RECORD OF DECISION

Silver Bow Creek/Butte Area NPL Site
Warm Springs Ponds Operable Unit
Upper Clark Fork River Basin, Montana

United States Environmental Protection Agency

September 1990

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PART I: THE DECLARATION

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RECORD OF DECISION
PART I: THE DECLARATION

Silver Bow Creek/Butte Area NPL Site
Warm Springs Ponds Operable Unit
Upper Clark Fork River Basin, Montana

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected interim remedial action for the Warm Springs Ponds, an operable unit of the Silver Bow Creek/Butte Area NPL Site (original portion), in the Upper Clark Fork River Basin of southwestern Montana. The selected remedial action was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 USC Sec. 9601, et. seq. and, to the extent practicable, the National Contingency Plan (NCP), 40 CFR Part 300. This decision is based on the administrative record for the site.[1]

All determinations reached in the Record of Decision were made in consultation with the Montana Department of Health and Environmental Sciences (MDHES), which conducted the Remedial Investigations and Feasibility Study for this operable unit and participated fully in the development of this Record of Decision.

[1] The administrative record index and copies of key site documents are available for public review at the Missoula Public Library, the Montana Tech Library on West Park Street in Butte and other information repositories in the Clark Fork Basin. The complete administrative record may be reviewed at the offices of the U.S. EPA, 301 South Park, Federal Building, Helena, MT.

ASSESSMENT OF THE SITE

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

DESCRIPTION OF THE REMEDY

The Warm Springs Ponds Operable Unit is one of eleven operable units identified as part of the Silver Bow Creek/Butte Area NPL Site in the Upper Clark Fork Basin area of Montana. The Warm Springs Ponds Operable Unit is located within Deer Lodge County, approximately 27 river miles northwest of Butte and just above the confluence of the Mill-Willow Bypass and Warm Springs Creek. Silver Bow, Mill, Willow and Warm Springs creeks are principal headwaters streams of the Clark Fork River, which begins at the northernmost boundary of the Warm Springs Ponds Operable Unit.

The operable unit covers approximately 2,500 acres that include three settling ponds, the area below the Pond 1 berm to the Clark Fork River's beginning point, a series of wildlife ponds, and the Mill-Willow Bypass (see Figure 1). The remedy includes means for controlling contamination associated with pond bottom sediments, surface water, tailings and contaminated soils, and ground water within the boundaries of the operable unit. The selected remedy for the Warm Springs Ponds Operable Unit may be summarized as follows:

- Allow the ponds to remain in place; Ponds 2 and 3 will continue to function as treatment ponds until upstream sources of contamination are cleaned up;

- Raise and strengthen all pond berms according to specified criteria, which will protect against dam failure in the event of major earthquakes or floods, and increase the storage capacity of Pond 3 to receive and treat flows up to the 100-year flood;

- Construct new inlet and hydraulic structures to prevent debris from plugging the Pond 3 inlet and to safely route flows in excess of the 100-year flood around the ponds;

- Comprehensively upgrade the treatment capability of Ponds 2 and 3 to fully treat all flows up to 3,300 cfs (100-year peak discharge) and construct spillways for routing excess flood water into the bypass channel;

- Remove all remaining tailings and contaminated soils from the Mill-Willow Bypass, consolidate them over existing dry tailings and contaminated soils within the Pond 1 and Pond 3 berms and provide adequate cover material which will be revegetated;

- Reconstruct the Mill-Willow Bypass channel and armor the north-south berms of all ponds to safely route flows up to 70,000 cubic feet per second (one-half of the estimated probable maximum flood);

- Flood (wet-close) all dry portions of Pond 2;

- Construct interception trenches to collect contaminated ground water in and below Pond 1 and pump the water to Pond 3 for treatment;

- Dewater wet portions of Pond 1 and cover and revegetate (dry-close) all areas within the Pond 1 berms;

- Establish surface and ground water quality monitoring systems and perform all other activities necessary to assure compliance with all applicable or relevant and appropriate requirements;

- Implement institutional controls to prevent future residential development, to prevent swimming, and to prevent consumption of fish by humans; and

- Defer, for not more than one year after the effective date of this document, decisions concerning the remediation of contaminated soils, tailings, and ground water in the area below Pond 1, pending evaluation of various wet- and dry-closure alternatives and a public review.

Although the majority of known tailings and contaminated sediments and soils deposits within this operable unit will be remediated by actions specified in this Record of Decision, a final soil cleanup level is not selected. A decision regarding a final soil cleanup level, which affects primarily the area below Pond 1, but also the Mill-Willow Bypass and all dry portions of the ponds, will be made within one year of the effective date of this document. In addition, the final decision concerning the ultimate disposition of Ponds 2 and 3 must be deferred until upstream sources are cleaned up and the two ponds cease to be needed as treatment ponds. Each of these decisions will be subjected to separate public reviews, during which a range of alternatives will be examined and public input solicited.

The selected remedy presented in this Record of Decision attempts to permanently remediate the principal threats posed by contamination at the site. The remedy will reduce or eliminate most of the human health and environmental threats present at this operable unit, but the remedy is an interim measure for the reasons stated below. Future records of decision, or other decision documents, will direct cleanup actions at the other operable units and NPL sites that affect Silver Bow Creek and the Warm Springs ponds.

Until those source areas are cleaned up, the effectiveness and permanence of this remedy cannot be fully or finally determined.

One component of the selected remedy presented in this Record of Decision departs significantly from the preferred remedy, as originally identified and evaluated in the feasibility study and described in the proposed plan. Whereas the feasibility study and proposed plan recommended construction of an upstream sediment settling basin, and as a consequence, discontinuance of Pond 2 as a treatment pond, the selected remedy presented herein calls for storage and treatment of flood flows (up to the 100-year event) in Pond 3 and retention of Pond 2 as a treatment pond.

The rationale for this significant change is as follows:

1. There was considerable public opposition to the proposed upstream settling basin. Residents of the Deer Lodge Valley were concerned about economic and environmental impacts that might have been caused by the impoundment.

2. Upon examination of an alternative proposal presented by the potentially responsible party, the Atlantic Richfield Company (ARCO), specifically to store and treat flows up to the 100-year flood within Pond 3, the EPA and State concluded that that is an acceptable alternative to the concept of an upstream settling basin. In fact, treatment of dissolved metals in flood waters would not have been a feature of the upstream settling basin; however, such treatment will be possible once the selected remedy is in place. This revised component of the selected remedy offers the additional advantage of keeping contaminants within the existing boundaries of the operable unit.

While this departure represents a significant change to the preferred remedy identified in the proposed plan, it was developed through constructive dialogue with the public and ARCO. The overall remedial objectives, as evaluated in the feasibility study and described in the proposed plan, remain unchanged.

As a result of the dialogue with the public and ARCO, which followed a series of public meetings concerning the proposed plan, the Mill-Willow Bypass Removal Action was initiated. On July 3, 1990, the EPA and ARCO entered into agreement through an Administrative Order on Consent to undertake expedited action on the tailings and contaminated soils along the Mill-Willow Bypass. In the process of developing a work plan for this removal action, many state and federal agencies, ARCO, and the public have cooperated to assure that the extensive excavation, consolidation and disposal of tailings and contaminated soils, and raising, widening, and armoring of the north-south pond berms are completed in a manner consistent with the overall remedy. At the time of signing of this document, the removal action is proceeding well and invaluable experience has been gained concerning site conditions, which will facilitate followup work prescribed in this Record of Decision.

DECLARATION

The selected remedy is protective of human health and the environment; attains and complies with federal and state requirements that are applicable or relevant and appropriate for this remedial action except where waivers, as noted, have been applied; and is cost-effective. The remedy utilizes permanent solutions and treatment alternatives that reduce the toxicity, mobility, or volume as a principal element to the maximum extent practicable for this operable unit. The use of treatment alternatives to address the human health and environmental threats posed by the pond bottom sediments, exposed tailings, and contaminated soils was determined not to be practicable because of the extensive volume of material present on the site and the absence of available technologies to effectively treat the contaminants.

Because this remedy will result in hazardous substances remaining onsite, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. Additionally, the remedy selected by this Record of Decision will be subject to a separate public review once work at the other NPL sites that affect this operable unit is completed.

Signature:

James J. Scherer
Regional Administrator (Region VIII)
U.S. Environmental Protection Agency

Sept. 28, 1990
Date

NOTICE

THIS PAGE IS NOT SUITABLE FOR MICROFILMING, BUT IS AVAILABLE FOR REVIEW AT THE U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION VIII, HELENA, MONTANA.

TITLE FIGURE 1 - COMPONENTS OF THE WARM SPRINGS PONDS AND MILL-WILLOW BYPASS REMOVAL ACTION

FILE NO. 5050700 DOCUMENT NO. 100099

RECORD OF DECISION

PART II: THE DECISION SUMMARY

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RECORD OF DECISION
PART II: THE DECISION SUMMARY

1.0 SITE NAME, LOCATION AND DESCRIPTION

The Warm Springs Ponds Operable Unit is part of the Silver Bow Creek/Butte Area NPL Site. The ponds are located at the downstream end of Silver Bow Creek, just above the confluence of the Mill-Willow Bypass and Warm Springs Creek. That confluence is the defined beginning point of the Clark Fork River. The Warm Springs Ponds Operable Unit is the first operable unit of the Silver Bow Creek/Butte Area NPL Site for which a remedy has been selected and a Record of Decision entered.

The Clark Fork River Basin, which includes the Silver Bow Creek/Butte Area Site, is one of the largest geographic areas in the nation being addressed under Superfund. The site has been impacted by over 100 years of mining and processing operations in the Butte and Anaconda areas.

Mining began with the discovery of gold in 1864 on Silver Bow Creek. By 1884, the Butte area contained over 300 combined copper and silver mines, at least nine silver mines, and at least eight smelters. Many of these mines, mills, and smelters were owned and operated by the Anaconda Minerals Company or its predecessors. Mining and smelting continued until 1982, when the Atlantic-Richfield Company, the successor corporation to the Anaconda Minerals Company, closed the Berkeley Pit in Butte. Mining and milling has since resumed, with the takeover of operations by Montana Resources, Inc., and others, in 1986.

Over the years, the mining and related activities have resulted in extensive soil, water, and air contamination within the Clark Fork River Basin, including Silver Bow Creek and the Warm Springs Ponds. Contamination of Silver Bow Creek occurred from the outset of mining activities. Mining, milling, and smelting wastes were dumped directly into Silver

Bow Creek and transported downstream to the Clark Fork River. Substantial deposits of these wastes have been found along the 120-130 miles of river below the Warm Springs Ponds, as far downstream as the Milltown Reservoir near Missoula. Approximately six million cubic yards of wastes from Butte, Anaconda, and Silver Bow Creek lie within the Milltown Reservoir, a separate NPL site.

In 1911, the Anaconda Copper Mining Company built its first treatment pond near the community of Warm Springs to settle out wastes from Silver Bow Creek before the water reached the Clark Fork River. This is now known as Warm Springs Pond 1. Warm Springs Ponds 2 and 3 were constructed in approximately 1916 and 1959, respectively, as additional settling capacity was needed (see Figure 1). The ponds now cover an area of approximately 4 square miles. Over the past 80 years, an estimated 19 million cubic yards of tailings and heavy metal-contaminated sediments and sludges have collected in the ponds. The volume of wastes present could cover the playing area of 100 football fields 90 feet deep.

Mining wastes are no longer released directly into Silver Bow Creek, but tailings deposits along the creek banks continue to erode and travel down the creek, particularly during periods of above-average flows and floods. It is estimated that approximately three million cubic yards of contaminated tailings are still present along the banks of Silver Bow Creek. Through dissolution, the tailings and sediments cause the water flowing in Silver Bow Creek to be contaminated with dissolved metals. Copper and zinc concentrations are particularly high. Other metals found to be elevated in Silver Bow Creek include arsenic, cadmium, lead, iron, aluminum, and manganese.

The Warm Springs Ponds are still used to contain entrained sediments and treat the contaminated water flowing down Silver Bow Creek before it reaches the Clark Fork River. The ponds operate by settling out tailings particles and other solids and by reducing the concentrations of the dissolved metals.

The berms containing the Warm Springs Ponds are susceptible to flood and earthquake damage. Their failure potentially could release millions of cubic yards of the tailings and sediments into the Clark Fork River. Because this could cause considerable environmental damage downstream of the ponds, the EPA and the State of Montana identified the ponds as the first operable unit of the original Silver Bow Creek Site to be cleaned up.

The Warm Springs Ponds Operable Unit also presents two other significant environmental and human health concerns:

- The surface waters of all three creeks (Mill, Willow, and Silver Bow) that enter the operable unit are contaminated with dissolved metals. The surface water quality standards adopted under the Montana Water Quality Act are frequently exceeded for copper and zinc within the area.

- Large areas of surface contamination, comprised of tailings and contaminated soils, are present within the boundaries of the Warm Springs Ponds Operable Unit. The tailings and contaminated soils, which include previously submerged pond bottom sediments that are now exposed, contain elevated levels of several metals and are either void of vegetation or sparsely vegetated. These tailings and contaminated soils subject humans to risks from exposure. Copper and zinc, which are significant contaminants in the tailings, are also suspected of causing several fishkills observed in the Mill-Willow Bypass and the Clark Fork River.

2.0 ENFORCEMENT ACTIVITIES

In August 1967, the Anaconda Minerals Company received an order from the Montana Water Quality Board, requiring steps to be taken to prevent the introduction of heavy metal salts into the Clark Fork River from the Warm Springs Ponds. In response to this order, water from below Pond 1 was pumped back into Pond 1 for further treatment. Additionally, in response to a fishkill in July 1989, ARCO (Anaconda Mineral Company's successor) agreed to isolate streamside tailings deposits by constructing berms between the tailings and the Clark Fork River. Finally, the EPA, in July 1990, ordered ARCO to remove all tailings and soils contaminated with heavy metals from the Mill-Willow Bypass. This work is ongoing and is expected to be completed by late 1990.

The Phase I Remedial Investigation Report of the entire Silver Bow Creek Site was released in 1987.[1] The Phase II Remedial Investigation Report, which concentrated solely on the Warm Springs Ponds Operable Unit, was completed in May 1989.[2] The remedial investigations focused on the nature and extent of contamination within the operable unit. The feasibility study incorporating the information obtained during the remedial investigations, was released for public comment on October 26, 1989.[3] The feasibility study developed and evaluated a range of remedial alternatives for cleanup of the operable unit.

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1 Multitech, 1987. Phase I Remedial Investigation Report.

2 CH2M HILL, 1989. Phase II Remedial Investigation Report.

3 Montana Department of Health and Environmental Sciences, 1989. Feasibility Study for the Warm Springs Ponds Operable Unit. Volume I, Report; Volume II, Appendixes.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

3.1 BACKGROUND

Community involvement in the Silver Bow Creek Superfund Site activities began early in the project. The initial community relations plan, in 1983, designated the Butte-Silver Bow County Health Department as the focal point for community relations and included the formation of a citizens advisory committee. That committee was active in the selection of a contractor for the initial Phase I remedial investigations of Silver Bow Creek.

Late in 1985, EPA conducted an assessment of the Site Community Relations Plan. The assessment recommended several improvements to the plan, including installation of a toll-free telephone number, preparation of fact sheets and updates, and an increase in the number of informal public meetings or briefings. Most of these improvements were in place by 1987.

Information repositories, containing key site studies, indexes and reports, are presently maintained at the following locations: Montana State Library in Helena, Montana Historical Society in Helena, University of Montana Library in Missoula, Missoula Public Library, National Park Service Main Office in Deer Lodge, Hearst Free Library in Anaconda, Montana Tech Library in Butte, Butte Public Library, and Montana State University Library in Bozeman. The complete administrative record is maintained at the EPA's offices in Helena.

The Phase II remedial investigation, followed by a feasibility study, began at the Warm Springs Ponds Operable Unit in 1986 and continued through 1989. During that time, MDHES and EPA staff provided information about the Warm Springs ponds activities at public meetings and through fact sheets and progress reports. These reports were distributed to people on a mailing list (271 individuals in 1987 and 800 individuals in 1990) in November 1986, November 1987, May 1988, July 1988, August 1988, October 1988, June

1989, September 1989, and May 1990. Special interest groups that indicated concern about the site included the Clark Fork Coalition, Butte Chapter of Trout Unlimited, Skyline Sportsmen of Anaconda, the Deer Lodge Chapter of Trout Unlimited, George Grant Chapter of Trout Unlimited, Anaconda Sportsmen's Club, Pintlar Audubon, and Upper Clark Fork Chapter of Trout Unlimited.

The Warm Springs Ponds Feasibility Study and Proposed Plan were released for public review in October 1989. The MDHES held public informational meetings in Butte, Anaconda, and Missoula during October and formal public hearings in the same cities in December. The public comment period for the Feasibility Study and Proposed Plan was open from October 1989 until the end of January 1990.

3.2 PUBLIC PERCEPTION OF ITS INVOLVEMENT AT WARM SPRINGS PONDS

The EPA and MDHES received 162 comment letters and 40 people presented testimony at the public hearings. Most comments indicated dissatisfaction with the level of public involvement in the Superfund process at the Warm Springs Ponds. The EPA and MDHES are striving to involve more fully all interested parties and other agencies in future activities at the Warm Springs Ponds and at other sites in the Clark Fork Basin.

Public involvement in the Mill-Willow Bypass Removal Action is an example of the effort to involve the public early in Superfund activities. A public scoping meeting on the Mill-Willow Bypass Removal Action was held in February of 1990. The agencies held five public meetings in February and May of 1990 to gather input from the general public on the removal activities and other actions planned by the agencies and ARCO. Coordination meetings involving local government officials, representatives of interested state agencies, and public interest groups were held in preparation for the summer's removal action. The agencies will continue similar efforts to involve the public in the Superfund process.

3.3 PUBLIC INPUT REGARDING PROPOSED REMEDIAL ACTION

The remedy selected in this Record of Decision was developed, to a large extent, to address comments and recommendations provided by ARCO and the general public during the public comment period. Several key revisions were made to the original preferred alternative:

There was considerable public opposition to the construction and use of an upstream settling basin to catch and control flood flows on Silver Bow Creek. This element has been dropped in favor of a major upgrade of Ponds 2 and 3 to store and treat flood flows. This upgrade includes substantial changes to the berms, as well as new intake structures and a new lime addition facility.

There was overwhelming support for expediting the removal of tailings from the Mill-Willow Bypass in an effort to prevent any future fishkills in the upper Clark Fork River. This work has already been started as part of the Mill-Willow Bypass Removal Order signed in July 1990. The majority of the removal is expected to be completed by the end of 1990.

There was considerable support for the protection of the pond berms to the full maximum credible earthquake and at least half of the probable maximum flood. The original preferred remedy would have used full earthquake protection, but less than 0.5 probable maximum flood protection for berms on Ponds 1 and 2. The agencies have agreed that 0.5 protection for all the ponds is appropriate, so the selected remedy now provides for full maximum credible earthquake and 0.5 probable maximum flood protection for all ponds.

4.0 SUMMARY OF SITE CHARACTERISTICS

4.1 SURFACE HYDROLOGY

The Warm Springs Ponds include the primary hydrologic features within the operable unit. They cover an area of approximately 2,500 acres (about 4 square miles). Three creeks from the south and the west flow through the operable unit (see Figure 2). Silver Bow Creek, the longest of the three creeks, flows from the south and enters Pond 3 near the southern end of the operable unit. Mill and Willow creeks from the west and south flow into the Mill-Willow Bypass, a diversion ditch, which routes the comparatively less contaminated water in these two creeks around the ponds and to the Clark Fork River.

Water flowing out of Pond 3 goes primarily into Pond 2, with a smaller volume being used to maintain several wildlife ponds located between Ponds 2 and 3 (see Figure 1). The effluent from Pond 2 flows into the Mill-Willow Bypass, as a regulated point-source discharge, and then down the bypass to the Clark Fork River. The average flows in the three creeks are 73 cubic feet per second (cfs) for Silver Bow Creek, and 27 cfs for combined Mill and Willow creeks.

The average flow of 100 cfs in the lower portion of the Mill-Willow Bypass is joined by the average flow of approximately 47 cfs in Warm Springs Creek at the northern end of the operable unit to form the Clark Fork River. Warm Springs Creek is also contaminated, possibly due to milling and smelting activities in the Anaconda area, west of the operable unit.

4.2 GROUNDWATER HYDROLOGY

The shallow ground water system in the Warm Springs Operable Unit is complex, owing to the heterogeneity of the near surface geology in the area. The site is in a ground water discharge area for the upper Deer Lodge Valley, typified by shallow ground water tables and swamps. The presence of the pond system affects shallow ground water elevations and ground water movement within the site.

Shallow aquifers occur along present-day stream channels but do not extend laterally throughout the site. Deeper aquifers are associated with Tertiary-age valley fill and thick deposits of glaciofluvial material. These aquifers generally exhibit moderate to low permeabilities and are probably connected on a regional scale, although fine-grained inter-beds tend to confine the deeper aquifers locally.

The uppermost aquifer at the site is a 10- to 15-feet-thick sand and gravel unit, which is typically present approximately 10 feet below ground surface. This sand and gravel aquifer appears to be present throughout most of the site. Ground water movement through the site is generally south to north, although a significant component of ground water enters from the Opportunity Ponds area to the southwest. (See Figure 2).

No domestic well is located within the Warm Springs Ponds Operable Unit. Several are located east of the pond system within a mile of the operable unit, but these wells are completed in bedrock aquifers that do not appear to be affected by the pond system. The town of Warm Springs derives its water from supply wells constructed in unconsolidated Tertiary deposits, from depths of approximately 200 feet. These wells appear to be supplied with water derived from ground water resources west of and hydraulically isolated from the Warm Springs Ponds.

4.3 NATURE AND EXTENT OF CONTAMINATION

Sediments, surface water, soils, and ground water are all affected by contaminants in the Warm Springs Ponds Operable Unit. A schematic that shows the contaminated areas and the migration pathways is presented as Figure 3. Four contaminated media have been identified for the operable unit: pond bottom sediments, surface water, tailings deposits and contaminated soils, and ground water. The media are discussed in the following

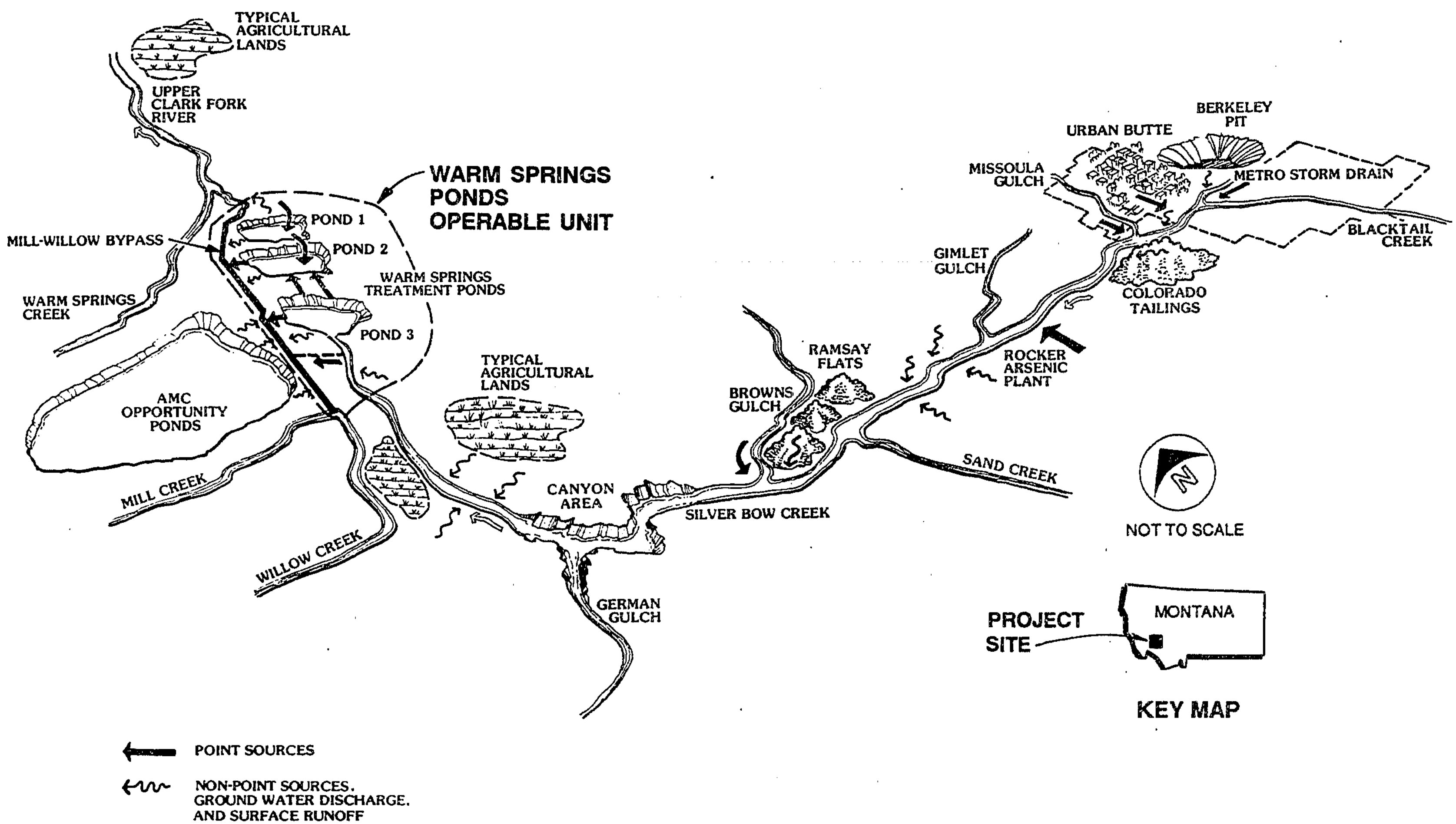
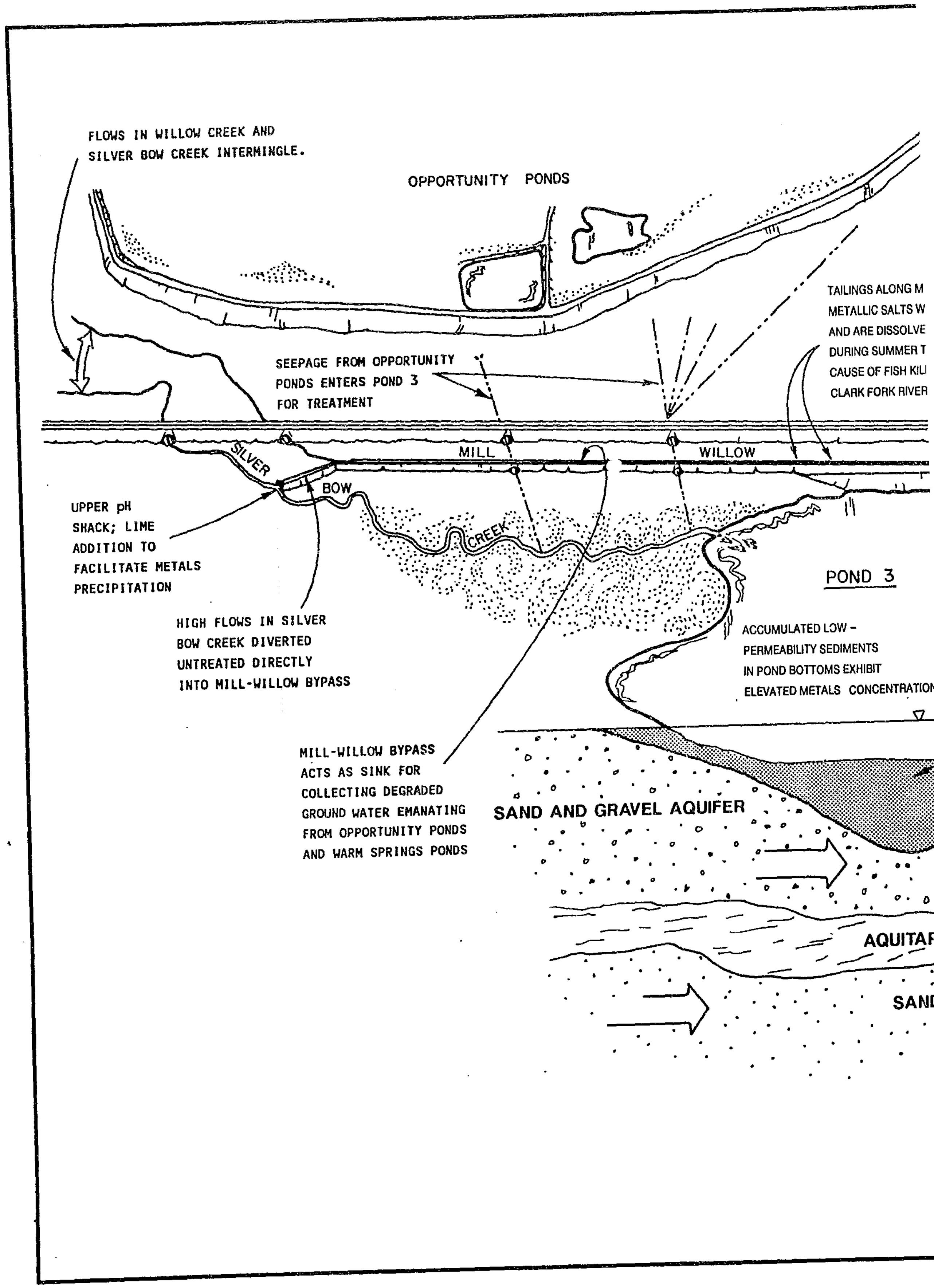


FIGURE 2

SILVER BOW CREEK SITE SCHEMATIC
WARM SPRINGS PONDS


FLOWS IN WILLOW CREEK AND SILVER BOW CREEK INTERMINGLE.
OPPORTUNITY PONDS
TAILINGS ALONG M
METALLIC SALTS W
AND ARE DISSOLVE
DURING SUMMER T
CAUSE OF FISH KILL
CLARK FORK RIVER
SEEPAGE FROM OPPORTUNITY PONDS ENTERS POND 3 FOR TREATMENT
MILL
WILLOW
SILVER
BOW
CREEK
UPPER pH SHACK; LIME ADDITION TO FACILITATE METALS PRECIPITATION
POND 3
HIGH FLOWS IN SILVER BOW CREEK DIVERTED UNTREATED DIRECTLY INTO MILL-WILLOW BYPASS
ACCUMULATED LOW-PERMEABILITY SEDIMENTS IN POND BOTTOMS EXHIBIT ELEVATED METALS CONCENTRATION
MILL-WILLOW BYPASS ACTS AS SINK FOR COLLECTING DEGRADED GROUND WATER EMANATING FROM OPPORTUNITY PONDS AND WARM SPRINGS PONDS
SAND AND GRAVEL AQUIFER
AQUITAR
SAND

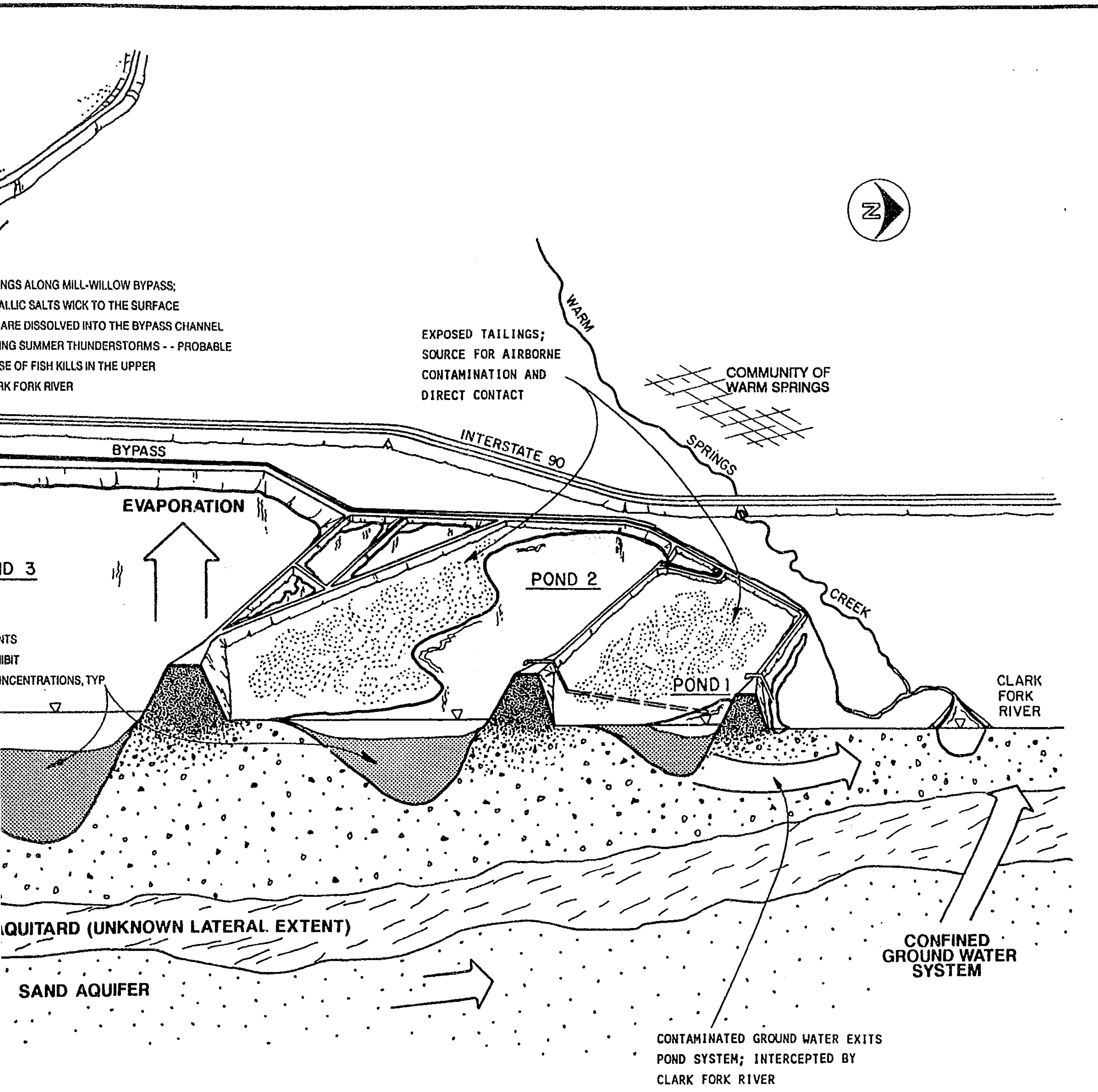


FIGURE 3

CONCEPTUAL MODEL OF CONTAMINANT MIGRATION PATHWAYS

WARM SPRINGS PONDS

sections. Table 1 presents a breakdown of the areas and volumes for each of the four media.

4.3.1 Sediments, Tailings, and Contaminated Soils

Two of the media--the pond bottom sediments, and the tailings deposits and contaminated soils--contain the majority of the contaminants in the Warm Springs Ponds Operable Unit. These materials are typically fine to coarse sand and generally contain metals associated with the sulfide ore body present near Butte. Pond bottom sediments are also comprised of precipitated hydroxides and oxyhydroxides resulting principally from the addition of lime to treat the water entering the pond system and from biologically mediated precipitation.

The exposed (unsubmerged) sediments, tailings deposits and contaminated soils cover an area of approximately 634 acres within the Warm Springs Ponds Operable Unit. Thicknesses of these deposits range from less than 1 inch to several feet. The submerged sediments in Ponds 1, 2, 3, and the wildlife ponds cover an area of approximately 1,227 acres and range in thickness from less than 1 foot to over 20 feet. (See Table 1.)

4.3.2 Surface Water

The data obtained during the remedial investigation characterize the surface water for near-average flow rates. Few data are available to characterize the surface water quality during higher flows because of drier-than-normal conditions in the area experienced during the remedial investigation. No opportunity was available during the sampling period to collect flow and contamination data during one of the high runoff events that cause inflows to be diverted around the pond system.

Surface water samples were collected at 25 sampling points in and adjacent to the Warm Springs Ponds Operable Unit during Phase I and Phase II remedial investigations. The Phase I remedial investigation showed that metals are being removed from the Silver Bow

TABLE 1
SUMMARY OF AREAS AND VOLUMES OF CONTAMINATED MEDIA

	Area (acres)	Volume (acre-feet)	Volume (cubic yards)
Pond Bottom Sediments			
Pond 1			
Exposed Sediments	59	455	734,000
Vegetated/Submerged Sediments	225	1,340	2,156,000
	284	1,795	2,890,000
Pond 2			
Exposed Sediments	155	800	1,300,000
Vegetated/Submerged Sediments	347	2,230	3,590,000
	502	3,030	4,890,000
Pond 3			
Submerged Sediments	665	6,903	11,180,000
Total Pond Bottom Sediments	1,451	11,755	18,960,000
Surface Water			
Silver Bow Creek[a]			
Mill and Willow Creeks[b]			
Tailings Deposits and Contaminated Soil			
Mill-Willow Bypass[c]			
Exposed Tailings	21	47	75,800
Vegetated Tailings & Contaminated Soil	33	80	130,000
	54	127	205,800
Area Above Pond 3			
Exposed Tailings	22	56	90,300
Vegetated Tailings & Contaminated Soil	268	700	1,130,000
	290	756	1,220,300
Area Below Pond 1			
Exposed Tailings	17	48	77,400
Vegetated Tailings & Contaminated Soil	59	246	397,000
	76	294	474,400
Ground water[d]			
Area of contaminated aquifer beneath & downgradient of Pond 1	180		

[a]Flow ranges from 28-112 cfs (73 cfs average). Data collection from March 1985 to August 1985
[b]Flow ranges from 3-87 cfs (27 cfs average). Data collected from December 1984 to August 1985.
[c]Insert Mill-Willow Bypass tailings and contaminated soils are being removed by an expedited action schedule for completion in November 1990.
[d]Exceedences of primary maximum contaminant levels for arsenic and cadmium.

Creek flow by the current pond treatment system. Inflow loads of total copper and total zinc were reduced by over 90 percent by the time the water left the pond system during the summer months and by 50 to 70 percent during winter months. Although metals concentrations are reduced in the pond system, Montana's chronic ambient water quality standards for copper, lead, and zinc were occasionally exceeded in the water leaving the pond system, particularly in winter months. Ambient standards for cadmium and iron were also frequently exceeded during the sampling events.

Four 24-hour, or diurnal, sampling episodes were completed within the Warm Springs Ponds system during the Phase II remedial investigation to gain a better understanding of changes in water quality over 1-day periods and on a seasonal basis. These sampling episodes were completed in September 1987 and in January, April, and July 1988.

