimated Expected Value in pounds/day	CV	Number of Samples	Estimated Expected Value in pounds/day	CV	Number of Samples	Estimated Expected Value in pounds/day	CV	Number of Samples
South Fork and Tributaries									
SF220 (below Mullan)	0.22	1.11	41	5	1.65	41	35	0.67	41
SF228 (below Trowbridge Gulch)	0.50	1.05	46	8.2	3.9	46	89.4	1.23	47
SF239 (Silverton)	7.8	0.88	56	140	4.9	56	1,110	0.83	56
SF249 (Osburn)	5.9	0.75	37	39.4	2.25	37	877	0.77	37
SF259 (SF above Big Creek)	8.3	0.88	38	49.5	2.64	38	1,200	0.85	38
SF268 (near Elizabeth Park)	8.9	0.68	67	130	5.89	67	1,280	0.691	67
SF270 (Smelterville)	16.4	0.90	45	116	3.43	45	2,100	0.64	45
SF271 (Pinehurst)	20.9	0.87	108	369	5.53	69	2,920	0.61	111
Canyon Creek									
CC276	0.1	0.73	41	1.2	2.16	41	8.2	1.29	41
CC278	0.2	0.58	38	1.5	0.83	38	34	1.06	38
CC291	0.5	0.67	35	3	1.04	35	75	0.57	35
CC282	1.5	0.71	23	40.1	3.46	23	239	0.77	23
CC284	1.4	0.81	42	13.4	1.99	42	227	0.7	42
CC285	2.9	1.1	39	98.1	5.08	38	400	0.82	38
CC287 and 288 combined	5.5	1.20	92	48.6	3.14	93	556	0.67	93
Ninemile Creek									
NM291	0.03	1.34	32	0.3	4.2	32	33.1	0.84	32
NM293	0.5	1.06	24	0.8	1.37	24	99.6	11.86	23
NM295	0.6	0.91	18	1.3	1.3	18	125	1.74	18
NM296	1.3	0.7	54	3.7	0.69	54	251	0.88	54
NM298	1.3	0.77	50	8.6	1.41	50	210	0.72	50
NM303	1.3	0.74	42	5.3	1.07	42	203	0.79	42
NM305	1.6	0.86	96	13.1	2.63	98	275.5	0.92	96

Table 5.2-7 (Continued)
Estimated Average (Expected) Values of Metals Loads in Surface Water in the Basin, 1991-1999 Data

Sampling Location	Dissolved Cadmium			Total Lead			Dissolved Zinc		
	Estimated Expected Value in pounds/day	CV	Number of Samples	Estimated Expected Value in pounds/day	CV	Number of Samples	Estimated Expected Value in pounds/day	CV	Number of Samples
Pine Creek									
PC307	0.07	1.18	39	0.2	7.51	39	26.1	1.21	39
PC308	0.05	0.92	33	0.04	1.36	33	18.5	0.99	33
PC305	5.4	96.4	12	12.3	19.9	38	90.2**	2.93**	36
Big Creek									
BC260 (mouth of Big Creek)	Not detected to 0.03*	NA	NA	1.7 to 91.1 (measured)*	*	NA	0.9 to 4.7 (measured)*	NA	NA
Moon Creek									
MC262 (mouth of Moon Creek)	0.05	2.24	58	0.42	6.00	57	9.9	3.06	58
Main Stem									
LC50 (Cataldo)	26.9	1.32	101	708	6.78	44	3,220	0.73	102
LC55 (Rose Lake)	28.1	1.34	71	1,750	6.89	35	4,260	0.69	12
LC60 (Harrison)	29	1.39	91	1,510	4.11	32	3,736***	1.02	91
Spokane River									
SR50 (Post Falls, ID)	NA	NA	9	156	3.86	9	3,640	3.67	10
SR55 (near Otis Orchard, WA)	NA	NA	7	247	5.68	7	5,000	4.65	7
SR60 (Greenacres)	NA	NA	7	380	9.19	7	5,560	5.06	7
SR65 (near Trentwood)	NA	NA	7	434	10.4	7	7,030	6.7	7
SR70 (Spokane)	NA	NA	7	278	6.45	7	7,110	7.24	7
SR75 (Spokane)	NA	NA	10	285	3.81	9	4,310	2.41	9
SR85 (Long Lake)	NA	NA	13	110	0.99	8	2,210	3.12	13

* Data-based value from USEPA (2001k), Part 2 Big Creek
** Without two outliers
*** Updated value; see Section C.4.3 of USEPA 2001f "Probabilistic Analysis of Post-Remediation Metal Loading."

Notes:
CV - coefficient of variation
TMDL - total maximum daily load

Table 5.2-8
Summary of Floodplain Areas Affected by Lead, by Wetland Unit

Wetland Unit	Wetland Area, Acres		Lateral Lake Area, acres		Riparian Areas, Acres	
	Total	Lead≥530[a] mg/kg	Total	Lead≥530[a] mg/kg	Total	Lead≥530 [a] mg/kg
Harrison Slough	41	40	679	669	34	30
Harrison Marsh	59	58	157	157	35	34
Thompson Marsh	60	59	125	122	21	16
Thompson Lake	303	299	260	256	32	25
Anderson Lake	47	44	527	505	39	36
Bare Marsh	165	160	0	0	17	17
Blue Lake	57	53	320	316	37	37
Black Lake	40	17	379	368	64	272
Swan Lake	367	362	475	471	210	205
Cave Lake	196	190	753	746	123	116
Medicine Lake	210	198	242	230	85	83
Blessing Slough	178	168	0	0	76	76
Moffit Slough	114	114	146	146	66	66
Campbell Marsh	174	173	107	106	135	129
Hidden Marsh	436	418	204	199	44	38
Killarney Lake	155	152	491	482	48	42
Strobl Marsh	275	269	0	0	79	77
Lane Marsh	430	425	0	0	82	80
Black Rock Slough	235	232	204	201	169	166
Bull Run	16	16	114	106	8	8
Rose Lake	436	409	362	357	142	135
Porter Slough	135	126	0	0	0	0
Orling Slough	58	49	54	52	16	15
Canyon Marsh	101	50	25	25	22	19
Cataldo Slough	151	114	325	314	246	228
Mission Slough	284	280	151	150	115	108
Whiteman Slough	177	171	0	0	43	32
27 units	4,901	4,646	6,100	5,979	1,986	1,844

Source: U.S. Fish and Wildlife Service, Upper Columbia Fish and Wildlife Office (July 2001)

[a] - 530 mg/kg represents the Lowest Observable Effect Level (LOEL) for waterfowl (Beyer et al. 2000)

References:

Kern, J.W. 1999. *Statistical Model for the Spatial Distribution of Lead Concentration in Surficial Sediments in the Lower Coeur d'Alene River Floodplain with Estimates of Contaminated Soils and Sediments*. Draft (August 26, 1999). Prepared for the U.S. Fish and Wildlife Service, Spokane, Washington.
Beyer, W. N., D. J. Audet, G. H. Heinz, D. J. Hoffman, and D. Ray. 2000. "Relation of Waterfowl Poisoning to Sediment Lead Concentrations in the Coeur d'Alene River Basin". *Ecotox*. 9: 207 - 218.

Table 5.2-9
Metals Loads and Retention in Coeur d'Alene Lake

Parameter	1994 (low discharge)	1995 (average discharge)	1997 (high discharge)	1999 (120% of average discharge)
Annual mean discharge (cfs)	2,970	6,300	10,300	7,530
Zinc				
Total Inflow (kg)	460,000	880,000	1,400,000	1,570,000
Total Outflow (kg)	260,000	580,000	860,000	1,080,000
Percent Retained	43	35	41	31
Lead				
Total Inflow (kg)	88,000	470,000	1,300,000	590,000
Total Outflow (kg)	16,000	37,000	100,000	51,300
Percent Retained	82	92	92	91
Cadmium				
Total Inflow (kg)	3,800	7,200	11,000	10,400
Total Outflow (kg)	1,700	3,600	5,800	4,940
Percent Retained	56	51	47	53

Note: Refers to whole-water recoverable metals loads

6.0 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

This section describes current and anticipated future land, groundwater, and surface water uses.

6.1 CURRENT LAND USE

The Basin includes areas within Shoshone, Kootenai, and Benewah counties in Idaho and Spokane and Stevens counties in Washington. The majority of the population of the Basin lives in the cities of Spokane, Coeur d'Alene, and Post Falls, which have populations exceeding 177,000, 24,000, and 7,000 people, respectively. All other communities in the Basin have populations less than 2,000. In Kootenai and Shoshone counties, over 38 percent of the total population is in rural areas.

Land use includes residential, commercial, light industrial, agriculture, mining, and recreation. The I-90 freeway generally parallels the South Fork of the Coeur d'Alene River from Cataldo east to the Idaho/Montana border. The UPRR right-of-way parallels the entire length of the river as well as a portion of the southern lake shore. This inactive rail line is currently being addressed and converted to a recreational trail.

Much of the Basin is rural, undeveloped land, a large part of which is federally or state-managed. These undeveloped lands and the numerous streams in the Basin provide a variety of recreation opportunities. Undeveloped areas include upland forest habitats and lowland floodplains with riverine, riparian, wetland, and lake habitats. The quality of these habitats and their ability to support natural populations of flora and fauna has been impacted to varying degrees by historic mining activity in the Basin.

The Basin is the ancestral home of the Coeur d'Alene and Spokane Tribes. Coeur d'Alene reservation lands are present in the Lower Basin, and Spokane reservation lands are adjacent to the lower Spokane River. Historically, the Coeur d'Alene and several other tribes, including the Spokanes, relied solely on resources of the Basin for sustenance. Subsistence lifestyles are a current land use and are a potential future land use in the contaminated areas of the Lower Basin; however, this lifestyle cannot currently be safely practiced in these areas due to the extent of this contamination. The Coeur d'Alene Tribe currently advises its members not to use these contaminated resources for subsistence.

Risks to persons, including Spokane tribal members, and others who may practice a subsistence lifestyle in the lower Spokane River now or in the future have not been quantified. EPA and the Spokane Tribe are cooperating in planning additional testing and studies that will be

implemented to evaluate the potential exposures to subsistence users. The results of those tests and studies will determine appropriate future response actions to be taken, if any.
When compared to conditions statewide, a number of indicators show that socio-economic conditions in the Basin upstream of Coeur d'Alene Lake are depressed. These indicators include:

- Higher unemployment
- Higher percentages of persons living below the poverty level
- Lower rates of high school and college graduation
- Higher per capita welfare payments
- Generally decreasing tax base

The socio-economic status of families has been noted to be a significant factor affecting children's blood lead levels in numerous studies (Pirkle et al. 1998, Brody et al. 1994, Clark et al. 1985, Bornschein et al. 1985). In the Basin, young children often have limited places to play, and when not at their home or at school are often found on commercial properties or other common areas.

6.2 ANTICIPATED FUTURE LAND USES

It is anticipated that future land use will be similar to current or reasonably foreseeable future land use. Although population levels in the Basin have declined in recent years, the City of Coeur d'Alene has experienced substantial population growth, and it is possible that population growth could expand into the Basin. It is not anticipated that areas of the Lower Basin floodplains that are currently undeveloped or used for agriculture could be developed for residential use due to regulatory restrictions on residential development in the floodplain. Increased recreational use of beaches may occur as a result of several factors: 1) increasing tourism in the Basin; 2) easier access due to the conversion of the UPRR right-of-way, which parallels the river, into a trail; and 3) increased population.

6.3 SURFACE WATER AND GROUNDWATER USES

The State of Idaho has identified designated beneficial uses for the surface water of the Idaho portion of the Basin. All waters are designated by statute for agricultural and industrial water supply, wildlife habitat, and aesthetics. In addition, all waters in the Basin are designated for cold water aquatic life and secondary contact recreation, although the cold water aquatic life use is not attained or only partially attained in some waters. Less-impacted waters may be designated for salmonid spawning, primary contact recreation, and drinking water supply; however, these uses are limited in some parts of the area of mining impacts. The designated uses are shown in Table 6.3-1. The lateral lakes in the Lower Basin, which are not listed in Table 6.3-1, are all designated for agricultural and industrial water supply, wildlife habitat, aesthetics, cold water aquatic life, and primary or secondary contact recreation.

The use designations do not reflect pre-mining use and condition of the stream. The designated uses generally reflect current surface water uses, with some exceptions where the designated uses are not currently attained. For example, Ninemile Creek, from and including East Fork Ninemile Creek to its mouth, is designated for cold water aquatic life and salmonid spawning. These uses are not currently attained in Ninemile Creek downstream of mining impacts. Similarly, cold water aquatic life is not attained in Canyon Creek downstream of mining impacts. The designated uses and areas of current non-attainment or partial attainment are presented in Table 6.3-1.

In addition to its designations for cold water aquatic life, drinking water supply, primary contact recreation, and salmonid spawning, Coeur d'Alene Lake is designated as a special resource water. Special resource waters are those specific segments or bodies of water which are recognized as needing intensive protection to preserve outstanding or unique characteristics or maintain current beneficial use (IDAPA 58.01.02§003). The lake is important to the economy of the region. Its aesthetic qualities and the recreation opportunities it affords enhance the area as a place to live and promote tourism.

The flowing water sections of the Spokane River in Washington are classified as Class A (excellent) (WAC 173-201A). The Spokane River from Long Lake Dam to Ninemile Bridge is classified as Lake Class. The characteristic uses of these classes include, but are not be limited to:

- Water supply (domestic, industrial, agricultural)
- Stock watering
- Fish and shellfish migration, rearing, spawning, and harvesting
- Wildlife habitat
- Recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment)
- Commerce and navigation

East of Coeur d'Alene Lake, groundwater and surface water are used as drinking water sources. Within the Upper Basin and Lower Basin, about 57 percent of residences obtain water from a public source and 43 percent obtain water from a private source. Table 6.3-2 describes the public drinking water systems in these areas, and Table 6.3-3 shows the estimated number of residences using private drinking water sources within the human health alternatives study area. Although groundwater data are limited, future use of groundwater from shallow, unconfined aquifers within the area of mining impacts in the Upper Basin and Lower Basin as drinking water may be limited by concentrations of cadmium, lead, and zinc that exceed maximum contaminant levels (MCLs) until cleanup is implemented. Although the Selected Remedy is expected to result in improvements to groundwater quality, it is not intended to satisfy the groundwater protection strategy for returning beneficial uses of groundwater as outlined in the NCP.

In addition to the beneficial use of groundwater as a drinking water supply, groundwater may influence surface water quality. In some parts of the Basin, surface water is in communication with groundwater. The interaction between surface water and groundwater is a route for migration of metals between these two media. The South Fork and its tributaries are important areas of interaction between surface water and groundwater. As described in Section 5.2.2, a significant load of metals is conveyed from groundwater to surface water is this area. This loading affects the ability to achieve surface water quality standards in the Basin. Because the groundwater protection strategy is also intended to protect critical environmental systems, such as fisheries in the Upper Basin, loading of metals from groundwater to surface water will be evaluated as the Selected Remedy is implemented.

The Spokane Valley-Rathdrum Prairie Aquifer, a sole source aquifer, underlies an area of about 327 square miles, including 125 square miles in Washington and 202 square miles in Idaho. Groundwater from the aquifer provides most of the water used in Spokane County for domestic, municipal, and industrial (other than aluminum production) purposes, and a large part of the irrigation supply. The total amount of groundwater pumped from the Spokane Valley portion of the aquifer in 1977 was about 164,000 acre-feet, of which about 70 percent was withdrawn for municipal and domestic use (Molenaar 1988). The Spokane Valley-Rathdrum Prairie Aquifer in western Idaho and eastern Washington receives an estimated 30 percent of its water from Coeur d'Alene Lake and the upper Spokane River (Wyman 1993).

On the Spokane Reservation, large terrace deposits of glacial outwash serve as aquifers near the Spokane River.

Table 6.3-1
Surface Water Designated Beneficial Uses in Idaho

Waters	Aquatic Life	Recreation	Other
South Fork Coeur d'Alene River - Canyon Creek to mouth	COLD	SCR	
Pine Creek - East Fork Pine Creek to mouth	COLD; SS	SCR	
Pine Creek - source to East Fork Pine Creek	COLD; SS	PCR	DWS
East Fork Pine Creek - source to mouth[a]			
Government Gulch - source to mouth	COLD; SS	SCR	
Big Creek - source to mining impact area	COLD; SS	PCR	DWS
Big Creek - mining impact area to mouth	COLD; SS	SCR	
Shields Gulch - source to mining impact area	COLD; SS	PCR	DWS
Shields Gulch - mining impact area to mouth		SCR	
Lake Creek - source to mining impact area	COLD; SS	PCR	DWS
Lake Creek - mining impact area to mouth	COLD; SS	SCR	
Placer Creek - source to mouth[a]			
South Fork Coeur d'Alene River - from and including Daisy Gulch to Canyon Creek	COLD	SCR	
Willow Creek - source to mouth[a]			
South Fork Coeur d'Alene River - source to Daisy Gulch	COLD; SS	PCR	DWS
Canyon Creek - from and including Gorge Gulch to mouth	COLD	SCR	
Canyon Creek - source to Gorge Gulch	COLD; SS	PCR	DWS
Ninemile Creek - from and including East Fork Ninemile Creek to mouth	COLD; SS	SCR	
Ninemile Creek - source to East Fork Ninemile Creek	COLD; SS	PCR	DWS
Moon Creek - source to mouth[a]			
West Fork Moon Creek - source to mouth[a]			
Bear Creek - source to mouth	COLD; SS	PCR	DWS
Coeur d'Alene River - Latour Creek to mouth	COLD	PCR	
Coeur d'Alene Lake	COLD; SS	PCR	DWS SRW
Spokane River - Coeur d'Alene Lake to Post Falls Dam	COLD; SS	PCR	DWS
Spokane River - Post Falls Dam to Washington/Idaho border	COLD; SS	PCR	DWS

Source of designated uses: IDAPA 58.01.02, Section 110

[a] These waters, although undesignated, are protected for cold water aquatic life and primary or secondary contact recreation (IDAPA 58.01.02, Section 101–Undesignated Uses)

Notes:
All waters are designated for agricultural and industrial water supply, wildlife habitat, and aesthetics.
COLD - Cold water aquatic life
DWS - Drinking water supply
PCR - Primary contact recreation
SCR - Secondary contact recreation
SRW - Special resource water
SS - Salmonid spawning

Table 6.3-2
Coeur d'Alene River Basin East of Coeur d'Alene Lake Public Drinking Water Systems

Type of System	Water Source	Population	Connections	Comments
Community public water system	Wells	4,490	1,875	
	Surface water	7,013	3,446	Central Shoshone Water District (population = 4,052, connections = 2,293) is temporarily using surface water while well undergoes corrosivity evaluation.
	Unknown	574	226	
Non-community transient public water system	Wells	385	120	
	Unknown	500	1	
Non-transient, non-community public water system	Wells	445	2	
	Surface water	490	13	
	Unknown	170	2	

Table 6.3-3
Estimated Number of Residences with Private, Unregulated Drinking Water Sources

Area of Investigation	Number of Residences[a]	Number of Residences within Water District	Estimated Number of Private, Unregulated Sources[b]	Nearest Water District	Availability of Suitable Alternative Aquifer
Upper Basin					
Upper Basin	4,633	3,417	1,216	East Shoshone County, Central Shoshone County, Kingston, and Pinehurst Water Districts	None to medium
Lower Basin					
Cataldo	1,642	842	400	Cataldo Water District	Medium
Harrison			400	Harrison Water District	High

[a]Based on site reconnaissance and demographic data from the human health risk assessment (IDHW 2001a).
[b]Assumes 100 percent of residences outside water district service boundaries have private, unregulated sources.
[c]Osburn has a moratorium on new well construction.

7.0 SUMMARY OF RISKS

This section provides a summary of the pertinent information from the human health and ecological risk assessments, focusing on the chemicals of concern (COCs) and other pertinent issues that are the basis for the response actions at the site. COCs are defined as "those chemicals of potential concern (COPCs) and media/exposure points that trigger the need for cleanup (the risk drivers)" (USEPA 1998c). This section does not provide a complete summary of the entire baseline risk assessment or other screening assessments conducted for the site but focuses on the information that is driving the need for the specific remedial actions described in this ROD.

7.1 SUMMARY OF HUMAN HEALTH RISK ASSESSMENTS

This section of the ROD summarizes the results of the baseline HHRA completed for the Harrison to Mullan portion of the site (CSM Units 1, 2, and 3) (IDHW 2001a). Also summarized are the results of two screening level risk assessments completed for Coeur d'Alene Lake (CSM Unit 4) and the Spokane River, Washington State (CSM Unit 5) (Appendix B of IDHW 2001a and USEPA 2000d). Unlike the baseline risk assessment, these screening level risk assessments did not estimate risks; rather, site-specific "safe" levels of COPCs were calculated and site concentrations were compared to the calculated levels. Locations within CSM Units 4 and 5 with chemicals at concentrations above the specified levels were further evaluated and are the subject, in some cases, of remedial action.

Typically, a baseline risk assessment estimates site risks if no action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. However, current conditions in the Basin are reflective of ongoing actions taken to reduce lead exposure. These efforts include the Lead Health Intervention Program (LHIP), which includes annual blood lead screening conducted by the PHD, and high-risk removal actions completed by EPA since 1997.

The lead section of the HHRA was prepared in accordance with EPA national guidance applying the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). The national guidance recommends using the IEUBK Model for "setting site-specific residential risk-based preliminary remediation goals (PRGs) at CERCLA sites" and describes the model as the "best tool currently available for predicting the potential blood lead levels of children exposed to lead in the environment" (USEPA 1998c). The HHRA also has been peer-reviewed by EPA Technical Review Workgroup for Lead (USEPA Technical Review Workgroup for Lead 2000).

For the HHRA, the IEUBK was used in two ways: (1) using the EPA recommended default parameters and site-specific soil and house dust concentrations and (2) using site-specific parameters derived from conditions observed within the Bunker Hill Box. The default approach is representative of conditions assuming no action has occurred. The site-specific analysis reflects local conditions including ongoing actions taken to reduce childhood lead exposure. The site-specific model (hereafter referred to as the Box model) was calibrated using paired blood lead and environmental data collected from ongoing remedial activities in the Box. The Box data included more than 10 years of information regarding lead in blood, soil, and dust. Approximately 4,000 children have participated in annual blood lead surveys in the Box since 1988.

Specifically, the Box model differed from the default model in two ways: (1) the Box model reduced the bioavailability input from 30 percent to 18 percent and (2) accounted for exposure to "neighborhood" soil in addition to yard soil and house dust. The results of the Box model are the basis for the 700 mg/kg soil action level described in this ROD. If the default model were used, a soil action level of 400 mg/kg would have been required to meet the target risk of a typical child having no more than a 5 percent probability of a blood lead level of 10 μg/dL or higher. The results of the Box model are supported by the quantitative analysis of the paired blood lead and environmental data. The regression analysis, which related blood lead levels to soil, dust, and paint lead exposure variables, indicated that blood lead levels are most strongly influenced by lead in house dust. Both contaminated soils and lead-based paint were identified as contributors to house dust lead levels in the Basin.

There are many uncertainties in assessing risks to people from chemicals occurring in the environment. These are described in more detail in Chapter 7 of the HHRA. Uncertainty reflects limitations in knowledge and simplifying assumptions that must be made in order to quantify health risks. Risk assessments involve several components, including analysis of toxicity and exposure, each with inherent uncertainty. The major uncertainties include representing chemical concentrations in environmental media, quantifying how people come in contact with chemicals, interpreting the toxicological significance of the exposure, and predicting how conditions may change in the future. In the case of lead, uncertainties related to exposure to adverse health effects are reduced by reliance on blood lead as a measure of risk. For example, the uncertainties of the Box model were less than those typically encountered at CERCLA sites due to the use of the extensive Box database, which includes comprehensive environmental air, soil, and dust data, paired with blood lead screenings conducted annually since 1988. The screenings consistently recruited 50 percent or more of the eligible children living in the Box. In addition, for both lead and arsenic, the understanding of toxicity is better than most based on epidemiological and laboratory studies that have been subjected to multiple scientific reviews (NAS 1993, 1999, and 2001).

7.1.1 Baseline Risk Assessment, Harrison to Mullan

There are four primary tasks in a baseline risk assessment: (1) identification of COPCs; (2) exposure assessment; (3) toxicity assessment; and (4) risk characterization. Risk characterization is the summarizing step of risk assessment. The risk characterization integrates information from the preceding components of the risk assessment and synthesizes an overall conclusion about risk that is transparent, reasonable, and useful for decision-makers. The risk assessment process identifies COCs that represent an ongoing or potential threat to human health for particular groups of people at particular locations. As previously noted, this section focuses on the COCs identified as the risk drivers for response actions described in this ROD, and does not summarize the entire risk assessment.

Due to the large geographical area involved, the study area (from Harrison to Mullan) was divided into eight principal subareas for the HHRA. These sub-areas were defined around existing communities, including consideration of identified routes of potential human exposure, public use patterns, and the results of environmental annual blood lead screening in each area. The geographic areas are described in Section 5.1.1 of this ROD.

Identification of COCs

A total of eight metals were initially selected as COPCs and evaluated in-depth in the HHRA. Two metals – lead and arsenic – have been identified as the COC's for the response actions described in this ROD. Lead is the primary COC because lead exposures are predicted to exceed target health goals at the largest number of locations and blood lead levels above 10 μg/dL are observed in the Basin. Arsenic is identified as a COC because concentrations exceeded target health goals the second most frequently, although significantly less often than lead. Other metals with media-specific concentrations exceeding health goals, such as cadmium and iron, were limited to isolated locations or were co-located with lead and arsenic, and therefore are not a primary concern. However, under certain circumstances, actions may be taken to address cadmium in drinking water in private wells where cadmium may not be co-located with arsenic and/or lead. Cadmium in drinking water was not found to be a concern in the majority of the Basin; only five homes out of 100 had water concentrations exceeding cadmium's MCL. Only one of these five homes also exceeded cadmium's health-based PRG in tap water. All of these homes were on private wells and alternate sources of water have been provided to residents. Cadmium is a COC under a future drinking water scenario if groundwater near source areas in the vicinity of Ninemile and Canyon Creek were ever used as a drinking water source. Based on cadmium MCL exceedances in groundwater, both in current drinking water from private wells and future drinking water scenarios, cadmium in private wells will be addressed by the Selected Remedy described in this ROD.

Tables 7.1-1 through 7.1-4 present all chemicals and scenarios with risks and hazards above target health goals that will be addressed by the Selected Remedy. These tables provide exposure point concentrations (EPCs) for each of the chemicals detected in each media and scenario for each of the evaluated areas. The EPCs were used in the risk equations to calculate cancer risks and non-cancer hazards. The table includes the range of concentrations detected for each COC, the EPC, and how the EPC was derived. Lead and arsenic concentrations are shown in these tables as are cadmium, iron, and zinc in the limited places where exposure to these additional chemicals resulted in hazards exceeding target health goals.

The majority of the COPCs were COCs for one of the two Lower Basin subsistence scenarios evaluated in the HHRA, referred to as the traditional scenario. For the modern subsistence scenario, the COCs were lead and arsenic. Subsistence scenarios are discussed separately in Section 7.1.1 Subsistence Scenarios because the Selected Remedy does not address risks/hazards from Lower Basin subsistence lifestyles. The chemicals and media exceeding target health goals for subsistence receptors are shown on Table 7.1-5.

Exposure Assessment

The exposure pathways reviewed, including pathways evaluated qualitatively and quantitatively evaluated are presented in Table 7.1-6, which presents the conceptual site model for human health in tabular form. The receptors and pathways evaluated are in the following five current exposure scenarios:

- Residential—evaluated for children and adults who live in the Basin. This evaluation was conducted for a variety of pathways with potential exposure to affected media in the home, in the yard and community, and from homegrown vegetables. In addition, a potential future drinking water evaluation for shallow groundwater in the Burke/Nine Mile area was performed. In general, EPA default exposure factors for residential exposures were used to quantify risks. The exposure factors are presented on Table 7.1-7.

- Neighborhood recreational—evaluated, in addition to the residential scenario, for community soils (lead only), and incremental exposures for elementary-aged school children at play in neighborhood creeks (exposure to sediments and surface water) and waste piles. Site-specific exposure factors were generally used for this scenario and are presented in Table 7.1-8.

- Public recreational—evaluated for children and adults who use developed parks and playgrounds, and undeveloped recreational areas, whether they are residents or visitors. Exposure scenarios included the incidental ingestion of soils, sediments, and surface water and the ingestion of fish by sport fishermen.

Site-specific exposure factors were generally used for this scenario and are presented in Table 7.1-9.

- Occupational—evaluated for adult construction workers who would have relatively short-term exposures to surface and subsurface soils during construction projects. EPA default exposure factors for occupational exposures were used to quantify risks, see Table 7.1-10.

- Subsistence—evaluated for two scenarios for both children and adults practicing a subsistence lifestyle, traditional and modern. All subsistence scenarios were assumed to take place within the confines of the Lower Basin. The traditional subsistence lifestyle assumed people live in the flood plain of the lower Coeur d'Alene River and practice an aboriginal lifestyle. The modern subsistence lifestyle assumed people migrate to the flood plain during the summer and engage in subsistence activities. In either scenario, people were assumed to consume native vegetation and fish containing metals, although consumption rates for the modern subsistence scenario were lower.

The risks from the presence of lead and other metals were evaluated separately for each of the scenarios.

Toxicity Assessment

Table 7.1-11 provides cancer and non-cancer risk information relevant to the eight COPCs evaluated in the risk assessment for soil, sediment, fish, and vegetables. Arsenic is the only carcinogen.

Lead is evaluated by comparing predicted blood lead levels from site exposures with blood lead levels known to be a health concern. The toxicity of lead is well understood and a wealth of human data is available from many years of study that links specific health effects to levels of lead in the blood. Lead induced neurological effects and decrements in IQ have been affirmed by multiple consensus reviews prepared by EPA, the National Academy of Sciences (NAS), the CDC, and the Agency for Toxic Substances Disease Registry (USEPA 1986, NAS 1993, CDC 1991, DHHS 1999).

The 1993 NAS lead review concluded the following:

> *The toxic effects of lead range from recently revealed subtle, subclinical responses to overt serious intoxication. It is the array of chronic effects of low-dose exposure that is of current public-health concern…We have several reasons for emphasizing low-dose exposure. As recently noted by (Landrigan 1989), the*

> *subtle effects of lead are bona fide impairments, not just inconsequential physiologic perturbations or slight decreases in reserve capacity.*

The NAS has received a request and is considering a peer review of the scientific information and risk analysis that forms the basis of the Selected Remedy described in this ROD.

While lead is a systemic poison (i.e., it adversely affects many systems and organs in the body), the effect of greatest concern at blood lead levels observed in the Basin is lead's potential to cause neurological developmental effects in children. Pregnant women also are a sub-population sensitive to the effects of lead. Recognition of low-dose health effects and the need for primary prevention is accepted among mainstream medical groups (see the American Academy of Pediatrics Statement at: http://www.aap.org/policy/re9815.html or the CDC Lead Prevention Fact Sheet http://www.cdc.gov/nceh/lead/factsheets/leadfcts.htm). Recent studies have suggested that clinical treatment (chelation therapy), which effectively lowers blood lead levels in treated children, is unable to prevent subtle neurological health effects (Rogan et al. 2001). Furthermore, subtle health effects may occur at blood lead levels below 10 µg/dL. Correlation and regression analyses of data on blood lead levels and various health outcomes point to a spectrum of undesirable effects that become apparent in populations having a range of blood lead levels from 10 to 15 µg/dL. These include effects on heme metabolism and erythrocyte pyrimidine nucleotide metabolism, serum vitamin D levels, mental and physical development of infants and children, and blood pressure in adults (USEPA 1990a and b; Wasserman et al. 1994; Rothenberg et al. 1999). Although correlations between blood lead levels persist when examined across a range of blood lead levels below 10 µg/dL, the risks associated with blood lead levels below 10 µg/dL are less certain (Schwartz 1994). More recent literature further supports the possibility of adverse consequence of exposures that result from blood lead levels below 10 µg/dL (Lanphear et al. 2000).

The toxicity criteria for arsenic also are based on human data. Both the slope factor and the reference dose for arsenic are derived from human epidemiological studies of long-term exposure to arsenic in drinking water. The arsenic health effects of concern are skin, lung, and bladder cancers and adverse non-cancer effects on the skin and circulatory system (NAS 1999, 2001).

EPA's reference dose (RfD) for iron is provisional at this time. Because iron is an essential nutrient, the RfD must be protective of both iron deficiency and iron toxicity. Iron's provisional RfD is the upper limit of mean dietary iron intakes (dietary plus supplemental) from the second National Health and Nutrition Examination Survey (NHANES II) database, which contains information from 20,000 individuals. This upper limit is the highest available value that ensures sufficient iron to protect against iron deficiency and is not associated with adverse health effects for the American population aged 6 months to 74 years, i.e., lifetime exposures. However, certain sub-populations such as infants, pre-adolescent children, and pregnant women require higher intakes than the RfD for less than lifetime exposures (as long as 12 years for children). As a result, there is insufficient information at this time to quantify the dose that is associated with toxic effects and it is not known how much higher the provisional RfD could be and still not be associated with toxicity. Iron toxicity to children in the United States has been associated primarily with poisoning incidences from iron supplements where relatively large amounts of iron were ingested (Berkovitch et al 1994; Morse et al 1997). Consequently, iron exposures in the Basin that were up to two times iron's RfD are not likely to present a serious health concern. Since Basin exposures to iron are below two times the RfD, iron exposures are unlikely to present a health concern and are not the focus of remedial actions described in this ROD.

Risk Characterization

Lead health risks are discussed separately from non-lead risks because the methodologies for assessing risk are different.

Lead Risk Summary. Lead health risk methods are unique owing to the ubiquitous nature of lead exposures and the reliance on blood lead concentrations to describe lead exposure, toxicity, and risks. Lead risks are characterized by predicting blood lead levels with computer models and guidance developed by EPA (USEPA 1994c and 1998c).

In contrast to risk assessment methodologies for cancer or non-cancer risks, lead risk assessments use central tendency exposure values to predict a central tendency (geometric mean) blood lead level, rather than the reasonable maximum exposure values used in non-lead risk assessments. The predicted geometric mean blood lead level is then used in conjunction with a modeled log-normal distribution to estimate the probability of exceeding a blood lead level of 10 µg/dL. This emphasis on blood lead integrates exposure, toxicity, and risk, which are separated in other types of risk assessment. For other chemicals, risk is described in terms of an external dose (e.g., mg/kg-day).

As previously mentioned, the EPA IEUBK Model was used to evaluate lead risks and to develop soil action levels to achieve target health goals for reducing lead exposure pathways for children. These goals are described in EPA national guidance (USEPA 1998c), which recommends that a "soil lead concentration be determined so that a typical child or group of children exposed to lead at this level would have an estimated risk of no more than 5 percent of exceeding a blood lead of 10 µg/dL." The guidance recommends that risks be assessed using an exposure unit defined as the individual residence and other areas where routine exposures are occurring. The guidance also recommends the evaluation of blood lead data where available, while noting that blood lead data should "not be used alone to assess risk from lead exposure or to develop soil lead cleanup levels." The HHRA was developed consistent with national guidance.

Tables 7.1-12a and 7.1-12b show the results of the default risk model and the Box model, and present the lead soil concentrations that would result in more than a 5 percent probability that a typical child would exceed a blood lead level of 10 μg/dL. The results of the Box model, which was the better predictor, indicate that children in the Upper Basin are predicted to have a greater than 5 percent risk of exceeding the 10 μg/dL blood lead level of concern for the baseline residential exposure scenario. Lower Basin children from homes located in the flood plain, or those that engage in extended recreational activities in flood plain areas, also are at a greater than 5 percent risk of experiencing elevated blood lead levels based on estimated soil concentrations in those areas.

Site-specific analysis of blood lead data paired with environmental lead data suggests exposure pathways that reflect exposures at both individual residence and neighborhood levels. The analysis showed that, for most children, the home is the largest source of lead exposure. Blood lead levels appear to be most closely related to lead in house dust (Figure 7.1-1) followed by effects of lead in yard soil, the condition of interior lead-based paint, and the lead content of exterior paint. House dust lead concentrations are total lead in dust and thus include all sources of lead, such as lead dust from yard and neighborhood soils and paint.

The HHRA concluded that both lead in soils and paint will need to be addressed to effect sufficient reductions in house dust lead concentrations. Site-specific analysis of alternative risk reductions scenarios, summarized in Tables 7-12a and 7-12b, indicate that reduction of soil lead concentrations to less than 700 mg/kg will be necessary to achieve the 5 percent risk criteria. Programs for paint abatement and stabilization would be developed and implemented concurrently with the soil remediation activities to mitigate exposure and minimize recontamination.

Significant exposures also may result from recreation in areas with high lead concentrations in the Upper Basin and throughout the floodplain areas west of the Box. This is a likely reason for the higher than predicted blood lead levels observed among Lower Basin children. Currently signs are posted at various Lower Basin recreational areas describing the hazards of lead and providing information on how lead exposures can be prevented during recreational activities. Additionally, swimming and water sport activities in disturbed sediment-laden surface water can result in substantial increases in intake and lead absorption. Potential exposures to neighborhood stream sediments in the Burke/Ninemile area and at public swimming areas in the Lower Basin are of particular concern.

Non-Lead Metals Risk Summary. Summaries of the non-lead metal pathway/exposure scenarios that exceed target risk goals are presented in Tables 7.1-13 through 7.1-19.

Health risks for chemicals that cause cancer are calculated differently than those for chemicals that cause non-cancer health effects. For non-cancer risks, if a person is exposed to a chemical dose equal to or less than the "threshold," no adverse effects are expected. The "hazard quotient" for a chemical is the exposure dose from the site (mg/kg-day) divided by the RfD (mg/kg-day). If the hazard quotient is near 1, then no adverse effects are anticipated. Cancer risks are calculated assuming that carcinogens, at any non-zero dose, contribute to cancer risk. Cancer risks are presented as the incremental increase in the likelihood of developing cancer. A cancer risk level of 1×10^{-6} describes an incremental increased risk of one in a million for a given individual. EPA uses the general excess order of magnitude risk range of (10^{-6} to 10^{-4}) (1/1,000,000 to 1/10,000) as a "target range" within which risks are managed as part of a Superfund cleanup. Cancer risks exceeding 10^{-4} and hazard quotients greater than 1 are discussed below. Note that all final risk and hazard estimates are presented to one significant figure only in the summary tables as recommended by EPA (USEPA 1989a) to reflect the uncertainty and imprecision of the estimates. Therefore, a hazard quotient of 1 could range between 0.95 and 1.4 and a risk of 2×10^{-5} could range between 1.5×10^{-5} and 2.4×10^{-5}.

The results of the risk characterization for non-lead metals reported in the human health risk assessment indicate that some exposure areas could pose an unacceptable threat of non-cancer effects for some individuals and exposure media under Reasonable Maximum Exposure (RME) conditions. The RME is defined as the highest exposure that is reasonably expected to occur at a site (USEPA 1989a).

Hazards are greatest for children up to 84 months of age exposed to metals in yard soils, and arsenic was the chemical with the highest hazards. Other media/scenarios with exceedances above target health goals are young children and children/adults in the Burke/Ninemile area who could ingest cadmium and zinc in groundwater in the future (groundwater in the Burke/Ninemile area is not currently used as a drinking water source), and children/adults ingesting cadmium in homegrown vegetables. Since lead and cadmium are co-located in garden soils ($r^2 = 0.9$), the Selected Remedy will address risks associated with cadmium in homegrown vegetables through the remediation of lead-contaminated garden soils. Iron hazards also exceeded one or contributed significantly to the total hazard exceeding one in a number of areas. However, iron is not a focus of the Selected Remedy because (1) it is co-located with lead and arsenic in the limited areas where its hazard quotient exceeded one, and (2) there are uncertainties surrounding its toxicity because it is an essential nutrient.

Arsenic is the only carcinogen evaluated at the site. Only cancer risks estimates for residential exposures in the Lower Basin and the Side Gulches were equal to or exceeded 10^{-4}. All other individuals in all other exposure areas had cancer risks within EPA's acceptable cancer risk range. Cancer risks are summarized on Tables 7.1-13 and 7.1-19 for residential and subsistence scenarios, respectively. For the residential scenarios, yard surface soil contributed the most to cancer risk and, in the Side Gulches, tap water in private wells also contributed significantly to cancer risk (see Table 7.1-13). The HHRA concluded that arsenic concentrations in some Basin yard soils may need to be addressed, independently of lead, to reduce risks and hazards. Table 7.1-20 provides various potential soil cleanup levels for arsenic based on a variety of target risk goals and exposure scenarios. In general, arsenic risks did not exceed target risk goals in drinking water, however, high concentrations of arsenic in a few scattered private wells may be a health concern (no arsenic concentrations in any tap water sampled thus far exceeded the new MCL of 10 μg/L).

No single neighborhood recreational cancer risks or non-cancer hazards exceeded target health goals in the Upper Basin or Lower Basin; therefore, this scenario is not included on the risk/hazard summary tables in this document. However, the Lower Basin, Kingston area, Side Gulches, and Burke/Ninemile area presented hazards near the target hazard index of one and risks were in the low 10^{-5} range. Thus, some combinations of child/adult residential plus neighborhood recreational scenarios could result in hazard/risk estimates that are higher than those discussed in this summary (other combinations than these two could also result in higher risks).

There were no exceedances of target health goals for the occupational scenario viewing the Basin as a whole; however, individual projects in specific locations where high-concentration materials might be disturbed would need to ensure workers are not over-exposed.

Subsistence Scenarios

While subsistence exposures could not be evaluated using the IEUBK Model because the magnitude of these exposures exceeded constraints of the Model, estimates of subsistence lead intake were evaluated. For subsistence lifestyles practiced in the Lower Basin, blood lead levels significantly above 10 μg/dL would be likely, which is of particular concern for children and pregnant women as discussed above. These exposures include but are not limited to, recreating on contaminated beaches, swimming in the Coeur d'Alene River, gathering and eating water potatoes and other tribal cultural plants throughout the wetlands, and eating large amounts of fish.

All populations and pathways for subsistence lifestyles, including fish and water potatoes, exceeded target risk goals for non-lead metals, see Figures 7.1-2 through 7.1-4 and Tables 7.1-17 through 7.1-19. For the Modern Subsistence scenario, arsenic and iron were the only chemicals with hazard quotients greater than 1, similar to residential hazards. For the Traditional Subsistence scenario, methylmercury in fish, manganese in soil and sediment, and cadmium in water potatoes also had hazard quotients greater than 1 in addition to arsenic and iron.

Surface soil and sediment contributed the most to cancer risks for the subsistence scenarios. Cancer risks were higher than residential risks for the Modern Subsistence scenario, but similar to those for the highest residential exposures. Risks for the Traditional Subsistence scenario were an order of magnitude higher than those for the residential scenario.

7.1.2 Summary of Screening Level Risk Assessment, Coeur d'Alene Lake

Unlike the HHRA, risks were not estimated for the Coeur d'Alene Lake screening level risk assessments. Rather, site-specific "safe" levels of COPCs were calculated based on recreational usage. The calculated levels are referred to as risk-based concentrations (RBCs), and site concentrations were compared to the calculated levels. A screening approach was selected for this area (CSM Unit 4) to expeditiously determine if recreational use presented an unacceptable risk to people frequenting the beaches.

Twenty-four beaches and wading areas adjacent to Coeur d'Alene Lake and the Idaho portion of the Spokane River were included in the screening level evaluation. EPA, the local health department, and BLM personnel familiar with the area selected the 24 beaches and parks most frequently used by the public as areas of concern. Sampling activities were conducted at these common use areas (CUAs) to collect surface soil, sediment, and water. Analytical results for seven COPCs (the same as in the HHRA, except manganese and iron, which were excluded because concentrations were sufficiently low, and copper, which was included because it was a concern in the Box) were compared to RBCs considered protective of human health under recreational use conditions. CUAs identified as exceeding a RBC were further evaluated in the HHRA. In contrast, sites with concentrations below the health-protective RBCs were considered to pose no public health risks and were excluded from further consideration.

Because children are the most sensitive population group, RBCs were developed to ensure protection of children and these RBCs would also be protective of adults. The RBC for soil and sediment assumes children will be exposed to beach sand through ingestion and dermal contact and will ingest more soil (i.e., eat more dirt) than they would in their home setting on a daily basis. The RBC for water assumes children will play in the near-shore area and be exposed to site chemicals through incidental ingestion of disturbed (or stirred-up) sediments in water and through dermal absorption of chemicals. Children are assumed to play in soil/sediment and water two days per week (all day, 10+ hours) for four months of the year.

Lead RBC values were calculated using the IEUBK Model for lead. RBCs were calculated using EPA's target risk goal of a typical child having no more than a 5 percent risk of a blood lead level above 10 µg/dL. An initial soil/sediment RBC of 1,400 mg/kg was identified as protective at beaches if soil at the homes contained no greater than 200 mg/kg of lead. If lead concentrations in soil or sediment exceeded 1,400 mg/kg, then the CUA was retained for further evaluation. After screening soil, a second step involved combining sediment and surface water exposures. If combined exposures resulted in a predicted risk of a typical child having greater than a 5 percent risk of exceeding a blood lead level of 10 µg/dL, then the site was retained for further evaluation.

For chemicals other than lead, RBCs were calculated using standard EPA risk equations and solving for a concentration. Target risk goals were established at 1 x 10^{-5} for carcinogens and a hazard quotient of 0.1 for non-carcinogens (one-tenth of the EPA RfD). Arsenic was the only carcinogen evaluated in this assessment. Arsenic has both carcinogenic and non-carcinogenic potential effects. The RBC for arsenic was selected based on non-carcinogenic potential in children because this RBC was lower than the RBC based on the cancer endpoint. Furthermore, because arsenic's soil RBC is below an estimate of its natural background concentration of 35 mg/kg for the Lake Coeur d'Alene area, site soil and sediments were screened against the background level rather than the RBC.

Once calculated, RBCs were compared to an upper 95th confidence limit of the arithmetic mean for non-lead chemical concentrations in soil, sediment, and surface water at each site. For lead, the arithmetic sample mean was used as the exposure point concentration. Drinking water concentrations (only two locations had a drinking water source) were compared to drinking water MCLs.

The comparison of RBCs to site concentrations revealed that only two of the 24 sites evaluated had chemicals in soil and sediment exceeding their respective RBC, Harrison Beach North and Blackwell Island. Lead and arsenic were present in concentrations above the RBC and were identified as COCs at Harrison Beach North and at Blackwell Island in soil and sediment. In addition, lead in drinking water at the Harrison Beach Campground was found to be approximately equal to the tap water action level for lead (lead does not have an MCL; instead, tap water levels requiring differing "actions" are set based on certain criteria). These two areas were retained for further evaluation in the HHRA. The other 22 sites required no action. The HHRA concluded that Blackwell Island did not have risks above target health goals (see Section 7.1.1); therefore, no actions are required at that location. Harrison Beach was evaluated in the HHRA as part of the Lower Basin area and has been remediated as part of the UPRR removal action.

The HHRA recognized fish consumption in Coeur d'Alene Lake as a data gap; therefore, a comprehensive fish sampling field effort was started in 2002.

7.1.3 Summary of Screening Level Risk Assessment, Spokane River, Washington State

The Spokane River screening evaluation followed the methodology for the Coeur d'Alene Lake screening evaluation—RBCs were developed and CUA concentrations were compared to the RBC values. CUAs with metal concentrations in sediment below the RBCs were considered to require no further actions, while CUAs with concentrations over RBCs were further evaluated. The same COPC metals that were identified in the HHRA were evaluated along the Spokane River.

Eighteen CUA sites located on public and private lands along the banks of the Spokane River, from the Washington/Idaho border to the confluence with the Columbia River were selected for sampling (CSM Unit 5). As with the Coeur d'Alene Lake sites, CUA selection involved personnel from local agencies (Washington Department of Ecology, Spokane Regional Health District, USFS) and local stakeholders providing information to the EPA on the areas most frequently used by people where the largest amounts of fine-grained sediment were regularly deposited. The rocky and boulder-dominated beach areas along the upper river are generally not a health concern because it is the finer-grained shore-line sediments that stick to children's hands and are ingested. Finally, because the northern side of the lower Spokane River near the confluence with the Columbia River is tribal land, the Spokane Tribe of Indians provided information to EPA on the areas most frequently used by the Tribe.

