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Focused Feasibility Study Report

Upper Basin of the Coeur d'Alene River, Bunker Hill Mining and Metallurgical Complex Superfund Site

Executive Summary

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Executive Summary

Introduction

This Focused Feasibility Study (FFS) Report presents and evaluates alternatives for cleanup of the Upper Basin of the Coeur d'Alene River in Northern Idaho, which is part of the Bunker Hill Mining and Metallurgical Complex Superfund Site (also referred to as "the Site" and "the Bunker Hill Superfund Site"). The Site was listed on the National Priorities List (NPL) in 1983 and has been assigned Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number IDD048340921. The Upper Basin is the area of historical mining and industrial activities and the primary source of downstream metals contamination. For the purposes of the FFS, the "Upper Basin" includes the South Fork of the Coeur d'Alene River (SFCDR); its tributaries downstream to the confluence of the South and North Forks of the river; and the 21-square-mile Bunker Hill "Box" around the old Bunker Hill smelter where USEPA began its cleanup in the 1980s.

Under the Superfund Law, the U.S. Environmental Protection Agency (USEPA) is required to develop cleanup plans to be protective of human health and the environment, and to attain applicable or relevant and appropriate requirements (ARARs) unless waivers are invoked. The latter includes meeting all federal or more stringent state environmental standards, such as achieving state water quality standards. In addition, the Coeur d'Alene Tribe owns land in the Upper Basin, and the Tribe's environmental standards must also be met for actions taken on Tribal lands. Over the last year USEPA and others have been evaluating and discussing Bunker Hill Superfund Site cleanup activities with a view to developing a comprehensive, prioritized cleanup approach for the Upper Coeur d'Alene Basin. This has been undertaken to incorporate improved knowledge of the Upper Basin and the Box, to move forward on Phase II cleanup activities in the Box in Operable Unit 2 (OU 2), and to address National Academy of Sciences recommendations (NAS, 2005). This effort will culminate in USEPA identifying and selecting additional cleanup actions for the Upper Basin and the Bunker Hill Box in a Record of Decision (ROD) Amendment after issuance of a Proposed Plan and consideration of public comments.

To develop this FFS Report for the Upper Basin portion of the Bunker Hill Superfund Site, USEPA has worked closely with the Idaho Department of Environmental Quality, the Coeur d'Alene Tribe, local governments, the federal Natural Resource Trustees (the Bureau of Land Management [BLM], the U.S. Fish and Wildlife Service, and the U.S. Forest Service), the Spokane Tribe, the Washington Department of Ecology, local communities, and other interested parties including the Basin Environmental Improvement Project Commission ("the Basin Commission"). The Basin Commission was established by the Idaho State Legislature under the Basin Environmental Improvement Act, Idaho Administrative Procedures Act Title 39, Chapter 810.

Background

Summary of Environmental Conditions

The Coeur d'Alene Basin contains mining-contaminated areas of the Coeur d'Alene River corridor, adjacent floodplains, downstream water bodies, river tributaries, and fill areas, and the Bunker Hill "Box". The principal source of metals contamination is tailings generated from the historical milling of ore, which until 1968 were discharged to the SFCDR and its tributaries or disposed of in large waste piles. Tailings were frequently used as fill for residential and commercial construction projects. Tailings were also transported downstream, particularly during high-flow events in the SFCDR, and deposited as lenses of tailings or as tailings/sediment mixtures in the beds, banks, and floodplains of local surface water bodies. Other major sources of contamination have included waste rock and air emissions from former smelter operations.

Concentrations of mining-related metals in surface water, soil, sediments, and groundwater are elevated in many parts of the Basin, and have been associated with increased mortality and decreased survival, growth, and reproduction of various plant and animal species (Stratus Consulting, 2000; USEPA, 2001a). The toxicity of these metals has also impacted humans, with historically high blood-lead levels in children that have been significantly reduced in recent years by the Superfund cleanup efforts.

Operable Units

USEPA has designated three OUs within the Bunker Hill Superfund Site. OUs 1 and 2 are located within the Bunker Hill Box, which includes the communities where historical ore processing and smelting occurred (Kellogg, Smelterville, Wardner, and Pinehurst). OU 3 includes all areas of the Basin outside the Box where mining-related contamination is located. The OUs are summarized as follows:

Bunker Hill Superfund Site Operable Units (OUs)	
OU 1	OU 1 is defined as the *populated areas* of the Bunker Hill Box because it is home to more than 7,000 residents of the towns of Pinehurst, Smelterville, Kellogg, and Wardner, as well as the unincorporated communities of Page, Ross Ranch, Elizabeth Park, and Montgomery Gulch. Residences also extend up side gulches and adjacent hillside areas. Populated-area issues of concern include residential yards, house dust, commercial properties, public use areas, and street rights of way.
OU 2	OU 2 includes the *non-populated areas* of the Bunker Hill Box. These areas include former industrial areas such as the Mine Operations Area (MOA) in Kellogg; Smelterville Flats (the floodplain of the SFCDR in the western half of the Bunker Hill Box); hillsides, creeks, and gulches; the Central Impoundment Area (CIA) in Kellogg; the Central Treatment Plant (CTP), a water treatment facility in Kellogg for acid mine drainage (AMD) and other metals-contaminated water; and the Bunker Hill Mine with its associated AMD.
OU 3	OU 3 includes all areas of the Coeur d'Alene Basin outside the Bunker Hill Box where mining-related contamination is located. OU 3 extends from near the Idaho-Montana border into the State of Washington, and includes floodplains, communities, lakes, rivers, and tributaries. Pine Creek and the portion of the SFCDR within the Bunker Hill Box are considered part of OU 3.

Substantial progress has been made in implementing the remedies selected in previous decision documents and actions for the OUs, primarily those focused on reducing the risks posed to human health by exposure to mining-related contamination:

- **OU 1:** Cleanup activities at the Bunker Hill Superfund Site first began in OU 1 because of the risks posed to human health from exposure to mine and smelter wastes. The ROD for OU 1 (USEPA, 1991a) focused on remediation of lead-contaminated soil in residential areas primarily through removals and partial removals and the installation of protective soil/vegetation barriers. The human health remedy installed by the potentially responsible parties (PRPs) for OU 1 was certified complete in 2008.
- **OU 2:** Phased cleanup activities in OU 2 began in the early 1990s. The ROD for OU 2 (USEPA, 1992) included actions to protect human health in the non-populated areas, commercial areas, and other common-use areas through removals, source control, capping, and other measures. Phase I source control actions for OU 2 are largely complete. Phase I has included removal, containment, and consolidation of extensive contamination from various areas, capping of source areas, demolition of structures, and corresponding public health response actions. This ROD also addressed some OU 1 remedial activities such as rights of way, commercial properties, and house dust.
- **OU 3:** Cleanup activities since the ROD for OU 3 (USEPA, 2002) have primarily focused on implementation of the human health remedy in community and residential areas. Prior to the 2002 ROD, limited removal actions in OU 3 were conducted by EPA and other entities such as the Silver Valley Natural Resource Trustees (SVNRT, now referred to as the Coeur d'Alene Natural Resource Trustees), USFS, IDEQ, and BLM. Implementation of the human health remedy selected for community, residential, and recreational areas in the Coeur d'Alene Basin outside the Box, presented in the ROD for OU 3, is ongoing and nearing completion. USEPA recently received additional funding through the American Recovery and Reinvestment Act of 2009 to accelerate the implementation of remaining human health cleanup activities in OU 3.

The human health remedies selected for OUs 1, 2, and 3 have functioned as designed and are protective of human health. In particular, the cleanup actions have resulted in significant and well-documented declines in children's blood lead levels. An Institutional Controls Program (ICP), administered by the Panhandle Health District, provides a locally enforced set of rules and regulations established to maintain the integrity of installed barriers[1] and to ensure that new barriers are installed during redevelopment that may occur within the administrative boundary of the ICP. In OU 2, where a phased program of remedial actions is being conducted, Phase I remedial work is largely complete as noted above. An evaluation of the effectiveness of the Phase I actions has been conducted along with studies to provide the basis for selecting appropriate Phase II actions to address long-term water quality issues.

In addition to selecting a human health remedy for community, residential, and recreational areas within OU 3, the 2002 ROD for OU 3 also selected an interim remedy for protection of the environment that focused on improving water quality, minimizing downstream

[1] Barriers are used as components of the human health remedies selected for OUs 1, 2, and 3 to prevent human contact with contaminated materials.

migration of metal contaminants, and improving conditions for fish and wildlife populations. Because a conscious decision to prioritize human health actions was made, most of the actions to protect the environment have not yet been implemented. However, USEPA has conducted some actions at mine and mill sites that addressed recreational human health as well as ecological exposures.