Hourly data from the diurnal sampling studies have been compiled.[4]

The data for the 24-hour sampling episodes indicate the following:

- pH varied by up to 2.2 units throughout the day at all stations sampled.

- Total metals concentrations decreased 50 to 90 percent between pond system inflow and outflows.

- Dissolved metals concentrations for copper and zinc were generally 20 to 50 percent higher in the winter at all sampling stations in the pond system. Higher dissolved metals concentrations in the winter correlate directly with lower pH values measured during winter sampling events.

[4] CH2M HILL, 1989. Phase II Remedial Investigation Data Summary.

The pond system reduced metals concentrations at the outflows from the system during the four diurnal sampling events, frequently to levels below both chronic and acute aquatic standards. Figure 4 shows an example of this phenomenon recorded during one of the diurnal sampling events.

Removal of metals in the ponds is accomplished by physical, biological, and chemical processes. Physical reduction of metal-bearing solids occurs through simple sedimentation. Increases in pH, which are partly due to the addition of lime and partly due to photosynthesis, can precipitate metals as a result of changing metals solubilities. Yet another important metals removal mechanism may be the precipitation of calcite and coprecipitation of metals and phosphorus, which follow the photosynthetic removal of carbon dioxide and a compensating shift in the bicarbonate buffering system.[5] Direct uptake or absorption of metals by algae and aquatic macrophytes is also probable. Addition of lime to the Silver Bow Creek inflow during the winter months also contributes to precipitating metal contaminants when the amount of sunlight to support photosynthesis is reduced.

Several fishkills have occurred in the Mill-Willow Bypass and in the upper Clark Fork River, with the most recent known episode being in July 1989. Analysis of fish tissue by Montana Department of Fish, Wildlife, and Parks from one event in the summer of 1986 revealed acute copper poisoning as the cause of the fish mortality. Although MDFWP did not determine the source of metals responsible for the killings, that source most likely consists of tailings material along the Mill-Willow Bypass.

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5 Wetzel, R.G., 1975. Limnology. Philadelphia: W.B. Saunders Company.

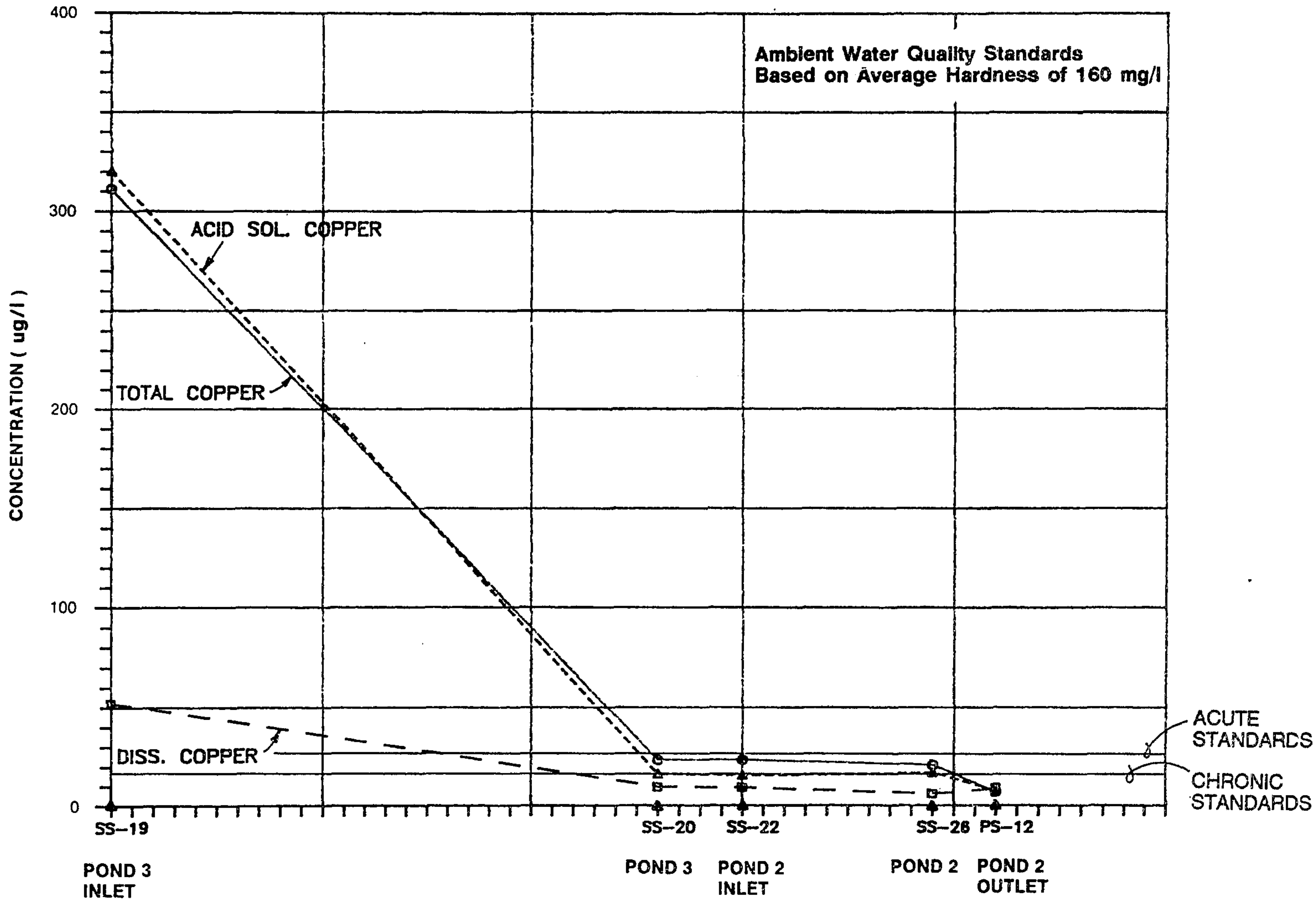


FIGURE 4

DECREASE IN COPPER CONCENTRATIONS THROUGH THE POND SYSTEM

WARM SPRINGS PONDS

NOTE:
BASED ON PHASE II RI,
24 HOUR SAMPLING——SEPTEMBER 1987.

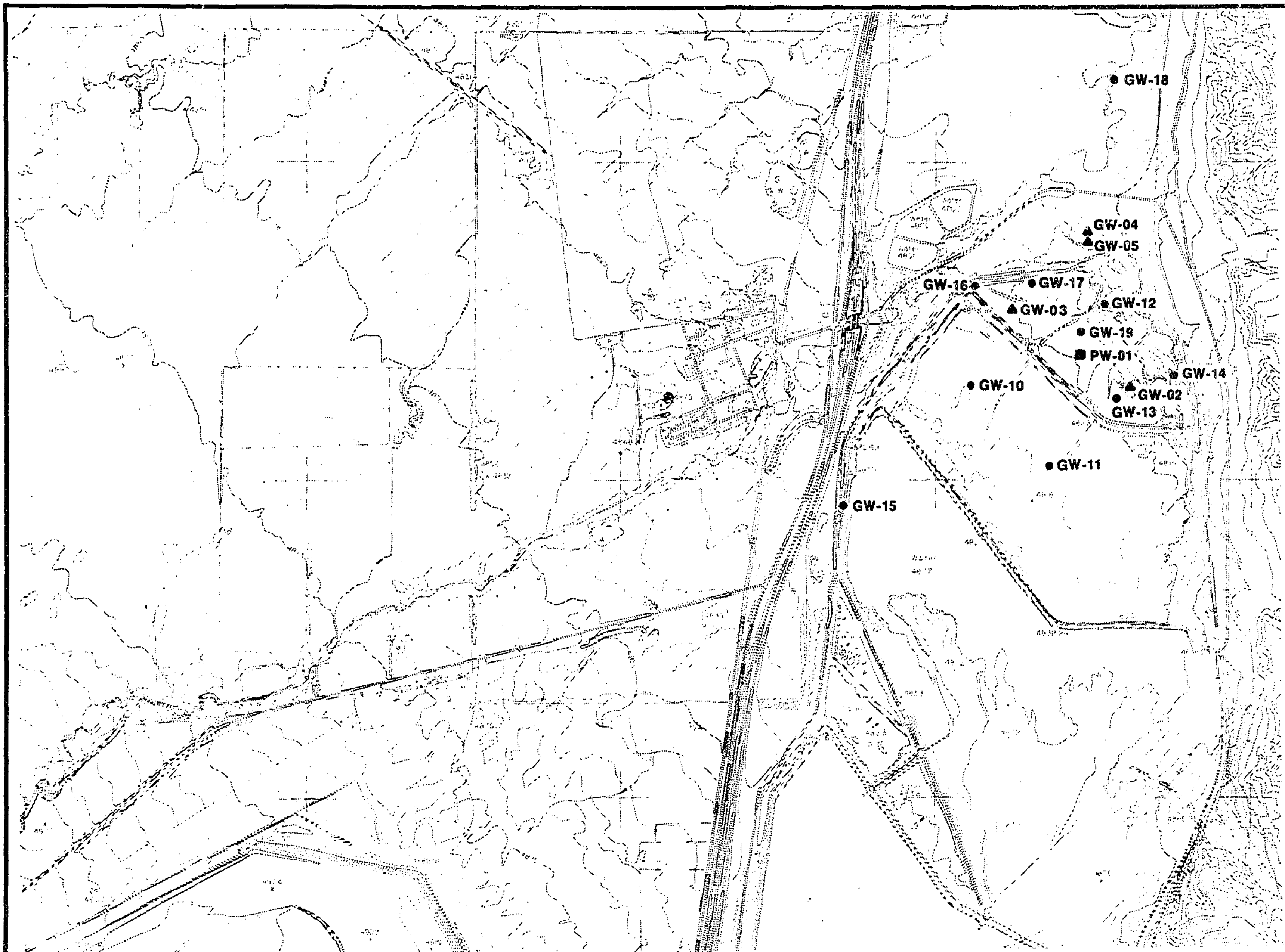
SOURCE: PHASE II RI REPORT; CH2M HILL 1989

4.3.3 Ground Water

Ground water quality data were generated through sampling of 19 monitoring wells on two occasions (January and May, 1988) Figure 5 shows the locations of the monitoring wells at the site. Table 2 summarizes ground water quality data for these monitoring wells. Ground water beneath Ponds 2 and 3 may be contaminated also. Wells were not installed to determine the quality of the ground water beneath those two ponds. Given the hydrogeology of the site, contaminated ground water under the ponds would flow north and be detected at the northern end of the pond system.

With one exception, all detected exceedences of the primary maxin.um contaminant levels for metals (arsenic and cadmium) were north of the Pond 1 berm. Ground water quality downgradient of Pond 1 is generally of poorest quality immediately north of the berm; most metal contaminants decrease to the north, or downgradient of the pond system. Concentrations of most metals also decrease with depth.

Highest concentrations of metals are generally associated with the shallow sand and gravel aquifer in the area immediately below the Pond 1 berm. Calculations of ground water discharge from the area below Pond 1 into the Clark Fork River indicate that the ground water system contributes very little flow to the river because of the relatively low permeability and low gradient of the shallow aquifer. Under average conditions, the flow in the Clark Fork River is approximately 137 cfs, while the ground water discharge to the river is approximately 1.0 cfs. Nevertheless, the exceedences of the maximum contaminant levels for arsenic and cadmium in the ground water constitute a violation of the drinking water standards.


GW-18
GW-04
GW-05
GW-16
GW-17
GW-03
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PW-01
GW-14
GW-10
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GW-11
GW-15

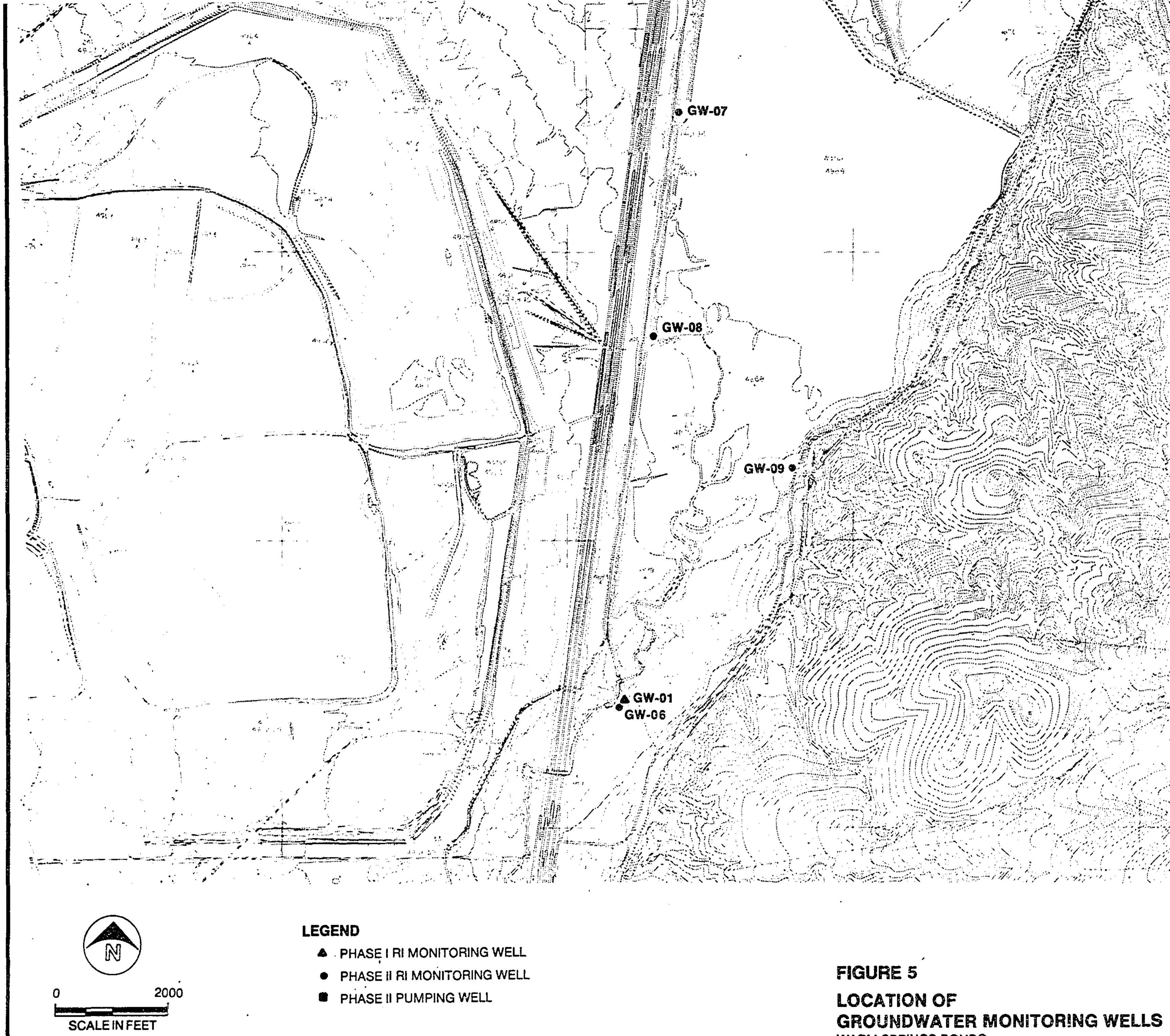

FIGURE 5

LOCATION OF GROUNDWATER MONITORING WELLS

WARM SPRINGS PONDS

TABLE 2
GROUND WATER QUALITY DATA SUMMARY
WARM SPRINGS PONDS OPERABLE UNIT

Parameter	Maximum Concentration(a)	Minimum Concentration(a)	Average Concentration(a)	Number of Samples	Maximum Contaminant Level(a) (Montana Ground Water Regulations)
Upgradient Monitoring Wells					
Arsenic	6.8	2.6	4.3	8	50[b]
Cadmium	7.0	<5.0	3.4	8	10[b]
Copper	9.7	6.1	5.8	8	1,000[c]
Lead	1.2	<1.0	0.84	8	50[b]
Manganese	22.0	<3.0	7.3	8	50[c]
Zinc	21.2	4.7	10.3	7	5,000[c]
Iron	28.0	<15.0	19	8	300[c]
Sulfate (mg/l)	68.0	23	49	8	250[c]
Mill-Willow Bypass (Shallow Wells)					
Arsenic	41.0	<2.0	9.2	10	50[b]
Cadmium	11.7	<5.0	3.7	10	10[b]
Copper	15.0	<6.0	4.6	10	1,000[c]
Lead	18.0	<1.0	2.5	10	50[b]
Manganese	14,500	45	4,755	10	50[c]
Zinc	1,250	12.7	265	10	5,000[c]
Iron	4,000	25.0	805	10	300[c]
Sulfate (mg/l)	1,130	60.0	563	10	250[c]
Mill-Willow Bypass (Deep Wells)					
Arsenic	<2.0	<2.0	1.1	8	50[b]
Cadmium	5.2	<5.0	2.9	8	10[b]
Copper	7.1	<6.0	4.0	8	1,000[c]
Lead	2.0	<1.0	1.1	8	50[b]
Manganese	8,550	7.0	2,121	8	50[c]
Zinc	38.0	6.2	22.2	8	5,000[c]
Iron	70	<15	33	8	300[c]
Sulfate (mg/l)	1,060	92.0	494	8	250[c]
Downgradient of Pond 1 (Shallow Wells)					
Arsenic	197.0	<2.0	28.0	14	50[b]
Cadmium	12.7	<5.0	3.6	14	10[b]
Copper	15.9	<6.0	5.8	14	1,000[c]
Lead	<2.0	<1.0	2.0	14	50[b]
Manganese	31,600	309	10,297	14	50[c]
Zinc	253	16.3	89.0	14	5,000[c]
Iron	80,900	45	16,220	14	300[c]
Sulfate (mg/l)	1,620	250	950	14	250[c]
Downgradient of Pond 1 (Deep Wells)					
Arsenic	<3.0	<2.0	1.0	13	50[b]
Cadmium	8.4	<5.0	4.3	13	10[b]
Copper	<8.0	<6.0	3.5	13	1,000[c]
Lead	<2.0	<1.0	0.8	13	50[b]
Manganese	4,460	3.0	577	13	50[c]
Zinc	43	6.2	19.8	13	5,000[c]
Iron	409	<15	52	13	300[c]
Sulfate (mg/l)	1,150	55	531	13	250[c]

a All values in ug/l unless otherwise noted.
b Primary standard (based on health criteria).
c Secondary standard (based on suitability criteria).

Notes:
1. Upgradient wells include WSP-GW-01, 06, and 09 (Figure 2-8).
2. Shallow wells are generally less than 15 feet deep; deep wells are generally 25 to 40 feet deep.
3. Mill-Willow shallow wells include WSP-GW-07S, 08S, 15S, 16S, and 17 (Figure 2-8).
4. Mill-Willow deep wells include WSP-GS-07D, 08D, 15D, and 16D (Figure 2-8).
5. Shallow wells downgradient of Pone 1 include WSP-GW-02S, 03S, 05, 12S, 13S, 14S, and 19S (Figure 2-8).
6. Deep wells downgradient of Pond 1 include WSP-GW-02D, 03D, 04, 12D, 13D, 14D, and 19D (Figure 2-8).
7. Average values calculated using one-half detection limit, when applicable. January and May 1988 data.
8. Additional maximum contaminant levels are: mercury and compounds: 2; nitrate: 10,000; selenium and compounds: 10; and silver: 50.

5.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Applicable or relevant and appropriate requirements (ARARs) are a basic standard by which all aspects of contaminant cleanup are measured. Compliance with ARARs or invocation of an appropriate ARAR waiver, is required by Section 121 (d) of CERCLA. The feasibility study evaluated potential compliance of the developed remedial alternatives with federal and Montana ARARs. Compliance with ARARs is a threshhold determination for selection of a remedy. 40 CFR § 300,430(f)(i)(A).

The discussion of ARARs in this section is a general discussion, which highlights the major ARARs for the remedial action. A full list of all ARARs and compliance points, as well as information to be considered ("TBCs"), and other relevant legal requirements, is contained in the attachment to Part II: The Decision Summary. The basis for EPA's selection of the ARARs is given in the feasibility study and Part III, Responsiveness Summary.

ARARs are divided into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs include laws and regulations that set human health- or environmentally-based numerical values governing materials having certain chemical or physical characteristics. These values set the acceptable concentrations of chemicals that may be found in, or released to, the environment. Location-specific ARARs restrict contaminant concentrations or cleanup activities due to the site's geographic or physical location. Action-specific ARARs are based on actions taken during contaminant cleanup.

Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4), provides for the waiver of ARARs if certain criteria are met. This Record of Decision waives two ARARs for surface water--arsenic and mercury--and establishes replacement numeric limitations for those standards waived. The waivers are based on technical impracticability from an engineering perspective, as permitted under section 121(d)(4)(c) of CERCLA, 42 U.S.C.

§ 9621(d)(4)(c). The replacement criteria will remain fully protective of human health and the environment. The replacement criteria are:

Mercury: 0.0002 mg/l

Arsenic: 0.02 mg/l

There is uncertainty over whether creation of permanent disposal facilities within Ponds 1 and 3 and the Pond 2 and 3 impoundments in place is in compliance with a relevant and appropriate requirement from the State's Solid Waste Disposal Regulations, which prohibits disposal of solid waste within the 100-year floodplain. EPA believes that the waste units will be outside of the floodplain when the Pond berms are raised and strengthened to specified standards. Even if the water within the ponds is considered part of the floodplain, the disposal units are probably outside of the 100-year flood pool of the water within the Ponds. To the extent the areas within the pond berms are considered to be within the 100-year flood plain, EPA waives the Solid Waste Disposal ARAR pursuant to section 121(d)(4)(c), as technologically infeasible from an engineering perspective and pursuant to section 121(d)(4)(A), as an interim action.

Additionally, if it is later determined that the area within the Pond berms is within the 100-year floodplain, then a waiver of the state's solid waste disposal regulations, prohibiting disposal within the 100-year floodplain, is invoked, on the same bases as above.

5.1 CHEMICAL-SPECIFIC ARARs

The most significant state and federal chemical-specific ARARs consist of standards protecting the quality of surface and ground water resources for human health and environmental purposes. Surface water ARARs include ambient water concentration limits to protect both aquatic life and public health, point source discharge standards for discharges from the pond system, and drinking water standards. Ground water ARARs include only drinking water standards. The contaminants of concern at the site are arsenic, cadmium, copper, iron, lead, silver, selenium, mercury, aluminum, and zinc.

5.2 LOCATION-SPECIFIC ARARs

Important location specific ARARs include cleanup activity restrictions to protect and minimize impacts on historically significant features and endangered species.

5.3 ACTION-SPECIFIC ARARs

Action-specific ARARs pertinent to the Warm Springs Ponds Operable Unit include regulations concerning dam safety in event of floods and earthquakes, hazardous waste management and land reclamation for mining areas.

Dam safety regulations address berm design and modification for the existing treatment system. Hazardous waste management ARARs include requirements for contaminant disposal. Reclamation ARARs require proper grading, backfilling, subsidence stabilization, water control, revegetation and other measures needed in surface mining areas to eliminate damage from soil erosion, subsidence, landslides, water pollution, and hazards dangerous to life and property.

SECTION 6.0
SUMMARY OF HUMAN HEALTH AND ENVIRONMENTAL RISKS

A public health and environmental risk assessment was conducted by the Montana Department of Health and Environmental Sciences to identify and characterize the actual and potential threats to human health and the environment posed by contaminants present at the Warm Springs Ponds Operable Unit. Carcinogenic and noncarcinogenic human health effects were characterized, as were significant environmental effects. With respect to both human health and the environment, endangerment was established.

6.1 HUMAN HEALTH RISKS

The EPA has determined that the Warm Springs Ponds Operable Unit poses the following actual or potential endangerment to human health:

- Workers at the ponds face an increased risk of cancer estimated to be 2×10^{-4}, or two excess cancers in 10,000 individuals exposed for a lifetime, due to incidental ingestion of arsenic in the contaminated soils, sediments and tailings. Recreationists (hunters, fishermen, bird watchers) also face increased cancer risk from exposure to arsenic.

- Workers and recreationists face additional cancer and noncancer health risks due to ingestion of lead and other hazardous substances in the contaminated soils, sediments, and tailings.

- Current residents adjacent to the ponds face actual or potential risks from contaminated soils, sediments, and tailings becoming wind-borne. If homes were to be built within the operable unit boundaries, residents would also face risks greater than the levels noted above.

- The contaminated ground water below Pond 1 poses a potential threat to users of the ground water.

- The berms protecting the ponds fail to meet current dam safety standards. Their failure due to a flood or earthquake could result in catastrophic consequences, including loss of life.

The baseline risk assessment establishes current and potential threats to human health. 40 CFR § 300.430(d)(4).

The NCP states that the goal of a Superfund cleanup should be reduction of risk to acceptable ranges, if ARARs do not exist or are not sufficiently protective. The point of departure, or target risk range, is 1 x 10^{-6} for cancer risk and levels that do not create adverse effect, incorporating a margin of safety, for systemic toxicants. 40 CFR § 300.430(e)(2)(i)(A)(2).

The preamble to the NCP states that the 1 x 10^{-6} risk range should be the goal of any cleanup, unless revision to a lesser protective level is appropriate for site specific reasons. 55 FR 8715-8717. Risks should not exceed 1 x 10^{-4}.

6.2 SUMMARY OF TOXICITY ASSESSMENT

Arsenic, a known carcinogen, is present at this operable unit. Samples of exposed tailings and contaminated soils contained a maximum arsenic concentration of 597 mg/kg and an average of 349 mg/kg arsenic. Lead, a hazardous substance that is both a suspected carcinogen and toxic noncarcinogen, is also present at elevated concentrations (maximum of 1000 mg/kg and average of approximately 490 mg/kg). Risks from lead were not quantified in the risk assessment, but the presence of lead risks is noted. In addition to its suspected carcinogenic effects, lead is known to damage the central nervous system and cause other serious health effects. The EPA believes there is no safe threshhold for lead intake. Other hazardous substances, such as cadmium, are also present at elevated concentrations.

6.3 SUMMARY OF EXPOSURE ASSESSMENT

In addition to serving as an active water treatment system for contaminants transported by Silver Bow Creek, the Warm Springs Ponds and surrounding area also function as a wildlife management area. Since two employees of the Montana Department of Fish, Wildlife and Parks work within the operable unit, managing the wildlife area, their occupational exposure was evaluated. A recreational exposure scenario was also evaluated because hunters and fishermen are often present at the ponds. The risk to current residents was evaluated because several homes are located near the operable unit boundary.

As required by EPA policy, the risk assessment also examined risks under a future residential scenario. Because the operable unit is comprised almost entirely of the ponds and associated wetlands, EPA considers it unlikely that homes will be built within its boundaries. To ensure that future residential development does not occur, the Record of Decision requires implementation of institutional controls. The remedy then focuses on active measures to address the occupational, recreational, and environmental threats.

The current human exposure routes are summarized on Figure 6 for each exposure scenario. The principal component of human health risk comes from incidental ingestion of arsenic during occupational activity.

6.4 RISK CHARACTERIZATION

The risk assessment evaluated risks from carcinogenic elements such as arsenic, lead, and cadmium, and risks from numerous noncarcinogenic elements such as copper, iron, lead, and zinc. The human health risks from noncarcinogens are evaluated based on their

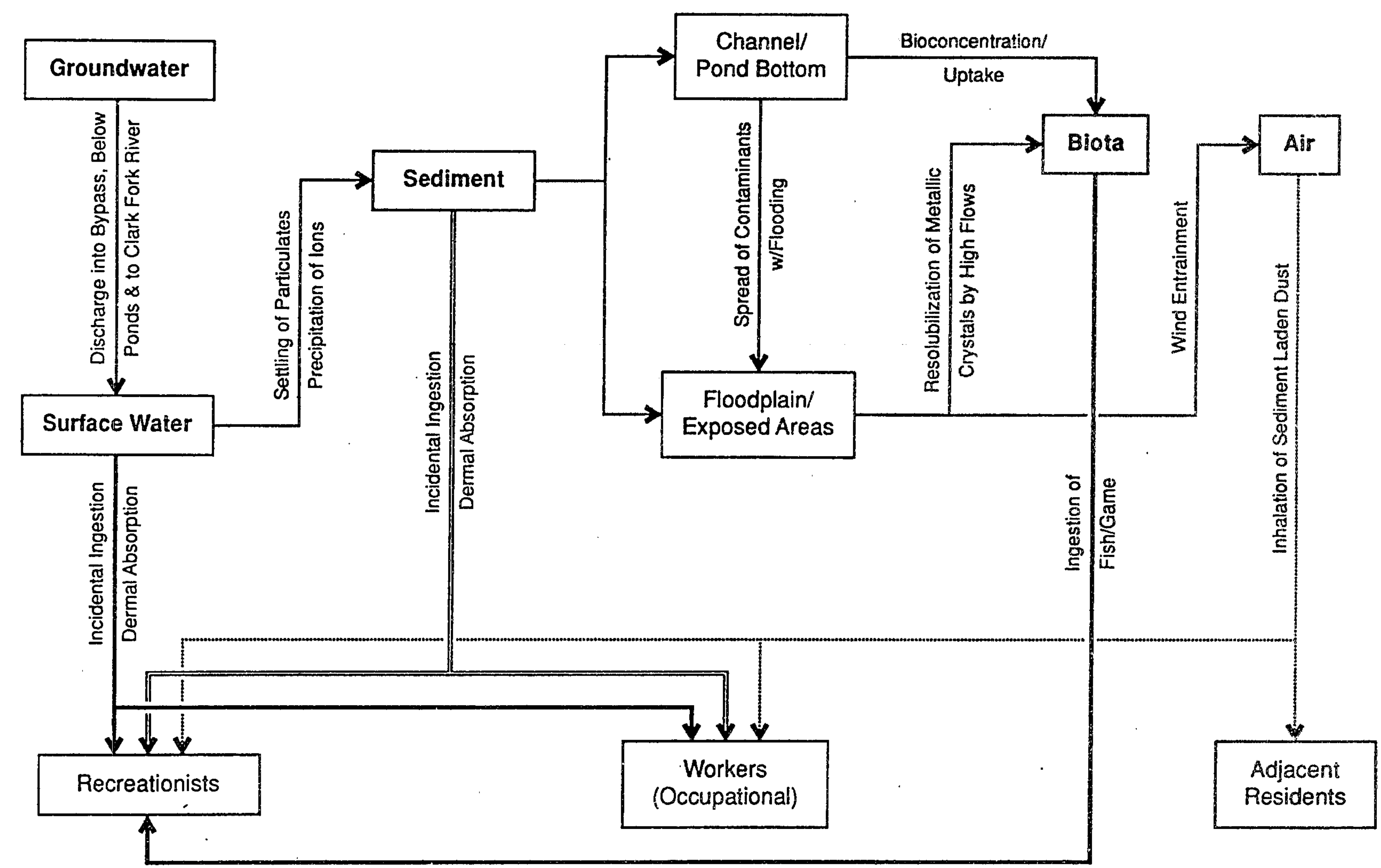

FIGURE 6

POTENTIAL CURRENT HUMAN PATHWAYS OF EXPOSURE

WARM SPRINGS PONDS

hazard index. If the combined chemical hazard index is greater than one (based on a detailed calculation presented in the risk assessment), then an unacceptable risk is present. Although some risks due to noncarcinogens were found, the hazard index was in all cases less than one. As indicated previously, lead was not quantitatively evaluated in the risk assessment. However, the EPA believes there is no safe threshhold for lead intake. Although copper and zinc do not present a risk to human health, they do pose significant risks to the environment, especially to aquatic organisms.

The maximum excess lifetime cancer risk due to arsenic exposure (arsenic is the contaminant of primary concern) for workers at the ponds is estimated to be 2×10^{-4}, or two excess cancers in every 10,000 exposed individuals. This estimated risk is based on exposure to maximum measured concentrations of arsenic in exposed tailings and contaminated soils present at the Warm Springs Ponds, but excluding the Mill-Willow Bypass.

Because of difficulties in developing risk-based cleanup levels for the occupational and recreational scenarios, EPA has elected to delay selection of a specific health-based soil cleanup action level. The EPA will continue to examine appropriate methods for calculating specific soil cleanup levels for this operable unit. Nevertheless, EPA is confident that the risk assessment has demonstrated actual and potential risks posed by conditions at this operable unit to justify the Record of Decision requirements. The next section, concerning environmental risks, explains how the human health risks will be reduced by mitigation of the environmental risks.

6.5 ENVIRONMENTAL RISKS

The EPA has determined that the Warm Springs Ponds pose the following actual or potential endangerment to the environment.

- Periodic fishkills have occurred due to salts of copper and zinc washing from tailings deposits into the Clark Fork River during thunderstorms. Contaminated soils, sediments, and tailings also pose an unquantifiable chronic risk to aquatic life and wildlife, both within the boundaries of the operable unit and in the river downstream.

- Water quality criteria for the protection of aquatic life have been exceeded by water discharged from the ponds, and by water routed around the ponds without treatment.

- The berms protecting the contaminated pond water and sediments fail to meet current dam safety standards. Their failure due to floods or earthquakes could result in catastrophic environmental consequences in the Clark Fork River.

Although this Record of Decision does not require a specific soil cleanup action level, EPA is confident that the risk assessment has sufficiently demonstrated the actual and potential environmental risks posed by conditions at the Warm Springs Ponds to justify the cleanup requirements.

The actions required by this Record of Decision are necessary and appropriate to address the risks described above, even though an exact quantification of acceptable risk levels was not determined. The actions required will reduce or eliminate the principal risks. This statement is based on the knowledge that several components of the selected remedy require excavation or covering of exposed tailings, sediments, and contaminated soils. For example, drying and covering Pond 1 will retard or stop the ground water contamination which currently exists, and increasing the operational level of Pond 2 will flood areas of contaminated soils, sediments, and tailings, thereby reducing exposure by direct contact to those areas.

6.6 FUTURE RISK ASSESSMENT ACTIONS

The determination of a final soil cleanup action level, which will be necessary for contaminated areas deferred by this action, and appropriate measures to remediate those areas, will be made within one year of the effective date of this document.

7.0 PROBLEM DEFINITION

Eight environmental and human health concerns were identified for which the feasibility study developed remedial objectives and alternatives for remedial action. The eight problems are based on the results of the remedial investigations, the applicable or relevant and appropriate requirements (ARARs) analysis, and the public health and environmental risk assessment.

The eight human health and environmental problems are described in terms of four contaminated media: (a) pond bottom sediments, (b) surface water, (c) tailings deposits and contaminated soils, and (d) groundwater. The contaminated media are discussed below in terms of the problems each medium presents to the Warm Springs Ponds Operable Unit.

7.1 POND BOTTOM SEDIMENTS

Dam Stability During Floods. Montana's dam safety rules control the minimum level of flood protection for the design of dams within the State of Montana. The dams at Warm Springs Ponds are classified as high hazard dams for which the State's dam safety rules require the ponds' outlet structures to pass varying fractions of a probable maximum flood. As the volume of water stored increases, the fraction becomes greater, to a maximum of one-half. The pond berms, as currently constructed, would likely fail during a moderate to major flood. In the event of partial or catastrophic dam failure during such a flood, the contaminated pond bottom sediments could cause incalculable damage to the Clark Fork River.

Dam Stability During Earthquakes. The Warm Springs Ponds are located within or very near the northern section of the Intermountain Seismic Belt, which is a zone of major earthquake activity within the North American tectonic plate.[6] At least 230 earthquakes with magnitudes greater than 4.0 have occurred at epicenters within 187 miles of the Warm Springs-Butte area during the last 107 years of recorded earthquakes.[7]

The ground-shaking that occurs during an earthquake can cause berms that are not adequately designed or constructed to flow somewhat like a liquid, causing them to slump and release the water and semisolids behind them. Earthquakes can also cause sloshing of the water in a pond, creating great waves that overflow and erode berms, often causing berm failure. A review of the limited information available on the construction of the Warm Springs Ponds berms shows that they are not strong enough to withstand even moderate earthquakes.

The Montana dam safety rules require that if a dam is in a region subject to earthquakes, the dam must be designed to withstand the most severe earthquake that can be reasonably anticipated. This design earthquake is known as the maximum credible earthquake.

A review of available information regarding the embankment materials confirms that the east-west and north-south berms are likely to fail in a moderate-to-severe earthquake. The likelihood of failure appears to be greater than previously reported. This was determined by a preliminary stability evaluation performed for this study, which indicated that the downstream slopes of the berms have potential to fail at accelerations from 0.05 to 0.07 g (g is the standard symbol for the acceleration of gravity). For comparison, in 1981, the International Engineering Company determined that the acceleration at Warm Springs Ponds during a maximum credible earthquake could be as high as 0.23 g. These preliminary conclusions will be investigated further and confirmed during the remedial design phase.

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6 International Engineering Company (IECO), 1981. Geotechnical and Hydrologic Studies, Warm Springs Tailings Ponds, Anaconda, Montana. Prepared for Anaconda Copper Company, Denver, Colorado.

7 Ibid.

Failure of the upstream slopes (faces) of the berms was not examined in this study because information on the materials and construction of the upstream slopes was not available. During the remedial design investigation, the potential for upstream slope failure also will be investigated.

Failure of the berms during an earthquake could result in at least partial release of the contents of the ponds. The sludges and tailings in the ponds are sufficiently liquid that they could migrate a considerable distance if released from the ponds. Although it has not been determined that the tailings in Warm Springs Ponds could also experience spontaneous liquefaction, this is a process that has been observed in seismically induced failures of other tailings ponds. If this process did occur, the tailings and sludges could flow for miles, contaminating the Clark Fork River downstream.

7.2 SURFACE WATER

Fishkills in the Mill-Willow Bypass. There have been five documented fishkills associated with the Mill-Willow Bypass since 1983. They occurred on August 9, 1983; August 2, 1984; July 3, 1987; May 27, 1988; and July 13, 1989, and are documented in Montana Department of Fish, Wildlife, and Parks memoranda for these years.

All five fishkills followed a similar pattern. They were associated with locally intense thunderstorms in the Warm Springs Ponds area, usually after extended dry periods. The fishkills started in the Mill-Willow Bypass and extended down the Clark Fork River for various distances. In the 1984 event, over a thousand dead fish were observed in a 15-to 20-mile stretch of the Clark Fork River. In July 1989, over 5,000 dead fish were reported. The fishkills have been linked to high concentrations of copper in the water; zinc concentrations and low pH levels may also be factors in fish mortality.

The available data indicate rapid elevation and dissipation of the metals concentrations during storm events, which implies that they are derived from a readily available source of highly soluble compounds, i.e., metal salts. A source of such salts has been identified along the Mill-Willow Bypass. During extended dry periods, salts of copper and zinc form by surface oxidation or the evaporation of soil moisture on the tailings deposits that exist along the bypass. There are approximately 21 acres of tailings deposits along the bypass. The copper salts are clearly visible on the tailings deposits during warmer months as green- and blue-colored surface deposits.