The RBCs developed for the Spokane River, Washington were similar to those developed for the Idaho Lake sites in that they were based on recreational river use and child exposures two days per week for four months a year. However, because of requests made in public participation forums by concerned residents and differing regulations in Washington State than in Idaho, different lead model inputs and target health goals were used to develop the Spokane RBCs. In addition, the Spokane area has different background concentrations of metals than the area surrounding Coeur d'Alene Lake. Therefore, the RBCs developed for the Spokane sites were not the same as those developed for Coeur d'Alene Lake. Lead in particular is lower, 700 mg/kg rather than 1,400 mg/kg. Although the screening levels differed in the two screening assessments, the final lead action levels along the Coeur d'Alene River, Lateral Lakes, and the Spokane River are consistent at 700 mg/kg.

Assumptions regarding the amount of soil, dust, and beach sediment ingested were different for the Spokane River than those used for Coeur d'Alene Lake. The Spokane assessment did not include suspended sediment ingestion as was done for Coeur d'Alene Lake and the Spokane RBC was based on differential weighing of exposures between river and the residence. For the Spokane River assessment, the weighting was reversed to give two-thirds weight to the River exposure during exposure days. For Coeur d'Alene Lake, during each of the two days per week of exposure, two-thirds of the exposure came from the residence and one-third came from the Lake.

The arsenic RBC is lower because of the target health goal of 1×10^{-6} required for use in Washington State rather than the 1×10^{-5} goal used in Idaho and because background arsenic concentrations in the Spokane area are also lower. The selected RBC for arsenic of 10 mg/kg is a local natural background concentration for the metal as identified by the Washington State

Department of Ecology (Ecology 1994). This background value is based on upland soil analysis, not sediment sampling.

For each metal except lead, the RBC was compared to a 95 percent upper confidence limit (UCL_{95}) of the mean concentration in sediment at each CUA. The lead RBC was compared to the mean concentration. Generally, measured concentrations of the metals were highest upstream of the Upriver Dam pool (that is, approximately river mile 84) and were considerably lower downstream of this area. For most locations downstream of Upriver Dam, sediment concentrations were only slightly elevated above background concentrations. While the RBCs were developed to be protective only of recreational-type exposures, the beach concentrations downstream of Upriver Dam indicate no use restrictions for other types of exposures that would be required to protect public health.

Of the 18 CUAs evaluated, only one, River Road 95, had both lead and arsenic concentrations exceeding the RBCs. Three additional CUAs (Harvard Road North, Barker Road North, and North Flora Road) had arsenic concentrations over the arsenic RBC of 10 mg/kg. Arsenic concentrations at these locations represent cancer risks in the 10^{-5} range, above Washington State's target risk goal of 1×10^{-6} for the general public. Therefore, these four areas were retained for further evaluation. Arsenic and lead concentrations at these four locations are presented on Table 7.1-21.

Arsenic concentrations exceeded the RBC at 6 of the 18 sites: Harvard Road S., Plante's Ferry Park, People's Park, Riverside Park at W. Fort George Wright Bridge, Jackson Cove, and Horseshoe Point Campground. However, for these sites, there are additional areas of uncertainty that may warrant consideration. These are:

- The concentrations of arsenic were only marginally greater than the natural background concentration of 10 mg/kg.
- The arsenic concentrations at the six beaches ranged from 12 to 16 mg/kg, which may be within the natural background range for fine particles of river sediments. (The Spokane arsenic background concentration of 10 mg/kg is based on particles of a larger size than the sampled particles, and the larger-size particles sampled from the Spokane River had lower concentrations.)
- The additional cancer risk from exposures to arsenic concentrations of 2 to 6 mg/kg greater than the background concentration is not significantly greater than the risk due to naturally occurring levels of arsenic (an increase in the chance of developing cancer of 1 to 2 in 1,000,000). Note that there are risks above 1×10^{-6} from exposures to the natural background concentration of 10 mg/kg.

The screening-level risk assessment did not evaluate fish consumption along the river; however, the USGS sampled fish for the State of Washington Department of Ecology in the area and analyzed them for several metals, including lead. The lead data from whole fish was evaluated in the HHRA for the subsistence scenarios and some lead concentrations in the whole fish data were found to be a potential concern (contributing to blood lead levels above the target health goal) for children and pregnant women if they ingested large amounts of fish. Lead concentrations in filet and whole fish are presented on Table 7.1-22.

In response to metals contamination, the Washington State Department of Health and Spokane Regional Health District have issued two health advisories for the upper reaches of the Spokane River. The first advisory alerts visitors to the presence of elevated lead in shoreline and beach sediments frequented by river and park users. The second alerts visitors to elevated lead concentrations in fish. Recommended fish consumption limits for children and adults have been established, with particular emphasis toward children and pregnant women or women considering pregnancy.

The locations identified in the screening level risk assessment as above RBCs or background levels were further assessed by EPA in coordination with the State of Washington Department of Ecology. Additional sampling was performed in depositional areas upstream of Upriver Dam. Analysis of these additional data resulted in 10 beaches selected for cleanup (the four identified in the screening level risk assessment, plus six additional depositional areas identified in subsequent sampling events, see Figure 12.4-1 for locations). These 10 beaches were identified for cleanup in accordance with the State of Washington Model Toxics Control Act (WAC 173-340-740).

7.1.4 Basis for Remedial Action

The response actions selected in this ROD are necessary to protect human health and the environment from both ongoing and threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment. A summary of risks to human health is presented below.

Specifically for the Upper Basin and Lower Basin:

- The Box model predicts lead risks above target risk goals for approximately 25 percent of the residential yards in the Basin.
- Analyses show that lead in house dust is the primary pathway of exposure for children, and that yard and community soils and lead paint contribute lead to house dust.

- Lead exposure in other areas, recreational soils and sediments, whole fish, and waste piles may contribute significantly to children's blood lead levels.

- Predicted arsenic exposures from yard soils in the Upper Basin and Lower Basin and from drinking water in selected private wells exceed target health goals. Generally, arsenic exposure occurs in yards requiring remediation for lead exposure.

- A small number of private wells exceed the MCL for cadmium.

- Cadmium and zinc levels in shallow groundwater near Canyon Creek and Ninemile Creek are predicted to result in hazards above target health goals if the water is used as a drinking water source in the future.

- Cadmium levels in homegrown vegetables result in hazards above target health goals.

- Risks above target health goals are predicted for all chemicals and media if subsistence lifestyles are practiced in the Lower Basin.

Specifically for Coeur d'Alene Lake:

- No sites exceeded target health goals; thus, actions are not required around the lake to protect human health except at Harrison Beach, which has been remediated as part of the UPRR removal action.

- Fish species caught for human consumption are being sampled in 2002.

Specifically for Spokane River, Washington:

- Four locations between Upriver Dam and the Idaho border exceeded background concentrations for arsenic, equating to an incremental increase in cancer risks from recreational use in the 10^{-5} range, above Washington State's target cancer goal of no more than a 1×10^{-6} additional chance of contracting cancer for exposure from a site.

- One of the above four locations exceeded the RBC for lead, indicating potential risks to children of exceeding the 10 µg/dL level of concern.

- Lead concentrations in fish, both whole and filet, could potentially contribute to blood lead levels above the 10 µg/dL level of concern.
- Further assessment of additional beaches (not evaluated in the initial screening level assessment) by Washington State under the State's Model Toxics Control Act (MTCA) regulations resulted in six additional beaches selected for cleanup due to concentrations above RBCs and/or background concentrations under MTCA protocols. These six beaches plus the four locations identified in the screening level risk assessment were selected as requiring actions to protect human health.

At present, the risks to persons, including Spokane tribal members and others who may practice a subsistence lifestyle in the Spokane River area, are not fully understood. EPA and the Spokane Tribe are cooperating in planning additional testing and studies that will be implemented to evaluate the potential exposures to subsistence users. The results of those tests and studies will determine appropriate future response actions to be taken, if any.

As previously mentioned, the Selected Remedy includes a complete remedy for protection of human health in the communities and residential areas of the Upper Basin and Lower Basin. Certain potential exposures outside of the communities and residential areas of the Upper Basin and Lower Basin are not addressed by this ROD, and will continue to present risks of human exposure to hazardous substances. These potential exposures impacting human health include:

- Recreational use at areas in the Upper Basin and Lower Basin where cleanup actions are not implemented pursuant to this ROD
- Subsistence lifestyles, such as those traditional to the Coeur d'Alene and Spokane Tribes
- Potential future use of groundwater that is presently contaminated with metals

7.2 SUMMARY OF ECOLOGICAL RISKS

The EcoRA for the Coeur d'Alene Basin (USEPA 2001a) was prepared as part of the Coeur d'Alene Basin RI/FS. The report characterized risks for aquatic and terrestrial organisms (i.e., plants and animals) exposed to hazardous substances associated with mining activities in the Coeur d'Alene River Basin in Idaho and the (downstream) Spokane River in Washington. The EcoRA evaluated potential threats to the environment in the absence of any remedial action under current and future land uses (which are assumed to be similar to current land uses for the purpose of assessing ecological risks). It identified and characterized the toxicity of chemicals of potential ecological concern (COPECs), possible exposure pathways, ecological receptors, assessment and measurement endpoints, and a range of possible risks under current conditions. These aspects of the document are explained in the various sections of the EcoRA and are summarized below.

EPA established the Coeur d'Alene Basin Ecological Risk Assessment Work Group (EcoRA Work Group) to provide an avenue for stakeholder input during development of the EcoRA. Membership in the EcoRA Work Group was open to any parties who expressed an interest and asked to be included. Using regularly scheduled teleconferences and milestone meetings, the EcoRA Work Group provided a forum by which interested parties could be involved early and often in the evaluation process. Groups to which information was provided include the State of Idaho, State of Washington, Coeur d'Alene Tribe, Spokane Tribe, Colville Tribe, USFWS, and other governmental partners, public interest group members, newspaper reporters, legislative staffers, mining company representatives, and other parties.

The EcoRA study area was the same as the RI/FS study area, which is described in Section 1.0 (Figure 1.0-1). It included the Coeur d'Alene River and associated tributaries, Coeur d'Alene Lake, and the Spokane River downstream to the Washington State Highway 25 bridge at Fort Spokane on the Spokane Arm of Lake Roosevelt. Collectively, this area is referred to as the Coeur d'Alene Basin. The specific portion of the study area upstream of Coeur d'Alene Lake is usually referred to as the Upper Basin and Lower Basin.

The study area was divided into five units (called conceptual site model [CSM] units) that were differentiated based on geomorphology, mixes of hazardous substances, and habitats (Figures 7.2-1 through 7.2-5). As a result of differences in habitats among the CSM units, the ecological receptors also vary, as discussed below in the next section (Habitat Types). The CSM units are briefly described here.

CSM Unit 1 (Figure 7.2-1) contains many of the primary sources for mining-related hazardous substances (metals) including mine workings, waste rock and other mining waste, mine tailings, concentrates, and other process wastes, and artificial fill (tailings and waste rock in roads, railroads, and building foundations). CSM Unit 1 includes the upper watershed of the South Fork (above Wallace) and associated creeks (Canyon Creek and Ninemile Creek). It also includes Prichard Creek, Beaver Creek, Moon Creek, Big Creek, and Pine Creek, all of which discharge to the North Fork or into the South Fork downstream of Wallace.

CSM Unit 2 (Figure 7.2-2) contains the remainder of the primary sources of mining-related hazardous substances within the surface water and sediments of mid-gradient streams and small tributaries within the main stem watershed downstream to Cataldo. Most of the Bunker Hill Superfund Site is in CSM Unit 2. The primary sources within this CSM unit are similar to those in CSM Unit 1.

CSM Unit 3 (Figure 7.2-3) consists of the low-gradient part of the main stem of the Coeur d'Alene River, from the Old Highway Bridge at Cataldo to Coeur d'Alene Lake. It includes the lateral lakes that occur within the floodplain of the river. Mining-related hazardous substances within this CSM unit are found in the beds and banks of the river, contaminated floodplain soils, surface water, groundwater, and biota (plants and animals) that have accumulated metals.

CSM Unit 4 (Figure 7.2-4) consists of Coeur d'Alene Lake, where mining-related hazardous substances include contaminated sediments and surface water. In addition, nutrients are of significant concern because they can change the trophic status of the lake and can cause secondary releases of metals from contaminated sediments.

CSM Unit 5 (Figure 7.2-5) consists of the Spokane River. Mining-related hazardous substances are found mainly in contaminated sediments and surface water.

The EcoRA included three main components, including Problem Formulation, Analysis, and Risk Characterization. These phases are presented in various sections of the EcoRA report, and key portions are briefly summarized here.

7.2.1 Habitat Types

Within the Basin, ecological risks associated with mining-related hazardous substances were evaluated within six habitat types. The occurrence of these habitats within different portions of the Basin varies, and the typical species associated with the habitats also vary from one portion of the Basin to another. The habitats and a few typical species include the following:

- Riverine habitat includes the wetlands and deepwater habitats within the channels of creeks and rivers of CSM Units 1, 2, 3, and 5. Typical fish expected to occur in this habitat include westslope cutthroat and bull trout, sculpin, mountain whitefish, and, in some portions of the Basin, introduced species such as rainbow, brook, and brown trout. In lower-elevation areas, typical fish species include chinook salmon, smallmouth bass, northern squawfish, and sucker. Characteristic wildlife species include salamanders, common merganser, osprey, bald eagle, spotted sandpiper, American dipper, water shrew, raccoon, mink, and river otter.

- Lacustrine habitat includes wetlands and deepwater habitats that occur in depressions (such as the lateral lakes and Coeur d'Alene Lake) or in dammed river channels (such as the Spokane River upstream of Post Falls Dam). Most plants occur as phytoplankton or as submerged vegetation. Typical fish include many of the same ones as in riverine habitat, in addition to largemouth bass, yellow perch, and northern pike. Characteristic birds and mammals include tundra swan, lesser scaup, common goldeneye, common merganser, osprey, bald eagle, tree swallow, little brown myotis (bats), and river otter.

- Palustrine habitat includes wetlands that are dominated by trees, shrubs, and other persistent emergent wetland plants. This habitat occurs in smaller areas within CSM Units 1, 2, 4, and 5, relative to larger areas within CSM Unit 3. Typical plants include wild rice, water potato, equisetum (horsetail), cattail, cottonwood, and willow. Characteristic wildlife species include spotted frog, salamanders, great blue heron, Canada goose, tundra swan, wood duck, mallard, bald eagle, common snipe, little brown myotis (bats), raccoon, mink, beaver, muskrat, and white-tailed deer.

- Riparian habitat is terrestrial habitat that is associated with one of the previously mentioned wetland habitats, most often the riverine habitat. It occurs along stream channels and around lakes within CSM Units 1, 2, 4, and 5, but is much more extensive in CSM Unit 3. Typical plants include reed canary grass, cow-parsnip, spiraea, cottonwood, alder, and willow. Common wildlife include salamander, spotted frog, northern harrier, American kestrel, wild turkey, great horned owl, Swainson's thrush, American robin, song sparrow, shrew, long-legged myotis (bats), raccoon, mink, white-tailed deer, muskrat, mice, and vole.
- Agricultural habitat includes portions of CSM Unit 3 that are used mostly for pasture and hay fields. Redtop, reed canary grass, oats, and barley are typical plants in this habitat, which may be seasonally flooded and used by waterfowl and other wetland species. Common wildlife species include Canada goose, northern harrier, wild turkey, common snipe, American robin, shrew, white-tailed deer, mice, and vole.

- Upland habitat occurs outside the floodplains of the creeks and the South Fork within CSM Units 1 and 2. Typical plants include grasses, shrubs, pine, hemlock, red cedar, Douglas-fir, and Rocky Mountain maple. Representative birds and mammals include American kestrel, ruffed grouse, wild turkey, great horned owl, Swainson's thrush, shrew, mule deer (which also serves as a surrogate for elk), mouse, and vole.

The bird species listed above, except for ruffed grouse and wild turkey, are protected under the Migratory Bird Treaty Act (MBTA). This statute protects almost all species of native birds in the United States from unregulated "take," which can include poisoning at contaminated sites. The MBTA is the primary tool of the USFWS and other federal agencies in managing migratory birds.

Some of the species mentioned above are considered to be "special-status species" for the EcoRA. These include federally listed endangered or threatened species, those identified by the USFWS as species of concern, state-listed sensitive plant species, and culturally significant plant species. Examples include the bald eagle, black tern, gray wolf, lynx, bull trout, westslope cutthroat trout, spotted frog, Ute ladies'-tresses, and water potato.

7.2.2 Ecological Receptors

Although more than 80 different species were evaluated in the risk assessment, it is not feasible to evaluate ecological risks to every plant, animal, and microbial species that may be present and potentially exposed within the Coeur d'Alene Basin. Consequently, receptors of high ecological or societal value or those believed to be representative of broader groups of organisms were selected for evaluation. Representative ecological receptors were selected on the basis of current information on habitat types present and potential for exposure in the Basin. Each receptor was chosen to represent a trophic category and particular feeding behaviors (e.g., diving birds versus shorebirds) that would represent different modes of exposure to COPECs. Thus, the species that were chosen for evaluation represent numerous trophic levels including hundreds of similarly exposed species in the Basin. The following criteria were used to select potential receptors:

- The receptor does or could use habitats present in the Basin.
- The receptor is important to either the structure or function of the ecosystem.
- The receptor is statutorily protected (i.e., threatened or endangered species, migratory birds) or is otherwise highly valued by society (i.e., species of cultural importance).
- The receptor is reflective and representative of the assessment endpoints for the Coeur d'Alene Basin.
- The receptor is known to be either sensitive or highly exposed to COPECs in the Coeur d'Alene Basin.

Where appropriate, the same receptors were used for more than one CSM unit to increase efficiency and consistency of the EcoRA and to allow for the comparative evaluation of CSM units (Table 7.2-1). Many of the receptors selected for evaluation are listed above for the different habitat types.

7.2.3 Ecological Management Goals and Assessment Endpoints

Ecological management goals, assessment endpoints, and measures for the Coeur d'Alene EcoRA were developed through consultation with the EcoRA Work Group and are consistent with the NCP and EPA guidance. The ecological management goals are:

- Maintenance (or provision) of soil, sediment, water quality, food source, and habitat conditions capable of supporting a "functional ecosystem" (as defined below) for the aquatic and terrestrial plant and animal populations in the Coeur d'Alene Basin

- Maintenance (or provision) of soil, sediment, water quality, food source, and habitat conditions supportive of individuals of special-status biota (including plants and animals) and migratory birds, protected under the MBTA, likely to be found in the Coeur d'Alene Basin

These ecological management goals include the need to reduce the toxicity and/or toxic effects of hazardous substances released by mining activities to ecological receptors within the Basin, and also the need to provide habitat conducive to the recovery of special-status species. By protecting the integrity of the food chain, water, and other natural resources, as well as habitat structure, the ecological management goals should be fulfilled. The ecological endpoints to evaluate these objectives are summarized below.

Assessment endpoints for the Coeur d'Alene Basin were developed in collaboration with the EcoRA Work Group, and are consistent with the NCP and EPA guidance. The selection of the assessment endpoints is crucial to the EcoRA because they define the important ecological values that are to be protected. They are developed on the basis of known information concerning the contaminants present, the receiving site, and the risk management goals. The assessment endpoints for the Coeur d'Alene Basin were based on the following principal criteria:

- Ecological relevance
- Political and societal relevance
- Susceptibility to known or potential stressors
- Consistency with ecological management goals

The protection of assessment endpoints for the Coeur d'Alene Basin as a whole will be considered to result in a "functional ecosystem" if soil, sediment, water quality, food source, and habitat conditions are capable of supporting natural populations of plants and animals; there are no direct adverse effects on migratory birds or special-status species; and habitat conditions are conducive to recovery of special-status species. Assessment endpoints were developed for four levels of biological organization: individual; population; community; and habitat, ecosystem, and landscape. Assessment endpoints for each level are described in the following text.

Assessment endpoints were identified on the basis of potential effects on individuals of migratory birds and threatened or endangered species within the Coeur d'Alene Basin. The effect levels for these endpoints were established to eliminate adverse effects to individuals by considering no-effect or minimal-effect levels of metals for the receptor species.

Assessment endpoints that pertain to potential effects on populations of species that are characteristic of natural habitats within the Basin were identified for the following: fish, amphibians, birds, mammals, and special-status plants (e.g., those that have cultural significance and those that are of special concern to state or federal agencies). Effect levels for these endpoints were established to eliminate adverse effects that may be experienced by greater than 20 percent of the naturally occurring populations.

Assessment endpoints also were identified that pertain to potential effects within the Basin on aquatic and terrestrial plant and invertebrate communities that are characteristic of natural habitats in the region. The effect levels for these endpoints were established to eliminate adverse effects to organisms that make up aquatic and terrestrial plant and invertebrate communities.

In addition, assessment endpoints were identified that pertain to potential direct and indirect effects of mining-related hazardous substances on habitats, ecosystems, and the landscape within the Coeur d'Alene Basin for the following: soil processes (based on viability and sustainability of the soil microbial community to support nutrient cycling and other ecosystem processes necessary for higher plants and animals), and physical and biological characteristics (landscape attributes necessary for sustaining plant and animal communities).

These assessment endpoints were evaluated through a series of measures (sometimes referred to as measurement endpoints) that are described below in the Analysis of Ecological Risk section.

7.2.4 Chemicals of Potential Ecological Concern

The media evaluated in the EcoRA included soil, sediment, and surface water. Groundwater, although contaminated in the Basin, was not evaluated. Animals do not come into contact with it, and the exposure of plants could best be evaluated through concentrations of COPECs in the soil (i.e., reference toxicity data are not available for evaluation of plant exposures to groundwater). Furthermore, groundwater interacts with surface water, which was evaluated in the EcoRA. The COPECs for the Coeur d'Alene Basin were tentatively identified during the evaluation of nature and extent of contamination in the draft Technical Work Plan for the RI/FS (USEPA 1998b). The following COPECs were carried forward to the EcoRA and were the focus of all subsequent evaluations in that report:

- Soil - arsenic, cadmium, copper, lead, and zinc
- Sediment - arsenic, cadmium, copper, lead, mercury, silver, and zinc
- Surface water - cadmium, copper, lead, and zinc

The EcoRA relied on numerous sets of historical data that included concentrations of COPECs in both abiotic media (soil, sediment, and surface water) and biological media (plant and animal tissue) collected by EPA, USGS, USFWS, BLM, University of Idaho, and other investigators. Additionally, URS Greiner, Inc., USGS, and CH2M HILL collected additional soil, sediment, groundwater and surface water samples on behalf of EPA beginning in 1997.

The abiotic media data (including soil, sediment, and surface water) were evaluated initially using general data qualification review and reduction protocols (presented in Appendix A of the EcoRA). The data were then further reduced for the specific uses of the EcoRA. The data qualification review served as a mechanism to apply consistent rules for qualification of data independent of the laboratories or individual data validators, and then to resolve multiple values within a given sample to arrive at a single value per chemical per sample. Following data qualification, the data set was reduced using an automated data selection processor. The data reduction routine was used to select the best value for each analyte or group of analytes.

For evaluation of terrestrial receptors, the data for soil and sediment were combined within a given habitat type and were evaluated as a single medium. The basis for evaluating soil and sediment as a single medium was that, in many cases, soils from either the same sampling location or from sampling locations very close to each other were labeled “soil” in some sampling events and “sediment” in others. This occurred predominantly in the agricultural floodplain areas and was a result of the condition of the site during sampling. When the ground was dry during sampling, the samples were typically identified as “soil,” whereas when it was wet or flooded, the samples were identified as “sediment.” Similarly, the same substrate material represents soil for terrestrial receptors during dry periods and sediment for waterfowl during flooded periods. In either case, the soil-sediment originated from the same source material so the approach for evaluating them together was considered valid.

For evaluation of aquatic receptors, the surface water and sediment data were reduced to those samples occurring in lakes, rivers, and wetlands. Sediments were not combined with soils for aquatic receptors because the evaluation was limited to specific habitat types that are typically wet year-round (lakes, rivers, wetlands).

Section 2.4 and Appendix A of the EcoRA provide a discussion of the data quality objectives (DQOs) as well as the data qualification and reduction procedures used to create the final database that was used for risk evaluations.

Tables 7.2-2 through 7.2-5 provide a summary of the occurrence and distribution of COPECs by medium (soil-sediment, sediment, and surface water) in various portions of the Basin. The tables show the frequency of detection as well as minimum, maximum, mean, and UCL_{95} of the mean concentrations. Analyses in subsequent portions of the EcoRA were conducted to determine which of the COPECs posed risks to ecological receptors; these chemicals vary by receptor and medium and are referred to as COECs.

7.2.5 Analysis of Ecological Risk

Three categories of measures were evaluated during the analysis phase: measures of exposure, measures of effects, and measures of ecosystem and receptor characteristics. The measures are described in the following text.

Exposure Analysis

The exposure analysis evaluated the contact or co-occurrence of mining-related hazardous substances and the assessment endpoint receptors. The measures of exposure used in the EcoRA were developed for each of the assessment endpoints and habitats within each of the CSM units. They included concentrations of COPECs in soil-sediment, surface water, and biota (plants and animals) to which the receptors could be exposed.

Many studies have been conducted in the Coeur d'Alene Basin to characterize exposures of plants and animals to mining-related hazardous substances, as summarized in Section 2.4 of the EcoRA. These include measurements of chemical concentrations in both abiotic media (soil-sediment, and surface water) and biological media (plant and animal tissue). COPEC concentrations in abiotic media are summarized in Tables 7.2-2 through 7.2-5. Data from the numerous studies of accumulation of metals in biota in the Coeur d'Alene Basin may be segregated into three groups based on their potential usability in the exposure estimates. Some data were used to estimate food-web exposures to consumer species (e.g., results from whole-body analyses of fish, invertebrates, and small mammals; analyses of plant tissues). Other data were used for estimating metals exposure of the species from which the tissues were obtained (e.g., metal concentrations in target organs [liver, kidney, and blood]; measures of delta-aminolevulinic acid dehydratase [ALAD] inhibition in blood). The last group of data, including metal concentrations in mammal hair, bird feathers, and fish fillets, were not readily usable in EcoRAs because of limitations on interpretability of their relation to ecological effects.

The potential routes of exposure indicate the means by which chemicals are transferred from a contaminated medium to ecological receptors. The routes by which ecological receptors may be exposed to COPECs in the Coeur d'Alene Basin include:

- Birds and mammals - ingestion of soil-sediment, surface water, and food

- Fish - ingestion and direct contact with sediment and surface water
- Benthic invertebrates - ingestion and direct contact with sediment or surface water
- Aquatic plants - root uptake and direct contact with sediment and surface water
- Amphibians - direct contact with surface water and soil-sediment
- Terrestrial plants - root uptake from soil-sediment
- Terrestrial invertebrates - ingestion and direct contact with soil-sediment
- Soil processes - direct contact of microbes with soil-sediment

Birds and mammals experience exposure through multiple pathways including ingestion of abiotic media (soil, sediment, and surface water) and biotic media (food) as well as inhalation and dermal contact. To address this multiple pathway exposure, modeling was required. Exposure estimates for each representative species were generated based on model assumptions, life history parameters, and estimated concentrations in exposure media (soil, sediment, and surface water) and food sources as described in Section 3.1 of the EcoRA. The end product or exposure estimate for external exposures for birds and mammals is a dosage (amount of chemical per kilogram receptor body weight per day [mg/kg/d]) rather than a media concentration as is the case for the other receptor groups (fish and other aquatic organisms, terrestrial plants, terrestrial invertebrates, and soil [microbial] processes). This is a function of both the multiple pathway approach as well as the typical methods used in toxicity testing for birds and mammals (as described in Section 3.2 of the EcoRA). Summaries of total (i.e., sum over all pathways) and partial (pathway-specific) exposure estimates are presented and compared to toxicity values in Section 4.1 of the EcoRA.

Exposure-point concentrations for soil-sediment and surface water incorporated into the exposure model for birds and mammals were the upper UCL concentrations. These values were selected to provide a conservative representation of exposures most likely to be experienced by birds and mammals within the Coeur d'Alene Basin. Because wildlife are mobile and their exposure is best represented by the average concentration within areas they inhabit, UCL_{95} is the measure traditionally used for estimation of exposure for wildlife.

Internal exposures consist of concentrations of COPECs in tissues of receptor species. These concentrations were measured directly from certain field-collected birds and/or mammals; for others, they were modeled using site-specific or literature-derived information. They were then compared to available literature information for concentrations of chemicals in specific tissues that are associated with adverse effects. This provided another measure of the potential nature and magnitude of effects birds and mammals may experience in the Coeur d'Alene Basin.

Fish and other aquatic organisms can also have both external and internal exposures, although they are not typically described as separate pathways. External exposure occurs as a consequence of living in a contaminated medium. Uptake of metals can be through the skin (dermal), through the gills, or through the diet, including ingestion of contaminated food, water, and possibly sediment. Internal exposures, which provide absolute evidence of exposure, were measured as concentrations of chemicals in tissues including whole body, muscle, kidney, and liver. Those data were presented separately in the EcoRA because information is available that allows the estimation of risks based on tissue concentrations.

Exposure estimates for amphibians consisted of external exposure only. These receptors are similar to aquatic organisms in that exposure is measured using concentrations of contaminants in abiotic media (e.g., surface water). Although amphibians are also exposed to sediment, these exposures were not estimated because corresponding toxicity data for sediment were not available for this receptor group. Exposure for amphibians was evaluated by considering the full distribution of dissolved COPEC concentrations in surface water from each CSM unit and/or watershed.

Exposures estimated for soil-associated biota (terrestrial plants, terrestrial invertebrates, and soil microbial processes) consisted of external exposure only. These receptors are similar to aquatic organisms and amphibians in that exposure is measured using concentrations of contaminants in abiotic media (e.g., soil-sediment). Exposure for soil-associated biota was evaluated by considering the full distribution of COPEC concentrations in soil-sediment from each CSM unit and/or watershed. Exposure for soil-associated biota was only evaluated based on soil-sediment samples from terrestrial habitat types (i.e., agricultural, riparian, and upland). Exposure evaluations were performed separately for each terrestrial habitat type within a CSM unit and/or watershed.

Ecological Effects Analysis

Two kinds of measures were evaluated for ecological effects: (1) measures of effects and (2) measures of ecosystem and receptor characteristics. Measures of effects are the quantifiable changes in an attribute of an assessment endpoint in response to a stressor. As with the measures of exposure, the measures of effect were developed for each of the assessment endpoints and habitats within each of the CSM units. The measures of effects also are defined according to the potential exposure media within each of the habitats in each CSM unit. The measures of effects are briefly stated as:

- Effects on health, survival, or reproduction of migratory birds or on special-status animal species at the individual level
- Effects on survival, reproduction, or abundance for fish, amphibian, avian, mammalian, or special-status plant species at the population level
- Effects on aquatic or terrestrial plant community composition, density, species diversity, or community structure

- Effects on aquatic or terrestrial invertebrate community composition, abundance, density, species diversity, or community structure

The ecological effects characterization consists of an evaluation of available toxicity or other effects information that can be used to relate the exposure estimates to a level of adverse effects. Stressor-response (i.e., effects) data that may be used to evaluate ecological risks resulting from chemical exposures fall into three general categories: (1) literature-derived or site-specific single-chemical toxicity data, (2) site-specific ambient media toxicity tests, and (3) site-specific field surveys (Suter et al. 2000). All three categories of data were available for the assessment of ecological risks in the Coeur d'Alene Basin and are summarized below.

- Single-chemical toxicity data consist of results of toxicity tests with single chemicals (or materials) as reported in published literature or performed on a site-specific basis. These data may also be represented as summaries of literature toxicity data (e.g., water quality criteria). Single-chemical toxicity data developed for use in the Coeur d'Alene Basin EcoRA are summarized in Section 3.2 of the EcoRA, while Appendix E of the EcoRA presents further details of the individual studies.

- Site-specific toxicity tests have been done in the Coeur d'Alene Basin. This testing provides important information on the toxic effects that have been observed in site-relevant organisms exposed to site media (soil, sediment, and/or surface water). The toxicity testing done in the Basin also is summarized in Section 3.2 of the EcoRA for each receptor group, and Appendix E of the EcoRA presents details for the primary studies.

- Site-specific field surveys have been conducted on most of the receptor groups. These surveys also provide vital information concerning effects observed in the Basin. A summary of the site-specific field surveys is presented in Section 3.2 of the EcoRA for each receptor group, while Appendix E of the EcoRA provides further details of primary surveys.

The relationship between the various receptor groups and ecological effects information available for each measure of effect are shown in Figure 7.2-6. The end-product of the ecological effects characterization is a range of toxicity reference values (TRVs) that was combined with the exposure estimates (birds and mammals) or the EPCs (fish and other aquatic organisms, amphibians, terrestrial plants, terrestrial invertebrates, and soil microbial process) to estimate potential risks in the risk characterization. Measures of ecosystem and receptor characteristics were also evaluated for their potential effects on identified receptors, including habitat for special-status or other species. These are factors that influence the behavior and location of ecological entities of the assessment endpoint (such as fish), the distribution of a stressor (such as water temperature), and the life-history characteristics of the assessment endpoint (such as reproduction) that may affect exposure in response to the stressor. Examples of these measures include bank stability, substrate composition and mobility, water temperature, spatial distribution and connectivity of habitat, riparian vegetation habitat quality, sediment deposition rate, and turbidity (total suspended solids). Evaluation of these measures was based on results from a number of studies conducted within the Basin, primarily CSM Units 1, 2, and 3. It focused on the relationships between mining-related hazardous substances and the indirect effects those stressors have had on physical and biological conditions within the Basin.

7.2.6 Characterization of Ecological Risk

The risk characterization phase of the EcoRA combined the results of the exposure analysis with those from the ecological effects analysis to determine which stressors posed risks to which receptors (assessment endpoints).

Potential risks to the representative species were quantified for each exposure pathway for which data were available. For single-chemical toxicity data, chemical-specific risk estimates were derived using a combination of methods. For birds, mammals, and aquatic biota, the HQ method was used whereby point estimates of exposure were compared to point estimates of effects. (Note that the "point estimates" for birds and mammals are the UCL_{95} of the mean.) For amphibians, terrestrial plants, soil invertebrates, and soil processes, full distributions of exposure and effects were compared, with risk being represented by the percent overlap of the two distributions. The magnitudes of the estimated risks for each receptor group are discussed with other lines of evidence in the risk description section (4.2) of the EcoRA. Because receptors were evaluated at differing levels of ecological organization (i.e., individual-, population-, and community-level), risk estimation was based on measures of exposure and effects appropriate for each level of ecological organization.

Risk estimates were also made based on available site-specific toxicity tests and field surveys. These risk estimates were derived by following the decision processes outlined in Suter et al. (2000). Results from site-specific toxicity tests were judged supportive of a conclusion of risk if statistically significant toxicity relative to controls or dose-response relationships for exposure of test species to site media were observed. Results from field survey data were judged supportive of a conclusion of risk if observations differed significantly from appropriate reference observations, or if measured parameters (such as ALAD activity of waterfowl blood) were outside of bounds assumed to be representative for that species. Wherever possible, correlation between observed responses in toxicity tests and field surveys with field concentrations of COPECs was made to provide information concerning causation of observed responses. The results of the risk estimation for each line of evidence and receptor group are presented in Section 4.1 of the EcoRA.

Determination of risk to receptors was performed by weight-of-evidence evaluation. The strengths, weaknesses, and relative power of each piece of available information (i.e., line of evidence) were considered individually and in combination to develop conclusions concerning the presence or absence of risks. For the chemical stressors, the results were presented as tables and graphs that show the frequency at which COPEC concentrations exceed the various potential effect levels for the different receptors. Based on the potential risks of adverse effects to those ecological receptors (and similarly exposed species), the EcoRA identifies the final COECs.

For physical and biological stressors, the evaluation of effects of mining-related hazardous substances relied on comparison of assessment areas within the Basin to reference areas with similar exposure to non-mining-related stressors (e.g., forestry, roads, development). This process served to isolate a level of effect attributable to mining-related hazardous substances. Several lines of evidence (i.e., measures of ecosystem and receptor characteristics) were used to assess adverse effects on the physical and biological characteristics endpoint. Examples of these measures include riparian habitat suitability index, streambank stability, substrate composition and mobility, and water temperature. Analysis of these lines of evidence included field observations and interpretation of aerial photographs to assess the spatial distribution and connectivity within riverine and riparian habitats. Fragmentation of these habitats can affect receptors by limiting the ability to migrate, acting as barriers to biotic interactions, and/or increasing susceptibility to predation. The detailed evaluation of secondary effects on physical and biological ecosystem characteristics is presented in Appendix K of the EcoRA. The results described were considered to represent adverse effects that are secondarily related to hazardous substances occurring within various portions of the Basin.

Uncertainties are inherent in all risk assessments, and the EcoRA (Section 4.3 of the EcoRA) presented a discussion of various uncertainties and limitations associated with the risk assessment process, or with the available data, that may result in under- or over-estimation of risks. The nature and magnitude of uncertainties depend on the amount and quality of data available, the degree of knowledge concerning site conditions, and the assumptions made to perform the assessment.

Uncertainties associated with problem formulation include use of historical data that may not completely meet EPA data usability criteria, inconsistent labeling of sample location types or lack of labeling for some data, and pooling of soil and sediment data by habitat type for terrestrial evaluations. However, despite the uncertainties described here, there is a very large volume of chemical and biological data for the Coeur d'Alene Basin that is suitable for evaluation of risks to ecological receptors. Data that were found to be questionable through the general review and evaluation were not used.

The uncertainties associated with the exposure characterization include exposure pathways not retained for quantitative evaluation, identification of ecological receptors, selection of representative species, exposure route assumptions, regression modeling, and speciation of metals. Uncertainties associated with the ecological effects characterization include evaluation of chemical toxicity (selection and use of toxicity reference values), and assumptions regarding use of bioassay test organisms or test results, and allometric scaling factors.

Uncertainties and limitations associated with the risk characterization include use of HQs as an indicator of potential ecological risk, lack of data for some multi-pathway risk estimates, joint multi-chemical toxicity, lack of multiple lines of evidence for certain receptor groups, treatment of estimated exposures that exceeded no observed adverse effect levels but not lowest observed adverse effect levels, and use of risk estimates for representative species to characterize risks to other plants and wildlife.

Results of the risk characterization are summarized below in the Conclusions section (7.2.9).

7.2.7 COEC Concentrations Protective of Receptors

Concentrations of COECs in environmental media (soil, sediment, and water) were identified that preserve the desired attributes of the assessment endpoints, and below which adverse effects are expected either to be absent or to be within defined limits of effects levels. These concentrations are often determined by levels of contaminants that would be protective of the most sensitive ecological receptor that is exposed to a particular medium.

These COEC concentrations need to account for the presence of special-status species and protected migratory birds where the level of protection should be higher (i.e., the acceptable effect threshold is lower) than that sought for population-level, community-level, or landscape-level endpoints. This is accomplished by considering the relative sensitivity of special-status species and migratory birds to metals compared to sensitivity of other species in their group, selecting toxicity test endpoints that offer protection at the individual level as a basis for TRVs, or applying a safety factor to TRVs developed using surrogate species. The availability of site-specific information for migratory birds has allowed the selection of TRVs or exposure parameters that reflect the protection of individuals. The availability of site-specific comparative toxicity testing with bull trout has allowed the evaluation of the relative sensitivity of bull trout to metals, compared to the sensitivity of other aquatic organisms.

The protective-level COEC concentrations are presented as ranges for the various receptor groups that were evaluated (i.e., birds and mammals combined, soil biota combined, etc.), segregated by the level of assessment (e.g., individual- or population-level) and the medium (e.g., soil or sediment). The protective-level COEC concentrations for aquatic organisms are set to cover the group as a whole, with consideration of possible effects on special-status species.

Protective-level COEC concentrations for birds and mammals that were evaluated at the individual level are based on no observed adverse effect level (NOAEL) values, whereas the lowest observed adverse effect level (LOAEL) or dose causing effects in 20 percent of test animals (ED20) (i.e., a less restrictive value) was used for receptors evaluated at the population level. Because soil is not the most appropriate source medium for evaluation of risks for all wildlife species, protective-level COEC concentrations were developed for representative species on the basis of the habitat types in which they predominantly occur. Species that occur in riparian, agricultural, or upland habitats were identified as "terrestrial" and protective-level COEC concentrations were calculated for soil (Table 7.2-6). Species that occur in riverine, lacustrine, and palustrine habitats were identified as being "aquatic" and protective-level COEC concentrations were calculated for sediment (Table 7.2-7).

Protective-level COEC concentrations for soil-associated biota (e.g., plants, invertebrates, and microbial processes) were based on toxicity data from the published literature and were based on no observed effect concentrations (NOECs) and lowest observed effect concentrations (LOECs) for each receptor group (Table 7.2-6).

Table 7.2-8 lists protective-level COEC concentrations for surface water based on the national AWQC, adjusted for hardness for specified metals. The national chronic criteria are estimates of the highest concentrations of materials in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

EPA published an update to the AWQC for cadmium (66 FR 18935; April 12, 2001) at about the same time as final changes were being incorporated into the EcoRA, and it was not feasible to re-analyze risks to aquatic organisms in time to make corresponding changes in the final EcoRA. Revised protective concentrations for cadmium are, however, shown in Table 7.2-8 and in later sections of the ROD. In relatively soft waters of the Basin, the updated cadmium AWQC is lower than the 1998 cadmium AWQC used in the EcoRA, and use of the 2001 criterion would result in larger estimated cadmium risks to aquatic biota than the risks identified in the EcoRA if the risks were recalculated.

All median values for background surface water were below the national chronic criteria AWQC (assuming hardness of 30 mg/L as CaCO3). Background values for metals are described in EPA's *Final Technical Memorandum* (USEPA 2001h). The 95th percentile of the background dissolved lead concentrations exceeded the national chronic criteria calculated at hardness of 30 mg/L as CaCO3 in the following areas: the Upper South Fork, the Page-Galena mineral belt area, and the South Fork basin as a whole ("entire South Fork"). The 75th percentile of the data exceeded the national chronic criteria in the Page-Galena mineral belt area. These results imply that the national criteria AWQC would only be exceeded in a very limited number of mineralized locations in the stated drainages at some times if mining-related impacts did not exist. All of the calculated values for zinc and cadmium, including the 95th percentile (assuming hardness of 30 mg/L as CaCO3), were well below the national criteria. Therefore, the AWQC are generally protective for surface-water biota. However, in areas of low hardness (e.g., 10 mg/L as CaCO3) the AWQC may not be protective, particularly with respect to individuals of special-status species such as bull trout and cutthroat trout.

Protective-level COEC concentrations for sediment are either toxicity-based or regional background concentrations of metals in sediment in the Basin (Table 7.2-9). The higher value of either background or the toxicity screening value is recommended as the protective-level COEC concentration. On the basis of the determinations of regional variations in soil and sediment upper background values (USEPA 2001h), separate background values for sediment were determined for CSM Units 1 and 2, CSM Units 3 and 4, and CSM Unit 5.

7.2.8 Ecological Goals for Physical and Biological Characteristics

Qualitative goals were developed for physical and biological characteristics (assessed as measures of ecosystem and receptor characteristics, such as stream bank stability, water temperature, etc.) that have been adversely affected by releases of mining-related hazardous substances (Table 7.2-10). The goals for these characteristics describe either a range of conditions found in the Coeur d'Alene Basin prior to mining activities or the range of conditions in these characteristics currently found in selected reference areas. These ecological goals are applicable to those CSM units that showed unacceptable risks for the specific physical characteristic, and are considered to be the equivalent of the protective-level COEC concentrations identified for hazardous substances (previous section).

7.2.9 Conclusions

A large volume of data regarding the impacts of mining-related hazardous substances is available for the Coeur d'Alene Basin and, while some data gaps may exist, there is more than adequate evidence to demonstrate the magnitude of the impacts to the ecosystem. High concentrations of metals are pervasive in the soil, sediment, and surface water in the Basin, and these metals pose substantial risks to the plants and animals that inhabit the Basin. The risk assessment evaluated impacts to more than 80 different species (see Table 7.2-1). The species evaluated represent numerous trophic levels, including hundreds of species that are similarly exposed. Species evaluated include "special-status species," such as those listed as endangered or threatened under the ESA, those listed by the USFWS as species of concern, state-listed sensitive plant species, and culturally significant plant species. The National Marine Fisheries Service has indicated that no anadromous fish species are present in the Coeur d'Alene Basin because the Grand Coulee Dam blocks passage of anadromous fish into the Basin. Examples of the special-status species evaluated in the EcoRA include the bald eagle, black tern, gray wolf, lynx, bull trout, Ute ladies'-tresses, and the water potato.

The results of the EcoRA indicate that most watersheds in which mining has occurred and a large portion of the Basin downgradient of mining areas are ecologically degraded as a direct or secondary effect of mining-related hazardous substances. This ecological degradation has resulted in demonstrated, observable effects in the Basin. In addition, the results of the EcoRA show that, if remediation is not conducted in the Basin, effects can be expected to continue for the foreseeable future. These demonstrated effects and the future risks predicted in the EcoRA, which are summarized below, were used as the basis for identifying remedial actions in the FS and this ROD.

Conclusions concerning the nature and extent to which mining-related hazardous substances present risks to ecological receptors within the Coeur d'Alene Basin were based on the weight-of-evidence analyses. The general conclusion is that heavy metals, primarily lead and zinc, present significant ecological risks to most ecological receptors throughout the Basin (Table 7.2-11). Few receptors were identified for which no ecological risks are estimated. In all receptor classes, ecological risks from at least one COEC in at least one area of the Basin were identified. Because multiple lines of evidence were available for evaluation of risks for some receptors in all receptor classes (except soil invertebrates and soil microbial processes), the strength of many risk conclusions is considered to be high. Brief summaries of the available lines of evidence and risk conclusions for each receptor class are presented below.

Birds

Conclusions for effects on birds are as follows:

- Risks to health and survival from at least one metal in at least one area were identified for 21 of 24 avian representative species.

- No risks were identified for ospreys, bald eagles, and northern harriers in the Lower Basin, Coeur d'Alene Lake, and Spokane River areas. Additional data obtained after finalization of the EcoRA have identified potential risks to fish-eating birds in the Upper Basin.

- Lead and zinc present the greatest risks to birds in the Coeur d'Alene Basin, with risks to at least one avian receptor estimated for 11 (for lead) and 10 (for zinc) of 13 areas, that were evaluated in the Coeur d'Alene Basin. Risks from these COECs are not only spatially widespread, but also are broadly distributed taxonomically and of great magnitude. For example, the HQ for exposure of spotted sandpipers to lead in Ninemile Creek was 387, based on a LOAEL for toxic effects.

- There is extensive documentation of lead poisoning among waterfowl due to contaminated sediments in the Lower Basin that is not associated with hunting (from lead shot) or fishing (from lead sinkers). Lead poisoning has been documented in Basin waterfowl year-round in the floodplain stretching from Smelterville to Coeur d'Alene Lake.

- Waterfowl deaths due to lead poisoning associated with the ingestion of contaminated sediments have been reported for decades. Ninety-five percent of available habitat in the Lower Basin has lead concentrations above the LOAEL for waterfowl (530 mg/kg), and 80 percent has lead concentrations that are lethal to waterfowl (greater than 1,800 mg/kg).

- In the Coeur d'Alene River basin, lead poisoning (primarily due to ingestion of contaminated sediments) is responsible for 96 percent of the total tundra swan mortality, compared to 20 to 30 percent (primarily due to ingestion of lead shot) at the Pacific flyway and national level.

- Members of 12 species of migratory birds and mammals have been killed through ingestion of lead-contaminated soils and sediments. Since 1981, a total of 27 species of wildlife have been documented with various degrees of lead exposure that exceed background.

- The number of waterfowl carcasses found in 1997 represented the largest documented die-off in the Coeur d'Alene River Basin since 1953. This and other wildlife data collected over the past 20 years are supportive of the fact that lead concentrations in soil and sediment in the Coeur d'Alene Basin still occur at toxic levels. Therefore, animal deaths by lead poisoning from the ingestion of contaminated soils and sediment are expected to continue.

- Risks from cadmium, copper, and mercury were spatially and taxonomically much less broadly distributed and of lower magnitude, although they presented risks to at least one bird receptor in 5 for cadmium, 3 for copper, and 1 for mercury of the 13 areas.