Remedy implementation in the three OUs has included continued studies, information gathering, monitoring, and assessment of the performance of remedial actions that have provided a greater understanding of conditions and risks in the Upper Basin. The resulting information indicates that it is necessary to augment the established remedies to ensure continued protection of human health and the environment in the Upper Basin.

Purpose and Scope of the Focused Feasibility Study

The overall purpose of the FFS was to develop and evaluate a range of alternatives that provide a comprehensive approach to remediation in the Upper Basin (remedial alternatives). The FFS has also evaluated actions to protect portions of the human health remedies selected in the RODs for the three OUs (USEPA, 1991, 1992, 2002) that are vulnerable to erosion and contamination of clean barriers (remedy protection alternatives). In addition, the FFS has refined the riparian preliminary remediation goal (PRG) for songbirds based on site-specific data collected since the issuance of the ROD for OU 3 in 2002. The alternatives have been evaluated in the FFS against seven criteria required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): overall protectiveness of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of the toxicity, mobility, and volume of hazardous substances through treatment; short-term effectiveness; implementability; and cost. Two additional criteria (state and Tribal acceptance and community acceptance) will be evaluated in the Upper Basin ROD Amendment following the receipt of state agency, Tribal, and public comments on the Proposed Plan for the Upper Coeur d'Alene Basin.

The study area for the FFS (Figure ES-1) includes the Bunker Hill Box (OUs 1 and 2) and the Upper Basin portion of OU 3. (Figures ES-1 through ES-3 are provided following the text of this Executive Summary.) For the purposes of the FFS, the "Upper Basin" includes the SFCDR; its tributaries downstream to the confluence of the South and North Forks of the river; and the Box. The Upper Basin is the area of historical mining and industrial activities and the primary source of downstream metals contamination. As shown in Figure ES-1, the FFS study area extends approximately one mile to the west beyond the confluence of the North and South Forks of the Coeur d'Alene River to include the town of Kingston, which is one of the communities assessed in the remedy protection evaluation. The North Fork portion of the Upper Basin is not included in the FFS study area because it has been less seriously impacted by mining activities and is being addressed under CERCLA by other (non-USEPA) agencies, primarily the U.S. Forest Service. It should also be noted that the Lower Coeur d'Alene Basin is not within the scope of the FFS; in the near-term, the focus of continuing work in the Lower Basin is to fill data gaps and develop an Enhanced Conceptual Site Model that will help guide effective decisionmaking with regard to future remedial actions in the Lower Basin.

The FFS has built on previous work to develop a comprehensive remedy for human health and environmental protection within the Upper Basin. The remedial alternatives have been designed to provide a final remedy for:

- human health protection for surface water used for drinking purposes;
- ecological protection for surface water; and
- human health and ecological protection for soil, sediments, and source materials at locations where remedial actions are taken.

Further, the remedy selected in the Upper Basin ROD Amendment is expected to significantly reduce both groundwater contamination levels and the contribution of contaminated groundwater to surface water. However, given the pervasive nature of the subsurface contamination, the Preferred Alternative may not achieve the drinking water standards for groundwater at all locations. USEPA will evaluate future monitoring data to determine whether additional actions are needed or would be effective in meeting drinking water standards. If further actions would not be effective, a Technical Impracticability (TI) waiver may be warranted at specific locations where groundwater does not achieve drinking water standards.[2]

In addition, the remedy protection alternatives have been designed to address portions of the previously selected human health remedies that are vulnerable to erosion and contamination of clean barriers.

Following finalization of this FFS Report and consideration of comments on the Proposed Plan, the forthcoming Upper Basin ROD Amendment will update and add to previous cleanup plans described in the RODs for OUs 1, 2 and 3 and in other related decision documents, as necessary.

Approach to the Focused Feasibility Study

The FFS built upon the analyses presented in the *Final (Revision 2) Feasibility Study Report, Coeur d'Alene Basin Remedial Investigation/Feasibility Study* (2001 FS Report; USEPA, 2001b), the ROD for OU 3 (USEPA, 2002), the *Phase I Remedial Action Assessment Report, Operable Unit 2* (CH2M HILL, 2007), and the *Source Areas of Concern Report, Operable Unit 2* (CH2M HILL, 2008).

In the 2001 FS Report, six ecological remedial alternatives, including a no-action alternative, were evaluated to address ecological risks to waterfowl, other birds, fish, and plants in OU 3, including both the Upper and Lower Basins. Consistent with CERCLA, its implementing regulations, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and the findings presented in the 2001 FS Report and the 2002 ROD for OU 3, USEPA has determined that it is appropriate to carry forward only the Upper Basin components of Ecological Alternatives 3 and 4 as the basis for remedial alternatives to be considered in the FFS for the Upper Basin. It was also determined that Ecological Alternatives 1, 2, 5, and 6 in

[2] Specific ARARs can be waived if appropriately justified [*Code of Federal Regulations* [CFR] 300.430(f)(1)(ii)(C)].

the 2001 FS Report would not be sufficiently protective of human health and the environment, and do not warrant further analysis.[3] Therefore, USEPA has updated and expanded Ecological Alternatives 3 and 4, using information obtained since the three RODs were issued, to develop remedial alternatives for evaluation in the FFS. The updated and expanded remedial alternatives for OU 3 are referred to as Alternatives 3+ and 4+.

This FFS Report also considers remedial alternatives for the Phase II actions of the OU 2 Remedy. Phase I work at OU 2 is largely complete; Phase II is intended to generally address issues encountered in implementing Phase I and to specifically address long-term water quality and environmental management issues.

In conjunction with the development of this FFS Report and the forthcoming Upper Basin ROD Amendment, USEPA is in the process of planning and prioritizing actions for implementation of the comprehensive remedy for the Upper Basin. The outcome of this effort will be an Implementation Plan that will prioritize and guide actions selected in the Upper Basin ROD Amendment. This Plan will be a separate "living document" from the ROD Amendment that will identify priority projects and guide cleanup actions into the future. The Implementation Plan will also use adaptive management to incorporate "lessons learned" and to guide future efforts to prioritize work. Adaptive management is a process in which decisions are made as part of an ongoing science-based process. It involves implementing, testing, monitoring, and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings. The Implementation Plan and adaptive management process will be tools to help USEPA and others make better decisions as more information becomes available on the effectiveness of initial cleanup actions, and will provide the framework for the implementation of future actions. The Implementation Plan will be routinely updated as increments of work are completed and decisions are made for new phases of work to guide future decisionmaking and help document adjustments to project priorities based on new information. USEPA will involve stakeholders and community members in the development of the Implementation Plan and during the implementation of cleanup actions.

For planning purposes, this FFS has taken the same conservative approach applied in the 2001 FS by including many sites, some of which have only limited or outdated data available. However, additional site-specific data will be collected during the design phase of the Upper Basin cleanup, and it may be determined that some sites do not require remedial action at all or that they require a smaller-scale action than identified in this FFS Report. Conversely, data collected during the design phase may indicate that more extensive actions may be required at some locations. The Implementation Plan and the adaptive management process will allow USEPA to begin near-term remedial actions in some areas where sufficient data are available and opportunities to achieve remedial action objectives are greater, rather than delaying remedial actions throughout the Upper Basin while additional data are being collected. At sites where limited data are available, pre-design data collection will occur in parallel with initial remedial actions and the cleanup plan will be refined over time in response. USEPA's approach to Upper Basin cleanup will therefore focus on refining the cleanup plan over time through a formalized adaptive management process, and with

[3] Alternative 1, the No Action Alternative, while not NCP-compliant, is evaluated in this FFS Report for comparative purposes only.

continued use and refinement of tools to assist in the prioritization of sites for remedial action.

In this FFS Report, remedial actions are evaluated for areas that are or may be subject to mining-related activities. USEPA will consider current and potential mining-related activities as it implements remedial actions in these areas. In addition, USEPA will coordinate the implementation of remedial actions, including timing, staging, and who would perform the work, with owners of property in these areas.

Consideration of these factors will help guide this important cleanup work and provide transparency on how cleanup decisions will be made, the expected outcomes, and progress towards meeting the objectives of the Upper Basin ROD Amendment.

Development of Alternatives

This section summarizes the development of the alternatives for the Upper Basin that are evaluated in this FFS Report: first the remedial alternatives, then the human health remedy protection alternatives.

Remedial Alternatives for the Upper Basin Portion of Operable Unit 3

As discussed above, the Upper Basin components of Ecological Alternatives 3 and 4 presented for the Coeur d'Alene Basin in the 2001 FS Report (USEPA, 2001b) are updated and expanded in this FFS Report in a consistent manner based on new information. The updated and expanded remedial alternatives are referred to as Alternatives 3+ and 4+ for OU 3. An overview of the source sites included in Alternatives 3+ and 4+ and their distribution in the Upper Basin is provided in Figure ES-1. Remedial alternatives for OU 2 were developed separately (as described below) and then combined with OU 3 Alternatives 3+ and 4+ to create 10 action alternatives that are evaluated in this FFS Report.