The postulated mechanism for the fishkills is that the rain water dissolves the metal salts and washes them into the bypass, resulting in metal concentrations high enough to cause mortality. Elevated levels of metals detected in the gills of dead fish suggest that the fish were exposed to acute levels of metals.

While transient phenomena such as the observed fishkills are difficult to study and even more difficult to model, the evidence available at this time points to the visible salts on the tailings deposits as the primary cause of the fishkills.

Metal Loads in the Stream Flows. Silver Bow Creek, and to a lesser degree Mill and Willow creeks, are all contaminated with detectable levels of heavy metals; primarily copper, arsenic, lead, and zinc. For example, in the Phase I remedial investigation, on the average, the inflow to the ponds, the discharge from Pond 2, and the combined flows of Mill and Willow creeks exceeded Montana's chronic water quality standard for copper in effect during the Phase I remedial investigation. The standard was exceeded in 100, 70, and 60 percent of the samples for those three sampling points, respectively.

The Mill-Willow Bypass was constructed to route the comparatively cleaner Mill and Willow creeks flows around the ponds and to the Clark Fork River without mixing with the comparatively more contaminated Silver Bow Creek flow. However, recent data indicate that, although Mill and Willow creeks are cleaner than Silver Bow Creek, they still contribute a portion of the total amount of metals reaching the operable unit (arsenic--34 percent, copper--6 percent, cadmium--3 percent, lead--3 percent, zinc--4 percent).

The pond system treats contaminated water by combinations of physical, chemical and biological process. Physical settling of suspended solids occurs simply because the flow velocities in the ponds are very low compared to the velocities in the creek channel. The removal of dissolved metals occurs in part because of photosynthetically-induced chemical precipitation, and uptake of metals by, and subsequent settling of, aquatic plants. The effectiveness of the ponds is enhanced by the addition of lime to precipitate metals during colder months when the amount of light available for photosynthesis and biological activity is diminished.

Without the treatment in the pond system, the Montana chronic water quality standards for the protection of aquatic life would be far more frequently exceeded at the Pond 2 outlet immediately upstream of the beginning of the Clark Fork River. For example, available information indicates the standard for copper (12 ug/l for a calcium carbonate hardness of 100 mg/l), would be exceeded more than 75 percent of the time. Even though the pond system currently treats Silver Bow, Mill, and Willow creeks , the water quality standards for several contaminants are often exceeded, particularly in winter months. The dissolved metals in the three creeks ultimately contribute to the chronic exposure by fish downstream.

Tailings in the Mill-Willow Bypass. The total amount of identifiable surficial tailings in the Mill-Willow Bypass has been estimated at 79,000 cubic yards. This includes 76,000 cubic yards of exposed tailings deposits and 3,000 cubic yards of tailings with vegetation cover. The primary source of these tailings is Silver Bow Creek. On numerous occasions over the past 20 years, the inlet structure of Pond 3 has been plugged by flood debris. This has caused Silver Bow Creek to enter the Mill-Willow Bypass and deposit its sediment load--much of it in the form of tailings--along the banks of the bypass channel.

These tailings have been further eroded and transported out of the bypass and into the Clark Fork River particularly during high flow conditions. Once deposited in and along the banks of the Clark Fork River, these contaminated tailings add to the problems that already exist there and thus contribute to adverse effects on aquatic organisms.

The Mill-Willow Bypass Removal Action, being conducted under an Administrative Order on Consent and scheduled for completion during late fall of 1990, will remove tailings and contaminated soils from the uppermost four miles of the bypass channel. The remaining portion of the bypass channel (approximately one-half mile), to its confluence with Warm Springs Creek, will be cleaned up as part of the overall remedial action for Warm Springs Ponds. All work required by the removal order is part of the overall remedy described herein and thus enforceable under this Record of Decision.

Transport of Upstream Tailings to the Clark Fork River. The W rm Springs Ponds are 27 river miles from Butte, where most of the mining-related activities occurred that led to the contamination at the Warm Springs Ponds. Silver Bow Creek is contaminated along most of those 27 miles, with several large deposits of tailings interspersed with many smaller deposits. There are also much smaller deposits of tailings along Mill and Willow creeks.

Altogether, some 3 million cubic yards of streamside tailings are estimated to exist upstream of the Warm Springs Ponds.[8] These tailings are eroded by normal and above normal flows in the creeks; however, high flows move larger quantities of these tailings. A recent flood study estimated that a 100-year flood on Silver Bow Creek would deliver 100,000 cubic yards (one football field 47 feet deep) of sediments to the Warm Springs Ponds.[9] These sediments would consist of both natural sediments and tailings.

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8 Hydrometrics, 1983. Summit and Deer Lodge Valleys Long-Term Environmental Rehabilitation Study, Butte-Anaconda, Montana, Volume VII, Warm Springs Ponds. Prepared for the Anaconda Minerals Company, Butte, Montana.

9 CH2M HILL, 1988. Silver Bow Creek Flood Modeling Study. Prepared for State of Montana Department of Health and Environmental Sciences, Helena, Montana.

Tailings Deposits and Contaminated Soils

In addition to the areas of tailings deposits around the pond system, there are soils that contain varying concentrations of metals or are mixed with tailings. In addition, there are areas of pond bottom sediments that were historically submerged in Ponds 1 and 2, but which are now exposed. The total area of tailings deposits and contaminated soils is estimated to be approximately 420 acres with a corresponding volume of 1.9 million cubic yards. (See Table 1)

The primary pathways identified for potential human exposure to these contaminants are direct (skin) contact, inhalation of dust from the surface, and incidental ingestion of contaminated soil and sediment. In addition, these contaminants may present environmental threats, through adverse effects on fish and wildlife within the pond system.

Ground Water

Exceedences of primary maximum contaminant levels for cadmium and arsenic were detected in one well located within Pond 1 and in several wells downgradient of Pond 1. The affected wells downgradient of Pond 1 are completed in the shallow sand and gravel aquifer. These exceedences could pose a threat to users of the aquifer, either currently or in the future, and to aquatic organisms in the Clark Fork River.

The known area of primary maximum contaminant level exceedences in groundwater caused by the pond system is in and below Pond 1 and is estimated to cover 180 acres. There are likely two primary reasons why the area of contamination is not more extensive. Most significantly, the pond bottom sediments (tailings and sludges) form a low permeability layer on the bottoms of the ponds, particularly in Ponds 2 and 3. Thus, the contaminated water in the ponds and in the sediments does not readily leak into and contaminate the groundwater to the degree that it otherwise would. Additionally, upward gradients in the aquifer north of Pond 1, and the interception of the groundwater in that area by the Clark Fork River, have kept the groundwater contamination in the area of the ponds from spreading very far north.

7.3 PROBLEMS UPSTREAM

In addition to the eight human health and environmental problems described above, the relationships among those problems and the remainder of the Silver Bow Creek/Butte Area NPL Site problems upstream of the Warm Springs Ponds are also important. Most significantly, the upstream areas are the sources of the very large volume of contaminated water flowing into and through the operable unit. The ponds, while not currently capable of providing totally adequate treatment of the contaminated flows in Mill, Willow, and Silver Bow creeks, are nonetheless an important treatment system. They provide significant protection of the Clark Fork River from the continuous flow of contamination currently coming from upstream areas.

The levels of contamination in Mill, Willow, and Silver Bow creeks will likely be reduced by future cleanup actions taken upstream of the Warm Springs Ponds. But, until that time, the pond system will be needed to treat the flows and thereby improve the water quality in the three creeks. This is an important factor in determining the types of alternatives that can be developed for the Warm Springs Ponds Operable Unit. Alternatives that would eliminate or substantially alter the existing pond treatment would have to include alternative treatment capacity for the contaminated surface water if an equivalent level of aquatic protection is desired.

In spite of the environmental problems, the Warm Springs Ponds have become a major nesting and resting place for abundant waterfowl in the upper Clark Fork River. Brown and rainbow trout also inhabit the wildlife ponds and Ponds 2 and 3. The ponds are an important sport fishing and hunting spot, attracting sportsmen from all parts of the United States. Trout are caught frequently in the range of 8-12 pounds. These points are noteworthy in light of the long term plans for improving the ponds' ability to support fish and wildlife. The selected remedy, which includes provisions for improving water quality, increasing wetlands areas, eliminating exposed tailings, and improving the configuration of the bypass channel, is not only a Superfund cleanup proposal but it is also a major fish and wildlife habitat enhancement proposal.

8.0 DESCRIPTION OF ALTERNATIVES

Objectives for remediation of the Warm Springs Ponds Operable Unit were identified as part of the feasibility study. These objectives were developed from the identification of environmental and human health problems, utilizing ARARs and site-specific human health and environmental protectiveness standards identified through the public health and environmental assessment. The remedial action objectives are listed in Table 3.

Following the identification of the remediation objectives, potential remedial technologies and process options were identified and evaluated for use at the site. All of the technologies and process options were initially screened to eliminate those that were unrelated to the problems at the site or that were technically infeasible for use at the site. The retained technologies and process options were evaluated a second time based on effectiveness, implementability, and cost to further reduce the list of potential technologies.

The technologies remaining following the second screening were combined to form media-specific actions addressing the remedial objectives identified for each of the media. The media-specific actions were developed to the conceptual design level in the feasibility study.

Six comprehensive remedial action alternatives were assembled in the feasibility study by combining one or more media-specific actions for each of the affected media into an overall remediation package. The action alternatives were assembled from the 16 media-specific actions developed in the feasibility study. In addition, a "no-action" alternative was added to the range of alternatives and evaluated with the action alternatives as required by the National Contingency Plan. The seven alternatives developed in the feasibility study for evaluation cover a range of possible combinations (Table 4). Also included in Table for comparison is Alternative 3+3A, the selected remedy.

TABLE 3
RELATIONSHIP OF SITE PROBLEMS TO REMEDIAL ACTION OBJECTIVES

Problems	Objectives
Pond Bottom Sediments	
Pond integrity--floods Pond integrity--earthquakes	Prevent the release of the pond sediments from design floods and earthquakes
Surface Water	
Fishkills Metal loads in the flows of Mill, Willow, and Silver Bow Creeks	Meet ambient water quality standards for aquatic life at the identified compliance point.
	Prevent ingestion above maximum contaminant levels and established reference doses for copper, iron, zinc, and cadmium. Also prevent ingestion of water containing arsenic in concentrations that would cause an excess cancer risk greater than 10^{-4} to 10^{-7}
Erosion of tailings in the Mill-Willow Bypass into the Clark Fork River	Reduce the potential for tailings in the Mill-Willow Bypass to reach the Clark Fork River
Transport of tailings from upstream reaches of Silver Bow Creek to the Clark Fork River during floods and other high flow events	Reduce the potential for tailings in upstream areas of Silver Bow Creek to reach the Clark Fork River
Tailings Deposits and Contaminated Soils	
Human and environmental exposure to surface contamination	Reduce the potential for human exposure to exposed tailings and other surface contamination to satisfy acceptable intake criteria
Groundwater	
Contaminated groundwater in the Pond 1 area	Reduce the metals contamination in the groundwater downgradient of the ponds to achieve compliance with maximum contaminant levels

TABLE 4
ASSEMBLED ALTERNATIVES FOR WARM SPRINGS PONDS OPERABLE UNIT FEASIBILITY STUDY

MEDIA	POND BOTTOM SEDIMENTS		SURFACE WATER				GROUNDWATER	SOIL
Alt	Sediments Floods	Sediments Earthquakes	Fishkills	Dissolved Metals	Erosion of Tailings	Transport of Upstream Tailings	Contaminated Groundwater	Tailings Deposits & Contaminated Soils
1	Cease current operation of the pond system and solidify sludges and sediments in all three ponds	Cease current operation of the pond system and solidify sludges and sediments in all three ponds	Remove tailings deposits and contaminated soils from bypass; dispose of in Pond 1 and solidify	Construct a new more effective treatment pond	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 2 or 3, and solidify	Construct an upstream flood impoundment of 8,000 acre-feet	Install trench drains in and below Pond 1. Pump to new treatment pond inlet for treatment	Excavate all material above the action level;[a] disposal in Pond 2 or 3 prior to solidifying the ponds
2	Protect ponds against a PMF	Protect ponds against an MCE	Remove tailings deposits and contaminated soils from the bypass; dispose of in an offsite TSDF.	Comprehensive upgrade of the Pond 3 treatment system	Remove tailings deposits and contaminated soils from the bypass; dispose of in an offsite TSDF	Construct an upstream flood impoundment of 8,000 acre-feet	Install trench drains in and below pond 1. Pump to Pond 3 inlet for treatment.	Excavate all exposed areas above the action level;[a] offsite disposal; cap and revegetate Pond 1 and flood Pond 2.
3	Protect ponds against fractions of a PMF.[b]	Protect ponds against an MCE	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 1 prior to capping.	Comprehensive upgrade of the Pond 3 treatment system	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 1 prior to capping	Construct an upstream settling basin of 2,000 acre-feet	Install trench drains in and below Pond 1. Pump to Pond 3 inlet for treatment.	Excavate all exposed areas above the action level;[a] disposal in Pond 1; cap and revegetated Pond 1. Flood Pond 2.
3+3A	Protect all three ponds against a 0.5 PMF	Protect ponds against an MCE	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 1 or pond 3 prior to covering and revegetating.	Upgrade of the pond treatment system	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 1 or Pond 3 prior to covering and revegetating.	Raise the Pond 3 berms so that it can provide flood detention and settling up to a 100-year capacity flood.	Install trench drains in and below Pond 1. Pump to Pond 3 inlet for treatment	Cover and revegetate Pond 1; flood tailings deposits above Pond 2.

TABLE 4 (continued)
ASSEMBLED ALTERNATIVES FOR WARM SPRINGS PONDS OPERABLE UNIT FEASIBILITY STUDY

MEDIA	POND BOTTOM SEDIMENTS		SURFACE WATER				GROUNDWATER	SOIL
Alt	Sediments Floods	Sediments Earthquakes	Fishkills	Dissolved Metals	Erosion of Tailings	Transport of Upstream Tailings	Contaminated Groundwater	Tailings Deposits & Contaminated Soils
4	Protect all ponds against fractions of a PMF.[b]	Protect ponds against an MCE.	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 1 prior to capping.	Comprehensive upgrade of the Pond 3 treatment system.	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 1 prior to capping.	Construct an upstream settling basin of 2,000 acre-feet.	Install trench drains in and below Pond 1. Pump to Pond 3 inlet for treatment.	Cap and revegetate all material above the action level. Excavate tailings deposits and contaminated soils in bypass; dispose in Pond 1. Flood Pond 2.
5	Protect ponds against fractions of a PMCF.[b]	Protect ponds against an MCE.	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 1 prior to capping.	Partial upgrade of the treatment system; replace fuse plug; improve trashrack and lime addition.	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 1 prior to capping.	Construct an upstream settling basin of 2,000 acre-feet.	Install trench drains below Pond 1; treat in onsite wetlands.	Cap and revegetate all exposed areas above the action level. Excavate tailings deposits and contaminated soils in bypass; dispose in Pond 1.
6	Protect ponds against fractions of a PMF.[b]	Protect ponds against an MCE.	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 1 prior to capping.	Partial upgrade of the treatment system; replace fuse plug; improve trashrack and lime addition.	Remove tailings deposits and contaminated soils from the bypass; dispose of in Pond 1 prior to capping.	No action.	Install trench drains below Pond 1; treat in onsite wetlands.	Flood all applicable areas;[a] excavate tailings deposits and contaminated soils in bypass and dispose in Pond 1; cap and revegetate Pond 1.
7	No action.	No action.	No action.	No action.	No action.	No action.	No action.	No action.

a All areas containing contaminated soils and tailings for which the specified technology is appropriate or applicable. For example, excavation is appropriate above Pond 3, below Pond 1, and along the bypass; it is not applicable for the tailings in Ponds 1 and 2. Preliminary action levels are 250 ppm for arsenic and 750 ppm for lead.

b Alternative would protect Pond 3 to a 0.5 PMF, Pond 2 to a 0.3 PMF, and Pond 1 to 0.2 PMF.

PMF - Probable Maximum Flood
MCE - Maximum Credible Earthquake

During the development of the feasibility study report, ARCO developed its own proposed plan (called Alternative 3A). It incorporated many of the features of the agencies' Alternative 3, but was significantly different in two major respects. Because the ARCO alternative had certain useful features, and it was clear that a combination of the features of the agencies' Alternative 3 and ARCO's Alternative 3A could be developed as an effective alternative for remediation of the site, a combined alternative, called Alternative 3+3A in this Record of Decision, has been developed. It is the selected remedy for the operable unit. Table 4 lists the alternatives and describes the specific actions that each includes. Each of the alternatives, including 3+3A, is described separately below.

8.1 ALTERNATIVE 1 ($1,191,500,000)

The components of Alternative 1 include solidifying all onsite contaminated soils, tailings, sediments, and sludges to protect against a probable maximum flood (PMF) and a maximum credible earthquake (MCE); constructing a new treatment pond for surface water treatment and an upstream flood impoundment to capture flood flows for additional treatment; and installing a groundwater interception trench to capture and then treat contaminated groundwater as it migrates from the ponds.

The current inability of the three existing ponds to withstand floods and earthquakes would be addressed by using an in situ solidification process to stabilize the pond bottom sludges and sediments. This would minimize the risk of pond failure due to an earthquake or flood event. In addition, contaminated soils and exposed tailings that exceed an action level of 250 ppm for arsenic and 750 ppm for lead would be excavated and disposed of in the existing ponds prior to solidification.

This alternative would effectively limit the toxicity and mobility of tailings to acceptable concentration levels and greatly reduce the potential for future human or animal contact with harmful contaminants.

Alternative 1 would also improve surface water quality with the construction of a new pond treatment system. A new treatment pond would be constructed to replace the existing, now solidified, pond system. The new pond would be capable of capturing and treating flows up to 600 cfs. This is the flow the current pond system is capable of treating.

In addition, an upstream flood impoundment (8,000 acre-feet) would be constructed to provide settling and treatment of flows on Silver Bow Creek up to the volume of a 100-year flood or the maximum flow rate of the maximum flood of 4,000 cfs. Currently, flood flows on Silver Bow Creek that exceed 600 cfs (the design limit of the Pond 3 inlet structure) are routed around the ponds, untreated. A flow of 600 cfs on Silver Bow Creek represents a 2- to 3-year return flood.

The goal of the upstream impoundment is to prevent large quantities of sediments and dissolved metals from bypassing the pond system and flowing into the Clark Fork River. The impoundment would serve two functions. First, it would serve as a conventional sedimentation basin; as the influent velocity slowed in the impoundment, the sediment being transported by the flow would settle out. Second, the impoundment would have the storage capacity to contain flows up to the 100-year flood. The water could then be metered to the ponds for treatment of dissolved metals. Floods exceeding 4,000 cfs would be routed around the impoundment to protect it from damage caused by scouring.

Contaminated groundwater moving from the operable unit would be collected from in and below Pond 1 through the installation of an open groundwater trench. The collected groundwater would then be pumped to the inlet of the new pond for treatment. This would reduce the discharge of contaminated groundwater into the Clark Fork River and enable the aquifer to be used for drinking water and other beneficial uses.

Alternative 1 is one of two alternatives expected to exceed at least one ARAR. Whereas Montana's dam safety standards require protection of the existing Ponds 1, 2, and 3 to 0.2, 0.3, and 0.5 PMF, respectively, the in situ stabilization process would provide protection of all three ponds against the full PMF. Alternative 1 is expected to meet all other ARARS with one exception; surface water standards for arsenic and mercury for protection of public health from ingestion of contaminated water and fish are technically impracticable to meet using this or any other remedial alternative.

The actions proposed in Alternative 1, however, would have a substantial adverse affect on existing wetlands. Over 1,200 acres of wetlands and open habitat for birds, fish, and mammals would be destroyed.

A potential adverse affect on an identified cultural resource within the area also exists. A concrete arch bridge located within the dry portion of Pond 2 has been determined to be eligible for inclusion in the National Register of Historic Places. Consultation with the State Historic Preservation Office would be necessary to minimize potential impacts to the bridge prior to commencing any remediation activities. Consultation with that office will be necessary with the remaining alternatives as well.

Certain institutional controls would be required for Alternative 1 and all the other remedial alternatives, as well. Institutional controls are generally defined as legal mechanisms that prevent or limit human access and exposure to the contamination and are used to enhance the effectiveness of a given remedial alternative. Upon solidification and closure of the ponds, the local zoning or land use authority and the EPA Regional Administrator must be notified of the type, location, and quantity of waste disposed of in each pond. A notation or deed to the facility property must be recorded in accordance with State law to notify any potential purchaser that the land has been used to manage hazardous waste. Finally, the prohibition against consumption of any fish caught within the pond system must be continued.

With the appropriate design, construction, and maintenance, Alternative 1 should reliably reduce human health and environmental risks. Because of the enormous volume of pond sludges (19 million cubic yards), Alternative 1 would take approximately 17 years to complete. Full risk reduction would not occur until that point. The estimated present worth cost for this alternative is $1,191,500,000. This present worth cost includes both capital costs and annual operations and maintenance costs. All future costs are reduced to present worth costs to allow remedial action alternatives to be compared on a relatively equivalent basis.

8.2 ALTERNATIVE 2 ($241,500,000)

Alternative 2 is the most comprehensive of the alternatives that retain the current pond treatment system. Its components include protecting the pond system against a probable maximum flood and the maximum credible earthquake; excavating and disposing offsite all contaminated soils and tailings within the Mill-Willow Bypass, Pond 3, and below Pond 1; capping Pond 1; flooding exposed tailings and contaminated soils within Pond 2; and upgrading the treatment system in Pond 3. It also includes two of the components of Alternative 1: constructing an upstream flood impoundment and installing groundwater interception trenches.

Pond stability would be achieved by protecting all three ponds against both a full probable maximum flood (PMF) and maximum credible earthquake (MCE). Thus, maximum protection is provided against release of the pond bottom sediments. While some damage to the pond berms could still occur under extreme conditions, there would be minimal risk of losing the pond bottom sediments during an earthquake or flood event.

All exposed tailings and contaminated soils along the Mill-Willow Bypass, and all exposed tailings and contaminated soils within Pond 3 and below Pond 1 that exceed an action level of 250 ppm arsenic and 750 ppm lead, would be removed and disposed of at an offsite RCRA disposal facility. The closest treatment, storage, and disposal facility able to accept the waste is near Boise, Idaho, approximately 480 miles from the site. Exposed tailings and contaminated soils within Pond 2 would be flooded, and Pond 1 would be

Contaminated groundwater would be collected through interception trenches below both Pond 1 and Pond 2 berms. The groundwater would then be pumped to the inlet of Pond 3 for treatment.

Alternative 2 is one of two alternatives expected to exceed at least one ARAR. Whereas Montana's dam safety standards require protection of the existing Ponds 1, 2, and 3 to 0.2, 0.3, and 0.5 PMF, respectively, Alternative 2 stabilizes all pond berms against a full PMF. This alternative is expected to attain aquatic water quality standards for surface water (except for arsenic and mercury, as described in Alternative 1), maximum contaminant levels for groundwater, and selected RCRA closure requirements for Pond 1.

All of the components of Alternative 2 should reliably reduce the human health and environmental risks at the site, if properly designed, operated, and maintained. The actions proposed may result in adverse effects to wetlands, endangered species, or historical resources. The estimated present worth cost for this alternative is $241,500,000. It is estimated that the remediation measures will take 5 years to complete.

8.3 ALTERNATIVE 3 ($71,100,000)

Alternative 3, identified by MDHES and EPA in the feasibility study and the proposed plan as the preferred alternative, is similar to Alternative 2 in that is includes protecting the ponds against an maximum credible earthquake completely upgrading the pond treatment system, capping Pond 1 and flooding Pond 2, and installing ground water interception trenches. It is different from Alternative 2 in that it requires protection of the ponds to a fraction of the probable maximum flood instead of the full probable maximum flood; it includes excavation of exposed tailings and contaminated soils with subsequent disposal in Pond 1 instead of offsite disposal; and it includes the smaller upstream settling basin in lieu of a large upstream impoundment. Only the new components are discussed below.

Pond stability in this alternative is achieved by protecting Pond 1 against a 0.2 PMF, Pond 2 against a 0.3 PMF, and Pond 3 against a 0.5 PMF. These are the standards that are required by Montana's dam safety regulations for high hazard dams such as those at the Warm Spring Ponds.

In Alternative 3, all exposed tailings and contaminated soils in the Mill-Willow Bypass, within Pond 3, and below Pond 1 that exceed an action level of 250 ppm arsenic and 750 ppm lead would be excavated and disposed of in Pond 1. Pond 1 would be closed with a RCRA-compliant cap as described in Alternative 1.

Consolidating excavated material into Pond 1 under a RCRA-compliant cap would effectively isolate the material from direct contact and effectively limit the mobility of the material. It would also effectively consolidate all material which exceeds the cleanup criteria within a smaller area. As long as the cap is properly maintained, the material would be safe from release because of erosion of the cap.

The final difference between Alternatives 2 and 3 is that Alternative 3 includes the construction of a smaller upstream settling basin (2,000 acre-feet). During flood flows on Silver Bow Creek greater than 600 cfs, surface water would pass through the upstream settling basin. The settling basin would be similar to the upstream impoundment with two exceptions. First, the storage capacity would be much lower (2,000 acre-feet versus 8,000 acre-feet). Second, the amount of water that would receive full treatment for both suspended solids and dissolved metals would be less.

During flood flows between 600 and 4,000 cfs, all surface water from Silver Bow Creek would pass through the upstream settling basin. Full treatment would be provided for floods that do not completely fill and then overflow the 2,000 acre-foot settling basin. Suspended solids would settle within the basin and the captured water would then be released slowly from the basin for treatment of dissolved metals in Pond 3. Floods that exceed the storing capacity of the settling basin, however, would be only partially treated.

Up to 80 percent of the suspended solids would continue to be settled out within the basin, but only flows up to 600 cfs (the inlet capacity of Pond 3) would then be treated in the ponds for dissolved metals. The remainder of the flows discharged over the spillway of the settling basin would be routed around Pond 3 and flow down the bypass without treatment of dissolved metals.

The actions proposed in Alternative 3 are expected to result in compliance with all State and federal ARARs. These include Montana's dam safety standards, aquatic water quality standards (with the exception of arsenic and mercury, as previously described), maximum contaminant levels, and selected RCRA closure requirements.

The actions proposed for Alternative 3 are technically feasible and are expected to reliably reduce the environmental and human health risks at the site. The actions proposed may result in adverse effects to wetlands, endangered species, or historical resources. The estimated present worth cost is $71,100,000. It is estimated that the remediation measure identified will take 5 years to complete.

8.4 ALTERNATIVE 3+3A $(57,416,000)

Alternative 3+3A, identified by the EPA and MDHES as the selected remedy, is a synthesis of Alternative 3 and ARCO's Alternative 3A. Alternative 3+3A was developed following consultation with the public and ARCO to address concerns about some of the aspects of Alternative 3 as presented in the feasibility study. Alternative 3+3A includes many of the features of Alternative 3, including protecting the pond berms against the maximum credible earthquake and fractions of the probable maximum flood, upgrading the treatment system, removing Mill-Willow tailings, covering and revegetating Pond 1, and installing ground water interception trenches. It is different from Alternative 3 in that storage of flood flows would be within Pond 3 rather than in an upstream impoundment; the bypass channel would be realigned in places; Pond 2 would be improved and retained as a treatment unit; and disposal of contaminated soils would be within the dry areas of either Ponds 1 or 3. The primary features of Alternative 3+3A are discussed below.

Pond stability would be achieved by altering all pond berms so that they would be stable during the maximum credible earthquake. This would be accomplished by flattening the downstream slopes or adding toe berms for stability. Additionally, the upstream faces of the berms would be analyzed during the remedial design phase to insure their stability during the maximum credible earthquake. All north-south berms along the Mill-Willow Bypass would be raised and strengthened to protect against failure during flood flows up to 70,000 cfs, which is one-half the peak flow rate of a probable maximum flood. The slopes of the berms along the bypass would be protected against scour by constructing soil-cement armoring for the entire length of the bypass.

The tailings and contaminated soils along the Mill-Willow Bypass would be excavated and disposed of at two locations: within Pond 1 prior to covering and within a dry area of Pond 3 near the Pond 3 berm (see Figure 1). This excavation and disposal was begun during the summer of 1990 as part of the Removal Action. The remainder of the excavation and disposal will be performed as part of the Remedial Action covered by this Record of Decision. The disposal areas in Pond 1 and in Pond 3 will ultimately be covered with lime and soil barriers, then revegetated with native species. The amount of contained materials to be disposed of at each location will be determined based upon the economics of haul distances.

The measures to upgrade Ponds 2 and 3 for this alternative would serve two primary purposes: 1) storage of flood flows up to the 100-year event and 2) improvement of the treatment processes to achieve the water quality standards at the point of discharge. The main features include:

- Raise Pond 2 and 3 embankments to increase storage capacities within those ponds and enable storage and treatment of the 100-year flood event in Pond 3.

The total storage capacity of Pond 3 would be increased to 13,000 acre-feet. The operating volume of Pond 2 would be increased to 2,200 acre-feet to increase retention time and improve treatment.

- Modify and replace hydraulic structures. The intake structure to Pond 3 would be completely replaced with a larger, more efficient structure capable of passing flows up to 3,300 cfs (the estimated peak flow of the 100-year flood event). Flows exceeding that amount would be routed to the Mill-Willow Bypass Channel using a combination of an overflow spillway and a fuse plug dike. The intake structure would be designed to minimize plugging through use of a trash rack. At the maximum water surface elevations anticipated during a major flood, the intake structure would be capable of passing no more than 4,000 cfs into the ponds.

  The two decant outlets on Pond 3 would be raised and modified to provide controlled releases into Pond 2, not to exceed 200 cfs. Additional outflows are required to avoid exceeding the allowable storage volume in Pond 3 during the 100-year flood. Outflows in excess of 200 cfs would be routed directly into the Mill-Willow Bypass channel via a pipe from the west decant tower. The outlet pipe to the bypass would be capable of discharges up to 500 cfs. The discharge to the bypass would be through an energy-dissipation structure to avoid excessive erosion. The outlet structure in Pond 2 would be raised and modified to accommodate the water level increase.

- Construct emergency spillways in the Pond 2 and Pond 3 berms. In Pond 2, the spillway would be designed to allow passing up to 12,500 cfs from a flood in the eastern hills, which is one-half the probable maximum flood of that drainage area above Pond 2. In Pond 3, the entire volume expected during a flood of one-half the probable maximum flood, from the eastern hills, can be contained within the upgraded storage capacity of Pond 3. However, as noted above, the inlet structure to Pond 3 can pass as much as 4,000 cfs during a major flood in Silver Bow Creek. Thus, the spillway in Pond 3 must be capable of passing 4,000 cfs directly into the bypass channel to avoid overtopping the berms during a major flood in Silver Bow Creek. The emergency spillways would be constructed in the western embankments of Ponds 2 and 3 and would be constructed using soil-cement similar to the soil-cement used to armor the embankments slopes.

- Upgrade lime treatment facilities and water quality controls. A new lime addition facility would be installed at the intake structure to Pond 3. The new facility would add hydrated lime to the Silver Bow Creek influent at a rate sufficient to raise and maintain pH levels at a minimum of 9.0. The treatment facility would be designed to handle both normal flows and flood flows up to the 100-year event. Pond 3 would provide sufficient retention time to allow metals to react and form insoluble hydroxide precipitates. Pond 2 would provide greater volume and retention time for final settling and clarifying of the Pond 3 effluent before discharging.

The contaminated ground water would be addressed using the same facilities as described for Alternatives 2 and 3. The ground water would be collected in interception drains below and within or adjacent to Pond 1. The ground water would then be pumped back to the inlet of Pond 3 for treatment.

Both surface and ground water quality monitoring would be needed. The existing ponded water in the eastern portion of Pond 1 would be pumped out and Pond 1 would then be dry-closed. The tailings and contaminated soils in Pond 1 would be protected from direct exposure by covering with lime and soil barriers, followed by revegetation with native species. The dry-closed Pond 1 would be protected from floods in the eastern hills through construction of a channel around the east side of the pond, discharging below Pond 1 to the Clark Fork River. The channel would be designed to safely pass a flood from the eastern hills of 8,500 cfs, which is one-half the probable maximum flood of that drainage area above Pond 1.

The exposed tailings above Pond 2 would be flooded as a result of the increased water elevation and volume of this pond. The exposed tailings deposits above Pond 3 will not be addressed as part of this alternative. The area above Pond 3 will be part of the active receiving pond, with floods up to the 100-year flood being routed into the pond. During these events, additional tailings and sediments will be deposited in Pond 3. Hence, the removal or capping of the exposed tailings in this area will be addressed at the 5-year review and at the time of the final closure of the pond system.

Institutional controls to prevent future residential development would be implemented. Deed notices and recording the locations of Ponds 1, 2 and 3 and all disposal areas would be required. Specific contractual provisions with the State may be required. Further development of Deer Lodge County's zoning scheme will be required. Institutional controls to prevent swimming and consumption of fish by humans is necessary. All other activities needed to comply with the final ARARs, Attachment to Part 2 would also be required.

The actions proposed in Alternative 3+3A are expected to result in compliance with state and federal ARARs. These include Montana's dam safety standards, aquatic water quality standards (with the exception of the standards for arsenic and mercury, which will be waived as previously described), and maximum contaminant levels.

The actions proposed for Alternative 3+3A are technically feasible and are expected to reliably reduce the environmental and human health risks at the site. The actions proposed may result in adverse effects to wetlands, endangered species, or historical resources. The estimated present worth cost is $ 57,416,000. It is estimated that remediation will take 3 to 5 years to complete.

8.4.1 COMPONENT UPGRADE

A component upgrade of the treatment system in Pond 3 may be necessary in the event that the remedies proposed in Alternative 3+3A for handling flood flows are not as effective as currently anticipated. The purpose of the component upgrade would be to address the potential for resuspension of bottom sediments in Pond 3.

The pond bottom sediments of concern are the very fine grained settled materials that are essentially composed of flows and sludges resulting from the existing (and proposed) treatment processes. These flows and sludges exist as a sludge bla ket on the bottom of Pond 3. They may be subject to resuspension during high winds or high flows. The amount and the effects of resuspension cannot be determined using existing modeling techniques.

Accordingly, tests will be performed on the pond bottom sediments to determine their impact on aquatic life. The tests would be performed in two phases:

- Phase 1 will include a bioassay survey of the pond bottom sediments. A model will be constructed assuming various levels of resuspension of these materials. Waters containing these levels of resuspended materials will then be used in a series of bioassays. Standard EPA-approved test species of biota (including fish and macroinvertebrates), or native biota if possible, will be subjected to acute and chronic bioassays using waters containing the materials to determine the effects on their ability to survive. In conjunction with the bioassays, a full spectrum of chemical analyses will be performed on the waters containing the resuspended materials. The bioassay survey will be completed prior to September 30, 1991.

- Phase 2 will be performed only if bioassay results indicate that there are adverse affects on the biota as a result of pond bottom material releases. Phase 2 would incorporate field scale resuspension testing using in situ techniques to determine the parameters necessary to develop resuspension modeling. Once these parameters have been defined, the Pond 3 system would be modeled to determine the extent of resuspension during high flows or high winds.

If the Phase 1 or Phase 2 investigations indicate that resuspension of pond bottom sediments will result in adverse effects to human health or the environment, additional measures would be required as part of the selected remedy. These measures would include:

- A separate study amendment to identify and analyze additional remedial measures to address the resuspension of pond bottom sediments.

- Construction of the selected additional remedial measures.

8.5 ALTERNATIVE 4 ($77,000,000)

Alternative 4 contains many of the same components as Alternative 3. These include protecting the pond system against a full maximum credible earthquake and a fraction of the probable maximum flood, capping Pond 1, completely upgrading the pond treatment system, constructing an upstream settling basin, and installing ground water interception trenches. The only difference between this alternative and Alternative 3 is that this alternative provides for capping exposed tailings and contaminated soils in place instead of excavating and consolidating them in Pond 1 prior to capping.

In Alternative 4, the only areas of exposed tailings and contaminated soils that would not be capped in place would be those along the Mill-willow Bypass and within Pond 2.

Material from the Bypass would be excavated and placed into Pond 1 prior to capping. The areas of exposed tailings and decontaminated soils within Pond 2 would be flooded. All other areas that exceed an action level of 250 ppm for arsenic and 750 ppm for lead would be capped in place. The capping would involve covering these areas with a 6-inch layer of agricultural lime to help prevent metals migration and then covering the area with 18 inches of topsoil. Capping the contaminated soils and exposed tailings in place with an 18-inch cap would effectively reduce the mobility of the material but would not be as effective or permanent in containing the wastes and minimizing the exposures as removal, consolidation, and placement under a RCRA-compliant cap as specified in Alternative 3. Fertilizer, soil amendments, and seed would be spread as necessary over the area to establish stable vegetative cover in accordance with State reclamation requirements.

The actions proposed in Alternative 4 are expected to result in compliance with all state and federal ARARs. These include Montana DNRC dam safety requirements, aquatic water quality standards (with the exception of arsenic and mercury, as previously described), maximum contaminant levels. RCRA compliant closure requirements (Pond 1), and State reclamation standard (exposed tailings and contaminated soils).

All of the components of Alternative 4 are technically feasible, and with appropriate design, construction, operation and maintenance, would reliably reduce the human health and environmental risks at the site. The actions proposed in Alternative 4 may have an adverse effect on wetlands, endangered species, or historical resources. It is estimated that implementation of this alternative will take 5 years at a total present worth cost of $77,000,000.

8.6 ALTERNATIVE 5 ($66,3000,000)

Alternative 5 is similar to Alternative 4 in all aspects except two. First, Alternative 5 includes a partial upgrade to the treatment system instead of the complete upgrade provided in Alternatives 2, 3, and 4. Second, Alternative 5 provides for treatment of contaminated ground water in an onsite wetland treatment system instead of in Pond 3.