- Arsenic did not present a risk to any avian receptor in any location in the Basin.

- Strength of risk conclusions, as determined by the abundance, quality, and concurrence of available lines of evidence, was high for eight avian species (Canada goose, tundra swan, wood duck, mallard, osprey, bald eagle, northern harrier, and great horned owl), moderate for five (American kestrel, spotted sandpiper, American dipper, American robin, and song sparrow), and low for eleven species (great blue heron, lesser scaup, common goldeneye, common merganser, ruffed grouse, wild turkey, common snipe, black tern, belted kingfisher, tree swallow, and Swainson's thrush).

Mammals

Conclusions for mammals are as follows:

- Risks to health and survival from at least one COEC in at least one area were identified for 12 of 18 mammalian receptor species.
- No risks were identified for fisher, wolverine, river otter, gray wolf, lynx, or beaver.
- No single COEC stands out as a predominant risk driver for mammals. Zinc, lead, and arsenic were the most common risk drivers, presenting risks within at least one CSM unit or segment in the Coeur d'Alene Basin for 9 of 18 receptors for zinc, 8 of 18 receptors for lead, and 7 of 18 receptors for arsenic. For example, HQs of 20 or higher were found for zinc for the masked shrew and long-legged myotis in Canyon Creek watershed, and the HQ for arsenic was 4.4 for muskrats in CSM Unit 3.
- Cadmium, copper, and mercury presented risks within at least one CSM unit or segment in the Coeur d'Alene Basin to 2, 4, and 3 species, respectively. Only in CSM Unit 3 did any COEC (zinc) present a risk to 50 percent or more of all mammalian receptors. Arsenic, cadmium, copper, and mercury did not present a risk to more than 25 percent of receptors in any area.
- Spatially, risks from zinc were most widespread (9 of the 13 areas) and copper the least widespread. Lead, cadmium, arsenic, and mercury posed risks in 8, 6, 5, and 5 areas, respectively.
- With the exception of receptors for which no risks were identified, the strength of risk conclusions, as determined by the abundance, quality, and concurrence of available lines of evidence, was generally low for most mammalian receptors. This is because few lines of evidence were available for most mammals and, when multiple lines of evidence were available, there was generally little concurrence. Conversely, given the generally conservative nature of the exposure models, risk conclusions for receptors estimated not to be at risk (fisher, wolverine, river otter, gray wolf, lynx, and beaver) are considered strong.

Fish and Other Aquatic Organisms

Review of the available evidence of risks to aquatic receptors (fish, invertebrates, and plants) leads to the following conclusions:

- Approximately 20 miles of the South Fork and 13 miles of tributaries are unable to sustain reproducing fish populations. Species density and diversity are reduced throughout the Basin, and the Ninemile and Canyon Creeks are essentially devoid of fish and other aquatic life in the area of mining impacts. Impacted species include the native bull trout, which is listed as "threatened" under the ESA.

- Some fish species (e.g., sculpins) are absent from areas of high metals concentrations.

- Exposure of aquatic organisms to metals was confirmed by the presence of elevated concentrations of metals in the tissues of fish, invertebrates, and plants in many portions of the Basin.

- Based upon comparison of metals concentrations to acute AWQC, surface waters are commonly lethal to some aquatic life in the following areas: upper Beaver Creek, Big Creek, Canyon Creek, Ninemile Creek Segments 2 and 4, Pine Creek Segments 1 and 3, Prichard Creek Segments 1 and 2, the entire South Fork Coeur d'Alene River, and the Coeur d'Alene River down to Harrison (see Figures 7.2-1 through 7.2-5 for stream and segment locations). For example, HQs for acute zinc exposure exceed 10 in more than 90 percent of the water samples from lower Canyon Creek and from lower Ninemile Creek. In addition, acute cadmium and lead HQs also are commonly greater than 10 in those areas.

- Toxicity testing using water from heavily contaminated portions of Canyon Creek and the South Fork indicated that substantial dilution with clean water (10-fold or more) is required to eliminate acute toxicity, consistent with the findings of the surface water-to-AWQC comparisons listed above.

- Based upon comparison of metals concentrations in surface waters to chronic AWQC, growth and reproduction of surviving aquatic life would be substantially reduced in the following areas: Big Creek; Canyon Creek Segments 3, 4, and 5; Ninemile Creek Segments 2 and 4; Pine Creek Segment 1; Prichard Creek Segments 1 and 2; the entire South Fork Coeur d'Alene River; and the Coeur d'Alene River down to Harrison.

- Site-specific toxicity testing and/or biological surveys indicate lethal effects of waters or reduced populations of aquatic life in lower Canyon Creek, lower Ninemile Creek, and the South Fork from Canyon Creek to Enaville.

- Because the bull trout and westslope cutthroat trout are evaluated on an individual level due to ESA coverage, and toxicity for some individuals can occur at levels below the AWQC, there may be areas where the AWQC is not protective of these species. This is particularly true in areas where there may be low hardness.

- Concentrations of metals in water exceed chronic AWQC by some amount in virtually all areas assessed that are downstream of sources of mining waste, indicating some adverse effects on growth and reproduction of aquatic life in all areas.

- Biological surveys in the Spokane River have suggested that metals toxicity contributes to high mortality rates of trout.

- Toxic effects of contaminated sediment are believed to contribute to adverse effects on aquatic life in Big Creek Segment 4, Canyon Creek, Ninemile Creek, Pine Creek, Prichard Creek Segment 3, the entire South Fork, the Coeur d'Alene River, the Spokane River, and, possibly, some parts of Coeur d'Alene Lake.

- Physical disturbances caused by land alterations, and modifications of stream channels caused by construction of infrastructure, adversely affect the ability of streams to support aquatic organisms in some portions of the Coeur d'Alene Basin. Those factors were considered, in part, by using reference areas as a comparison when evaluating biological surveys and habitat conditions.

- The strength of risk conclusions, as determined by exceedances of criteria, site-specific toxicity tests, and biological surveys, is moderate to high in many CSM units and segments.

Amphibians

Conclusions for amphibians are as follows:

- Risks to health and survival from heavy metals are present for three of the four amphibian species evaluated.
- Available lines of evidence suggest that COPECs in the Coeur d'Alene Basin do not present a significant risk to long-toed salamanders.

- Cadmium, lead and/or zinc present risks to both Idaho giant salamanders and Coeur d'Alene salamanders throughout CSM Unit 1 (except for Big, Moon, and Prichard Creeks and the Upper South Fork) and CSM Unit 2. These salamander species do not occur in CSM Units 3, 4, or 5.

- Cadmium, lead and/or zinc present risks to spotted frogs in CSM Units 1 and 2. No risks were identified for the spotted frogs in CSM Unit 3 and they do not occur in CSM Units 4 or 5.

The strength of risk conclusions, as determined by the abundance, quality, and concurrence of available lines of evidence, is considered moderate for spotted frogs, Idaho giant salamanders, and Coeur d'Alene salamanders; and high for long-toed salamanders.

Risks to health and survival from heavy metals are present for three of four species. Cadmium, lead, or zinc (singly or in combination) present risks to spotted frogs, Idaho giant salamanders, and Coeur d'Alene salamanders throughout most of CSM Unit 1 (except for Big, Moon, and Prichard creeks, and the Upper South Fork), and in CSM Unit 2. These salamander species do not occur in CSM Units 3, 4, or 5; no risks were identified for the frogs in CSM Unit 3. More than 10 percent of the measured concentrations of dissolved cadmium or zinc in the CSM Unit 1 and 2 watersheds exceeded the LOEC for amphibian embryos. In addition, there was more than 10 percent overlap in the range of soil-sediment concentrations of COPECs and the LOEC, indicating that toxic effects are likely to occur.

The strength of risk conclusions, as determined by the abundance, quality, and concurrence of available lines of evidence, is considered moderate for spotted frogs, Idaho giant salamanders, and Coeur d'Alene salamanders; and high for long-toed salamanders.

Terrestrial Plants

Review of available evidence of risks for plants leads to these conclusions:

- Available information suggests that exposure to arsenic, cadmium, copper, lead, and/or zinc in CSM Units 1, 2, 3, 4, and 5 may present significant risks to populations of selected plant receptors and to the plant community in general. More than 20 percent of the measured COPEC concentrations in soil exceeded ecological effects levels for plants in many areas, and biological surveys documented adverse effects on vegetation in some of those same areas.

- The strength of risk conclusions, as determined by the abundance, quality, and concurrence of available lines of evidence, is considered moderate for Ute ladies'-tresses, cottonwood, willow, and Rocky Mountain maple; low for porcupine sedge and prairie cordgrass; and high for the plant community.

Soil Invertebrates

Conclusions for soil invertebrates are as follows:

- Arsenic, cadmium, copper, lead, and/or zinc present risks to the soil invertebrate community in CSM Units 1, 2, 3, and 5. More than 20 percent of the measured COPEC concentrations in soil exceeded ecological effects levels for soil invertebrates in many areas.

- The strength of risk conclusions, as determined by the abundance, quality, and concurrence of available lines of evidence, is considered low because only a single line of evidence was available.

Soil Processes

Conclusions for risks to soil processes are as follows:

- Arsenic, cadmium, copper, lead, and/or zinc present risks to soil processes in CSM Units 1, 2, and 3. More than 20 percent of the measured COPEC concentrations in soil exceeded ecological effects levels for soil processes in many areas.

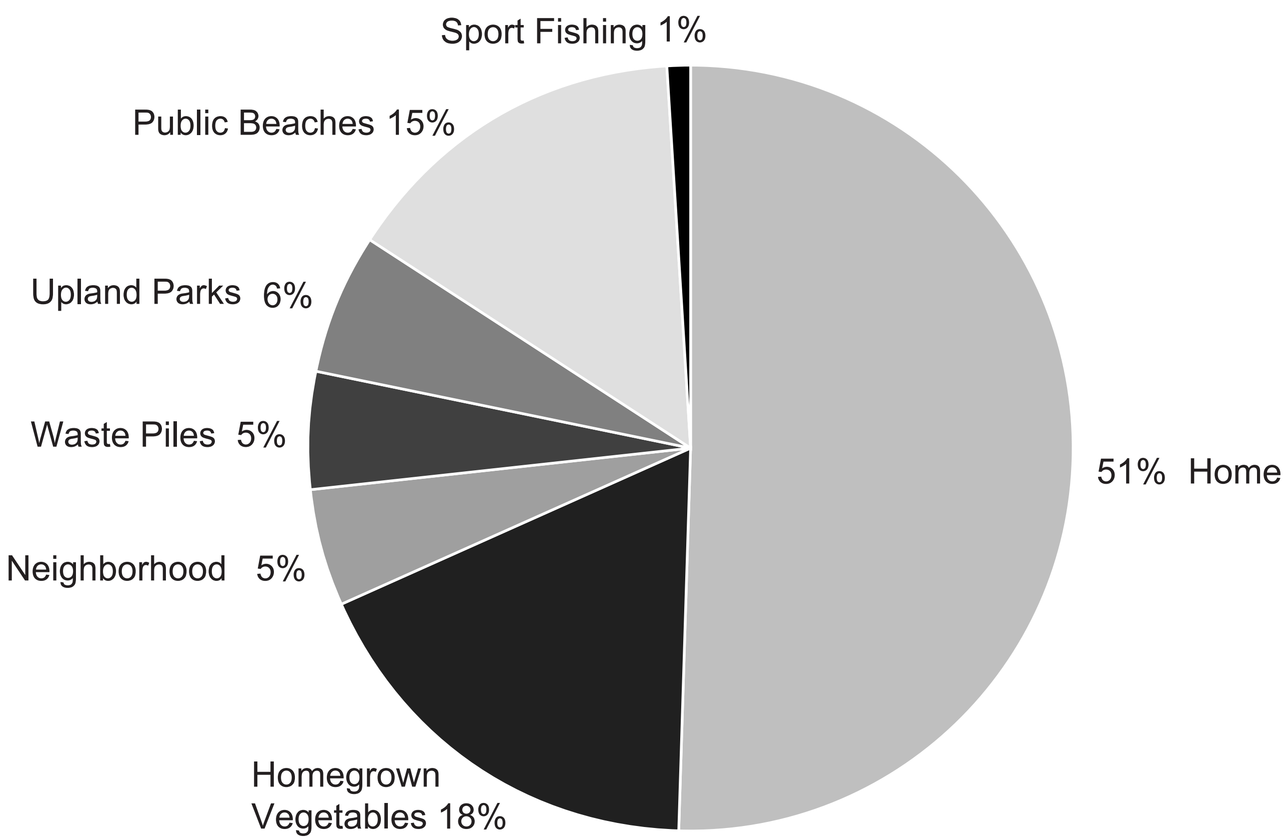
- The strength of risk conclusions, as determined by the abundance, quality, and concurrence of available lines of evidence, is considered low because only a single line of evidence was available.

Physical and Biological Characteristics

Risks to plants and animals also are associated with physical and biological characteristics evaluated in this assessment. Increased bank instability, changes in stream substrate composition and mobility, increased water temperature (from the loss of riparian vegetation along streams), and habitat fragmentation pose a risk to aquatic organisms in affected riverine habitat of the South Fork and its tributaries (Table 7.2-12). Elevated levels of suspended solids pose a risk to aquatic organisms in the Coeur d'Alene River. Increased sediment deposition rates pose risks to aquatic organisms in affected portions of Coeur d'Alene Lake. Decreased spatial distribution and connectivity of riparian habitat, and habitat suitability, pose risks to wildlife using the affected riparian habitat on the South Fork and its tributaries.

Selection of Remedial Action

The remedial action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.



NOTE: Percentages are for a hypothetical average child, and exposures for individual children would be determined by the characteristics of their yard and that child's activities. Data were compiled from the Human Health Risk Assessment, IDHW 2001.

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EPA No. 2.9

Figure 7.1-1
Average Child's Basin-Wide Lead Exposure

Figure 7.1-2
Total RME Noncancer Hazard - Modern and Traditional Subsistence Exposure Scenarios, All Chemicals (Child Age 0 to 6 Years)

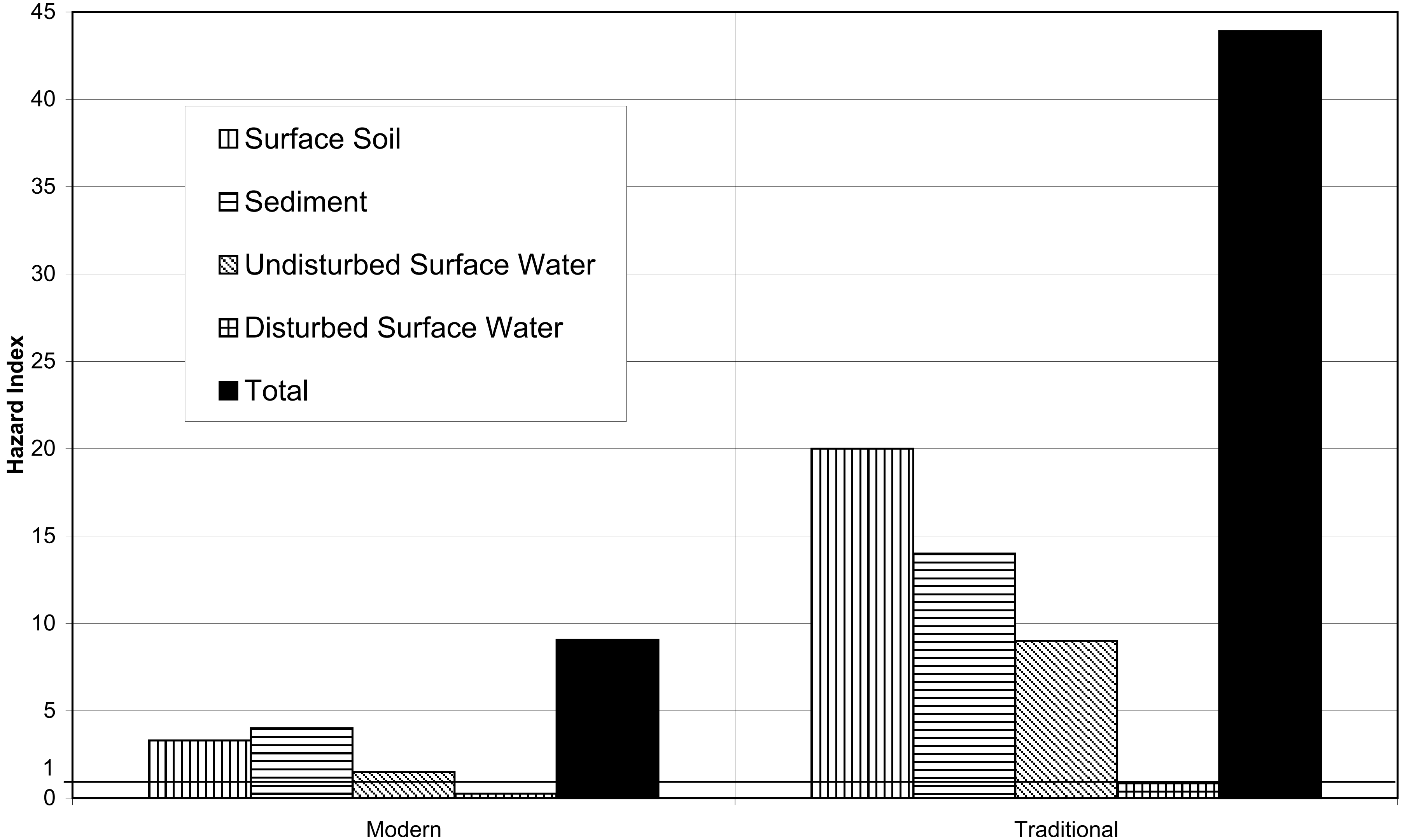
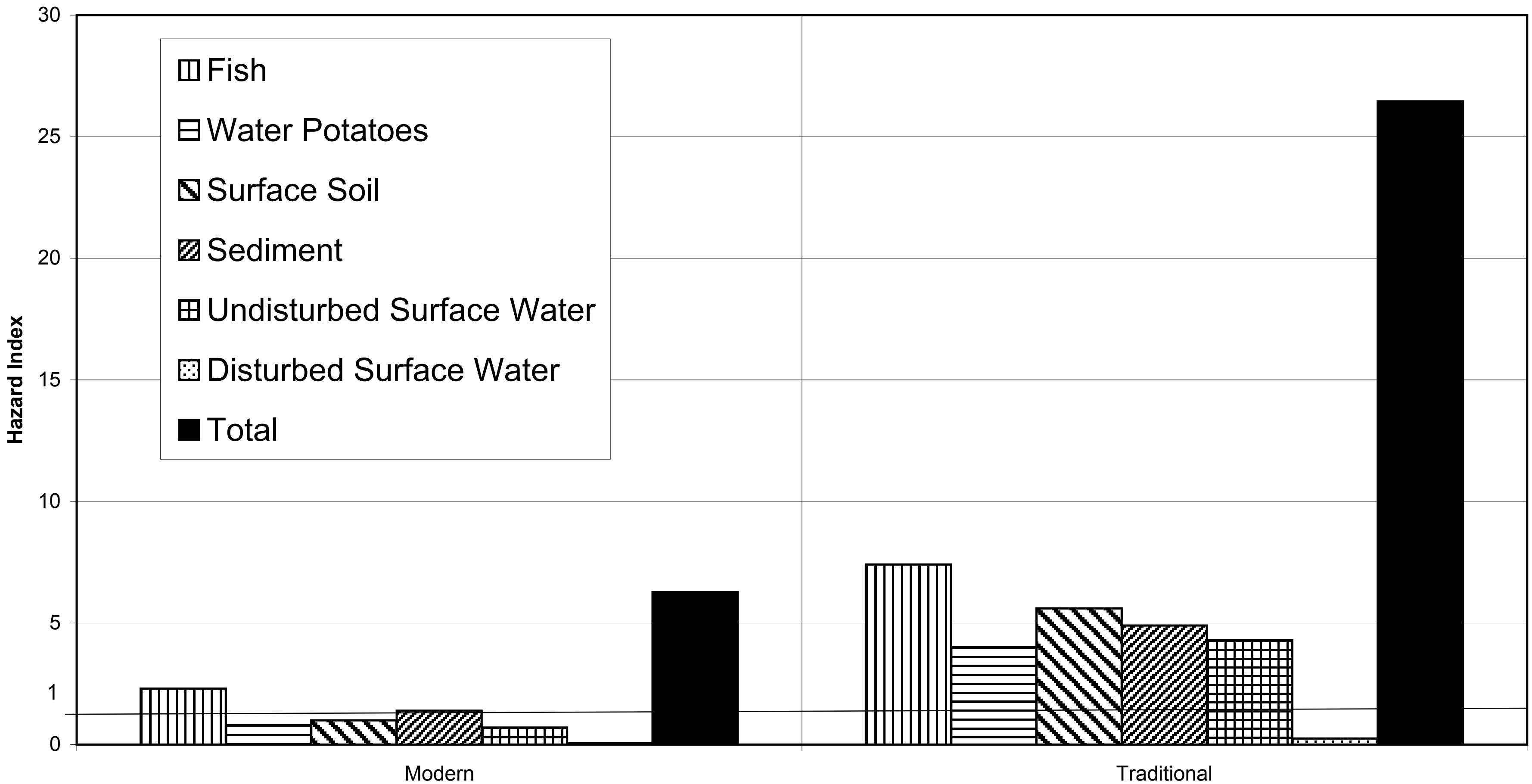


Figure 7.1-3
Total RME Noncancer Hazard - Modern and Traditional Subsistence Exposure Scenarios, All Chemicals (Adult/Child)



Note: The fish ingestion pathway was evaluated for the Adult only receptor age group, all other pathways were evaluated for the combined Adult/Child receptor age group.

Figure 7.1-4
Total RME Cancer Risk - Modern and Traditional Subsistence Exposure Scenarios
(Adult/Child)

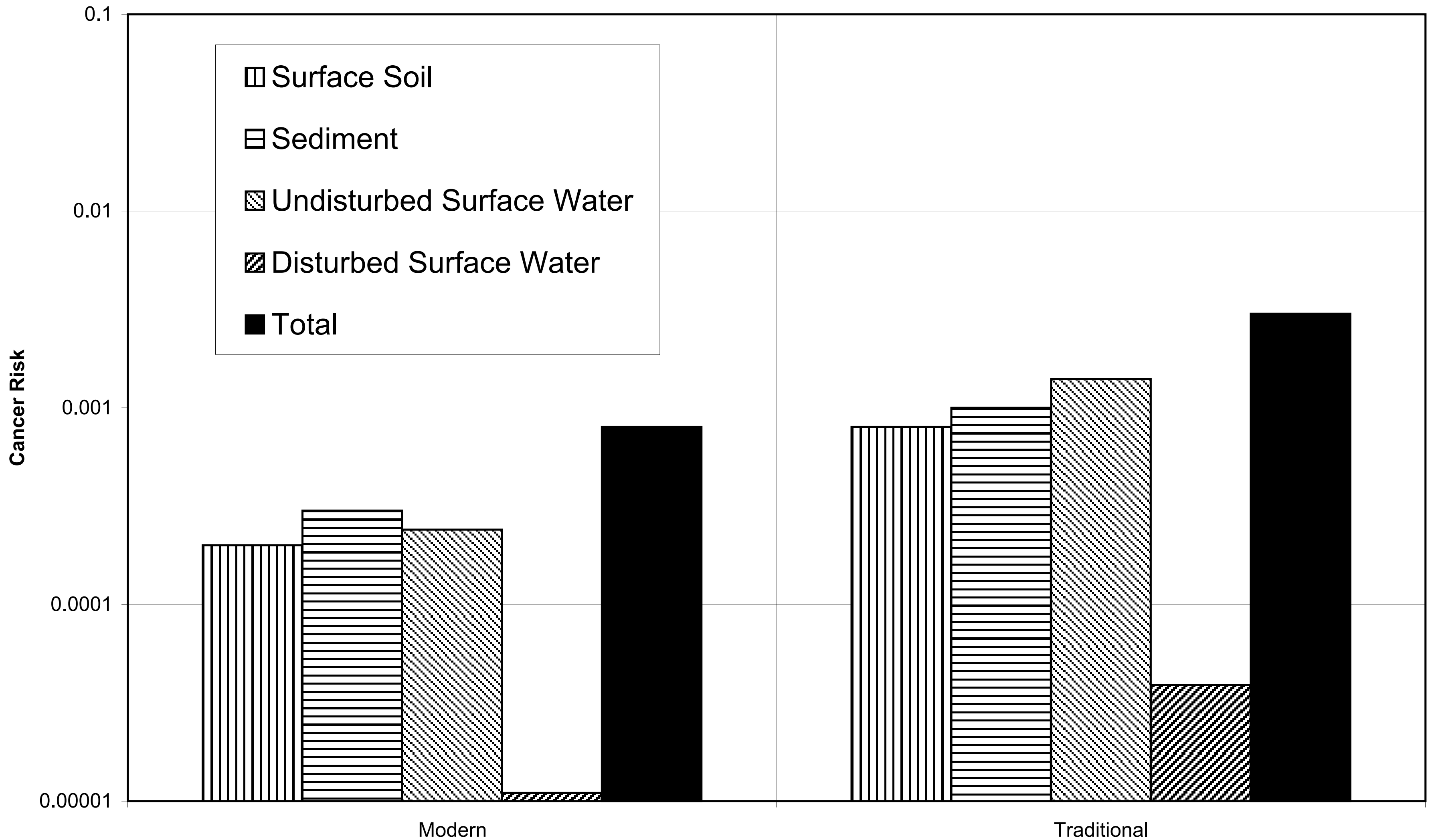
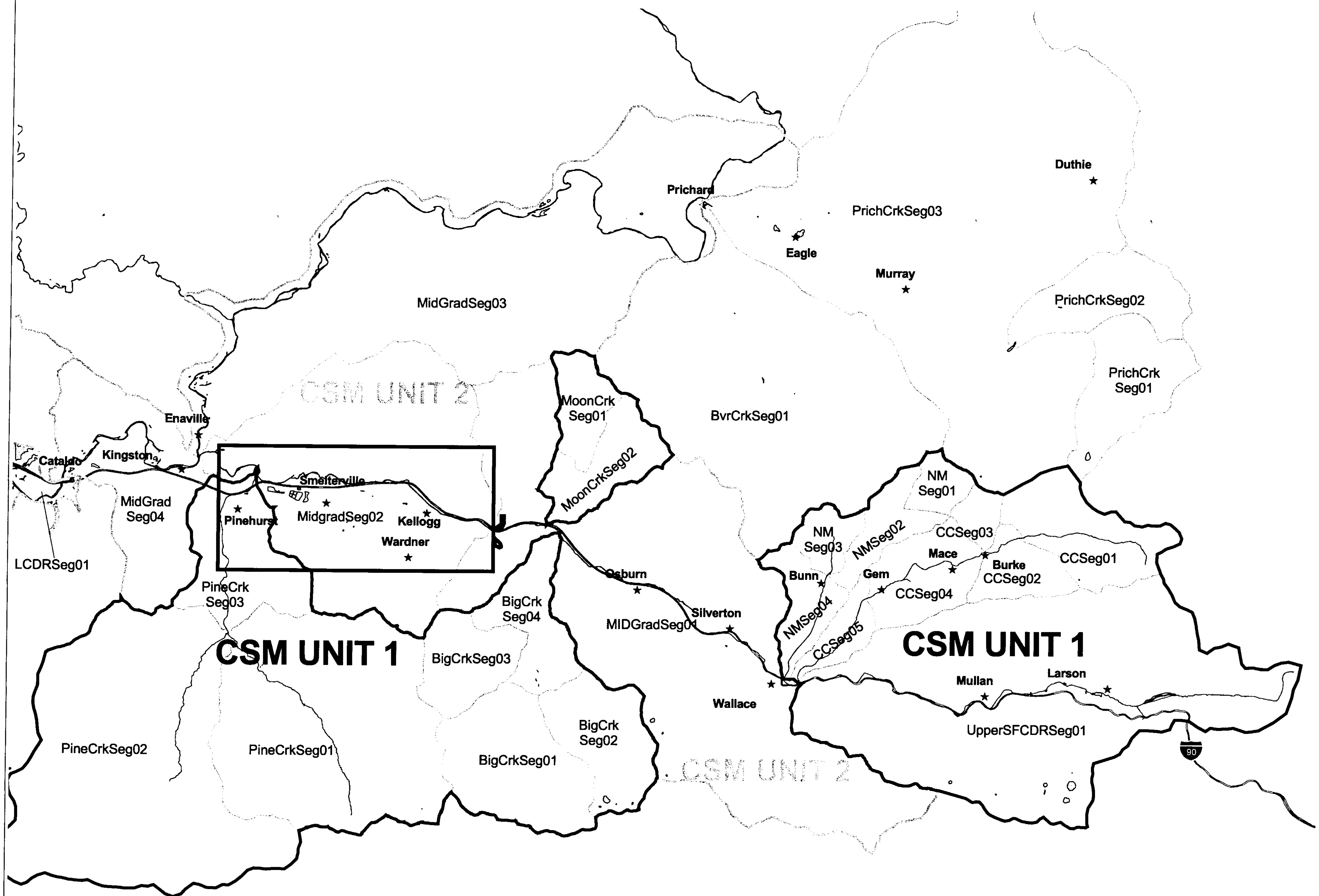
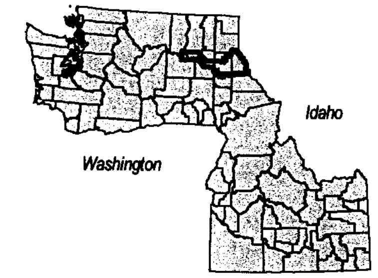


Figure 7.2-1
CSM Unit 1 Boundaries



LEGEND

- ★ City
- CSM Unit Boundary for FS
- Bunker Hill Superfund Site Boundary
- Interstate 90
- Lakes and Rivers
- Segment Boundary



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: 170,000

0 — 4 Miles

N

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Coeur d' Alene Basin RI/FS
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Document Control Numbers:
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EPA No. 2.9
CH2M HILL DCN: WKP0032
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V: CSM1
E: 1
L: CSM1
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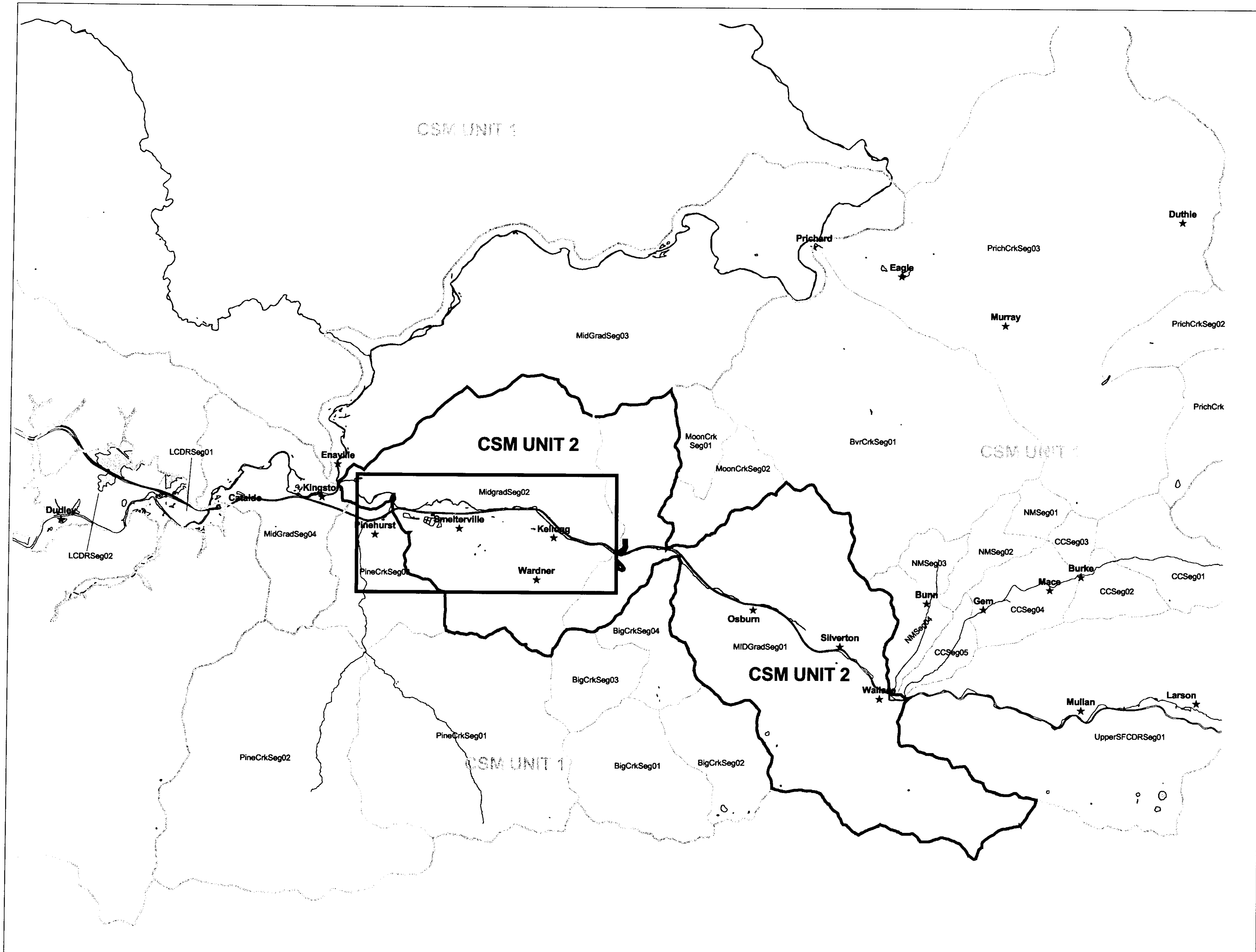
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

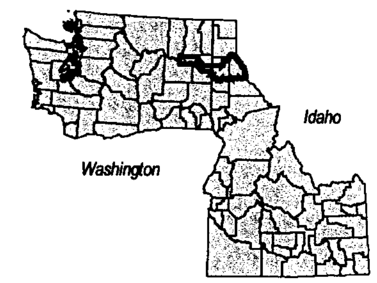
Date of Plot: August 14, 2002

Figure 7.2-2
CSM Unit 2 Boundaries



LEGEND

- ★ City
- CSM Unit Boundary for FS
- Bunker Hill Superfund Site Boundary
- Interstate 90
- Lakes and Rivers
- Segment Boundary



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: 170,000

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RECORD OF DECISION

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Document Control Numbers:
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EPA No. 2.9
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L: L CSM2
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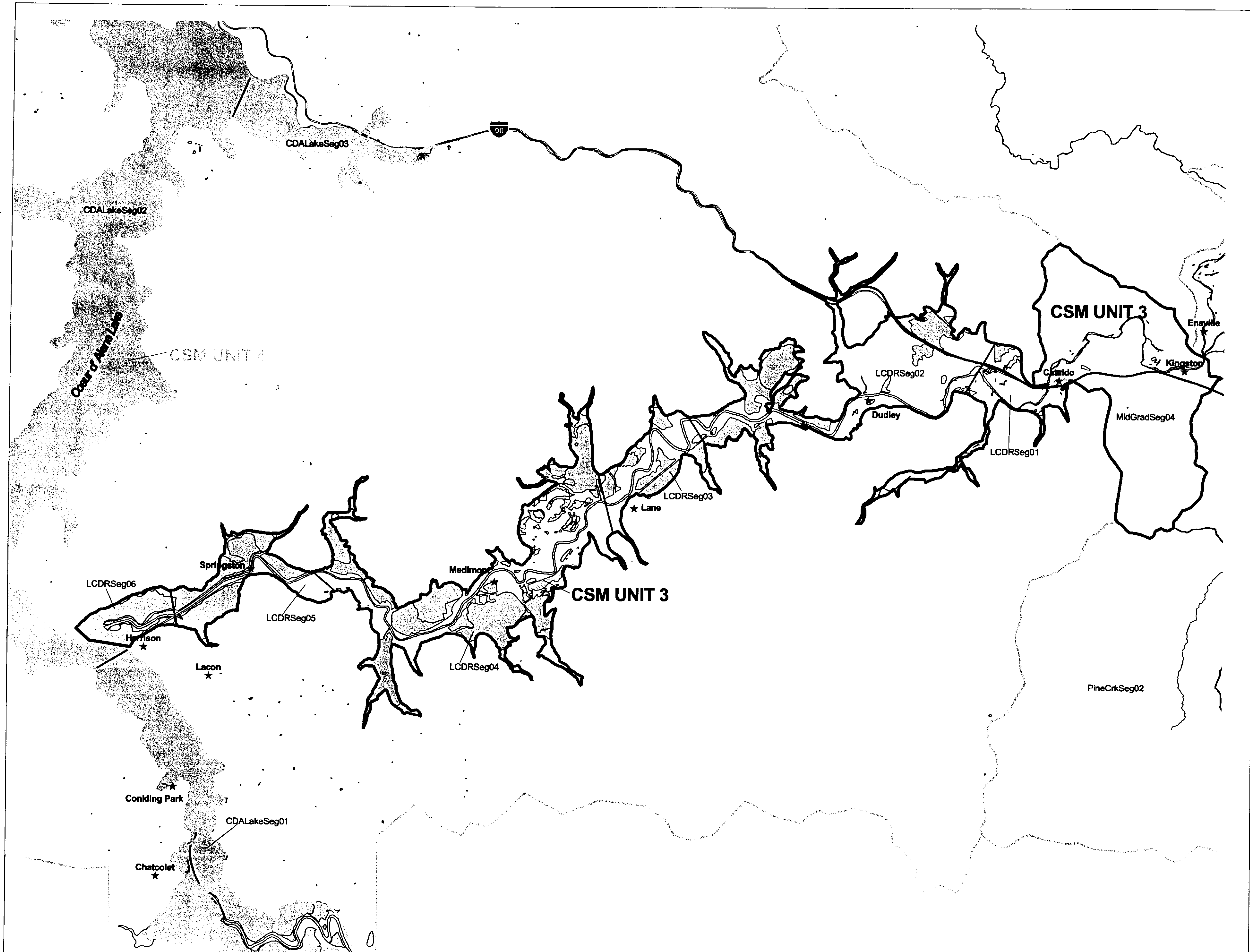
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

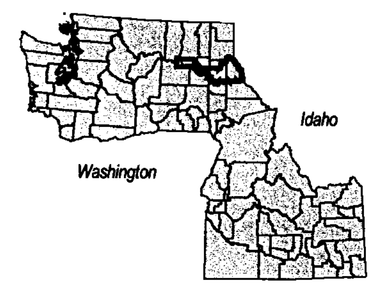
Date of Plot: August 14, 2002

Figure 7.2-3
CSM Unit 3 Boundaries



LEGEND

- ★ City
- CSM Unit Boundary for FS
- Interstate 90
- Lakes and Rivers
- Segment Boundary



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: 140,000

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Coeur d' Alene Basin RI/FS
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EPA No. 2.9
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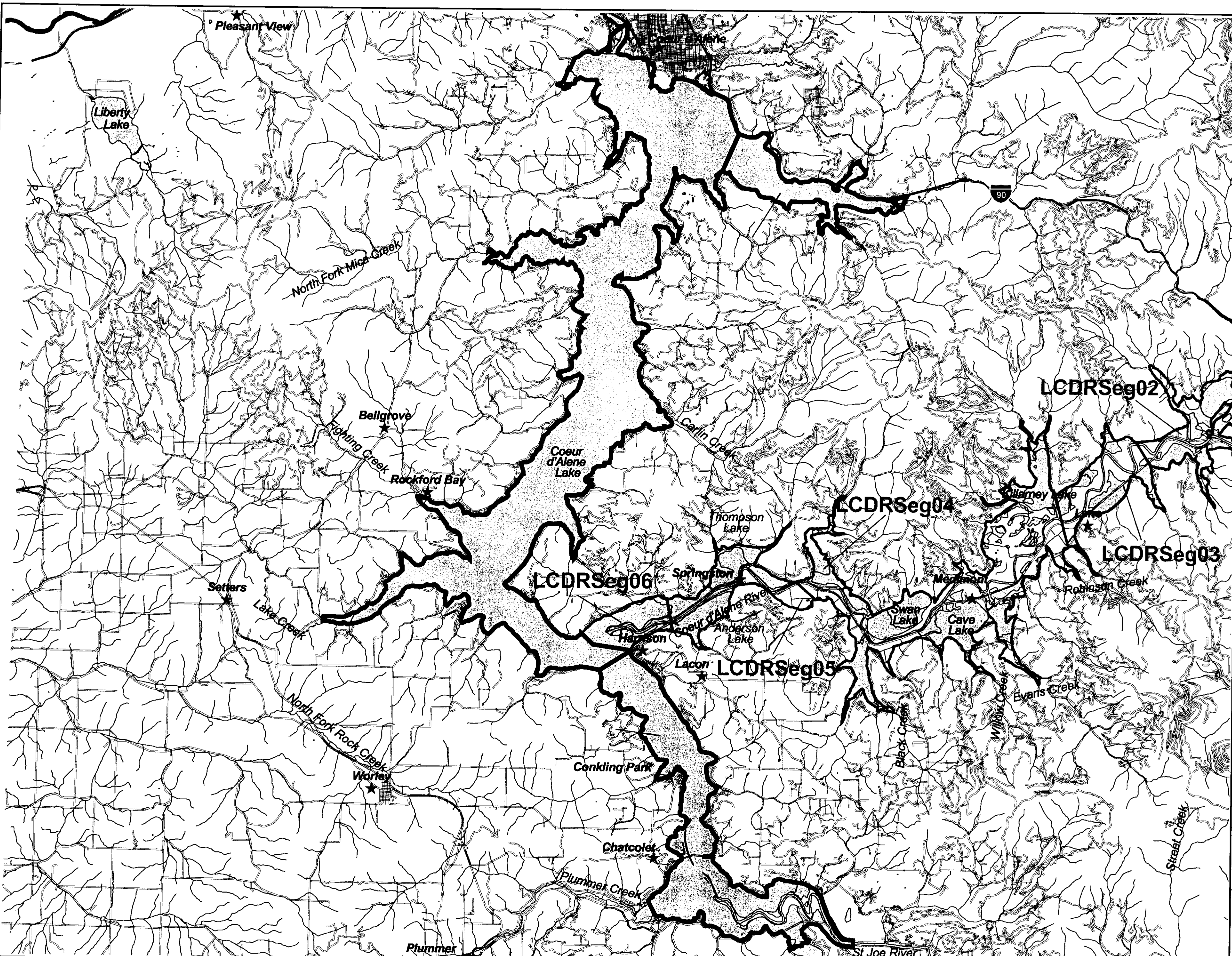
L: L CSM3
05/01/2002

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

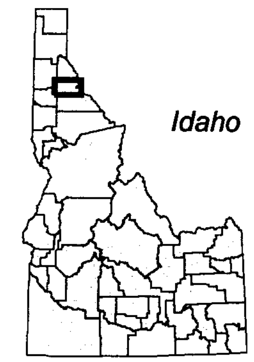
Date of Plot: May 01, 2002

Figure 7.2-4
CSM Unit 4 Boundaries



LEGEND

- Stream
- Road
- Interstate 90
- City
- Coeur d'Alene Lake Watershed
- River Segment
- Lake/River



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.