Alternatives 3+ and 4+ evaluate the same sites for potential remedies as were considered in Ecological Alternatives 3 and 4 in the 2001 FS Report. As shown below, a total of 761 sites are considered:

Sites	Alternative 3	Alternative 3+	Alternative 4	Alternative 4+
Sites with Proposed Action(s)	332	348	699	704
Sites with No Proposed Actions	429	413	62	57
Total	**761**	**761**	**761**	**761**

The differences between Ecological Alternative 3 and Alternative 3+ and between Ecological Alternative 4 and Alternative 4+ are relatively minor in terms of the number of sites that have changed from no proposed action to proposed action. Other differences result from updates to the typical conceptual designs (TCDs) for cleanup methods and the estimated volumes of materials to be addressed. Based on new information that was not available when the 2001 FS Report was published, groups of sites and associated remedial actions in OU 3 that have been modified in this FFS Report include the following:

- **Sites added on the basis of relatively high estimated dissolved metals loading to surface water.** Based on analysis of site data that were not available at the time of the 2001 FS Report, 11 sites were added to Alternative 3+ on the basis of relatively high estimated dissolved metals loading to surface water. None of these sites were included in Ecological Alternative 3 in the 2001 FS Report, and four were not included in Ecological Alternative 4.
- **Formerly and currently operating sites.** Actions at four formerly or currently operating sites were changed from "hydraulic isolation" to "hydraulic isolation and capping" in both Alternatives 3+ and 4+. These sites were acknowledged in the 2001 FS Report, but complete remedial actions were not identified.
- **Updated conceptual design for hydraulic isolation.** The method by which hydraulic isolation will be accomplished at six sites along the SFCDR was revised for Alternatives 3+ and 4+. "Hydraulic isolation using slurry walls" was replaced with "hydraulic isolation using stream liners and French drains" based on updated analysis.
- **Sites with a water treatment component.** A total of 59 sites in Alternative 3+ and 96 sites in Alternative 4+ include different water treatment TCDs than those included in Ecological Alternatives 3 and 4, respectively, in the 2001 FS Report. The updated TCDs include changes (resulting from further analysis) in the location of the centralized, active treatment plant,[4] the method of treatment for specific sites (active to semi-passive and vice versa), and the manner of providing semi-passive treatment.
- **Sites within the Pine Creek Watershed.** Based on discussions with BLM, the remedial actions identified for the Pine Creek Watershed have been modified to account for remedial work that has been completed and new data that have been collected since the 2001 FS Report was issued. In addition, several sites have been added to the list for remedial action based on recommendations provided by BLM.
- **Sites located within the Woodland Park area of Canyon Creek.** Woodland Park has been an area of focused study since the ROD for OU 3 was completed because it is a significant source of dissolved metals loading in surface water in the Upper Basin. It is also an alluvial area where, at the time when the 2002 ROD was published, the groundwater system and groundwater-surface water interactions were not well understood. The post-ROD studies included groundwater modeling, groundwater-surface water interaction studies, and water treatability studies. These studies found that the surface water treatment actions included for Woodland Park in Ecological Alternative 3 in the 2001 FS Report were not feasible. It was determined, based on groundwater modeling, that by treating groundwater with relatively high metals concentrations, remedial objectives could be achieved more efficiently. Remedial components for Alternatives 3+ and 4+ for Woodland Park have been developed based on the post-ROD studies and evaluation of remedial options.

As was the case with Ecological Alternatives 3 and 4 in the 2001 FS Report, the primary difference between Alternatives 3+ and 4+ is the extent of excavation and removal of wastes. Alternative 3+ focuses on a combination of in-place containment and excavation of wastes

[4] The 2001 FS Report proposed constructing a new high-density sludge plant for water treatment in Pinehurst. This FFS Report proposes expanding and upgrading the existing Central Treatment Plant in Kellogg.

inside the nominal 100-year floodplain, as well as wastes outside the 100-year floodplain that are probable sources of metals loading. Active and semi-passive water treatment of adit drainages and hydraulic isolation of groundwater are also included in Alternative 3+. Under Alternative 3+, an estimated average flow of 12,000 gallons per minute (gpm) of contaminated water would be treated at the Central Treatment Plant (CTP) located in Kellogg, Idaho, and an additional 800 gpm would be treated by onsite semi-passive systems.

Alternative 4+, on the other hand, focuses on complete excavation and hydraulic isolation of all wastes that are probable sources of metals loading. Wastes that are outside the 100-year floodplain and probably not significant sources of metals loading would be covered in place. Expanded use of active and semi-passive water treatment of adit drainages and hydraulic isolation of groundwater is also included in Alternative 4+. Under Alternative 4+, an estimated average flow of 14,000 gpm of contaminated water would be treated at the CTP and an additional 1,400 gpm would be treated by onsite semi-passive systems.

Estimated treated-water flow rates for Alternatives 3+ and 4+ (above) represent water from OU 3 only, and do not include the water that currently flows from the Bunker Hill Mine to the CTP, or additional water that would result from the implementation of OU 2 Phase II remedial actions (discussed below).

Remedial Alternatives for Operable Unit 2

The OU 2 Phase II remedial alternatives were developed by taking into consideration the effectiveness of the source removal, containment, and surface capping completed as part of Phase I remedial actions at OU 2. Given the surface water and groundwater concerns in OU 2, remedial alternatives with the potential to address significant portions of the remaining metals loading to the SFCDR in the Bunker Hill Box were identified for Phase II work. The development of Phase II remedial alternatives for OU 2 focused on source control, water collection and management, and water treatment actions, which were combined as applicable into the five FFS OU 2 Alternatives (a) through (e). These alternatives are summarized below.

The OU 2 Phase I effectiveness evaluation indicated that the largest source of dissolved metals contamination to groundwater and surface water in OU 2 is contaminated materials located in floodplains and beneath the populated areas and infrastructure within the OU. Because of the widespread nature of contaminated materials, USEPA's commitment to not displace the community, and the complexity of contaminant transport within OU 2, a remedial approach focusing on groundwater-based actions was developed. To support this, a groundwater flow model was constructed, calibrated, and used to assist with the development of Phase II remedial alternatives. Model simulations were performed on all water management/collection actions, and subsequent load reductions for each action were estimated. A cost-benefit analysis was also performed for each individual action based on the cost per pound of dissolved zinc load reduction to the SFCDR.

In order to achieve compliance with the order from USEPA to capture all discharges of acid mine drainage (AMD) from the Bunker Hill Mine, all the OU 2 alternatives include the same phased water collection and management actions for the Reed and Russell Adit Tunnels (part of the Bunker Hill Mine). These actions comprise a check dam installed in each tunnel in the interior of the mine to keep the discharge from the Reed and Russell Adit Tunnels

from flowing out of the adit, and instead redirect it back into the mine. If the required water quality criteria are not achieved in the residual discharge, additional measures will be implemented to collect and convey the AMD from the tunnels by constructing a collection system and pipeline that will ultimately drain, along with all other AMD from the Bunker Hill Mine, to the CTP for active treatment.

- **OU 2 Alternative (a): Minimal Stream Lining.** OU 2 Alternative (a) consists of limited stream-lining actions in losing reaches (where surface water enters underlying groundwater) of OU 2 streams to reduce recharge to the shallow alluvial groundwater system. Actions would include lining the SFCDR on the north side of the Central Impoundment Area (CIA); lining Bunker, Deadwood, and Magnet Creeks; and phased implementation of the actions for the Reed and Russell Adit Tunnels discussed above. No additional water treatment would be required under this alternative (unless needed for discharges from the Reed and Russell Adit Tunnels).
- **OU 2 Alternative (b): Extensive Stream Lining.** OU 2 Alternative (b) consists of extensive stream-lining actions in OU 2 streams to reduce recharge to the shallow alluvial groundwater system. Groundwater cutoff walls would be installed at selected locations. Actions would include lining Bunker, Government, Deadwood, and Magnet Creeks; installing slurry walls and extraction wells upgradient of tributary stream liners (except Bunker Creek) to direct groundwater into the lined channels; and phased implementation of the actions for the Reed and Russell Adit Tunnels discussed above. No additional water treatment would be required under this alternative (unless needed for discharges from the Reed and Russell Adit Tunnels).
- **OU 2 Alternative (c): French Drains.** OU 2 Alternative (c) consists of a French drain system located in the central portion of OU 2, along the northern and western ends of the CIA in the area with the highest dissolved metal load gains observed in the SFCDR. This French drain system would intercept dissolved-metals-contaminated groundwater prior to it otherwise discharging to the SFCDR. Actions would include installing a French drain along the northwest end of the CIA and to the southwest across the SFCDR valley floor, terminating on the west side of Government Gulch; conveying water collected in the French drain to the CTP for treatment; conveying the CTP effluent directly to the SFCDR in a pipeline installed on the east side of the CIA or in a pipe along Bunker Creek (instead of discharging to Bunker Creek as is currently done); and phased implementation of the actions for the Reed and Russell Adit Tunnels discussed above. An estimated average flow of 3,900 gpm of contaminated groundwater would be treated at the CTP under this alternative (in addition to current flows of AMD from the Bunker Hill Mine and waters to be added from OU 3).
- **OU 2 Alternative (d): Stream Lining/French Drain Combination.** OU 2 Alternative (d) consists of French drains, stream liners, cutoff walls, and extraction wells located in the central portion of OU 2, primarily in the area with the highest dissolved metal load gains observed in the SFCDR. Actions would include lining Government Creek; installing a slurry wall and extraction wells across Government Gulch (on the upgradient end of the liner); installing a French drain along the northwest end of the CIA and extending south across the SFCDR valley, terminating on the east side of Government Gulch; conveying water collected in the French drain to the CTP for treatment; installing extraction wells