The partial upgrade of the pond treatment system would include the following four measures:

1. Diverting Mill and Willow Creeks into Pond 3 for treatment

2. Modifying the inlet to Pond 3 by adding a trash rack and an overflow weir and relocating the fuse plug

3. Improving the lime treatment system

4. Retaining the existing effluent structures in Pond 3 and keeping Pond 2 in service

This less comprehensive upgrade to the pond system would provide some improved treatment to surface waters, but not to the extent necessary to effectively treat flows up to 600 cfs as provided in Alternatives 2, 3, and 4. Consistent treatment would be provided for flows only up to approximately 210 cfs. This flow rate is based upon calculations that determine the maximum flow rate that could be directed from Pond 3 to Pond 2 while still providing acceptable metals removal in Pond 2 and preventing the resuspension of pond bottom sediments. Since the effluent structure that directs the flow from Pond 3 to Pond 2 will not be modified, Pond 2 remains as an active treatment cell in the pond system and becomes a limiting factor with regard to the volume of flow that can be treated in the ponds.

Because of the limited capacity of Pond 2, flows greater than 210 cfs would be directed around the pond system without treatment for dissolved metals. This will result in violations of aquatic water quality standards during above average flows. (The average flow of surface waters through the operable unit is approximately 90 cfs). Also, because the effective treatment capacity of Pond 2 is nearly exhausted due to the volume to sediments accumulated in the Pond, keeping Pond 2 in the treatment system provides an opportunity for sediments to be resuspended during periods of high winds. The future life of Pond 2, and therefore the future life of the treatment system, would be limited to an estimated 15 years.

The ground water contamination problem would be addressed by constructing a wetlands treatment system below Pond 1. Contaminated ground water would be collected by an open ground water trench and pumped up to the entrance of the wetlands for treatment. The area available for the establishment of a wetlands treatment system is approximately 100 acres.

Two separate treatment cells would be constructed within the wetlands to enhance the metals removal efficiencies. The cells would operate in series, with effluent water from the first cell discharging into the second cell. Treated water from the second cell would be discharged to the Clark Fork River.

Due to plant uptake of toxic metals and vegetation die-off, periodic removal of organic matter from the wetlands area would be necessary. However, with periodic cleaning and proper maintenance, the wetlands could be expected to remain viable for at least the life of the treatment system. Treating contaminated ground water in an onsite wetlands should result in compliance with groundwater standards. However, wetlands treatment is not expected to be as consistently reliable as the pond treatment system proposed in Alternatives 2, 3, and 4.

Alternative 5 is expected to result in compliance with most but not all ARARs. By providing only a partial upgrade to the pond treatment system, exceedences of aquatic water quality standards can be expected. Compliance with maximum contaminant levels for ground water is expected to be achieved, but not with the consistency expected with alternatives 1 through 4. Certain RCRA closure requirements for Pond 1 and reclamation standards are expected to be achieved.

The actions proposed in Alternative 5 may have an adverse effect on wetlands, endangered species, or cultural resources. It is estimated that this alternative will take 5 years to implement at a present worth cost of $66,3000,000.

8.7 ALTERNATIVE 6 ($55,100,000)

The components of Alternative 6 are a combination of many of the components found in Alternatives 1 through 5. Alternative 6 includes protecting the pond system against a full maximum credible earthquake and a fraction of the probable maximum flood, excavating tailings and decontaminated soils within the Mill-Willow Bypass and disposing of them in Pond 1, partially upgrading the pond treatment system, and collecting and treating contaminated ground water in an onsite wetlands treatment system.

The unique features of Alternative 6 are that: 1) it does not include the installation of an upstream impoundment or settling basin; and 2) the action proposed for isolating the contaminated soils and tailings within the site includes flooding wherever possible. Only the two unique features are discussed below.

This alternative does not address the transportation of contaminated soils and tailings from upstream sources expect for flows less than 210 cfs. As discussed in Alternative 5, this flow rate is a limitation of Pond 2 and the partial upgrade of the pond treatment system. Therefore, flows greater than 210 cfs on Silver Bow Creek would bypass the pond system since no upstream impoundment or settling basin would be present to detain larger flows and thus enhance settlement of solids and treatment of metals. In addition, over the long term, deposition of upstream sources may lead to recontamination of the Mill-Willow Bypass.

In Alternative 6, exposed tailings and contaminated soils below Pond 1 and within Ponds 2 and 3 would be isolated by flooding the areas and maintaining a constant water level. The flooding of tailings and contaminated soils below Pond 1 would be accomplished through the construction of the wetlands treatment system.

The exposed tailings and contaminated soils within Pond 2 would be flooded. A small berm would be designed to cross Pond 2, running east to west in order to facilitate the flooding of the higher southern end of the pond. A small amount of water would be discharged from Pond 3 to Pond 2 in order to keep the newly bermed area wet. Discharge from Pond 2 would flow directly into the Mill-Willow Bypass.

The actions proposed for Alternative 6 should result in compliance for most but not all ARARs identified. Because only a partial upgrade to the pond treatment system will be realized, and an upstream impoundment or settling basin will not be constructed, compliance with aquatic water quality standards will only be met at flows less than 210 cfs on silver Bow Creek. Compliance with maximum contaminant levels for ground water is expected to be achieved but not with the consistency expected with Alternatives 1 through 4. Certain RCRA closure standards and State reclamation standards are expected to be met.

The actions proposed in Alternative 6 may result in adverse effects to wetlands, endangered species, or cultural resources at the site. It is estimated that Alternative 6 will take 5 years to implement at a total present worth cost of $55,100,000.

8.8 ALTERNATIVE 7

Alternative 7 is the no-action alternative required by the National Contingency Plan. It is used as a baseline alternative against which to judge the other alternatives. As the name implies, this alternative does not include any remediation activities. Current activities at the site being carried out by the agencies would diminish substantially. The only activities assumed to continue are those being carried out by the owner (e.g., lime addition to the influent during winter months and general maintenance of the site). Accordingly, there would be no reduction in risk or increase in protectiveness of human health and the environment. As a result of the continued occurrence of a number of processes onsite, the risks to human health and the environment would increase over time if left unmitigated. Major fishkills will continue to occur on a periodic basis. Catastrophic failure of the ponds could occur in a moderate earthquake or a moderate flood (probably less than a 100-year event).

9.0. COMPARATIVE ANALYSIS OF ALTERNATIVES

The alternatives described in the previous section, with the exception of Alternative 3+3A, were based on certain standards and criteria which have since been reevaluated. Those standards are the probable maximum flood standard for pond berms (now 0.5 for all berms), the RCRA standards for an impermeable cap (no longer required), and the action levels for lead and arsenic deferred and substituted by other criteria. These changes require only minor adjustments in the actual cleanup actions. In performing the comparative analysis of their various alternatives, EPA and MDHES assessed the alternatives with the revisions as described. The comparative analysis which follows assumes these changes would be incorporated into the alternatives. Cost estimates given would not change significantly due to these changes.

CERCLA requires EPA to examine several factors when selecting a remedy. EPA has identified nine evaluation criteria to be examined. 40 CFR § 300.515(e)(9)(iii): § 300.515(f)(1)(i).

Two of the criteria are threshhold criteria--the remedy must be protective of human health and the environment and must comply or result in compliance with ARARs, unless a specific ARAR is waived.

Five of the criteria are primary balancing criteria--long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.

The two remaining criteria are modifying criteria--state and community acceptance.

This section of the ROD analyzes the various alternatives against each of these criteria and weighs the advantages and disadvantages of each alternative relative to the other alternatives.

The evaluation is presented using the nine evaluation criteria as headings. Under each heading the alternatives are discussed approximately in order of decreasing performance for that criterion.

9.1 OVERALL PROTECTION OF HUMAN HEALTH AND ENVIRONMENT

As previously explained, two elements of the operable unit cleanup are deferred to a later date, as permitted by 40 CFR § 300.515(f)(5)(iii)(D). Final action levels for contaminants in soils, sediments, and tailings will be selected within one year. This will determine additional cleanup requirements, especially for the area below Pond 1. Final cleanup decisions for the final disposition of Ponds 2 and 3, after the need for treatment of the incoming water is no longer necessary, cannot be made until after the effectiveness of upstream cleanup actions is known. Therefore, this analysis addresses protectiveness within the scope of this interim remedy only, and does not address the deferred actions described above.

Each of the first six alternatives (including Alternative 3 and 3A) addresses the eight human health and environmental concerns identified at the site to varying degrees of protectiveness. Alternative 6 leaves one of the concerns unaddressed--the transport of tailings down the bypass during flood flows in excess of 210 cfs. Other alternatives do not consider containment and treatment of the 100-year flood flows. Alternative 7 is the no-action alternative; it would not alter the site, and it does not address any of the identified concerns.

Overall, Alternative 1 is the most protective of the alternatives, because it alone contains measures to treat the pond bottom sediments, tailings deposits, and contaminated soils to permanently reduce their mobility. However, because in situ solidification is still a developing technology, its feasibility would have to be further explored during the predesign or design stage. It would destroy important fish and wildlife habitat and necessitate treatment ponds elsewhere in the Clark Fork River Basin. The remaining action alternatives (Alternatives 2-6) include measures to stabilize the pond berms to limit the mobility of the sediments and sludges by improving their existing containment. Alternatives 2 through 6 also include measures to contain the tailings and contaminated soils exposed at the surface throughout the operable unit either onsite (Alternatives 3-6) or offsite (Alternative 2).

Of the alternatives that do not eliminate the existing pond system (Alternatives 2-7), Alternative 2 offers the most protection against pond failure by protecting the pond berms against the maximum expectable forces--a probable maximum flood or a maximum credible earthquake. Alternatives 3 through 6 protect the pond berms against an maximum credible earthquake and fractions of a probable maximum flood. Of these, Alternative 3+3A would be the most protective because it would upgrade all the ponds to withstand a 0.5 PMF, whereas the other alternatives would upgrade Ponds 1, 2 and 3 to withstand a 0.2, 0.3, and 0.5 PMF, respectively. In addition, Alternative 3+3A is most effective in preserving and enhancing wetlands, and containing the 100-year flood without creating new contaminated areas.

The no-action alternative would be the least protective by leaving the berms in their present unstable state.

Containment measures for tailings deposits and contaminated soils are proposed for Alternatives 2 through 6. In general, the containment measures are not expected to be as protective or as permanent as the solidification action proposed for Alternative 1. This is because the tailings and soils would still exist in a form that could, in theory, be disturbed by severe weather or other forces, though the probability of dispersal of the contaminants would be very low for most of these alternatives. Alternative 2 includes offsite disposal of the contaminated material. This would remove the direct threat from the site, but it would also introduce new risks and the liability associated with the offsite disposal of untreated material. Alternative 3 would consolidate the material onsite under a RCRA-compliant cap. This could effectively contain the material without introducing the additional liabilities and risks of offsite disposal. Alternatives 3+3A would cap contaminants within Pond 1 and dry portions of Pond 3; it would also flood the tailings deposits and contaminated soils in Pond 2. All of the contaminated materials would be in flood protected areas. The exposed tailings within Pond 3 would not be remediated at the present time because this will be an active area of the pond. Floods up to the 100-year flood will be routed into Pond 3 resulting in occasional flooding of some of these tailings. Alternatives 4 and 5 would cap in place all of the material possible. Less protective caps would be used, and the lack of consolidation would increase maintenance costs and the potential for cap failure. Alternative 6, flooding, is the least protective of the action alternatives. Flooding these materials would limit direct contact but may increase mobility. Alternative 7 does not address the risks associated with the tailings deposits and contaminated soils.

The surface water and ground water actions included as parts of Alternatives 1 and 2 and 3+3A would provide the most effective and most comprehensive treatment for surface water and ground water of the seven alternatives. Surface water treatment in an upgraded pond system would be provided for all flows up to the volume of a 100-year flood (13,000 acre-feet) or until the maximum flow of 3,300 cfs had been reached. With appropriate design and operation, water quality ambient and point source discharge standards should be met for nearly all flows up to the 100-year flood event. Alternatives 3, 4, 5, and 6 include various levels of pond treatment, decreasing in the degree of effectiveness. Alternatives 3 and 4 would provide suspended solids treatment for flood flows between 600 and 4,000 cfs. Except for 2,000 acre-feet stored in the settling basin, flows above 600 cfs would not be treated for dissolved metals. Alternative 5 would upgrade the pond system, but it would only accept flows up to 210 cfs for dissolved metals treatment. Again, except for 2,000 acre-feet stored in the settling basin, flows between 210 and 4,000 cfs would receive treatment for suspended solids only. The lack of dissolved metals treatment for above-average flows would lead to increased violations of water quality standards for flows out of the operable unit. Because of the decreases in levels or volume of treatment, water quality standards would be violated with greater frequency for each decrease in the upgrade of the treatment system. Alternatives 6 and 7 would likely experience regular violations during above average flows.

Trench drains for ground water collection and treatment are included as part of all seven action alternatives. Alternatives 1, 2, 3, and 4 include trench drains both in and below Pond 1. Alternative 3+3A includes an interception trench below Pond 1 and further examination of the need for additional trenches, such as in Pond 1. Alternatives 5 and 6 only call for a single drain below Pond 1. A single drain would effectively limit the offsite migration of contaminated groundwater but would not aid attempts to dewater Pond 1. Alternatives 1 through 4 would treat the groundwater in the pond system. Alternatives 5 and 6 include the addition of onsite wetlands for treatment. The wetlands system would decrease pumping requirements but could increase treatment operation and maintenance requirements and lead to further contamination of the soil and ground water at the lower end of the site.

In general, permanence of the remedial actions is greatest for the more comprehensive alternatives. The solidification of pond bottom sediments is the only alternative that would permanently limit the mobility of the pond bottom sediments. Actions to stabilize the pond berms (Alternatives 2 through 6) would protect the sediments as long as they are maintained but would not permanently affect the sediments themselves.

Surface water treatment would continue for as long as the ponds are functional. Under current conditions, the estimated life of Pond 3 is approximately 10 to 25 years. The new treatment pond (Alternative 1) could be constructed with an estimated life of up to 100 years. The increased pond volumes established with Alternative 3+3A would significantly increase the estimated life Pond 3. However, any increase in estimated life would result in decreased storage capacity for flood flows.

The permanence of efforts to cleanup the bypass would depend on efforts to keep the bypass free of future deposition. Alternatives 1 and 2, and 3+3A offer the greatest effectiveness, containing and treating all flows up to the 100-year event. For Alternatives 3, 4, and 5, flows up to the 100-year event would have up to 80 percent of the suspended solids load removed.

The permanence of soils and tailings remediation is greatest for Alternative 1 because all contaminated material would be solidified in the ponds. Alternatives 2 and 3 would contain the material in several consolidated units that would reduce maintenance requirements and aid permanence. The permanence of capping in-place or flooding (Alternatives 4 through 6) is much more dependent on the continued maintenance of the cap or cover.

9.2 COMPLIANCE WITH ARARs

All of the alternatives would comply with most of the ARARs and replacement standards, except for surface water ARARs. All of the alternatives would control non-point source contamination from the Bypass, and contribute to overall surface water ARAR compliance. Alternative 1, 2, and 3+3A would result in compliance with point source discharge ARARs for surface water in normal conditions, and would ensure compliance up to 100 year flood flows, by trapping those flows in full treatment systems. Alternatives 3 and 4 would result in compliance with point source discharge ARARs, but would fully capture only limited flood events, and would not achieve ARARs compliance for surface water during other flood events. Alternatives 5 and 6 would not achieve compliance with point source discharge ARARs during certain times, and would not achieve compliance with surface water ARARs during certain flood events. (Alternative 7, the no action alternative, would not achieve compliance with any of the identified ARARs.)

Alternatives 5 and 6 would not achieve compliance with Floodplain Management requirements. Alternatives 1, 2, 3+3A, and 4 would comply with these ARARs.

Table 5 summarizes each alternative's compliance with federal and Montana ARARs. A complete list of ARARs is found in Attachment 1.

9.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

The residual risks that would remain after implementation of each of the alternatives increase from Alternative 1 through the no-action alternative (Alternative 7), which involves the greatest residual risk. Alternative 1 would result in the least residual risk because the measures it includes to eliminate or contain the risks are more comprehensive than any of the other alternatives. This is primarily the case in regards to the pond bottom sediments and the tailings and contaminated soils. Alternative 1 is the only alternative to include treatment (solidification) of these materials.

Although Alternative 2 would not reduce the residual risk to the same risk level as Alternative 1, it would protect the ponds from the threat of failure to a greater extent than the remaining alternatives, and it would remove the majority of the contaminated soils and tailings from the site. The residual risk in Alternative 2 results from the presence of the untreated pond bottom sediments onsite.

Alternatives 3 through 6, in turn, contain a slightly higher level of residual risk from the pond bottom sediments because the pond berms would be protected against only a fraction of a PMF, rather than a full PMF (Alternative 2). However, the probability of a catastrophic failure of the pond berms during a flood would still be small because the likelihood of even a 0.2 PMF is quite small. (No specific return intervals are associated with probable maximum floods, though their probability of occurrence is only once in several thousand years.) Alternative 7, which would not further stabilize the pond berms, would carry the greatest residual risk of flood damage to the ponds. The extent of environmental damage that would result from a pond failure would also increase over time with Alternative 7 because of the continued deposition of sediments within the pond.

TABLE 5
ALTERNATIVE DESIGN
COMPLIANCE SUMMARY FOR FEDERAL AND MONTANA ARARs

ARAR Subject	Montana Statutory/ Regulatory Section	Description of Provision	Alt. 1	Alt. 2	Alt. 3	Alt. 3+3A	Alt. 4	Alt. 5	Alt. 6	Alt. 7
Surface Water	ARM16.20.622	Ambient surface water quality standards for Montana's C-2 classification	Yes, could treat the 100 year flood	Yes could treat the 100 year flood	Yes[b]	Yes	Yes[b]	No[c]	No[c]	No[d]
	ARM16.20.622	Waste treatment requirements for point source discharges to receiving waters	Yes, could treat the 100 year flood	Yes, could treat the 100 year flood	Yes[b]	Yes	Yes[b]	No[c]	No[c]	No[d]
	ARM16.20.203	Maximum contaminant levels for inorganic chemicals in potential community water systems	Yes, could treat the 100 year flood	Yes, could treat the 100 year flood	Yes[b]	Yes	Yes[b]	No[c]	No[c]	No[d]
	40 CFS 122-125	MPDES monitoring requirements	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	40 CFR 125.130(b)	Best Management Practice	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	40 CFT Parts 230 & 231	Dredge and fill requirements	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA[f]
Air	ARM16.8.815	Montana air standard for lead	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
	ARM16.8.818	Montana particulate air standard	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
	ARM16.2.1401(4)	Montana PM-10 standard	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
	40 CFR Part 50	National primary and secondary ambient air quality standards	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	40 CFR Part 61	National emission standards for hazardous air pollutants	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Ground water	ARM16.20.1003	Montana Class II ground water quality standards	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Floodplain management	ARM36.15.606	Criteria for flood control works allowed within designated floodways	Yes	Yes	Yes	Yes	Yes	No	No	No

TABLE 5 (continued)
ALTERNATIVE DESIGN
COMPLIANCE SUMMARY FOR FEDERAL AND MONTANA ARARs

ARAR Subject	Montana Statutory/ Regulatory Section	Description of Provision	Alt. 1	Alt. 2	Alt. 3	Alt. 3+3A	Alt. 4	Alt. 5	Alt. 6	Alt. 7
	ARM36.2.404	Evaluation criteria for Natural Streambed and Land Preservation Act (1975) standards and guidelines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	40 CFR 6(App. A) Exec. Order 11,988	Floodplains Management	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	40 CFR 6 (App. A) Exec. Order 11,990	Protection of Wetlands	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dam Safety	ARM36.14.501	Design criteria for high hazard dams	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
	ARM36.14.502	High hazard dam inflow design criteria	Exceeds ARAR	Exceeds ARAR	Yes	Exceeds ARAR	Yes	Yes	NA	NA
Reclamation	ARM26.4.505	Require adequate cover over waste materials to prevent salt migration, adverse plant effects, and water pollution	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	ARM26.4.520	Criteria for disposal of soil materials (tailings and contaminated soils)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	ARM26.4.633	Require that all surface drainage from disturbed areas be treated by the best available technology	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	ARM26.4.642	Permanent impoundment construction and operation requirements	Yes	Yes	Yes	Yes	Yes	Yes	NA	NA
	ARM26.4.711	Revegetation actions must establish a diverse, effective, and permanent cover capable of self-regeneration and plant succession	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
Hazardous Waste	ARM16.4.701-ARM16.4.703	Incorporation of federal regulatory requirements that establish the standards for permitted hazardous waste management facilities	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Solid Waste	ARM16.14.505	Siting criteria for solid waste disposal sites	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	40 CFR Part 257	Criteria for solid waste classification and disposal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

TABLE 5 (continued)
ALTERNATIVE DESIGN
COMPLIANCE SUMMARY FOR FEDERAL AND MONTANA ARARs

ARAR Subject	Montana Statutory/ Regulatory Section	Description of Provision	Alt. 1	Alt. 2	Alt. 3	Alt. 3+3A	Alt. 4	Alt. 5	Alt. 6	Alt. 7
Occupational Safety	29 USC 651-678	Occupational Safety and Health Act	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Historic Preservation	16 USC 469 40 CFR 6.301(c)	Archaeological and Historic Preservation Act	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	16 USC 470 40 CFR 6.301(b) 36 CFR Part 800	National Historic Preservation Act	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	16 USC 461-467 40 CFR 6.301(a)	Historic Sites, Buildings, and Antiquities Act	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	16 US 1531-1566 40 CFR 6.302(g)	Fish and Wildlife Coordination Act	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Natural Resources	16 USC 1531-1543 50 CFR Parts 17 & 402 40 CFR 6.302(h)	Endangered Species Act	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	40 CFR 6(App.A)	Protection of Wetlands	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

[a] ARAR compliance indicates that the requirements stated will be met with the exception that ambient water quality standards for arsenic and mercury will not be met under any alternative and will require a waiver based on technical impracticability, as discussed in Chapter 8.

[b] Alternatives 3 and 4 could treat pond in-flows up to 6000 cfs. This magnitude of flow is expected to be exceeded once every 2 years.

[c] Alternatives 5 and 6 could treat pond in-flows up to 210 cfs. This magnitude of flow is expected to be exceeded once each year.

[d] Current operating procedures result in the exceedance of water quality standards about 40 percent of the time.

[e] NA = not applicable.

Alternatives 1 and 2, and 3+3A would carry the least residual risk resulting from surface water and groundwater contamination. Both alternatives include measures to treat basically all flows less than a 100-year flood passing through or from the system. Surface water flows up to a 100-year flood flow would be detained and treated for suspended solids and dissolved metals. Only flows greater than 100-year flood flow would pass through the system untreated.

The residual risks associated with contaminated surface water increase with each of the remaining alternatives. Alternatives 3 and 4, although treating most flows in an upgraded treatment system, include only suspended solids treatment for flows between 600 and 4,000 cfs that exceed 2,000 acre-feet. Alternatives 5 and 6 retain the current pond system with a few modifications and would only allow dissolved metals trea' nent in the ponds for flows up to 210 cfs because of the capacity limitations of Pond 2. For Alternative 5, flows between 210 and 4,000 cfs would be treated for suspended solids in the upstream settling basin. Up to 2,000 acre-feet of the flow would be retained and could be metered slowly into the ponds for dissolved metals treatment, if required. The modification of the current pond system in Alternatives 5 and 6 also would not address the problem of potential short-circuiting in the ponds. Short-circuiting decreases the effectiveness of the ponds. Alternative 6, which does not include any treatment for flows greater than the current capacity of the treatment system (210 cfs), may eventually result in the recontamination of the bypass and the area below Pond 1.

Water quality standards for ambient and point source discharges should be met for all flows up to at least 100-year flood for Alternatives 1, 2, and 3+3A. Alternatives 3 and 4 may exceed these water quality standards during flows above 600 cfs. Alternatives 5, 6, and 7 would experience more frequent violations and violations at lower flows than Alternatives 1 through 4.

Both of the groundwater treatment actions should be able to meet the appropriate treatment standards in the long term. However, pumping the collected groundwater to

Pond 3 for treatment (Alternatives 1 through 4) would require less startup effort and less long-term operation and maintenance. The wetland system (Alternatives 5 and 6) would require periodic maintenance and/or replacement of vegetation, and more intensive care during winter months than the pumping option. The addition of the wetlands would also result in the eventual recontamination of soils, sediments, and groundwater in the treatment area, which may require future remediation during system closure.

The operation and maintenance requirements for all of the action alternatives would be fairly constant, because most of the requirements would be related to the water treatment systems. Alternatives 1 and 2 would require somewhat greater operation and maintenance than Alternatives 3, 4, 5, and 6 with respect to the requirements of the upstream flood impoundment. Alternatives 3, 4, and 5 would have less substantial operation and maintenance requirements associated with the upstream settling basin. Alternative 3+3A would not involve operation and maintenance of a separate flood detention basin. Alternative 6 would require the periodic removal of tailings from the bypass. Alternatives 5 and 6 include a wetlands treatment system that would require some operation and maintenance. Alternatives 3 through 5 include onsite capping of contaminated material. Maintenance of the cap(s) will also increase the operation and maintenance requirements. Alternative 3, which would consolidate the contaminated material under a single RCRA-compliant cap, would have less maintenance requirements than the alternatives that would cap the material in place. Flooding the contaminants (Alternative 6) would potentially have the greatest maintenance costs while offering the least protection.

Monitoring requirements would basically be the same for all alternatives, limited to ensuring conformance with surface and groundwater standards. No monitoring above the current MPDES monitoring requirements would be added with Alternative 7, no-action.

9.4 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT

Alternative 1 is the only alternative to use treatment in the remediation of pond bottom sediments and contaminated soils and tailings. This treatment would reduce the mobility of these materials by solidifying the sediments in place. It would also decrease the potential for leaching metals from the sediment. A drawback to the in situ solidification process is that it would substantially increase the total volume of the pond bottom material. Approximately 2 cubic yards of solidification agents would have to be added to every 1 yard of sediments treated in the wet portions of the ponds, thus tripling the volume of the sediments in these areas.

The remaining action alternatives would contain but would not treat the pond bottom sediments. The containment actions would reduce the sediments' mobility to a lesser extent than Alternative 1 because they stabilize the containment structures but not the material itself. The containment actions would not affect the toxicity or volume of the material. Alternative 2 includes the most stringent of the containment actions, stabilizing the existing pond berms against the largest expectable forces, a probable maximum flood and an maximum credible earthquake. The remaining action alternatives would limit the mobility of the pond bottom material during events up to a full maximum credible earthquake and a fraction of a probable maximum flood. The no-action alternative would not affect the toxicity, mobility, or volume of the pond bottom material.

Remediation options proposed for the tailings and contaminated soils also vary in their effectiveness in limiting the future mobility of the material. Through offsite disposal of a majority of these materials, Alternative 2 removes the threat of remobilization at the site, although the material would continue to exist in an untreated state at a separate site. Alternative 3 offers the best onsite reduction in mobility through consolidation followed by containment under a RCRA-equivalent cap. Alternative 3+3A incorporates tailings and contaminated soils disposal in Ponds 1 and 3 under a protective soil cover, revegetated with native grasses. Alternatives 4 and 5 would also reduce the mobility of the material, although not to the same extent as Alternative 3. Alternative 3+3A and 6 would not greatly reduce the mobility of the contaminated tailings and soils that would be flooded, although they would reduce the threat of direct contact.

All of the action alternatives include treatment to reduce the toxicity of the surface water to some degree. The alternatives differ in the amount and level of treatment. Alternatives 1 and 2, and 3+3A include treatment to reduce the toxicity of contaminated water for all flow conditions up to a 100-year flood. Flows above the 100-year flood flow would bypass the system untreated.

The remaining alternatives reduce the toxicity of the surface water to a lesser extent. For Alternatives 3 and 4, only flows below 600 cfs and 2,000 acre-feet of flows above 600 cfs would be treated in the pond system for suspended solids and dissolved metals. Flows between 600 and 4,000 cfs would be treated for suspended solids only in the upstream impoundment. Alternatives 5 and 6 retain the present pond system with a few modifications to improve treatment. Alternative 5 includes a settling basin to contain up to 2,000 acre-feet and treat flows between 210 and 4,000 cfs for suspended solids. Flows above 210 cfs would not be treated for dissolved metals. Alternative 6 does not include any treatment for flows greater than the capacity of the current pond treatment, 210 system.

9.5 SHORT-TERM EFFECTIVENESS

Most of the components of the action alternatives would take 2 to 3 years to complete. The components are similar for the most part, varying primarily in size or layout. The solidification of the pond bottom sediments is an exception to this. Alternative 1 would require approximately 17 years to complete because of the large volume of soils and sediments to be solidified. Although the stability of the sediments would increase during the solidification process, it would still take a substantially longer time to reach complete protection from Alternative 1 than from any of the other alternatives.

The wetlands treatment system included as part of Alternatives 5 and 6 may need up to 5 years startup time to reach the design objectives of the system. This time is needed to establish plant species in the system in order to realize effective treatment. None of the other treatment components included with the alternatives would require an extended startup period, though optimizing operation of a modified or new pond treatment system may require a full year or more of operational experience.

Alternative 2 would have substantial impacts on the area, by causing trucks carrying contaminated soils to travel on public roads.

None of the action alternatives are expected to substantially affect the community of Warm Springs during remediation. Local releases of metal-contaminated tailings or dust would likely occur during construction work carried out in contaminated areas, but such releases would be minimized by dust control techniques and would not be expected to affect the community. There is also the potential for short-term violations of the water quality standards at the compliance point as a result of remediation work in or adjacent to the bypass and stream beds. Those violations would differ somewhat between alternatives and could be minimized through use of sedimentation barriers and sedimentation ponds.

Construction contractors would need protection against dermal and respiratory exposure to the tailings while working in contaminated areas. Dermal threats could be controlled using long-sleeve protective clothing, and inhalation threats could be controlled using appropriate dust or face masks. Health risks to operation and maintenance workers would be substantially less than for such workers under the existing conditions (see the PHEA, Appendix A of the Warm Springs Ponds Operable Unit Feasibility Study). These risks would be similar for all alternatives.

Planning for all remediation activities would have to consider potential impacts to a pair of bald eagles, which are protected under the Endangered Species Act, that have previously nested within the operable unit. The eagles are not currently nesting within the operable unit but they continue to use the ponds as a food source during the summer months. Only Alternative 1 would substantially affect this food source. If the eagles return to nesting in the area surrounding the ponds, steps would be required to minimize any impact resulting from construction. This would be done during project planning in the design and construction phase of remediation. With attention to the necessary controls, adverse impacts to the eagles can likely be avoided. This would be true for all seven of the action alternatives.

Environmental impacts to the operable unit would be greatest for Alternative 1 because of the in situ solidification process proposed for the existing ponds. Solidification of the existing ponds would alter several hundred acres of land that is currently wetland wildlife habitat. Prior to solidification, the ponds would be drained; about 17 years later, following solidification and covering with soil and vegetation, they would be left as dry, vegetated terrestrial habitat. Some of the lost open-water habitat would be replaced by the new treatment pond, which would be constructed upstream of the present ponds. The new flood impoundment pond, although not typically containing water, would permanently remove approximately 1,000 acres of rangeland from use, bringing the total acreage affected by this alternative to approximately 2,250 acres.

The remainder of the alternatives would not significantly affect the environment in and around the pond system on a long-term basis, except for the loss of wetlands in Pond 1 and the effects of the upstream impoundments. The flood impoundment, as discussed above, would affect approximately 1,000 acres. The smaller settling basin (Alternatives 3 through 5) would affect approximately 500 acres. Alternatives 2 through 6 (except 3+3A) would affect the local environment during implementation as a result of construction activities. These alternatives would affect the surrounding wildlife habitat with increased noise and dust levels. Some habitat would also be temporarily destroyed as a result of necessary earthwork. These impacts would likely be short-lived and the areas returned to their preconstruction condition fairly quickly.

9.6 IMPLEMENTABILITY

For the most part, there is not a great deal of difference in the implementability of the seven action alternatives. Most of the components proposed as part of the alternatives are well-developed technologies, used to some extent in either the hazardous waste, water, or standard civil engineering disciplines. The technical feasibility of these components appears to be good. The exceptions are the two innovative components included as part of a number of the alternatives: in situ solidification, and wetlands treatment for metals removal.

The technical feasibility of in situ pond bottom solidification (Alternative 1) is not known for certain at this time. It has been used with success to solidify marshlands for foundation stabilization in Japan, but it has not been used extensively on hazardous waste sites. Consequently, it has a greater risk of implementation difficulties and failure than any of the other media-specific actions proposed for the pond bottom sediments. If it fails to adequately solidify the pond bottoms, for whatever reason, additional stabilization of the pond berms (as in Alternatives 2 through 6) would be necessary.

Wetlands treatment (Alternatives 5 and 6) has been used with some success for removing metals loadings from acid mine drainage, and its technical feasibility is somewhat more defined than in situ solidification. However, because effective treatment relies on the development of a resilient living ecosystem in the wetland, the implementation of an effective wetland could prove difficult and/or time consuming. The effectiveness of the wetlands system also depends to some extent on the weather. A large winter buildup of ice could result in severe short-circuiting in the wetland, decreasing the observed removal effectiveness. The technical feasibility of the other groundwater treatment component, which relies on treatment in the pond system (Alternatives 1-4), is greater.

The technical feasibility of the remainder of the components would be about equal. Protecting the pond berms against a fraction of a PMF (Alternatives 3-6) would be more feasible than protecting the berms from a full PMF (Alternative 2) simply because of the magnitude of the project. The same holds true for the upstream settling basin (Alternatives 3, 4 and 5) versus the upstream flood impoundment (Alternatives 1 and 2). Because the settling basin would be smaller and would require fewer materials, its overall feasibility would be greater.

From an administrative feasibility standpoint, all of the alternatives are about equal. All eight alternatives (no-action alternative included) would require compliance with discharge standards for water from the treatment system into the Clark Fork River. The discharge standards are more likely to be met for Alternatives 1 through 4 because they include a more comprehensive upgrading of the treatment system. They are not likely to be met with sufficient regularity under Alternatives 5 through 7. Alternative 2 would require obtaining permits for off-site disposal.

Alternatives 1 through 5 (except Alternative 3+3A) would require the acquisition of 500 to 1,000 acres of rangeland for construction of the settling basin or the upstream flood impoundment. Because less land is needed for the smaller settling basin, Alternatives 3, 4 and 5 might be easier to implement.

The offsite disposal option, proposed for the majority of the tailings deposits and contaminated soils as part of Alternative 2, would be more difficult to implement than the remainder of the contaminated soils options. Required permits for off-site disposal would have to be obtained. The interstate transport of up to 1.5 million cubic yards of untreated waste would be administratively undesirable from both a transportation and disposal point of view. The onsite disposal options (Alternatives 1 and 3-6) would likely be easier to implement.

An apparent lack of locally available riprap would favor the alternatives that require smaller amounts of that material (e.g., Alternatives 3-6 over Alternatives 1 and 2). However, Alternative 3+3A utilizes soils cement which incorporates on-site materials. This would be significant especially if the material would need to be quarried specifically for implementation. Other materials and equipment would be readily available for construction. The in situ solidification units for Alternative 1 would require up to 9 months for fabrication, but this could be incorporated into the scheduled implementation without causing unforeseen delay.

9.7 COST

The cost comparisons are straightforward. Comparing present worth costs, Alternative 1 is most expensive and Alternative 6 is the least expensive of the action alternatives. The long implementation schedule more strongly affects the present worth cost for Alternative 1 than do the implementation schedules of the other alternatives, which are shorter. The costs of the action alternatives are listed in Table 6, both with and without present worth considerations.

9.8 STATE ACCEPTANCE

The State of Montana, acting through the Department of Health and Environmental Sciences, generally agrees with this Record of Decision. The State has withheld concurrence on this Record of Decision until EPA selects cleanup action levels and determines appropriate measures for the control of soils, sediments and tailings above those levels which are not addressed by this action.

The State agrees with the final ARARs list. The State is particularly concerned that the point source discharge from the Warm Springs Ponds remain as a regulated discharge subject to the MPDES permit requirement.

TABLE 6
COST ESTIMATES FOR THE ACTION ALTERNATIVES

Cost Components	Alternative 1	Alternative 2	Alternative 3	Alternative 3+3A	Alternative 4	Alternative 5	Alternative 6
Estimated Construction Cost	$1,665,000,000.00	$250,000,000.00	$60,100,000.00	45,700,000.00	$65,500,000.00	$56,000,000.00	$46,100,000.00
Engineering Design	4,000,000.00	4,000,000.00	4,200,000.00	3,500,000.00	4,600,000.00	3,900,000.00	3,200,000.00
Services During Construction	7,000,000.00	4,000,000.00	4,200,000.00	3,500,000.00	4,600,000.00	3,900,000.00	3,200,000.00
Administrative & Legal	3,000,000.00	3,000,000.00	3,000,000.00	2,800,000.00	3,300,000.00	2,800,000.00	2,300,000.00
Total Project Cost	1,679,000,000.00	261,000,000.00	71,500,000.00	55,500,000.00	78,000,000.00	66,600,000.00	54,800,000.00
Operation and Maintenance (Yearly Costs)	283,000.00	301,000.00	300,000.00	379,000.00	293,000.00	284,000.00	270,000.00
Total Present Worth Cost	$1,191,500,000.00	$241,500,000.00	$71,100,000.00	$57,416,000	$77,000,000.00	$66,300,000.00	$55,100,000.00

9.9 COMMUNITY ACCEPTANCE

Community reaction to the proposed plan was vigorous and widespread across communities in the Clark Fork River Basin. A full response to comments from the community and from ARCO is contained in the responsiveness summary attached to this Record of Decision.

Generally, the comments from the community fell into these categories:

- The process for selecting a remedy should provide for additional and earlier community involvement. In response EPA extended the public comment period for the proposed plan to 90 days, and has held several public meetings, and meetings with interested groups over the last year. EPA has initiated several activities at other operable units within the Clark Fork River Basin to increase community involvement in the Superfund process at earlier stages.

  EPA will also include community involvement in the process which will address further remedy action selection at the Warm Springs Ponds.

- There was widespread opposition to the creation of an additional upstream settling basin, particularly by residents of Opportunity and Anaconda. In response, EPA has reevaluated the preferred alternative described in the proposed plan, and has selected alternative 3+3A, which provides for flood storage within existing Pond 3.

- Many comments stressed the need for flood protection and treatment of flood flows before water from the operable unit enters the Clark Fork River. In response, EPA has reexamined the berm-strengthening ARAR, and determined that a standard of one-half of the probable maximum flood is necessary for all berms within the operable unit. In addition, EPA has selected a remedy which will fully treat flows entering the system up to the 100-year flood flows before that water is released into the Clark Fork River.

- Many comments stressed the need for permanent remedies which utilized treatment of hazardous substances found at the site. In response, EPA carefully examined the issue and concluded that the extensive berm strengthening and contaminant cover requirements of the selected remedy provide a permanent remedy for the site. The EPA notes that floods of Mill and Willow creeks may not be allowed to enter the ponds after the berms are strengthened, and that Silver Bow Creek floods will enter the ponds in a secure and controlled manner which will prevent releases of contaminants.