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Coeur d'Alene Basin RI/FS
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EPA REGION 10

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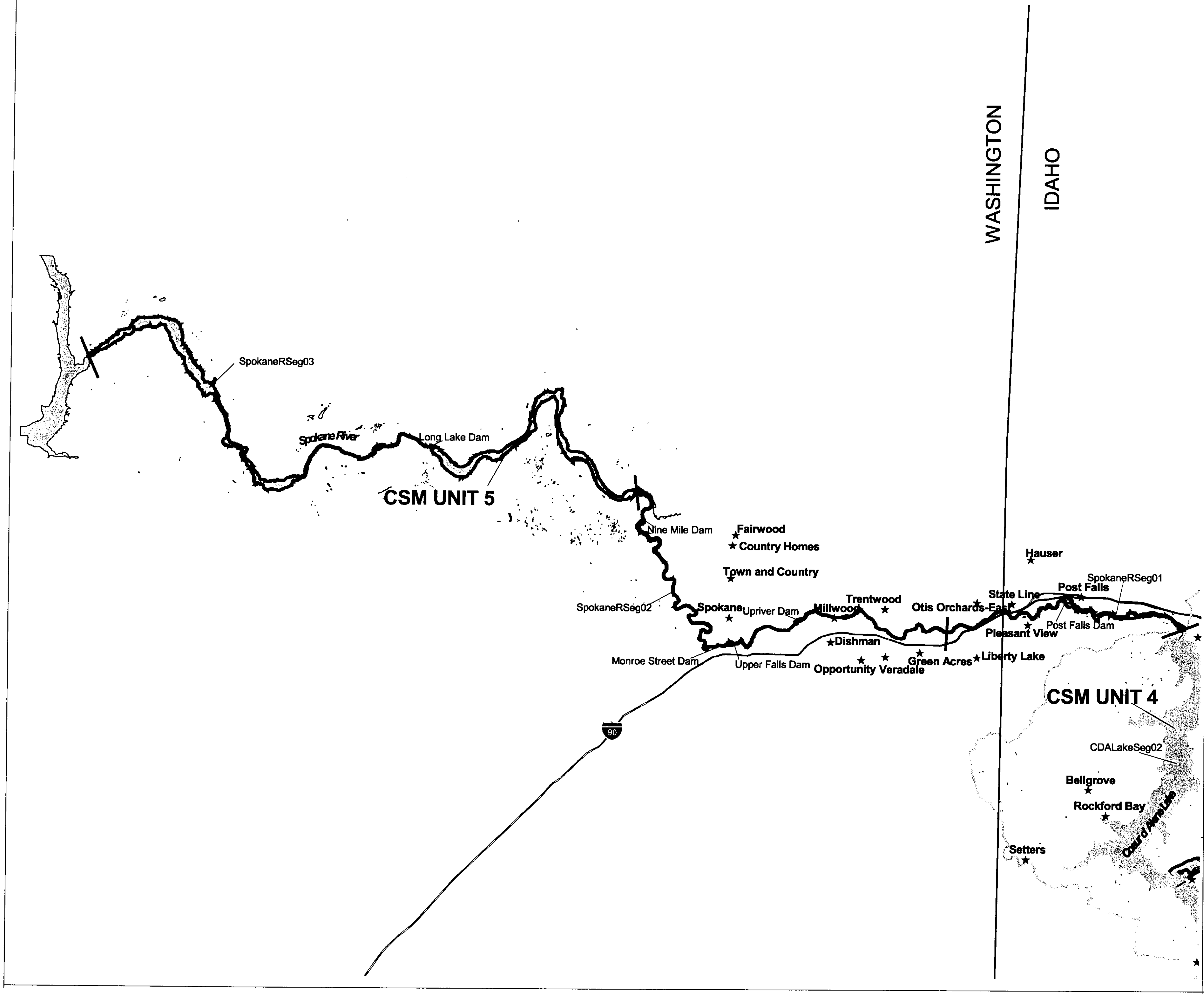
E: CDA lake
L: FS-Part 3 8.0-1
09/04/02

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

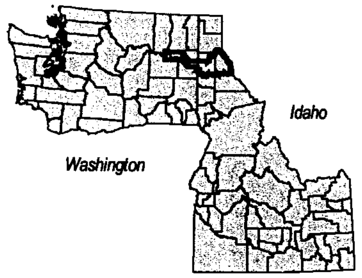
Date of Plot: September 4, 2002

Figure 7.2-5
CSM Unit 5 Boundaries



LEGEND

- ★ City
- CSM Unit Boundary for FS
- Interstate 90
- Lakes and Rivers
- Segment Boundary



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: 400,000

0 5 Miles

027-RI-C0-102Q
Coeur d' Alene Basin RI/FS
RECORD OF DECISION

EPA REGION 10

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05/01/02

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

Date of Plot: May 01, 2002

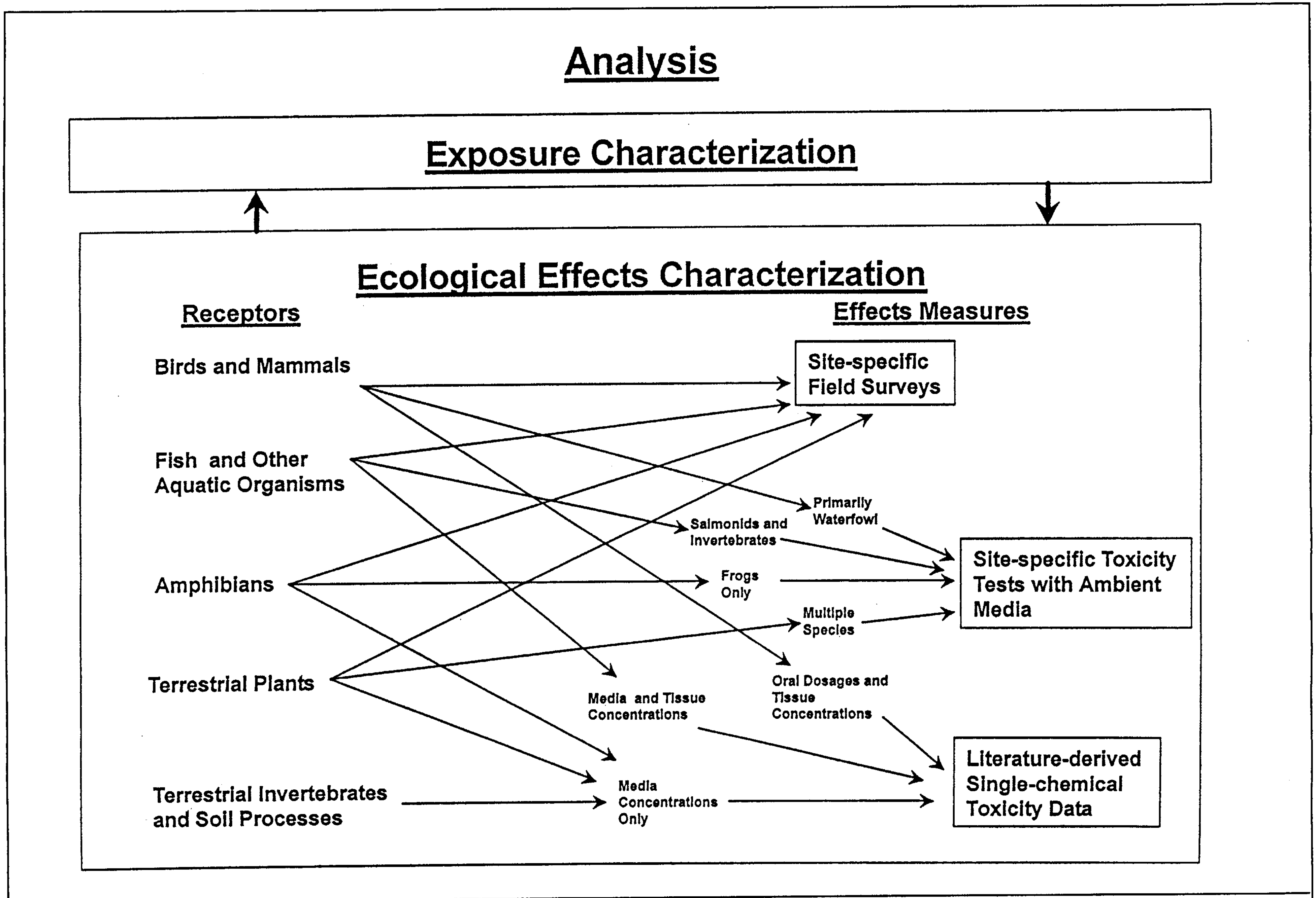

Figure 7.2-6
Ecological Effects Characterization

Table 7.1-1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations
Current/Future Residential Exposure Scenario

Scenario Timeframe: Current/Future

Geographical Area	Exposure Point[a]	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure[b]
			Min	Max					
Lower Basin	**Exposure Medium: Soil**								
	Yard Soil - Direct Contact	arsenic	4.3	115	mg/kg	28/28	48.53	mg/kg	95% UCL
		iron	9,710	93,000	mg/kg	25/25	37,703	mg/kg	95% UCL
		lead	15	7,350	mg/kg	160/160	110	mg/kg	geometric mean
	House Dust - Direct Contact	lead	49	3,140	mg/kg	31/31	301	mg/kg	geometric mean
Upper Basin[c]	**Exposure Medium: Soil**								
	Yard Soil - Direct Contact	arsenic	2.9 – 6.9	66.1 – 1150	mg/kg	53/53 – 308/309	21.46 – 50.74	mg/kg	95% UCL
		iron	5,910 – 13,000	46,700 – 123,000	mg/kg	54/54 – 282/282	20,198 – 27,190	mg/kg	95% UCL
		lead	22 – 94	3,356 – 20,218	mg/kg	70/70 – 262/262	257 – 771	mg/kg	geometric mean
	House Dust - Direct Contact	lead	23 – 429	1,750 – 29,725	mg/kg	26/26 – 35/35	466 – 1,004	mg/kg	geometric mean
	Exposure Medium: Groundwater (concentrations represent total metals in water)								
	Tap Water - Ingestion	arsenic	0.19	9.2	µg/L	11/16	8.4[d]	mg/kg	Max
All Areas	**Exposure Medium: Plant Tissue**								
	Homegrown Vegetables – Ingestion	cadmium	0.02	1.85	mg/kg	35/35	0.319	mg/kg	95% UCL
		lead	0.48	48.6	mg/kg	24/24	7.8	mg/kg	arithmetic mean

Notes:
Min – minimum
Max – maximum
Exposure Point Concentration: Estimate of the average concentration a person would encounter at the location where the exposure occurs.
Statistical Measure: The statistical measure describes how the exposure point concentration was calculated from the data.
95% UCL: 95 percent upper confidence limit of the mean
[a]The exposure point concentration for lead in house dust that was used in the lead model is the geometric mean of vacuum bag data.
[b]The exposure point concentration for lead in yard soil that was used in the Lead Model is the geometric mean.
[c]The Upper Basin was divided into seven sub-areas, the ranges of values presented for the Upper Basin represent the ranges of the seven sub-areas.
[d]This concentration is the average of static (first-draw water) and purged (flushed line water) samples.

Table 7.1-2
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations
Current/Future Neighborhood Recreational Exposure Scenario

Scenario Timeframe: Current/Future

Geographical Area	Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration[a]	Exposure Point Concentration Units	Statistical Measure
			Min	Max					
Upper Basin[b]	**Exposure Medium: Soil/Sediment**								
	Neighborhood Stream Sediments - Direct Contact	lead	88	67,100	mg/kg	17/17	29,500	mg/kg	95th percentile
	Exposure Medium: Surface Water (concentrations are total metals)								
	Surface Water - Direct Contact	lead	0.3	1,650	µg/L	79/80	296	µg/L	95th percentile
	Exposure Medium: Soil								
	Waste Piles - Direct Contact	lead	83	63,700	mg/kg	27/27	49,800	mg/kg	95th percentile

Notes:
Min – minimum
Max – maximum
Exposure Point Concentration: Estimate of the average concentration a person would encounter at the location where the exposure occurs.
Statistical Measure: The statistical measure describes how the exposure point concentration was calculated from the data.
[a]Not used directly in the lead model, used to assess incremental increases in blood lead over residential blood lead levels.
[b]Concentrations only exceeded for the Burke/Ninemile sub-area of the Upper Basin.

Table 7.1-3
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations
Current/Future Public Recreational Exposure Scenario

Scenario Timeframe: Current/Future

Geographical Area	Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
			Min	Max					
Lower Basin	**Medium: Soil/Sediment**								
	Floodplain Soil/Sediment near the Lower CDAR - Direct Contact	arsenic	2	492	mg/kg	388/388	119	mg/kg	95% UCL
		iron	4,450	256,000	mg/kg	388/388	105,451	mg/kg	95% UCL
		manganese	92	26,400	mg/kg	388/388	9,886	mg/kg	95% UCL
		lead	15	29,200	mg/kg	388/388	5,750[a]	mg/kg	95th Percentile
	Medium: Surface Water (concentrations are total metals in water)								
	Disturbed Surface Water - Direct Contact	lead	117	81,500	µg/L	122/122	31,700[b]	µg/L	95th Percentile
Upper Basin	**Medium: Soil/Sediment**								
	Surface Soil and beach sediments near confluence of North and South Forks CDAR Direct Contact (only location exceeding)	arsenic	73	266	mg/kg	19/19	163	mg/kg	95% UCL
		iron	39,900	174,000	mg/kg	19/19	100,621	mg/kg	95% UCL
		manganese	3,000	14,800	mg/kg	19/19	8,585	mg/kg	95% UCL

Notes:
CDAR – Coeur d'Alene River
Min – minimum
Max – maximum
Exposure Point Concentration: Estimate of the average concentration a person would encounter at the location where the exposure occurs.
Statistical Measure: The statistical measure describes how the exposure point concentration was calculated from the data.
95% UCL: 95 percent upper confidence limit of the mean
[a]Not used directly in the lead model. This value is the 95th percentile for sediment only, used in the lead evaluation to estimate incremental increases in children's blood lead in combination with lead in Lower Basin soils and disturbed surface water samples.
[b]Not used directly in the lead model. Used to assess incremental increases in blood lead in combination with lead in Lower Basin soils and sediment.

Table 7.1-4
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations
Future Residential Use of Tap Water

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Concern	Total Metal Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Nine Mile								
Tap Water - Ingestion	Cadmium	0.1	996	µg/L	70/80	130.85	mg/kg	95% UCL
	Zinc	2.8	145,000	µg/L	79/80	19,756	mg/kg	95% UCL

Notes:
Min – minimum
Max – maximum
Exposure Point Concentration: Estimate of the average concentration a person would encounter at the location where the exposure occurs.
Statistical Measure: The statistical measure describes how the exposure point concentration was calculated from the data.
95% UCL: 95 percent upper confidence limit of the mean

Table 7.1-5
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations
Future Subsistence Scenario in the Lower Basin

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration[a]	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Medium: Soil								
Floodplain Surface Soil - Direct Contact	Antimony	1.2	58.6	mg/kg	142/155	21.16	mg/kg	95% UCL
	Arsenic	5.4	492	mg/kg	155/155	124.44	mg/kg	95% UCL
	Cadmium	0.21	86.4	mg/kg	155/155	30.45	mg/kg	95% UCL
	Iron	12,700	222,000	mg/kg	155/155	97,440	mg/kg	95% UCL
	Manganese	511	25,200	mg/kg	155/155	8,960	mg/kg	95% UCL
	Lead	15.3	7,250	mg/kg	155/155	4,900	mg/kg	95th Percentile
Medium: Sediment								
Floodplain Sediment - Direct Contact	Antimony	1	73.7	mg/kg	211/233	25.2	mg/kg	95% UCL
	Arsenic	1.5	375	mg/kg	233/233	120.96	mg/kg	95% UCL
	Cadmium	0.24	105	mg/kg	228/233	39.33	mg/kg	95% UCL
	Iron	4,450	256,000	mg/kg	233/233	113,073	mg/kg	95% UCL
	Manganese	92.3	26,400	mg/kg	233/233	10,700	mg/kg	95% UCL
	Lead	18.3	29,200	mg/kg	233/233	5,750	mg/kg	95th Percentile
Medium: Plant Tissue								
Water Potatoes (with skin) - Ingestion	Cadmium	0.0675	3.71	mg/kg	88/95	0.489	mg/kg	95% UCL
	Lead	0.33	127	mg/kg	95/95	94	mg/kg	95th Percentile
Water Potatoes (without skin) - Ingestion	Lead	0.25	1.98	mg/kg	93/93	0.53	mg/kg	95th Percentile

Table 7.1-5 (Continued)
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations
Future Subsistence Scenario in the Lower Basin

Exposure Point		Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration[a]	Exposure Point Concentration Units	Statistical Measure
			Min	Max					
Medium: Surface Water									
Undisturbed Surface Water at Lower CDAR - Direct Contact		Arsenic	7	20	µg/L	4/9	20	µg/L	Max
		Lead	2	430	µg/L	91/93	110	µg/L	95th Percentile
Medium: Animal Tissue									
Fish Fillets from CdA Lateral Lakes - Ingestion	**Species**								
	Northern Pike	Methylmercury	0.025	0.48	mg/kg	63/63	0.133	mg/kg	95% UCL
	Bullhead	Lead	0.03	0.69	mg/kg	126/126	0.1	mg/kg	geometric mean
	Northern Pike	Lead	0.03	0.15	mg/kg	63/63	0.03	mg/kg	geometric mean
	Perch	Lead	0.09	2.41	mg/kg	123/123	0.34	mg/kg	geometric mean

Notes:
Min – minimum
Max – maximum
CdA – Coeur d'Alene
Exposure Point Concentration: Estimate of the average concentration a person would encounter at the location where the exposure occurs.
Statistical Measure: The statistical measure describes how the exposure point concentration was calculated from the data.
95% UCL: 95 percent upper confidence limit of the mean.
[a]The exposure point concentrations for lead were not used in the Lead Model, but rather were used to calculate potential lead intake rates. These rates were compared to residential intakes derived from the Lead Model. Various concentrations were compared to the residential intakes, the highest values are presented in this table.

Table 7.1-6
Selection of Exposure Pathways
Baseline Risk Assessment, Harrison to Mullan

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Tailing Deposits and Slag Piles (Soil)	Surface Water[a]	Stream and River Water	Recreational	Child/Adult	Ingestion Dermal	NA NA	Quant. Quant.	Children/adults may be in direct contact with surface water during intermittent recreational activities; therefore, the ingestion and dermal pathways were be quantitatively evaluated.
			Stream and River Sediment	Recreational	Child/Adult	Ingestion Dermal	NA NA	Quant. Quant.	Children/adults may be in contact with impacted sediments during intermittent recreational / tribal activities (e.g., swimming and beach play).
			Native Plants *	Subsistence	Child/Adult	Ingestion	NA	Quant.	Water potatoes growing in surface water/sediments were evaluated as a surrogate for other food plants for which there was insufficient data.
			Cattle[b] *	Residential	Child/Adult	Ingestion	NA	Qual.	Children and adults eat potentially affected cattle that graze on grasses growing in impacted sediment.
			Wild Fowl[b] *	Recreational	Child/Adult	Ingestion	NA	Qual.	Children and adults hunt and eat potentially affected wild fowl that are found in floodplain.
			Fish from lower CdA River[c]	Recreational	Child/Adult	Ingestion	NA	Quant.	Children and adults may collect fish that are potentially affected by impacted surface water and sediments; therefore, this pathway will be quantitatively evaluated.

**Table 7.1-6 (Continued)
Selection of Exposure Pathways
Baseline Risk Assessment, Harrison to Mullan**

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current (continued)		Surface Soil[d]	Surface Soil	Residential Recreational	Child/Adult	Ingestion Dermal	NA NA	Quant. Quant.	Children and adults may potentially be in direct contact with impacted surface soils during outdoor activities at their homes and/or parks; therefore, the ingestion and dermal pathways will be quantitatively evaluated.
			Vegetables *	Residential	Child/Adult	Ingestion	NA	Quant.	Children and adults eat vegetables from gardens potentially containing impacted soils; therefore, this pathway will be evaluated quantitatively. Susistence populations may collect native plants growing in impacted soils.
			Native Plants[e]*	Subsistence	Child/Adult	Ingestion	NA	Qual.	
			Game[g] *	Subsistence	Child/Adult	Ingestion	NA	Qual.	Game animals (e.g., deer, beaver, and muskrats), except for water fowl, are unlikely to contain significant levels of metals, see text.
		Groundwater[f]	Tap Water	Residential	Child/Adult	Ingestion Dermal	NA NA	Quant. Quant.	Residents currently use groundwater for drinking and for household activities; therefore, this pathway will be quantitatively evaluated if elevated concentrations are observed.
		Air	Resuspended Particulates from Surface Soils	Residential Recreational	Child/Adult	Inhalation	NA	Qual.	The inhalation pathway is likely negligible at the site as compared to the ingestion and dermal contact pathways for soil, except air exposures were quantified for lead.

Table 7.1-6 (Continued)
Selection of Exposure Pathways
Baseline Risk Assessment, Harrison to Mullan

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Tailing Deposits Slag Piles (Soil)	Groundwater/ Surface Soil	Subsurface Soil	Residential	Child/Adult	Ingestion Dermal	NA NA	Qual. Qual.	If affected soils below ground surface remain undisturbed, exposures are not likely to occur. Residential subsurface soil disturbance is likely minimal. Where there are risks to residents from surface soil, subsurface soil is also considered a risk and will be remediated.
				Occupational	Adult	Ingestion Dermal	NA NA	Quant. Quant.	If affected soils below ground surface remain undisturbed, occupational exposures are likely to be minimal. The occupational exposure pathway under a future, short-term construction scenario with intensive soil contact was quantitatively addressed.
						Inhalation	NA	Quant.	
		Surface Water[a]	Stream and River Water	Subsistence Recreational	Child/Adult	Ingestion Dermal	NA NA	Quant. Quant.	Children and adults may be in direct contact with surface water during intermittent recreational activities; therefore, the ingestion and dermal pathways will be quantitatively evaluated.
			Stream and River Sediment	Subsistence Recreational	Child/Adult	Ingestion Dermal	NA NA	Quant. Quant.	Children/adults may be in contact with impacted sediments during intermittent recreational / tribal activities (e.g., swimming and beach play).

Table 7.1-6 (Continued)
Selection of Exposure Pathways
Baseline Risk Assessment, Harrison to Mullan

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future (continued)			Fish from lower CdA River[c]	Subsistence Recreational	Child/Adult	Ingestion	NA	Quant.	Children and adults may collect fish that are potentially affected by impacted surface water and sediments; therefore, this pathway will be quantitatively evaluated.
		Surface Soil[d]	Surface Soil	Residential Subsistence[h] Recreational	Child/Adult	Ingestion Dermal	NA NA	Quant. Quant.	Children and adults may potentially be in direct contact with impacted surface soils during outdoor activities at their homes and/or parks; therefore, the ingestion and dermal pathways will be quantitatively evaluated.
		Groundwater[f]	Tap Water	Residential	Child/Adult	Ingestion Dermal	NA NA	Quant. Quant.	Groundwater for future scenario is not currently being used as a drinking water source; groundwater identified under the current scenario is being used and will continue to be used. Future groundwater use near Canyon Creek and Ninemile Creek was quantified.
		Air	Resuspended Particulates from Surface Soils	Residential Subsistence Recreational	Child/Adult	Inhalation	NA	Qual.	The inhalation pathway is likely negligible at the site as compared to the ingestion and dermal contact pathways for soil, only lead was quantified for air exposures.

Table 7.1-6 (Continued)
Selection of Exposure Pathways
Baseline Risk Assessment, Harrison to Mullan

NA – Not applicable to CdA site; Quant. = quantitative analysis in the risk assessment; Qual. = qualitative analysis in the risk assessment; SW = surface water
[a]In addition to impacts from surface soil erosion / stormwater runoff / impacted sediment, surface water is also affected by surface seepage of the groundwater.
[b]Cattle graze in floodplain on grasses that grow in contaminated sediment. Wild fowl, also found in floodplain, are hunted and eaten by people.
[c]In addition to impacts from contaminated surface water, fish are also affected by contaminated sediments.
[d]In addition to direct contact with tailing deposits and waste piles, other soils have been impacted by depositions from water- and air- transported materials.
[e]Terrestrial plant pathways were qualitatively discussed, data insufficient to evaluate risks (e.g., data from Hawthorne berries).
[f]In addition to impacts from soil leachate, groundwater is also affected by surface water infiltration.
[g]Limited samples have been collected from a variety of terrestrial game animals, e.g., muskrat, beavers, and deer; however, data is insufficient for quantification, qualitatively discussed in the risk assessment.
[h]No subsistence populations have homes on impacted soils; however, subsistence exposures to surface soil were quantified under future conditions, assuming populations live in the floodplain in the Lower Basin.

Note:
* Pathway also complete under a future exposure scenario

Table 7.1-7
Residential Exposure Factors for Non-Lead Chemicals

Exposure Parameter	RME Value	Reference	CT Value	Reference
Exposure Assumptions for Ingestion of Chemicals in Yard Soil				
IRa: Ingestion rate - adult (mg/day)	100	USEPA 1991b	50	USEPA 1993
IRch: Ingestion rate - child (mg/day)	200	USEPA 1991b	100	USEPA 1993
EF: Exposure frequency (days/yr)	350	USEPA 1991b	260	A
EDa: Exposure duration - adult (years)	24	USEPA 1991b	7	USEPA 1993
EDch: Exposure duration - child (years)	6	USEPA 1991b	2	USEPA 1993
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BWa: Body weight - adult (kg)	70	USEPA 1991b	70	USEPA 1991b
BWch: Body weight - child (kg)	15	USEPA 1991b	15	USEPA 1991b
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer, child/adult (days)	10,950	USEPA 1989c	3,285	USEPA 1989c
ATnc: Averaging time - noncancer, child (days)	2,190	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Dermal Contact with Chemicals in Yard Soil				
SAa: Skin surface area - adult (cm^2)	2,500	USEPA 1998b	2,500	USEPA 1998b
SAch: Skin surface area - child (cm^2)	2,200	USEPA 1998b	2,200	USEPA 1998b
AFa: Adherence factor - adult (mg/cm^2-event)	0.1	USEPA 1998b	0.1	USEPA 1998b
AFch: Adherence factor - child (mg/cm^2-event)	0.2	USEPA 1998b	0.2	USEPA 1998b
EF: Exposure frequency (events/year)	350	USEPA 1991b	260	A
ED: Exposure duration - adult (years)	24	USEPA 1991b	7	USEPA 1993
ED: Exposure duration - child (years)	6	USEPA 1991b	2	USEPA 1993
BWa: Body weight - adult (kg)	70	USEPA 1991b	70	USEPA 1991b
BWch: Body weight - child (kg)	15	USEPA 1991b	15	USEPA 1991b
ABS: Dermal absorption factor (unitless)	chem. specific	USEPA 1998b	chem. Specific	USEPA 1998b
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer, child/adult (days)	10,950	USEPA 1989c	3,285	USEPA 1989c
ATnc: Averaging time - noncancer, child (days)	2,190	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Ingestion of Tap Water				
IRa: Ingestion rate - adult (L/day)	2	USEPA 1991b	1.4	USEPA 1993
IRch: Ingestion rate - child (L/day)	1	USEPA 1999f	1	USEPA 1999f
EDa: Exposure duration - adult (years)	24	B	7	USEPA 1993
EDch: Exposure duration - child (years)	6	B	2	USEPA 1993
BWa: Body weight - adult (kg)	70	USEPA 1991b	70	USEPA 1991b
BWch: Body weight - child (kg)	15	USEPA 1991b	15	USEPA 1991b
EF: Exposure frequency (days/yr)	350	USEPA 1991b	234	USEPA 1993
CF: Conversion factor (mg/µg)	1.0E-03	NA	1.0E-03	NA
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c

Table 7.1-7 (Continued)
Residential Exposure Factors for Non-Lead Chemicals

Exposure Parameter	RME Value	Reference	CT Value	Reference
ATnc: Averaging time - noncancer, child/adult (days)	10,950	USEPA 1989c	3,285	USEPA 1989c
ATnc: Averaging time - noncancer, child (days)	2,190	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Ingestion of Homegrown Vegetables				
IRveg: Intake rate of homegrown vegetables (g/kg-day)	5.04	C	0.492	C
EF: Exposure frequency (days/yr)	365	D	365	D
ED: Exposure duration (years)	30	USEPA 1991b	9	USEPA 1993
CF: Conversion factor (kg/g)	1.0E-03	NA	1.0E-03	NA
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer (days)	10,950	USEPA 1989c	3,285	USEPA 1989c

Notes:
[a]Exposure frequency was based on 3 months limited soil exposure due to snow-covered/frozen ground.
[b]USEPA 1991b recommends an adult/child exposure duration of 24/6 years for ingestion of soil; for consistency, an exposure duration of 24/6 years was selected for ingestion of tap water.
[c]Ingestion rate is seasonally adjusted and incorporates the body weights of all participants in the study (children and adults) from USEPA 1997b.
[d]Ingestion rate of vegetables is an average daily consumption rate, therefore 365 days/year was selected as the frequency of exposure for both the RME and CT cases.

Table 7.1-8
Neighborhood Recreational Exposure Factors for Non-Lead Chemicals

Exposure Parameter	RME Value	Reference	CT Value	Reference
Exposure Assumptions for Ingestion of Chemicals in Waste Pile Soil				
IR: Ingestion rate (mg/day)	300	A	120	A
EF: Exposure frequency (days/yr)	17	B	8.5	B
ED: Exposure duration (years)	7	C	2	USEPA 1993
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BW: Body weight (kg)	28	D	28	D
ATc: Averaging time - cancer (days)	25,500	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer (days)	2,555	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Dermal Contact with Chemicals in Waste Pile Soil				
SA: Skin surface area (cm^2)	5,080	USEPA 1997b	5,080	USEPA 1997b
AF: Soil to skin adherence factor (mg/cm^2-event)	0.2	USEPA 1998b	0.2	USEPA 1998b
ABS: Dermal absorption factor (unitless)	chem-specific	USEPA 1998b	Chem-specific	USEPA 1998b
EF: Exposure frequency (events/year)	34	E	17	E
ED: Exposure duration (years)	7	C	2	USEPA 1993
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BW: Body weight (kg)	28	D	28	D
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer (days)	2,555	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Ingestion of Chemicals in Upland Soil (Parks/Schools/Elk Creek Area)				
IR: Ingestion rate (mg/day)	300	A	120	A
EF: Exposure frequency (days/yr)	34	F	17	F
ED: Exposure duration (years)	7	C	2	USEPA 1993
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BW: Body weight (kg)	28	D	28	D
ATc: Averaging time - cancer (days)	25,500	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer (days)	2,555	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Dermal Contact with Chemicals in Upland Soil (Parks/Schools/Elk Creek Area)				
SA: Skin surface area (cm^2)	5,080	USEPA 1997b	5,080	USEPA 1997b
AF: Soil to skin adherence factor (mg/cm^2-event)	0.2	USEPA 1998b	0.2	USEPA 1998b
ABS: Dermal absorption factor (unitless)	chem-specific	USEPA 1998b	Chem-specific	USEPA 1998b
EF: Exposure frequency (events/year)	68	G	34	G
ED: Exposure duration (years)	7	C	2	USEPA 1993
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BW: Body weight (kg)	28	D	28	D
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer (days)	2,555	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Ingestion of Chemicals in Floodplain Soil/Sediment				
IR: Ingestion rate (mg/day)	300	A	120	A
EF: Exposure frequency (days/yr)	21	H	10	H
ED: Exposure duration (years)	7	C	2	USEPA 1993

Table 7.1-8 (Continued)
Neighborhood Recreational Exposure Factors for Non-Lead Chemicals

Exposure Parameter	RME Value	Reference	CT Value	Reference
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BW: Body weight (kg)	28	D	28	D
ATc: Averaging time - cancer (days)	25,500	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer (days)	2,555	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Dermal Contact with Chemicals in Floodplain Soil/Sediment				
SA: Skin surface area (cm^2)	5,080	I	5,080	I
AF: Soil to skin adherence factor (mg/cm^2-event)	0.2	USEPA 1998b	0.2	USEPA 1998b
ABS: Dermal absorption factor (unitless)	chem-specific	USEPA 1998b	Chem-specific	USEPA 1998b
EF: Exposure frequency (events/year)	96	J	48	J
ED: Exposure duration (years)	7	C	2	USEPA 1993
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BW: Body weight (kg)	28	D	28	D
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer (days)	2,555	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Ingestion of Surface Water				
IR: Ingestion rate (mL/hour)	30	USEPA 1998d	30	USEPA 1998d
ET: Exposure time (hours/day)	1	USEPA 1997b	1	USEPA 1997b
EF: Exposure frequency (days/yr)	96	I	I	
ED: Exposure duration (years)	7	C	2	USEPA 1993
CF1: Conversion factor (mg/µg)	0.001	NA	0.001	NA
CF2: Conversion factor (L/mL)	0.001	NA	0.001	NA
BW: Body weight (kg)	28	D	28	D
ATc: Averaging time - cancer (days)	2.6E+04	USEPA 1989c	2.6E+04	USEPA 1989c
ATnc: Averaging time - noncancer (days)	2,555	USEPA 1989c	730	USEPA 1989c

Reference Notes:
[a]The RME value of 300 mg/day is the 90th percentile soil intake from van Wijnen (1990); the CT value of 120 mg/day is the mean soil intake from the same study, as cited in USEPA 1999f.
[b]Exposure frequency is calculated as: 34 weeks/year x 7 hours/day x 1 day/week / 14 hours/day = 17 days/year for the RME; 34 weeks/year x 7 hours/day x once every other week, 0.5 / 14 hours/day = 8.5 days/year.
[c]Neighborhood exposure assumes children between the ages of 4 and 11 are playing in the waste piles.
[d]Value is the 50th percentile for boys and girls, ages 4 to 11.
[e]Exposure frequency is calculated as: 34 weeks/year x 1 event/week = 34 events/year for RME; 34 weeks/year, once every other week = 17 events/year for CT.
[f]The exposure frequency is calculated as: 34 weeks/year x 7 hours/day x 2 days/week / 14 hours/day = 34 days/year for the RME; this assumes weekend outdoor exposure. For the CT, exposure frequency is 34 weeks/year x 7 hours/day x 1 day/week / 14 hours/day = 17 days/year.
[g]Exposure frequency is calculated as 34 weeks/year x 2 events/week = 68 events/year for RME, and 34 weeks/year x 1 event/week = 34 events/year.
[h]Exposure frequency is calculated as 24 weeks/year x 3 hours/day x 4 days/week / 14 hours/day = 21 days/year for the RME case; 3 hours/day is the high end of the 50th percentile range (1 to 3 hours/day) from USEPA 1997b. For the CT case, exposure frequency is 24 weeks/year x 3 hours/day x 2 days/week / 14 hours/day = 10 days/year.

Table 7.1-8 (Continued)
Neighborhood Recreational Exposure Factors for Non-Lead Chemicals

[i]Exposure frequency is calculated as 24 weeks/year x 4 events/week = 96 events/year for RME; and 24 weeks/year x 2 events/week = 48 events/year for the CT case.

[j]At Lower Basin and Kingston (north-south confluence), a skin surface area of 7,960 cm^2 was used to reflect the possibility that swimming and therefore exposure of the entire body to contaminants in sediment could occur at these locations. It was assumed that swimming would occur during 16 weeks of the year (the warmest months), while wading and playing along the shoreline without swimming would occur during 8 weeks of the year. The median skin surface area for male children age 4 to 11 is 9,400 cm^2 (USEPA 1997b). The skin surface area was calculated as follows: ((16 weeks x 9,400 cm^2) + (8 weeks x 5,080 cm^2)) / 24 weeks = 7,960 cm^2

Table 7.1-9
Public Recreational Exposure Factors for Non-Lead Chemicals

Exposure Parameter	RME Value	Reference	CT Value	Reference
Exposure Assumptions for Ingestion of Chemicals in Upland Soil (Parks/Schools)				
IRa: Ingestion rate - adult (mg/day)	100	USEPA 1991b	50	USEPA 1993
IRch: Ingestion rate - child (mg/day)	300	A	120	A
EFa: Exposure frequency - adult (days/yr)	30	B	15	B
EFch: Exposure frequency - child (days/yr)	34	B	17	B
EDa: Exposure duration - adult (years)	24	USEPA 1991b	7	USEPA 1993
EDch: Exposure duration - child (years)	6	USEPA 1991b	2	USEPA 1993
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BWa: Body weight - adult (kg)	70	USEPA 1991b	70	USEPA 1991b
BWch: Body weight - child (kg)	15	USEPA 1991b	15	USEPA 1991b
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer, child/adult (days)	10,950	USEPA 1989c	3,285	USEPA 1989c
ATnc: Averaging time - noncancer, child (days)	2,190	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Dermal Contact with Chemicals in Upland Soil (Parks/Schools)				
SAa: Skin surface area - adult (cm^2)	2,500	USEPA 1998b	2,500	USEPA 1998b
SAch: Skin surface area - child (cm^2)	2,200	USEPA 1998b	2,200	USEPA 1998b
AFa: Adherence factor - adult (mg/cm^2-event)	0.1	USEPA 1998b	0.1	USEPA 1998b
AFch: Adherence factor - child (mg/cm^2-event)	0.2	USEPA 1998b	0.2	USEPA 1998b
EF: Exposure frequency (events/year)	68	C	34	C
ED: Exposure duration - adult (years)	24	USEPA 1991b	7	USEPA 1993
ED: Exposure duration - child (years)	6	USEPA 1991b	2	USEPA 1993
BWa: Body weight - adult (kg)	70	USEPA 1991b	70	USEPA 1991b
BWch: Body weight - child (kg)	15	USEPA 1991b	15	USEPA 1991b
ABS: Dermal absorption factor (unitless)	chem. Specific	USEPA 1998b	chem. Specific	USEPA 1998b
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer, child/adult (days)	10,950	USEPA 1989c	3,285	USEPA 1989c
ATnc: Averaging time - noncancer, child (days)	2,190	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Ingestion of Chemicals in Floodplain Soil/Sediment				
IRa: Ingestion rate - adult (mg/day)	100	USEPA 1991b	50	USEPA 1993
IRch: Ingestion rate - child (mg/day)	300	A	120	A
EF: Exposure frequency (days/year)	32	D	16	D
EDa: Exposure duration - adult (years)	24	USEPA 1991b	7	USEPA 1993
EDch: Exposure duration - child (years)	6	USEPA 1991b	2	USEPA 1993
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BWa: Body weight - adult (kg)	70	USEPA 1991b	70	USEPA 1991b
BWch: Body weight - child (kg)	15	USEPA 1991b	15	USEPA 1991b
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer, child/adult (days)	10,950	USEPA 1989c	3,285	USEPA 1989c
ATnc: Averaging time - noncancer, child (days)	2,190	USEPA 1989c	730	USEPA 1989c

Table 7.1-9 (Continued)
Public Recreational Exposure Factors for Non-Lead Chemicals

Exposure Parameter	RME Value	Reference	CT Value	Reference
Exposure Assumptions for Dermal Contact with Chemicals in Floodplain Soil/Sediment				
SAa: Skin surface area - adult (cm^2)	18,000	USEPA 1998b	18,000	USEPA 1998b
SAch: Skin surface area - child (cm^2)	6,500	USEPA 1998b	6,500	USEPA 1998b
AFa: Adherence factor - adult (mg/cm^2-event)	0.1	USEPA 1998b	0.1	USEPA 1998b
AFch: Adherence factor - child (mg/cm^2-event)	0.2	USEPA 1998b	0.2	USEPA 1998b
EF: Exposure frequency (events/year)	32	D	16	D
ED: Exposure duration - adult (years)	24	USEPA 1991b	7	USEPA 1993
ED: Exposure duration - child (years)	6	USEPA 1991b	2	USEPA 1993
BWa: Body weight - adult (kg)	70	USEPA 1991b	70	USEPA 1991b
BWch: Body weight - child (kg)	15	USEPA 1991b	15	USEPA 1991b
ABS: Dermal absorption factor (unitless)	chem. Specific	USEPA 1998b	chem. Specific	USEPA 1998b
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer, child/adult (days)	10,950	USEPA 1989c	3,285	USEPA 1989c
ATnc: Averaging time - noncancer, child (days)	2,190	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Ingestion of Surface Water				
IR: Ingestion rate (mL/hour)	30	USEPA 1998d	30	USEPA 1998d
ET: Exposure time (hours/day)	1	USEPA 1997b	1	USEPA 1997b
EDa: Exposure duration - adult (years)	24	E	7	USEPA 1993
EDch: Exposure duration - child (years)	6	E	2	USEPA 1993
BWa: Body weight - adult (kg)	70	USEPA 1991b	70	USEPA 1991b
BWch: Body weight - child (kg)	15	USEPA 1991b	15	USEPA 1991b
EF: Exposure frequency (days/yr)	32	D	16	D
CF: Conversion factor (mg/µg)	1.0E-03	NA	1.0E-03	NA
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer, child/adult (days)	10,950	USEPA 1989c	3,285	USEPA 1989c
ATnc: Averaging time - noncancer, child (days)	2,190	USEPA 1989c	730	USEPA 1989c
Exposure Assumptions for Ingestion of Fish				
IR: Ingestion rate of fish (g/day)	46	ATSDR 1989c	25	USEPA 1997b
EF: Exposure frequency (days/yr)	365	F	365	F
ED: Exposure duration (years)	30	USEPA 1991b	9	USEPA 1993
CF: Conversion factor (kg/g)	1.0E-03	NA	1.0E-03	NA
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer (days)	10,950	USEPA 1989c	3,285	USEPA 1989c

Reference Notes:
[a]The RME value of 300 mg/day is the 90th percentile soil intake from van Wijnen (1990); the CT value of 120 mg/day is the mean soil intake from the same study, as cited in USEPA 1999f.
[b]RME exposure frequency for adult: 34 weeks/year x 7 hours/day x 2 days/week / 16 hours/day = 30 days/year; for child: 34 weeks/year x 7 hours/day x 2 days/week / 14 hours/day = 34 days/year. Two days/week assumes weekend outdoor exposure. The CT exposure frequency for adults is: 34 weeks/year x 7 hours/day x 1 day/week / 16 hours/day = 15 days/year; for a child, 34 weeks/year x 7 hours/day x 1 day/week / 14 hours/day = 17 days/year.

Table 7.1-9 (Continued)
Public Recreational Exposure Factors for Non-Lead Chemicals

[c]Exposure frequency is calculated as: 34 weeks/year x 2 events/week = 68 events/year for the RME case; 34 weeks/year x 1 event/week = 34 events/year for the CT case.
[d]Professional judgment
[e]USEPA 1991b recommends an adult/child exposure duration of 24/6 years for ingestion of soil; for consistency, an exposure duration of 24/6 years was selected for ingestion of tap water.
[f]Ingestion rate of fish is an average daily consumption rate, therefore 365 days/year was selected as the frequency of exposure for both the RME and CT cases.

Table 7.1-10
Occupational Exposure Factors for Non-Lead Chemicals

Exposure Parameter	RME Value	Reference	CT Value	Reference
Exposure Assumptions for Ingestion of Chemicals in Construction Site Soil				
IR: Ingestion rate (mg/day)	300	USEPA 1999f	200	USEPA 1999f
EF: Exposure frequency (days/yr)	195	A	43	A
ED: Exposure duration (years)	25	USEPA 1991b	6.6	USEPA 1997b
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BW: Body weight (kg)	70	USEPA 1991b	70	USEPA 1991b
ATc: Averaging time - cancer (days)	25,500	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer (days)	9,125	USEPA 1989c	2,409	USEPA 1989c
Exposure Assumptions for Dermal Contact with Chemicals in Construction Site Soil				
SA: Skin surface area (cm^2)	2,500	USEPA 1998b	2,500	USEPA 1998b
AF: Soil to skin adherence factor (mg/cm^2-event)	0.1	USEPA 1998b	0.1	USEPA 1998b
ABS: Dermal absorption factor (unitless)	Chem-specific	USEPA 1998b	chem-specific	USEPA 1998b
EF: Exposure frequency (events/year)	195	A	43	A
ED: Exposure duration (years)	25	USEPA 1991b	6.6	USEPA 1997b
CF: Conversion factor (kg/mg)	1.0E-06	NA	1.0E-06	NA
BW: Body weight (kg)	70	USEPA 1991b	70	USEPA 1991b
ATc: Averaging time - cancer (days)	25,550	USEPA 1989c	25,550	USEPA 1989c
ATnc: Averaging time - noncancer (days)	2,555	USEPA 1989c	730	USEPA 1989c

Reference Note:
A-Professional judgment

Table 7.1-11
Toxicity Data Summary

NON-CANCER TOXICITY DATA—ORAL/DERMAL									
Chemical of Concern	**Chronic/ Subchronic**	**Oral RfD Value**	**Oral RfD Units**	**Dermal RfD**	**Dermal RfD Units**	**Endpoint/Primary Target Organ**	**Combined Uncertainty/ Modifying Factors**	**Sources of RfD/ Target Organ**	**Dates of RfD: Target Organ (MM/DD/YY)**
Antimony	Chronic	4.00E-04	mg/kg-day	NA	mg/kg-day	LOAEL/longevity, blood chemistry	1,000	IRIS	10/25/99
Arsenic	Chronic	3.00E-04	mg/kg-day	NA	mg/kg-day	NOAEL/skin pigmentation	3	IRIS	10/25/99
Cadmium (food)	Chronic	1.00E-03	mg/kg-day	2.50E-05	mg/kg-day	NOAEL/proteinuria	10	IRIS	10/25/99
Cadmium (water)	Chronic	5.00E-04	mg/kg-day	NA	NA	NOAEL/proteinuria	10	IRIS	10/25/99
Iron	NS	3.00E-01	mg/kg-day	NA	mg/kg-day	NS	1	Region III RBCs & NCEA	10/25/99
Lead[a]									
Manganese (food)	Chronic	1.40E-01	mg/kg-day	NA	mg/kg-day	NOAEL/Central Nervous System	1	IRIS	10/25/99
Manganese (water)	Chronic	4.70E-02	mg/kg-day	NA	mg/kg-day	NOAEL/Central Nervous System	3	IRIS	10/25/99
Methylmercury	Chronic	1.00E-04	mg/kg-day	NA	mg/kg-day	prenatal developmental effects	10	IRIS	10/25/99
Zinc	Subchronic (10 weeks)	3.00E-01	mg/kg-day	NA	mg/kg-day	LOAEL/enzyme-level effects	3	IRIS	10/25/99
CANCER TOXICITY DATA—ORAL/DERMAL									
Chemical of Concern	**Oral Cancer Slope Factor**	**Dermal Cancer Slope Factor[b]**	**Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date (MM/DD/YY)**	--	--	--
Arsenic	1.50E+00	NA	$(mg/kg\text{-}d)^{-1}$	A	IRIS	10/25/99	--	--	--

[a]Toxicity criteria not applicable for lead; see discussion in text
[b]The oral slope factor will be used to evaluate dermal exposures (USEPA Region 9 PRG Tables)

Notes:
N/A – Not Applicable
NS – Not Specified
-- – no value available
NOAEL – No observed adverse effect level
LOAEL – Lowest observed adverse effect level
IRIS – Integrated Risk Information System
NCEA – National Center for Environmental Assessment
Weight of Evidence/Cancer Guideline Description
A - Human carcinogen

Table 7.1-12a
Predicted Lead Risk for a Typical Child
Upper Basin, Side Gulches, and Kingston

Predicted Risk (Percent) of Attaining a Blood Lead Level of 10 μg/dL for a Typical 9-84 Month Child		
Soil Action Level	**EPA Default Model**	**Box Model**
2,000 mg/kg	64–70%	24-31%
1,500 mg/kg	50–58%	14-20%
1,000 mg/kg	32–46%	7-12%
800 mg/kg	30–36%	6-7%
600 mg/kg	20–33%	3-4%
400 mg/kg	5-6%	1

Note:
Adapted from HHRA Figures 8-8a-g

Predicted risks are ranges of all subareas excluding the Lower Basin. Lower Basin risks are presented separately because exposures associated with elevated blood lead levels are associated with exposures to Coeur d'Alene River sediments rather than residential soil. Lower Basin exposure patterns were described in the HHRA based on PHD LHIP follow-up investigations of children with elevated blood lead levels.

Table 7.1-12b
Predicted Lead Risk for a Typical Child
Lower Basin

Predicted Risk (Percent) of Attaining A Blood Lead Level of 10 μg/dL for a Typical 9-84 Month Child		
Soil Action Level	**EPA Default Model**	**Box Model**
2,000 mg/kg	59%	16%
1,500 mg/kg	48%	11%
1,000 mg/kg	38%	7%
800 mg/kg	31%	5%
600 mg/kg	17%	2%
400 mg/kg	-	-

Note:
Adapted from HHRA Figures 8-8a-g

Table 7.1-13
RME Risk Characterization Summary - Carcinogens Residential Exposure Scenario - Child/Adult

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
Lower Basin							
Soil	Surface Soil	Yard Soil	Arsenic	7E-05	N/A	8E-06	8E-05
Groundwater	Groundwater	Tap Water	Arsenic	2E-05	N/A	N/A	2E-05
						Total Risk:	1E-04
Upper Basin[a]							
Soil	Surface Soil	Yard Soil	Arsenic	7E-05	N/A	8E-06	8E-05
Groundwater	Groundwater	Tap Water	Arsenic	2E-04	N/A	N/A	2E-04
						Total Risk:	3E-04

[a]Only the Side Gulches area had cancer risks exceeding 10^{-4}.

Notes:
RME – reasonable maximum exposure
N/A – Route of exposure is not applicable to this medium

Table 7.1-14
RME Risk Characterization Summary - Non-Carcinogens
Residential Exposure Scenario - Child

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child (0 to 6 years)

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ[a]	Non-Carcinogenic Hazard Quotients/Indices[a]			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Lower Basin								
Soil	Surface Soil	Yard Soil	Arsenic	Skin	1	N/A	0.14	1
			Iron	Blood	2	N/A	N/A	2
Total Soil Hazard Index[b]								3
Upper Basin[c]								
Soil	Surface Soil	Yard Soil	Arsenic	Skin	0.6 – 1	N/A	0.06 - 0.1	0.6 - 1
			Iron	Blood	0.9 – 1	N/A	N/A	0.9 - 1
Total Soil Hazard Index								2 - 3
Groundwater	Groundwater	Tap Water	Arsenic	Skin	2	N/A	N/A	2
Total Tap Water Hazard Index								2
Groundwater	Groundwater	Future Drinking Water	Cadmium	Kidney	17	N/A	N/A	17
			Zinc	Blood	4	N/A	N/A	4
Total Future Groundwater Hazard Index								21
All Areas								
Soil	Plant Tissue	Homegrown Vegetables	Cadmium	Kidney	2	N/A	N/A	2
Total Soil Hazard Index								2

[a]None of the chemicals within one media/receptor group have similar target organ endpoints; therefore, separate total summaries by target organ are not provided.
[b]Note that all hazard quotients and indices are rounded to one significant figure per EPA guidance, and a hazard of 1, for example, could range between 0.95 and 1.4. Therefore, totals may not look as if they add up correctly.
[c]The Upper Basin was evaluated as seven separate sub-areas; consequently hazards for soil are provided as ranges based on the results from the seven areas. For groundwater, current tap water, only the Side Gulches area had concentrations exceeding target health goals. For groundwater, future drinking water, only the Burke/Ninemile area had shallow groundwater evaluated.

Notes:
RME - reasonable maximum exposure
N/A - Route of exposure is not applicable to this medium

Table 7.1-15
RME Risk Characterization Summary - Non-Carcinogens Residential Exposure Scenario - Child/Adult

Scenario Timeframe:	Current/Future
Receptor Population:	Residents
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ[b]	Non-Carcinogenic Hazard Quotients/Indices[a]			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Upper Basin[c]								
Soil	Surface Soil	Yard Soil	Arsenic	Skin	0.4	N/A	0.04	0.4
			Iron	Blood	0.3	N/A	N/A	0.3
							Total Soil Hazard Index	0.7
Groundwater	Groundwater	Tap Water	Arsenic	Skin	1	N/A	N/A	1
							Total Tap Water Hazard Index	1
							Total Receptor Hazard Index	2
Groundwater	Groundwater	Future Drinking Water	Cadmium	Kidney	9	N/A	N/A	9
			Zinc	Blood	2	N/A	N/A	2
							Total Tap Water Hazard Index	11
All Areas								
Soil	Plant Tissue	Homegrown Vegetables	cadmium	Kidney	2	N/A	N/A	2
							Total Soil Hazard Index	2

[a]Note that all hazard quotients and indices are rounded to one significant figure per EPA guidance, and a hazard of 1, for example, could range between 0.95 and 1.4. Therefore, totals may not look as if they add up correctly.
[b]None of the chemicals within one media/receptor group have similar target organ endpoints; therefore, separate total summaries by target organ are not provided.
[c]The Upper Basin was evaluated as seven separate sub-areas; consequently hazards for soil are provided as ranges based on the results from the seven areas. For groundwater, current tap water, only the Side Gulches area had concentrations exceeding target health goals. For groundwater, future drinking water, only the Burke/Ninemile area had shallow groundwater evaluated.