across the mouth of Government Gulch and conveying the extracted water to the CTP for treatment; conveying the CTP effluent directly to the SFCDR in a pipeline installed on the east side of the CIA or in a pipe along Bunker Creek (instead of discharging to Bunker Creek as is currently done); and phased implementation of the actions for the Reed and Russell Adit Tunnels discussed above. An estimated average flow of 3,900 gpm of contaminated groundwater would be treated at the CTP under this alternative (in addition to current flows of AMD from the Bunker Hill Mine and waters to be added from OU 3).

- **OU 2 Alternative (e): Extensive Stream Lining/French Drain Combination.** OU 2 Alternative (e) is the most extensive water collection and management alternative, incorporating extensive stream lining of the SFCDR and its tributaries as well as French drain systems. Actions would include lining of the SFCDR and Bunker, Government, Deadwood, Magnet, Grouse, and Humbolt Creeks; installing a French drain at the north end of the CIA along the gaining reach (groundwater entering surface water) of the SFCDR, as in OU 2 Alternatives (c) and (d), and conveying the collected water to the CTP for treatment; installing a French drain extending from mid-Smelterville Flats west to the Pinehurst Narrows, and conveying the collected water to the CTP for treatment; installing slurry walls and extraction wells upgradient of tributary liners (except in Bunker Creek) to direct groundwater into the lined channels; across the SCFDR valley floor, installing a slurry wall and extraction wells at Elizabeth Park and a slurry wall at Pinehurst Narrows; and phased implementation of the actions for the Reed and Russell Adit Tunnels discussed above. An estimated average flow of 2,400 gpm of contaminated groundwater would be treated at the CTP under this alternative (in addition to current flows of AMD from the Bunker Hill Mine and waters to be added from OU 3).

The OU 2 alternatives are combined with the alternatives for OU 3 to create the 10 remedial alternatives for the Upper Coeur d'Alene Basin that are evaluated in this FFS Report [Alternatives 3+(a) through 3+(e) and Alternatives 4+(a) through 4+(e)].

Remedy Protection Alternatives

The remedy protection alternatives for the Upper Basin focus on protecting the soil remedial actions completed as part of the human health remedies selected in the RODs for OUs 1, 2, and 3 (USEPA, 1991, 1992, and 2002). The final remedies selected for OUs 1, 2, and 3 that have been implemented to date have functioned as designed and are protective of human health, as documented in the Five-Year Review Reports prepared for the Bunker Hill Superfund Site (USEPA, 2000a, 2000b, 2005). As part of the existing selected remedies, clean, protective barriers have been installed in residential, commercial, common use, and right-of-way areas to prevent direct contact and exposure to mining-related contaminants in soil. Long-term maintenance of these barriers is a key component of the success of the existing remedies. USEPA is aware of certain circumstances, however, that have the potential to adversely impact, and in limited circumstances have already impacted, the successful long-term effectiveness and permanence of the barriers installed as part of these remedies. These circumstances include inadequate infrastructure to effectively convey floodwater and surface water through communities without damaging the existing remedies.

Before developing alternatives to enhance the protectiveness of the existing remedies in the Upper Basin, the potential threat of damage posed to the remedies by localized storm events

was assessed. The assessment focused on eight of the most densely populated communities in the Upper Basin: Pinehurst, Smelterville, Kellogg, Wardner, Osburn, Silverton, Wallace, and Mullan. Erosion (or scour) of clean barriers that exposes contamination and deposition of contaminated sediments on previously clean barriers are the major threats posed to the existing remedies. The threat of sediment deposition exists in the following scenarios: (1) deposition of contaminated creek sediments on protective barriers if a creek overtops its banks during a flood; (2) scour of contaminated materials below a protective barrier and deposition of these materials on a previously clean area; and (3) scour of contaminated materials from a nearby hillside or other source and deposition of these materials on previously clean barriers.

The remedy protection alternatives evaluated in the FFS Report focus on localized tributary flooding and precipitation (storm) events that may impact human health and the environment by eroding protective barriers and/or by depositing contaminated sediments in previously clean areas, thereby exposing contaminated soil and gravel to human and ecological receptors. Hydrologic and hydraulic models analyzed the total expected impact area of barrier scouring and resultant deposition of potentially contaminated sediments for 5-, 25-, and 50-year storm events. The results of these analyses were used to assess whether remedy protection projects could improve the long-term effectiveness and permanence of the in-place barriers within each community.

Two remedy protection alternatives are described in the FFS Report and are summarized as follows:

- **Alternative RP-1: No Further Action (Post-Event Response).** Alternative RP-1 would not modify any of the existing conditions in the Upper Basin to increase the current level of long-term permanence of the existing remedies. If the existing remedies were damaged during storm events and this damage posed risks to human health and/or the environment that warranted response actions to reduce the risks, USEPA and state agencies would determine the best approaches for addressing such contamination. In the event of catastrophic flooding, USEPA and other federal and state agencies would evaluate response needs as appropriate. Because various portions of the existing remedies are expected to be damaged during storm events, based on hydrologic and hydraulic analyses conducted during the FFS, Alternative RP-1 includes the estimated costs for repair of the selected remedies in the Upper Basin communities. Although detailed analyses were not conducted for the side gulches (i.e., drainages located outside the eight primary Upper Basin communities), the expected damage due to storm events was estimated based on the trends found in the hydrologic and hydraulic analyses of the Upper Basin communities.

- **Alternative RP-2: Modifications to Selected Remedies to Enhance Protectiveness (Remedy Protection Projects).** Alternative RP-2 comprises combinations of various technology and process options to protect the existing selected remedies against tributary flooding and high precipitation events up to the 50-year storm. Each community has different water conveyance infrastructure-related issues that pose risks to the existing remedies. General technologies and process options that could be applicable to remedy protection projects were developed from common engineering practice used for stormwater conveyance projects. The technologies and process options identified to mitigate the risks posed to the existing remedies in Alternative RP-2 were

determined based on current conditions in each community area, and on hydrologic and hydraulic analyses. For the purposes of this evaluation, the Alternative RP-2 remedy protection projects and estimated costs were preliminarily defined for each of the eight primary Upper Basin communities. Although detailed analyses were not conducted for side gulches, approximate costs to address problems in the side gulches were developed for Alternative RP-2 based on the trends found in the analysis of the Upper Basin communities. Easements and operations and maintenance (O&M) agreements may be a necessary component of Alternative RP-2 to ensure long-term access and functionality of the remedy protection projects. If necessary to ensure long term maintenance of the remedy protection projects, USEPA, IDEQ, and the Work Trust will also rely on local governments to ensure continued operation and maintenance as property use changes.

Evaluation and Comparison of Alternatives to CERCLA Criteria

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

Threshold Criteria
1. Overall protection of human health and the environment
2. Compliance with ARARs
Primary Balancing Criteria
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume [of hazardous substances] through treatment
5. Short-term effectiveness
6. Implementability
7. Cost of implementation
Modifying Criteria
8. State and Tribal acceptance
9. Community acceptance

The three criteria categories are based upon the role of each criterion during the evaluation and remedy selection process. The two Threshold Criteria relate directly to statutory requirements that must be satisfied by a selected alternative, as ultimately documented in a ROD. The five Primary Balancing Criteria represent the primary technical, cost, institutional, and risk factors that form the basis of the evaluation. The two Modifying Criteria will be evaluated in the ROD Amendment following the receipt of state agency, Tribal, and public comments on the Proposed Plan.

Evaluation and Comparison of the Remedial Alternatives

The evaluation and comparison of the combined remedial alternatives for OUs 2 and 3 are summarized in Figure ES-2. This figure is used to provide the reader with a "relative" comparison between remedial alternatives that are NCP-compliant. As such, differences portrayed, while visually appearing significant, can be more subtle. Past FSs for these OU areas already examined a wide range of remedial alternatives, as required by CERCLA, which demonstrated significant differences between remedial alternatives, as would be expected.