Treatment options and off-site disposal options are not technically feasible at this time, or present negative aspects such as destruction of wetlands or excessive traffic, and are extremely expensive in relation to the benefits gained. Superfund remedies are required to be cost effective.

The EPA will continue to examine treatment options carefully at other operable units in the Clark Fork River Basin. The EPA also notes that the final determination for Ponds 2 and 3 will be made at a later date, when sources of contamination from upstream have been cleaned up and the ponds are no longer needed as treatment facilities.

10.0 THE SELECTED REMEDY

After evaluating alternatives with respect to each other and the nine required criteria, the EPA and MDHES have identified Alternative 3+3A as the selected remedy for this Warm Springs Ponds Operable Unit Record of Decision. The agencies have determined that Alternative 3+3A is the most effective of the alternatives evaluated, offers the greatest potential for being a permanent remedy, is supported by the public and is cost effective. The selected remedy is an interim cleanup measure that provides the highest degree of certainty that it will be successful and permanent. The final measure of these qualities awaits additional actions at this operable unit and cleanup decisions upstream. The components of Alternative 3+3A are as follows:

- Allow the ponds to remain in place; Ponds 2 and 3 will continue to function as treatment ponds until upstream sources of contamination are cleaned up;

- Raise and strengthen all pond berms according to specified criteria, which will protect against dam failure in the event of major earthquakes or floods, and increase storage capacity of Pond 3 to receive and treat flows up to the 100-year flood;

- Construct new inlet and hydraulic structures to prevent debris from plugging the Pond 3 inlet and to safely route flows in excess of the 100-year flood around the ponds;

- Comprehensively upgrade the treatment capability of Ponds 2 and 3 to fully treat all flows up to 3,300 cubic feet per second (100-year peak discharge) and construct spillways for routing excess flood water into the bypass channel;

- Remove all remaining tailings and contaminated soils from the Mill-Willow Bypass, consolidate them over existing dry tailings and contaminated soils within the Pond 1 and Pond 3 berms, and provide adequate cover material which will be revegetated.

- Reconstruct the Mill-Willow Bypass channel and armor the north-south berms of all ponds to safely route flows up to 70,000 cubic feet per second (one-half of the estimated probable maximum flood);

- Flood (wet-close) all dry portions of Pond 2;

- Construct interception trenches to collect contaminated ground water in and below Pond 1 and pump the water to Pond 3 for treatment;

- Dewater wet portions of Pond 1 and cover and revegetate (dry-close) all areas within the Pond 1 berms;

- Establish surface and ground water quality monitoring systems and perform all other activities necessary to assure compliance with all applicable or relevant and appropriate requirements;

- Implement institutional controls to prevent future residential development, to prevent swimming, and to prevent consumption of fish by humans; and

- Defer, for not more than one year after the effective date of this document, decisions concerning the remediation of contaminated soils, tailings, and ground water in the area below Pond 1, pending evaluation of various wet- and dry-closure alternatives and a public review.

10.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 3+3A reduces or eliminates those risks to human health and the environment at this operable unit which are within the scope of this Record of Decision.

Pond stability is addressed by protecting the ponds against both the maximum credible earthquake and one-half of the probable maximum flood. Only under extreme flooding conditions would the stability of the pond berms be in question. Protection of the pond berms would continue for as long as the berms are properly maintained and repaired.

Alternative 3+3A will improve surface water quality by completely upgrading the existing pond treatment system to provide treatment for all flows up to 3,300 cfs or 13,000 acre-feet (the estimated peak flow and volume, respectively, of the 100-year flood), by removing tailings from along the bypass, and by raising the berms for Ponds 2 and 3. Pond 2 will be increased in volume, reducing the problem of resuspension of sediments during high winds and flow rates. With the upgraded treatment system, most of the surface water quality violations, which now occur, should be avoidable.

All flood flows up to 3,300 cfs will be routed through the pond system, which will result in removal of the majority of the suspended particles. Thus, Alternative 3+3A will substantially reduce the potential for future recontamination of the bypass by settled tailings and reduce the continued transport of tailings into the Clark Fork River.

Contaminated ground water moving from the site will be collected from Pond 1 and below. It will then be pumped to the Pond 3 inlet for treatment in the pond system. This will reduce the discharge of metals loading into the Clark Fork River and should enable compliance with primary MCLs for groundwater at the selected compliance point.

Dry-closure of Pond 1, which includes dewatering, covering and revegetation of tailings and contaminated soils, will effectively isolate them from direct contact and limit their mobility. The cap will provide a barrier against ingestion, inhalation, and runoff. As long as the cap is maintained, the material will be safe from releases due to erosion of the cap. Capping the material in Pond 1 will not, however, reduce the toxicity, volume, or persistence of the material.

Flooding the tailings deposits and contaminated soils in the dry portions of Pond 2 will reduce the potential for exposures to these materials, although the exposed tailings above Pond 3 will not be addressed until final closure of the ponds.

All of the components of Alternative 3+3A are technically feasible. With the appropriate design, construction, operation, and maintenance, the components of Alterative 3+3A will reliably reduce the risks for which they are proposed. Any increased risks to the surrounding environment and community during implementation can be kept to a minimum with appropriate containment and construction safety measures.

10.2 COMPLIANCE WITH ARARS

Within the boundaries defined below, Alternative 3+3A should result in compliance with all the state and federal ARARs identified for the Warm Springs Ponds Operable Unit.

The actions proposed for Alternative 3+3A meet the Montana ARARs for protecting the pond system against one-half of the probable maximum flood and the maximum credible earthquake. Providing flood detention within the pond system and the upgrading of the pond treatment system should result in effluent compliance with ambient and point source discharge surface water quality standards for all flows up to 3,300 cfs, the estimated peak flow of the 100-year flood.

Alternative 3+3A should comply with Montana ground water standards, and would satisfy Montana's requirements for floodplain management. Excavating and moving tailings deposits and contaminated soils from the Mill-Willow bypass to dry portions of Pond 3 prior to capping will comply with state and federal siting criteria for solid and hazardous waste disposal and can be done so as to selected RCRA requirements for closure of a hazardous waste management facility.

Flooding the tailings deposits and contaminated soils in Pond 2 will reduce the risks identified in the public heath and environmental assessment and meet the remedial objectives established for the operable unit. A complete summary of this alternative's compliance with the state and federal ARARs is presented in Table 5.

The actions proposed in Alternative 3+3A could result in adverse effects on wetlands, endangered species, and historical resources. To mitigate these potential impacts, additional consultation with state and federal resource agencies will be required during implementation of this interim remedy.

10.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 3+3A addresses all of the identified risks at the site by using measures intended to limit or remove the risks. The primary risk at the site, the release of 19 million cubic yards of metal-contaminated tailings located in the treatment ponds, will be addressed by protecting the pond berms against failure due to a full maximum credible earthquake and one-half of the probable maximum flood. This will address the threat of pond failure in all but extreme cases and this aspect of the remedy is permanent and effective over the long term.

Residual risks will result from the continued existence of the 19 million cubic yards of sediments and sludge in the pond system although those risks will be reduced to a low level. The sediments in the ponds may still be released to the environment in either dissolved or suspended form under extreme conditions. This includes not only the sludges presently in the ponds, but also all the excavated soils and tailings from around the site that will be placed in Pond 1 or Pond 3 prior to capping.

Because the material beneath the cap will be untreated, maintenance and periodic inspection of the Pond 1 and Pond 3 caps will be necessary. Maintenance activities will be directed at preventing erosion or deterioration of the cap. Periodic inspection and maintenance of the stabilized pond berms will also be necessary to ensure continued protection.

Continued maintenance of the ground water interception and pump system will be necessary. By drying Pond 1, rather than wet closing it, this operation maintenance period is expected to be shorter and less complicated.

10.4 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME, THROUGH TREATMENT

Protecting the pond berms against failure due to a maximum credible earthquake and one-half of the probable maximum flood will substantially reduce the potential mobility of the sludges in the ponds, although this will not affect their volume, persistence, or toxicity. Only in the extreme case of flooding above the design floods for Alternative 3+3A would the current containment of the pond bottom sediments be affected.

Onsite disposal of excavated soils and tailings within Ponds 1 and 3, designed to meet selected RCRA requirements will reduce the mobility of those materials and will prevent direct human contact. The materials will be taken from currently exposed areas along the bypass. The tailings deposits and contaminated soils in Pond 2 will be covered by water, but the naturally deposited tailings above Pond 3 will remain exposed until final closure of the ponds. The pond bottom sediments in Ponds 2 and 3 will remain covered by water but will not be completely immobilized against wind and water action.

The toxicity, volume, persistence, and propensity to bioaccumulate of the pond bottom sediments and the tailings deposits and contaminated soils will not be altered by the proposed actions of Alternative 3+3A. To date, no feasible technology exists which will provide effective treatment of wastes present at this operable unit.

The flood detention capacity will address the threat resulting from floods, the transport of tailings through the system and into the Clark Fork basin, by ensuring that all flows through the reach, up to the 100-year flood, are at least treated for suspended solids.

Flows in excess of 3,300 cfs will bypass the pond system and not be treated for either suspended or dissolved metals. This may lead to short-term water quality exceedences in the effluent from the operable unit during high flows, but it will probably not have a long-term impact on the operable unit.

10.5 SHORT-TERM EFFECTIVENESS

It will take approximately two construction seasons to protect the pond berms against a maximum credible earthquake and one half of the probable maximum flood. During that time, the protectiveness provided for the downstream community of Warm Springs and the environment will decrease. The overall level of protectiveness of Alternative 3+3A will not be attained until construction is completed. The potential for increased risk to either the community or the environment during the berm stabilization process is limited. Remediation contractors may be at risk from direct contact and inhalation of contaminants during foundation excavation and associated tasks. These risks will be controlled by using protective equipment as necessary.

Risks to the remediation contractors will be limited to standard construction risks associated with similar projects. The diversion and inlet structures will be constructed in the contaminated stream channel. Precautions will be required to avoid excessive additional contamination of the creek flows during construction of these features.

10.6 IMPLEMENTABILITY

Protecting the pond berms against a maximum credible earthquake and one-half of the probable maximum flood is feasible. The current uncertainties involve the existence of suitable foundation material downstream of the toes of the existing berms, the nature of the upstream slopes, and the actual value of the maximum credible earthquake. Preliminary investigations indicate that the base material beneath the surface soils will be adequate, but this will have to be verified during the design phase. The materials and construction of the upstream slopes, and the maximum credible earthquake also will have to be determined during the design phase.

A revised Montana Pollution Discharge Elimination System permit to discharge water from the treatment system into the Clark Fork River will be required and the discharge standards are expected to be met.

10.7 COMMUNITY AND STATE ACCEPTANCE

This remedy was designed to meet the community concerns expressed during the comment period. The State has been actively involved with the development of this alternative, and generally agrees with its selection.

10.8 SUMMARY OF THE PREFERRED ALTERNATIVE

In summary, the preferred alternative satisfies the statutory preference for remedies that employ treatment as a principal element to reduce the toxicity, mobility, or volume of contamination at the site to the maximum extent practicable. With the comprehensive upgrade of the current pond treatment system, both surface and ground water will be treated and their toxicity will be reduced.

The preferred alternative will attain federal and State requirements that are applicable or relevant and appropriate for the site with minor exceptions: State ambient water concentrations of toxic or deleterious substances to protect public health from ingestion of contaminated water and fish for arsenic and mercury require a waiver based upon technical impractability and upon the fact that this is an interim remedy. The arsenic standard for water and fish ingestion is 2.2 nanograms per liter and the mercury standard is 144 nanograms per liter. It is not technically feasible to treat water to those levels at this time. In addition, arsenic cannot be detected at 2.2 nanograms per liter with sampling and detection methods currently available. Because it is not possible to treat or to determine compliance with these standards, and because this remedy is an interim cleanup action, these requirements are waived. In addition, should the areas within the pond berms be considered within the 100-year floodplain, requirements prohibiting disposal of solid waste within the floodplain are hereby waived.

Based upon the information available at this time, the State and EPA believe that the selected remedy will be protective of human health and the environment, will comply with federal and State ARARs, will be cost-effective, and will utilize permanent solutions and treatment technologies to the maximum extent possible., recognizing the scope of this interim cleanup action.

11.0 STATUTORY DETERMINATIONS

Under their legal authorities, the EPA and MDHES have the primary responsibility at Superfund sites to undertake remedial actions that achieve protection of human health and the environment. In addition, Section 121 of CERCLA establishes that, the selected remedial action must comply with applicable or relevant and appropriate environmental standards established under federal and State environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practical. The statute also includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

11.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedies for the various contaminant sources are protective of human health and the environment, within the scope of this interim action. They will meet the ARARs identified for the operable unit and reduce the risks identified in the PHEA to acceptable levels.

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

Federal and State applicable or relevant and appropriate requirements have been determined. The selected remedy will comply with most applicable or relevant and appropriate requirements. However, three chemical- and location-specific ARARs pertaining to water quality standards and potential solid waste disposal requirements will be waived.

11.2.1 Waivers and Promulgated Standards

Federal law recognizes there may be instances in which ARARs cannot be met with respect to remedial actions onsite. It, therefore, identified six circumstances under which ARARs may be waived. However, other statutory requirements--specifically, the requirement that remedies be protective of human health and the environment--cannot be waived. Waivers occur as the exception, not the rule. Waivers are appropriate if:

- The remedial action selected is an interim remedy and only part of a total remedial action that will attain ARARs.
- Compliance with ARARs at the site would result in greater risk to human health and the environment than alternative options.
- Compliance with ARARs is technically impracticable, from an engineering perspective.
- The remedial actions selected will attain an equivalent standard of performance, although ARARs are not met.
- With respect to State ARARs, the State has not consistently applied ARARs in similar circumstances at other remedial actions within the State.
- In the case of fund-financed remedial actions, financial restrictions within the Superfund program require fund-balancing such that satisfactions of ARARs at the site must give way to a greater need for protection of public health and welfare and the environment at other sites.

The feasibility study, which provides a detailed analysis of the remedial action alternatives, identifies how each alternative complies with ARARs. If an ARAR would not be satisfied, then a waiver may be required, based on the interim nature of this action and the technical infeasibility of meeting those standards. See section 4.0 of the ROD and the ARARs list. There is the possibility that the area within Ponds 2 and 3 to the 100 year flood flow event may be considered part of the 100 year flood plain. If so, the ARAR prohibiting disposal of solid waste within the 100 year flood plain is waived on the same basis.

11.3 COST-EFFECTIVENESS

The selected remedial alternatives are cost-effective options for cleanup of the Warm Springs Ponds. This determination is based on the cost and overall effectiveness of the selected remedy when viewed in light of the cost and overall effectiveness of other alternatives.

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

The selected remedy satisfies the statutory preference for utilization of permanent solutions and alternative treatment technologies to the maximum extent practicable. Treatment of contaminated water is an element of the selected alternative. Implementation of the selected alternative. Other forms of treatment are not yet technically feasible or practicable at this time. Implementation of the selected alternative will decrease the concentrations of contamination sources.

12.0 DOCUMENTATION OF SIGNIFICANT CHANGES TO COMPONENTS OF THE SELECTED REMEDY

Section 117(b) of CERCLA requires documentation and explanation of any significant change from the preferred alternative originally presented in the Proposed Plan. The remedy selected in this Record of Decision does, in fact, reflect significant changes to the originally preferred alternative. Therefore, in accordance with specific requirements of Superfund guidance (OWSER Directive 9335.3-02)[10], the originally preferred alternative will be identified, the significant changes described, and the reasons for the changes explained.

12.1 THE ORIGINALLY PREFERRED REMEDY

The Warm Springs Ponds Proposed Plan (October, 1989)[11] described six cleanup alternatives. The preferred alternative, Alternative 3, may be summarized as follows:

- Allow the ponds to remain in place; Pond 3 would continue to function as a treatment pond;
- Raise and strengthen all three pond berms to protect against dam failure in the event of major earthquakes or floods;
- Construct new inlet and hydraulic structures to prevent debris from plugging the Pond 3 inlet and to safely route flows in excess of 600 cfs around the ponds.

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[10] OSWER Directive 9335.3-02, November, 1989, EPA/540/G-89-007, Interim Final Guidance on Preparing Superfund Decision Documents

[11] Montana Department of Health and Environmental Sciences and United States Environmental Protection Agency, 1989. Warm Springs Ponds Proposed Plan, Silver Bow Creek Superfund Site Report.

- Construct an upstream sediment settling basin capable of storing up to 2,000 acre feet of flood waters, with hydraulic structures to meter the water into Pond 3 for treatment;

- Comprehensively upgrade the treatment capability of Pond 3, including construction of a berm across the pond to prevent flows from short-circuiting.

- Remove all tailings and contaminated soils in the Mill-Willow Bypass and consolidate them over existing dry tailings and soils behind the Pond 1 berm;

- Reconstruct the Mill-Willow Bypass channel and armor the north-south berms of all three ponds to withstand fractions of the probable maximum flood (0.2, 0.3 and 0.5 PMF for Ponds 1, 2 and 3, respectively);

- Flood (wet-close) or excavate, consolidate and cap (dry-close) all exposed tailings and contaminated soils with arsenic or metals concentrations exceeding the prescribed health-based action levels;

- Construct ground water interception trenches within the below Pond 1 to prevent contaminated ground water from entering the Clark Fork River and pump the collected water up to Pond 3 for treatment; and

- Excavate tailings and contaminated soils below the Pond 1 berm (largely within the original Silver Bow channel), consolidate and cap them behind the Pond 1 berm, and dry-close Pond 1.

12.2 SIGNIFICANT DIFFERENCES BETWEEN THE ORIGINALLY PREFERRED ALTERNATIVE AND SELECTED REMEDY

The remedy selected in this Record of Decision differs from the originally preferred alternative in the following respects:

- The upstream sediment settling basin will not be constructed. Instead, flood flows up to the 100-year event will be routed into Pond 3;

- Pond 2 will be retained as a treatment pond, as opposed to simply being wet-closed;

- The berms of all three ponds will be raised, strengthened, and their north-south aspects armored, to withstand one-half of the estimated probable maximum flood (70,000 cfs), as opposed to less protective fractions of the PMF for Ponds 1 and 2 (0.2 and 0.3 PMF, respectively);

- Comprehensive upgrading of the treatment capability of Pond 3 will not include construction of a berm across the pond. Instead, bioassay tests will be conducted to evaluate the effect of resuspended bottom sediments on aquatic species. If effects are observed, measures other than a berm can be incorporated as a component upgrade.

- Two aspects of the decision are deferred. A final cleanup level for soil contaminants will be selected at a later date. Once this decision is made, additional cleanup of soils, sediments, and tailings may be required, especially below Pond 1. The decision on final disposition of Ponds 2 and 3 is also deferred, until upstream cleanup decisions are made and there is no longer a need for use of the ponds as water treatment facilities.

12.3 REASONS FOR SIGNIFICANT CHANGES

The most prominent difference between the originally preferred remedy and the selected remedy is the elimination of the upstream sediment settling basin. In fact, that change is perhaps the only significant difference between the two cleanup approaches; the other differences summarized above are consequences of the decision to route floods up to the 100-year event through the pond system. Their expected performance in relation to their predecessor components and in relation to the nine criteria specified by the NCP is thoroughly evaluated and described in Section 8.0, comparative analysis of the alternatives.

The rationale for eliminating the upstream sediment settling basin is explained in the Declaration (page 1-5) and documented in the Responsiveness Summary. Briefly, the changes were made in response to public opposition to another contaminated pond in the vicinity of the Opportunity Tailings Ponds or the town of Opportunity.

Additionally, an alternative proposal presented by the potentially responsible party, ARCO, was determined by the EPA and State to be an acceptable remedy for storage and treatment of flows up to the 100-year flood. It obviates the need for the upstream impoundment and it offers the additional advantages of improved treatment of dissolved metals in flood waters and keeping contaminants within the existing boundaries of the operable unit. This detailed proposal is part of the administrative record for the site, and is referenced in the Proposed Plan. The EPA has determined these changes are significant; however, a revised Proposed Plan or renewed public comment period is not required. Guidance (OSWER Directive 9335.3-02)[12] states:

"If the significant change to a component of the alternative could have been reasonably anticipated by the public, the lead agency need only document the significant change in the Decision Summary". In this instance, a majority of the public requested the change, fully

[12] OSWER Directive 9335.3-02, November, 1989, EPA/540/G-89/007

aware that the elimination of the upstream impoundment would necessitate routing of flood flows into the pond system.

The decision to defer certain aspects of the cleanup does not significantly change those aspects of cleanup which are selected in this Record of Decision. Therefore, there is no need to submit a revised Proposed Plan to address this decision.

Finally, it should be recognized that these changes are the product of a constructive dialogue with both the public and the potentially responsible party, which retains ownership of the ponds and has extensive experience in operating them as an effective water treatment facility. The selected remedy formulated and evaluated in this Record of Decision blends the remedial action plans of the regulatory agencies and the potentially responsible party, and it is supported by the public.

ATTACHMENT TO PART II

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, STANDARDS, CONTROLS, CRITERIA, OR LIMITATIONS FOR THE SILVER BOW CREEK/BUTTE AREA SUPERFUND SITE - ORIGINAL PORTION - WARM SPRINGS PONDS OPERABLE UNIT

Section 121(d) of CERCLA, 42 U.S.C. Section 9621(d), certain provisions of the current National Contingency Plan (the NCP), 40 CFR Part 300 (1990), and guidance and policy issued by the Environmental Protection Agency (EPA) require that remedial actions taken pursuant to Superfund authority shall comply with substantive provisions of applicable or relevant and appropriate standards, requirements, criteria, or limitations from State environmental and facility siting laws, and from federal environmental laws at the completion of the remedial action, and/or during the implementation of the remedial action, unless a waiver is granted. These requirements are threshold standards that any selected remedy must meet. The Feasibility Study for the Warm Springs Ponds operable unit proposed a set of such requirements, and gave justification for identifying the proposed requirements. After consideration of public comments on the proposed requirements, and further review of applicable guidance and standards, including the NCP, the following is the final list of ARARs for the Warm Springs Ponds operable unit Record of Decision.

Each ARAR or group of related ARARs identified here is followed by a specific statutory or regulatory citation, a classification describing whether the ARAR is a federal or State requirement and whether the ARAR is applicable or relevant and appropriate, and a compliance description which addresses how and when compliance with the ARAR will be measured (some ARARs will govern the conduct of the implementation of the remedial action, some will govern the measure of success of the remedial action, and some will do both). Contaminant specific ARARs are followed by a description of the point of compliance, which describes where compliance with the ARAR will be measured.

Also contained in this list are policies, guidance or other sources of information which are "to be considered" during the selection and implementation of the ROD. Although not enforceable requirements, these documents are important sources of information which EPA and the State of Montana Department of Health and Environmental Sciences (MDHES) referred to during selection of the remedy, especially in regard to the evaluation of public health and environmental risks; or which will be referred to as appropriate during evaluation and approval of various activities during the ROD implementation.

Finally, this list contains other legal provisions or requirements which should be complied with during the implementation of this ROD.

Responses to comments on the proposed ARARs and further discussion of EPA's basis for selecting these ARARs is contained in the responsiveness summary attached to this ROD. The portions of the Feasibility Study (FS) which address ARARs (primarily Chapter 3 and Appendix B) and the ARARs section of the responsiveness summary, and applicable EPA guidance, policy, regulation, and statutory authority, form the basis for the final selection of ARARs contained in this list.

ARARs are divided into contaminant specific, location specific, and action specific requirements, as described in the new NCP and EPA guidance. Each category contains both federal and State ARARs. For contaminant specific ARARs, ARARs are listed according to the appropriate media.

Contaminant specific ARARs include those laws and regulations governing the release to the environment of materials possessing certain chemical or physical characteristics or containing specific chemical compounds. Contaminant specific ARARs generally set health or risk based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Location specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of cleanup activities because they are in specific locations. Location specific ARARs relate to the geographic or physical position of the site, rather than to the nature of the site contaminants. Action specific ARARs are usually technology or activity based requirements or limitations on actions taken with respect to hazardous substances.

For action specific ARARs, certain provisions pertain to the entire cleanup action and are so indicated. Other ARARs pertain to specific portions of the cleanup, and are so indicated.

Many requirements listed here are promulgated as identical or near identical requirements in both federal and State law, usually pursuant to delegated environmental programs administered by EPA and the States, such as the requirements of the federal Clean Water Act and the Montana Water Quality Act. The preamble to the new NCP states that such a situation results in citation to the State provision as the more stringent standard, but treatment of the provision as a federal requirement.

I. Contaminant Specific

1. Groundwater

A.	Arsenic	0.02 milligrams per liter (mg/l)
B.	Cadmium	0.010 mg/l
C.	Chromium	0.050 mg/l
D.	Lead	0.050 mg/l
E.	Mercury	0.0002 mg/l
F.	Nitrate (as N)	10.000 mg/l
G.	Selenium	0.010 mg/l
H.	Silver	0.05 mg/l

POINT OF COMPLIANCE: The standards identified in I.1.A. - H. above must be complied with at the down gradient edge of the ground water capture trench, located below Pond 1, if the waste below Pond 1 is excavated. If the ROD is amended to include construction of a wetland at Pond 1 rather than dry closure, the point of compliance would be at the downgradient edge of the wetland and/or capture trench. No mixing zone will be used in determining compliance.

CITATION: The standards identified in I.1.A. - H. above are promulgated at Administrative Rules of Montana (ARM) Sections 16.20.1003, .203, .204, .206, and .207, and are known as Maximum Contaminate Limits (MCLs). Classification of the contaminated shallow aquifer within the Warm Springs Ponds operable unit as a Class II aquifer suitable for future drinking water or domestic use was done pursuant to ARM s^{s}§ 16.20.1002. Such a determination is consistent with the classification criteria found in EPA's "Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites", December, 1988, (OSWER Directive # 9283.1-2). These standards were promulgated pursuant to the authority given in the Montana Public Water Supplies Act and the Groundwater Pollution Control Act. Corresponding federal citations for the federally authorized and delegated program are the Safe Drinking Water Act, 42 U.S.C. s^{s}§s^{s}§ 300f, et seq., and at 40 CFR s^{s}§s^{s}§ 141.11 - 16 (MCLs). The standards for arsenic, cadmium, lead, and silver are also found at 40 CFR s^{s}§ 264.94, pursuant to the Resource Conversation and Recovery Act, 42 U.S.C. s^{s}§s^{s}§ 6901 et seq.

CLASSIFICATION: Federal, relevant and appropriate

COMPLIANCE: At the conclusion of the remedial action and continuing thereafter.

I. Contamination of ground water is prohibited. Ground water wells must be constructed and maintained so as to prevent waste, contamination, or pollution of ground water.

POINT OF COMPLIANCE: At the location of any ground water well located on-site.

CITATION: Promulgated at MCA s§ 85-2-505, a provision of the Montana Water Use Act. Only those provisions of section 505 described above are identified as applicable to this action.

CLASSIFICATION: State, applicable

COMPLIANCE: During the implementation of the remedial action, construction of any ground water wells must comply with this standard.

J. Non-degradation. Any ground water whose existing quality is higher than the established ground water quality standards for its classification must be maintained at that high quality, unless it has been affirmatively demonstrated that such a change is justifiable, and will not preclude present or anticipated use of such waters. Compliance with the standards identified in I.1.A. - H. above will achieve compliance with this standard.

POINT OF COMPLIANCE: Because compliance with the MCL standards will achieve compliance with this standard, the standard must be complied with at the down gradient edge of the ground water capture trench, located below Pond 1.

CITATION: Promulgated at ARM s§ 16.20.1011

CLASSIFICATION: State, applicable.

COMPLIANCE: At the conclusion of the remedial action and continuing thereafter.

2. Air

A. Lead - No person shall cause or contribute to concentrations of lead in the ambient air which exceed 1.5 micrograms per cubic meter (mg/cm) of air, measured over a 90-day average.

POINT OF COMPLIANCE: Within the confines of the Warm Springs Ponds operable unit, where human exposure is probable.

CITATION: Promulgated at ARM s[s]§ 16.8.818 as part of a federally approved State Implementation Plan (SIP), pursuant to the Clean Air Act of Montana, MCA 75-2-101 et seq.. Corresponding federal regulations are found at 40 CFR s[s]§ 50.12, promulgated pursuant to section 109 of the Clean Air Act, 42 U.S.C. s[s]§ 7409.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action, and at the conclusion of the action and thereafter. Compliance shall be measured in accordance with methods described in 40 CFR Part 50, and corresponding State provisions.

B. Particulate matter that is 10 microns in diameter or smaller (PM - 10) - No person shall cause or contribute to concentrations of PM - 10 in the ambient air which exceed :

- 150 micrograms per cubic meter of air, 24 hour average, no more than one expected exceedence per calendar year.

- 50 micrograms per cubic meter of air, annual average.

POINT OF COMPLIANCE: Within the confines of the Warm Springs Ponds operable unit, where human exposure is probable.

CITATION: Promulgated at ARM s[s]§ 16.8.821 as part of a federally approved SIP, pursuant to the Clean Air Act of Montana, MCA 75-2-101 et seq.. Corresponding federal regulations are found at 40 CFR s[s]§ 50.6, promulgated pursuant to section 109 of the Clean Air Act, 42 U.S.C. s[s]§ 7409.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action, and at the conclusion of the action and thereafter. Compliance shall be measured in accordance with methods described in 40 CFR Part 50, and corresponding State provisions.

C. Airborne particulate matter - Construction must not be undertaken unless reasonable precautions are taken to control emissions of airborne particulate matter.
POINT OF COMPLIANCE: At the construction activity.

CITATION: Promulgated at ARM 16.8.1401(4), pursuant to the Clean Air Act of Montana, MCA 75-2-101 et seq.. These regulations were promulgated pursuant to an approved State Implementation Plan pursuant to section 110 of the Clean Air Act, 42 U.S.C. s[s]§ 7410.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action. Compliance shall be measured in accordance with methods described in 40 CFR Part 50, and corresponding State provisions.

D. Opacity - Emissions of airborne particulate matter from any stationary source shall not exhibit any opacity of 20 percent or greater averaged over six consecutive minutes.

POINT OF COMPLIANCE: At the source of emission.

CITATION: Promulgated at ARM 16.8.1401(4), pursuant to the Clean Air Act of Montana, MCA 75-2-101 et seq.. These regulations were promulgated pursuant to an approved State Implementation Plan pursuant to section 110 of the Clean Air Act, 42 U.S.C. s^s§ 7410.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action. Compliance shall be measured in accordance with methods described in 40 CFR Part 50, and corresponding State provisions.

E. Road dust suppression - Construction activity must employ reasonable measures to control road dust.

POINT OF COMPLIANCE: At the construction activity.

CITATION: Promulgated at ARM 16.8.1401(3), pursuant to the Clean Air Act of Montana, MCA 75-2-101 et seq.. These regulations were promulgated pursuant to an approved State Implementation Plan pursuant to section 110 of the Clean Air Act, 42 U.S.C. s^s§ 7410.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action.

F. Settled particulate matter - No person shall cause or contribute to concentrations of particulate matter in the ambient air such that the mass of settled particulate matter exceeds 10 grams per square meter, 30-day average.

POINT OF COMPLIANCE: Within the confines of the Warm Springs Ponds operable unit, where human exposure is probable.

CITATION: Promulgated at ARM s^s§s^s 16.8.818, pursuant to the Clean Air Act of Montana, MCA 75-2-101 et seq..

CLASSIFICATION: State, applicable.

COMPLIANCE: During the implementation of the remedial action, and at the conclusion and thereafter.

G. Occupational Health and Safety Standards. No worker shall be exposed to:

* Arsenic	0.5 micrograms per cubic meter (mg/m3)
Inorganic Arsenic	10.0 ug/m3
Copper dusts	1.0 mg/m3
* Lead	0.15 mg/m3
Manganese	5.0 mg/m3
Selenium compounds	0.2 mg/m3
Silver	0.01 mg/m3
Cadmium dust	0.2 mg/m3, 8 hour time weighted average
Mercury	0.1 mg/m3 acceptable ceiling
Silica-crystalline quartz	250 millions of particulates per cubic foot of air
	10 mg/m3
Inert or nuisance dust	15 mppcf
	5 mg/m3
Total dust	50 mppcf
	15 mg/m3

POINT OF COMPLIANCE: At the worker.

CITATION: Promulgated at 29 CFR s^s§s^s§ 1910.1000, 1910.1018(c), and 1910.1025(c), pursuant to the Occupational Safety and Health Act, 29 U.S.C. s^s§s^s§ 651 - 678, except for those standards marked with a *, which are promulgated at ARM s^s§ 16.42.102, pursuant to the Occupational Health of Montana, MCA s^s§ 50-70-113.

CLASSIFICATION: Federal, applicable, except for * standards, which are State, relevant and appropriate.

COMPLIANCE: During implementation of the remedial action.

H. Generators of air pollution must achieve and maintain such levels of air quality as will protect human health and safety, to the greatest extent practicable.

Point of compliance: within the Warm Springs Ponds operable unit, where human exposure is probable.

Citation: MCA § 75-2-102, pursuant to the Clean Air Act of Montana.

Classification: State, applicable

Compliance: During implementation of the remedial action and thereafter. Compliance with the numeric standards listed will achieve compliance with this standard.

3. Surface Water - Ambient.

		Chronic (mg/l)	Acute (mg/l)
A.	Arsenic (III)	0.36	0.19
B.	Arsenic (V)	0.85	0.048
C.	Arsenic (Total)	2.2	--
D.	Cadmium	0.0039*	0.0011*
E.	Copper	0.018*	0.012*
F.	Iron	--	1.0
G.	Lead	0.082*	0.0032*
H.	Mercury	144.0 ng/l	0.000012
I.	Selenium	0.28	0.036
J.	Silver	0.0041*	0.00012*
K.	Zinc	0.12*	0.11*

* indicates an assumption of 100 mg/l hardness. If the average hardness can be demonstrated to occur at a different level within the Ponds for this compliance point, or within the receding stream, for the ambient water compliance point. These standards will be adjusted appropriately.

L. Dissolved oxygen concentrations may not be reduced below 7.0 mg/l from October 1 through June 1, nor below 6.0 mg/l from June 2 through September 30.

M. Induced variation of pH within the range of 6.5 to 9.0 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0

N. The maximum allowable increase above naturally occurring turbidity is 10 nephelometric turbidity units except for short-term construction or hydraulic projects, game fish population restoration, as permitted in ARM s§ 16.20.633.

O. A 1 degree F maximum increase above naturally occurring water temperature is allowed within the range of 32 degrees to 66 degrees F; within the naturally occurring range of 66 degrees F to 66.5 degrees F, no discharge is allowed which will cause the water temperature to exceed 67 degrees F; and where the naturally occurring water temperature is 66.5 degrees F or greater, the maximum allowable increase in water temperature is 0.5 degrees F. a 2 degree F-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55 degrees F, and a 2 degree F maximum decrease below naturally occurring water temperature is allowed within the range of 55 degrees F to 32 degrees F.

P. No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, or other wildlife.

Q. True color must not be increased more than 5 units above naturally occurring color.

POINT OF COMPLIANCE: These standards must be met at the beginning of the Clark Fork River, that is just above the confluence of Warm Springs Creek and just past the Mill-Willow Bypass.

CITATION: These standards are promulgated at ARM s[s]§ 16.20.622(2), pursuant to the Montana Water Quality Act, MCA s[s]§s[s]§ 75-5-101 et seq.. These standards are based upon the designation of the upper reaches of the Clark Fork River as a C-2 class river in ARM s[s]§ 16.20.604(1)(e), as further described in ARM s[s]§ 16.20.622, where designated uses are described. These standards were developed by EPA pursuant to section 304 of the Clean Water Act, 42 U.S.C. s[s]§ 1314, and are published in the "Gold Book", Water Quality Criteria for Water 1986, EPA 44/5-86-001 (May 1, 1986). The State has enacted them as applicable requirements pursuant to delegated authority found section 303 of the Clean Water Act, 42 U.S.C. s[s]§ 1313.

CLASSIFICATION: Federal, applicable (by virtue of being promulgated State water quality standards which are directly applicable to the river bodies).

COMPLIANCE: Upon the completion of the remedial action, and thereafter.

ARAR WAIVER: The standards for arsenic (total) and mercury described above cannot be achieved using currently available technology. Pursuant to section 121(d)(4)(A) and(C), 42 U.S.C. s[s]§ 9621(d)(4)(A)and (C), EPA is waiving compliance with these standards. The standards would be replaced by the following:

Arsenic (total)	0.02 mg/l
Mercury	0.2 ug/l

The standards identified for arsenic and mercury are below detection limits and cannot be achieved using currently available technology, and are waived due to the interim nature of this action. The replacement standards are based on the detection limits for mercury, and the non-degradation standard for arsenic.

S. The State's non-degradation requirements require that sources of pollution do not degradate existing high quality water. Compliance with the specific criteria identified above will achieve compliance with this provision.

POINT OF COMPLIANCE: These standards must be met at the beginning of the Clark Fork River, that is just above the confluence of Warm Springs Creek and just past the Mill-Willow Bypass.

CITATION: Promulgated at ARM s^{s}§ 16.20.702, pursuant to the Montana Water Quality Act, MCA s^{s}§ 75-5-303.

CLASSIFICATION: State, relevant and appropriate.

COMPLIANCE: Upon the completion of the remedial action, and thereafter.

4. Point Source Discharge

A. Because the discharge from Pond 2 which is expected to remain after completion of the remedial action will enter the Clark Fork River, the water quality standards identified above in I. 3. A. - K., including the ARAR waiver replacement standards, are identified as the appropriate numeric limitations for the point source at Pond 2 which will remain after completion of the remedial action.

POINT OF COMPLIANCE: At the point of discharge. These numeric standards must be met when stream flows equal or exceed the minimum consecutive 7-day average flow, which may be expected to occur on the average of once in ten years. **Special note** - Because this discharge is a pre-existing permitted discharge, which has been subject to a MPDES water quality permit for several years, continuing the application and permit process would ensure continuity within the State's program. Although not required by CERCLA, permit for this discharge must continue to be applied for (as part of the remedial design process) and received. The permit should be consistent with the standards stated in section I.4. of this ARARs list, and any other standards determined to be applicable through the permit process.

CITATION: Promulgated at ARM s^{s}§ 16.20.622, pursuant to the Montana Water Quality Act, MCA s^{s}§ 75-5-101 et seq.. Point source standards are required in section 402(a) of the Clean Water Act, 42 U.S.C. s^{s}§ 1342(a).

CLASSIFICATION: Federal, applicable.