RME – reasonable maximum exposure
N/A – Route of exposure is not applicable to this medium

Table 7.1-16
RME Risk Characterization Summary - Non-Carcinogens Public Recreational Exposure Scenario - Child

Scenario Timeframe: Current/Future
Receptor Population: Visitor
Receptor Age: Child (0 to 6 years)

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ[b]	Non-Carcinogenic Hazard Quotients/Indices[a]			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Lower Basin								
Soil/Sediment	Soil/Sediment	Floodplain Soil/Sediment in Lower CDAR	Arsenic	Skin	0.4	N/A	0.1	0.5
			Iron	Blood	0.6	N/A	N/A	0.6
			Manganese	Central Nervous System (CNS)	0.4	N/A	N/A	0.4
							Total Soil Hazard Index	2
Upper Basin								
Soil/Sediment	Soil/Sediment	Surface Soil and Beach Sediments near confluence of North and South Forks CDAR was only location with exceedances	Arsenic	Skin	0.6	N/A	0.1	0.7
			Iron	Blood	0.6	N/A	N/A	0.6
			Manganese	Central Nervous System (CNS)	0.3	N/A	N/A	0.3
							Total Soil Hazard Index	2

[a]Note that all hazard quotients and indices are rounded to one significant figure per EPA guidance, and a hazard of 1, for example, could range between 0.95 and 1.4. Therefore, totals may not look as if they add up correctly.
[b]None of the chemicals within one media/receptor group have similar target organ endpoints; therefore, separate total summaries by target organ are not provided.

Notes:
RME – reasonable maximum exposure
N/A – Route of exposure is not applicable to this medium
CDAR – Coeur d'Alene River

Table 7.1-17
RME Risk Characterization Summary - Carcinogens Subsistence Exposure Scenario - Child/Adult

Scenario Timeframe:	Future
Receptor Population:	Subsistence Residents
Receptor Age:	Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
Traditional Subsistence							
Soil	Surface Soil	Floodplain Surface Soil	Arsenic	6E-04	N/A	2E-04	8E-04
Sediment	Sediment	Floodplain Sediment	Arsenic	4E-04	N/A	7E-04	1E-03
Undisturbed Surface Water	Undisturbed Surface Water	Lower CDAR	Arsenic	1E-03	N/A	N/A	1E-03
						Total Risk	3E-03
Modern Subsistence							
Soil	Surface Soil	Floodplain Surface Soil	Arsenic	1E-04	N/A	7E-05	2E-04
Sediment	Sediment	Floodplain Sediment	Arsenic	1E-04	N/A	2E-04	3E-04
Undisturbed Surface Water	Undisturbed Surface Water	Lower CDAR	Arsenic	2E-04	N/A	N/A	2E-04
						Total Risk	7E-04

Notes:
RME – reasonable maximum exposure
N/A – Route of exposure is not applicable to this medium
CDAR – Coeur d'Alene River

Table 7.1-18
RME Risk Characterization Summary - Non-Carcinogens
Subsistence Exposure Scenario - Child

Scenario Timeframe: Future
Receptor Population: Subsistence Residents
Receptor Age: Child (0 to 6 years)

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Non-Carcinogenic Hazard Quotients/Indices[a]			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Traditional Subsistence								
Soil	Surface Soil	Floodplain Surface Soil	Antimony	Blood	1	N/A	N/A	1
			Arsenic	Skin	5	N/A	2	7
			Cadmium	Kidney	0.6	N/A	0.14	0.8
			Iron	Blood	7	N/A	N/A	7
			Manganese	Central Nervous System (CNS)	4	N/A	N/A	4
							Total Soil Hazard Index	19
Sediment	Sediment	Floodplain Sediment	Antimony	Blood	0.7	N/A	N/A	0.7
			Arsenic	Skin	3	N/A	2	5
			Cadmium	Kidney	0.5	N/A	0.3	0.8
			Iron	Blood	4	N/A	N/A	4
			Manganese	CNS	3	N/A	N/A	3
							Total Sediment Hazard Index	14
Undisturbed Surface Water	Undisturbed Surface Water	Lower CDAR	Arsenic	Skin	7	N/A	N/A	7
							Total Undisturbed Surface Water Hazard Index	7
							Total Receptor Hazard Index	39
							Blood Hazard Index	13
							Skin Hazard Index	18
							Kidney Hazard Index	2
							CNS Hazard Index	6
Modern								
Soil	Surface Soil	Floodplain Surface Soil	Arsenic	Skin	0.8	N/A	0.3	1
			Iron	Blood	1	N/A	N/A	1
			Manganese	CNS	0.6	N/A	N/A	0.6
							Total Soil Hazard Index	3
Sediment	Sediment	Floodplain Sediment	Arsenic	Skin	1	N/A	0.7	2
			Iron	Blood	1	N/A	N/A	1
			Manganese	CNS	0.8	N/A	N/A	0.8
							Total Sediment Hazard Index	3
Undisturbed Surface Water	Undisturbed Surface Water	Lower CDAR	Arsenic	Skin	1	N/A	N/A	1
							Total Undisturbed Surface Water Hazard Index	1
							Total Receptor Hazard Index	7
							Blood Hazard Index	2
							Skin Hazard Index	4
							CNS Hazard Index	1

Table 7.1-18 (Continued)
RME Risk Characterization Summary - Non-Carcinogens
Subsistence Exposure Scenario – Child

[a]Note that all hazard quotients and indices are rounded to one significant figure per EPA guidance, and a hazard of 1, for example, could range between 0.95 and 1.4. Therefore, totals may not look as if they add up correctly.

Notes:
RME – reasonable maximum exposure
N/A – Route of exposure is not applicable to this medium
CDAR – Coeur d'Alene River

Table 7.1-19
RME Risk Characterization Summary - Non-Carcinogens
Subsistence Exposure Scenario - Child/Adult

Scenario Timeframe: Future
Receptor Population: Subsistence Residents
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Non-Carcinogenic Hazard Quotients/Indices[a]			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Traditional								
Soil	Surface Soil	Floodplain Surface Soil	Arsenic	Skin	1	N/A	0.5	2
			Iron	Blood	2	N/A	N/A	2
			Manganese	Central Nervous System (CNS)	1	N/A	N/A	1
							Total Soil Hazard Index	5
Sediment	Sediment	Floodplain Sediment	Arsenic	Skin	0.8	N/A	2	2
			Iron	Blood	1	N/A	N/A	1
			Manganese	CNS	0.7	N/A	N/A	0.7
							Total Sediment Hazard Index	4
Undisturbed Surface Water	Undisturbed Surface Water	Lower CDAR	Arsenic	Skin	3	N/A	N/A	3
							Total Undisturbed Surface Water Hazard Index	3
Surface Water/Sediment	Plant Tissue	Water Potato (with skin)	Cadmium	Kidney	4	N/A	N/A	4
							Total Water Potato (with skin) Hazard	4
Surface Water/Sediment	Animal Tissue	Northern Pike in Lower CDAR	Methylmercury	CNS	10	N/A	N/A	10
							Total Northern Pike Hazard Index	10
							Total Receptor Hazard Index	26
							Blood Hazard Index	3
							Skin Hazard Index	7
							CNS Hazard Index	12
							Kidney Hazard Index	4
Modern								
Soil	Surface Soil	Floodplain Surface Soil	Arsenic	Skin	0.2	N/A	0.2	0.4
			Iron	Blood	0.3	N/A	N/A	0.3
							Total Soil Hazard Index	0.7
Sediment	Sediment	Floodplain Sediment	Arsenic	Skin	0.2	N/A	0.4	0.7
			Iron	Blood	0.4	N/A	N/A	0.4
							Total Sediment Hazard Index	1
Undisturbed Surface Water	Undisturbed Surface Water	Lower CDAR	Arsenic	Skin	0.5	N/A	N/A	0.5
							Total Undisturbed Surface Water Hazard Index	0.5
Surface Water/Sediment	Animal Tissue	Northern Pike in Lower CDAR	Methylmercury	CNS	3	N/A	N/A	3
							Total Northern Pike Hazard Index	3
							Total Receptor Hazard Index	5
							Blood Hazard Index	0.7
							Skin Hazard Index	2
							CNS Hazard Index	3

Table 7.1-19 (Continued)
RME Risk Characterization Summary - Non-Carcinogens
Subsistence Exposure Scenario - Child/Adult

[a]Note that all hazard quotients and indices are rounded to one significant figure per EPA guidance, and a hazard of 1, for example, could range between 0.95 and 1.4. Therefore, totals may not look as if they add up correctly.

Notes:
RME – reasonable maximum exposure
N/A – Route of exposure is not applicable to this medium
CDAR – Coeur d'Alene River

Table 7.1-20
Potential Soil Cleanup Levels for Arsenic Using Various Target Risk Goals and Scenarios

	Residential Soil Ing. And Dermal (child 0-6) mg/kg	**Residential Soil Ing. and Dermal (child/adult) mg/kg**	**Public Recreational Soil/Sed Ing. and Dermal (child 0-6) mg/kg**	**Public Recreational Soil/Sed Ing. and Dermal (child/adult) mg/kg**	**Neighborhood Recreational Waste Pile Ing. And Dermal (child 4-11) mg/kg**	**Neighborhood Recreational Soil/Sed Ing. And Dermal (child 4-11) Lower Basin and Kingston mg/kg**	**Neighborhood Recreational Soil/Sed Ing. And Dermal (child 4-11) All other areas mg/kg**
Arsenic – Cancer (10^{-4} risk)		64		420	1,663	815	1,016
Arsenic – Cancer (10^{-5} risk)		6		42	166	81	102
Arsenic – Cancer (10^{-6} risk)		1		4	17	8	10
Arsenic – Noncancer (Hazard goal of one)	35	123	234	810	748	367	457

Table 7.1-21
Summary of Chemicals of Concern and Exposure Point Concentrations in Spokane River CUA Sediment

Scenario Timeframe: Current
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Conc.	Exposure Point Conc. Units	Statistical Measure[a]
		Minimum Conc.	Maximum Conc.					
River Road 95 Sediment	Arsenic	21.4	35.1	mg/kg	7/7	29.3	mg/kg	95% UCL
	Lead	656	2,360	mg/kg	7/7	1,410	mg/kg	Mean
Harbor Road North	Arsenic	15.1	23.6	mg/kg	7/7	20.2	mg/kg	95% UCL
	Lead	261	534	mg/kg	7/7	424	mg/kg	Mean
Barker Road North	Arsenic	13	45.6	mg/kg	7/7	36.2	mg/kg	95% UCL
	Lead	106	822	mg/kg	7/7	478	mg/kg	Mean
North Flora Road	Arsenic	15.9	24.8	mg/kg	9/9	21.4	mg/kg	95% UCL
	Lead	496	1,040	mg/kg	9/9	681	ppm	Mean

[a]The statistical measure describes how the exposure point concentration was calculated from the data. A 95% UCL is the 95 percent upper confidence limit of the average concentration.

Notes
Conc – concentration
mg/kg – milligrams of chemical per kilograms of sediment
Mean – average concentration

Table 7.1-22
Summary of Chemicals of Concern and Exposure Point Concentrations in Spokane River Fish Tissue

Exposure Point		Chemical of Concern	Concentration Detected (Wet Weight)		Frequency of Detection (mg/kg)	Exposure Point Concentration	Statistical Measure
			Min (mg/kg)	Max (mg/kg)			
Fillet Fish from Spokane River – Ingestion	Wild Rainbow Trout	Lead	0.03	0.48	19/19	0.12	geometric mean
	Hatchery Rainbow Trout	Lead	0.02	0.23	5/5	0.11	geometric mean
	Large Scale Sucker	Lead	0.02	0.28	20/20	0.07	geometric mean
	Mountain Whitefish	Lead	0.02	0.07	10/10	0.03	geometric mean
Whole fish from Spokane River – Ingestion	Wild Rainbow Trout	Lead	0.6	1.14	3/3	0.79	geometric mean
	Hatchery Rainbow Trout	Lead	1.59	1.59	1/1	1.59	Max
	Large Scale Sucker	Lead	1.77	4.34	4/4	2.56	geometric mean
	Mountain Whitefish	Lead	0.56	0.65	2/2	0.6	geometric mean

Notes:
Min – minimum
Max – maximum

Table 7.2-1
Summary of Representative Species Evaluated in Coeur d'Alene Basin

Species		Level of Biological Organization to be Assessed				Habitat Types and CSM Units[a]					
Common Name	Scientific Name	Individual-level	Population-level	Community-level	Habitat/ Ecosystem-level	Riverine	Lacustrine	Palustrine	Riparian	Upland	Agricultural
Birds											
Great blue heron	*Ardea herodias*	X	X			3		3,4,5			
Canada goose	*Branta canadensis*	X	X			5		3,4,5			3
Tundra swan	*Cygnus columbianus*	X	X				3	3,4			
Wood duck	*Aix sponsa*	X	X					3,4,5			
Mallard	*Anas platyrhynchos*	X	X			5		1,2,3,4,5			
Lesser scaup	*Aythya affinis*	X	X				3,4,5				
Common goldeneye	*Bucephala clangula*	X	X			5	3,4,5				
Common merganser	*Mergus merganser*	X	X			2,3,5	3,4,5				
Osprey	*Pandion haliaetus*	X	X			2,3,5	3,4,5				
Bald eagle (T&E)	*Haliaeetus leucocephalus*	X	X			3	3,4,5	3			
Northern harrier	*Circus cyaneus*	X	X					3,4	3,5		3
American kestrel	*Falco sparverius*	X	X						3,5		3
Ruffed grouse	*Bonasa umbellus*		X							1,2	
Wild turkey	*Meleagris gallopavo*		X						1,2,3,5	1,2	3
Spotted sandpiper	*Actitis macularia*	X	X			1,2,3,5					
Common snipe	*Gallinago gallinago*	X	X					2,3,4			3
Black tern (species of concern)	*Chlidonias niger*	X	X				3,4	3,4			
Great horned owl	*Bubo virginianus*	X	X						1,2,3,5		3
Belted kingfisher	*Ceryle alcyon*	X	X			3,4,5					
Tree swallow	*Tachycineta bicolor*	X	X			1,2,3,5	3,4,5				
American dipper	*Cinclus mexicanus*	X	X			1,2					
Swainson's thrush	*Catharus ustulatus*	X	X						1,2	1,2	
American robin	*Turdus migratorius*	X	X						1,2,3,5		3
Song sparrow	*Melospiza melodia*	X	X						1,2,3,5		
Mammals											
Water shrew	*Sorex palustris*		X			1,2					
Masked shrew	*Sorex cinereus*		X							1,2	
Vagrant shrew	*Sorex vagrans*		X						2,3,5		3
Long-legged myotis (species of concern)	*Myotis volans*	X	X						1,2,3,5	1,2	

Table 7.2-1 (Continued)
Summary of Representative Species Evaluated in Coeur d'Alene Basin

Species		Level of Biological Organization to be Assessed				Habitat Types and CSM Units[a]					
Common Name	Scientific Name	Individual-level	Population-level	Community-level	Habitat/ Ecosystem-level	Riverine	Lacustrine	Palustrine	Riparian	Upland	Agricultural
Little brown myotis	*Myotis lucifugus*		X			3,5	3,4,5	2,3,4,5			
Raccoon	*Procyon lotor*		X			1,2,3,5		1,2,3,4,5	1,2,3,5	1,2	3
Fisher (species of concern)	*Martes pennanti*	X	X						1,2	1,2	
Wolverine (species of concern)	*Gulo gulo luscus*	X	X						1,2	1,2	
Mink	*Mustela vison*		X			1,2,3,5		1,2,3,4,5	1,2,3,5		
River otter	*Lontra canadensis*		X			3,5	3,4,5				
Gray wolf (T&E)	*Canis lupus*	X	X					3	1,2,3	1,2	3
Lynx (T&E)	*Lynx canadensis*	X	X							1,2	
White-tailed deer	*Odocoileus virginianus*		X					4	1,2,3,5		3
Mule deer	*Odocoileus hemionus*		X							1,2	
Beaver	*Castor canadensis*		X					1,2,3,4,5	1,2,3,5		
Muskrat	*Ondatra zibethicus*		X					1,2,3,4,5	1,2,3,5		
Deer mouse	*Peromyscus maniculatus*		X						1,2,3,5	1,2	3
Meadow vole	*Microtus pennsylvanicus*		X						1,2,3,5		3
Fish											
Bull trout (T&E)	*Salvelinus confluentus*	X				1,2,3,5	3,4,5				
Westslope cutthroat trout (species of concern)	*Oncorhynchus clarki lewisi*	X				1,2,3,5	3,4,5				
Chinook salmon	*Oncorhynchus tshawytscha*		X			2,3	4				
Rainbow trout	*Oncorhynchus mykiss*		X			2,3,5					
Mountain whitefish	*Prosopium williamsoni*		X			2,3					
Large-scale sucker	*Catostomus macrocheilus*		X			3,5					
Brown bullhead	*Ameiurus melas*		X				3				
Northern pike	*Esox lucius*		X			3	3,4				
Sculpins			X			1,2					
Smallmouth bass	*Micropterus dolomieu*		X			3					
Largemouth bass	*Micropterus salmoides*		X				3				
Yellow perch	*Perca flavescens*		X				3				
Walleye	*Stizostedion vitreum*		X				5				

Table 7.2-1 (Continued)
Summary of Representative Species Evaluated in Coeur d'Alene Basin

Species		Level of Biological Organization to be Assessed				Habitat Types and CSM Units[a]					
Common Name	Scientific Name	Individual-level	Population-level	Community-level	Habitat/ Ecosystem-level	Riverine	Lacustrine	Palustrine	Riparian	Upland	Agricultural
Aquatic Invertebrates											
Mixed invertebrates				X		1,2,3,5					
Crayfish			X					1,2,3,4,5			
Odonates			X					1,2,3,4,5			
Zooplankton				X			3,4,5				
Benthic invertebrates				X			3,4,5				
Aquatic Plants											
Phytoplankton				X		3,5	3,4,5				
Periphyton				X		1,2,5		3,4			
Wild rice	*Zizania aquatica*		X					3,4			
Water potato	*Sagittaria* spp.		X					3,4			
Cattail	*Typha latifolia*		X					1,2,3,4,5			
Algae				X			3,4				
Submerged vegetation				X			3,4,5				
Amphibians											
Idaho (Pacific) giant salamander (species of concern)	*Dicamptodon aterrimus*	X	X			1,2					
Coeur d'Alene salamander (species of concern)	*Plethodon idahoensis*	X	X						1,2		
Spotted frog (species of concern)	*Rana pretiosa*	X	X					1,2,3	2		
Long-toed salamander	*Ambystoma macrodactylum*		X					4,5	3,5		
Terrestrial Plants											
Ute ladies'-tresses (T&E)	*Spiranthes diluvialis*		X						1,2,3,5		
Cottonwood	*Populus* spp.		X					4	1,2,3,5		
Willow	*Salix spp.*		X					4	1,2,3,5		
Rocky Mountain maple	*Acer glabrum*		X							1,2	
Porcupine sedge (state sensitive species)	*Carex hystericina*		X					5	5		
Prairie cordgrass (state sensitive species)	*Spartina pectinata*		X						5		
Plant community				X					1,2,3,5	1,2	

Table 7.2-1 (Continued)
Summary of Representative Species Evaluated in Coeur d'Alene Basin

Species		Level of Biological Organization to be Assessed				Habitat Types and CSM Units[a]					
Common Name	Scientific Name	Individual-level	Population-level	Community-level	Habitat/ Ecosystem-level	Riverine	Lacustrine	Palustrine	Riparian	Upland	Agricultural
Terrestrial Invertebrates											
Mixed invertebrates				X					1,2,3,5	1,2	
Soil microbial processes				X					1,2,3,5	1,2	
Soil Processes					X				1,2,3,5	1,2	
Landscape Characteristics					X	1,2,3			1,2,3		

[a] The numbers in these columns refer to individual CSM Units (1, 2, 3, 4, or 5)

Table 7.2-2
Concentrations of Chemicals of Potential Ecological Concern
Soil-Sediment Combined

CSM Unit	Chemical	Number of Samples	Number of Detections	Minimum Detected, mg/kg	Maximum Detected, mg/kg	Mean, mg/kg	95% UCL of Mean, mg/kg
1 & 2	Arsenic	327	322	1.40	3,610	82.2	102
1 & 2	Cadmium	410	311	0.113	543	27.0	32.1
1 & 2	Copper	364	335	5.79	3,100	153	174
1 & 2	Lead	482	403	5.16	67,100	6,865	7,800
1 & 2	Mercury	259	212	0.011	51.5	3.93	4.78
1 & 2	Silver	256	221	0.170	347	23.1	27.5
1 & 2	Zinc	420	337	10.0	83,900	3,792	4,480
3	Arsenic	1,269	1,152	1.00	634	111	116
3	Cadmium	1,401	1,291	0.210	200	25.2	26.1
3	Copper	804	771	2.10	554	119	123
3	Lead	1,483	1,404	9.00	35,600	3,665	3,802
3	Mercury	703	644	0.010	23	2.57	2.699
3	Silver	680	635	0.269	97.9	17.8	18.6
3	Zinc	1,408	1,327	7.70	21,800	3,269	3,405
4	Arsenic	345	220	0.710	275	18.1	22.4
4	Cadmium	345	301	0.130	148	7.2	9.09
4	Copper	219	219	5.60	283	35.6	40.0
4	Lead	345	345	4.80	12,100	269	351
4	Mercury	218	102	0.020	4.8	0.562	0.718
4	Silver	218	101	0.240	22.8	2.26	2.83
4	Zinc	345	345	10.2	9,100	612	717
5	Arsenic	59	59	5.90	83.4	33.3	37.4
5	Cadmium	59	59	2.10	28	14.2	15.6
5	Copper	59	59	17.3	144	46.5	51.5
5	Lead	59	59	54.7	3,500	624	730
5	Mercury	59	36	0.110	0.78	0.333	0.385
5	Silver	59	33	0.540	4.7	1.72	2.02
5	Zinc	59	59	265	6,500	2,375	2,628

Table 7.2-3
Chemicals of Potential Ecological Concern
Aquatic Sediments

CSM Unit	Chemical	Number of Samples	Number of Detections	Minimum Detected, mg/kg	Maximum Detected, mg/kg	Mean, mg/kg	95% UCL of Mean, mg/kg
1 & 2	Arsenic	74	72	2.00	384	107	124
1 & 2	Cadmium	68	61	0.560	177	26.6	33.5
1 & 2	Copper	74	73	16.0	706	143	173
1 & 2	Lead	74	74	9.00	40,500	6,039	7,983
1 & 2	Mercury	64	52	0.030	25.1	4.57	6.10
1 & 2	Silver	71	51	1.00	120	23.592	30.1
1 & 2	Zinc	74	74	22.0	9,900	2,574	3,031
3	Arsenic	1,110	993	1.00	634	111	116
3	Cadmium	1,110	1,083	0.280	200	25.7	26.7
3	Copper	562	562	2.10	554	129	134
3	Lead	1,117	1,116	14.8	35,600	3,834	3,998
3	Mercury	533	503	0.020	23.0	2.71	2.87
3	Silver	560	520	0.269	97.9	18.3	19.2
3	Zinc	1,117	1,117	14.3	21,800	3,268	3,416
4	Arsenic	330	206	0.710	275	18.5	23.1
4	Cadmium	330	289	0.130	148	7.381	9.35
4	Copper	204	204	5.60	283	36.7	41.4
4	Lead	330	330	4.80	12,100	276	361
4	Mercury	204	96	0.020	4.80	0.588	0.753
4	Silver	204	94	0.240	22.8	2.25	2.86
4	Zinc	330	330	10.2	9,100	626	736
5	Arsenic	52	52	5.90	83.4	35.8	40.1
5	Cadmium	52	52	2.10	28.0	15.2	16.6
5	Copper	52	52	21.4	144	48.9	54.3
5	Lead	52	52	54.7	3,500	660	777
5	Mercury	52	29	0.110	0.780	0.362	0.423
5	Silver	52	33	0.540	4.70	1.72	2.02
5	Zinc	52	52	441	6,500	2,574	2,825

Table 7.2-4
Chemicals of Potential Ecological Concern
Aquatic Surface Water – Dissolved Metals

CSM Unit	Chemical	Number of Samples	Number of Detections	Minimum Detected, µg/L	Maximum Detected, µg/L	Mean, µg/L	95% UCL of Mean, µg/L
1 & 2	Cadmium	2,321	1,878	0.020	408	10.7	11.3
1 & 2	Copper	486	153	0.100	260	5.18	8.02
1 & 2	Lead	2,304	1,825	0.001	578	21.4	22.8
1 & 2	Zinc	2,342	2,195	0.101	17,300	1,487	1,561
3	Cadmium	182	178	0.020	4.80	1.96	2.05
3	Copper	3	2	1.10	14.0	7.550	48.3
3	Lead	181	178	1.50	22.0	6.64	7.06
3	Zinc	182	181	78.0	920	342	360
4	Cadmium	31	4	2.70	3.20	2.95	3.19
4	Copper	7	6	1.70	18.0	12.2	17.0
4	Lead	26	4	1.00	1.01	1.00	1.01
4	Zinc	31	9	1.00	13.0	5.18	7.93
5	Cadmium	72	21	0.120	1.00	0.784	0.917
5	Copper	6	3	0.560	1.50	1.02	1.81
5	Lead	73	38	0.340	1.20	0.949	0.992
5	Zinc	72	68	1.00	92.0	48.5	53.8

Table 7.2-5
Chemicals of Potential Ecological Concern
Aquatic Surface Water – Total Metals

CSM Unit	Chemical	Number of Samples	Number of Detections	Minimum Detected, µg/L	Maximum Detected, µg/L	Mean, µg/L	95% UCL of Mean, µg/L
1 & 2	Cadmium	2,179	1,809	0.050	407	11.0	11.6
1 & 2	Copper	460	173	0.160	310	6.92	10.5
1 & 2	Lead	2,217	1,946	0.060	4,260	74.0	82.9
1 & 2	Zinc	2,213	2,083	0.940	18,000	1,568	1,646
3	Cadmium	89	88	0.890	21.0	2.64	3.14
3	Copper	7	5	1.40	11.0	7.28	10.7
3	Lead	89	88	2.50	430	39.1	50.6
3	Zinc	88	87	120	690	354	378
4	Cadmium	27	4	4.00	6.00	4.50	5.68
4	Copper	7	1	2.40	2.40	2.40	NM
4	Lead	24	2	0.170	4.80	2.49	17.1
4	Zinc	28	19	1.10	60.0	20.1	27.4
5	Cadmium	34	9	0.160	0.460	0.284	0.361
5	Copper	6	3	0.790	2.30	1.60	2.88
5	Lead	65	63	0.510	8.00	2.24	2.56
5	Zinc	60	60	7.20	100	51.1	56.8

Notes:
NM - not measured

Table 7.2-6
COEC Concentrations for Soil (mg/kg) Protective for Terrestrial Biota[a]

Analytes Evaluated	Soil Biota[b]	Wildlife[b]			90th Percentile of Soil-Sediment Background		
	Population/ Community	Individual/ NOAEL-based	Population/ LOAEL-based	Population/ ED20-based	Upper Basin[c]	Lower Basin[d]	Spokane River[e]
Arsenic	16.8	14	67	40	22	12.6	9.34
Cadmium	10	9.8	105	386	2.7	0.678	0.72
Copper	100	496	751	1,021	53	25.2	23.9
Lead	450	2.5	159	522	171	47.3	14.9
Zinc	106	27	434	261	280	97.1	66.4

[a] Birds and mammals occurring in upland, agricultural, and riparian habitats; terrestrial plants and invertebrates; and soil processes.
[b] Based on various lines of evidence available for evaluation (such as comparisons to single-chemical laboratory toxicity studies; toxicity testing using soil, sediment, or water from the Coeur d'Alene Basin; and field studies in the Basin).
[c] Gott and Cathrall (1980)
[d] USEPA (2001h)
[e] WDOE (1994)

Notes:
ED_{20} - effective dose - 20 percent response
LOAEL - lowest observed adverse effect level
NOAEL - no observed adverse effect level

Table 7.2-7
COEC Concentrations for Sediment (mg/kg) Protective for Aquatic Birds and Mammals[a]

Analytes Evaluated	Wildlife[b]			Site-specific Individual-level Protective Conc. for Waterfowl[b]	90th Percentile of Soil-sediment Background		
	Individual/ NOAEL-based	Population/ LOAEL-based	Population/ ED20-based		Upper Basin[c]	Lower Basin[d]	Spokane River[e]
Arsenic	54	222	138	NA	22	12.6	9.34
Cadmium	11.7	173	664	NA	2.7	0.678	0.72
Copper	1,606	2,157	2,209	NA	53	25.2	23.9
Lead	3.65[f]	249[f]	718[f]	93.3[g]	171	47.3	14.9
Mercury	0.2	2.5	7	NA	0.3	-[h]	0.032
Zinc	5.3	519	390	NA	280	97.1	66.4

[a] Birds and mammals occurring in palustrine, lacustrine, and riverine habitats.
[b] Based on various lines of evidence available for evaluation (such as comparisons to single-chemical laboratory toxicity studies; toxicity testing using soil, sediment, or water from the Coeur d'Alene Basin; and field studies in the Basin).
[c] Gott and Cathrall (1980)
[d] USEPA (2001h)
[e] WDOE (1994)
[f] For comparison, Beyer et al. (2000) derived a waterfowl no-effect concentration of 24 mg/kg and a lowest-effect concentration of 530 mg/kg and concluded that waterfowl mortality would occur if concentrations exceed 1,800 mg/kg.
[g] 10th percentile of individual-level sediment PRGs calculated for tundra swans, Canada geese, mallards, and wood ducks.
[h] Mercury was not measured in lower Basin sediment samples. Therefore, a background concentration could not be calculated.

Notes:
ED_{20} - effective dose - 20 percent response
LOAEL - lowest observed adverse effect level
NOAEL - no observed adverse effect level

Table 7.2-8
COEC Concentrations for Surface Water Protective for Aquatic Organisms

Analytes Evaluated	Acute Concentrations (µg/L)[b]					Chronic Concentrations (µg/L)[b]					
	Hardness-adjusted Values					Hardness-adjusted Values					Aquatic Plant - Lowest Chronic Value
	10	25	30	50	100	10	25	30	50	100	
Cadmium	0.21[a]	0.52	0.62	1.0	2.0	0.049[a]	0.094[a]	0.11[a]	0.15[a]	0.25[a]	2
Copper	1.5[a]	3.6	4.3	7	13	1.3[a]	2.7	3.2	5.0	9.0	1
Lead	4.9	13.9	17	30	65	0.2[a]	0.54[a]	0.66[a]	1.2	2.5	500
Zinc	16.7[a]	36.2	42	65	117	16.7[a]	36.2	43	66	118	30

[a] Background surface water concentrations are greater than the hardness-adjusted protective values in certain locations and selected background statistical percentiles. See Table 2-14 of USEPA (2001a) for specific areas where background concentrations may exceed the protective concentration.
[b] National Ambient Water Quality Criteria for copper, lead, and zinc as published in the National Recommended Water Quality Criteria – Correction, EPA 822-ZZ-99-001, April, 1999. The National Ambient Water Quality Criteria for cadmium as published on April 12, 2001, 66 FR 18935.

Note:
Hardness values (10, 25, 30, 50, and 100) are mg/L $CaCO_3$

Table 7.2-9
COEC Concentrations for Sediment Protective for Aquatic Organisms

Analytes Evaluated	COEC Concentrations (mg/kg dw)		
	CSM Units 1 and 2	CSM Units 3 and 4	CSM Unit 5
Arsenic	22	13	9.3
Cadmium	2.7	0.68	0.72
Copper	53	28[a]	28[a]
Lead	171	47	35[a]
Mercury	0.3	0.17[a]	0.17[a]
Silver	1.1	0.73[a]	0.73[a]
Zinc	280	98[a]	98[a]

[a] Concentrations based on toxicity reference values; other protective concentrations default to background concentrations for those portions of the Basin.

Table 7.2-10
Protective Goals for Physical and Biological Characteristics

Physical Characteristic	CSM Unit	Ecological Goals
Riparian Habitat		
Habitat suitability index	1	Habitat suitability index for the riparian habitat that is either within the range of historical conditions prior to mining activities or within the range of conditions currently found in selected reference areas
Spatial distribution and connectivity	1	Spatial distribution and connectivity of riparian habitat that is either within the range of historical conditions prior to mining activities or within the range of conditions currently found in selected reference areas
Riverine Habitat		
Bank stability	1 and 2	Bank stability that is either within the range of historical conditions prior to mining activities or within the range of conditions currently found in selected reference areas
Substrate composition and mobility	1 and 2	Substrate composition and mobility that is either within the range of historical conditions prior to mining activities or within the range of conditions currently found in selected reference areas
Water temperature	1 and 2	Water temperature that is either within the range of historical conditions prior to mining activities or within the range of conditions currently found in selected reference areas
Spatial distribution and connectivity	1 and 2	Spatial distribution and connectivity of riverine habitat that is either within the range of historical conditions present in the basin or within the range of conditions currently found in selected reference areas
Total suspended solids	3	Total suspended solids that are either within the range of historical conditions prior to mining activities or within the range of conditions currently found in selected reference areas
Lacustrine Habitat		
Sediment deposition rate	4	Sediment deposition rate that is either within the range of historical conditions prior to mining activities or within the range of conditions currently found in selected reference areas

Table 7.2-11
Summary of Results From the Coeur d'Alene Basin Ecological Risk Assessment

Receptor Type	Number of Receptors Evaluated	Lines of Evidence	Risk to Receptors	COPEC Posing Risk (COPECs = As, Cd, Cu, Pb, Hg, Zn)	Receptors with No Identified Risk	Areas with No Identified Risk
Birds	24	Single-chemical external exposure, single-chemical internal exposure (blood), single-chemical internal exposure (liver or kidney), ambient toxicity tests, biological surveys	21 of 24 receptors showed risk from at least one metal, maximum LOAEL-based HQ for Pb=387 (spotted sandpiper), HQ for Zn=35 (song sparrow), HQ for Cd=6.12 (song sparrow)	Pb followed by Zn, then Cd and Cu pose greatest risks; risks from Hg are minimal; risks from As are absent; at least one COPEC in almost every CSM Unit or segment presented a risk for all but three avian species	Osprey, bald eagle, northern harrier	Beaver and Prichard Creeks in CSM Unit 1
Mammals	18	Single-chemical external exposure, single-chemical internal exposure (liver or kidney), ambient toxicity test	12 of 18 receptors showed risk from at least 1 metal; maximum ED_{20}-based HQ for Zn=25.5 (masked shrew), HQ for As=4.4 (muskrat), HQ for Cu=1.55 (masked shrew)	Although no one COPEC was the dominant risk driver, risks from Zn and Pb were most widely distrbuted, followed by Cd, As, Hg, and Cu	Fisher, wolverine, river otter, gray wolf, lynx, beaver	Beaver and Prichard Creeks in CSM Unit 1
Fish and Other Aquatic Organisms	13+	Single-chemical toxicity testing, site-specific toxicity testing, biological surveys	Risks to survival, growth, and reproduction of fish and benthic invertebrates because of concentrations of metals 10 times that of acute and chronic ambient water quality criteria in more than 25 and 50 percent of samples, respectively, from some areas	Cd, Cu, Pb, and Zn pose a risk in surface water to fish and other aquatic organisms; As, Cd, Cu, Pb, and Zn in sediment pose a potential risk to fish and other aquatic organisms	None identified	No areas identified

Table 7.2-11 (Continued)
Summary of Results from The Coeur d'Alene Basin Ecological Risk Assessment

Receptor Type	Number of Receptors Evaluated	Lines of Evidence	Risk to Receptors	COPEC Posing Risk (COPECs = As, Cd, Cu, Pb, Hg, Zn)	Receptors with No Identified Risk	Areas with No Identified Risk
Amphibians	4	Single-chemical toxicity data, ambient media toxicity tests, biological surveys	Risk posed to three of four receptors	Cd, Cu, Pb, and Zn pose risks; Cd and Pb present individual risk to three receptors in four locations; Cu presents individual-level risks at six locations; Zn presents individual-level risk at seven locations; Pb presents greatest risk in upper basin, Cd presented greatest risk in lower basin, Zn presents risks throughout	Long-toed salamander	Big, Moon, and Prichard Creeks in CSM Unit 1
Terrestrial Plants	6	Single-chemical toxicity data, ambient media toxicity tests, biological surveys	All six plant receptors at risk	As, Cd, Pb, Zn, and Cu pose risk to plants at community or population level; As, Cd, Pb, and Zn pose risk to Ute ladies'-tresses in CSM Units 1,2, 3 and 5	None identified	Beaver and Prichard Creeks in CSM Unit 1
Soil Invertebrates	1	Single-chemical toxicity data	Receptors at risk	Pb and Zn pose risk in CSM Units 1, 2, 3, and 5; Cd poses risk in Canyon Creek and Upper South Fork in CSM 1 and all segments of 2, 3, and 5; Cu poses risk in Big, Canyon, and Ninemile Creeks and the Upper South Fork in CSM Unit 1, and in all segements of Units 2 and 3; As poses risk in Pine Creek and Upper South Fork in CSM Unit 1 and in all of CSM Units 2 and 3	None identified	Beaver and Prichard Creeks in CSM Unit 1

Table 7.2-11 (Continued)
Summary of Results from The Coeur d'Alene Basin Ecological Risk Assessment

Receptor Type	Number of Receptors Evaluated	Lines of Evidence	Risk to Receptors	COPEC Posing Risk (COPECs = As, Cd, Cu, Pb, Hg, Zn)	Receptors with No Identified Risk	Areas with No Identified Risk
Soil processes	1	Single-chemical toxicity data	Receptors at risk	Pb and Zn pose risk in all segments of CSM Units 1, 2, and 3; Cd poses risk in five of six segments in CSM Unit 3; Cu poses risk in Canyon and Ninemile Creeks and the Upper South Fork in CSM Unit 1 and in 2 segments of CSM Unit 3; As poses risk in CSM Unit 3	None identified	Beaver and Prichard Creeks in CSM Unit 1

Notes:
NA - not applicable
No soil data were available from the Beaver or Prichard Creek watersheds.

Table 7.2-12
Summary of Results from the Measures of Ecosystem and Receptor Characteristics Analysis in the Coeur d'Alene Ecological Risk Assessment

Watershed	Measure	Level of Adverse Effects	Nature of Secondary Effects	Extent of Adverse Effects - Narrative
Upper South Fork Coeur d'Alene River	Riparian HSI	Low	• Stream channel and riparian areas modified by tailings pond and mining facility development. • Recovery of riparian vegetation impaired by floodplain deposits and tailings ponds. • Historic inputs of contaminated bedload and mine tailings material to the stream channel. • Floodplain deposits of hazardous substances in downstream areas. • Ecological connectivity has been fragmented by degraded conditions in downstream segments.	Mining related activities and impacts increase on a downstream gradient. Conditions range from relatively intact riparian and riverine habitat conditions in the upper half of the drainage, to increasingly degraded conditions in downstream reaches. Ecological connectivity of intact habitats fragmented by degraded conditions in the Mid-Gradient SFCDR watershed.
	Bank Stability	None		
	Substrate Composition and Mobility	None		
	Temperature	None		
	Spatial Distribution and Connectivity	Moderate		
Canyon Creek	Riparian HSI	None to High	• Historic inputs of contaminated bedload and mine tailings material to the stream channel. • Floodplain deposits of hazardous substances in the downstream segments of the watershed. • Recovery of riparian vegetation limited in some areas by loss of topsoil (due to ore recovery activities), and phytotoxic levels of contaminants in soils. • Channel destabilization due to inputs of bedload material and loss of bank vegetation. • High stream temperatures due to lack of shading vegetation. • Disrupted surface water/groundwater relationships due to riparian zone impacts. • Ecological connectivity fragmented due to extensive degradation in downstream segments.	Relatively intact conditions in CCSeg01 and portions of CCSeg02. Loss of bank and stream channel structure in CCSeg03, CCSeg04, and CCSeg05. Bank and channel instability in these areas exacerbated by lack of riparian vegetation. Lack of shade and degraded channel structure contributes to high stream temperatuers in CCSeg05. Ecological connectivity of intact habitats fragmented by degraded conditions in downstream segments of the watershed, and in the Mid-Gradient SFCDR watershed.
	Bank Stability	None to Moderate		
	Substrate Composition and Mobility	None to Moderate		
	Temperature	High		
	Spatial Distribution and Connectivity	High		

Table 7.2-12 (Continued)
Summary of Results from the Measures of Ecosystem and Receptor Characteristics Analysis in the Coeur d'Alene Ecological Risk Assessment

Watershed	Measure	Level of Adverse Effects	Nature of Secondary Effects	Extent of Adverse Effects - Narrative
Ninemile Creek	Riparian HSI	None to High	Similar conditions to the Canyon Creek watershed	Loss of channel structure in NMSeg01, NMSeg02, and NMSeg04 due to historic inputs of bedload and tailings material. Degraded riparian vegetation structure and high stream temperatures due to lack of shade in downstream areas of watershed. Ecological connectivity fragmented by degraded conditions within the watershed and downstream in Mid-Gradient SFCDR watershed.
	Bank Stability	None to Moderate		
	Substrate Composition and Mobility	Moderate		
	Temperature	High		
	Spatial Distribution and Connectivity	High		
Big Creek	Riparian HSI	None to Moderate	• Historic inputs of contaminated bedload and mine tailings material to the stream channel. • Channel destabilization due to inputs of bedload material and loss of bank vegetation. • Recovery of riparian vegetation limited in some areas by tailings pond development and potentially phytotoxic soils. • Ecological connectivity fragmented due to extensive degradation in downstream segments.	Limited mining related impacts in BigCrkSeg01, BigCrkSeg02, and BigCrkSeg03. More extensive mining related impacts in lower half of BigCrkSeg04, including milling facilities and wastepiles, tailings pond development, and floodplain deposits of contaminated material. Degraded riparian vegetation structure in tailings pond areas. Ecological connectivity of intact headwaters habitats fragmented by degraded conditions in BigCrkSeg04 and the Mid-Gradient SFCDR watershed.
	Bank Stability	Low		
	Substrate Composition and Mobility	Low		
	Temperature	Low		
	Spatial Distribution and Connectivity	High		
Moon Creek	Riparian HSI	None to Low	• Historic inputs of contaminated bedload and mine tailings material to the stream channel. • Floodplain deposits of hazardous substances in downstream areas.	Historic mining activities impacted the stream channel and riparian habitats of the mainstem of Moon Creek along most of its length. However, stream channel and riparian vegetation structure appears to have recovered in many areas. Ecological connectivity of intact habitats in MoonCrkSeg01 and MoonCrkSeg02
	Bank Stability	None to Low		
	Substrate Composition and Mobility	None	• Bank instability and deposition of fine grained material in the stream channel.	

Table 7.2-12 (Continued)
Summary of Results from the Measures of Ecosystem and Receptor Characteristics Analysis in the Coeur d'Alene Ecological Risk Assessment

Watershed	Measure	Level of Adverse Effects	Nature of Secondary Effects	Extent of Adverse Effects - Narrative
Moon Creek (continued)	Temperature	None	• Ecological connectivity fragmented due to extensive degradation in downstream segments.	fragmented by degraded conditions in the Mid-Gradient SFCDR watershed.
	Spatial Distribution and Connectivity	High		
Pine Creek	Riparian HSI	High	• Historic inputs of contaminated bedload and mine tailings material to the stream channel. • Floodplain deposits of hazardous substances in downstream areas. • Channel destabilization due to inputs of bedload material and loss of bank vegetation. • Impaired recovery of riparian vegetation. • Ecological connectivity fragmented due to extensive degradation in downstream segments.	Historic mining activities impacted the stream channel and riparian habitats of PineCrkSeg01 (East Fork Pine Creek) along much of its length, and PineCrkSeg03 below the East Fork. Extensive floodplain and riparian zone impacts present in these segments. Remedial actions to reduce contamination and rehabilitate riparian and channel structure have been conducted by BLM. Ecological connectivity of intact habitats fragmented by degraded conditions in the Mid-Gradient SFCDR watershed.
	Bank Stability	None to High		
	Substrate Composition and Mobility	Low to Moderate		
	Temperature	None		
	Spatial Distribution and Connectivity	High		
Beaver Creek	No Measures Evaluated	-	Insufficient Information available to evaluate risks for all receptors.	
Prichard Creek	Riparian HSI	Moderate		
	Bank Stability	Low		
	Substrate Composition and Mobility	Low		
	Temperature	Low		
	Spatial Distribution and Connectivity	Moderate		

Table 7.2-12 (Continued)
Summary of Results from the Measures of Ecosystem and Receptor Characteristics Analysis in the Coeur d'Alene Ecological Risk Assessment

Watershed	Measure	Level of Adverse Effects	Nature of Secondary Effects	Extent of Adverse Effects - Narrative
MidGradient SFCDR	Riparian HSI	High	• Extensive deposits of contaminated jig and floatation mining tailings material present in floodplains and riparian areas. • Channel destabilization due to inputs of bedload material and loss of bank vegetation. • Recovery of riparian vegetation limited in some areas by phytotoxic levels of hazardous substances in mining related floodplain deposits. • Degraded riparian and riverine habitat conditions throughout MidGradSeg01 and MidGradSeg02 contribute to fragmented ecological connectivity.	Floodplain deposits of jig and floatation era mine tailings present in depositional areas throughout the mid-gradient SFCDR. Loss of stabilizing riparian vegetation from phytotoxic effects, and large historic inputs of bedload material contribute to channel and substrate instabililty in the stream system. Degraded riparian and riverine structure and physical function throughout MidGradSeg01 and MidGradSeg02 contribute to fragmented ecological connectivity throughout the watershed.
	Bank Stability	Moderate to High		
	Substrate Composition and Mobility	Moderate		
	Temperature	High		
	Spatial Distribution and Connectivity	High		
North Fork Coeur d'Alene River	Riparian HSI	None		
	Bank Stability	Not Rated		
	Substrate Composition and Mobility	Not Rated		
	Temperature	Moderate		
	Spatial Distribution and Connectivity	None		
Mainstem Coeur d'Alene River	Riparian HSI	None		
	Bank Stability	None		
	Substrate Composition and Mobility	Not Rated		
	Temperature	None		
	Spatial Distribution and Connectivity	Not Rated		

Table 7.2-12 (Continued)
Summary of Results from the Measures of Ecosystem and Receptor Characteristics Analysis in the Coeur d'Alene Ecological Risk Assessment

Watershed	Measure	Level of Adverse Effects	Nature of Secondary Effects	Extent of Adverse Effects - Narrative
Lower Coeur d'Alene River	Riparian HSI	Not Rated	• Extensive deposits of contaminated jig and floatation mining tailings material present in sediments on the river bottom and in lateral lakes and wetlands, and on the river bank and floodplain. • Degraded channel stability due to extensive bedload inputs. • Recovery of bank and riparian vegetation possibly limited by phytotoxic effects. • Recovery of bank and riparian vegetation possibly limited by phytotoxic effects. • Extensive bank erosion contributes to high levels of suspended solids and elevated sediment deposition rates.	Deposits of contaminated material along 260,000 feet (49 miles) of shoreline, averaging approximately 90 feet in width (CSM segments LCDRSeg02-LCDRSeg06). Actively eroding streambank identified along 57,900 feet (11 miles) of shoreline in all CSM segments, the majority associated with contaminated deposits.
	Bank Stability	Not Rated		
	Suspended Solids	Moderate		
	Sediment Deposition Rate	Low to High		
Coeur d'Alene Lake	Sediment Deposition Rate	None to High		Core sampling locations at the mouth of the Coeur d'Alene River and approximately 2.25 miles to the NW (CDALakeSeg02) indicate deposition rates corresponding to moderate to high adverse effects. All other locations throughout CDALakeSeg02 indicate no adverse effects. One location at the northern end of CDALakeSeg01 indicated deposition rates having a low level of adverse effects. The southern end of CDALakeSeg01 and CDALakeSeg03 were used as reference areas.

Table 7.2-12 (Continued)
Summary of Results from the Measures of Ecosystem and Receptor Characteristics Analysis in the Coeur d'Alene Ecological Risk Assessment

Watershed	Measure	Level of Adverse Effects	Nature of Secondary Effects	Extent of Adverse Effects - Narrative
Upper Spokane River	Sediment Deposition Rate	None		Due to lack of adverse effects in areas of Coeur d'Alene Lake away from the mouth of the Coeur d'Alene River, no adverse effects are expected in the Spokane River

Notes:
HSI - Habitat Suitability Index

8.0 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) provide a general description of the goals of the overall cleanup. RAOs have been developed for the protection of human health and ecological receptors. The Selected Remedy provides prioritized actions toward achieving the RAOs.