Overall Protection of Human Health and the Environment. Protection of human health and the environment is one of two threshold requirements that each alternative must meet in order to be eligible for selection as a remedy (the other being compliance with ARARs). All of the alternatives, except the No Action Alternative, would achieve the criterion of overall protection of human health and the environment.

Although this criterion is evaluated as either "meets" or "does not meet", it can be helpful to also look at the different approaches to protectiveness, in that some alternatives may be more favorable than others. For example, all of the alternatives based on Alternative 3+ may provide benefits different than Alternative 4+ regardless of which OU 2 alternative is included. The estimated implementation time frame for Alternative 4+ may be decades longer than that for Alternative 3+ and, during this time, Alternative 4+ would involve construction-related risks to workers, the community, and the environment resulting from the much larger extent of long-term construction and hauling involved. These risks are considered to outweigh the long-term benefits of the additional proposed actions compared to Alternative 3+. Alternative 4+ would also have the greatest short-term environmental effects at offsite locations where borrow materials would be obtained. Implementation time frames are shorter for Alternative 3+, and the remedial actions are less extensive and would carry fewer risks to workers, the community, and the environment.

Compliance with ARARs. Compliance with ARARs is the second threshold requirement that each alternative must meet in order to be eligible for selection as a remedy. All of the alternatives would achieve the criterion of compliance with ARARs. PRGs for soil and sediments would be met upon completion of remedial actions in all locations where remedial actions are taken under each alternative, while ARARs for surface water would be met for all the alternatives through implementation of the remedial actions and different periods of natural source reduction (described further below). As with the overall protectiveness criterion, although this criterion is evaluated as either "meets" or "does not meet", it can be helpful to also look at the differences between the initial effectiveness of each alternative in the progress towards meeting surface water quality standards (i.e., AWQC).[5]

An analysis was conducted to estimate relative post-remediation AWQC ratios and dissolved zinc load reductions in the SFCDR at Elizabeth Park and Pinehurst for each alternative, the results of which are shown in the table below.

[5] Note that maximum contaminant levels (MCLs) for drinking water are also ARARs for surface water as a drinking water source in the Upper Basin. However, the AWQC are used as an indication of compliance with surface water ARARs because, in general, the AWQC are lower than the MCLs for the site contaminants of concern.

Estimated Post-Remediation Dissolved Zinc AWQC Ratios and Load Reduction at Pinehurst

Alternative	Estimated Post-Remediation AWQC Ratio for Dissolved Zinc at Pinehurst	Estimated Post-Remediation Dissolved Zinc Load Reduction at Pinehurst
Alternative 3+(a)	2.9	940 lb/day (41%)
Alternative 3+(b)	3.0	930 lb/day (41%)
Alternative 3+(c)	1.8	1,340 lb/day (59%)
Alternative 3+(d)	1.7	1,380 lb/day (60%)
Alternative 3+(e)	1.5	1,450 lb/day (63%)
Alternative 4+(a)	2.8	1,040 lb/day (45%)
Alternative 4+(b)	2.8	1,030 lb/day (45%)
Alternative 4+(c)	1.6	1,440 lb/day (63%)
Alternative 4+(d)	1.5	1,480 lb/day (65%)
Alternative 4+(e)	1.3	1,550 lb/day (68%)
No Action Alternative	5.2	N/A

Notes:

AWQC = ambient water quality criteria

lb/day = pounds per day

N/A = not applicable

Note: For reference the estimated current average annual dissolved zinc load at Pinehurst is 2,290 lb/day.

The results of this analysis indicate that all of the action alternatives would meet the threshold criterion of compliance with ARARs for surface water, but only after a natural source depletion period, which is common to all of the alternatives. The relative period of time required between alternatives is expected to be related to the water quality improvement achieved upon the completion of remedial actions. It is important to note that this analysis was only conducted at two key locations on the SFCDR: Pinehurst and Elizabeth Park. These two locations provide an estimate of overall cleanup progress in the Upper Basin, as the Elizabeth Park location is on the SFCDR upstream of the Box and Pinehurst location is on the SFCDR near the confluence with the North Fork and at the downstream end of the Box.

It is expected that dramatic localized improvements in surface water quality would be observed throughout areas of the Upper Basin resulting from remedial actions in various watershed and tributaries to the SFCDR.

Because the No Action Alternative was only included for baseline comparison purposes and does not meet either of the Threshold Criteria (overall protection of human health and the environment, and compliance with ARARs), it is not discussed further in the following sections that discuss the remaining evaluation criteria (the Primary Balancing Criteria).

Long-Term Effectiveness and Permanence. All of the alternatives based on Alternative 4+ rank slightly higher under the criterion of long-term effectiveness than those based on Alternative 3+, regardless of which OU 2 alternative it is coupled with. Alternative 4+ would achieve the highest degree of long-term effectiveness and permanence and would

result in the fewest residual risks to human health and ecological receptors. Alternative 4+ has a higher degree of permanence than Alternative 3+ as a result of the much higher volumes of contaminated materials that would be removed from the system and managed in repositories. The estimated effectiveness at the completion of remedial actions is also slightly higher for Alternative 4+ than for Alternative 3+. The differences in ranking among the OU 2 alternatives under this criterion do not outweigh the differences between Alternatives 3+ and 4+. The ranking of the OU 2 alternatives, from highest to lowest, is (e), (d), (c), (a), and (b). This ranking is based on the relative differences in estimated post-remediation load in the SFCDR.

Reduction of Toxicity, Mobility, or Volume through Treatment. All the 10 combined remedial alternatives are considered to satisfy the statutory preference for treatment. Although the treated water flow rates are relatively similar for all the alternatives, the estimated mass of dissolved zinc removed through treatment ranges from 230 to 1,500 pounds per day (lb/day). Surface water treatment would occur through both active treatment at the CTP in Kellogg and semi-passive treatment near the source sites.

OU 2 Alternatives (a) and (b) do not include treatment and, therefore, rank lower under this criterion. OU 2 Alternative (c) would treat the greatest dissolved zinc load, followed by Alternative (d) and then (e). Alternative 4+ includes greater volumes of water treated at the CTP than Alternative 3+. However, Alternative 3+ is expected to remove more contaminant mass through treatment than Alternative 4+ (330 lb/day versus 230 lb/day, respectively); therefore, Alternative 3+ ranks higher than Alternative 4+. The statutory preference for treatment is satisfied through reduction of total volume of contaminated media—in this case, surface water. The water treatment technologies to be employed would separate the metals from the water. These metals would then require disposal in repositories.

Short-Term Effectiveness. All of the alternatives based on Alternative 3+ rank higher under the criterion of short-term effectiveness than those based on Alternative 4+ because Alternative 4+ would pose much greater short-term negative impacts during construction than Alternative 3+, regardless of which OU 2 alternative it is coupled with. This is primarily due to the more extensive nature of the remedial actions that would be conducted under Alternative 4+, which would require a much longer time period to complete (up to decades longer); the similar water quality expected to be achieved after the implementation of remedial actions; and the similar time frame needed for natural source depletion to further improve water quality and achieve ARARs. The ranking of the OU 2 alternatives from highest to lowest short-term effectiveness is as follows: (d), (c), (b), (a), and (e). This ranking is based on a balance of implementation time, effectiveness, and short-term risks.

Implementability. All of the alternatives based on Alternative 3+ rank higher under the criterion of implementability than those based on Alternative 4+, because Alternative 4+ would have substantially increased technical and administrative feasibility considerations compared to Alternative 3+. Alternative 4+ has generally the same types of implementability considerations as Alternative 3+, but with much larger quantities and larger repository requirements. The ranking of the OU 2 alternatives from most to least desirable on the basis of implementability is as follows: (c), (d), (b), (a), and (e).

Cost of Implementation. Estimated costs for each remedial alternative are presented in Table ES-1. As shown, costs for alternatives based on Alternative 4+ are consistently higher than

those based on Alternative 3+, regardless of which OU 2 alternative it is coupled with. The OU 2 costs are relatively small, ranging from 1 to 20 percent of the total alternative cost. The ranking of the OU 2 alternatives based on lowest to highest cost is as follows: (b), (c), (d), (a), and (e). The cost for OU 2 Alternative (a) is higher than the cost for OU 2 Alternative (b) because, although (b) includes more linear feet of stream lining, (a) includes a liner on the SFCDR that carries a significantly higher cost.

Evaluation and Comparison of the Remedy Protection Alternatives

For the remedy protection alternatives, a summary of the comparative evaluation is presented in Figure ES-3. This figure summarizes the various trade-offs between alternatives when compared to the CERCLA Threshold and Primary Balancing Criteria. The comparative analysis of the remedy protection alternatives is discussed below.