COMPLIANCE: At the conclusion of the remedial action and thereafter. No mixing zone will be applied to measure compliance with these requirements.

B. A maximum pH standard of 9.5, as contained in the current MPDES permit for the pond discharges, is identified as applicable to the point source discharge from Pond 2 which will remain after this remedial action.

POINT OF COMPLIANCE: At the point of discharge. These numeric standards must be met when stream flows equal or exceed the minimum consecutive 7-day average flow, which may be expected to occur on the average of once in ten years.

CITATION: Promulgated at ARM s[s]§ 16.20.622, pursuant to the Montana Water Quality Act, MCA s[s]§ 75-5-101 et seq.. Point source standards are required in section 402(a) of the Clean Water Act, 42 U.S.C. s[s]§ 1342(a).

CLASSIFICATION: Federal, applicable.

COMPLIANCE: At the conclusion of the remedial action and thereafter, as provided in the water quality permit which will be required for the point source discharge.

C. Monitoring and best management practices described at
40 CFR s[s]§ 440.104 are required for point source discharge from Pond 2 which will remain after this remedial action (See action ARARs).

CLASSIFICATION: Federal, applicable.

COMPLIANCE: At the conclusion of the remedial action and thereafter, as provided in the water quality permit which will be required for the point source discharge.

II. Location Specific

1. Structures such as parks and wildlife management areas are permitted within floodplains.

CITATION: Promulgated at MCA s[s]§ 75-5-402, as part of the Floodplain and Floodway Management Act.

CLASSIFICATION: State, applicable.

COMPLIANCE: During the implementation of the remedial action and thereafter.

2. Water conversation and flood control projects, including projects for conversation, recreation and wildlife protection, streamflow stabilization, and pollutant abatement are permitted. These may include dikes, embankments, impounding reservoirs, and other watercourse improvements.

CITATION: Promulgated at MCA s[s]s[s]§§ 75-5-1101 and 1102, as part of the Floodplain and Floodway Management Act.

CLASSIFICATION: State, relevant and appropriate.

COMPLIANCE: During the implementation of the remedial action and thereafter. Only those substantive provisions described above are identified as ARARs for this action.

3. Flood control works are permitted if they are protective to the 100 year flood frequency flow.

CITATION: ARM s§ 36.15.606, pursuant to the Floodplain and Floodway Management Act.

CLASSIFICATION: State, relevant and appropriate.

COMPLIANCE: Compliance with these provision has been achieved or will be achieved through construction of the Mill-Willow Bypass and associated berm in accordance with the approved Work Plan for that effort. Only those substantive provisions described above are identified as ARARs for this action.

4. Wildlife management and natural areas are permitted and encouraged uses within a floodplain.

CITATION: ARM s§ 36.15.801, pursuant to the Floodplain and Floodway Management Act.

CLASSIFICATION: State, applicable (substantive provisions only).

COMPLIANCE: During the implementation of the remedial action and thereafter. Only those substantive provisions described above are identified as ARARs for this action.

5. Soil erosion and sedimentation to Montana natural rivers musty be kept to a minimum.

CITATION: MCA s§ 75-7-102, of the Natural Streambed and Land Preservation Act of 1975.

CLASSIFICATION: State, applicable (substantive provisions only).

COMPLIANCE: During the implementation of the remedial action and thereafter. Only those substantive provisions described above are identified as ARARs for this action.

6. The rainbow bridge within Pond 3 has been identified as eligible for the Register of Historic Places. The selected remedy may have adverse effects on the bridge. Accordingly, the following mitigation measures are required during the conduct of the remedial action.

The bridge must be photographed and recorded, according to state regulations. Additional measures, such as establishments of a roadside display, may be identified during the remedial design phase.

CITATION: 40 CFR s[s]§ 6.301(b) and 40 CFR Part 800, pursuant to the National Historic Preservation Act, 16 U.S.C. s[s]§ 470 et seq..

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action.

7. If significant scientific, prehistorical, historic, or archaeological data is found at the Warm Springs Ponds operable unit, it must be preserved in an appropriate manner. To date, no such data has been found at the operable unit. However, if such data is discovered, this ARAR must be complied with.

CITATION: 40 CFR s[s]§ 6.301(c), pursuant to the Archaeological and Historic Preservation Act, 16 U.S.C. s[s]§ 469.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action.

8. A pair of bald eagles has been identified as nesting near the Warm Springs Ponds operable unit. The appropriate mitigative measures to be followed during the conduct of the remedial action are:

Continued consultation with the U.S. Fish and Wildlife Service to determine mitigative measures regarding on-site construction.

CITATION: 50 CFR Parts 17 and 402, 40 CFR s[s]§ 302(h), pursuant to the Endangered Species Act, 16 U.S.C. s[s]§ 1531.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action.

9. Modification of the Mill-Willow Bypass and Silver Bow Creek must provide for adequate protection of fish and wildlife resources. The specific requirements for this ARAR were incorporated into the Work Plan for the Mill-Willow Bypass removal.

CITATION: 40 CFR s[s]§ 6.302(g), pursuant to 16 U.S.C. s[s]§s[s]§ 661 et seq..

CLASSIFICATION: Federal, applicable.

COMPLIANCE: Compliance with these provision has been achieved or will be achieved through construction of the Mill-Willow Bypass and associated berm in accordance with the approved Work Plan for that effort. Only those substantive provisions described above are identified as ARARs for this action.

10. The activities described in the ROD will minimize potential harm to or within the floodplain and improves the natural and beneficial values of the floodplain.

CITATION: 40 CFR s^{s}§ 6.302(b) and Executive Order on Floodplain Management, No. 11,988.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action. The activities described in this ROD will comply with this ARAR.

11. The activities described in the ROD have avoided, to the extent possible, adverse impacts to existing wetlands within the Warm Springs Ponds operable unit, and avoid construction in wetlands if practicable.

CITATION: 40 CFR 6.302(a) and 40 CFR Part 6, Appendix A, Executive Order No. 11,990.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action.

12. The Pond 1, 2 and 3 disposal facilities must be designed, constructed, operated, and maintained to avoid washout, because they are located next to the 100 year flood plain for Silver Bow, Mill, and Willow Creeks, and the Clark Fork River.

CITATION: ARM s^{s}§ 16.44.702, pursuant to the Montana Hazardous Waste Management Act. Corresponding federal regulations of this federally authorized and delegated program are found at 40 CFR s^{s}§ 264.18(a) and (b), pursuant to the Resource Conversation and Recovery Act, as amended, 42 U.S.C. s^{s}§s^{s}§ 6901 et seq..

CLASSIFICATION: Federal, relevant and appropriate.

COMPLIANCE: At the completion of the remedial action and thereafter.

III. Action Specific

1. General ARARs

A. During construction at the site, and afterwards, standards governing the protection of occupational health and safety must be complied with. These include the establishment of health and safety programs and practices for on-site workers, and the provision of protective equipment, should conditions warrant.
Full requirements are contained in the cited provisions.

CITATION: 29 CFR Part 1926, 20 CFR s^{s}§s^{s}§ 1910.120, and 1910.132, promulgated pursuant to the Occupational Health and Safety Act, 29 U.S.C. s^{s}§s^{s}§ 651 - 678.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action, and thereafter if jurisdictional requirements are met for conditions existing after the completion of the remedial action.

B. Every employer must provide a safe place of employment, provide safety devices and safeguards and use practices, and ensure that operations and processes are reasonably adequate to render the place of employment safe. The employer must also do every other thing reasonably necessary to protect he life and safety of its employees.

CITATION: MCA s^{s}§ 50-71-201, of the Montana Safety Act.

CLASSIFICATION: State, applicable.

COMPLIANCE: During the implementation of the remedial and thereafter, if the jurisdictional prerequisites of the statute are met.

C. Each employer must maintain at the work place a list of chemical names of each chemical in the work place, and indicate the work area where the chemical is stored or used.. If any Material Safety Data Sheets exist for the chemicals, they must be kept at the work place. Employees must be informed of the chemicals at the work place, and trained in the proper use of the chemicals.

CITATION: MCA s^{s}§s^{s}§ 50-78-202, 203, 204, and 307, promulgated pursuant to the Employee and Community Hazardous Chemical Information Act.

CLASSIFICATION: State, applicable.

COMPLIANCE: During the implementation of the remedial and thereafter, if the jurisdictional prerequisites of the statute are met.

2. Cleanup and reconstruction of the Mill-Willow Bypass.

Part of the remedial action involves cleanup and reconstruction of the Mill-Willow Bypass. ARARs for that action were previously identified as an attachment to the Administrative Order on Consent governing that early action. Those ARARs are hereby incorporated by reference. In addition, the following ARARs are identified for the continued cleanup and reconstruction activities taking place in the Mill-Willow Bypass.

A. At this time, no additional mitigative measures are identified to achieve compliance with the dredge and fill requirements of the Clean Water Act. Consultation with the Corps of Engineers is continuing, and requirements may be identified during the implementation of the remedial action, including the cleanup and reconstruction of the Mill-Willow Bypass.

CITATION: 40 CFR Parts 230, 231 (substantive provisions only), 33 CFR Parts 323 and 330 (substantive provisions only), pursuant to section 404 of the Clean Water Act, 42 U.S.C. s[s]§ 1344,

CLASSIFICATION: Federal, applicable.

COMPLIANCE: During the implementation of the remedial action.

B. Reclaimed drainages must be designed to emphasize channel and floodplain dimensions that will blend with the undisturbed drainage above and below the area to be reclaimed. The channel must be restored to its natural habitat or characteristic pattern with a geomorphically acceptable gradient. The drainage must safely pass through a 24-hour precipitation event with a 100-year recurrence interval. Reclamation must provide for long-term stability of the landscape, establishment or restoration of the stream to include a diversity of aquatic habitats (generally a series of riffles and pools), and restoration enhancements, or maintenance of natural riparian vegetation.

CITATION: ARM s[s]§ 26.4.634, promulgated pursuant to the Montana Strip and Underground Mine Reclamation Act, MCA 82-4-101 et seq..

CLASSIFICATION: State, relevant and appropriate.

COMPLIANCE: At the conclusion of the remedial action.

C. Temporary diversion structures at the Bypass or on Silver Bow Creek must be constructed to safely pass the peak run-off from a precipitation event with a 10-year, 24-hour recurrence interval. Channel lining must be designed using standard engineering practices such a riprap, to safely pass designed velocity. Free board must be no less than 0.3 feet.

CITATION: ARM s[s]§ 26.4.636, promulgated pursuant to the Montana Strip and Underground Mine Reclamation Act, MCA 82-4-101 et seq..

CLASSIFICATION: State, relevant and appropriate.

COMPLIANCE: At the conclusion of the remedial action.

D. Disturbed areas which will remain above high flow levels along the Mill-Willow Bypass must comply with general revegetation requirements described in the following section.

3. General revegetation requirements. The remedial action will involve excavation of some contaminated material into disposal facilities, covering some contaminated areas with clean soil, and creating two disposal facilities. The following requirements are ARARs for those activities. These requirements are not ARARs for contaminated areas which will be flooded or made into or maintained as a wetland.

A. The disposal units and other revegetated areas will be capped with clean soil and revegetated in an appropriate manner, consistent with the Timber Butte removal action and its accompanying work plan.

CITATION: 30 CFR s[s]§ 816.111, promulgated pursuant to the Surface Mining Control and Reclamation Act, 30 U.S.C. s[s]§s[s]§ 1201 - 1326.

CLASSIFICATION: Federal, relevant and appropriate.

COMPLIANCE: At the conclusion of the remedial action, and thereafter.

B. Revegetation of the disposal units, the excavated areas, and the covered, contaminated areas must meet the substantive standards of the regulations cited below.

CITATION: ARM s[s]§s[s]§ 26.4.501, .501(a), .505, .520, .631, .633, .638, .644, .703, .711, .713, .714, .716, .718, .719, .721, .724, .726, .727, .728, .729, .730, .751, and .761, all of which are promulgated pursuant to the Montana Strip and Underground Mine Reclamation Act, MCA s[s]§s[s]§ 82-4-101 et seq.. These standards provide the specific method to ensure compliance with § 82-4-231 and 82-4-233 of the MSUMRC.

CLASSIFICATION: State, relevant and appropriate.

COMPLIANCE: At the completion of the remedial action, and thereafter.

4. Continued operation of Ponds 1 and 2.

Ponds 2 and 3 will continue to function as contaminant capture and treatment surface impoundments until water quality standards and other ARARs are achieved upstream, and contaminated soils and waste are stabilized or removed from the floodplain. Until that time, the operation of Ponds 2 and 3 must comply with the following ARARs:

A. The structural integrity of the Ponds must comply with the provisions cited below, to prevent overtopping and other problems. The operation and maintenance should provide for regular inspection and maintenance of the Ponds.

CITATION: Certain provisions (only substantive provision which incorporate 40 CFR s[s]§s[s]§ 264.221(f), (g), (h), and .226) of ARM s[s]§s[s]§ 161.44.701 - 703, which are promulgated pursuant to the Montana Hazardous Waste Management Act. Corresponding federal regulations for this authorized and delegated program are found at 40 CFR s[s]§s[s]§ 264.221(f), (g), (h), and .226, which are promulgated pursuant to the Resource Conversation and Recovery Act, as amended, 42 U.S.C. s[s]§s[s]§ 6901 et seq..

CLASSIFICATION: Federal, relevant and appropriate.

COMPLIANCE: After completion of the remedial action, and thereafter.

5. Berm Strength

The berms contained within the Warm Springs Ponds operable unit are considered dams and/or reservoirs, pursuant to the Montana Dam Safety Act. Further, the dams have been classified as high hazard dams, pursuant to ARM s[s]§ 36.14.202. All berms within the operable unit must comply with the following ARARs.

A. All dams and reservoirs which divert or store water must be constructed in a secure, thorough, and substantial and safe manner.

CITATION: MCA §§ 85-15-207 and 208, a provision of the Montana Dam Safety Act.

CLASSIFICATION: State, applicable.

COMPLIANCE: At the conclusion of the remedial action and thereafter.

B. All high hazard cams must comply with the criteria given in the provision cited below, including compliance with the Maximum Credible Earthquake standards.

CITATION: ARM s[s]§ 36.14.501, which is promulgated pursuant to the Montana Dam Safety Act.

CLASSIFICATION: State, applicable.

COMPLIANCE: At the conclusion of the remedial action and thereafter.

C. All high hazard dams must be able to safely pass the flood calculated from the inflow design flood. In this situation, all berms within the operable unit must be able to safely manage 0.5 Probable Maximum Flood (PMF).

CITATION: ARM s^{s}§ 36.14.502, which is promulgated pursuant to the Montana Dam Safety Act.

CLASSIFICATION: State, applicable.

COMPLIANCE: At the conclusion of the remedial action and thereafter.

6. Closure and post closure care of the two disposal facilities.

Pond 1 and the upland disposal facility above Pond 3 (created as a result of the removal action at the Mill-Willow Bypass) will be used to permanently dispose of contaminated soils and sediments, and tailings. These disposal facilities must be closed and cared for according to the following ARARS:

A. All waste of disposed within the facilities must be drained of free liquids, and stabilized appropriately.

CITATION: Certain portions of ARM s^{s}§ 16.44.702 (namely, that portion which incorporates 40 CFR s^{s}§ 264.228(a) which addresses the standard described above), promulgated pursuant to the Montana Hazardous Waste Management Act. Corresponding federal regulations for this authorized and delegated program are found at 40 CFR s^{s}§s^{s}§ 264.228(a), which are promulgated pursuant to the Resource Conversation and Recovery Act, as amended, 42 U.S.C. s^{s}§s^{s}§ 6901 _et seq._.

CLASSIFICATION: Federal, relevant and appropriate.

COMPLIANCE: At the completion of the remedial action and thereafter.

B. Closure must be done in such a manner as to minimize the need for further maintenance and to control, minimize or eliminate, to the extent necessary to protect public health and the environment, post-closure escape of hazardous wastes, hazardous constituents, leachate, contaminated run-off or hazardous waste decomposition products to the ground water or surface waters or to the atmosphere. This ARAR does not require an impermeable cap or liners.

CITATION: Certain portions of ARM s^{s}§ 16.44.702 (namely, that portion which incorporates 40 CFR s^{s}§ 264.111 which addresses the standard described above), promulgated pursuant to the Montana Hazardous Waste Management Act. Corresponding federal regulations for this authorized and delegated program are found at 40 CFR s^{s}§s^{s}§ 264.111, which are promulgated pursuant to the Resource Conversation and Recovery Act, as amended, 42 U.S.C. s^{s}§s^{s}§ 6901 _et seq._.

CLASSIFICATION: Federal, relevant and appropriate.

COMPLIANCE: At the completion of the remedial action and thereafter.

C. The disposal facility cover for each unit must function with minimum maintenance, promote drainage and minimize erosion or abrasion of the final cover, and accommodate settling and subsidence.

CITATION: Certain portions of ARM s^{s}§ 16.44.702 (namely, that portion which incorporates 40 CFR s^{s}§ 264.228(b)(c) and (d) which address the standards described above), promulgated pursuant to the Montana Hazardous Waste Management Act. Corresponding federal regulations for this authorized and delegated program are found at 40 CFR s^{s}§s^{s}§ 264.228(b)(c) and (d), which are promulgated pursuant to the Resource Conversation and Recovery Act, as amended, 42 U.S.C. s^{s}§s^{s}§ 6901 et seq..

CLASSIFICATION: Federal, relevant and appropriate.

COMPLIANCE: At the completion of the remedial action and thereafter.

D. The owner of the disposal facilities must submit to the local land use or zoning authority a survey plat indicating the location and dimensions of waste disposed of in each unit. Additionally, the owner must record a deed restriction, in accordance with State law, that will in perpetuity notify potential purchasers that the property has been used for waste disposal and that its use is restricted.

CITATION: Certain portions of ARM s^{s}§ 16.44.702 (namely, that portion which incorporates 40 CFR s^{s}§ 264.116 and 119 which address the standards described above), promulgated pursuant to the Montana Hazardous Waste Management Act. Corresponding federal regulations for this authorized and delegated program are found at 40 CFR s^{s}§s^{s}§ 264.116 and .119, which are promulgated pursuant to the Resource Conversation and Recovery Act, as amended, 42 U.S.C. s^{s}§s^{s}§ 6901 et seq..

CLASSIFICATION: Federal, relevant and appropriate.

COMPLIANCE: At the completion of the remedial action and thereafter.

E. A private party's solid waste may be disposed of on property belonging to the private party, unless such disposal creates a nuisance or public health hazard.

CITATION: MCA s^{s}§ 75-10-214, which is part of the Montana Solid Waste Management Act.

CLASSIFICATION: State, applicable.

COMPLIANCE: At the conclusion of the remedial action or thereafter.

F. Solid waste must be disposed of outside of the 100 year flood plain, must be disposed of in a manner which prevents pollution of the ground or surface water, contain adequate drainage structures, and prevent run-off from entering disposal areas. Solid waste must be transported to the area in such a manner as to prevent its discharge, dumping, spillage, or leaking.

CITATION: Certain provisions of ARM s[s]§s[s]§ 16.14.505 and 523, as described above, which are promulgated pursuant to the Montana Solid Waste Management Act. Corresponding federal regulations are found in specific portions of 40 CFR Part 257, which was promulgated pursuant to the Resource Conversation and Recovery Act, as amended, 42 U.S.C. s[s]§s[s]§ 6901 et seq..

CLASSIFICATION: Federal, relevant and appropriate.

COMPLIANCE: At the conclusion of the remedial action and thereafter.

WAIVER: Hazardous substances will be left within the Pond berms. EPA has examined the Solid Waste Management Act, and believes the area within the berms, after berm strengthening activities, is not within the 100 year flood plain of Silver Bow, Mill, or Willow Creeks, or the Clark Fork River. Therefore, EPA believes that this action is in compliance with this ARAR.

However, if it is determined that the materials are within the 100 year flood plain, a waiver of this ARAR is appropriate, pursuant to section 121(D)(4)(A) of CERCLA, as this action is an interim action.

7. Ground water monitoring.

The ongoing waste management units and waste disposal units at the site must be monitored for compliance with ground water ARARs described in section I.1. above. The monitoring system for this site must comply with the following ARARs:

A. The monitoring system must comply with the provision cited below, for detection of those contaminants identified in section I.1. above only. The monitoring system can treat the collection of Ponds and disposal units as one consolidated unit.

CITATION: Certain portions of ARM s[s]§ 16.44.702 (namely, those portions which incorporate 40 CFR s[s]§ 264.97), which is promulgated pursuant to the Montana Hazardous Waste Management Act. Corresponding federal regulations for this authorized and delegated program are found at 40 CFR s[s]§s[s] 264.97, which is promulgated pursuant to the Resource Conversation and Recovery Act, as amended, 42 U.S.C. s[s]§s[s]§ 6901 et seq.. In addition, compliance with this requirement will also achieve compliance with ARM § 16.20-1016.

CLASSIFICATION: Federal, relevant and appropriate.

COMPLIANCE: Upon installation of the ground water monitoring system.

8. Operation of Pond 2.

Pond 2 will continue to be a point source discharge to the Clark Fork River. Numeric standards for that discharge are identified in section I.4. above. As previously stated, because the discharge is a preexisting discharge, the operator of Pond 2 (ARCO) must obtain an MPDES permit for the point source discharge from Pond 2. That permit must ensure compliance with the following ARARs, at a minimum.

A. The discharge must be monitored in compliance with the provision cited below, to ensure compliance with the standards identified in section I.4 above.

CITATION: ARM s^{s}§ 26.20.904, promulgated pursuant to the Montana Water Quality Act. Corresponding federal regulations for this authorized and delegate` program are found at 40 CFR s^{s}§ 122.41.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: At the conclusion of the remedial action and thereafter.

B. The Pond must be managed using Best Management Practices, to ensure compliance with the standards identified in section I.4. above.

CITATION: ARM s^{s}§ 26.20.904, promulgated pursuant to the Montana Water Quality Act. Corresponding federal regulations for this authorized and delegated program are found at 40 CFR s^{s}§ 125.100.

CLASSIFICATION: Federal, applicable.

COMPLIANCE: At the conclusion of the remedial action and thereafter.

C. Ponds such as the Warm Springs Ponds must be operated and maintained so as to prevent pollution of surface waters above the numeric standards identified in section I.4 above.

CITATION: ARM s^{s}§ 16.20.633 & 75-6-112(2) & 75-5-605, promulgated pursuant to the Montana Water Quality Act.

CLASSIFICATION: State, applicable.

COMPLIANCE: At the conclusion of the remedial action and thereafter.

POLICIES, GUIDANCE, ADVISORIES, CRITERIA OR OTHER INFORMATION TO BE CONSIDERED

Identification of policies, guidance, advisories, criteria, or other information which does not rise to the level of ARARs by the lead agency is authorized in 40 CFR § 300.400(g)(3). TBCs are to be used as appropriate in developing Superfund remedies. As the Preamble to the final NCP states, TBCs may be useful in helping to determine what is protective at a site, or how to carry out certain actions or requirements. 55 FR 8744-8745.

Accordingly, the following list is divided into those TBCs which were used by EPA and the State in considering and evaluating human health and environmental risks posed by the site, and those that will be used by EPA and the State as it continues to implement or monitor implementation of the ROD.

I. TBC used in evaluating risks at the site.

Agency of Toxic Substance and Disease Registry (ATSDR). 1988. Draft, toxicological profile for lead. U.S. Public Health Service, Atlanta, GA.

EPA, 1986. Guidelines for the health risk assessment of chemical mixtures. Federal Register 51(185):34014-34025.

EPA, 1986. Superfund public health evaluation manual. EPA 540/1-86/060, Office of Emergency and Remedial Response, Washington, D.C.

EPA, 1987. Final, Superfund exposure assessment manual. Office of Emergency and Remedial Response, Washington, D.C.

EPA, 1988. Final, Superfund exposure assessment manual. Office of Emergency and Remedial Response, Washington, D.C.

EPA, 1988. Final, Superfund exposure assessment manual. Office of Emergency and Remedial Response, Washington, D.C. (OSWER Dir. # 9285.5-1)

EPA, 1988. Integrated risk information system. Office of Research and Development, Cincinnati, OH.

EPA, 1989. Second quarter FY 89 health effects assessment summary tables. Environmental Criteria and Assessment Office, OERR 9200.6-303-(89-1). Cincinnati, OH.

EPA, 1989. Regulating Lead: an update. AWWA J. 81(7): 24.

Epa, 1989. Evaluation of the potential carcinogenicity of lead and lead compounds in support of reportable quantity adjustments pursuant to CERCLA section 102. EPA/600/8-89/045A, Office of Health and Environmental Assessment, Washington, D.C.

EPA, September, 1989. Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites. OSWER Dir. #9355.4-02.

Recommended Agency Policy on the Carcinogenicity Risk Associated with the Ingestion of Inorganic Arsenic, June 21, 1988, Lee Thomas, EPA Administrator.

Special Report on Ingested Inorganic Arsenic: Skin Cancer; Nutritional Essentially (EPA, 1988).

Interim Final Guidance for Soil Ingestion Rates (EPA, 1989; OSWER Dir. # 9850.4).

Supplement to Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites, (EPA, 1990; OSWER Dir. #9355.4-02A)

Risk Assessment Guidance (EPA, 1990)

Interim Final Environmental Evaluation Manual, (EPA, 1990; OSWER Dir. # 9285.7-01); otherwise known as the Risk Assessment Guidance for Superfund - Environmental Evaluation Manual.

* EPA's Proposed Drinking Water Standard for maximum Concentration Limits for Copper and lead, 53 FR 31516 (August 18, 1988).

* EPA's Proposed MCLG levels for cadmium, mercury, and selenium. 54 Fed. Reg. 22,062, May 22, 1989).

* State of Montana's Ambient Air Guidelines for Non-Criteria Air Pollutants.

*These standards are not promulgated as of the date of this ROD, and therefore are not ARARs. Because existing ARARs for these contaminants, taken from State water quality standards or the State's Clean Air Act are protective of human health and the environment, these standards were not chosen for this action. EPA and the State reserve the right to use these standards at other sites within the Clark Fork Basin or the State of montana to achieve full protection of human health and the environment.

II. TBCs to evaluate the conduct of the remedial action. These TBCs are not mandatory, and will be used only as guidance as appropriate by EPA as it reviews the remedial design and remedial action activities.

EPA's RCRA Design Guidelines for Surface Impoundments.

EPA's RCRA Permit Writer's Guidance Manual for Hazardous Waste Land Treatment, Storage, and Disposal Facilities.

EPA's RCRA Technical Resource Document for Closure of Hazardous Waste Surface Impoundments.

EPA's NPDES Guidance Document on NPDES Best Management Practices (June 1981);

EPA's Guidance on Remedial Action for Contaminated Ground Water at Superfund Sites, OSWER Dir. # 9283.1-2, December, 1988.

**The State of Montana general inspection and reporting requirements for dam and reservoir construction and mine revegetation found at MCA § 85-15-211, 85-15-213, 85-15-310, 82-4-237, and 82-14-237; and ARM § 36.14.601, .602, .603, 26.4.305, .307, .309, .320, and .1129.

**The State of Montana's general permit application requirements for dam construction and mine revegetation, found at MCA § 85-15-212 and 84-4-222, and ARM §36.14.301, .303, .305, .305, .306, .308, .402 - 407, .503, 26.4.305, .307, .320, and 36.15.216, and .801, and 36.2.404, and 26.4.311 - 315.

**The State of Montana's bond assurance and liability protection provisions found at MCA § 82-4-223, and ARM § 36.14.309, .311, and 26.4.1102, .1119, and 1125.

**These requirements are part of the State's environmental laws, and are administrative requirements, as defined by the NCP. They therefore are not ARARs, and are not mandatory requirements to be followed at the site during remedial action. Nevertheless, EPA recognizes that such provisions may be useful to the State and EPA as it reviews and approves of various deliverables during the remedial design and remedial action Superfund process, such as remedial design plans, remedial action plans, operation and maintenance plans, and financial assurance submittals.

OTHER POTENTIALLY RELEVANT LAWS

The ARARs process is the exclusive process for applying federal or State environmental or siting laws to a Superfund cleanup. However, the State of montana has identified a non-comprehensive list of other State laws which may impact the conduct of the remedial action. Those laws are:

Noise levels for protection of on-site workers, found at ARM § 16.42.101.

Ground water well and monitoring well drillers must be licensed and registered as stated in ARM § 36.21.402, .403, .405, .406, .411, .701, and .703.

Ground water wells must be logged and reported to the Department of Natural Resources Conservation, as stated in MCA § 85-2-516.

Water rights must be protected as stated in MCA § 85-2-301, 85-2-306, 85-2-311, 85-2-402, 75-7-104, 87-5-506, and ARM § 36.16.104 - .106, and 26.4.648.

RECORD OF DECISION

PART III: THE RESPONSIVENESS SUMMARY

Silver Bow Creek/Butte Area NPL Site
Warm Springs Ponds Operable Unit
Upper Clark Fork River Basin, Montana

United States Environmental Protection Agency

September 1990

Printed on recycled paper

PART A - PUBLIC COMMENTS

1.0 RESPONSES TO PUBLIC COMMENTS, AN OVERVIEW

This Responsiveness Summary for the Warm Springs Ponds Operable Unit of the Silver Bow Creek Site was prepared to document and respond to the issues and comments raised by the public regarding the feasibility study (FS) and the Proposed Plan for the operable unit.

A remedial investigation (RI) and a public health and environmental assessment (PHEA) for the operable unit have been completed. The RI and the PHEA examined the human health and environmental risks posed by the operable unit.

The FS developed a set of remedial alternatives representing a range of approaches to protect human health and the environment from the risks identified in the RI and PHEA. This range of alternatives was presented to the public by the release of the feasibility study report. The Proposed Plan detailing the remedial approach favored by the Montana Department of Health and Environmental Sciences (MDHES) and EPA, was released at the same time as the FS. While the FS was being developed, ARCO prepared a feasibility-level study of its own proposal, identified as Alternative 3A. ARCO presented this alternative to the agencies and the public at numerous meetings and public presentations. The agencies have conducted a focused technical review of ARCO's proposal (CH2M HILL 1990). That review is part of the administrative record.

The public comment period for the FS and Proposed Plan began in November 1989 with the release of the two documents. The comment period was extended once and ran until the end of January 1990. Public reaction, as expressed at the public meetings and in

The public comment period for the FS and Proposed Plan began in November 1989 with the release of the two documents. The comment period was extended once and ran until the end of January 1990. Public reaction, as expressed at the public meetings and in written comments, included many questions about how the preferred alternative would work, concerns about the impacts of the remediation, suggestions for modifying the Proposed Plan, and requests that the remediation begin as soon as possible. State and local agencies also responded to the Proposed Plan. Their comments included additional questions and suggested modifications to the Proposed Plan.

Several concepts came up repeatedly in the public's comments. Many commenters suggested that the contaminated sediments in the ponds (approximately 19 million cubic yards) would have to be removed from the floodplain before the cleanup could be considered a permanent remediation. Several commenters pointed out that one feature of the Proposed Plan, diverting the flows in Mill and Willow Creeks into the pond system for treatment, would have negative impacts on the fisheries in those creeks and the upper Clark Fork River. Many commenters expressed concerns about the possibility of constructing a settling basin in the location considered in the FS. Several commenters expressed concerns that the Proposed Plan would not do enough to provide treatment for the contaminated water in Silver Bow Creek, and several of these stated that the goal should be to treat all flows in Silver Bow Creek, up to the flows of a 100-year flood, to meet the aquatic criteria at all times. The selected remedy addresses all of these concerns as addressed below.

ARCO submitted as comments on the FS its own Plan 3A and detailed technical comments on the MDHES FS Report. ARCO's comments on the FS were extensive on almost every section, and repeatedly argued for the alternate proposal they had submitted.

The Responsiveness Summary contains EPA's and MDHES' responses to comments received from the public. Addressed are oral comments received at the public hearings, written comments from individual citizens and private organizations and written comments from various government entities. Because many of the comments addressed similar issues, the comments were consolidated and summarized. A listing of each commenter is included as Attachment III-A to this Responsiveness Summary. Also included is a cross-reference of individual commenters against the summarized comments that are responded to. By utilizing this cross-reference, each commenter should be able to locate his/her comment and the agency response.

The comments received from ARCO were voluminous and comprehensive. They addressed each individual section of the FS point by point. Accordingly, the responses to ARCO's comments are separated from the public comments and the responses follow the format of ARCO's comments.

All comments, whether the public's or ARCO's, were considered fully, and adjustments to the Proposed Plan were made in response to the public comments and ARCO comments.

2.0 RESPONSES TO PUBLIC COMMENTS

2.1 General Comments

2.1.1 Overall Remediation Approach

The agencies received numerous comments and recommendations that dealt with the relationship between the Warm Springs Ponds (WSP) remediation and the other Clark Fork River Superfund sites and operable units, and with the goals and objectives of WSP remediation. Several commenters (Letters 1, 56, 65, 91, 126, 127, 129, 144, 154, 157) made general requests that vigorous efforts be made toward cleaning up the Clark Fork River. Three commenters (Letters 101, 108, 126) noted that clear goals and objectives should be developed for the entire Clark Fork Superfund site, that water quality and health risks should be controlling factors in the goals, that the Warm Springs Ponds proposals must be evaluated with respect to these overall goals, and that dividing the Clark Fork sites into subunits appears to have fostered uneven progress. The same commenters added that the overall site needs more coordination. Numerous other commenters (Letters 4, 45, 55, 57, 68, 84, 85, 86, 89, 92, 101, 105, 107, 108, 111, 119, 124, 139, 143, 151; Testimony A-2, A-9, A-12, A-15, A-16, B-6, B-10, M-3, M-9, M-10) also recommended that the agencies begin cleanup activities at the sources upstream of the WSP.

Response: MDHES and the U.S. Environmental Protection Agency (EPA) are aggressively pursuing cleanup of the Clark Fork River Superfund sites. The overall site cleanup is coordinated by EPA. The agencies' strategy for the cleanup work is described in the Clark Fork Superfund Master Plan. The most recent revision of the Master Plan is scheduled for final release in October 1990. Because of the size and extent of problems in the Clark Fork Basin, it was necessary that the site be broken into smaller units for study.

The agencies decided to put the Warm Springs Ponds cleanup ahead of the upstream Silver Bow Creek operable units because of the potential for catastrophic failure of the pond berms during floods or earthquakes. A catastrophic failure would result in a release to the Clark Fork River of at least a portion of the 19 million cubic yards of tailings and sludges currently in the ponds. This type of failure would result in significant damage to the Clark Fork River. This sequencing will make it necessary to readdress the ultimate disposition of the ponds when upstream Silver Bow Creek is remediated, but initial action on the ponds could not be delayed.

Cleanup at other parts of the Silver Bow Creek Site and at other sites in the Clark Fork Basin is being moved along as fast as the Superfund process will allow. Warm Springs Ponds is just one of the 25 operable units that require study and cleanup in the Clark Fork Basin. These are all complex units that require action, and it will take time to address all of them. Additional information on the schedule for the site-wide cleanup is in the Clark Fork Superfund Master Plan.

One of the overall goals for cleanup of the Basin is to achieve water quality standards for the surface-water bodies within the Basin. The selected remedy will achieve this goal for water entering the Clark Fork River from Silver Bow, Mill, and Willow Creeks, until upstream cleanup actions result in water quality standard compliance in those streams.

One commenter (Letter 151) stated that MDHES and EPA should recognize the need for a phased response at the Warm Springs Ponds, in which the ponds can serve on an interim basis as a treatment system for Silver Bow Creek until the upstream sources are cleaned up. Once that is achieved, a final remedy could then be chosen for Warm Springs Ponds.

Response: The goals and objectives for the cleanup of the Warm Springs Ponds are described in detail in Chapters 3 and 5 of the FS and in the ROD. Protection of human health and meeting ambient water quality standards in the upper Clark Fork River are two of the remedial objectives.

The cleanup at Warm Springs Ponds is being phased in a manner consistent with that requested by the commenter. Remediation is progressing rapidly with action at the Mill-Willow Bypass under way during the 1990 construction season. Tailings are being removed from the bypass, and the western berms of the ponds are being strengthened to withstand the maximum credible earthquake (MCE) and design floods as part of this action. The cleanup of the remainder of the remaining Warm Springs Ponds area will follow the Mill-Willow Bypass removal.

The ROD for this operable unit is an interim ROD. The selected remedies will necessarily remain in place until such time that the upstream contamination sources and depositions along Silver Bow Creek are remediated and there is no longer a need to treat Silver Bow Creek waters. At that time the ultimate disposition of the Warm Springs Ponds will be determined.

One comment (Letter 129) suggested that the agencies keep working on increments that show action at the site, such as the removal and renovation of the Mill-Willow Bypass and the experimental reseeding of streamside tailings.

Response: Action will continue in these areas. As indicated above removal of the tailings in the Mill-Willow Bypass and strengthening of the western berms in the bypass are underway during this construction season. Work on developing methods to revegetate streamside tailings is continuing under the Streamside Tailings and Revegetation Study. It is the goal of MDHES and EPA to continue to move the cleanup of these sites along as rapidly as possible.

Several commenters (Letters 24, 27, 29, 41, 44, 55, 57; Testimony A-2, A-16) suggested that Superfund remediation efforts should be concerned more with impacts on people than with impacts on fish and wildlife.

Response: Remediation strategies must address the impacts of site contamination on people and impacts on the environment. The remedial investigation and feasibility study dealt with both. The selected remedy is thought to be protective of both public health and the environment.

2.1.2 Remediation Schedule.

Many commenters (Letters 48, 56, 68, 70, 91, 96, 97, 98, 100, 109, 112, 114, 116, 118, 119, 122, 123, 125, 131, 132, 134, 135, 139, 142, 146, 147, 149, 151, 153, 154, 155, 159, 161; Testimony B-2, B-4, M-1, M-5, M-10) recommended that work should start as soon as possible, and no later than the construction season of 1990. One commenter (Letter 139) recommended that the Mill-Willow Bypass receive immediate attention to prevent a fishkill in 1990. One commenter (Letter 151) recommended specifically that the upgrading of the pond treatment system, berm stabilization, and removal of tailings from the Mill-Willow bypass be segregated from development of flood control alternatives and that work should begin on the upgrading, stabilization, and removal activities this construction season. The commenter further recommended that this work should proceed during 1990 under a unilateral order if negotiations with ARCO are unable to produce an acceptable consent order, and that the stabilization and removal activities should utilize the most conservative and protective design criteria. Two commenters (Letters 139, 154) thought that construction of improvements upstream of the ponds should begin immediately.