8.1 HUMAN HEALTH

The RAOs for human health protection are shown in Table 8.1-1. The primary RAOs for the selected human health remedy are designed to:

- Reduce human exposure to lead-contaminated soils, sediments, and house dust exceeding health risk goals particularly in children up to 84 months of age
- Reduce human exposure to soils and sediments that would exceed a cancer risk of one in ten thousand
- Reduce ingestion of groundwater or surface water withdrawn or diverted from a private, unregulated source that contains COCs exceeding drinking water standards and risk-based levels[11] (The drinking water standards are shown in Table 8.1-2.)

8.2 ECOLOGICAL

The RAOs developed for ecological protection are shown in Table 8.2-1. Overall, the RAOs are designed to:

- Return the rivers and tributaries to conditions that will fully support healthy fish and other aquatic receptors, with an emphasis on native species, including sensitive native fish such as the westslope cutthroat trout and the bull trout (listed as “threatened” under the ESA).
- Return the wetland, lake, riparian, riverine, and upland areas to conditions protective of waterfowl, migratory birds, and other plants and animals that live in these areas.

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[11] The State of Idaho has adopted the federal drinking water standards for the chemicals of potential concern by reference (IDAPA 58.01.08.050).

The RAOs are long-term goals that were used to develop the comprehensive ecological alternatives that are described in Section 9, but are not the objectives of the remedy selected in this ROD. The Selected Remedy establishes benchmarks (actions and criteria), which are near-term objectives that will serve as landmarks and measurements to evaluate the progress of the remedy toward achievement of the long-term goals. The Selected Remedy identifies prioritized actions to address environmental risks in the Upper Basin and Lower Basin. The benchmarks identified for the Selected Remedy are discussed in Section 12 and shown in Table 12.2-1.

Potential cleanup criteria for surface water are set forth in the Idaho Water Quality Standards and Wastewater Treatment Requirements, the Washington Water Quality Standards, tribal standards, or federal criteria, which have been established through the Clean Water Act to protect aquatic organisms. These standards and criteria were drivers for development of the comprehensive alternatives and for identification of the priority actions included in the Selected Remedy. State, tribal, and federal standards and criteria for protection of aquatic life in surface water are listed in Tables 8.2-2, 8.2-3, and 8.2-4.[12]

40 CFR 131.11 provides states the opportunity to adopt site-specific water quality criteria (SSC) that are "...modified to reflect site specific conditions." The State of Idaho promulgated SSC for cadmium, lead, and zinc in the flowing waters of the Upper Basin as a permanent rule in March 2002 (IDAPA 58.01.02.284). The status of the SSC as potential ARARs for cleanup in the Basin is discussed in Section 13.2.

Table 7.2-8 presents concentrations of metals in surface water that represent the lowest chronic effects levels of metals that may affect aquatic plants. However, these effects levels for plants are screening-level benchmarks. The AWQC also take into account the protection of aquatic plants. Therefore, the AWQC are considered adequately protective for aquatic plants and animals.

Protection of certain species is required by the MBTA and the ESA. In order to comply with these ARARs, cleanup criteria will be protective of these species within the areas where they may occur. Based on the EcoRA, 19 of 22 migratory bird species evaluated are at risk. These species are representative of hundreds of species that are similarly exposed. Protection of MBTA and ESA species was a driver for development of the comprehensive alternatives and for identification of the priority actions for soil, sediment, and surface water included in the Selected Remedy.

[12] Cleanup levels would not be less than background concentrations of metals in surface water.

As described in Section 12.2.3, Benchmark Cleanup Criteria, a benchmark cleanup criterion of 530 mg/kg for lead in Lower Basin soil and sediment has been selected for implementation of the Selected Remedy. This criterion may be revised as additional information becomes available to ensure protectiveness of the remedy.

In riparian areas where remedial actions are conducted (e.g., banks and tributaries), risks to riparian receptors will be mitigated using removal and replacement with clean soil or capping with clean soil to isolate contaminants and reduce or eliminate exposure pathways.

Table 8.1-1
Remedial Action Objectives for Protection of Human Health

Environmental Media	Remedial Action Objectives
Soils, Sediments and Source Materials	Reduce mechanical transportation of soil and sediments containing unacceptable levels of contaminants into residential areas and structures. Reduce human exposure to soils, including residential garden soils, and sediments that have concentrations of contaminants of concern greater than selected risk-based levels for soil. (As described in Sections 7 and 12 of this ROD.)
House Dust	Reduce human exposure to lead in house dust via tracking from areas outside the home and air pathways, exceeding health risk goals.
Groundwater and Surface Water as Drinking Water	Reduce ingestion by humans of groundwater or surface water withdrawn or diverted from a private, unregulated source, used as drinking water, and containing contaminants of concern exceeding drinking water standards and risk-based levels for drinking water.
Aquatic Food Sources	Reduce human exposure to unacceptable levels of contaminants of concern via ingestion of aquatic food sources (e.g., fish and water potatoes).

Table 8.1-2
ARARs for Drinking Water

Metal	MCL[1] or TT[2], µg/L
Arsenic	10
Cadmium	5
Lead	TT[3]; Action Level = 15

[1]Maximum Contaminant Level (MCL) - The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCL goals as feasible using the best available treatment technology and taking cost into consideration.
[2]Treatment technique (TT) - A required process intended to reduce the level of a contaminant in drinking water.
[3]Lead is regulated by a treatment technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps.

Note:
µg/L - micrograms per liter

Table 8.2-1
Remedial Action Objectives for Protection of Ecological Receptors

Subject	Remedial Action Objective
Ecosystem and physical structure and function	Remediate soil, sediment, and water quality and mitigate mining impacts in habitat areas to be capable of supporting a functional ecosystem for the aquatic and terrestrial plant and animal populations in the Coeur d'Alene Basin. Maintain (or provide) soil, sediment, and water quality and mitigate mining impacts in habitat areas to be supportive of individuals of special-status biota that are protected under the Endangered Species Act and the Migratory Bird Treaty Act.
Soil, sediment, and source materials	Prevent ingestion of arsenic, cadmium, copper, lead, mercury, silver, and zinc by ecological receptors at concentrations that result in unacceptable risks. Reduce loadings of cadmium, copper, lead, and zinc from soils and sediments to surface water so that loadings do not cause exceedances of potential surface water quality ARARs. Prevent transport of cadmium, copper, lead, and zinc from soils and sediments to groundwater at concentrations that exceed potential surface water quality ARARs. Prevent dermal contact with arsenic, cadmium, copper, lead, mercury, silver, and zinc by ecological receptors at concentrations that result in unacceptable risks.
Mine water, including adits, seeps, springs, and leachate	Prevent discharge of cadmium, copper, lead, and zinc in mine water, including adits, seeps, springs, and leachate to surface water at concentrations that exceed potential surface water quality ARARs.
Surface water	Prevent ingestion of cadmium, copper, lead, and zinc by ecological receptors at concentrations that exceed potential surface water quality ARARs. Prevent dermal contact with cadmium, copper, lead, and zinc by ecological receptors at concentrations that exceed potential surface water quality ARARs.
Groundwater	Prevent discharge of groundwater to surface water at concentrations of cadmium, copper, lead, and zinc that exceed potential surface water quality ARARs.

Note:
The Selected Remedy is designed to achieve the benchmarks (actions and criteria) shown in Table 12.2-1. The Selected Remedy for ecological protection provides prioritized actions toward achieving the RAOs.

Table 8.2-2
Water Quality Standards and Criteria for Protection of Aquatic Life in Surface Water in the Upper Basin (CSM Units 1 and 2)

Metal	EPA-Approved Idaho Water Quality Standards[a,c]						Idaho Site-Specific Criteria[a,d]						National Ambient Water Quality Criteria[a,e]					
	Acute			Chronic			Acute			Chronic			Acute			Chronic		
Hardness[b]	**30**	**50**	**100**	**30**	**50**	**100**	**30**	**50**	**100**	**30**	**50**	**100**	**30**	**50**	**100**	**30**	**50**	**100**
Cadmium	1.0	1.7	3.7	0.42	0.62	1.0	0.61	1.0	2.1	0.42	0.62	1.0	0.62	1.0	2.0	0.11	0.15	0.25
Copper	5.5	8.9	17	4.1	6.3	11	5.5	8.9	17	4.1	6.3	11	4.3	7.0	13	3.2	5.0	9.0
Lead	17	30	65	0.66	1.2	2.5	80	129	248	9.1	15	28	17	30	65	0.66	1.2	2.5
Zinc	41	64	114	38	58	105	88	123	195	88	123	195	42	65	117	43	66	118

[a]Standards and criteria in micrograms per liter (µg/L)
[b]Hardness in milligrams of calcium carbonate per liter (mg$CaCO_3$/L)
[c]EPA-approved Idaho Water Quality Standards, IDAPA 58.01.02.210, as submitted by Idaho to EPA by May 30, 2000.
[d]Idaho site-specific criteria (SSC) for cadmium, lead, and zinc, IDAPA 58.0102.284, as adopted by Idaho on March 15, 2002. Copper criteria apply statewide (IDAPA 58.0102.210).
[e]National Ambient Water Quality Criteria for copper, lead, and zinc as published in the National Recommended Water Quality Criteria – Correction, EPA 822-ZZ-99-001, April 1999. The National Ambient Water Quality Criteria for cadmium as published on April 12, 2001, 66 FR 18935.

Notes:
Idaho and national guidelines set a maximum hardness to be used in calculating the criteria at 400 mg/L.

Equations used to calculate water quality standards and criteria

Metal	Acute criteria equation	Chronic criteria equation
Cadmium (EPA-Approved State Standard)	{1.136672-(ln(H)*0.041838)}*{exp(1.128*ln(H)-3.828)}	{1.101672-(ln(H)*0.041838)}*{exp(0.7852*ln(H)-3.49)}
Cadmium (State SSC)	0.973*exp(1.0166*ln(H)-3.924)	{1.101672-(ln(H)*0.041838)}*{exp(0.7852*ln(H)-3.49)}
Cadmium (National AWQC)	{1.136672-(ln(H)*0.041838)}*{exp(1.0166*ln(H)-3.924)}	{1.101672-(ln(H)*0.041838)}*{exp(0.7409*ln(H)-4.719)}
Copper (EPA-Approved State Standard and State SSC)	0.96*exp(0.9422*ln(H)-1.464)	0.96*exp(0.8545*ln(H)-1.465)
Copper (National AWQC)	0.96*exp(0.9422*ln(H)-1.700)	0.96*exp(0.8545*ln(H)-1.702)
Lead (EPA-Approved State Standard and National AWQC)	{1.46203-(ln(H)*0.145712)}*{exp(1.273*ln(H)-1.46)}	{1.46203-(ln(H)*0.145712)}*{exp(1.273*ln(H)-4.705)}
Lead (State SSC)	exp(0.9402*ln(H)+1.1834)	exp(0.9402*ln(H)-0.9875)
Zinc (EPA-Approved State Standard)	0.978*exp(0.8473*ln(H)+0.8604)	0.986*exp(0.8473*ln(H)+0.7614)
Zinc (State SSC)	exp(0.6624*ln(H)+2.2235)	Same as acute
Zinc (National AWQC)	0.978*exp(0.8473*ln(H)+0.884)	0.986*exp(0.8473*ln(H)+0.884)

Table 8.2-3
Water Quality Standards and Criteria for Protection of Aquatic Life in the Lower Basin, Coeur d'Alene Lake, and Spokane River Within Idaho (CSM Units 3, 4, and 5)

Metal	EPA-Approved Idaho Water Quality Standards[a,c]						Coeur d'Alene Tribe Water Quality Standards[a,d]						National Ambient Water Quality Criteria[a,e]					
	Acute			Chronic			Acute			Chronic			Acute			Chronic		
Hardness[b]	20	30	50	20	30	50	20	30	50	20	30	50	20	30	50	20	30	50
Cadmium	0.82	1.0	1.7	0.37	0.42	0.62	0.65	1.0	1.7	0.31	0.42	0.62	0.42	0.62	1.0	0.080	0.11	0.15
Copper	4.6	5.5	8.9	3.5	4.1	6.3	3.7	5.5	8.9	2.9	4.1	6.3	2.9	4.3	7.0	2.3	3.2	5.0
Lead	14	17	30	0.54	0.66	1.2	11	17	30	0.42	0.66	1.2	11	17	30	0.42	0.66	1.2
Zinc	35	41	64	32	38	58	29	41	64	27	38	58	30	42	65	30	43	66

[a]Standards and criteria in micrograms per liter (μg/L)
[b]Hardness in milligrams of calcium carbonate per liter ($mgCaCO_3/L$)
[c]EPA-approved Idaho Water Quality Standards, IDAPA 58.01.02.210, as submitted by Idaho to EPA by May 30, 2000.
[d]Tribal water quality standards apply only within reservation lands and water bodies.
[e]National Ambient Water Quality Criteria for copper, lead, and zinc as published in the National Recommended Water Quality Criteria – Correction, EPA 822-ZZ-99-001, April 1999. The National Ambient Water Quality Criteria for cadmium as published on April 12, 2001, 66 FR 18935.

Notes:
Idaho, Coeur d'Alene Tribe, and national guidelines set a maximum hardness to be used in calculating the criteria at 400 mg/L. Statewide Idaho water quality standards also set a minimum hardness to be used in calculating the criteria at 25 mg/L. If hardness is <25 mg/L within reservation lands and water bodies, tribal standards are more stringent.

Equations used to calculate water quality standards and criteria

Metal	Acute criteria equation	Chronic criteria equation
Cadmium (EPA-Approved State Standard and Tribe)	{1.136672-(ln(H)*0.041838)}*{exp(1.128*ln(H)-3.828)}	{1.101672-(ln(H)*0.041838)}*{exp(0.7852*ln(H)-3.49)}
Cadmium (National AWQC)	{1.136672-(ln(H)*0.041838)}*{exp(1.0166*ln(H)-3.924)}	{1.101672-(ln(H)*0.041838)}*{exp(0.7409*ln(H)-4.719)}
Copper (EPA-Approved State Standard and Tribe)	0.96*exp(0.9422*ln(H)-1.464)	0.96*exp(0.8545*ln(H)-1.465)
Copper (National AWQC)	0.96*exp(0.9422*ln(H)-1.700)	0.96*exp(0.8545*ln(H)-1.702)
Lead (EPA-Approved State Standard, Tribe, and National AWQC)	{1.46203-(ln(H)*0.145712)}*{exp(1.273*ln(H)-1.46)}	{1.46203-(ln(H)*0.145712)}*{exp(1.273*ln(H)-4.705)}
Zinc (EPA-Approved State Standard and Tribe)	0.978*exp(0.8473*ln(H)+0.8604)	0.986*exp(0.8473*ln(H)+0.7614)
Zinc (National AWQC)	0.978*exp(0.8473*ln(H)+0.884)	0.986*exp(0.8473*ln(H)+0.884)

Table 8.2-4
Water Quality Standards and Criteria for Protection of Aquatic Life in Surface Water in the Spokane River Within Washington (CSM Unit 5)

Metal	EPA-Approved Washington Water Quality Standards[a,c]						Spokane Tribe Water Quality Standards[a,d]						National Ambient Water Quality Criteria[a,e]					
	Acute			Chronic			Acute			Chronic			Acute			Chronic		
Hardness[b]	**30**	**50**	**100**	**30**	**50**	**100**	**30**	**50**	**100**	**30**	**50**	**100**	**30**	**50**	**100**	**30**	**50**	**100**
Cadmium	1.0	1.7	3.7	0.42	0.62	1.0	1.0	1.7	3.7	0.42	0.62	1.0	0.62	1.0	2.0	0.11	0.15	0.25
Copper	5.5	8.9	17	4.1	6.3	11	4.3	7.0	13	3.2	5.0	9.0	4.3	7.0	13	3.2	5.0	9.0
Lead	17	30	65	0.66	1.2	2.5	17	30	65	0.66	1.2	2.5	17	30	65	0.66	1.2	2.5
Zinc	41	64	114	38	58	105	41	64	114	38	58	105	42	65	117	43	66	118

[a]Standards and criteria in micrograms per liter (µg/L)
[b]Hardness in milligrams of calcium carbonate per liter ($mgCaCO_3/L$)
[c]EPA-approved Washington Water Quality Standards, WAC 173-201A-040, as submitted by Washington to EPA by May 30, 2000.
[d]Tribal water quality standards apply only within reservation lands and water bodies.
[e]National Ambient Water Quality Criteria for copper, lead, and zinc as published in the National Recommended Water Quality Criteria – Correction, EPA 822-ZZ-99-001, April 1999. The National Ambient Water Quality Criteria for cadmium as published on April 12, 2001, 66 FR 18935.

Equations used to calculate water quality standards and criteria

Metal	Acute criteria equation	Chronic criteria equation
Cadmium (EPA-Approved State Standard and Tribe)	{1.136672-(ln(H)*0.041838)}*{exp(1.128*ln(H)-3.828)}	{1.101672-(ln(H)*0.041838)}*{exp(0.7852*ln(H)-3.49)}
Cadmium (National AWQC)	{1.136672-(ln(H)*0.041838)}*{exp(1.0166*ln(H)-3.924)}	{1.101672-(ln(H)*0.041838)}*{exp(0.7409*ln(H)-4.719)}
Copper (EPA-Approved State Standard)	0.96*exp(0.9422*ln(H)-1.464)	0.96*exp(0.8545*ln(H)-1.465)
Copper (Tribe and National AWQC)	0.96*exp(0.9422*ln(H)-1.700)	0.96*exp(0.8545*ln(H)-1.702)
Lead (EPA-Approved State Standard, Tribe, and National AWQC)	{1.46203-(ln(H)*0.145712)}*{exp(1.273*ln(H)-1.46)}	{1.46203-(ln(H)*0.145712)}*{exp(1.273*ln(H)-4.705)}
Zinc (EPA-Approved State Standard and Tribe)	0.978*exp(0.8473*ln(H)+0.8604)	0.986*exp(0.8473*ln(H)+0.7614)
Zinc (National AWQC)	0.978*exp(0.8473*ln(H)+0.884)	0.986*exp(0.8473*ln(H)+0.884)

9.0 DESCRIPTIONS OF ALTERNATIVES

This section describes the comprehensive alternatives for protection of human health and the environment that were developed and evaluated in the FS. Human health and ecological alternatives for the basin were developed, analyzed, and compared following EPA guidance (USEPA 1988). This section summarizes the components of each of the alternatives, which are organized as follows:

- **Section 9.1.** Alternatives for protection of human health in the residential and community areas of the Upper Basin and Lower Basin
- **Section 9.2.** Alternatives for protection of ecological receptors in the Upper Basin and Lower Basin
- **Section 9.3.** Alternatives for Coeur d'Alene Lake
- **Section 9.4.** Alternatives for protection of human health and ecological receptors for the Spokane River between the Washington-Idaho state line and Upriver Dam

The Selected Remedy is described in Section 12. The alternative development process for both human health and ecological protection included identification of all potentially applicable technologies and process options; screening of technologies and process options on the basis of technical implementability only; and evaluation and screening of retained technologies and process options based on effectiveness, implementability, and cost. The retained process options were then assembled into alternatives that cover a range of remedial options, including "no action," as required by the NCP.

The remedial alternatives are not mutually exclusive choices and do not limit the choice of a remedy. The Selected Remedy can combine elements of the various alternatives, refine or modify those elements, or add to them. Alternatives are developed and evaluated in the remedy selection process to the level of detail appropriate to provide information needed to support a Proposed Plan and ROD. This level of detail is considered a planning level, not a design level. Remedial actions require appropriate site-specific remedial designs, which may generally include collection of site-specific chemical, hydrologic, hydraulic, and geotechnical data from areas identified as requiring cleanup. These areas may include those where previous cleanup actions have taken place, such as floodplain areas of the UPRR right-of-way or other areas where previous removal actions have addressed some, but not all, contamination present. Remedial design and construction (remedial action) are post-ROD activities that are based on the remedy selected in the ROD.

Cleanup plans for the Basin have also been developed by the State of Idaho (State of Idaho Cleanup Plan) and the mining companies (Mining Companies Cleanup Plan). Because the ecological components of these plans enhance the range of remedial options available to decision makers, these plans are presented as ecological Alternatives 5 (State of Idaho Cleanup Plan) and 6 (Mining Companies Cleanup Plan), based on interpretation of available documentation. The human health alternatives include the human health components of these plans, with minor exceptions, and the State Plan and Mining Companies Plan are not presented as distinct alternatives for protection of human health.

9.1 HUMAN HEALTH ALTERNATIVES FOR THE COMMUNITY AND RESIDENTIAL AREAS

Human health alternatives were developed for the primary potential exposure media:

- Soil
- Drinking water
- House dust
- Aquatic food sources

Risk from eating homegrown vegetables is addressed by the yard soil alternatives. The ultimate effectiveness of the aquatic food sources alternatives would be highly dependent on the reductions of fish uptake of metals achieved through implementation of ecological remedies.

9.1.1 Soil Alternatives

Soil Alternative S1—No Action

This alternative would leave contaminated soil in place with no change in existing conditions. It would not remove contaminated soil from residential yards and gardens in the Basin, it would provide no information, education, or counseling for residents with contaminated yards, and it would not monitor blood lead levels to evaluate the impacts of continued exposure. The no action alternative provides a baseline from which to compare the action alternatives.

Soil Alternative S2—Information and Intervention

This alternative would include deed notices, pamphlet distribution, press releases, public meetings, publicly posted notices, and advisory signs in public areas to both inform the public of risk mitigation and new risk information and solicit public input and involvement. This alternative also would include a program similar to the PHD's Lead Health Intervention Program, which provides personal health and hygiene information to help mitigate exposure to contaminants. Services also include biological monitoring, yard and home sampling, and nursing follow-up services. An institutional controls program that would include local construction regulations (developed and implemented in conjunction with local zoning, building, or planning commissions) may also be considered in certain areas if risk conditions warrant.

Soil Alternative S3—Information and Intervention and Access Modifications

In addition to information and intervention, this alternative would include constructing fences or other barriers around certain areas and providing maintenance to prevent or limit access to certain areas where risk level and persistency warrant. This alternative is not intended for use at residential properties.

Soil Alternative S4—Information and Intervention and Partial Removal and Barriers

In addition to information and intervention, this alternative would include removing a limited amount of contaminated soil and placing clean barriers. Contaminated yards would be excavated to a typical depth of about 1 foot. Garden areas would be provided with a minimum of 2 feet of clean fill. In order to mitigate potential exposure pathways, the excavated areas would be backfilled with clean soils and/or capped. Where appropriate, structure exteriors would be pressure-washed before remedial measures are performed, to reduce the potential for recontamination from lead-based paint. Risk would be further reduced by installing visual markers to delineate the limits of soil removal. In addition to residential yards, common use areas such as streets, alleys, rights-of-way, and playgrounds would also be candidates for remediation if soil contamination and exposure risks warrant. This alternative would also include revegetation and interim dust control during soil excavation. For recreational areas, this alternative would include site improvements to reduce exposure risks. These would be specific to individual recreational areas and, in addition to partial soil removal and access restrictions, could include stabilizing river banks, constructing paved boat ramps and parking areas, excavating or capping day-use and overnight camping areas, and providing picnic tables.

Soil Alternative S5—Information and Intervention and Complete Removal

In addition to information and intervention, this alternative would include complete removal and disposal of soil that exceeds action levels. The depth of contaminated soil is expected to vary considerably within the Basin, but complete removal is considered to be excavation of residential yard and garden areas to a depth of 4 feet. If warranted, structure exteriors would be pressure-washed to reduce the potential for recontamination from lead-based paint. This alternative would include backfilling the properties with clean soil to re-establish site grades and revegetating the reclaimed ground surface. It would also include interim dust control during soil excavation. This alternative is not envisioned for recreational areas.

9.1.2 Drinking Water Alternatives

Drinking Water Alternative W1—No Action

This alternative would leave contaminated drinking water sources in place with no changes in existing use. It would take no action to prevent exposure to COCs in drinking water, and would provide no information or education to exposed residents. The no action alternative provides a baseline from which to compare the action alternatives.

Drinking Water Alternative W2—Public Information

This alternative would include pamphlet distribution, press releases, public meetings, and publicly posted notices to inform the public of risk mitigation and new risk information and solicit public input and involvement. This alternative would require an ongoing effort and would be intended primarily for use at the community level. It is generally not considered feasible for individual residences, except for raising general awareness of risks.

Drinking Water Alternative W3—Public Information and Residential Treatment

In addition to public information, this alternative would include wellhead filtration (if applicable) and point-of-use filtration. Filters would be placed at each tap or other point of use in residences. If possible, a single filter would be placed on the main residence service line to avoid potential confusion and change-out costs for multiple filters. A change-out program would be required to ensure that filters are changed on the required schedule.

Drinking Water Alternative W4—Public Information and Alternative Source, Public Water Utility

In addition to public information, this alternative would include constructing drinking water conveyances from public water utilities to residences or common-use areas. Information programs would be used to better inform residents about lead risks from in-home plumbing.

Drinking Water Alternative W5—Public Information and Alternative Source, Groundwater

For properties currently supplied by contaminated water wells or other unregulated sources this alternative would include (in addition to public information) constructing new wells into a suitable alternative aquifer, installing necessary appurtenances, and abandoning existing contaminated wells. The suitability of the alternative aquifer (for example, water yield and quality) would need to be evaluated before drilling any new wells. After well construction, groundwater sampling would be conducted to verify that new wells supply water capable of achieving the RAOs. Subsequent monitoring would also be conducted to ensure continual achievement of RAOs. Information programs would be used to better inform residents about lead risks from in-home plumbing.

Drinking Water Alternative W6—Public Information and Multiple Alternative Sources

This alternative would include public information, in addition to one of the above-described alternatives, depending on geographic issues. For areas inside water districts, the alternative would provide individual residences or common areas with a hookup to the existing public conveyance system. For areas outside water districts (mostly in the tributary gulches), it is assumed that public water utilities will not be able to provide an alternative water source because of the annexation and engineering issues of constructing distribution systems; therefore, the assumed alternative for these areas would be to provide either point-of-use treatment or new groundwater wells. Alternative W6 would include a survey of residences during remedial design to determine whether they were served by public water utilities, and to determine residences at which COCs in drinking water exceed maximum contaminant levels.

9.1.3 House Dust Alternatives

House Dust Alternative D1—No Action

The No Action alternative would leave contaminated house dust in place and would not change existing conditions. It would take no action to prevent exposure, and provide no information or education to exposed residents. The no action alternative provides a baseline from which to compare the action alternatives.

House Dust Alternative D2—Information and Intervention and Vacuum Loan Program/Dust Mats

This alternative has three major components. First, information and intervention for house dust would include pamphlet distribution, press releases, public meetings, and publicly-posted notices to inform the public of remedial actions and to provide exposure education. In addition, public input and involvement would be sought. This program has been administered as part of the PHD's Lead Health Intervention Program in the Bunker Hill Box for approximately 15 years and throughout the basin since 1996. The second component of this alternative would be initiation of a Vacuum Loan Program similar to the one used in the Bunker Hill Box, which allows residents to use a heavy-duty vacuum cleaner equipped with high-efficiency particulate air (HEPA) filters. The third component would be free dust mats for entryways, which would be provided to residents to reduce tracking exterior dust into the home. Monitoring would also be conducted to ensure continued achievement of RAOs.

House Dust Alternative D3—Information and Intervention, Vacuum Loan Program/Dust Mats, Interior Source Removal, and Contingency Capping/More Extensive Cleaning

In addition to the components of Alternative D2, this alternative would include interior cleaning, and removing and replacing some household items that are either difficult to clean effectively or which provide a source for recontamination. Interior cleaning would include a one-time cleaning of hard surfaces and heating and cooling systems and removal and replacement of major interior dust sources such as carpet and some soft furniture. In addition, this alternative would consider crawl spaces, attics, and basements. Contaminated crawl spaces would be capped with a sand or synthetic cover to prevent generation of dust and tracking of soil into the home. Accessible attics and basements would also be cleaned. The exact scope of this alternative will depend on the conditions of each residence. These activities would occur only after exterior sources of contamination had been permanently remediated, to ensure cost-effectiveness and prevent recontamination. Based on observations from yard remediation in the Bunker Hill Box, once exterior yard soil is cleaned up, relatively few homes (a maximum of 20 percent of the homes that required yard cleanup, or about 100 to 200 homes) are expected to require the additional interior cleaning provided by Alternative D3. Temporary relocation of residents might be required during cleaning to protect their safety. Monitoring would also be conducted to ensure that RAOs continue to be achieved after the Selected Remedy is implemented.

9.1.4 Aquatic Food Sources Alternatives

Aquatic Food Sources Alternative F1—No Action

This alternative would take no action to address the potential human health risk to residents and tribal members of eating contaminated fish. It would take no action to prevent exposure and provide no information or education to people likely to consume contaminated fish. The no action alternative provides a baseline from which to compare the action alternatives.

Aquatic Food Sources Alternative F2—Information and Intervention

In addition to the information and intervention efforts of other alternatives, this alternative would educate fishermen and other recreational users of the potential health risk of consuming contaminated fish caught in waterways and wetlands. All printed materials, press releases, and public meetings developed to inform the public of basin metals issues would include information about the fish risks, how to reduce exposure, prevention, and other pertinent issues. Fish hazard information programs would be expanded to the Coeur d'Alene Indian Reservation communities, as appropriate, to ensure that tribal members are kept informed. Targeted community education programs would be implemented in Benewah, Kootenai, and Shoshone Counties. A well-maintained signage program to educate fishermen and other water users of metals hazards would be implemented at all river/lake access sites and common use areas, including the Coeur d'Alene

River Trail system corridor. Idaho Department of Fish and Game, Idaho State Parks, USFS, and BLM field personnel who regularly contact basin fishermen and recreational users would be trained in metals risk management and supplied with appropriate pamphlets and signs.

Aquatic Food Sources Alternative F3—Information and Intervention and Monitoring

This alternative would build on the efforts of informing and educating fishermen of risks from consumption of metals-contaminated fish included under Alternative F2. An effort to gain more fish metals load data from each of the lateral lakes, the South Fork, lower Coeur d'Alene River, and Coeur d'Alene Lake is the keystone of this alternative. The current limited fish flesh data from three lateral lakes would be expanded so that lake-specific recommendations and intervention can be accurately provided to the public. Surface waters and fish species that are totally free of metals risks would be identified and highlighted. As basin cleanup and mitigation efforts proceed, periodic resampling would provide valuable effectiveness monitoring data for biological response to cleaner waters, sediment, and upstream soils. A trained seasonal "river ranger" program would be instituted to make daily contacts with fishermen and boaters to inform and educate them of metals hazards and prevention methods. Fishermen would be directed to lakes or rivers where fish metals risks are known to be the lowest.

9.2 ECOLOGICAL ALTERNATIVES FOR THE UPPER BASIN AND LOWER BASIN

Six ecological alternatives were developed for the Upper Basin and Lower Basin. These are:

- Alternative 1—No Action
- Alternative 2—Contain/Stabilize with Limited Removal and Treatment
- Alternative 3—More Extensive Removal, Disposal, and Treatment
- Alternative 4—Maximum Removal, Disposal, and Treatment
- Alternative 5—State of Idaho Cleanup Plan
- Alternative 6—Mining Companies Cleanup Plan

Remedial actions were identified for various contamination sources under each of the alternatives. Table 9.2-1 describes the generalized approach each alternative takes to remediating source types.

Each alternative consisted of typical conceptual designs (TCDs) that are applied on a site-by-site basis. Table 9.2-2 presents descriptions of TCDs used with Alternatives 2, 3, and 4. Tables 9.2-3, 9.2-4, and 9.2-5 present unit costs for these TCDs. Tables 9.2-6 and 9.2-7 present descriptions and unit costs of TCDs used with Alternatives 5 and 6, respectively. The TCDs associated with these alternatives vary in design details from the TCDs used to develop Alternatives 2, 3, and 4. As a result, the unit costs are different.

Table 9.2-8 presents a summary of the volumes of waste material addressed by each of the alternatives. Table 9.2-9 summarizes the numbers of acres of waterfowl feeding area contaminated with lead at concentrations exceeding the LOAEL for waterfowl (530 mg/kg) that are addressed by each of the alternatives.

For the purpose of comparing the effectiveness of the six alternatives, estimates were made of the reduction in zinc loads at the completion of remedy implementation (USEPA 2001f). The estimates were made for the South Fork at Pinehurst and the Coeur d'Alene River at Harrison, and do not include sources within the Bunker Hill Box. The results are shown in Table 9.2-10. Alternative 4 is estimated to result in the greatest reduction in zinc load following remedy implementation: a 73 percent reduction at Pinehurst and a 64 percent reduction at Harrison. Alternative 3 is predicted to result in about 15 and 11 percent smaller reductions in zinc loads compared to Alternative 4 at Pinehurst and Harrison, respectively. Alternative 2 is predicted to result in about a 59 percent smaller reduction in zinc load compared to Alternative 4 at both Pinehurst and Harrison. Alternatives 5, 6, and 1 result in increasingly smaller reductions in zinc load.

Alternative 1—No Action

Alternative 1 includes no actions to control exposures of ecological receptors to contaminants. Risks to fish and other aquatic receptors, birds, and terrestrial receptors would continue to exist for the foreseeable future.

Alternative 2—Contain/Stabilize with Limited Removal and Treatment

Actions are generally aimed at controlling sources having the highest metal loadings to groundwater and surface water and the highest levels of ecological exposure. Limited removals and in-place and on-site waste containment would be used to control ecological and human exposures and metal transport via erosion and leachate loading to groundwater and surface water. Bioengineering would be used to provide bank and stream stabilization, control erosion of contaminated sediments, and support natural recovery of riverine and riparian habitat. Chemical treatment would be limited to passive treatment of drainage from the adits that are the major metals loaders and of groundwater collected as part of hydraulic isolation (limited to the Hecla-Star tailings pounds in Canyon Creek and the Cataldo/Mission Flats dredge spoil area). Residual risks would be associated with contaminated media left in place or only partially contained.

Alternative 3—More Extensive Removal, Disposal, and Treatment

Alternative 3 would extend the level of cleanup included under Alternative 2 through the use of more extensive and effective removal, containment, and treatment, including:

- Regional repositories for disposal of contaminated materials excavated from source areas in the Upper Basin
- A regional active water treatment plant for treatment of collected groundwater, leachate, and adit drainage water
- More extensive use of hydraulic isolation, including inaccessible current and historic 100-year floodplain sediments and additional tailings impoundments in the Upper Basin
- Comprehensive removal of river bed and bank sediments

A passive treatment pond near the mouth of Canyon Creek is also included as part of Alternative 3. The pond would be used to reduce metal loadings to the South Fork before upstream source control was accomplished.

Disposal of materials removed from the Lower Basin (including river banks, levees, and beds; wetlands; and lateral lakes) would be at a regional repository or by confined aquatic disposal (CAD).

Alternative 4—Maximum Removal, Disposal, and Treatment

Alternative 4 would include removal of sources to the maximum practical extent with disposal in regional repositories. It would extend the use of active water treatment, and employ hydraulic isolation to contain metals within floodplain sediments. Residual risks resulting from contaminated materials left in place or only partially contained would be minimized to the greatest extent practicable.

Alternative 5—State of Idaho Plan

Alternative 5, developed by IDEQ, would focus on containing or stabilizing the largest sources of metals loading to surface water. Alternative 5 includes measures similar to Alternatives 2 and 3; it includes regional repositories and passive water treatment, but does not include an active water treatment plant. In developing the alternative, IDEQ sought to achieve a balance between benefit, cost, and impact to the environment in both the long term and short term.

Alternative 6—Mining Companies Plan

Alternative 6 consists of prioritized actions primarily focused on regrading or removing source material from water courses to reduce erosion and the potential for contact with surface and groundwater that could result in leaching and surface water loading. Local areas of bioengineered and vegetative stream bank stabilization are included. Mine water management and/or passive treatment are included for four major adits. Regional repositories and active water treatment plants are not included.

9.3 COEUR D'ALENE LAKE

Two alternatives were developed for Coeur d'Alene Lake. These are:

- Alternative 1—No Action
- Alternative 2—Institutional Controls

As described in Sections 5.2.3 and 7.1.2, Harrison Beach, which is the subject of cleanup as part of the UPRR action, is the only area evaluated that had risks exceeding target health goals. Consequently, alternatives were not developed for protection of human health.

As described in the FS (USEPA 2001c), active remediation (e.g., dredging, capping) of lakebed sediments was not retained for alternative development based on technical implementability and cost. Although a large volume of contaminated sediments are present in the lake bottom, under current conditions, more metals enter the lake annually from the Coeur d'Alene River than flow out of the lake into the Spokane River.

Alternative 1—No Action

The no action alternative is developed to provide a basis for comparing existing and future environmental impacts that would be present if no remedy is implemented in Coeur d'Alene Lake. Alternative 1 would include monitoring.

Alternative 2—Institutional Controls

This alternative includes institutional controls such as signage, monitoring, and implementation of the Lake Management Plan (Coeur d'Alene Tribe, et al. 1996). The latter is summarized in the following paragraphs.

A lake management study was initiated in 1991. One of the objectives of this study was to develop a lake management plan that would identify actions needed to achieve water quality goals. It was not deemed appropriate to apply a single water management strategy to the entire lake, therefore, the lake was divided into the following four water quality management zones:

- **Nearshore** (water depths less than 20 feet)
- **Shallow, southern lake** (south of the mouth of the Coeur d'Alene River and including the shallow lakes such as Benewah, Chatcolet, Hidden, and Round)
- **Lower rivers** (lower reaches of the St. Joe and Coeur d'Alene Rivers that are affected by backwater from the lake)
- **Deep, open water** (north of the mouth of the Coeur d'Alene River)

Management goals for the nearshore zone primarily involve implementation of best management practices to control erosion from watersheds that feed the lake. Residential and municipal sewer systems will also be addressed to reduce nutrient loadings entering the lake from these sources.

In the shallow, southern lake, best management practices would also be employed to reduce sediments entering the lake through erosion from littoral areas of the lake, riverbanks, and watersheds. Where necessary, municipal water treatment plants would be upgraded to reduce nutrient contributions to the lake. Establishment of "no wake" zones was suggested in the Lake Management Plan for erosional stream banks.

The principal focus of the Lake Management Plan in the lower Coeur d'Alene River is to reduce riverbank erosion. This would be accomplished through bank stabilization.

In the deep, open water zone, management practices to improve water and sediment quality would primarily be those employed in the other three zones. Deep waters in the lake would be a beneficiary of actions taken to reduce erosion and nutrient loading from within the Basin.

9.4 SPOKANE RIVER

Five alternatives have been developed for the Spokane River upstream of the Spokane Indian Reservation. These are:

- Alternative 1—No Action
- Alternative 2—Institutional Controls
- Alternative 3—Containment with Limited Removal and Disposal

- Alternative 4—More Extensive Removal, Disposal, and Treatment
- Alternative 5—Maximum Removal and Disposal

The State of Idaho and the Mining Companies did not develop cleanup plans for the Spokane River.

Alternatives for the Spokane River address both human health and ecological protection and were developed based on specific input from the State of Washington. The scope of the alternatives is limited to sites from the Washington/Idaho border downstream to Upriver Dam. The Washington State Department of Ecology, EPA, the Spokane Tribe, and the U.S. Department of Interior are continuing to evaluate the river downstream of Upriver Dam, and the need for actions in these areas will be considered in the future.

Alternative 1—No Action

Alternative 1 includes no actions to control exposures of humans and ecological receptors to contaminants. Risks to humans, fish and other aquatic receptors, birds, and terrestrial receptors would continue to exist for the foreseeable future.

Alternative 2—Institutional Controls

Institutional controls would include the maintenance of the existing health postings and advisories at beaches and restriction of vehicular access at certain key locations. Although pedestrian access to the sites would not be restricted, the postings and advisories may encourage some individuals to reduce their exposure to the contaminated deposits. Restricting vehicular access would help reduce erosion of the contaminated deposits and allow vegetation to naturally re-establish.

Alternative 3—Containment with Limited Removal and Disposal

Alternative 3 includes actions focused on addressing potential human health risks. Containment actions, supplemented by removals where necessary, would be used to reduce or eliminate the direct contact and ingestion human health exposure pathways. Beach material posing potential human health risks would generally be left in place and covered with a clean layer of imported beach material. In locations where habitat may be adversely affected by the grade changes created by a cover, other actions such as excavation and disposal, or excavation and on-site consolidation, would be used. In these areas, the excavated areas would be backfilled with suitable material to restore desired grades and elevations. In-stream sediments would receive no action under Alternative 3.

Alternative 4—More Extensive Removal, Disposal, and Containment

Alternative 4 includes actions to address potential human health risks and ecological risks. Actions for beach and bank deposits would include all areas addressed under Alternative 3, as well as critical habitat areas that may pose significant ecological risks. The affected beach and bank materials would be excavated and disposed of off-site, permanently eliminating the human health and ecological exposure pathways of concern. All excavated areas would be backfilled with suitable material, to restore desired grades and elevations. In-stream sediments (behind Upriver Dam) exceeding PRGs would be capped to minimize direct ecological exposures.

Alternative 5—Maximum Removal and Disposal

Alternative 5 includes more extensive beach and in-stream sediment cleanup actions to remove, where practicable, all materials posing significant human health or ecological risks. The affected beach and bank materials would be excavated and disposed of off-site, permanently eliminating the human health and ecological exposure pathways of concern. All excavated areas would be backfilled with suitable material, to restore desired grades and elevations. In-stream sediments behind Upriver Dam that exceed PRGs would be dredged and disposed of off-site, eliminating the ecological exposures of concern.

Table 9.2-1
Summary of Ecological Alternatives Developed for the Upper and Lower Basins

Source/Area	Alternative 2 Contain/Stabilize with Limited Removal and Treatment	Alternative 3 More Extensive Removal, Disposal, and Treatment	Alternative 4 Maximum Removal, Disposal, and Treatment	Alternative 5 State of Idaho Cleanup Plan	Alternative 6 Mining Companies Cleanup Plan
Upper Basin					
Floodplain Sediment	Removals of tailings-impacted deposits in the current 100-year floodplain (excluding in-stream deposits) with disposal in local repositories; bank and stream stabilization using bioengineering methods	Same as Alternative 2 plus removal of accessible tailings-impacted deposits on the channel-side of I-90, with disposal in regional repositories;[a] selected areas of hydraulic isolation with treatment of groundwater in a regional water treatment plant;[b] and passive treatment of Canyon Creek surface water[d]	Same as Alternative 3 but with maximum removal of tailings-impacted deposits and maximum use of hydraulic isolation with treatment of groundwater at a regional water treatment plant[c]	Selected removals from the 100-year floodplain, with capping; bioengineering and vegetative stabilization of selected stream banks and floodplains; selected use of riprap.	Limited removals; bank and stream stabilization using bioengineering methods
Tailings Piles/ Impoundments	Regrading and capping in place, as practical; otherwise, removal with disposal in on site or local repositories. Hydraulic isolation used for the Hecla-Star tailings impoundments in Canyon Creek	Similar to Alternative 2 but greater use of removals with disposal in on-site, local, or regional repositories; and greater use of hydraulic isolation	Maximum excavation and use of regional repositories	Removal from the 100-year floodplain with disposal in local or regional repositories; in-place closure of existing impoundments	Soil cover in place; limited removal (Hecla-Star complex at Burke) with disposal in an offsite repository

Table 9.2-1 (Continued)
Summary of Ecological Alternatives Developed for the Upper and Lower Basins

Source/Area	Alternative 2 Contain/Stabilize with Limited Removal and Treatment	Alternative 3 More Extensive Removal, Disposal, and Treatment	Alternative 4 Maximum Removal, Disposal, and Treatment	Alternative 5 State of Idaho Cleanup Plan	Alternative 6 Mining Companies Cleanup Plan
Upper Basin (Continued)					
Waste Rock Piles	Within the 100-year floodplain, in-place regrading and capping, as practical, or removal; no action otherwise	Similar to Alternative 2 but with more removal and less regrading	Removal from the 100-yr floodplain with disposal in regional repositories; regrading and vegetative cover otherwise.	Regrading or relocation out of the 100-year floodplain, with selected capping	Removal from the 100-yr floodplain; no action otherwise
Adits	Major load sources—Treatment using passive, on-site technologies Minor load sources—No action	Major Load Sources—Collection and conveyance to a regional water treatment plant Minor Load Sources—Treatment using passive, on-site technologies	Major load sources—Same as Alternative 3, but applied to more adits Minor load sources—Same as Alternative 3, but applied to more adits	Major load sources (14 total)—Treatment using passive, on-site technologies Minor load sources—No action	Major load sources—Infiltration and water level control followed by wetland treatment if necessary Minor load sources—No action
Lower Basin					
River Banks and Levees	Partial removal of contaminated “bank wedges” with disposal in a regional repository at Cataldo/Mission Flats	Complete removal of contaminated “bank wedges;” disposal in a regional repository at Cataldo/Mission Flats or consolidation using CAD (confined aquatic disposal) in one or more of the lateral lakes	Same as Alternative 3	Partial removal and stabilization by grading and bioengineering. Implementation of a river management plan to prevent unacceptable erosion of the banks.	Revegetation, bioengineering, and limited removals based on susceptibility of banks to erosion.

Table 9.2-1 (Continued)
Summary of Ecological Alternatives Developed for the Upper and Lower Basins

Source/Area	Alternative 2 Contain/Stabilize with Limited Removal and Treatment	Alternative 3 More Extensive Removal, Disposal, and Treatment	Alternative 4 Maximum Removal, Disposal, and Treatment	Alternative 5 State of Idaho Cleanup Plan	Alternative 6 Mining Companies Cleanup Plan
Lower Basin (Continued)					
River Bed	No action	Complete removal of affected sediments; same disposal options as for river banks and levees	Same as Alternative 3	Partial removal and disposal of contaminated sediments to eliminate hot spots and create hydraulic capacity as needed.	No action
Wetlands	Strobl Marsh and Thompson Marsh—Limited removals, capping and protective dikes to control potential re-contamination from flood events	Strobl Marsh, Campbell Marsh, Orling Slough, Hidden Marsh, Moffit Slough, Thompson Marsh, Lane Marsh, and wetland areas of Thompson, Killarney, Swan, and Medicine Lakes—Sediment removal; same disposal options as for river removals; revegetation with native plants and soil amendments	Maximum sediment removal; revegetation with native plants and soil amendments; disposal same as for Alternative 3	Spot removals, capping and/or chemical treatments and re-vegetation in areas with high lead concentrations and high use by water fowl, including within or surrounding Orling Slough, Strobl Marsh, Lane Marsh (including seven splay areas), Hidden Marsh, Campbell Marsh, Thompson Marsh, Moffit Slough; Medicine Lake, Swan Lake, and Thompson Lake.	Habitat shifting techniques, and consideration of selective in situ chemical stabilization and/or capping with biosolid material of some of the most lead-enriched sediments

Table 9.2-1 (Continued)
Summary of Ecological Alternatives Developed for the Upper and Lower Basins

Source/Area	Alternative 2 Contain/Stabilize with Limited Removal and Treatment	Alternative 3 More Extensive Removal, Disposal, and Treatment	Alternative 4 Maximum Removal, Disposal, and Treatment	Alternative 5 State of Idaho Cleanup Plan	Alternative 6 Mining Companies Cleanup Plan
Lower Basin (Continued)					
Lateral Lakes	Thompson Lake—Dredging from the shore to a water depth of approximately 6 feet with disposal in a repository adjacent to the lake	Thompson, Killarney, Swan, and Medicine Lakes—Dredging from the shore to water depths of about six feet; same disposal options as for river removals	Maximum dredging; disposal same as for Alternative 3	Included with wetlands	Similar to wetlands
Other Floodplain Areas	Soil amendments to promote vegetation for erosion control and chemical stabilization to reduce metal availability to ecological receptors and transport to surface water	Sediment removal; disposal in a local repository at Cataldo/Mission Flats; revegetation with native plants and soil amendments	Same as wetlands	Soil treatment and re-vegetation for highly contaminated areas	Similar to wetlands
Cataldo/Mission Flats	Hydraulic isolation (using a groundwater cutoff wall with a reactive barrier for passive in situ treatment of groundwater); surface water diversion structures, as needed; amend soils to provide a suitable growth medium combined with planting of suitable vegetation. Construction of an engineered repository for disposal of river bank, levee, and wetland removals.	Same as Alternative 2 except treatment of groundwater at a regional water treatment plant	Removal and disposal in an on-site regional repository	Groundwater cutoff walls; spot removals, soil treatment and re-vegetation	No action

Table 9.2-1 (Continued)
Summary of Ecological Alternatives Developed for the Upper and Lower Basins

[a] Regional repositories in Canyon Creek, Ninemile Creek, and along the South Fork Coeur d'Alene River, in addition to the Lower Basin
[b] Active water treatment assumes high-density sludge hydroxide precipitation with media filtration, processes that are similar to what is being used for the BHSS Central Treatment Plant. It is assumed that the regional treatment plant would be located near Pinehurst. Pipelines would be used in Canyon Creek, Ninemile Creek, and the South Fork Coeur d'Alene River to transport collected adit discharge and groundwater to the regional treatment plant. Collected groundwater from the Cataldo/Mission Flats dredge disposal area would be pumped to the regional treatment plant.
[c] One plant located near Pinehurst as for Alternative 3
[d] Passive treatment of surface water diverted from lower Canyon Creek. Assumed capacity of 60 cfs, and flows greater than 60 cfs would be bypassed.