Overall Protection of Human Health and the Environment. Both Alternatives RP-1 and RP-2 would be protective of human health and the environment because the existing human health remedies have been shown to be protective (USEPA, 2005). Alternative RP-2 would be more protective of human health and the environment because it would increase the long-term effectiveness and permanence of the existing remedies by decreasing the risk of recontamination due to flooding and uncontrolled surface water flows. Alternative RP-1 would only maintain and repair the existing remedies if they were damaged or recontaminated.

Compliance with ARARs. Both Alternatives RP-1 and RP-2 can be implemented in compliance with location- and action-specific ARARs. (Chemical-specific ARARs were not included as part of this evaluation because the remedy protection alternatives would only enhance the protectiveness of the existing remedies, and do not directly address metals contamination.)

Long-Term Effectiveness and Permanence. Alternative RP-2 would increase the long-term effectiveness and permanence of the existing remedies by increasing flooding controls and localized surface water controls, thereby decreasing the risk of recontamination and damage to the remedies due to flooding and uncontrolled surface water flows. Alternative RP-1 would only maintain and repair the existing remedies if they were damaged or recontaminated.

Reduction of Toxicity, Mobility, or Volume through Treatment. Neither Alternative RP-1 nor Alternative RP-2 would include treatment and, therefore, neither would reduce the toxicity, mobility, or volume of metal contaminants through treatment.

Short-Term Effectiveness. Both alternatives would be effective in the short term because the existing remedies have proven effective in protecting human health and the environment. Alternative RP-2 would reduce the mobility of potentially contaminated sediments transported by floodwaters and surface water flows through the communities by effectively conveying floodwaters up to a 50-year storm event, thereby reducing the potential routes of exposure. Alternative RP-1 would not reduce the current mobility of contaminated sediments transported by floodwaters through the communities.

Implementability. Both Alternatives RP-1 and RP-2 are implementable, but each would have typical implementation issues that would need to be addressed. Alternative RP-1 would

require clean up of recontaminated or scoured portions of the existing remedies. Contaminated sediments may also be deposited on other areas within the communities such as streets, buildings, and parking lots. The effective implementation of Alternative RP-1 would require a coordinated overall response within the communities. Administrative implementability issues would exist for Alternative RP-1 with respect to the repair and replacement of the existing remedies following storm events. These storm events cannot be predicted, and the availability of funds to repair the existing remedies and maintain their protectiveness in the future is unknown. In some cases, the repair of the protective barriers could be time-sensitive in order to maintain protectiveness and limit community residents' risk of exposure.

By comparison, Alternative RP-2 would have minimal implementability issues, except that it would be beneficial to implement the remedy protection projects during the low-flow season to minimize cost. Alternative RP-2 may have administrative implementability issues associated with O&M of the water conveyance improvement projects. Prior to construction, agreements will have to be completed regarding which state or local entity will perform O&M tasks associated with Alternative RP-2 and ensure that sufficient resources are available, or a determination will be made that a local regulatory scheme ensures performance of O&M. Additionally, there would be logistical feasibility issues associated with the construction of remedy protection projects on private property. Access and easement agreements would have to be obtained prior to the implementation of Alternative RP-2.

Cost of Implementation. Alternative RP-2 would cost less than Alternative RP-1. Table ES-1 presents a side-by-side comparison of the total costs (30-year net present value [NPV]) for Alternatives RP-1 and RP-2. The total cost (30-year NPV) for Alternative RP-1 includes the expected cost to repair and re-remediate the existing remedies based on model outputs and flood event probabilities. For Alternative RP-2, the total cost (30-year NPV) includes direct and indirect capital costs and O&M costs (30-year NPV) for construction of the remedy protection projects. Total costs for both alternatives include estimated costs for the side gulches. Detailed analyses were not conducted for the side gulches, but approximate costs were developed for both alternatives based on trends observed in the Upper Basin communities.

Next Steps

The Draft Final FFS Report and the Proposed Plan—the latter of which identifies a Preferred Alternative for the Upper Coeur d'Alene Basin—are available for a 45-day public comment period from July 12, 2010 to August 25, 2010.

The Draft Final FFS Report is presented on CD-ROM (along with the Proposed Plan and other supporting documents) because of the size of the document and the costs associated with hardcopy production and distribution. If this CD-ROM format does not enable easy review of the document, please contact USEPA to discuss other options to facilitate your review.

Comments are due to USEPA Region 10 by Wednesday, August 25, 2010. One of the files on the CD-ROM is an optional comment form which could be used to provide comments to USEPA via:

1. E-mail to cdabasin@epa.gov

2. Mail to: Coeur d'Alene Basin Team
   U.S. Environmental Protection Agency Region 10
   Mailstop ECL-113
   1200 Sixth Avenue, Suite 900
   Seattle, WA 98101

3. Comments can also be provided at the Open House and Public Meeting to be held on Wednesday, August 4, 2010 at the Shoshone Medical Center, Health and Education Center, 858 Commerce Drive, Smelterville, Idaho 83868. The Open House will take place from 5:00 to 6:30 p.m., and the Public Meeting from 7:00 to 8:30 p.m.

Following the Proposed Plan comment period, USEPA will consider and respond to all comments and plans to issue the Upper Basin ROD Amendment. The ROD Amendment will include a Responsiveness Summary with responses to comments received during the public comment period for the Proposed Plan. This decision document is anticipated to be issued in late 2010.

References

CH2M HILL. October 2007. *Phase I Remedial Action Assessment Report, Operable Unit 2, Bunker Hill Mining and Metallurgical Superfund Site.* Prepared for U.S. Environmental Protection Agency Region 10.

CH2M HILL. March 24, 2008. *Source Areas of Concern Report, Operable Unit 2, Bunker Hill Mining and Metallurgical Complex Superfund Site*. Prepared for U.S. Environmental Protection Agency Region 10.

National Academy of Sciences (NAS). 2005. *Superfund and Mining Megasites: Lessons from the Coeur d'Alene River Basin*.

Stratus Consulting. 2000. *Report of Injury Assessment and Injury Determination: Coeur d'Alene Basin Natural Resource Damage Assessment.* Prepared for the U.S. Department of the Interior, the U.S. Fish and Wildlife Service, the U.S. Department of Agriculture, the U.S. Forest Service, and the Coeur d'Alene Tribe.

U. S. Environmental Protection Agency (USEPA). August 1991. *Record of Decision, Bunker Hill Mining and Metallurgical Complex Residential Soils Operable Unit, Shoshone County, Idaho*.

U. S. Environmental Protection Agency (USEPA). September 1992. *Record of Decision (ROD), Bunker Hill Mining and Metallurgical Complex, Shoshone County, Idaho.*

U. S. Environmental Protection Agency (USEPA). January 1996 (1996a). *Explanation of Significant Differences for Revised Remedial Actions at the Bunker Hill Superfund Site, Shoshone County, Idaho.*

U. S. Environmental Protection Agency (USEPA). September 3, 1996 (1996b). *Amendment to the Record of Decision for the Bunker Hill Mining and Metallurgical Complex (Non-Populated Areas) Superfund Site.*

U. S. Environmental Protection Agency (USEPA). April 1998. *Explanation of Significant Differences for Revised Remedial Actions at the Bunker Hill Superfund Site OU 2, Shoshone County, Idaho.*

U. S. Environmental Protection Agency (USEPA). February 2000 (2000a). *Bunker Hill Populated Areas Operable Unit First Five-Year Review Report*.

U. S. Environmental Protection Agency (USEPA). September 2000 (2000b). *First Five-Year Review of the Non-Populated Area Operable Unit Bunker Hill Mining and Metallurgical Complex, Shoshone County, Idaho*.

U. S. Environmental Protection Agency (USEPA). September 2001 (2001a). *Final (Revision 2) Remedial Investigation Study Report, Coeur d'Alene Basin Remedial Investigation/Feasibility Study.* Prepared by URS Greiner and CH2M HILL for USEPA Region 10.