Response: MDHES and EPA agree that as much work as possible should begin during the 1990 construction season. A consent order was signed by EPA and

ARCO in July tc allow for removal of tailings from the Mill-Willow Bypass and reinforcement of the western berms of Ponds 2 and 3 for earthquake and flood protection. It was decided by the agencies that only that amount of work could be reasonably completed by the end of the 1990 construction season. By the end of this season, however, any threat of fishkills being caused by tailings in the Mill-Willow Bypass will be virtually eliminated and the potential for catastrophic failure of the Ponds due to floods and earthquakes will be substantially reduced.

The agencies intend to expedite and phase the remedial design of this project in order that construction activities can continue smoothly during the 1991 construction season. It is presently expected that the remaining berm improvements for earthquake and flood protection and the inlet/outlet structure and treatment improvements for Pond 3 will be undertaken at that time. The specific schedule of the future remediation activities will be determined in the remedial design. As discussed in detail in the following section, the public will be kept informed about all elements of the proposed remediation.

The schedule for remediation of contamination deposition along Silver Bow Creek and in Butte will proceed as described in the Clark Fork Superfund Master Plan. While the agencies agree that remediation upstream of the ponds should begin as soon as possible, there remains the need to continue evaluation of alternative remediation approaches before plans for upstream remediation can be finalized. Those activities, which are proceeding, are outlined in the Clark Fork Superfund Master Plan.

Another commenter (Letter 119) stated that design assumptions concerning the prediction that the tailings along Silver Bow Creek and problems at the Berkeley Pit will be cleaned up in 30 years appear to be unrealistic, since it took over 100 years to create the situation. The commenter further suggested that the agencies address the possibility of stretching out the cleanup in the operable unit up to

100 years, and providing flood protection for the ponds during the interim, based on risks of failures and acceptable occurrences of floods routing around the ponds without treatment. Another commenter (Letter 93) suggested that the agencies concentrate on developing an adequate solution over a long period.

Response: There is no reason that it should take as long to clean up the contamination as was spent creating it. It is the goal of both MDHES and EPA to have these sources of contamination remediated within the 30-year time frame. With respect to the stretching out the Warm Springs Ponds cleanup over 100 years, the agencies believe that a more immediate approach to the hazards presented by the ponds is necessary. Leaving the berms unprotected, or only partially protected for several decades, while the upstream contaminants are emediated, is not an acceptable approach.

2.1.3 Interim vs. Permanent Remedies

Numerous commenters (Letters 53, 64, 65, 68, 69, 73, 74, 75, 78, 89, 92, 96, 97, 98, 100, 101, 106, 107, 108, 109, 112, 115, 116, 117, 118, 123, 124, 126, 128, 129, 130, 131, 133, 135, 136, 138, 140, 142, 143, 146, 147, 149, 151, 152, 159; Testimony A-15, M-5, M-7, M-8, M-9, M-10, M-11, M-13, M-15) stated that both MDHES/EPA's and ARCO's proposals for remediation of the Warm Springs Ponds are interim remedies and that, although these remedies are needed now, permanent cleanup up of the sites between Butte and Warm Springs Ponds are needed before making a final decision on Warm Springs Ponds.

Response: MDHES and EPA recognize that the current proposal for Warm Springs Ponds is an interim remedy. The final decision on the cleanup of the ponds 2 and 3 will be delayed at least 5 years. At that time, the degree of cleanup on Silver Bow Creek will be assessed and, if the cleanup has progressed far enough, alternatives for the final disposition of the ponds will be presented to the public.

All studies to date have indicated that permanent treatment or total removal of the pond sediments are not likely to be the most desirable permanent solution. CERCLA requires EPA to rely on treatment of wastes to reduce their toxicity, mobility, and volume whenever practicable in order to achieve permanent remedies. However, the RI/FS guidance document recognizes that permanent treatment solutions may not be practicable for high volume waste sites such as mining sites. The volumes of wastes can be so large that treatment of the wastes is not feasible. An in situ treatment-based alternative was developed in the FS to allow the public and the agencies to gauge the costs of treatment-based approaches for the volumes of wastes that exist at Warm Springs Ponds. The results indicate that even for in situ treatment, which is often less expensive and quicker than treatment approaches requiring excavation, the time and costs involved are not reasonable. In short, the prospects for a treatment-based permanent solution to the wastes in the ponds are not good, even several years from now once the upstream areas have been remediated. However, if at that time new treatment processes have become available that offer some promise for treating the nearly 19 million cubic yards of wastes at this operable unit, those options can be explored.

The future potential for moving the sediments to another location is also not promising. EPA and ARCO are presently conducting a study to site a RCRA-equivalent waste repository facility in the Anaconda area. However, the technical difficulties of trying to remove 19 million cubic yards of contaminated materials and safely transport them to a disposal facility is daunting. Such a repository facility for these wastes would also require continuing operation, maintenance, and monitoring, and would be a continuing threat to groundwater. In addition, such a facility would be no more permanent than an upgraded pond system. It may well be that an upgraded pond system is the safest, most cost-effective, and environmentally sound permanent remediation of the site.

Another commenter (Letter 119) thought that the remediation should be "for posterity." This means that the proposed structures should be free from hydrologic and geologic hazards and should be maintenance free for at least 1,000 years. The commenter stated that if the sediments are left in the pond system, the criteria could not be met. He also noted that the measures proposed in the FS would require periodic maintenance to ensure that they continue to provide adequate protection.

Response: EPA and MDHES recognize that maintenance will be required on the berms and their associated flood protection. Budgetary costs for operation and maintenance shown in Chapter 8 of the Feasibility Study include allowances for berm and flood protection maintenance. Maintenance of the various structures will likely be the responsibility of ARCO. Requirements for maintenance will be included in the Record of Decision, and will be more fully developed in the remedial design/remedial action (RD/RA) phase. It would be prohibitively expensive to design and construct engineering structures that would last 1,000 years without maintenance. Regardless of the final disposition of the Warm Springs Ponds sediments, some maintenance will be required. Even if the sediments are removed and disposed of outside the floodplain, some maintenance on items such as contaminant berms, liners, caps, landscaping, etc., will be required.

Three commenters (Letters 101, 108, 126) stated that provisions must be clearly spelled out concerning what happens after remediation, if the standards are violated, and who will pay the bills for any necessary additional remedial measures. Six commenters (Letters 11, 20, 34, 39, 43, 86) asked about liability insurance to require that the cleanup is done correctly. One commenter (Testimony B-4) noted that ARCO will remain liable even after a remedy is in place. Another commenter (Testimony M-13) suggested that ARCO be required to establish a trust fund to cover the costs of future improvements to the remedial action that may be required.

Response: The provisions of CERCLA (the Superfund Act) are very specific in terms of financial liability. In this case, ARCO is responsible for paying for all necessary remedial actions, now and in the future.

After the issuance of the Record of Decision, a monitoring plan will be developed. The provisions of the monitoring and compliance plan will be very specific in terms of locations, parameters, types of analyses, standards to be met, and reporting requirements. In addition, penalties can be imposed by EPA for violations of the compliance requirements.

It should also be noted that the provisions of CERCLA require periodic reviews at 5-year intervals for remedial actions that leave wastes in place. These reviews will examine in detail the performance of the remediation in meeting the goals established by the Record of Decision. If the goals are not being met, further actions may be required in the future and would be paid for by the responsible party. In any enforcement action, the responsible party will be required to demonstrate assurances of financial capability. Those assurances may include the establishment of trust funds or bonds.

2.1.4 Public Participation.

Numerous commenters (Letters 3, 12, 14, 15, 17, 19, 20, 23, 26, 28, 34, 35, 36, 40, 49, 60, 76, 78, 81, 87, 89, 96, 100, 101, 105, 108, 110, 113, 118, 123, 126, 129, 131, 138, 139, 151, 159; Testimony A-2, A-5, A-6, A-7, A-8, A-12, A-14, A-15, B-4, B-8, B-10, M-5, M-7, M-8, M-10, M-11, M-12, M-16) expressed a desire for better public involvement and greater cooperation among the agencies, local governmental and elected officials, and local citizens and public interest groups during the Superfund process. Some indicated that Anaconda/Deer Lodge County should be involved in the decision-making process. Many of these commenters formally requested an extension of the public comment period. Another commenter (Letter 151) stated that the public participation process followed for the Warm Springs Ponds FS was flawed because it did not give the public an opportunity to participate in the scoping of alternatives, and recommended that the agencies use an approach similar to that followed under the National Environmental Policy Act (NEPA). One commenter (Letter 138) interpreted the CERCLA guidelines to not allow public agencies to disclose cleanup alternatives to the public before they have been approved and screened by EPA. One commenter (Letter 150) stated that the agencies did a good job in keeping the public informed.

Response: A short description of the public involvement program for the Warm Springs Ponds operable unit is provided in the ROD. Although the public participation process followed for the WSP FS was in compliance with all requirements of the National Contingency Plan (NCP), it is obvious that additional efforts are needed to facilitate increased involvement of local citizens early in the process. The agencies are striving to involve all appropriate parties and agencies in future activities at Warm Springs Ponds and at other sites in the Clark Fork Basin.

Public involvement in the Mill-Willow Bypass Removal Action is representative of this effort. A scoping meeting on the Mill-Willow Bypass and other issues was held on February 6, 1990, with participation by EPA, MDHES and other state agencies, various city and county representatives, and public interest group representatives. Public meetings were held at Fairmont and Missoula on February 27 and 28, 1990, respectively, to gather input from the general public on the Mill-Willow Bypass activities and other actions planned by the agencies and ARCO. Once the Mill-Willow Bypass removal plans were more fully developed, three more public meetings were held (in Anaconda, Deer Lodge, and Missoula) in late May. Numerous coordination meetings involving local government officials, representatives of interested state agencies (such as the Department of Fish, Wildlife, and Parks and the MDHES Water Quality Bureau), and public interest groups were held in preparation for this summer's removal action. Active efforts to involve the public will continue at Warm Springs Ponds and the other Clark Fork Basin sites.

Although presentation of the alternatives and proposed plan are mandated by the NCP to occur at the conclusion of the preparation of the Feasibility Study and Proposed Plan, there is nothing in the guidelines to preclude public involvement at an earlier stage. In fact, such involvement is encouraged. As discussed above, EPA and MDHES are making strong efforts to increase early public involvement. Specific elements about how and when the public can be involved are made on a site-by-site basis and are included in the site's Community Relations Plan. In all cases, the public is involved when the Public Draft Feasibility Study and proposed plan are completed, and public comment is taken and considered at that time.

The public comment period for this project was extended for an additional one month. The number of comments received is a good indication of the success of extending the comment period.

ARCO commented at the public hearings (Testimony A-3, B-3, M-6) that it had not been given the opportunity to be involved throughout the Warm Springs RI/FS process. Other commenters (Letters 60, 87; Testimony B-8) stated that ARCO should have been given the opportunity to participate.

Response: EPA and MDHES agree that responsible parties must be included in the RI/FS process. ARCO has not been excluded from the CERCLA process at the Warm Springs Ponds. When CERCLA activities began on the Silver Bow Creek Site (Warm Springs Ponds are a part of this site), ARCO was offered the opportunity to conduct the activities at the site. ARCO declined that offer. As a result, the agencies conducted the RI/FS studies at WSP. ARCO was given the opportunity to comment on all studies conducted at the site and all documents produced, and has commented formally to the agencies on most of the site activities. Recently, ARCO has been more receptive to offers to conduct the various Superfund activities under agency oversight and, in fact, is presently conducting many studies and activities, under agency enforcement supervision, on Clark Fork Superfund sites. The removal action at the Mill-Willow Bypass and the berm improvements for earthquake and flood protection this summer are being undertaken by ARCO.

One commenter (Letter 46) asked about the status of the proposal to bring an EPA office to Butte?

Response: An EPA office has been set up in Butte and is located in the Butte-Silver Bow City-County Building.

2.1.5 Miscellaneous General Comments.

Two commenters (Letters 52, 70) stated that all contractors and their employees should be required to comply with 29 CFR Part 1910. The same commenters recommended that EPA and MDHES implement rules ensuring all contractors pay the prevailing wages for work performed and that locally-trained personnel be employed to remediate the environmental hazards at the Warm Springs Ponds.

Response: 29 CFR Part 1910 specifies requirements for employee health and safety training and employee protection programs for work on hazardous waste sites. It is an Occupational Safety and Health Administration (OSHA) requirement. Since it is expected that ARCO and its contractors will be conducting the remediation, ARCO will be required to have its employees and contractors meet this applicable OSHA requirement.

If ARCO implements the remedy at Warm Springs Ponds, it will be up to ARCO to decide which contractors will conduct and perform the work. ARCO's work being performed under the Mill-Willow Bypass Removal this summer has utilized local contractors and employees from local unions. If EPA implements the selected remedy, then specific federal regulations regarding the hiring of contractors and workers will apply.

Another commenter (Letter 50) wondered why an out-of-state company (CH2M HILL) was hired to drill the monitoring wells at Warm Springs Ponds for approximately $1.4 million. Will they just leave the state after the work is done? Wouldn't a Montana well driller be cheaper?

Response: CH2M HILL was selected to conduct the remedial investigation and feasibility studies (RI/FS) for the Silver Bow Creek Site, which includes the Warm Springs Ponds, based on the results of the competitive procurement process conducted by MDHES. The cost for the work included many activities in addition to drilling wells. These activities included sampling of soils, tailings, surface water and groundwater, conducting treatability tests, developing a flood model, preparing the remedial investigation, public health and endangerment assessment, and the FS report.

Much of the work conducted as part of this project was conducted by local subcontractors. The driller used at Warm Springs Ponds was O'Keefe Drilling of Butte.

One commenter (Testimony A-8) stated that the FS needed to look at more alternatives, and that the alternatives need to be evaluated in more detail.

Response: In response to the comments from the public and ARCO on the FS and Proposed Plan, the agencies have evaluated and considered alternatives not specifically addressed in detail in the FS. The selected remedy is a combination of elements of several alternatives. The level of engineering detail in the FS is consistent with that required to complete a full, feasibility-level evaluation of alternatives. Detailed engineering analyses will be part of the remedial design phase of this project.

Three commenters (Letters 46, 63, Testimony A-4) stated that too many studies had been done already on the Silver Bow Creek and Clark Fork Basin Superfund sites, and that these studies have been a waste of time and money.

Response: CERCLA requires that EPA investigate and develop remedial actions that are protective of human health and the environment and are permanent and cost effective to the extent possible. Responsible parties are required to pay for or reimburse EPA for all cleanup investigations and actions. It would be inappropriate to undertake large, multi-million dollar cleanup actions without substantial detailed investigations to determine effective remediation approaches.

One comment (Letter 113) recommended Superfund funding be directed to landowners for conservation efforts on their land. Another commenter (Letter 130) thought that monies should be given to Dear Lodge County as compensation for their lost economic potential.

Response: Superfund monies cannot be used for payments to landowners for conservation efforts. Remedies for cleanup of existing contamination can be implemented on private, non-PRP lands, however. This work would be paid for but either the party responsible for the contamination or by E. A. Compensation for lost economic potential of contaminated areas could not come from CERCLA (Superfund) funds, but would have to be obtained in separate action from those parties responsible for the contamination.

One comment (Letter 155) requested notice of the approved cleanup plan when it was completed.

Response: The Record of Decision (ROD) states EPA's decision on the cleanup methods to be implemented at Warm Springs Ponds. This has been prepared after reviewing all public comments and reconsidering the various possible remediation alternatives. A public notice will be issued regarding the availability of this ROD and Responsiveness Summary to the public.

One commenter (Letter 101) encouraged everyone to help the agencies to attract and keep the quality of personnel and the commitment of resources needed to move through the cleanup process.

Response: MDHES and EPA agree.

Three commenters (Letters 25, 26, 41) opposed the concept of removing topsoil from pasture land for reclamation work at Warm Springs Ponds.

Response: The need for topsoil during the remediation is discussed in the FS. Much of the topsoil required will largely come from areas within the operable unit. It would not be reasonable to strip acres of pasture land of their topsoil to provide the soil needed. Instead, poorer soils that can be amended to serve as cover soil will be used wherever possible. Sources of suitable soils and the amendments necessary to make them work for the intended purposes will be explored during the remedial design phase of the project.

One commenter (Letter 48) expressed support for the ARCO berming project downstream of the Warm Springs Ponds.

Response: The referenced berming work was done by ARCO under order from MDHES in an effort to alleviate future fishkills in the upper Clark Fork River. That work is being done downstream of the Warm Springs Ponds operable unit and has therefore not been addressed in this FS or ROD.

One commenter (Letter 3) asked if the arsenic on Smelter Hill is being stored temporarily or permanently. Another commenter (Testimony A-1) suggested that the agencies investigate beryllium sites in the Opportunity Ponds. Another commenter (Letter 86) recommended keeping water in the Opportunity Ponds to reduce dust.

Response: Cleanup studies at the Anaconda Smelter site, including the Opportunity Ponds and Smelter Hill, are ongoing. No final cleanup decision has been made to date. The problems of fugitive dust, groundwater contamination, and beryllium disposal will be addressed as part of these activities. While these studies are ongoing, actions have been taken to reduce dust from the ponds. These activities have included putting a layer of limestone on the surface of the dry portions of the ponds.

2.2 SITE CHARACTERIZATION AND PROBLEM DESCRIPTION

2.2.1 Groundwater

One commenter (Letter 67) stated that the Superfund investigations of the Warm Springs Ponds may underestimate the current amount of groundwater that discharges from the Warm Springs Ponds to the Mill-Willow Bypass and the Clark Fork River and therefore minimize the importance of the contaminants this groundwater contains. Based on the data presented in the Phase I and II Remedial Investigation (RI) reports, groundwater contributes a substantial portion of the flow and contaminant load to the river during low flow periods. Except for a trench, which may intercept a fraction of the flow in one area, no remediation is planned.

Using data from the Phase I and Phase II RI reports, the commenter states that the combined calculated groundwater inflow to the upper bypass from the east and west is probably somewhat greater than 3.4 cfs and that the inflow from the lower bypass, though more difficult to estimate, may be close to 3.8 cfs. The total groundwater discharge to the entire Mill-Willow Bypass could be as high as 7.5 cfs. None of the Warm Springs Ponds studies recognize that magnitude of groundwater discharge.

The comment also notes that contaminant loads in surface water increase though the bypass and upper Clark Fork and that the most likely source of copper and zinc contaminants is the groundwater plume downgradient of Pond 1. Groundwater in this area has high sulfate and zinc concentrations.

To summarize, contaminated groundwater emanating from the ponds discharges metals and sulfate to the bypass and river and exacerbates the poor aquatic life conditions in the river during low flow periods.

Response: Groundwater inflow rates were estimated for various reaches of the Mill-Willow Bypass using both direct analytical calculations and empirical methods. Because direct analytical calculations of groundwater inflow to the bypass require use of numerous assumptions, EPA and MDHES contend that inflow estimates using empirical methods are more representative of site conditions.

Discharge was measured in the upper Mill-Willow Bypass during July 1988, when surface water in the Mill-Willow Bypass was diverted into the upper end of Pond 3. Measurements of flow below the diversion point were considered to be the most accurate means of determining the rate of groundwater inflow to the bypass channel, because all water flowing in the bypass channel at the time was derived from groundwater seepage. Discharge measurements completed at four locations along the bypass below the point of diversion to midway along Pond 2 indicated the total seepage rate to the Mill-Willow bypass was 2.57 cfs. The average gain in surface flow between stations SS-18 and SS-25 during low flow measurements was 2.4 cfs. Based on these data, the combined rate of groundwater inflow to the channel from the east and west was approximately 0.18 cfs per 1,000 feet of bypass channel. Extrapolating these unit inflow rates to the entire bypass from SS-18 to the northwest corner of Pond 1 results in a total groundwater inflow rate to the bypass of approximately 3.7 cfs. The agencies believe this inflow rate is conservative and is a much better characterization of site conditions than the 7.5 cfs presented by the commenter.

The purpose in completing groundwater inflow calculations (both empirical and analytical) for the Mill-Willow Bypass was to provide reasonable estimates of inflow quantity for use during the FS in evaluating construction of a groundwater interception drain along the entire reach of the bypass. Construction of this type of interception drain was evaluated to determine the feasibility of: 1) intercepting groundwater emanating from the Warm Springs Ponds and the Opportunity Ponds before the groundwater enters the Mill-Willow Bypass, and; 2) maintaining groundwater levels at an elevation below the base of tailings located adjacent to the bypass.

Subsequent data collected at the site indicated that groundwater inflow to the bypass does not exceed maximum contaminant levels or Gold Book aquatic standards. Data to support this conclusion were collected primarily in conjunction with surface water sampling completed at three locations ir the bypass channel during July 1988, when Mill and Willow Creeks were diverted into Pond 3. Samples collected at that time from sampling sites SS-18C, SS-18C1, and SS-18D essentially represented groundwater seeping into the bypass channel. Analytical results of those samples indicated that all parameters analyzed were below Gold Book standards. Because freshwater aquatic criteria are based on acid-soluble analyses, use of dissolved cadmium concentrations ranging from 5.8 to 6.4 $\mu g/l$ measured at sampling stations SS-18C, SS-18C1, and SS-18D, in evaluating exceedances of chronic and acute water quality criteria is not appropriate. In addition, concentrations of metals measured in samples obtained from monitoring wells located adjacent to the Mill-Willow Bypass are less than Gold Book standards. Because of these data, it became apparent that interception of groundwater inflow to the bypass channel was unnecessary in meeting ARARs established for the operable unit.

Groundwater inflow to the Clark Fork River between Pond 1 and Perkins Bridge (SS-29) was not calculated or presented in the Phase II RI. The values cited by the commenter as inflow to the bypass in this reach of the bypass (1.8 and 3.8 cfs) are actually estimates of the groundwater flux in the shallow sand and gravel aquifer beneath the Pond 1 berm. It is unknown what portion of the groundwater moving beneath the Pond 1 berm actually surfaces in the Clark Fork River south of Perkins Lane Bridge.

However, surface water quality data collected during the Phase I RI do not show a measurable increase of copper and zinc at SS-29, as compared to upstream sites SS-25, SS-28, and PS-12, even during low flow periods when the largest impacts from groundwater inflows should be realized in the stream. In addition, groundwater samples obtained from monitoring wells located downgradient of Pond 1 near the Clark Fork River exhibited copper and zinc concentrations well below that measured in the Clark Fork River.

The same commenter (Letter 67) notes that well completion logs for Wells WSP-GW-17, 18S, 18D, 19S, and 19D and WSP-PW-01 are not in the Phase II RI, so a complete analysis of the groundwater investigation could not be done.

Response: These logs were inadvertently omitted from the Phase II RI. Well completion logs for these wells have been added to the agencies' response to ARCO's comments on the Phase II RI, which is part of the administrative record.

In addition, Letter 67 states that well development for most observations wells was inadequate because the final water produced from the wells was not clear. Wells completed in sands and gravels, such as those encountered in the area, can be developed to produce clear water, but it can take longer than the 10 to 85 minutes spent at each well. Measured trace-metal concentrations in turbid water samples from wells that have been inadequately developed or purged may not be representative of actual levels in groundwater.

Response: Well development following monitoring well installation using hand-lift pumps, surge blocks, and bailers was the initial step in ensuring representative formation water was obtained for laboratory analysis. Prior to obtaining a sample from each monitoring well during each sampling episode, water in the well was evacuated until relatively clear, sand-free water was obtained. Well evacuation was continued while the evacuated water was monitored for field parameters including temperature, specific conductivity, and pH. When measurements of these field parameters were within 5 percent for three consecutive samples of the evacuation water, the well was deemed ready for sampling. This process sometimes resulted in an additional 1 to 1.5 hours of development time for particularly turbid wells.

All samples collected for metals analysis were field-filtered with a 0.45μ filter to remove any residual turbidity prior to preserving the samples with nitric acid. This procedure was consistent with the project Sampling and \nalysis Plan and is standard practice for preparing water samples for dissolved metals analysis.

The same commenter (Letter 67) describes the map of the extent of groundwater contamination as incomplete because the boundaries of the plume either stop at the boundaries of the operable unit or at the Mill-Willow Bypass and the Clark Fork River. The plume probably extends beyond these boundaries. These streams may be a groundwater divide and, therefore, limit further migration of the plume as the RI investigations seem to assume, but this has not been documented. A complete risk assessment cannot be done without knowledge of the full extent of the plume.

Response: The intent of Figure 2-19 was to provide the reader with a feel for the extent of groundwater contamination as related to iron, manganese, and sulfate concentrations within and directly adjacent to the Warm Springs Ponds Operable Unit. Separate studies of the Anaconda Smelter-Opportunity Ponds site and the Clark Fork River are being conducted to characterize groundwater quality west of the Mill-Willow Bypass and north of the Warm Springs Ponds, respectively. Combining data from the three studies would likely indicate that the regional extent of the groundwater contaminant plume (associated with relatively high concentrations of iron, manganese, and sulfate) is greater than that depicted on

Figure 2-19. The risk assessment for the Warm Springs Ponds Operable Unit was completed for the operable unit itself; future risk assessments will investigate other components of the upper Clark Fork Basin CERCLA sites.

Finally, Letter 67 notes that interconnections between the shallow and deep aquifers may be more significant than the RI reports indicate. Samples from nested wells WSP-GW-7 and 15 along the bypass and WSP-GW-10 near Pond 1 show that sulfate concentrations are higher in the deeper aquifer than the shallow aquifer. Manganese is also present in the deeper aquifer's plume. It appears that the plume in the deeper aquifer has not developed as fully as in the shallow aquifer, but given sufficient time, it could.

Response: ARARs established for groundwater at the Warm Springs Ponds Operable Unit include primary maximum contaminant levels. Sulfate and manganese are not included in these standards and, as such, are not addressed in remedial alternatives associated with the FS.

The occurrence of these parameters in the deeper aquifer in the vicinity of the Mill-Willow Bypass and Pond 1 is consistent with the presence of relatively high sulfate and manganese concentrations in groundwater systems in the vicinity of the Opportunity Ponds. This suggests that the distribution and occurrence of sulfate and manganese in the groundwater environment is more regional and is probably a result of multiple contaminant sources and pathways of contaminant movement.

2.2.2 Tailings and Sediments

One commenter (Letter 72) states that the FS notes on page 2-30 that seven samples of tailings deposits were collected in the areas above Pond 3 and below Pond 1 and tested for EP Toxicity. None of the samples failed the test. The comment states that the fact that the samples did not fail the EP Toxicity test does not adequately indicate their hazard to the environment. The comment suggests that the samples should be tested by "bulk sediment and elutriate bioassay testing."

Response: The paragraph discussed in this comment was not intended to imply that the tailings and contaminated soils deposits do not present a threat to the environment simply because they do not fail the EP Toxicity test. It is fairly standard in a remedial investigation to test various wastes by this test, as one indication of whether the hazardous waste management regulations should be considered or followed in treating, storing, or disposing of the wastes. The indicated paragraph merely reports the results of testing the materials by this standard test.

The two types of test suggested in the comment are not further described. It is not clear what specific tests are being recommended or how the results from such tests could be used to determine cleanup levels for tailings and soils. Numerous samples of tailings have been analyzed for metals content. The resulting data have been used in developing remediation alternatives for these materials.

One commenter (Letter 3) asked how the estimate of 19 million cubic yards of sediments in the ponds was made.

Response: The volume of pond bottom sediments (approximately 19 million cubic yards), as presented in Table 2-2 of the FS, was calculated using data collected during the Phase I Remedial Investigation and the Phase II Remedial Investigation at the Warm Springs Ponds Operable Unit. These data included bottom sediment thickness information collected during bottom sediment sampling activities at about 45 locations within the three ponds and data developed to prepare a bathymetric map of the pond bottom surface. The base of the pond bottom sediments was defined as the contact between fine-grained sediments and native material. Native material at the Warm Springs Ponds was typically either peat or coarse-grained sand and gravel.

One commenter (Letter 154) stated that the annual sediment loads and the sediment loads from smaller flood events in Warm Springs Creek are more significant than the sediment loads from larger events and should be addressed in the FS.

Response: The accumulation of sediments in the Warm Springs Ponds was used to estimate an average annual sediment loading to the ponds. The purpose of the FLUVIAL-12 bedload sediment transport study was to determine potential erosion of bank and floodplain tailings sediments from Silver Bow Creek during flood events. Erosion of tailings was expected to be insignificant for flow ranges up to nearly bankfull (estimated at about 500 cfs or a 2- to 5-year flood event). Since most of the bedload toxic sediment transport would only occur in major flood events, the treatment and containment system was designed considering the peak flow and volume of the 100-year flood.

Total sediment reaching the ponds, as presented in this comment, is defined quite differently. Total sediment includes both suspended load and bedload from all sources and flow ranges. A large quantity of suspended load originates from "natural" forest and rangeland erosion. This total load is what the commenter is describing with the analysis of USGS flow and sediment data. Total sediment load transport would be expected to greatly increase for flows above the 90th percentile flow duration exceedance, since most of the annual flows in that range represent overland spring snowmelt runoff from forest and rangeland. Peak flood flows, in the 10-year to 100-year range, are above the 99th percentile on a flow-duration exceedance curve.

2.2.3 Surface Waters

One commenter (Letter 72) points out the correlation (noted in the FS) between low pH values and higher dissolved metals levels in the streams. The commenter notes that copper toxicity varies with pH and that the interaction between aluminum and low pH may pose a significant hazard to aquatic fauna at the concentrations detected in the surface water at the site.

Response: EPA and MDHES agree that copper toxicity varies. The agencies feel that alkalinity plays a somewhat more important role in the toxicity of copper, as evidenced by the dependence of the freshwater ambient water quality criterion to alkalinity (alkalinity is generally considered equal to carbonate hardness), but not pH. The copper ion is complexed by anions, which, in turn, affects the toxicity of copper. At lower alkalinity, copper is generally more toxic.

A significant volume of recent literature has discussed the association of low pH (below 5.2) and extreme aluminum toxicity. The agencies believe that if the criterion of pH is met, the toxicity of aluminum can be controlled.

Aluminum was analyzed in samples taken from three sampling stations during the spring 1986 high flow event. The pH range during this sampling event was from a low of 6.5 to a high of 9.5. The maximum concentration of dissolved aluminum at each sampling station did not exceed the acute ambient water quality criterion of 760 μg/l. At the two sampling stations where only two samples were taken (outflow from Pond 3 and Mill-Willow Bypass), the concentrations of dissolved aluminum exceeded the chronic criterion of 87 μg/l (averages of 97 and 139 μg/l). The chronic criterion was not exceeded at the sampling station with 12 sampling events (average of 67 μg/l at the inflow to the ponds). Total aluminum concentrations exceeded both acute and chronic criteria at the Mill-Willow Bypass sampling station and chronic criteria at the inflow to the ponds and within the ponds.

The potential exists for a hazard to aquatic fauna from aluminum toxicity, as several sampling events did detect aluminum at concentrations greater than the acute criterion.

Several commenters (Testimony M-1, M-2, M-3) expressed general concern over fishkills in the Clark Fork River. One comment (Letter 138) noted that the July 1989 fishkill was caused not only by the tailings in the Mill-Willow Bypass, but also by the streamside tailings downstream of the Warm Springs Ponds. Another commenter (Letter 3) asked why fishkills occur if fish can live in the ponds. ARCO (Testimony A-3, B-3, M-6) recognized the problem of fishkills, but stated that, on the whole, fish and wildlife in the Warm Springs Ponds operable unit are healthy and abundant.

Response: The agencies share everyone's concern over fishkills in the Clark Fork River. The fishkills are thought to be the result of shock loadings of waters in the Mill-Willow Bypass and upper Clark Fork River with highly soluble metal salts during summer thunderstorm events after extended dry spells. The problem exists because of the exposed tailings slickens found within the bypass channel and along the upper Clark Fork banks, not within the ponds. The fish in the ponds are not subjected to the extremely high concentrations of metals that cause the fishkills. For a full discussion of the causes of the fishkills, see Chapter 4 of the FS.

It is recognized that tailings downstream of the Warm Springs Ponds contributed to the July 1989 fishkill that extended downstream to Deer Lodge. Temporary control of the downstream tailings is being addressed through ARCO's berming project, but long-term solutions will be developed in the Clark Fork River remedial investigation and feasibility study. It is understood that actions at the Mill-Willow

Bypass along the Warm Springs Ponds will not solve the fishkill problems for those cases where the tailings below the ponds are the cause of the fishkills.

The agencies agree that terrestrial and aquatic life appear to be productive and improving from past years. However, impacts to terrestrial organisms are difficult to determine unless they are acute or cumulative. There remains the potential for chronic effects on individuals organisms. Chronic aquatic life criteria have been and continue to be exceeded for selected contaminants.

2.2.4 Risk Assessment

Two commenters criticized the environmental risk assessment. One commenter (Letter 154) thought that the ecosystem analysis was casual, ad hoc, and without a guiding plan, and that ecosystem techniques have not been applied. That same commenter and others (Letters 101, 108, 126) added that downstream ecological risks of toxic metal sediments in the Clark Fork River should be evaluated. Several comments suggested that the agencies conduct an incremental risk assessment in developing dam safety ARARs.

Response: A detailed ecosystem analysis has not been conducted at the Warm Springs Ponds. At the time the investigations were conducted for Warm Springs Ponds, an full ecosystem analysis was not a requirement in the CERCLA process. The agencies do not agree with the commenter that the ecosystem analysis is inadequate. Sampling of key receptors, including fish and waterfowl, has been conducted. Additionally a survey of all literature on macroinvertebrates from Butte to Deer Lodge and an analysis of algae and vegetation were conducted. While the sampling program at the Warm Springs Ponds was not designed to quantitatively answer questions on the environmental health of the pond system, the data obtained can and have been used to qualitatively determine risk to the ecosystem.

Ecosystem assessments to determine the effects of contamination are difficult to undertake and time consuming. It is often difficult to separate the natural interactions and cycles in the environment from the effects of contamination, unless acute effects can be seen. Acute effects are rarely seen and even when they are (e.g., the Kesterson Reservoir natural selenium contamination problem) the interactions and ripple-through effect on the ecosystem are mostly hypothesized and can rarely be shown through quantitative sampling as cause-and-effect.

The downstream ecosystem was not ignored in the assessment of ecological risk. Only qualitative statements could be made as data with which to model the effects of a massive release of tailings do not exit. The assessment was conducted according to EPA guidelines available at the time the report was prepared to meet the requirements of CERCLA. While a more detailed risk assessment may be necessary, it will be prepared in the future as part of other operable units.

Those comments regarding an incremental risk assessment for dam safety design are addressed in the next section under Dam Safety ARARS.

2.3 ARARS AND CLEANUP STANDARDS

One commenter (Letter 111) thought that the wording in the Proposed Plan is indefinite about meeting MDHES and federal ARARs and reducing risks.

Response: CERCLA requires any remedial action to protective of human health and the environment, and to comply with ARARs unless an appropriate waiver is invoked. The selected remedy, documented in this ROD, meets these criteria. Any language in the Proposed Plan that suggests any other interpretation was not intended.

2.3.1 Surface Water Quality ARARs.

Numerous commenters (Letters 53, 64, 65, 66, 69, 73, 74, 75, 77, 89, 97, 98, 99, 101, 102, 104, 106, 107, 108, 109, 111, 112, 115, 116, 118, 121, 122, 123, 126, 128, 131, 132, 133, 134, 135, 138, 139, 142, 143, 144, 145, 146, 147, 151, 153, 154, 155, 159, 162; Testimony A-15, M-1, M-3, M-4, M-5, M-7, M-8, M-9, M-10, M-11, M-13, M-15) recommended requiring remediation of the ponds to result in Gold Book (Federal Ambient Water Quality Criteria, AWQC) values being met in the Clark Fork River and the Mill-Willow Bypass. Many of these commenters stated that the appropriate goal should be to prevent all exceedances of Gold Book criteria up to the 100-year flood level until upstream sources are cleaned up, and then for all flows after that. Several thought that Gold Book criteria should be met for all floods and at all times.

Response: Although the term "Gold Book" was not used in Chapter 4 of the FS for stating the goals for the operable unit, the water quality criteria cited are the Gold Book AWQC. These criteria were adopted as standards by the State. Remediation of the Warm Spring Ponds alone cannot guarantee that the standards will be met in the Clark Fork River, even at the headwaters of the river. Warm Springs Creek and the Clark Fork River itself are also contaminated, and will have to be cleaned up before the water quality in the Clark Fork can be assured. However, the selected remedy will modify the pond system in order to achieve the Gold Book standards under normal conditions for the water leaving the operable unit, and this will go a long way toward improving the water quality in the river.

The ambient water quality regulations do not address the concept of meeting the water quality standards during major floods. On the contrary, the regulations allow for periodic exceedances of the standards: as often as once in a 3-year period, the 4-day average can exceed the standards without being considered a violation.

However, the selected remedy will treat flows to the 100-year flood and water leaving the operable unit should meet these standards.

It is important to note that the standards are probably less likely to be exceeded during large floods than during small runoff events. The maximum concentrations of metals in the bypass are seen when a short, but intense, thunderstorm rinses the soluble metal salts off the tailings deposits and into the bypass with a minimum amount of dilution. This is what has caused fishkills. Large floods are unlikely, near their peak flows, to exceed the standards. The reason for this is simple: there is too much water and too little readily available contaminants.

Metals levels that would be seen in the river, under all the possible flood scenarios up to 100-year floods, cannot be predicted with accuracy. Models to deal with a contamination situation as complex as that along Silver Bow Creek do not exist. Models would have to be developed, and considerable data would have to be collected to calibrate the models. This would delay cleanup for years, and it is not certain that a model satisfactory to all parties could be developed. Instead of attempting to model and understand the contamination of the creek water under any and all flow conditions, the FS took the approach of identifying major contributions to the contamination and then developing systems to treat a wide range of flows. In this way, whatever the details of the runoff event and the resulting contamination, the treatment system would be able to provide treatment and protection for the Clark Fork River.

The water within the Ponds are not part of any river or creek, and are not covered by the State's water quality standards. Therefore, those standards are not applicable to the Ponds themselves. Nevertheless, the remedy must be protective of human health and the environment, including the environment within the Ponds. The ROD requires that exposed contaminants and tailings within the Ponds will be flooded or covered and revegetated. This will protect the ecosystem within the Ponds, and support the fish and wildlife population which already exist there.

The agencies believe that the methods proposed in the ROD for treating flood flows are adequate and reasonable and that such treatment would enable the water quality at the compliance point to meet the Gold Book standards at nearly all times.

One commenter (Letter 67) recommended that the proposed compliance point for the Warm Springs Ponds Operable Unit be located near the current beginning point of the Clark Fork River (Fig. 5-1, CH2M HILL, 1989b). As noted elsewhere in these comments and in the FS (Note 4, Fig. 6-1, CH2M HILL, 1989b), contaminated groundwater discharges to the Clark Fork River. Therefore, it may be advisable to relocate the compliance point far enough downstream to ensure interception of the operable unit's entire current and future groundwater plume.