Table 9.2-2
Descriptions of Typical Conceptual Designs (TCDs) Used with Alternatives 2, 3, and 4

TCD	Purpose	Application Criteria
Excavation	Removal of materials from areas where they are subject to erosion or leaching.	Tailings, waste rock mixtures, contaminated floodplain sediments, and waste rock piles that are potentially erodable or significant sources of metals loading.
Regrade/Consolidate/ Vegetative Cover	Isolate waste from human or ecological contact Decrease potential for erosion of waste Doesn't significantly decrease infiltration	Erodable or otherwise unstable waste rock piles without significant leaching potential under Alts 2 and 3. Waste rock with minimal leaching potential under Alt 4.
Low Permeability Cap	Significantly reduce infiltration	Contaminated sediments, tailings, waste rock and waste rock/tailings mixtures that are potentially significant sources of metals loading under Alt 2. Waste rock and waste rock/tailings mixtures that are not potential significant sources of metals loading under Alts 3 and 4.
Low Permeability Cap with Erosion Protection	Significantly reduce infiltration + minimize erosion of waste below the nominal 100-year flood level at sites where relocation above the flood level could not be implemented due to steep ground slopes.	Waste rock or waste rock/tailings mixtures that are not significant sources of metal loading under Alt 2. Waste rock piles subject to erosion that are remotely located or relatively small sources of metals loading under Alt 3. Would not be used under Alt 4.
Local Repository Above Flood Level	Provide a relatively high degree of protectiveness for wastes that are potentially significant sources of metals loading.	Used for contaminated sediments, tailings, and tailings/waste rock mixtures under Alt 2. Used for tailings and tailings/waste rock mixtures under Alt 3. Used for waste rock with erosion or leaching potential under Alt 4.
Regional Repository	Provide the highest level of protection among the containment TCDs.	Used for tailings and contaminated sediments under Alt 3. More general use under Alt 4, including all tailings, all tailings/waste rock mixtures that are potentially significant sources of metals loading, all floodplain sediments containing levels of metals above PRGs, and all tailings currently contained in abandoned tailings impoundments. May also be used for some lower-level wastes where it is the most cost effective TCD.
Tailings Impoundment Closure	To address the closure of abandoned tailings impoundments or cells under Alternatives 2 and 3.	All abandoned tailings impoundments and cells under Alts 2 and 3.

Table 9.2-2 (Continued)
Descriptions of Typical Conceptual Designs (TCDs) Used with Alternatives 2, 3, and 4

TCD	Purpose	Application Criteria
Hydraulic Isolation Using Slurry Wall	To minimize the discharge of contaminated groundwater to the surface water system, thereby reducing the dissolved metals loading to the surface water system.	Areas where metals impacts to groundwater are not controlled by removal and containment of source materials under Alts 3 and 4.
Hydroxide Precipitation with Media Filtration	To remove heavy metals from an aqueous stream using active treatment.	Active treatment used to provide relatively high metals removal rates and treatment reliability for water containing high metals loads. It would also be used for treating flow rates in excess of those that could practically be treated using passive treatment. Active treatment used under Alts. 3 and 4 for adits identified as major loaders, leachate from regional repositories, and contaminated groundwater.
Permeable Reactive Barrier	To remove metals through adsorption/precipitation reactions using apatite or another chemical reagent within a permeable reactive barrier or treatment bed. Typically for oxidizing or low iron conditions.	Generally applicable for lower flow volumes such as drainage from adits, seeps, leachate from repositories, and runoff from waste piles. Used under Alt 2 for adits identified as major loaders. Used under Alts 3 and 4 for adits not identified as major loaders, but discharging metals at levels of concern. Potentially used for leachate from repositories and contaminated groundwater under Alternatives 3 and 4.
Passive Treatment Pond	To remove metals from surface water using passive treatment	Used to treat moderate to high surface water flow rates under Alternative 3. Storm flows would typically not be treated. Used where source-by-source treatment is very costly and/or difficult to implement.
Current Deflector	Directs stream energy away from erodable areas, or uses series of deflectors to dissipate stream energy. Creates scour holes, pools and other habitat features. May be oriented to serve as sediment traps.	Apply throughout Upper Basin where stream bank and bedload stabilization, and dissipation of stream energy is desirable.
Bank Stabilization Using Bioengineered Revetments	Protects eroding streambanks or rehabilitates banks after excavation.	Applicable in low to high energy stream environments in Upper Basin
Vegetative Bank Stabilization	Stabilizes eroding streambanks or reconstructs them after excavation and removal of bank material. Rock toe prevents undermining.	Applicable in low energy stream environments in Upper Basin and Lower Basin. May be used in higher-energy stream environments in conjunction with current deflectors.

Table 9.2-2 (Continued)
Descriptions of Typical Conceptual Designs (TCDs) Used with Alternatives 2, 3, and 4

TCD	Purpose	Application Criteria
Floodplain/Riparian Planting	Stabilize exposed floodplains, or floodplains disturbed by remedial activities.	Applicable in floodplain areas in the Upper Basin and Lower Basin.
Off-Channel Hydrologic Features	Attenuate stream energy during high flow periods; improve habitat for aquatic and riparian species.	Applicable in floodplain areas in Upper Basin where extensive remedial excavation occurs.
Channel Realignment	Alter stream channel to form a more stable morphology	Primarily applicable in lower-gradient stream reaches in the Upper Basin.
Soil Amendment	Modify surface soil so that it will support vegetative growth by using nutrients and other amendments.	Apply in non-wetland floodplain areas such as existing or historical agricultural and grazing lands.
Subaqueous Disposal	Contain dredge spoils in an area where they are isolated from the environment and from potential receptors including fish and diving waterfowl.	Applicable to lacustrine sediments and potentially to wetland sediments. Need sufficient water depth and area for volume of dredge spoils and sufficient material for a clean cap. Need community acceptance of subaqueous disposal as an option.
Dredge and Barge	Remove contaminated sediment from lacustrine and palustrine environments and transport the material to a disposal facility.	Dredging is applicable to sediment with concentrations exceeding an action level in locations that are accessible to dredging equipment. This TCD could be applied to all sediment or to a subset such as sediments within a depth window accessed by diving waterfowl.
Dredge and Pipeline	Same as above	Same as above (dredging). Selection of conveyance equipment would be based on economic and material availability and suitability to a particular site.
Sediment Trap	Remove contaminated bedload and suspended load from the river to prevent it from spreading to downstream locations.	Applicable to areas where the river has historically left its banks. Used to collect sediment in a controlled manner before it spreads over the floodplain.
Hydraulic Control Structure	Control flow of water and sediments between the river and adjacent lakes and wetland areas.	Applicable to existing or proposed connections between the river and adjacent water bodies where water flow or sediment transport could lead to re-contamination prior to complete source control in upstream source areas.
Local Repository (Lower Basin)	Contain dredge spoils in an area where they are isolated from the environment and from potential receptors including fish and diving waterfowl.	Applicable to lacustrine sediments and potentially to wetland sediments. Need sufficient water depth and area for volume of dredge spoils and sufficient material for a clean cap. Need community acceptance of subaqueous disposal as an option.

Table 9.2-2 (Continued)
Descriptions of Typical Conceptual Designs (TCDs) Used with Alternatives 2, 3, and 4

TCD	Purpose	Application Criteria
Dike/Levee Enhancement	To heighten a levee system to protect back-levee areas from flooding.	Applicable prior to source control to protect back-levee areas. Applicable when the existing levee, if any, is too low, or where no levee exists.
Wetland Cap	To isolate contaminated materials in place.	Applicable to wetland or floodplain areas where installing a cap provides a sufficient level of protectiveness and leaching of contaminants to groundwater is not a significant concern. Applicable in relatively quiescent areas that are protected from recontamination.

Table 9.2-3
Summary of Estimated Unit Costs for Removal, Containment, and Treatment TCDs
Alternatives 2, 3, and 4

TCD	Description	Unit	Direct Capital Costs	Indirect Capital Costs	Annual O&M Costs
Removal and Containment TCDs					
C1	Excavation	CY	$2.70	$1.60	$0
C1a	Excavation Below Water Table	CY	$26.00	$16.00	$0
C1b	Sediment Excavation	CY	$10.00	$6.00	$0
C2a	Regrade/Consolidate/Revegetate	AC	$56,000	$34,000	$565
C2b	Regrade/Consolidate/Revegetate	AC	$110,000	$66,000	$1,100
C2c	Erosion Protection	AC	$11,000	$6,600	$200
C3	Low Permeability GCL Cap	AC	$151,000	$91,000	$1,500
C4	Low Permeability GCL Cap w/Seepage Coll & Trmt	AC	$170,000	$100,000	$3,100
C5	Low Permeability GCL Cap w/Erosion Protection	AC	$170,000	$100,000	$3,100
C6*	Local Repository w/Erosion Protection	CY	$10.40	$6.20	$0.19
C7*	Local Repository Above Flood Level	CY	$9.70	$5.80	$0.18
C8a*	Regional Repository, 1 million cy	CY	$13.10	$7.90	$0.24
C8b*	Regional Repository, 10 million cy	CY	$7.70	$4.60	$0.11
C8c*	Regional Repository, 50 million cy	CY	$6.20	$3.70	$0.07
C9	Tailings Impoundment Closure	AC	$170,000	$100,000	$2,700
C10	Adit Drainage Collection	LS	$6,200	$3,700	$88
C11	Hydraulic Isolation Using Slurry Wall	LF	$280	$168	$9
C12	Hydraulic Isolation Using Lined Channel	LF	$500	$300	$16.10
OTHER					
HAUL-1	Haul to Repository	CY-MI	$0.89	$0.53	$0
ACC-1	Temporary Access Road	MI	$200,000	$120,000	Assume road will not be maintained.
Active Treatment TCDs					
CONVEYANCE					
PIPE-1	Conveyance Pipeline-6”	LF	$39	$23.00	$0.24
PIPE-2	Conveyance Pipeline-12”	LF	$58	$35	$0.35
PIPE-3	Conveyance Pipeline-24”	LF	$94	$56	$0.57
PIPE-4	HDPE Conveyance Pipeline Cost Factor, $/dia- in.	DIA IN	$5.10	$3.10	$0.03
PRIMARY ACTIVE TREATMENT: HIGH DENSITY SLUDGE HYDROXIDE PRECIPITATION					
Variations with Media Filtration					
TRMT-1a	5,000 gpm	GPM	$2,180	$1,640	$352
TRMT-1b	45,000 gpm	GPM	$1,190	$893	$192
TRMT-2a	w/Sulfide Feed - 5,000 gpm	GPM	$2,270	$1,700	$366
TRMT-2b	w/Sulfide Feed - 45,000 gpm	GPM	$1,230	$923	$198
Variations with Microfiltration					
TRMT-3a	5,000 gpm	GPM	$3,550	$2,660	$573
TRMT-3b	45,000 gpm	GPM	$2,580	$1,940	$416
TRMT-4a	w/Sulfide Feed - 5,000 gpm	GPM	$3,650	$2,740	$589
TRMT-4b	w/Sulfide Feed - 45,000 gpm	GPM	$2,620	$1,970	$423

Table 9.2-3 (Continued)
Summary of Estimated Unit Costs for Removal, Containment, and Treatment TCDs
Alternatives 2, 3, and 4

TCD	Description	Unit	Direct Capital Costs	Indirect Capital Costs	Annual O&M Costs
Passive and In-Situ Treatment TCDs					
PASSIVE TREATMENT					
PT-1a	Permeable Reactive Trench w/Apatite	CY	$440	$264	$213
PT-1b	Permeable Reactive Trench w/Organic Mixture	CY	$51	$31	$45
PT-2a	Permeable Reactive Bed w/Apatite	CY	$530	$318	$256
PT-2b	Permeable Reactive Bed w/Organic Mixture	CY	$53	$32	$47
PT-3	Aerobic Wetland	MSF	$2,700	$1,600	$436
PT-4	Anaerobic Wetland	MSF	$7,700	$4,600	$5,800
IN-SITU TREATMENT					
PT-5a	Shallow Soil Mixing	CY	$12	$7.20	$0.20
PT-5b	Deep Soil Mixing w/Deep Tiller	CY	$16	$9.60	$0.30
PT-5c	Deep Soil Mixing w/Excavator	CY	$22	$13	$0.40
PT-5d	Deep Soil Mixing w/Auger	CY	$52	$31	$1.10
PT-6a	Underwater Applied with Barge	MSF	$840	$504	$16.90
PT-6b	Underwater Applied with Spreader or Diffuser	MSF	$850	$510	$17
PT-6c	Underwater Applied w/ Spray Equipment from Shore	MSF	$820	$492	$16.50
Human Health TCDs					
HH1	Access Restrictions (Fence)	LF	$25	$15	$0.20
HH2	Upland Waste Pile Soil Cover	AC	$43,000	$26,000	$433
HH3	Millsite Decontamination	LS	$100,000	$60,000	$403
HH4	Millsite Demolition/Disposal	CY	$120	$72	$1.20

* Does not include haul costs

Notes:
AC - acre
CY - cubic yard
CY-MI - cubic yard - mile
DIA INCH - diameter inch
EA - each
GPM - gallons per minute
LF - linear foot
LS - lump sum
MI - mile
MSF - thousand square feet
TCD - typical conceptual design

Table 9.2-4
Summary of Estimated Bioengineering TCD Unit Costs, Alternatives 2, 3, and 4

Unit Price Code/TCD	Description	Unit	Direct Capital Costs	Indirect Capital Costs	Annual O&M Costs
Current Deflectors					
CD-1	Current Deflector-Groynes (Spur Dikes, Spurs)	EA	$1,330	$798	$31
CD-2	Current Deflector-Bank Deflector with Root Wad	EA	$1,160	$696	$28
CD-3	Current Deflector-Riprap Groynes	EA	$1,260	$756	$31
CD-4	Current Deflector-Log Weir & Dam Structure	EA	$1,850	$1,100	$45
CD-5	Current Deflector-Angled Vortex Rock Weir w/Rootwads	EA	$1,260	$756	$31
CD-6	Current Deflector-Riprap Turning Rock Wall	EA	$1,470	$882	$36
CD-7	Current Deflector-Riprap Tieback	EA	$1,350	$810	$33
CD-Avg	Current Deflector Average Cost	EA	$1,380	$828	$33
Vegetative Bank Stabilization					
VBS-1	Brush Mattress w/Rock Toe	LF	$37	$22	$0.90
VBS-2	Brush Layer	LF	$19	$11	$0.50
VBS-3	Live Stake, Live Post & Joint Planted Fascines	LF	$53	$32	$1.30
VBS-Avg	Category Average	LF	$36	$22	$0.88
Bank Stabilization Using Bioengineered Revetments					
BSBR-1	Vegetated Geogrid	LF	$75	$45	$1.90
BSBR-2	Live Cribwall	LF	$140	$84	$3.40
BSBR-3	Low Energy Tree Revetment	LF	$41	$25	$0.99
BSBR-4	Moderate Energy Tree Revetment	LF	$70	$42	$1.70
BSBR-5	Tree Deflector	LF	$62	$37	$1.50
BSBR-6	Woody Debris & Vegetated Geogrid System	LF	$110	$66	$2.70
BSRB-Avg	Category Average	LF	$80	$50	$1.90
Floodplain/Riparian Planting					
FP/RP-1	Floodplain/Riparian Planting	SF	$0.39	$0.20	$0.01
FP/RP-2	Floodplain Planting	SF	$1.49	$0.89	$0.02
FP/RP-Avg	Category Average	SF	$0.94	$0.56	$0.01
Off-Channel Hydrologic Features					
OFFCH-1	Groundwater-Fed Side Channel	SY	$17	$10	$0.20
OFFCH-2	Surface-Fed Side Channel	SY	$29	$17	$0.40
OFFCH-3	Off-Channel Pond	SY	$42	$25	$0.59
OFFCH-Avg	Category Average	SY	$29	$17	$0.40
Channel Realignment					
CH REAL-1	Channel Realignment	SY	$29	$17	$0.40

Notes:
EA - each
LF - linear foot
SF - square foot
SY - square yard
TCD - typical conceptual design

Table 9.2-5
Summary of Estimated Unit Costs for Lower Basin TCDs, Alternatives 2, 3, and 4

Unit Price Code/TCD	Description	Unit	Total Unit Cost	Annual O&M Costs
LB-1	Excavate Coeur d'Alene River banks (barge-based excavator)	CY	$ 4.92	0
LB-2	Soil amendment	AC	$ 1,636	$23
LB-3a	Subaqueous disposal in lateral lake	CY	$ 5.23	$0.32
LB-3b	Subaqueous disposal in Coeur d'Alene Lake	CY	$ 6.20	$0.38
LB-4a	Dredge and barge	CY	$ 8.81	0
LB-4b	Dredge and pipeline	CY	$ 7.59	0
LB-5	Sediment trap	EA	$ 270,000	$109,000
LB-6	Hydraulic control structure	EA	$ 57,200	$920
LB-7a	Dike/levee construction	LF	$ 151	$2.40
LB-7b	Dike/levee enhancement	LF	$ 97	$1.60
LB-8	Wetland cap	CY	$ 8.02	$0.13
LB-9	Local repository	CY	$ 6.96	$0.42

Notes:
AC - acre
CY - cubic yard
EA - each
LF - linear foot
TCD - typical conceptual design

Table 9.2-6
Description of Alternative 5 (State Of Idaho) TCDs and Estimated Unit Costs

DEQ Design	Action	Estimated Unit Costs [a]			Assumptions
		Direct Capital Costs	Indirect Costs	Annual O&M Costs	
1	Excavate waste and dispose locally	$8.50/cy	$5.10	$0	Consists of $3.50/cy for excavation of dry materials and $5/cy for a 1-hr rt haul.
2	Excavate waste or soil and dispose in region landfill	$18.50/cy	$11	$0	Consists of $3.50/cy for excavation of dry materials and $15/cy for a 3-hr rt haul.
3	Excavate stream sediments or banks and dispose	$19.50/cy	$12	$0	Consists of $3.50/cy for excavation of wet materials and $15/cy for a 3-hr rt haul plus $1/cy for access improvements and dewatering or water controls.
4	General grading	$2/cy	$1.20	$0.02	Assumes regrade an average 3' depth over area.
5	Relocate	$6/cy	$3.60	$0.06	Consists of moving waste from drainages onto high ground, soil cover, rip-rap toe protection and stream stabilization.
6	Toe stabilization	$50 lf	$30	$0.91	Assumes rip-rap 10' up slope w/ 3' diameter rock.
7	Cap - general	$16.50/cy	$9.90	$0.17	Includes $15/cy delivered material and $1.50/cy for spreading and grading.
8	Cap - low permeability	$20.50/cy	$12	$0.21	Includes $18.50/cy delivered material and $2.50/cy for spreading, grading and compacting.
9	Cap - geocover system	$45,000	$27,000	$820	Consists of 6" subgrade @ $2/cy, geosynthetic liner @ $3/sy, 12" drain layer @ $6/cy, surface water control @ $0.25/sy, and soil and vegetation @ $11/cy.
10	Upland vegetation	$5,000/ac	$3,000	$50	Mechanical planting for erosion control.
11	Wetland vegetation	$11,000/ac	$6,600	$160	Hand/mechanical planting for stabilization, biofiltration and habitat.
12	Streamwork - Riprap	$13/lf	$7.80	$0.21	Assumes 3' up the slope or river bank if for erosion control. In-stream rock structures for habitat improvement.
13	Bioengineering streambanks	$40/lf	$24	$0.97	Includes a combination of plantings, soil wraps, root wads, matting, rip-rap, sills, barbs and other hydraulic features @ $30/lf plus streambank preparation @ $10/lf.
14	Excavate river bed, bank wedges and floodplain by barge	$50/cy	$30	$0.81	Consists of excavation from a barge @ $30/cy, dewatering and access improvements @ $2/cy and a three hours haul @ $18/cy. Wedges assumed as 1 cy/lf.

Table 9.2-6 (Continued)
Description of Alternative 5 (State of Idaho) TCDs and Estimated Unit Costs

DEQ Design	Action	Estimated Unit Costs [a]			Assumptions
		Direct Capital Costs	Indirect Costs	Annual O&M Costs	
15	Bioengineering streambank wedge after excavation	$30/lf	$18	$0.73	Includes a combination of plantings, soil wraps, root wads, matting, rip-rap, sills, barbs and other hydraulic features. Assumes that excavation prepared banks.
16	Bioengineering streambank w/o excavation	$60/lf	$36	$1.50	Includes grading of banks @ $30/lf plus a combination of plantings, soil wraps, root wads, matting, rip-rap, sills, barbs and other hydraulic features @ $30/lf. Assumes difficult access or access by barge.
17	Adit Closure	$62,000	$37,000	$880	Includes gate or barrier and water collection and conveyance system.
18	Adit Water Treatment	$1,000,000	$600,000	$60,000	Unit cost is based upon bid specifications for the Success treatment project and scaled up to a 1cfs adit discharge.
19	Groundwater Cutoff	$150/lf	$90	$4.80	Unit cost is EPA's estimate for LB-3C.
20	Soil Amendment	$20,000/ac	$12,000	$400	Unit cost is based upon EPA's estimate of $1,600/cy assuming mixing of the top one foot.
21	Subaqueous Capping/Treatment	$37,000/ac	$22,000	$750	Equivalent to EPA's $850/1,000 sf. Capping material may include soil, biosolids, or chemical amendment
22	Mill Site Demolition	$250,000	$150,000	$2,500	Based upon Bunker Hill industrial complex demolition costs for buildings. Costs for minor structures such as crib walls are some fraction.
23	Repository Construction	$5.50/cy	$3.30	$0.10	Generally equivalent to EPA's 1,000,000 cy repository but with only a single liner system and cover. DEQ includes a passive treatment to immobilize metals in leachate during dewatering. Hauling material to repository is included in DEQ excavation unit costs. Construction of access road included in DEQ infrastructure allowance.

[a] The State of Idaho was a source of the estimated direct capital costs.

Table 9.2-7
Alternative 6 (Mining Companies) TCDs and Estimated Unit Costs

TCD	Description	Direct Capital Unit Cost[a]	Indirect Cost[a]	Annual O&M Cost
PRP01	General Grading	$10,400/acre	$6,250	$100
PRP02	Slope Regrade	$10.30/cy	$6.20	$0.10
PRP03	Toe Pullback at Stream	$210/lf	$130	$2.10
PRP04	Capping	$67,000/acre	$40,000	$680
PRP05	Revegetation	$2,000/acre	$1,200	$2
PRP06	Material Removal and Disposal at Repository	$18/cy	$10.80	$4.10
PRP07	Stream Cleanout/Disposal at Repository	$89/lf	$53	$20
PRP08	Stream Stabilization	$36/lf	$22	$0.73
PRP09	Adit Source Control	$1,100,000/ea	$660,000	$13,000
PRP10	Adit Discharge Drain Piping	$38/lf	$23	$0.23
PRP11	Block Access	$9,100/ea	$5,500	$130
PRP12	Treatment Wetland Construction	$3,900/gpm	$2,300	$240
PRP13	Riparian enhancement	$5/lf	$3	$0.12
PRP14	Bioengineering BMPs	$42/lf	$25	$1.00
PRP15	Tailings removal	$58/lf	$35	$1.40
PRP16	Streambank actions	$53/lf	$32	$1.30

[a] The mining companies were the source of estimated direct capital costs.

Table 9.2-8
Summary of Basin Source Quantities Addressed by Alternative

Area/Source Type	Units	Total Quantity	Quantity of Source Material Addressed, by Upper Basin and Lower Basin Ecological Alternative				
			2	3	4	5	6
Upper Basin							
Floodplain Sediments[a]	cy	7,100,000	2,000,000	5,700,000	7,100,000	195,000	170,000
Tailings[b]	cy	11,000,000	3,800,000	8,600,000	9,300,000	2,800,000	3,500,000
Waste Rock[c]	cy	11,700,000	5,600,000	7,000,000	9,800,000	2,500,000	5,300,000
Adit Drainage[d]	#Zn/d	101	89	101	101	94	65
Lower Basin							
River bed Sediments[e]	cy	20,600,000	0	20,600,000	20,600,000	350,000	0
Bank Wedges[e]	cy	1,780,000	610,000	1,780,000	1,780,000	180,000	27,000
Wetland Sediments[e]	cy	5,900,000	480,000	2,000,000	5,900,000	240,000	0
Lateral Lake Sediments[e]	cy	5,900,000	67,000	570,000	5,900,000	94,000	0
Floodplain Sediments[e]	cy	10,200,000	430,000	2,300,000	10,200,000	2,300,000	0
Cataldo/Mission Flats Dredge Spoils	cy	13,600,000	10,900,000	10,900,000	10,900,000	10,900,000	25,000
Spokane River[f]			**Quantity of Source Material Addressed, by Spokane River Alternative**				
			2	**3**	**4**	**5**	**Not used**
Beach/Bank Deposits and In-Stream Sediments	cy	260,000	0	20,000	110,000	260,000	

[a]Sediment total volume does not include either less-impacted, generally deeper and more dispersed sediments that are potential source of zinc loading or impacted materials within fills or embankments (e.g., I-90 and UPRR rights-of-way); these additional sediment volumes may be as high as approximately 20,000,000 cy.
[b]Tailings volumes include unimpounded tailings and impounded tailings in both inactive and active facilities.
[c]Waste rock volumes include waste rock in floodplains and uplands, as well as waste rock at active facilities.
[d]Data used to calculate average zinc loading are available for only 53 of 114 discharging adits in the upper basin. Although data are available for the largest loaders, the cumulative average zinc load from all discharging adits may exceed the amount shown in this table.
[e]Volumes estimates for all impacted media in the lower basin, CSM Unit 3, are based on lead concentrations exceeding 1,000 mg/kg. Additional volumes of impacted sediments that are potential sources of zinc loading are not included in these estimates.
[f]The study area for the Spokane River ecological alternatives is limited to selected sites identified by the Washington State Department of Ecology between the Washington-Idaho state line and Upriver Dam.

Notes:
This is a condensed summary with approximate quantities—for a detailed accounting of sources and remedial actions see the FS Part 3, Sections 5 and 6 and appendices as referenced therein. Quantities of source materials within the BHSS are not included in this table.
Quantities of source material potentially addressed by institutional controls (e.g., access restrictions) or bioengineering actions (e.g., floodplain/riparian zone revegetation or bank stabilization) are not included.
Alternative 1 is no action. Alternatives 2 through 6 are integrated alternatives for the Upper Basin and Lower Basin. Alternatives 2 through 5 were developed separately for the Spokane River.
cy - cubic yards #Zn/d - pounds per day of zinc

Table 9.2-9
Lower Basin Contaminated Habitat Area Remediated by Alternative

Wetland Unit	Contaminated Area, Acres[a]				Total Habitat Area Remediated by Alternative, Acres				
	Wetland	Lake	Riparian	Total	2	3	4	5	6
Harrison Slough	40	668	30	738	0	0	738	0	0
Harrison Marsh	58	157	34	249	0	0	249	0	0
Thompson Marsh	59	122	16	197	197	197	197	197	0
Thompson Lake	299	256	25	580	580	580	580	580	0
Anderson Lake	44	505	36	585	0	0	585	0	0
Bare Marsh	160	0	17	177	0	0	177	0	0
Blue Lake	53	316	37	406	0	0	406	0	0
Black Lake	17	368	27	412	0	0	412	0	0
Swan Lake	362	471	205	1,038	0	1,038	1,038	1,038	0
Cave Lake	190	746	116	1,052	0	0	1,052	0	0
Medicine Lake	198	230	83	511	0	511	511	511	0
Blessing Slough	168	0	76	244	0	0	244	0	0
Moffit Slough	114	146	66	326	0	326	326	326	0
Campbell Marsh	173	106	129	408	0	408	408	408	0
Hidden Marsh	418	199	38	655	0	655	655	655	0
Killarney Lake	152	482	42	676	0	676	676	0	0
Strobl Marsh	269	0	77	346	346	346	346	346	0
Lane Marsh	425	0	80	505	0	505	505	505	0
Black Rock Slough	232	201	166	599	0	0	599	0	0
Bull Run	16	106	8	130	0	0	130	0	0
Rose Lake	409	357	135	901	0	0	901	0	0
Porter Slough	126	0	0	126	0	0	126	0	0
Orling Slough	49	52	15	116	0	116	116	116	0
Canyon Marsh	50	25	19	94	0	0	94	0	0
Cataldo Slough	114	314	228	656	0	0	656	0	0
Mission Slough	280	150	108	538	0	0	538	0	0
Whiteman Slough	171	0	32	203	0	0	203	0	0
27 units	4,646	5,979	1,844	12,469	1,123	5,358	12,469	4,682	0

\

[a] Areas of contamination estimated by U.S. Fish and Wildlife Service, Upper Columbia Fish and Wildlife Office (July 2001). Area of contamination defined as that containing lead at a concentration greater than 530 mg/kg, the Lowest Observable Effect Level (LOEL) for waterfowl (Beyer, et al. 2000)

<u>References</u>:

Kern, J.W. 1999. Statistical Model for the Spatial Distribution of Lead Concentration in Surficial Sediments in the Lower Coeur d'Alene River Floodplain with Estimates of Contaminated Soils and Sediments. Draft (August 26, 1999). Prepared for the U.S. Fish and Wildlife Service, Spokane, Washington.

Beyer, W. N., D. J. Audet, G. H. Heinz, D. J. Hoffman, and D. Ray. 2000. Relation of Waterfowl Poisoning to Sediment Lead Concentrations in the Coeur d'Alene River Basin. Ecotox. 9: 207 - 218.

Table 9.2-10
Estimated Effectiveness of the Ecological Alternatives for the Upper Basin and Lower Basin for Reducing Dissolved Metals Loads in the Coeur d'Alene River

Alternative	Estimated Percent Zinc Load Reduction at Completion of Remedy Implementation	
	Pinehurst	Harrison
4	73	64
3	62	57
2	30	26
5	13	12
6	8	9
1	0	0

Note: estimates of dissolved zinc load reductions do not include consideration of loads from the Bunker Hill Box.
Reference: USEPA (2001f). *Probabilistic Analysis of Post-Remediation Metal Loading.*

10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section describes the evaluation of the comprehensive alternatives for protection of human health and the environment using the CERCLA criteria. EPA uses nine criteria to evaluate the remedial alternatives individually and against each other in order to select a remedy. These criteria are shown in Table 10.0-1. The purpose of the comparative analysis is to evaluate the relative performance of the alternative with respect to the nine evaluation criteria so that the advantages and disadvantages of each are clearly understood. The Selected Remedy is described in Section 12.

The results of the comparative analysis are organized in four sections. These are:

- Section 10.1: Human Health in Community and Residential Areas
- Section 10.2: Environmental Protection in the Upper Basin and Lower Basin
- Section 10.3: Coeur d'Alene Lake
- Section 10.4: Spokane River

The results are also summarized in a series of tables. In these tables, each of the alternatives is given a rating (lowest, low, medium, or highest) for each evaluation criterion. The tables also provide the basis for each rating.

the evaluation of the balancing criteria (state and tribe acceptance and community acceptance) for the Preferred Alternative in the Proposed Plan is presented in section 12.7.

10.1 HUMAN HEALTH ALTERNATIVES

Based on the comparative analysis, EPA believes the best balance of tradeoffs is represented by Alternative S4 for soil, Alternative D3 for house dust, Alternative W6 for drinking water, and Alternative F3 for aquatic food sources.

For soil, Alternatives S4 and S5 are the only alternatives believed likely to meet the human health RAOs. Consequently, Alternatives S1, S2, and S3 are not considered adequately protective. The increased implementability, fewer short-term impacts to the community, and lower cost of the partial removals under Alternative S4 outweigh the somewhat greater reduction of residual risk resulting from complete removals under Alternative S5. A summary of the comparison of alternatives for soil is presented in Table 10.1-1.[13]

[13] Costs for soil alternative S4 differ from those presented for the Selected Remedy because the analysis of Alternative S4 in the FS included 10 recreational areas and the Selected Remedy included 31 recreational areas.

For house dust, both Alternatives D2 and D3 are expected to achieve the human health RAOs at most homes where residents participate in the programs. Alternative D1 is not considered protective for risks from house dust. Alternative D3 provides for additional cleaning at some homes where exterior soil remediation, dust mats, and vacuum loan programs do not provide sufficient reductions in exposure to contaminated house dust. The greater reduction in residual risk and greater long-term reliability of extensive cleaning under Alternative D3 outweigh the lower cost of the vacuum loan and dust mat programs under Alternative D2. A summary of the comparison of alternatives for house dust is presented in Table 10.1-2.

For drinking water, Alternatives W3, W4, W5, and W6 are all potentially protective and ARAR-compliant. Alternatives W1 and W2 are not expected to be protective or ARAR-compliant where MCLs are exceeded. Alternative W6 provides the best balance of tradeoffs because the most appropriate technology at each site would be used. Protectiveness and compliance with ARARs could be achieved at all sites, including those where no suitable alternative aquifer exists and connection to a public water source would not be feasible. Where a suitable alternative aquifer does exist or connection to a public water source is feasible, these actions would be taken and would be expected to have greater long-term reliability than point-of-use treatment (Alternative W3). A summary of the comparison of alternatives for drinking water is presented in Table 10.1-3.

For aquatic food sources, Alternative F3 is expected to more effectively limit exposures to metals than Alternatives F1 or F2. The use of monitoring is expected to more reliably identify areas of potential exposures and be more likely to result in reduced consumption of aquatic food sources in areas of exposure. A summary of the comparison of alternatives for aquatic food sources is presented in Table 10.1-4.

10.2 ECOLOGICAL PROTECTION IN THE UPPER BASIN AND LOWER BASIN

Some of the key issues for evaluating the ecological alternatives identified through the comparative analysis using the nine CERCLA criteria are discussed below.

Impacted Sediments

Over 100 million tons of impacted sediments are distributed over thousands of acres in the Upper Basin and Lower Basin. As described in Section 7, the impacted sediments are a major source of metals exposures for ecological receptors, as well as humans engaged in recreation and subsistence practices. Impacted sediments are believed to be the major source of metals loading in the Basin. In the Upper Basin, tailings-impacted floodplain sediments and associated groundwater are the major sources of dissolved metals to the rivers and streams. In the Lower Basin, erosion of river bank and bed sediments is the major source of particulate lead. This particulate lead is a continuing source of contamination for the Coeur d'Alene River, Coeur d'Alene Lake, and the Spokane River. Lead transported in the river system has impacted recreational areas in the Lower Basin and the Spokane River, resulting in posted health advisory signs at beaches and swimming areas. During flood events, lead transported by the river also impacts the wetlands and floodplains. The potential exists for future particulate lead transport and recontamination of recreation and feeding areas cleaned up as part of the Selected Remedy. Therefore, addressing impacted sediments is a key issue for protection of human health and the environment.

Large-scale cleanup of impacted sediments, however, would be difficult and costly, presenting major technical and administrative challenges, as well as significant adverse short-term impacts. Likely impacts to the local communities and natural environment include increased truck traffic, dust and noise generation, potential disruption of services and recreation opportunities, and reduced aesthetic quality. Much of the sediment in the Upper Basin is not considered accessible due to its location beneath I-90 and other infrastructure. Private property ownership issues must also be addressed as a component of cleanup.

The alternatives vary in the degree to which they address the contaminated sediments, with Alternatives 3 and 4 addressing the sediments to a greater degree than Alternatives 1, 2, 5, and 6. As summarized in Table 9.2-9, Alternatives 1 through 6 include cleanup of 0 acres, 1,123 acres, 5,358 acres, 12,469 acres, 4,682 acres, and 0 acres, respectively, of contaminated sediments in wetland, lake, and riparian feeding areas in the Lower Basin. As summarized in Table 9.2-8, Alternatives 1 through 6 include dredging of 0 cy, 0 cy, 20,600,000 cy, 20,600,000 cy, 350,000 cy, and 0 cy, respectively, of river bed sediments, which are a potential source of particulate lead in surface water. Alternatives 1 through 6 include removal of 0 cy, 610,0000 cy, 1,780,000 cy, 1,780,000 cy, 180,000 cy, and 27,000 cy, respectively, of contaminated sediments in Lower Basin riverbanks, which also are a potential source of particulate lead in surface water. The greater use of removals under Alternatives 3 and 4 would improve the long-term effectiveness and permanence of these alternatives compared to alternatives that rely more heavily on in-place bank stabilization measures. In addition, Alternatives 3 and 4 include bioengineering measures to stabilize remediated banks, which would promote the return of a fully-functioning ecosystem to a greater degree than alternatives that include armoring to stabilize the banks. Bank armoring, while potentially effective for stabilizing the banks, uses materials such as riprap and therefore does not employ materials, such as plants and woody debris, that would promote the return of a fully-functioning ecosystem.

Time to Achieve Overall Cleanup Goals

The time needed to achieve overall cleanup goals, including AWQC and risk-based sediment cleanup goals, will be lengthy and require a period of natural recovery for all the alternatives. The probable time period decreases dramatically with the aggressiveness and completeness of the alternative. As noted in Table 9.2-10, the estimated percent zinc load reductions at the completion of remedy implementation at Pinehurst are approximately 0, 30, 62, 73, 13, and 8 for Alternatives 1 through 6, respectively. The estimated percent reductions at Harrison are approximately 0, 26, 57, 64, 12, and 9 for Alternatives 1 through 6, respectively. These pronounced differences result in considerable differences in the estimated length of time necessary to achieve AWQC, and hence, protectiveness of aquatic life. As noted in Table 10.2-1 and graphed in Figure 10.2-1, the expected lengths of time to achieve AWQC, on average, at Pinehurst is estimated to be approximately 225, 161, 46, 198, and 205 percent longer for Alternatives 1, 2, 3, 5, and 6, respectively, compared to Alternative 4. At Harrison, the expected lengths of time to achieve AWQC, on average, are approximately 278, 195, 45, 239, and 253 percent longer for Alternatives 1, 2, 3, 5, and 6, respectively, compared to Alternative 4. These longer periods are particularly noteworthy when considering that the estimated lengths of time to achieve AWQC, even under the aggressive Alternative 4, are lengthy. While it is not presently possible to estimate the time to achieve AWQC due to uncertainty with respect to the effectiveness of remedial actions to be implemented in the Box, modeling of Alternative 4 suggests the expected time to achieve AWQC, on average, will be on the order of approximately 280 and 210 years at Pinehurst and Harrison, respectively, as graphed in Figure 10.2-2.

Benefits to aquatic life begin long before the point in time when AWQC are finally met. As remedies are implemented, resulting in reduced metals concentrations, aquatic conditions begin to improve and benefits accrue as concentrations drop further over time. Such benefits will occur much sooner with the more aggressive alternatives (i.e., Alternatives 3 and 4). As graphed in Figures 10.2-3 and 10.2-4, water quality conditions at completion of remediation (Time 0 on the graphs), as represented by multiples of AWQC, will be considerably better under Alternatives 3 and 4 than the other alternatives. Although the resulting conditions will not be fully supportive of aquatic life, the reduced dissolved metals concentrations will allow a substantial improvement to the fisheries and ecosystem, as described in more detail in Section 12.2.1 Dissolved Metals in Rivers and Streams and the Interim Fishery Benchmarks Technical Memorandum (URS 2001d). The population and species diversity of fish and aquatic organisms will continue to improve as cleanup progresses in the Basin.

Availability of Materials

The availability of materials for covering, backfilling, and revegetating waste piles, removal areas, and repositories is limited. These materials include topsoil (either natural or manufactured) and uncontaminated fill. Mining of native topsoil could create adverse environmental impacts at borrow locations. Larger quantities of these materials would be required to implement alternatives that include more comprehensive levels of cleanup, such as Alternatives 3 and 4.

Repository Siting

There are limitations on the availability of suitable sites for large engineered repositories for disposal of excavated or dredged contaminated media. A larger number and capacity of repositories would be required to implement alternatives that include more comprehensive levels of cleanup, such as Alternatives 3 and 4.

Long-Term Management and Associated Costs

An effective remedy would likely require substantial long-term management with associated costs. Institutional programs to protect human health and the environment would be needed. Depending on the remedy, long-term management may include operation and maintenance of engineered controls, such as repositories, and water treatment systems. Required periodic cleanups of remediated areas that are recontaminated by subsequent flood events would add to long-term management costs, as would the long-term monitoring and periodic site reviews required under Superfund.

Balance of Tradeoffs

Based on the comparative analysis, EPA believes Alternative 3 represents the best balance of tradeoffs for a long-term cleanup approach, as summarized in Table 10.2-1. Alternatives 3 and 4 provide substantially greater protection of the environment and shorter times to achieve compliance with ARARs than Alternatives 1, 2, 5, and 6. Alternatives 3 and 4 would result in more than twice the reduction of metals loads in surface water relative to the other alternatives, as shown in Table 9.2-10. Alternatives 3 and 4 also would provide more safe feeding area for waterfowl and other receptors than Alternatives 1, 2, 5, and 6, as summarized in Table 9.2-9. Finally, as a result of the greater extent of bed and bank removals included under Alternatives 3 and 4, these alternatives would provide for more comprehensive and permanent reductions in particulate lead transported in the river system than Alternatives 1, 2, 5, and 6.

Although Alternative 4 would provide greater long-term effectiveness than Alternative 3, this consideration is outweighed by the greater implementability, fewer short-term impacts to the communities and the environment, and the lower cost of Alternative 3 compared to Alternative 4. Alternative 3 relies more on groundwater and surface water treatment to reduce dissolved metals loads from the Upper Basin and Mission Flats than Alternative 4, which relies more heavily on removals. In addition, Alternative 4 includes actions in areas (for example, waste rock piles that are not located near streams) that pose relatively little risk. Because it relies on extensive removals, Alternative 4 would likely be more difficult to implement than Alternative 3. As a result, Alternative 3 would be more cost effective, have fewer community and environmental impacts from excavation and trucking, and require less repository space and topsoil or growth media than Alternative 4. Since Alternative 3 includes more treatment than Alternative 4, it satisfies CERCLA's preference for reduction of toxicity, mobility, or volume through treatment to a greater extent than Alternative 4.

10.3 COEUR D'ALENE LAKE

Based on the comparative analysis, the best balance of tradeoffs is represented by Alternative 2. Alternative 2 contains measures to reduce the likelihood of an increased rate of metals release from the 44 to 50 million cubic yards of contaminated sediments in the lake. Alternative 1 contains no measures to control metals release from sediments. The increased long-term effectiveness of Alternative 2 outweighs its marginal increase in cost and marginal reduction in implementability relative to Alternative 1. Table 10.3-1 summarizes the comparative analysis of the alternatives for Coeur d'Alene Lake. The details of the evaluation can be found in Part 3 Section 8 of the FS.

Alternative 2 provides for implementation of the Lake Management Plan. The Plan was developed by local regulatory stakeholders. It has not been fully implemented to date. However, those entities have expressed an interest in implementing the Plan under their independent authorities.

10.4 SPOKANE RIVER

Based on the comparative analysis, the best balance of tradeoffs is represented by a combination of Alternatives 3, 4, and 5. The best balance of tradeoffs at each individual site would depend on site-specific characteristics including the potential risks to human and ecological receptors, potential for recontamination and other long-term maintenance requirements, and cost.

Alternatives 3, 4, and 5 are all potentially protective and ARAR-compliant. Alternatives 1 and 2 are not expected to be protective or comply with sediment ARARs. Table 10.4-1 summarizes the comparative analysis of the alternatives for the Spokane River. The details of the evaluation can be found in Section 7 of Part 3 of the FS.

10.5 CONCLUSIONS FROM COMPARATIVE ANALYSIS

Based on the comparative analysis, EPA determined that Alternatives S4, D3, W6, and F3 for protection of human health and Ecological Alternative 3 for protection of the environment represent the best balance of tradeoffs in the Upper Basin and Lower Basin and that a combination of Alternatives 3, 4, and 5 represents the best balance of tradeoffs for the Spokane River.

Implementation of the human health remedy in the community and residential areas can be achieved within a reasonable timeframe. However, given the amount of work to be performed under Ecological Alternative 3, the vast area involved, and the broad variety of media and source types to be addressed, EPA, in consultation with stakeholders, has determined that an adaptive management strategy is a more reasoned approach to implement the environmental cleanup of the Basin. This approach starts with existing information and progressively incorporates lessons learned from experience as remedial actions are implemented, monitored, and refined. During implementation, EPA will learn which remedial actions are most effective. This process can help assure that as progress toward the long-term cleanup goals for the Basin is made, actions could be prioritized within available funds and be cost-effective. EPA recognizes that combined improvements from cleanup activities and natural recovery will be required to achieve ARARs.

The Selected Remedy, which is described in Section 12.0, is an interim measure and represents a significant remedial response toward meeting the goal of full protection of human health and the environment in the Basin. The Selected Remedy includes the full remedy needed to protect humans from exposures that currently occur in the community and residential areas, including identified recreational areas, of the Upper Basin and Lower Basin, as well as at Spokane River recreational sites upstream of Upriver Dam. For environmental protection, the Selected Remedy identifies approximately 30 years of prioritized actions in areas of the Basin upstream of Coeur d'Alene Lake. It also includes cleanup of Spokane River sites between the Washington/Idaho border and Upriver Dam.

Specifically, EPA has selected a remedy that will:

- Provide a cost-effective remedial action
- Allow cleanup activities for human health and environmental protection to proceed concurrently
- Prioritize remediation of upstream sources while beginning actions in selected downstream areas
- Provide measurable, tangible benefits to humans and environmental receptors (e.g. fish, birds) within a relatively short time in the areas addressed
- Balance priorities identified by stakeholders (states, tribes, federal trustees, and the public)
- Build upon past remedial work performed by others

- Expend a level of effort annually that would allow the cleanup to efficiently move forward while applying the experience gained
- Moderate short-term environmental and socioeconomic impacts
- Take advantage of innovative, more cost-effective technologies as they emerge

The Selected Remedy meets the criteria established in the NCP and EPA guidance. EPA's threshold criteria in selecting a final remedy include overall protection of human health and the environment and compliance with ARARs. The Selected Remedy includes the complete remedy for human health in the communities and residential areas, including identified recreational areas, of the Upper Basin and Lower Basin and along the Spokane River upstream of Upriver Dam. It would be protective of human health and comply with human health ARARs in these areas. Although the Selected Remedy is not anticipated to be fully protective of the environment and achieve environmental ARARs, it represents what EPA believes is a significant step toward these goals. The Selected Remedy would comply with those ARARs that are included within the scope of the proposed work. Compliance with ARARs would be achieved as work is planned and performed.

The Selected Remedy should neither be inconsistent with nor preclude implementation of the final remedy (see 40 CFR 300.430(a)(1)(ii)(B)). The Selected Remedy for environmental protection includes prioritized Upper Basin and Lower Basin actions derived from FS Ecological Alternative 3, which is the level of cleanup EPA believes, based on existing information, is necessary to achieve long-term cleanup goals, as well as the full remedy for the Spokane River between the state line and Upriver Dam.