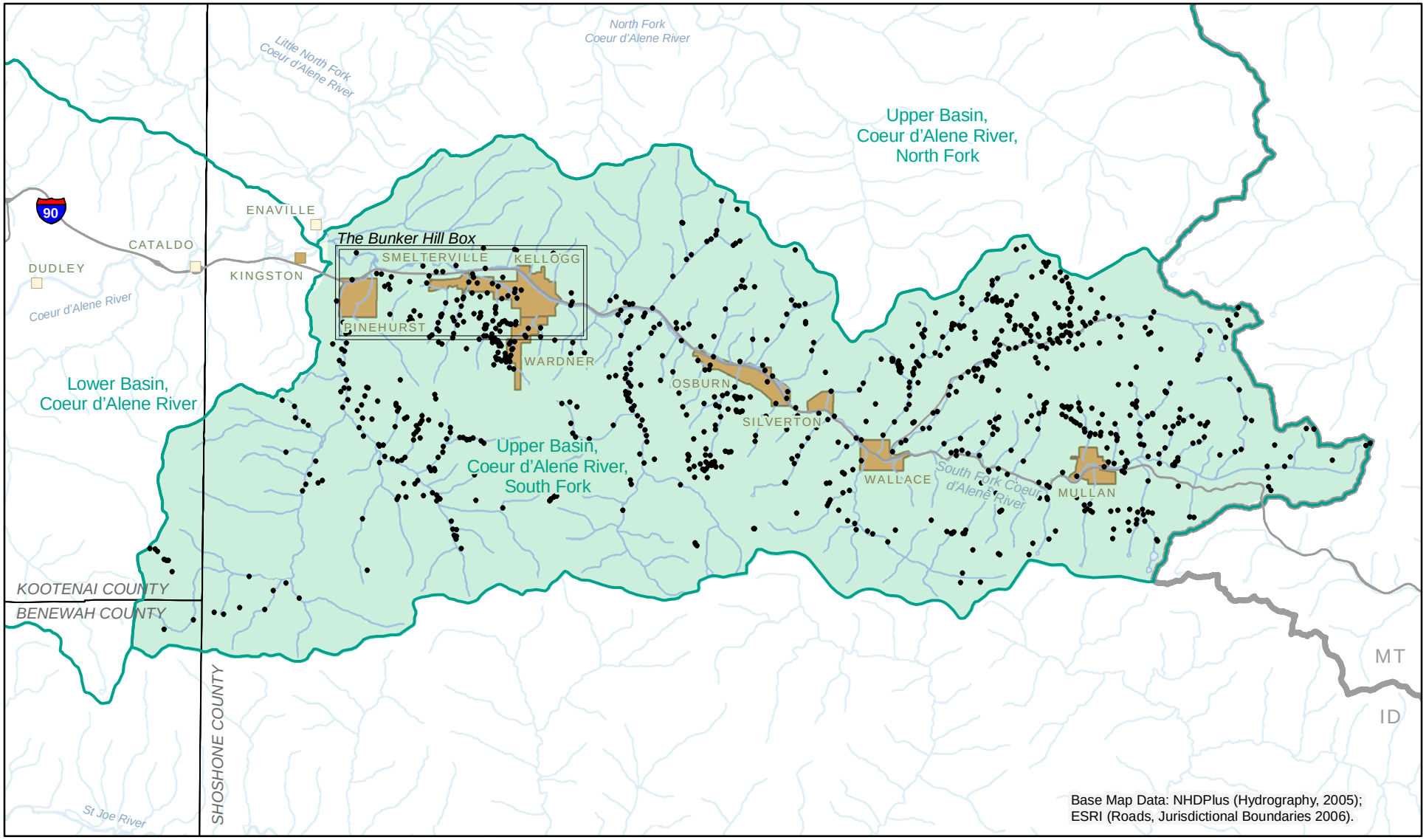
U. S. Environmental Protection Agency (USEPA). October 2001 (2001b). *Final (Revision 2) Feasibility Study Report, Coeur d'Alene Basin Remedial Investigation/Feasibility Study.* Prepared by URS Greiner and CH2M HILL for USEPA Region 10.

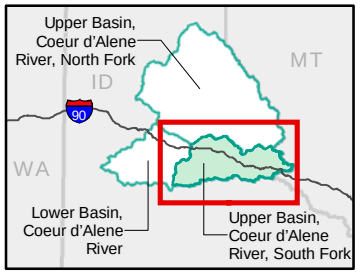
U. S. Environmental Protection Agency (USEPA). December 10, 2001 (2001c). *Record of Decision Amendment: Bunker Hill Mining and Metallurgical Complex Acid Mine Drainage, Smelterville, Idaho*.

U. S. Environmental Protection Agency (USEPA). September 2002. *Record of Decision, The Bunker Hill Mining and Metallurgical Complex Operable Unit 3*.

U. S. Environmental Protection Agency (USEPA). October 2005. *Five-Year Review Report: Second Five-Year Review for the Bunker Hill Mining and Metallurgical Complex Superfund Site, Operable Units 1, 2, and 3, Idaho and Washington.*

Figures





Focused Feasibility Study Area
Approximate Remedy Protection Study Area
Coeur d'Alene River Subbasin Boundary
Source Site
River/Creek
County Boundary
State Boundary

Notes:
1. The Focused Feasibility Study Area includes the Bunker Hill Box (OU 1 and OU 2) and the portions of OU 3 within the Upper Basin.
2. Operable Unit 3 is defined as all contaminated areas of the Coeur d'Alene River Basin, Coeur d'Alene Lake, and the Spokane River, outside the Box.
3. Source sites are based on the inventory of source sites conducted by the Bureau of Land Management (BLM) in 1999 in support of the Remedial Investigation/Feasibility Study (RI/FS) for the Coeur d'Alene Basin (U.S. Environmental Protection Agency [USEPA], 2001a, 2001b).

N
0 1 2 4 Miles

Figure ES-1
Focused Feasibility Study Area
Focused Feasibility Study
Upper Basin of the Coeur d'Alene River
BUNKER HILL SUPERFUND SITE

Criterion	Alternative 3+(a)	Alternative 3+(b)	Alternative 3+(c)	Alternative 3+(d)	Alternative 3+(e)	Alternative 4+(a)	Alternative 4+(b)	Alternative 4+(c)	Alternative 4+(d)	Alternative 4+(e)
Threshold Criteria										
Overall Protectiveness of Human Health and the Environment evaluates the overall protectiveness of the alternatives and describes how risks posed are eliminated, reduced, or controlled through treatment, engineering, or institutional controls.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether an alternative meets federal, state, and tribal environmental statutes, regulations, and other requirements that pertain to the site, and/or whether a waiver is justified.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Primary Balancing Criteria										
Long-Term Effectiveness and Permanence considers an alternative's ability to protect human health and the environment over time.	●	●	●	●	●	●	●	●	●	●
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.	•	●	●	●	●	•	•	●	●	●
Short-Term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.	●	●	●	●	●	●	●	●	●	•
Implementability considers the technical and administrative feasibility of implementing an alternative, including factors such as the availability of goods and services.	●	●	●	●	•	•	•	•	•	○
Cost includes estimated present worth capital and operation and maintenance (O&M) costs. O&M costs are estimated for a 30-year period using a discount rate of 7 percent.	●	●	●	●	●	○	○	○	○	○
Modifying Criteria										
State/Tribal Acceptance considers whether the States and Tribes agree with USEPA's analyses and recommendations, as described in the Focused Feasibility Study Report and the Proposed Plan.	**To be evaluated after comments are received on the Proposed Plan.**									
Community Acceptance considers whether the local community agrees with USEPA's analyses and the Selected Remedy. Comments received on the Proposed Plan during the public comment period are an important indicator of community acceptance.										

✓ Alternative meets this Threshold Criterion.

Comparative Ranking Symbols:

● **Highest** – The alternative is either the most favorable, compared to the other alternatives, or is equally favorable among the alternatives ranked highest.

● **High** – The alternative is highly favorable in regard to this criterion, but at least one other alternative is ranked higher.

● **Medium** – The alternative is moderately favorable (i.e., other alternatives are more or less favorable for this criterion).

• **Low** – The alternative is somewhat favorable for this criterion, but at least one alternative is ranked lower.

○ **Lowest** – The alternative is either the least favorable, compared to other alternatives, or does not meet the criterion.

Figure ES-2
Overview of Comparative Analysis of Remedial Alternatives
Focused Feasibility Study
Upper Basin of the Coeur d'Alene River
BUNKER HILL SUPERFUND SITE

Criterion	Alternative RP-1	Alternative RP-2
Threshold Criteria		
Overall Protectiveness of Human Health and the Environment evaluates the overall protectiveness of the alternatives and describes how risks posed are eliminated, reduced, or controlled through treatment, engineering, or institutional controls.	✓	✓
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether an alternative meets federal, state, and tribal environmental statutes, regulations, and other requirements that pertain to the site, and/or whether a waiver is justified.	✓	✓
Primary Balancing Criteria		
Long-Term Effectiveness and Permanence considers an alternative's ability to protect human health and the environment over time.	●	⬤
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.	○	○
Short-Term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.	●	⬤
Implementability considers the technical and administrative feasibility of implementing an alternative, including factors such as the availability of goods and services.	●	⬤
Cost includes estimated present worth capital and operation and maintenance (O&M) costs. O&M costs are estimated for a 30-year period using a discount rate of 7 percent.	●	⬤
Modifying Criteria		
State/Tribal Acceptance considers whether the States and Tribes agree with USEPA's analyses and recommendations, as described in the Focused Feasibility Study Report and the Proposed Plan.	**To be evaluated after comments are received on the Proposed Plan.**	
Community Acceptance considers whether the local community agrees with USEPA's analyses and the Selected Remedy. Comments received on the Proposed Plan during the public comment period are an important indicator of community acceptance.		