The Selected Remedy has therefore been determined by EPA to represent the best balance of tradeoffs using the CERCLA balancing criteria. The Selected Remedy would achieve long-term effectiveness by reducing residual risks resulting from exposure to lead in soil, house dust, drinking water, and aquatic food sources to acceptable levels. An institutional controls program and follow-up health services would be used to maintain remedy effectiveness over time. The Selected Remedy would go a long way towards achieving long-term effectiveness and permanence by beginning to control the sources and reduce ecological exposure in high-use areas. It would achieve substantial reductions in residual risks to aquatic receptors resulting from metals in surface water and to waterfowl and other animals resulting from metals in wetland and lateral lake sediments. The Selected Remedy includes treatment of surface water in the Canyon and Ninemile Creek areas, which is consistent with EPA's preference to reduce toxicity, mobility, or volume through treatment.

The Selected Remedy would provide short-term effectiveness through prioritizing human health actions and focusing environmental emphasis on dissolved metals in rivers and streams, lead in floodplain soil and sediment, and particulate lead in surface water, while limiting adverse impacts on the communities and ecosystems. As construction is completed at individual sites, RAOs for those soils, sediments, and source materials addressed by the Selected Remedy would be achieved. Implementation of the human health remedies is a top priority, and it is anticipated the human health RAOs would be achieved within a relatively short time. The Selected Remedy includes sequenced cleanup actions that would be both technically and administratively implementable. Requirements for repository space and relatively scarce materials such as topsoil or growth media would be spread out over time to enhance implementability. The Selected Remedy achieves a significant reduction in residual risk relative to its cost. It would be cost effective as its costs are proportional to its overall effectiveness.

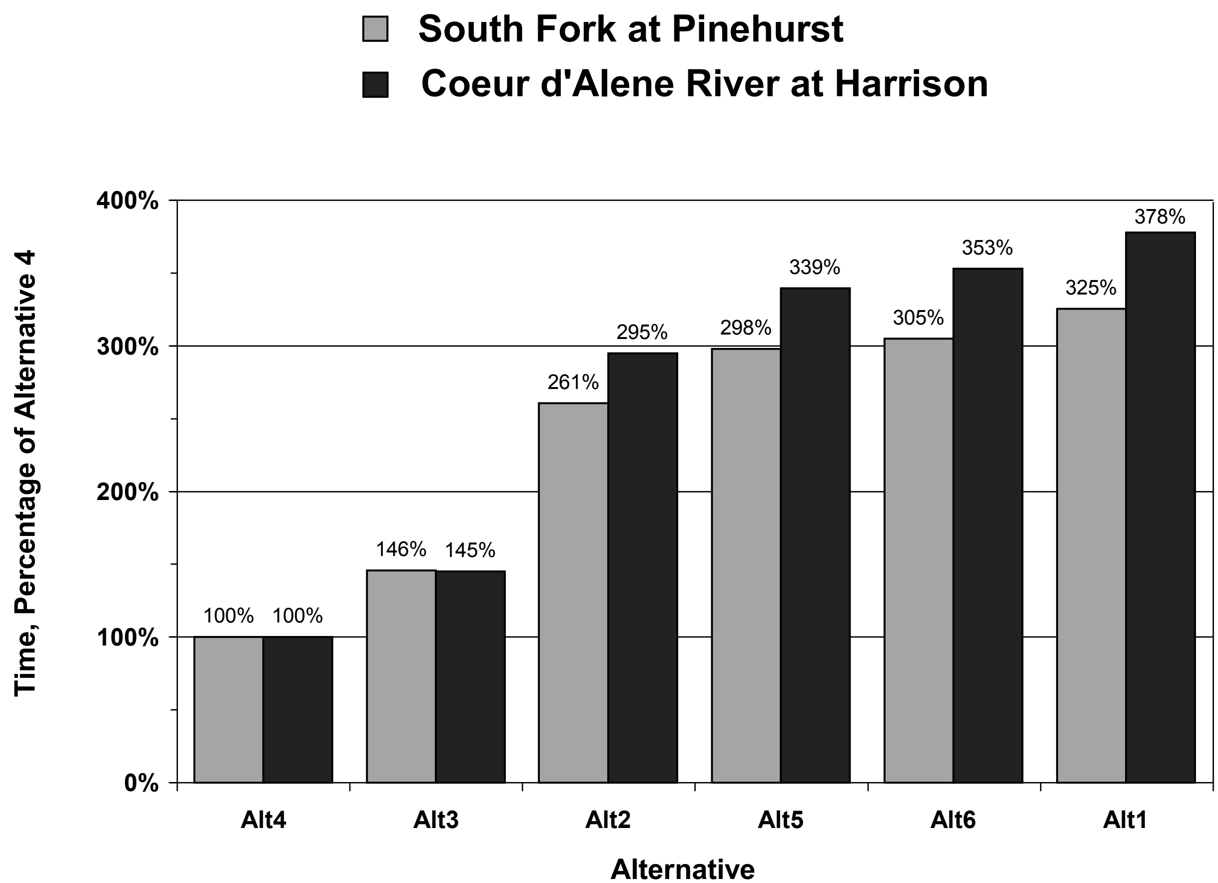


Figure 10.2-1
Estimated Relative Time to Reach AWQC Without Bunker Hill Box Loading

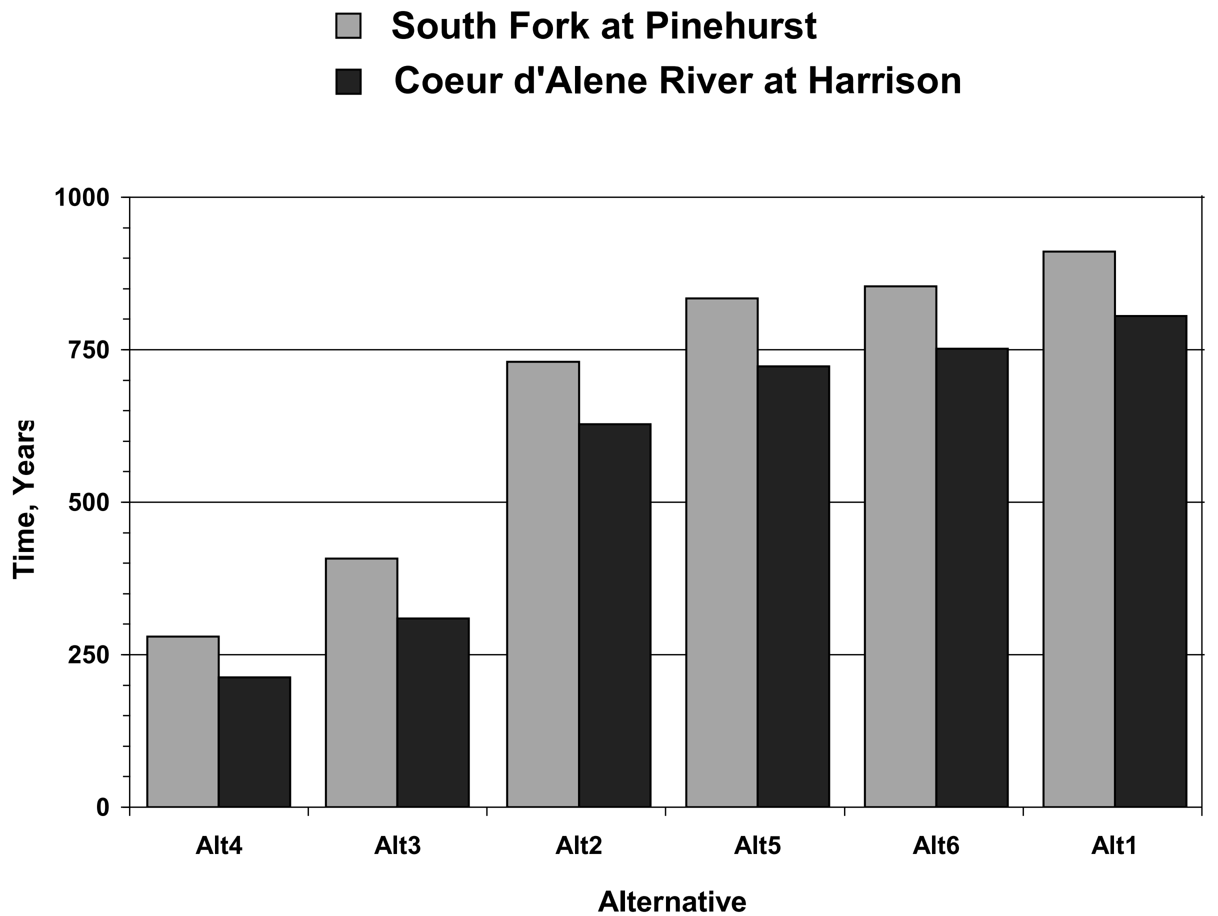
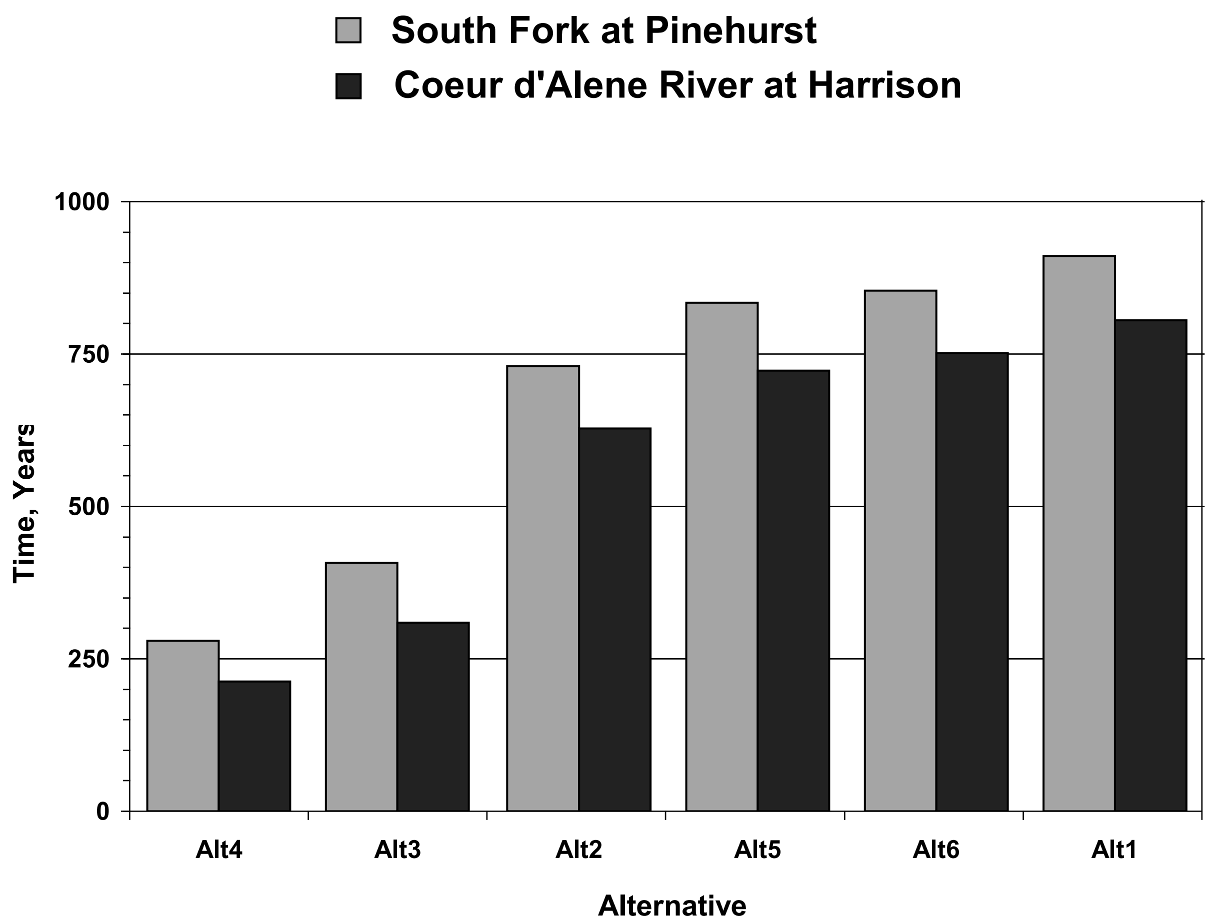


Figure 10.2-2
Estimated Time to Reach AWQC Without Bunker Hill Box Loading



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027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
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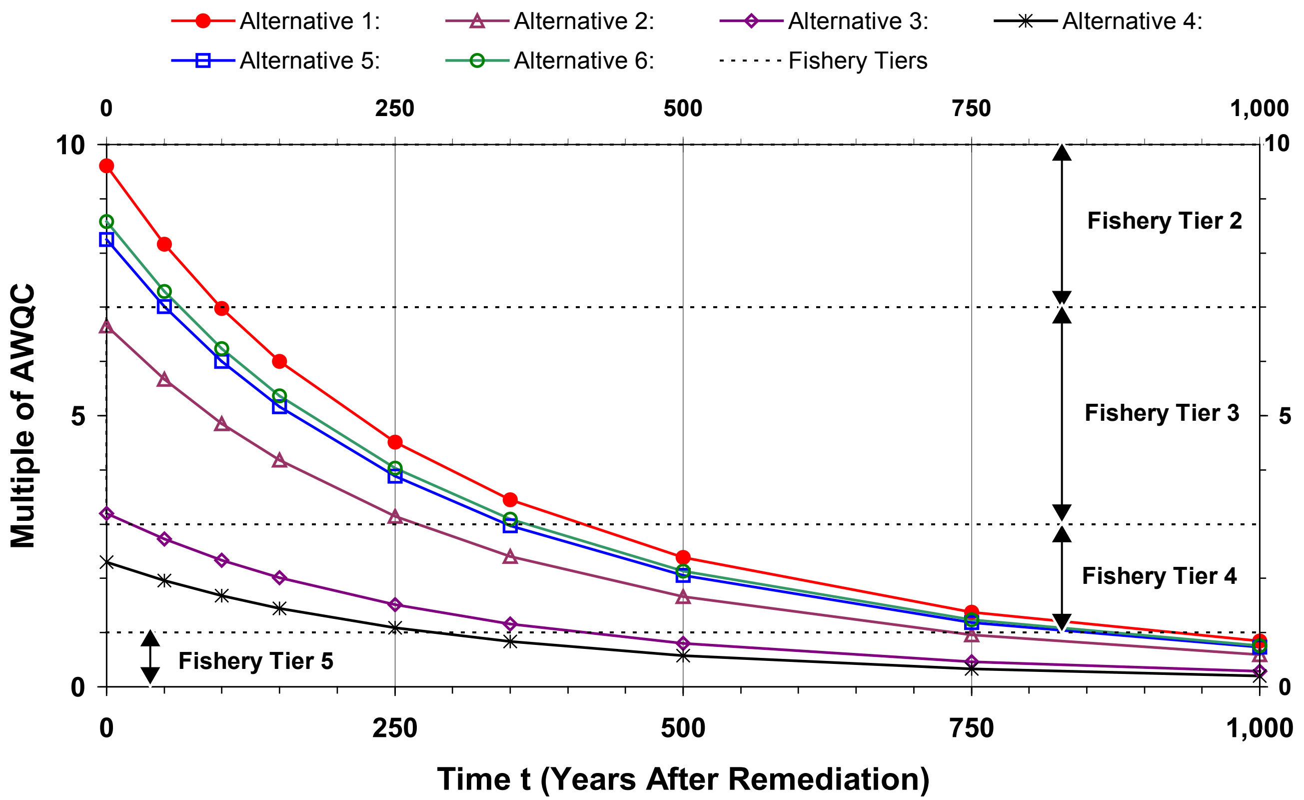
Figure 10.2-2
Estimated Time to Reach AWQC Without Bunker Hill Box Loading



Note:
If historic loadings from the Box were included without any future reduction, AWQC multiple would increase by a factor of approximately:

- Alt 1 2.1
- Alt 2 2.6
- Alt 3 4.0
- Alt 4 5.2
- Alt 5 2.3
- Alt 6 2.2

Fishery Tier Definitions

Tier 0: No migrating or resident fish observed (concentrations generally >20X chronic AWQC)
Tier 1: Presence of migrating fish only, no fish observed during resident fish surveys (concentrations below <20X acute AWQC)
Tier 2: Presence of resident salmonids (trout) of any species, sculpin absent (concentrations from 7X to 10X chronic AWQC)
Tier 3: Presence of 3 or more classes of resident salmonids, including young of the year (YOY) sculpin absent (concentrations from 3X to 7X chronic AWQC)
Tier 4: Presence of 3 or more classes of resident salmonids, including YOY and sculpin (concentrations from 1X to 3X chronic AWQC)
Tier 5: Presence of 5 salmonid age classes, including YOY, sculpin, and bull trout. Fauna dominated by native species at high densities (0.1 to >0.3 fish/m^2) (least impacted watersheds with concentrations <1X chronic AWQC)

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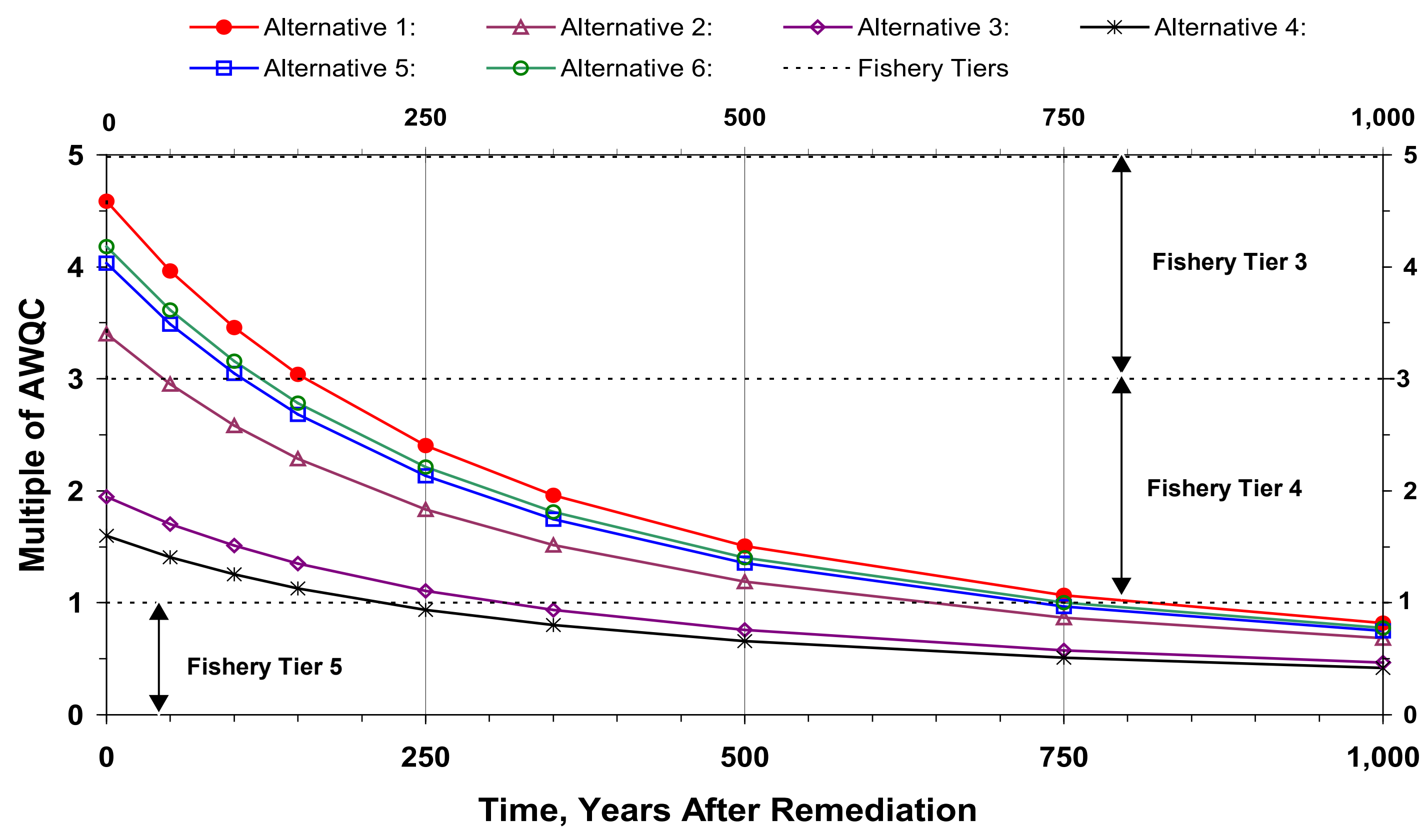
Figure 10.2-3
Comparison of Expected Values of Zinc AWQC Ratio at Pinehurst Without Bunker Hill Box Loading



Note:
If historic loadings from the Box were included without any future reduction, AWQC multiple would increase by a factor of approximately:

Alt 1 1.7
Alt 2 2.0
Alt 3 2.6
Alt 4 3.0
Alt 5 1.8
Alt 6 1.8

Fishery Tier Definitions

Tier 0: No migrating or resident fish observed (concentrations generally >20X chronic AWQC)

Tier 1: Presence of migrating fish only, no fish observed during resident fish surveys (concentrations below <20X acute AWQC)

Tier 2: Presence of resident salmonids (trout) of any species, sculpin absent (concentrations from 7X to 10X chronic AWQC)

Tier 3: Presence of 3 or more classes of resident salmonids, including young of the year (YOY) sculpin absent (concentrations from 3X to 7X chronic AWQC)

Tier 4: Presence of 3 or more classes of resident salmonids, including YOY and sculpin (concentrations from 1X to 3X chronic AWQC)

Tier 5: Presence of 5 salmonid age classes, including YOY, sculpin, and bull trout. Fauna dominated by native species at high densities (0.1 to >0.3 fish/m^2) (least impacted watersheds with concentrations <1X chronic AWQC)

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Figure 10.2-4
Comparison of Expected Values of Zinc AWQC Ratio at Harrison Without Bunker Hill Box Loading

Table 10.0-1
Evaluation Criteria for Superfund Remedial Alternatives

Criterion		Description
Threshold criteria	Overall protection of human health and the environment	Determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
Threshold criteria	Compliance with ARARs	Evaluates whether the alternative meets federal, state, and tribal environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.
Balancing criteria	Long-term effectiveness and permanence	Considers the ability of an alternative to maintain protection of human health and the environment over time.
Balancing criteria	Reduction of toxicity, mobility, or volume through treatment	Evaluates an alternative's use of treatment to reduce a) the harmful effects of principal contaminants, b) their ability to move in the environment, and c) the amount of contamination remaining after remedy implementation.
Balancing criteria	Short-term effectiveness	Considers the length of time needed to implement an alternative and the risk the alternative poses to workers, residents, and the environment during implementation.
Balancing criteria	Implementability	Considers the technical and administrative feasibility of implementing the alternative, including factors such as the availability of materials and services.
Balancing criteria	Cost	Includes estimated present worth capital and operations and maintenance (O&M) costs. O&M costs are estimated for a 30-year period using a discount rate of 7%.
Modifying criteria	State/tribal acceptance	Considers whether the States and Tribes agree with the EPA's analyses and recommendations, as described in the RI/FS and the Proposed Plan.
Modifying criteria	Community acceptance	Considers whether the local community agrees with the EPA's analyses and the Selected Remedy. Comments received on the Proposed Plan during the public comment period are an important indicator of community acceptance.

Table 10.1-1
Comparison of Soil Alternatives for Protection of Human Health in Residential and Community Areas

Criterion	Alternative S1 No Action	Alternative S2 Information and Intervention	Alternative S3 Access Modifications	Alternative S4 Partial Removal	Alternative S5 Complete Removal
Overall Protection of Human Health and the Environment	**Lowest** Would not be protective. Unlikely to achieve health risk goals.	**Low** Limited reduction in exposure from behavior modification, would not achieve full protection. Not preventative- intervention would occur only after child exhibits elevated blood lead. Unlikely to achieve health risk goals.	**Low** Access would be limited at recreation areas, but exposures at the home would be the same as Alternative S2. Unlikely to achieve health risk goals.	**Highest** Removal and replacement of top layer of contaminated soil with clean cap would result in a large increase in protectiveness relative to Alternative S3. Addresses exposures at recreational areas. Expected to achieve health risk goals.	**Highest** Most protective for yards and community areas where all contaminated soil would be removed; however, does not address exposures at recreational areas. Expected to achieve health risk goals, with possible exception of frequent recreational users.
Compliance with ARARs	**Not applicable** No ARARs apply to Alternative S1.	**Not applicable** No ARARs apply to Alternative S2.	**Not applicable** No ARARs apply to Alternative S3.	**Highest** Could be implemented in compliance with action and location-specific ARARs.	**Highest** Could be implemented in compliance with action and location-specific ARARs.
Long-Term Effectiveness and Permanence	**Not evaluated** Alternative does not meet the threshold criteria.	**Low** Residual risks would be associated with contaminated soil left in place. Long-term reliability of institutional controls would rely on voluntary compliance and participation.	**Low** Residual risks would be associated with contaminated soil left in place. Long-term reliability of institutional controls would rely on voluntary compliance and participation.	**Medium** Large reduction in residual risk and reliability of controls relative to Alternative S3 because contaminated soil would be removed. Some residual risk from potential exposure to deeper contaminated soils not removed.	**Medium** Complete soil removal would result in least residual risk and greatest reliability for yards and community areas. Residual risks would remain in recreational areas.
Reduction of Toxicity, Mobility, or Volume through Treatment		None of the alternatives include treatment			
Short-Term Effectiveness Short-term impacts to community and environment - Time to achieve RAOs		**Low** Few impacts to community and environment; however, would not achieve human health RAOs because yard soil is not addressed.	**Low** Relatively few impacts to community and the environment; however, would not achieve human health RAOs because yard soils are not addressed.	**Highest** Would achieve human health RAOs after the completion of remedial actions in all areas. Some impacts to community from traffic and dust generation.	**Medium** Would achieve human health RAOs after the completion of remedial actions in all areas except recreational areas. Most impacts to community from increased truck traffic and dust generation.
Implementability		**Highest** Few implementability considerations.	**Highest** Relatively few implementability considerations.	**Medium** Availability of topsoil for capping of yards may be limited. Some limitations may be encountered siting repositories for contaminated soil.	**Lowest** Availability of topsoil for capping of yards may be limited. Most limitations for siting repositories for contaminated soil. Complete removal more difficult than partial removal.
Cost		Total estimated present worth cost = $5,400,000 Estimated present worth O&M cost = $0	Total estimated present worth cost = $2,900,000 Estimated present worth O&M cost = $110,000	Total estimated present worth cost = $81,000,000 Estimated present worth O&M cost = $640,000	Total estimated present worth cost = $123,000,000 Estimated present worth O&M cost = $740,000
State/Tribal Acceptance	Evaluated for the selected remedy in Section 12.7				
Community Acceptance	Evaluated for the selected remedy in Section 12.8				

Note:
Costs for Alternative S4 differ from those presented for the selected remedy because the analysis of Alternative S4 in the FS included 10 recreational areas and the selected remedy includes 31 residential areas.

Table 10.1-2
Comparison of House Dust Alternatives for Protection of Human Health in Residential and Community Areas

Criterion	Alternative D1 No Action	Alternative D2 Information & Intervention and Vacuum Loan Program/Dust Mats	Alternative D3 Extensive Cleaning
Overall Protection of Human Health and the Environment	**Lowest** Unlikely to achieve health risk goals.	**Medium** Likely to be protective where contamination moderately exceeds action levels and residents participate in program. Expected to achieve health risk goals where residents participate in program.	**Highest** Most protective alternative. Expected to achieve health risk goals.
Compliance with ARARs	**Not applicable** No ARARs apply to Alternative D1.	**Highest** Could be implemented in compliance with ambient air quality regulations.	**Highest** Could be implemented in compliance with ambient air quality regulations.
Long-Term Effectiveness and Permanence	**Not evaluated** Alternative does not meet the threshold criteria	**Medium** Would be less effective at reducing residual risks than extensive cleaning. Long-term reliability of vacuum loan program would depend on participation of residents.	**Highest** Greatest reduction of residual risk. Long-term reliability would depend on participation of residents.
Reduction of Toxicity, Mobility, or Volume through Treatment		None of the alternatives include treatment	
Short-Term Effectiveness - Short-term impacts to community and environment - Time to achieve RAOs		**Low** Short-term impacts to residents and workers could be limited using health and safety precautions. Expected to achieve RAOs where residents participate in program.	**Medium** Short-term impacts to residents and workers could be limited using health and safety precautions. Expected to meet human health RAOs when cleaning is implemented.
Implementability		**Highest** Administrative and technical feasibility has been demonstrated in Basin.	**Medium** No significant administrative or technical feasibility difficulties anticipated.
Cost		Total estimated present worth cost = $1,400,000[a] Estimated present worth O&M cost = $0	Total estimated present worth cost = $4,300,000 Estimated present worth O&M cost = $0
State/Tribal Acceptance	Evaluated for the Selected Remedy in Section 12.7		
Community Acceptance	Evaluated for the Selected Remedy in Section 12.8		

[a]Cost for monitoring

Table 10.1-3
Comparison of Drinking Water Alternatives for Protection of Human Health in Residential and Community Areas

Criterion	Alternative W1 No Action	Alternative W2 Public Information	Alternative W3 Public Information and Residential Treatment	Alternative W4 Public Information and Alternative Source, Public Water Utility	Alternative W5 Public Information and Alternative Source, Groundwater	Alternative W6 Public Information and Multiple Alternative Sources
Overall Protection of Human Health and the Environment	**Lowest** Would not be protective where MCLs are exceeded.	**Low** Least protective of action-oriented alternatives.	**Medium** Potentially protective, but long-term effectiveness would be limited by reliability and maintenance of treatment units.	**Highest** A reliable source of clean water would be provided at most locations where MCLs are exceeded. Implementability would be a limitation at locations far from a public water source.	**Highest** A source of clean water would be provided at most locations where MCLs are exceeded. Implementability would be a limitation in some areas where no suitable alternative aquifer exists.	**Highest** Clean water would be provided at all locations where MCLs are exceeded. Most appropriate technology would be selected for each site.
Compliance with ARARs	**Lowest** Would not comply with ARARs where MCLs are exceeded.	**Lowest** Would not comply with ARARs where MCLs are exceeded.	**Medium** Would usually comply with action-specific ARARs at locations where maintenance of treatment units is conducted, but would not address groundwater contamination.	**Highest** Would comply with action-specific ARARs in all areas where connection to a public water source is feasible, but would not address groundwater contamination.	**Highest** Would comply with action-specific ARARs in all areas where a suitable alternative aquifer is present, but would not address groundwater contamination.	**Highest** Would comply with action-specific ARARs at almost all locations, but would not address groundwater contamination.
Long-Term Effectiveness and Permanence	**Not evaluated** Alternative does not meet the threshold criteria	**Low** Includes no actions to permanently reduce residual risks where MCLs are exceeded. Long-term reliability of institutional controls would be limited.	**Medium** Long-term effectiveness would be limited by reliability and maintenance of treatment units.	**Highest** Would be very effective and reliable all areas where connection to a public water source is feasible.	**Medium** Long-term reliability of groundwater wells may be less than public water supply.	**Highest** Most appropriate technology would be selected for each site.
Reduction of Toxicity, Mobility, or Volume through Treatment		No treatment included	**Highest** Most reduction of toxicity using point-of-use treatment units	No treatment included	No treatment included	**Medium** Reduction of toxicity would occur at locations where point-of-use treatment units are used.
Short-Term Effectiveness - Short-term impacts to community and environment - Time to achieve RAOs		**Low** Unlikely to achieve RAOs for drinking water	**Highest** Relatively short period to implement, which would be followed almost immediately by achievement of drinking water RAOs.	**Medium** Relatively long period to implement in areas outside of water district, which would be followed almost immediately by achievement of drinking water RAOs.	**Medium** Relatively long period to implement completely, which would be followed almost immediately by achievement of drinking water RAOs.	**Highest** Relatively short period to implement, which would be followed almost immediately by achievement of drinking water RAOs.
Implementability		**Highest** Few implementability considerations.	**Highest** Relatively few implementability considerations.	**Medium** Potential administrative considerations and limitations on capacity in areas within water districts. Numerous administrative and technical considerations related to designing and constructing water systems outside of water districts.	**Low** Implementability would be very limited in areas where no suitable aquifer exists. Moratoriums on construction of new wells exist in some areas.	**Highest** Most implementable technology could be selected.
Cost		Total estimated present worth cost = $430,000 Estimated present worth O&M cost = $0	Total estimated present worth cost = $1,400,000 Estimated present worth O&M cost = $530,000	Total estimated present worth cost = $10,000,000 Estimated present worth O&M cost = $90,000	Total estimated present worth cost = $2,900,000 Estimated present worth O&M cost = $160,000	Total estimated present worth cost = $2,200,000 Estimated present worth O&M cost = $100,000
State/Tribal Acceptance	Evaluated for the selected remedy in Section 12.7					
Community Acceptance	Evaluated for the selected remedy in Section 12.8					

Table 10.1-4
Comparison of Aquatic Food Sources Alternatives for Protection of Human Health

Criterion	Alternative F1 No Action	Alternative F2 Information and Intervention	Alternative F3 Information and Intervention and Monitoring
Overall Protection of Human Health and the Environment	**Lowest** No reduction in potential exposure and not protective	**Medium** Anticipated to produce some reduction of exposure. Long-term protectiveness would primarily depend on reductions of metals in environmental media.	**Highest** Monitoring would be expected to result in a greater reduction of exposure than Alternative F2. Long-term protectiveness would primarily depend on reductions of metals in environmental media.
Compliance with ARARs	No ARARs specifically address consumption of aquatic food sources.		
Long-Term Effectiveness and Permanence	**Not evaluated** Alternative does not meet the threshold criteria	**Medium** Long-term effectiveness primarily depends on reductions of metals in environmental media. Program anticipated to last for 30 years.	**Medium** Long-term effectiveness primarily depends on reductions of metals in environmental media. Program anticipated to last for 30 years.
Reduction of Toxicity, Mobility, or Volume through Treatment		None of the alternatives include treatment	
Short-Term Effectiveness - Short-term impacts to community and environment - Time to achieve RAOs		**Medium** Remedy could be implemented rapidly; however, reduction of fish consumption anticipated to be limited. Minimal impacts to community or environment.	**Highest** Remedy could be implemented rapidly; monitoring is anticipated to result in greater reduction of fish consumption in areas of exposure. Minimal impacts to community or environment.
Implementability		**Highest** Could be readily implemented.	**Highest** Could be readily implemented.
Cost		Total estimated present worth cost = $230,000 Estimated present worth O&M cost = $0	Total estimated present worth cost = $910,000 Estimated present worth O&M cost = $0
State/Tribal Acceptance	Evaluated for the Selected Remedy in Section 12.7		
Community Acceptance	Evaluated for the Selected Remedy in Section 12.8		

Table 10.2-1
Comparison of Ecological Alternatives for the Upper Basin and Lower Basin

Criterion	Alternative 1 No Action	Alternative 2 Contain/Stabilize with Limited Removal and Treatment	Alternative 3 More Extensive Removal, Disposal and Treatment	Alternative 4 Maximum Removal, Disposal and Treatment	Alternative 5 State of Idaho Cleanup Plan	Alternative 6 Mining Companies Cleanup Plan
Overall Protection of Human Health and the Environment	**Lowest** Not protective	**Medium** Intermediate level of long-term effectiveness and time to achieve RAOs, including ARARs. Potential short-term impacts and implementability problems.	**Highest** Slightly lower long-term effectiveness and slightly longer time to achieve RAOs, including ARARs, compared to Alternative 4 balanced by lesser short-term impacts and greater implementability.	**Highest** Slightly greater long-term effectiveness and slightly shorter time to achieve RAOs, including ARARs, compared to Alternative 3 balanced by greater short-term impacts and reduced implementability.	**Low** More protective than Alternative 6, particularly in the Lower Basin, but less protective than Alternative 2. Lower protectiveness relative to Alternative 2 balanced by fewer short-term impacts and implementability concerns.	**Low** Least protective of action alternatives.
Compliance with ARARs	**Lowest** Would not comply with ARARs within a reasonable timeframe	**Medium** Intermediate time to achieve ARARs compliance. Estimated times to achieve AWQC 161% and 195% longer than Alternative 4 at Pinehurst and Harrison, respectively.	**Highest** Second shortest time to achieve ARARs compliance. Estimated times to achieve AWQC 46% and 45% longer than Alternative 4 at Pinehurst and Harrison, respectively.	**Highest** Shortest time to achieve ARARs compliance.	**Low** Second longest time to achieve ARARs compliance. Estimated times to achieve AWQC 198% and 239% longer than Alternative 4 at Pinehurst and Harrison, respectively.	**Low** Longest time to achieve ARARs compliance among action alternatives. Estimated times to achieve AWQC 205% and 253% longer than Alternative 4 at Pinehurst and Harrison, respectively.
Long-Term Effectiveness and Permanence	**Not evaluated** Alternative does not meet the threshold criteria	**Low** Residual risk includes moderate potential for future erosion of impacted bed and bank sediments in Lower Basin and loading from sediments in Upper Basin. Most wetlands unremediated. Estimated reductions of dissolved metals load of 30% and 26% at Pinehurst and Harrison, respectively, at completion of remedy implementation. Passive water treatment used, which may be less reliable than active treatment. Includes cleanup of 1,123 acres of wetland and lateral lake feeding area. Effectiveness of soil treatment in Lower Basin is uncertain.	**Medium** Substantially greater long-term effectiveness than Alternatives 2, 5, and 6 due to more extensive actions to control metals loads from sediments and river beds. Estimated reduction of dissolved metals load of 62% and 57% at Pinehurst and Harrison, respectively, at completion of remedy implementation. Hydraulic isolation used to limit loading from inaccessible sediments in Upper Basin, which may be less reliable than removals. Includes cleanup of 5,358 acres of wetland and lateral lake feeding area. Active water treatment used, which may be more reliable than passive treatment.	**Highest** Fewest residual risks. Greatest long-term effectiveness and permanence as a result of most widespread use of removal and disposal. Estimated reduction of dissolved metals load of 73% and 64% at Pinehurst and Harrison, respectively, at completion of remedy implementation. Most extensive remediation of wetlands and lateral lakes. Includes cleanup of 12,469 acres of wetland and lateral lake feeding area.	**Low** Residual risks result from limited actions to address sediments and associated dissolved metals loads in Upper Basin. Generally similar level of long-term effectiveness in Lower Basin as Alternative 2. Estimated reduction of dissolved metals load of 13% and 12% at Pinehurst and Harrison, respectively, at completion of remedy implementation. Passive water treatment used, which may be less reliable than active treatment. Includes cleanup of 4,682 acres of wetland and lateral lake feeding area. Effectiveness of soil treatment in Lower Basin is uncertain.	**Lowest** Highest residual risks among action alternatives, resulting from fewest actions to address sediments in Upper Basin and contaminated banks, beds, and wetlands in Lower Basin. Estimated reduction of dissolved metals load of 8% and 9% at Pinehurst and Harrison, respectively, at completion of remedy implementation. Relies primarily on institutional controls to reduce waterfowl exposure to metals. Uses passive water treatment, which may be less reliable than active treatment.
Reduction of Toxicity, Mobility, or Volume through Treatment		**Medium** Drainage from major adits using passive treatment; no groundwater treatment. Total reduction through treatment similar to Alternative 5.	**Highest** Maximum reduction of water toxicity through treatment of adit drainage, groundwater, and surface water.	**Highest** Maximum reduction of water toxicity through treatment of adit drainage and groundwater.	**Medium** Drainage from major adits using passive treatment; no groundwater treatment. Total reduction through treatment similar to Alternative 2.	**Low** Wetlands treatment of drainage from four adits. Least reduction of toxicity through treatment of action alternatives.
Short-Term Effectiveness - Short-term impacts to community and environment		**Medium** Intermediate level of potential short-term water quality impacts. Moderate potential for short-term habitat loss. Greater potential risks to community from increased truck traffic and dust generated by remedial activities than Alternatives 5 and 6.	**Low** Substantial potential for short-term water quality impacts, especially from river bed dredging, and for short-term loss of habitat. Second greatest potential risks to community from increased truck traffic and dust generated by remedial activities among alternatives.	**Lowest** Greatest potential for short-term water quality impacts and short-term loss of habitat . Greatest potential risks to community from increased truck traffic and dust generated by remedial activities among alternatives.	**Medium** Relatively little potential for short-term water quality impacts. Moderate potential for short-term habitat loss. Relatively few risks to the community from remedy implementation.	**Highest** Relatively little potential for short-term water quality impacts or habitat loss. Relatively small risks to the community from remedy implementation.
- Time to achieve RAOs		**Low** Longer implementation period than Alternative 5, but shorter period of natural recovery would be needed to achieve surface water RAOs.	**Medium** Relatively long implementation period, but soil/sediment RAOs would be achieved at most locations, and a relatively short period of natural recovery would be needed to achieve surface water RAOs.	**Medium** Longest implementation period, but soil/sediment RAOs would be achieved at the largest number of locations, and the shortest period of natural recovery would be needed to achieve surface water RAOs.	**Low** Relatively short implementation period, but soil/sediment RAOs would be achieved at a limited number of locations, and a long natural recovery period would be needed to achieve surface water RAOs.	**Lowest** Relatively short implementation period, but soil/sediment RAOs would be achieved at relatively few locations, and the longest natural recovery period would be needed to achieve surface water RAOs.
Implementability		**Medium** Potential concerns with availability of topsoil (or other growth media) and clean fill needed for revegetation of removal areas and repositories. Siting of repositories with 2.5 million cy capacity may be feasible. Potential problems with feasibility of sediment removals.	**Low** Limited availability of topsoil (or other growth media) and clean fill needed for revegetation of removal areas and repositories. Substantial siting problems associated with 26 million cy of repository capacity. Potential problems with feasibility of sediment removals and hydraulic isolation.	**Lowest** Greatest implementability problems related to availability of materials, technical feasibility, and siting of repositories with 67 million cy of capacity.	**Highest** Relatively small materials requirements. Siting of repositories with 1.4 million cy capacity should be feasible.	**Highest** Least materials requirements. Siting of repositories with 260,000 cy capacity should be feasible.

Table 10.2-1 (Continued)
Comparison of Ecological Alternatives for the Upper Basin and Lower Basin

Criterion	Alternative 1 No Action	Alternative 2 Contain/Stabilize with Limited Removal and Treatment	Alternative 3 More Extensive Removal, Disposal and Treatment	Alternative 4 Maximum Removal, Disposal and Treatment	Alternative 5 State of Idaho Cleanup Plan	Alternative 6 Mining Companies Cleanup Plan
Cost		Total estimated present worth cost = $370,000,000 Estimated present worth O&M cost = $44,000,000	Total estimated present worth cost = $1,300,000,000 Estimated present worth O&M cost = $133,000,000	Total estimated present worth cost = $2,600,000,000 Estimated present worth O&M cost = $200,000,000	Total estimated present worth cost = $257,000,000 Estimated present worth O&M cost = $25,000,000	Total estimated present worth cost = $194,000,000 Estimated present worth O&M cost = $21,000,000
State/Tribal Acceptance	Evaluated for the selected remedy in Section 12.7					
Community Acceptance	Evaluated for the selected remedy in Section 12.8					

Table 10.3-1
Comparison of Alternatives for Coeur d'Alene Lake

Criterion	Alternative 1 No Action	Alternative 2 Implement Lake Management Plan
Overall protection of human health and the environment	**Low** Potentially not protective of human health and the environment. Includes no measures to control nutrients, which may affect the rate of release of metals from the lake bed sediments.	**Medium** Potentially protective of human health and the environment. Includes measures to control nutrients, which may reduce the rate of release of metals from the extremely large volume of contaminated lake bed sediments compared to no action.
Compliance with ARARs	**Low** Potentially higher rate of release of metals compared to Alternative 2 may result in longer time to achieve AWQC.	**Medium** Potentially lower rate of release of metals compared to Alternative 1 may result in shorter time to achieve AWQC.
Long-term effectiveness and permanence	**Lowest** Includes no actions to reduce residual risk	**Medium** Includes measures to potentially reduce release of metals from lake bed sediments. Long-term reliability would depend on continued enforcement of institutional controls designed to reduce nutrient loads.
Reduction of toxicity, mobility, or volume through treatment	**Lowest** No treatment included	**Medium** Although specific sources have not been identified, the Lake Management Plan contains provisions for treatment of sources of nutrients.
Short-term effectiveness Protection of community, workers, environmental impacts Time to achieve RAOs	**Highest** No impacts to community, workers or environment **Low** Includes no actions to reduce the time to meet surface water RAOs	**Medium** Actions identified under the Lake Management Plan may result in risks to community and workers and environmental impacts. Medium- Reductions in nutrient loads would potentially reduce time to achieve surface water RAOs.
Implementability	**Highest** No implementability considerations	**Low** Implementation may require passage of new ordinances and coordination between agencies. There may be private property ownership issues for some actions.
Cost	Total estimated present worth cost = $1,300,000 (see note) Estimated present worth O&M cost = $1,300,000 (see note)	Total estimated present worth cost = $8,800,000 Estimated present worth O&M cost = $8,800,000
State/Tribal Acceptance	Evaluated for the Selected Remedy in Section 12.7	
Community Acceptance	Evaluated for the Selected Remedy in Section 12.8	

Note: Estimated costs for Alternative 1 include costs for monitoring.

Table 10.4-1
Comparison of Alternatives for the Spokane River

Criterion	Alternative 1 No Action	Alternative 2 Institutional Controls	Alternative 3 Containment with Limited Removal and Disposal	Alternative 4 More Extensive Removal, Disposal, and Containment	Alternative 5 Maximum Removal and Disposal
Overall Protection of Human Health and the Environment	**Lowest** Would not be protective.	**Lowest** May be ineffective in reducing risks to humans. Would not reduce risks to ecological receptors.	**Medium** Would effectively contain sediments posing risks to humans, and would effectively contain some, but not all, sediments posing risks to ecological receptors.	**Medium** Removal and disposal of sediments would provide more reliable protection of humans as well as ecological receptors in critical habitat areas compared to Alternative 3.	**Highest** Removal and disposal of all sediments posing significant human health and ecological risks would provide the most reliable protection.
Compliance with ARARs	**Lowest** Would not comply with ARARs for sediments.	**Lowest** Would not comply with ARARs for sediments.	**Medium** Would comply with ARARs for sediments.	**Medium** Would comply with ARARs for sediments. Complies with MTCA, including MTCA requirement to use permanent solutions to the maximum extent practicable.	**Highest** Would comply with ARARs for sediments. Complies with MTCA, including MTCA requirement to use permanent solutions to the maximum extent practicable.
Long-Term Effectiveness and Permanence	**Not evaluated** Alternative does not meet the threshold criteria.	**Not evaluated** Alternative does not meet the threshold criteria.	**Low** Moderate residual risks to ecological receptors. Low residual risks to humans. Moderate maintenance requirements. Some additional actions due to recontamination could be needed.	**Medium** Low residual risks to humans and ecological receptors. Moderate maintenance requirements. Some additional actions due to recontamination could be needed.	**Highest** Very low residual risks to humans and ecological receptors. No long-term maintenance requirements. Some additional actions due to recontamination could be needed.
Reduction of Toxicity, Mobility, or Volume through Treatment			None of the alternatives include treatment		
Short-Term Effectiveness - Short-term impacts to community and environment - Time to achieve RAOs			**Highest** Limited short-term impacts to community and environment resulting from hauling and construction activities within the floodplain. **Low** Longest time to achieve RAOs among the action-oriented alternatives.	**Medium** Limited short-term impacts to community from hauling, but potentially significant impacts to the environment from construction activities within the floodplain. **Medium** Second shortest time to achieve RAOs.	**Low** Limited short-term impacts to community from hauling, but most significant impacts to the environment from construction activities within the floodplain. **Highest** Shortest time to achieve RAOs
Implementability			**Highest** No significant technical or administrative feasibility concerns. Services and materials readily available.	**Highest** No significant technical or administrative feasibility concerns. Services and materials readily available.	**Medium** Potentially somewhat greater feasibility considerations due to larger scope of actions. Potential limitations on local landfill capacity.
Cost		Total estimated present worth cost = $900,000 Estimated present worth O&M cost = $890,000	Total estimated present worth cost = $1,800,000 Estimated present worth O&M cost = $940,000	Total estimated present worth cost = $6,500,000 Estimated present worth O&M cost = $1,300,000	Total estimated present worth cost = $28,000,000 Estimated present worth O&M cost = $1,700,000
State/Tribal Acceptance	Evaluated for the selected remedy in Section 12.7				
Community Acceptance	Evaluated for the selected remedy in Section 12.8				