✓ Alternative meets this Threshold Criterion.

Comparative Ranking Symbols:

⬤ **Highest** – The alternative is either the most favorable, compared to the other alternatives, or is equally favorable among the alternatives ranked highest.

⬤ **High** – The alternative is highly favorable in regard to this criterion, but at least one other alternative is ranked higher.

⬤ **Medium** – The alternative is moderately favorable (i.e., other alternatives are more or less favorable for this criterion).

● **Low** – The alternative is somewhat favorable for this criterion, but at least one alternative is ranked lower.

○ **Lowest** – The alternative is either the least favorable, compared to other alternatives, or does not meet the criterion.

Figure ES-3
Overview of Comparative Analysis of Remedy Protection Alternatives
Focused Feasibility Study
Upper Basin of the Coeur d'Alene River
BUNKER HILL SUPERFUND SITE

Tables

TABLE ES-1

Summary of Cost Estimates for Remedial Alternatives and Remedy Protection Alternatives

Focused Feasibility Study, Upper Basin of the Coeur d'Alene River, Bunker Hill Superfund Site

Remedial Alternative	Remedial Actions	Total Capital Cost	O&M Cost (30-Year NPV)	O&M Cost (Annual Average)	Total Cost (30-Year NPV)
Alternative 3+(a)	Alternative 3+ for OU 3	$ 1,170,000,000	$ 93,600,000	$ 7,540,000	$ 1,270,000,000
	Alternative (a) for OU 2	$ 60,200,000	$ 1,190,000	$ 95,900	$ 61,400,000
	Sludge Disposal Cell	$ 5,055,000	$ 254,000	$ 20,500	$ 5,310,000
	Total	**$ 1,240,000,000**	**$ 95,000,000**	**$ 7,660,000**	**$ 1,340,000,000**
Alternative 3+(b)	Alternative 3+ for OU 3	$ 1,170,000,000	$ 93,600,000	$ 7,540,000	$ 1,270,000,000
	Alternative (b) for OU 2	$ 24,800,000	$ 1,020,000	$ 82,200	$ 25,900,000
	Sludge Disposal Cell	$ 5,055,000	$ 254,000	$ 20,500	$ 5,310,000
	Total	**$ 1,200,000,000**	**$ 94,900,000**	**$ 7,640,000**	**$ 1,290,000,000**
Alternative 3+(c)	Alternative 3+ for OU 3	$ 1,170,000,000	$ 93,600,000	$ 7,540,000	$ 1,270,000,000
	Alternative (c) for OU 2	$ 21,800,000	$ 5,790,000	$ 466,600	$ 27,600,000
	Sludge Disposal Cell	$ 7,370,000	$ 397,000	$ 32,000	$ 7,770,000
	Total	**$ 1,200,000,000**	**$ 99,800,000**	**$ 8,040,000**	**$ 1,300,000,000**
Alternative 3+(d)	Alternative 3+ for OU 3	$ 1,170,000,000	$ 93,600,000	$ 7,540,000	$ 1,270,000,000
	Alternative (d) for OU 2	$ 32,900,000	$ 6,460,000	$ 520,600	$ 39,400,000
	Sludge Disposal Cell	$ 7,330,000	$ 397,000	$ 32,000	$ 7,730,000
	Total	**$ 1,210,000,000**	**$ 100,500,000**	**$ 8,090,000**	**$ 1,310,000,000**
Alternative 3+(e)	Alternative 3+ for OU 3	$ 1,170,000,000	$ 93,600,000	$ 7,540,000	$ 1,270,000,000
	Alternative (e) for OU 2	$ 250,000,000	$ 10,000,000	$ 805,900	$ 260,000,000
	Sludge Disposal Cell	$ 6,490,000	$ 340,000	$ 27,400	$ 6,830,000
	Total	**$ 1,430,000,000**	**$ 104,000,000**	**$ 8,370,000**	**$ 1,530,000,000**
Alternative 4+(a)	Alternative 4+ for OU 3	$ 1,770,000,000	$ 144,000,000	$ 11,600,000	$ 1,910,000,000
	Alternative (a) for OU 2	$ 60,200,000	$ 1,190,000	$ 95,900	$ 61,400,000
	Sludge Disposal Cell	$ 5,480,000	$ 279,000	$ 22,500	$ 5,760,000
	Total	**$ 1,840,000,000**	**$ 145,000,000**	**$ 11,700,000**	**$ 1,990,000,000**
Alternative 4+(b)	Alternative 4+ for OU 3	$ 1,770,000,000	$ 144,000,000	$ 11,600,000	$ 1,910,000,000
	Alternative (b) for OU 2	$ 24,800,000	$ 1,020,000	$ 82,200	$ 25,900,000
	Sludge Disposal Cell	$ 5,480,000	$ 279,000	$ 22,500	$ 5,760,000
	Total	**$ 1,800,000,000**	**$ 145,000,000**	**$ 11,700,000**	**$ 1,950,000,000**
Alternative 4+(c)	Alternative 4+ for OU 3	$ 1,770,000,000	$ 144,000,000	$ 11,600,000	$ 1,910,000,000
	Alternative (c) for OU 2	$ 21,800,000	$ 5,790,000	$ 466,600	$ 27,600,000
	Sludge Disposal Cell	$ 7,880,000	$ 426,000	$ 34,300	$ 8,310,000
	Total	**$ 1,800,000,000**	**$ 150,000,000**	**$ 12,100,000**	**$ 1,950,000,000**
Alternative 4+(d)	Alternative 4+ for OU 3	$ 1,770,000,000	$ 144,000,000	$ 11,600,000	$ 1,910,000,000
	Alternative (d) for OU 2	$ 32,900,000	$ 6,460,000	$ 520,600	$ 39,400,000
	Sludge Disposal Cell	$ 7,830,000	$ 423,000	$ 34,100	$ 8,250,000
	Total	**$ 1,810,000,000**	**$ 151,000,000**	**$ 12,200,000**	**$ 1,960,000,000**
Alternative 4+(e)	Alternative 4+ for OU 3	$ 1,770,000,000	$ 144,000,000	$ 11,600,000	$ 1,910,000,000
	Alternative (e) for OU 2	$ 250,000,000	$ 10,000,000	$ 805,900	$ 260,000,000
	Sludge Disposal Cell	$ 6,930,000	$ 369,000	$ 29,700	$ 7,300,000
	Total	**$ 2,030,000,000**	**$ 154,000,000**	**$ 12,400,000**	**$ 2,180,000,000**

TABLE ES-1

Summary of Cost Estimates for Remedial Alternatives and Remedy Protection Alternatives

Focused Feasibility Study, Upper Basin of the Coeur d'Alene River, Bunker Hill Superfund Site

Remedy Protection Alternative	Remedial Actions	Total Capital Cost	O&M Cost (30-Year NPV)	O&M Cost (Annual Average)	Total Cost (30-Year NPV)
RP-1	Upper Basin Communities[1]	$ -	$ -	$ -	$ 33,800,000
	Side Gulches[2]	$ -	$ -	$ -	$ 16,300,000
	Total	**$ -**	**$ -**	**$ -**	**$ 50,100,000**
RP-2	Upper Basin Communities[1]	$ 13,700,000	$ 4,980,000	$ 401,000	$ 18,800,000
	Side Gulches[2]	$ 10,900,000	$ 4,180,000	$ 337,000	$ 15,100,000
	Total	**$ 24,600,000**	**$ 9,160,000**	**$ 738,000**	**$ 33,900,000**

Notes:

O&M = operation and maintenance
NPV = net present value
OU 2 = Operable Unit 2
OU 3 = Operable Unit 3

[1]The costs for Alternatives RP-1 and RP-2 in the eight primary Upper Basin communities include Pinehurst, Smelterville, Kellogg, Wardner, Osburn, Silverton, Wallace, and Mullan.
[2]Side gulch costs for Alternatives RP-1 and RP-2 are approximate based on assumptions discussed in Appendix D of this FFS Report.

The above costs are presented rounded to three significant figures.

The above cost opinion is a Feasibility-Study-level estimate with a nominal accuracy of –30 percent to +50 percent (–30/+50%).

The above cost opinion is in 2009 dollars and does not include future escalation. The order-of-magnitude cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, the final project scope, the final project schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

The OU 3 total capital cost includes the roads and bridges costs.
The NPV sludge disposal cell closure costs includes closure of the existing sludge disposal cell.
The NPV sludge disposal cell closure costs are based on the time for the existing sludge disposal cell to reach capacity.
The O&M cost (annual average) is calculated by dividing the O&M cost (30-Year NPV) by a factor of 12.409 to account for the 30 years at 7%.