Response: The precise locations of the compliance points for groundwater and surface water are described in the ROD. The compliance area illustrated on Figure 5-1 is accurate. These compliance points will ensure protection of the aquifer and the Clark Fork River.

With respect to the FS's proposed waiver of the ambient water quality standard for mercury, one commenter (Letter 72) recommended an additional mechanism for determining whether mercury is adversely affecting the environment within the Warm Springs Ponds. The commenter suggested that the tissues of fish from Pond 3 be periodically analyzed for mercury and other heavy metals to determine if the selected remedial action is reducing the threat that these substances pose to public health and the environment.

Response: Analyzing tissue from fish in Pond 3 would provide more information on the degree of cleanup on Silver Bow Creek than Warm Springs Ponds. The goal of the improvement of the treatment in the ponds is to have the effluent of the ponds meet ambient water quality standards, not the water in the pond system. Tissue from fish downstream of the ponds could be analyzed, but it may be difficult to isolate impacts of Warm Springs Ponds from other sources of contamination, such as Warm Springs Creek. Analyzing tissue from fish in Pond 3 might provide useful information on the impacts to the fish, but it may not provide specific information on the success of the Warm Springs Ponds remediation.

One commenter (Letter 111) thought that the standards for arsenic and mercury should be maintained at below detection levels.

Response: EPA believes that the waiver of the mercury and arsenic standards is appropriate, given the detection limits for both contaminants and the inability of current technology to achieve these standards. The replacement standards are still very low, and are protective of human health and the environment, based upon currently available information.

2.3.2 Dam Safety ARARs for Earthquake and Flood Protection.

Two commenters (Letters 119, 151) stated that MDHES should have applied the MDNRC dam safety regulations based on the total volume of water and sediments in the ponds and on the basis of treating the entire pond system as one pond. Using the implied value of the stored contents of the total pond system (water and sediments), the level of protection for the ponds should be 0.75 probable maximum flood (PMF) for all 3 of the ponds. Numerous commenters (Letters 45, 79, 89, 91, 93, 97, 98, 99, 100, 101, 102, 104, 106, 108, 111, 114, 116, 118, 122, 123, 125, 126, 131, 132, 134, 138, 142, 143, 145, 149, 151, 152, 153, 157, 161; Testimony A-15) added that the remedy should assure that all sediments remain contained in the ponds up to the maximum credible earthquake (MCE) and half of the probable maximum flood (0.5 PMF) or greater. Other commenters (Letters 106, 116, 118, 119, 123, 135, 136, 140, 143, 145, 147, 149, 151, 159, 161; Testimony A-15, M-3, M-5, M-11, M-13) suggested that the agencies perform a risk analysis to determine the appropriate level of protection for the ponds. They further stated that all ponds should be protected equally, and the protection should be conservative.

Response: EPA and MDHES have reconsidered the use of varying levels of protection for the ponds and concluded that it is more reasonable, and in compliance with the applicable law, to provide all 3 ponds with the same level of protection. Consequently, the selected alternative will include protection of all 3 ponds to withstand a 0.5 PMF. The agencies do not believe that there is reason to protect the ponds to a greater level than this. The specified level of earthquake protection is to the MCE.

In order to conduct a quantitative hazard/risk assessment for the pond system, a model would need to be developed that would simulate the various failure scenarios under different flood flows at the ponds. Additionally, a model to predict the transport of the mobilized sediments and their deposition downstream on the Clark Fork River would also have to be developed. It is unlikely that models could be developed that would accurately predict the environmental, human health, and economic damage caused by these events in the flood ranges of interest, 0.5 to 1.0 PMF.

In developing an appropriate level of protection, not only the damage caused by the event, but also the probability of the event occurring, is important. Although no specific frequency of occurrence is established for the PMF or fractions of the PMF, the probability of flows greater than 70,000 cfs occurring on Silver Bow Creek is extremely small.

One commenter (Letter 138) was not clear whether the design standards would protect against flooding in Silver Bow Creek, Mill and Willow Creeks, or the three drainages combined.

Response: The design floods presented in the FS include flows from all three drainages combined for areas below the confluence of Silver Bow Creek and Mill-Willow Creeks. These are the flood flows on which the 0.5 PMF protection is based.

2.3.3 Soils Cleanup Action Levels.

One commenter (Letter 72) recommended that action levels for copper, cadmium, and zinc in contaminated soils and tailings need to be set based on aquatic life exposure.

Response: It is recognized that action levels for copper, cadmium, and zinc would be desirable for soils and tailings that lie within the Mill-Willow Bypass. It is very difficult, however, to develop cleanup criteria for soils based on a direct relationship between ambient water quality criteria and metal concentrations in soils.

The mass of metals available from tailings and contaminated soils is dependent on a number of factors including the mass of metals in the material, the metallic compounds themselves, the rate of sulfide oxidation, the rate of transport of metals to the surface of the tailings, the mass of tailings, and the time elapsed since the previously accumulated surface salts were washed away during a precipitation event. Additionally, the intensity of a precipitation event and the surface water flow rate will impact the metals concentration in the surface water.

Because of the difficulty in establishing meaningful soil cleanup concentrations based upon aquatic standards, a more direct approach was taken for the initial removal action in the Mill-Willow Bypass. The depth of copper, cadmium, and zinc migration from the tailings was determined by screening sampling, and was confirmed to be consistently correlated with visual staining of contaminated soils. The amount of tailings and contaminated soils to be removed or otherwise controlled was established based on visual identification, correlated with target metal concentrations developed from evaluating the metal concentrations in the soil profile, and subject to confirmation sampling and analyses. While the final confirmation sampling has not been completed, preliminary results indicate that this approach has resulted in cleanup to background levels in the Bypass.

As stated in the ROD, a final action level for soils cleanup and accompanying additional cleanup measures will be determined at a later date. The action number will be based on human health threats. EPA believes that such a number will also provide adequate protection for the environment. The ultimate check on this will be the requirement that surface water standards be met at the point of compliance.

2.4 IDENTIFICATION AND EVALUATION OF ALTERNATIVES

The majority of the comments received on the Feasibility Study dealt with the identification, selection, and evaluation of alternative remediation approaches. To more easily understand the comments themselves, and the Agencies' consideration of and response to those comments, they have been grouped into 15 subject areas. Some of these deal with remediation alternatives in general, much as the Media Specific Actions in the FS were presented. Other comments relate to specific alternatives, either presented in the FS or found elsewhere.

2.4.1 Flood Modeling Studies.

Several comments questioned the estimates of various flood events that have been developed as part of the Silver Bow Creek Superfund studies. EPA and MDHES prepared a Flood Modeling Study that utilized historical meteorological and hydrological data and several computer models to estimate the intensity and duration of various potential flood events. ARCO countered with other estimates based on different assumptions and modeling approaches.

One commenter (Letter 119) thought the methodology for calculating the PMF was inaccurate and imprecise. Another commenter (Testimony M-10) suggested that, since MDHES and ARCO disagree on the magnitude of the various floods, a third party, such as the United States Geological Survey (USGS), should perform an independent evaluation of the flood modeling.

Response: USGS was consulted for an independent evaluation of the flood modeling. USGS evaluated the 100-year event and concluded that the peak discharge for this event for Silver Bow Creek above the Mill-Willow confluence should be 3,910 cubic feet per second (cfs), which is closer to the 4,000 cfs estimated by MDHES than the 3,300 cfs estimated by ARCO. The USGS also stated that the assumptions and selection of model parameters used in the MDHES modeling yielded results that are well calibrated for use in the upper Clark Fork Basin.

USGS also stated that both the MDHES model and the ARCO model may have overestimated the volume of the 100-year flood. Both models predicted a total 5-day volume of approximately 13,000 acre-feet. The most important parameter of the 100-year flood is the design volume of runoff because it governs the amount of flow to be treated. For design purposes, the agencies have decided to use 3,300 cfs as the peak design flow for the Pond 3 intake structure and 13,000 acre-feet as the design volume for the Pond 3 upgrade. For more detail, please refer to the responses to ARCO comments on Section 4.1.1 of the FS.

Although USGS didn't review the modeling of the PMF calculations, the same hydrologic model used by MDHES for the 100-year event was also used to calculate the probable maximum flood (PMF). Thus, the agencies believe that the PMF modeling is appropriate and defensible. As discussed in the Flood Modeling Study prepared by CH2M HILL, the PMF depends on a number of assumptions. They include future climatic conditions, precipitation event characteristics, antecedent precipitation, ground conditions, and hydraulic channel characteristics. Even though it is impossible to substantiate these assumptions exactly, they can reasonably be studied and estimates can be made from historic records. The Flood Modeling Study used a calibrated precipitation vs. runoff model (HEC-1) to calculate flow values for various frequency floods. This model was calibrated using existing recorded rainfall and corresponding runoff data. Publications exist that present methods for calculating probable maximum precipitation (PMP) for a given area. Since the Silver Bow Creek Drainage is located along the Continental Divide, there are two publications which cover the drainage for computation of PMP. These are published by National Oceanic and Atmospheric Administration and are Hydrometeorological Report No. 43 and 55A. Probable maximum precipitation, as calculated using the above reports, was input to the calibrated HEC-1 model to calculate runoff during a PMP. This calculation produced a range of possible values of the PMF, 129,000 cfs to 201,000 cfs. The agencies have adopted a PMF of 140,000 cfs for design purposes.

One commenter (Letter 78) stated that the FS should consider a simultaneous flood on Warm Springs Creek and Silver Bow Creek, and its impact on Pond 1.

Response: The 100-year flood, as calculated for the Clark Fork River downstream of Warm Springs Creek in the flood modeling study, included the contribution of

Warm Springs Creek. The flood modeling study used streamflow records recorded within the entire Silver Bow Creek Basin and also those drainages upstream of the gage on the Clark Fork River at Deer Lodge. Historical floods were used as calibration for the hydrologic model constructed for the entire drainage upstream of Deer Lodge including Warm Springs Creek and Silver Bow Creek. Flood flows do occur simultaneously, but due to differing basin hydrology and flood-producing mechanisms, the 100-year flood would likely not occur at the same time on both Warm Springs Creek and Silver Bow Creek.

One commenter (Letter 47) was concerned that CH2M HILL could not provide the information at a public meeting that 27 percent of the annual flow in the Silver Bow Creek watershed comes from Mill and Willow Creek .

Response: The information on the annual flow from Mill and Willow Creeks was determined as part of the Silver Bow Creek Flood Modeling Study conducted by CH2M HILL. The CH2M HILL representative at the Anaconda public meeting on November 9, 1989, stated that, although he could not recall the exact figure, he estimated that it was between 20 and 25 percent, but would need to check the reports to respond with the precise value.

2.4.2 Flood Control and Flood Treatment Alternatives.

Several comments were concerned with the issue of how to effectively control and treat the sediment-laden waters associated with flood events. Numerous commenters (Letters 5, 53, 64, 66, 69, 72, 73, 74, 82, 92, 97, 98, 99, 101, 102, 104, 106, 107, 108, 109, 111, 112, 115, 116, 120, 121, 122, 126, 128, 131, 132, 133, 134, 135, 138, 139, 142, 143, 144, 145, 146, 147, 151, 153, 154, 155, 159, 161; Testimony A-15, M-1, M-3, M-7, M-8, M-9, M-10, M-11, M-13, M-15) recommended that some or all of those Silver Bow Creek flows that are now diverted to the Mill-Willow Bypass be controlled and treated because they are associated with erosive events and contain higher than average loadings of contaminated sediments. Most commenters suggested full treatment of up to the 100-year flood. Several suggested treating even greater flood flows. Three commenters (Letter 101, 108, 126) further stated that water quality criteria violations should not be allowed, even during floods, and that routing the flood flows through the pond system will not be effective because the detention times during floods would be too short. The comment supported the concept of an upstream impoundment to meter flows into the pond system.

Response: The high flows mentioned are those associated with large floods. At present, the pond system is able to provide sedimentation and treatment for flows that are less than approximately 600 cfs, the peak discharge of the 2- to 3-year flood. Under Alternative 3 in the FS (the State's Proposed Plan), the upstream impoundment would detain most of the flows associated with the 100-year flood and remove the majority of the sediments in such flows. It appears that the flood waters would not require further treatment in the ponds once they had passed through the settling basin and would not pose a threat to the Clark Fork River.

Under the ROD's selected remedy Ponds 2 and 3 improvements will be implemented to enable the Pond system to hold and treat adequately the design volume of the 100-year flood. For more discussion on the development of the design criteria, please refer to the response to ARCO's Comment No. 3 on the FS Section 4.1.1.

One comment (Letter 104) recommended that a sediment survey be done and correlated with historic flood amounts in order to project required storage capacity of the Warm Springs Ponds to help determine their potential for use in controlling flood events.

Response: Qualitative and empirical regional data from other sediment surveys and studies of mass loading from streamside deposits and upland areas along with sediment transport (sediment and bedload) are used to estimate reasonable ranges of sediment inflow to the project area. Short-term monitoring and sediment surveys are not considered representative of long-term trends due to the changes in upstream sources (e.g., raw tailings and the Weed Concentrator flows are no longer discharged directly to Silver Bow Creek). Monitoring of sediments should be included in the monitoring plan (to be prepared during remedial design) to evaluate the long-term project performance and to identify any additional maintenance requirements.

Another commenter (Letter 154) stated that an unknown fraction of suspended sediment will be carried through the treatment system under high flows and will never settle out, and that treatability studies indicate that lime precipitation may not be an effective treatment technique during flood events, given the large surface-to-volume ratio and wind-generated mixing.

Response: The agencies acknowledge that turbid water may be released during high flow conditions, and the removal efficiency of Pond 3 will likely be reduced compared to normal flow conditions. However, with careful design and operation, it will be possible to upgrade the current treatment system to provide adequate treatment for all but extreme flows.

Lime treatment was selected as the best available method for treating the large volume of water entering the pond system. The conceptual design of Alternative 3 was based on providing treatment for 600 cfs, the design maximum flow into the ponds. The lab-scale treatability studies identified in the commenter's text evaluated only the removal efficiency provided by metal hydroxide precipitation. Additional metals removal would be provided by bio-uptake, calcite coprecipitation, and the settling of suspended solids. In order to prevent adverse effects to aquatic life, the system's pH would be kept between 7.5 and 9.0.

One commenter (Letter 95) suggested that flood flows upstream of Pond 3 be diverted into the Opportunity Ponds.

Response: The Warm Springs Ponds system is already in place for the purpose of treating the waters of Silver Bow Creek. Utilizing the existing ponds is a much more direct and cost-effective approach to handling Silver Bow Creek floods than building a new system to divert the flood waters into the Opportunity Ponds. Remediation of the Opportunity Ponds is being studied as part of the Anaconda Smelter Superfund site.

2.4.3 Proposed Upstream Impoundment.

A large number of the public comments were opposed to the Agencies' preferred plan because of the upstream impoundment or settling basin that it included. The opposition of most of the commenters (Letters 2, 3, 7, 8, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 47, 48, 49, 51, 55, 57, 58, 60, 76, 78, 80, 81, 83, 85, 86, 87, 105, 130, 148, 158; Testimony A-1, A-2, A-6, A-7, A-9, A-10, A-11, A-14, A-16, B-3, B-5, B-6, B-9) was based on perceived impacts of the impoundment on land, groundwater, gardens, property values, county tax base, adjacent lands, public health, and environmental aesthetics affecting tourism. One commenter (Letter 8) also thought it would take too long to acquire the land for the impoundment.

Response: EPA and MDHES agree that the settling basin would have some negative impacts at the location examined in the FS. In light of the overwhelming public opposition to the upstream impoundment and careful review of the possibility of treating major flood events in the Warm Springs Ponds system (after extensive capacity and treatment modifications), the selected remedy does not include the upstream impoundment. If monitoring during the first years of operation of the selected remedy reveals inadequacies in the treatment and flood handling capabilities of the pond system, then the agencies will have to reconsider the need for an upstream impoundment.

One commenter asked for clarification regarding the location of the proposed 2,000 acre-foot upstream impoundment.

Response: The upstream impoundment would have been located just south of Montana Highway 1 and west of Silver Bow Creek. Its location was shown on Figures 7-10 and 7-16 of the FS.

One commenter (Letters 7, 49) sent two letters opposed to an 8,000-acre-foot impoundment because that would be oversized for potential floods in this area.

Response: The Silver Bow Creek Flood Modeling Study (CH2M HILL, November 30, 1989) was based on a comprehensive analysis of historical flood and precipitation events for the Silver Bow Creek drainage area. As part of the study, a precipitation-runoff computer model was calibrated using recorded rainfall and snowmelt zones vs. recorded streamflow events. Using this calibrated model and statistics on precipitation/snowmelt frequency, the calibrated precipitation/runoff model calculated the 100-year 5-day flood volume as 13,000 acre-feet for Silver Bow Creek above the Mill-Willow Creek confluence. The 8,000 acre-feet size was determined using an inflow-outflow mass balance analysis based on the storm hydrograph.

Another comment (Letter 154) noted that a 2,000 acre-foot upstream impoundment would not even contain the flood volumes from a 10-year event in Silver Bow Creek. The commenter added that, as a settling basin, the impoundment's effectiveness would also be in question since it would not begin to divert Silver Bow Creek flows until they reach 600 cfs. At 600 cfs, Silver Bow Creek would already be carrying a substantial sediment load. Because of these factors, the commenter suggested that Alternative 3 could not meet the water quality standards.

Response: EPA and MDHES agree that a 2,000 acre-foot impoundment would likely not be able to totally retain a 10-year event in Silver Bow Creek. As noted in Chapter 7 of the FS, the smaller impoundment was analyzed to determine the efficiency of settling the entrained sediments as a comparison against the storage mode of the 8,000 acre-foot impoundment. Preliminary estimates indicated that the smaller impoundment was only about 5 percent less efficient as a settling basin than the larger impoundment. The fact that either impoundment would not divert flows less than 600 cfs does not mean that these flows would go untreated. Flows below 600 cfs would still be diverted into Pond 3 for treatment, including settling. Preliminary calculations, however, indicate that the standards for dissolved metals would likely be met with the original preferred alternative during flood events in the 10- to 100-year range.

The selected remedy includes neither the 2,000 acre-feet or the 8,000 acre-feet upstream settling basins. It will, however, use the upgraded existing pond system to retain and treat the full 100-year flood flows.

Two commenters (Letters 5, 82) expressed concerns about the location of the settling basin in the floodway, stating that it should be protected to withstand a 100-year flood.

Response: The upstream settling basin, as developed in the FS, was to be protected from a 0.5 PMF, a flood many times greater than a 100-year flood.

Another commenter (Letter 72) suggested looking into the feasibility of providing lime treatment to runoff entering or exiting the upstream impoundment.

Response: This concept was explored during the initial phases of the FS, but was not carried further because redundancy of treatment facilities was not determined to be cost-effective. In addition, the upstream impoundments were proposed for temporary storage and physical settling only. They were not designed to have the detention times necessary for effective chemical treatment.

Numerous commenters (Letters 56, 64, 66, 68, 69, 73, 74, 75, 90, 99, 101, 107, 108, 112, 113, 115, 116, 119, 120, 122, 125, 126, 128, 131, 134, 135, 138, 144, 145, 146, 150, 151, 154, 156, 160, 161; Testimony A-2, A-7, A-10, A-14, M-3, M-13) thought that other upstream flood control dams in the upper drainages of the Clark Fork basin should have been evaluated during the FS. They suggested that flood control dams would reduce the magnitude of major floods, would reduce the sediment transport, and could be used to augment recreational opportunities in the area.

Response: EPA and MDHES did consider the possibility of constructing flood control dams on the tributaries of Silver Bow Creek during the FS. Preliminary locations were identified on Silver Bow Creek, Browns Gulch, Flint Creek, Perdee Creek, Homestead Creek, Whitecraft Gulch, and German Gulch. There were several reasons for not pursuing this concept further for the Warm Springs Ponds FS.

- The drainages are generally steep, which means that relatively high dams would be required (generally 80 to 200 feet high), and that the storage capacity gained by construction of the dams would not be great compared to either the expense of building them or the hazards they would represent.

- The structures would all be on-channel dams, unlike the off-channel impoundments considered in the FS. Because they would be on-channel dams, each would have to be constructed with a PMF or partial PMF spillway for protection against failure during major floods. These spillways are very expensive structures, and would add considerably to the cost of construction.

- The number of dams that would have to be built to achieve the purpose (moderating flood flows on Silver Bow Creek) seemed unreasonable. Probably as many as six dams would have to be built to partially control flood flows on Silver Bow Creek. Maintaining and operating so many dams would be a very expensive undertaking that would have to be funded and monitored for the indefinite future. This is not in keeping with the sense of permanence required for remedial actions under Superfund.

- Some of the dams probably could not be built due to the adverse environmental and other impacts associated with their construction. For instance, the possibility of constructing a dam on Silver Bow Creek, in the canyon area near the confluence with German Gulch, would likely not be feasible (at least for the limited purpose of flood moderation) because of the need to relocate two railroad lines and a power transmission line, and because of the adverse environmental impacts that such a facility would cause.

- To gain the maximum flood-control capacity from these dams, they would have to be kept empty most of the time. This would severely limit their usefulness as water storage or recreational reservoirs.

- Some of the reservoirs would eventually collect contaminated sediments. This would be particularly true of a reservoir on Silver Bow Creek. The sediments would have to be cleaned out of the reservoirs, or they would become sources of acute releases of contaminants to the creek and possibly cause fishkills, much as the tailings along the Mill-Willow Bypass currently do.

One commenter (Letter 72) noted that the upstream impoundment would settle out only the larger particle sizes in the sediments carried by flood flows. It is suspected that the smaller particle sizes (which would not settle out) carry proportionately more metals than the larger sediment sizes. The potentia' sediment toxicity to aquatic organisms from these smaller sediment sizes should be evaluated more thoroughly.

Response: The agencies agree that it would be desirable to evaluate the toxicity of flood sediments more thoroughly. Unfortunately, it is difficult to determine the toxicity without experiencing and sampling an actual flood event of sufficient magnitude to yield meaningful results.

2.4.4 Flood Protection of Pond Berms.

Four commenters (Letters 62, 111, 119, 140) recommended that the hydrologic standard for emergency and principal spillways, contained in the Dam Safety and Administration Rules under Section 36.14.502, not be used as the sole criteria in the selection of the design flood, due to the hazardous nature of the material stored in the dams. Numerous commenters (Letters 53, 56, 62, 64, 66, 68, 69, 73, 74, 75, 90, 91, 97, 101, 102, 104, 106, 108, 109, 114, 115, 116, 119, 121, 122, 126, 128, 131, 132, 134, 135, 136, 138, 142, 143, 145, 146, 149, 151, 152, 153, 157, 158, 159; Testimony A-7, A-14, A-15, M-1, M-2, M-3, M-7, M-10, M-13, M-15) made general statements that the pond protection should be conservatively designed. Several specifically stated that the level of protection should be 0.5 PMF or the full PMF. Several of the commenters recommended that the study include a risk analysis of possible dam failure and offer rationale for selection of the design flood event.

Response: MDHES and EPA recognize that the Dam Safety and Administration Rules represent a minimum level of protection required for the Warm Springs Ponds. The level of protection required, based on these rules, considers that these are high hazard dams with the potential for loss of life downstream due to flooding in the event of a dam failure. The agencies have decided to not use varying levels of protection, but rather to protect the entire set of pond berms along the major flood route, the Mill-Willow Bypass, to a peak flood discharge of 70,000 cubic feet per second (cfs). This level of protection is equivalent to protection from the 0.5 PMF for the entire pond system.

While it might be desirable to conduct a full incremental risk assessment of possible dam failure events in an attempt to determine the most cost-effective level of dam protection, the agencies feel that such a study would be too costly, take too long, and would likely not provide definitive enough answers regarding expected risk. It was felt that using a conservative number based on DNRC dam safety requirements was the proper approach.

The selected remedy includes measures to protect the pond berms from failure even in large floods, up to a 0.5 PMF. The ponds would not fail in floods up to this level, and therefore would not add to the damage that would result from any flood of less than 0.5 PMF. If a larger flood, such as a full PMF, did occur, and damaged the ponds, the amount of water released by the failure of the ponds would be small compared to the size of the flood. It's probable that the downstream communities would be much more affected by the flood itself than by the failure of the ponds.

One commenter (Letter 119) thought that twenty million dollars could be trimmed from the state's preferred alternative by designing to substantially lower standards than the fractional PMFs listed. The money saved could be applied to ultimate removal of the sediments from the floodplain. On the other hand, another commenter (Letter 101) thought that the flood-protection measures needed to be significantly more stringent than those proposed and should be based on the hazards and costs associated with catastrophic release of toxic materials. This commenter stated that the flood protection costs must be compared with removal to a repository outside the floodplain.

Response: The ARARs for flood protection and earthquake stability were determined based on the anticipated risks associated with catastrophic release of sediments from the ponds. Even if it was known that the sediments would be removed within a given time frame (say 30 years) the risk of catastrophic failure in any given year would remain the same. Thus, designs would still have to be performed to the level of protection as determined by the ARARs analysis.

The costs for providing adequate flood protection for the Warm Springs Ponds are substantially less than the costs to remove the sediments from the floodplain. The costs for raising the berms and armoring them against the designated floods are estimated at about $13.5 million. The costs to remove and dispose of the pond materials to a repository outside the floodplain would be approximately $400 to $500 million, using conventional excavate-and-haul techniques.

One comment (Letter 160) thought the FS should have considered an option for flood and earthquake protection that would entail driving piles (30 to 60 feet in length) through the center of the berms on 18- to 24-inch centers. Then, if the berms did give way, the sediments would be retained behind the piles.

Response: This concept was not considered because it would be much more expensive than berm modifications (flattening the downstream slopes and riprap armoring) in protecting against floods and earthquakes. It would not provide any greater protection against flooding and, without very special designs, might not provide as much protection against earthquakes.

One comment (Letter 138) stated that the collection system designed to route eastside runoff around the pond system should be designed to prevent, to the extent possible, sediment from entering the Clark Fork River.

Response: The berm/channel system along the east side of the ponds would be designed to prevent overtopping of the berms during flood events in the eastern hills. The natural sediments carried by runoff from the eastern hills will enter the Clark Fork River unabated, exactly as would occur under natural conditions if the Warm Springs Ponds were not in place. These sediments are not believed to be contaminated.

2.4.5 Earthquake Protection of Ponds.

Numerous commenters (Letters 45, 53, 56, 62, 64, 66, 68, 69, 73, 74, 75, 90, 91, 97, 98, 99, 102, 104, 106, 109, 114, 115, 116, 119, 120, 122, 125, 126, 128, 131, 132, 134, 135, 138, 142, 143, 145, 146, 149, 151, 153, 157, 158, 159, 160; Testimony A-7, A-14, A-15, M-1, M-3, M-7, M-15) stated that the pond berms should incorporate the most conservative design possible for earthquake protection.

Response: The agencies agree. The selected remedy provides protection of the berms from the maximum credible earthquake (MCE).

One commenter (Letters 47, 158) said the cross-sectional view of the proposed berm modifications does not show any increase in height. In addition, some of the existing berms have downstream slopes of 2.25 to 1. Flattening the downstream slopes to 2.5 to 1 does not provide much additional strength.

Response: The original MDHES proposed plan included increasing berm heights along the Mill-Willow Bypass. Figures 7-1 and 7-2 of the FS show the intent to add that additional height. In addition, the ROD's selected remedy includes the ARCO concept of treating major flood events in the pond system. This alternative requires substantial raising of all of the Pond 2 and 3 berms for increased flood storage and treatment capacity. Depending upon location, the downstream slopes of the existing berms vary from approximately 1.75:1 to more than 2.5:1. The seismic analysis was preliminary in nature and recommended a minimum of 2.5:1 for cost-estimating purposes. A detailed seismic stability analysis will be performed during the final design. The configuration and slope of the berm stabilization (to withstand the MCE) will be optimized at that time based upon site-specific information. DNRC dam safety engineers have reviewed the designs of the berms along the Mill-Willow Bypass and have found them to be appropriate for MCE protection.

One commenter (Letter 138) stated that the siphons crossing under the Mill-Willow Bypass from the Opportunity system should meet earthquake and flood protection standards to prevent release of contaminants into the Clark Fork.

Response: The siphons from the Opportunity Ponds no longer carry substantial flows, except during local rainfall events. However, during these events, contamination due to a breaching of the siphon pipelines is possible. The agencies agree that the siphons should be evaluated for earthquake and flood stability. This evaluation will be performed during remedial design.

2.4.6 Tailings Removal and Disposal Options.

Numerous commenters (Letters 9, 56, 64, 66, 68, 69, 73, 74, 75, 78, 79, 90, 93, 97, 98, 99, 101, 102, 103, 106, 107, 108, 109, 114, 115, 116, 117, 119, 120, 121, 125, 126, 132, 133, 134, 135, 138, 140, 142, 143, 144, 145, 146, 149, 151, 152, 154, 155, 159, 161; Testimony A-15, M-3, M-5, M-8, M-9, M-10, M-11, M-14, M-15) stated that the agencies should find a site outside the floodplain, such as Smelter Hill in Anaconda, for disposal of tailings and should reevaluate the alternative of removing the Warm Springs Ponds tailings to that disposal site. Many of the commenters thought that the contaminated materials currently contained in the Warm Springs Ponds should be removed from the floodplain following permanent cleanup of upstream sites, when the Warm Springs Ponds are no longer needed to treat Silver Bow Creek waters.

Response: Because of the upstream contamination on Silver Bow Creek, the ponds must remain in place to treat the creek to reduce contamination of the Clark Fork River until the upstream sources are cleaned up. The current remedy for Warm Springs Ponds is interim, and the ultimate disposition of the ponds will be addressed as cleanup of Silver Bow Creek progresses.

Removal of all contaminated materials from the Silver Bow Creek floodplain, with disposal at a local repository, was considered during the screening of technologies and process options in Chapter 6. It was screened from further consideration at that time because of very high costs. The agencies' preliminary analysis indicated that conventional excavation, transport, and disposal of the 19,000,000 cubic yards of contaminated materials (using over-the-road transport vehicles) would cost approximately $400 to $500 million. In addition, locating a permanent repository for this volume of material would be difficult. For example, if the materials were piled 30 feet deep, it would require a storage area of approximately 600 acres. It may be difficult to find a suitable storage area this size within reasonable distance of the Warm Springs Ponds that would be acceptable to all parties concerned.

Three comments (Letters 58, 88, 124) recommend that the mine wastes in the ponds be removed and disposed of in the mined-out areas or in the Berkeley pit. Two of the commenters (Letters 88, 124) thought that the agencies should have considered an alternative which would use a slurry pipeline to pump the contaminated sediments back to the Berkeley Pit near Butte. The contaminated water now slowly flooding the Berkeley Pit could be used for makeup water for the slurry pipeline. This alternative would provide a permanent repository for the wastes, resolve the future problem of disposal of the Berkeley Pit waters, and allow a central location for metallurgical or chemical removal of the heavy metals in both the Warm Springs wastes and Berkeley Pit waters.

Response: This is a potentially viable alternative for ultimate disposal of the Warm Springs Ponds sediments. However, until the sources of contamination upstream of the ponds are eliminated, the Warm Springs Ponds must remain in operation to remove sediments and metals. It would not be advisable to begin the slurry pumping operation until the ponds are taken out of service as a treatment system. The primary reason is that the slurry operation would require dredging the pond bottom sediments, likely resulting in considerable resuspension of sediments. It would be better to wait until the ponds no longer discharge to the Clark Fork River before beginning this operation.

The costs for dredging and pumping the Warm Springs sludges to the Berkeley Pit would be substantial. Very preliminary cost estimates indicate capital costs of $30 to $50 million with operation and maintenance costs of $2 to $3 million per year. If a 12-inch pipeline were employed, it would require approximately 8 to 10 years of around-the-clock operation to pump the 19 million cubic yards of material to the Berkeley Pit.

Two important features of this concept should be pointed out.

- The use of a second pipeline to allow use of Berkeley Pit waters as makeup water for the slurry operation is not advisable. The Berkeley Pit waters are very acidic, with pH of 1 to 2. Not only is this type of water highly corrosive to pumps and pipelines, but its use as makeup water to slurry the pond sludges would likely result in redissolution of the metals. It is likely that the Berkeley Pit waters will eventually have to be treated; thus, the re-dissolved metals would have to be removed at that time.

- The makeup water for the slurry would most likely come from Silver Bow Creek in the vicinity of the Warm Springs Ponds. Because of water rights issues, the water would have to be returned to Silver Bow Creek at the Berkeley Pit after the slurry operation. This would require a dewatering operation and likely a treatment plant for the supernatant prior to discharge to Silver Bow Creek.

One comment (Letter 119) stated that removal of the sediments from the floodplain to a nearby disposal site could be done economically ($3.00/cubic yard) if done over a period of years utilizing an efficient transport system such as a slurry pipeline. The construction of this system should be deferred until after the upstream contamination sources are cleaned up, since the Warm Springs Ponds will be needed until then. However, if the money for the removal and disposal system were invested today, the interest earned could substantially reduce the investment required when the system is placed in operation.

Response: If it is decided in the future to remove the sediments from the ponds, the agencies agree that some form of slurry pipeline would likely be a more cost-effective transport system than a conventional excavate and haul system. The pond sediments can likely be dredged, slurried, and transported for costs similar to the $3.00/cubic yard (1990 dollars) noted, depending upon the pipeline length. However, substantial other costs would be incurred. There is some doubt as to whether a feasible and acceptable repository can be located outside of a floodplain within reasonable distance of the Warm Springs Ponds. If a repository can be located, the costs to develop, construct, and then ultimately cap, close, and monitor the repository would also have to be considered.

EPA and MDHES agree that if the appropriate funds to develop these facilities were invested today, it would be likely that the interest earned would reduce the investment required when the facilities are built. However, the responsibility for funding the overall Silver Bow Creek remediation efforts rests with ARCO and other PRPs. The investment and financing decisions will be theirs.

Several comments dealt with the agencies' proposal to leave the tailings in place within the present Warm Springs Ponds system. One comment (Letter 79) was opposed to disposal of contaminated materials in Pond 1 due to the potential for contamination of the Clark Fork River.

Response: Pond 1 already contains almost 3 million cubic yards of tailings and other contaminated materials. The Proposed Plan would add another 290,000 cubic yards, or about an additional 10 percent over what is already there. The pond would be drained and covered with a low permeability cap that would keep rain and snow from penetrating into the wastes. This would result in a large reduction in the potential for Pond 1 to leach contamination into the groundwater and surface water, as it currently does. The pond will also be stabilized to protect against earthquake and flood events. This will result in a very secure and stable disposal area.

The plans for cleaning up the Mill-Willow Bypass this summer include placing the excavated materials into suitable dry areas of Pond 3, thus reducing the amount of material that will eventually be placed in Pond 1.

2.4.7 Tailings Reclamation and Reprocessing Options.

Numerous commenters (Letters 6, 64, 66, 68, 69, 71, 73, 74, 75, 88, 99, 100, 102, 103, 107, 109, 115, 116, 117, 120, 123, 124, 128, 134, 140, 143, 145, 146, 151, 155, 159, 161, 162; Testimony A-15, B-5, M-1, M-3) thought the agencies should have included alternatives evaluating additional treatment technologies for hazardous wastes at the Warm Springs Ponds, including alternatives employing proven or innovative technologies to extract and recycle minerals from wastes in the ponds.

Response: Media Specific Actions for treating the sediments from the ponds and extracting minerals from them were included in the preliminary alternatives screening of the FS. These alternatives were screened out early in the process because they were not found to be feasible, appropriate, or economical. Metals recovery from the pond sediments would not be economically viable, would do little to reduce the amount of wastes to be disposed of, and could pose considerable threats to the environment. Metals recovery, even from normal ore, is expensive and difficult, and poses numerous potential threats to the environment. The wastes in the ponds contain much lower levels of metals than even the poorest quality usable ores; they are the wastes left over after the metals have been removed. Processing these wastes to extract the remaining metals, as a means to reduce their toxicity, would not be cost-effective by today's standards. Much less expensive (but still very expensive) treatment methods are available to reduce the environmental threat posed by the pond bottom sediments, such as solidification. If technology in the future allows for recovery of the metals from the sediments, recovery would be reevaluated at that time.

Two comments (Letters 113, 139) stated that the agencies should continue to research, and implement where possible, revegetation approaches. One thought that the Schafer and Associates pilot program for neutralizing the tailings holds promise for curing the problem rather than just moving it.

Response: The pilot program described in the comment is based on technology developed in an ongoing 3-year program that has been conducted by MDHES at the Silver Bow Creek site to develop innovative cleanup methods for the site. It is applicable to exposed tailings deposits under certain conditions, but would not be useful to treat the pond bottom sediments. It is also not by itself capable of preventing release of the 19 million cubic yards of sediment in the ponds during flood or earthquake events. It would therefore be necessary to incorporate methods other than neutralization and revegetation to reduce the risk of a loss of the pond bottom sediments.

For the WSP operable unit, revegetation of exposed tailings areas and of the disposal units will be undertaken. If the approaches described above have application in this revegetation effort, they can be incorporated during the remedial design phase.

2.4.8 Use of the Ponds for Treatment.

Several comments (Letter 138) deal with the capability of the ponds to provide adequate treatment of suspended and dissolved metals to meet the desired water quality criteria at the discharge point from Pond 2. One comment notes that high levels of metals have been measured in the discharge, particularly in the winter and spring. The same commenter, and another (Letter 115), also stated that remediation of the ponds should address problems associated with the short circuiting in the winter and wind action during the ice-free period that are thought to resuspend sediments and contribute to metals loading in the Clark Fork River.

Response: The agencies agree that the final pond configuration must be able to provide treatment that will meet the appropriate discharge requirements. The agencies' original Proposed Plan contained elements, including the upstream settling basin, improved liming facilities, and the construction of a berm across part of Pond 3, to alleviate treatment problems. The selected remedy includes a more comprehensive upgrade of both Ponds 2 and 3, and is thought to adequately address concerns over pond retention time, sediment resuspension, lime addition, and treatment capabilities in general, without the need for the upstream impoundment. The ROD contains provisions to continue to investigate resuspension issues. If it is shown that resuspension may cause significant water quality violations, additional remedial measures will be required.

One commenter (Letter 72) recommended the consideration of a new pond immediately south of Pond 3, stating that a new pond would reduce the extensive modification required for the inlet structure; avoid the need to channelize Silver Bow Creek within the dry areas of Pond 3; cover the contaminated soils and tailings in the dry areas of Pond 3; and increase the pond capacity by 70 percent.

Response: The media-specific actions (FS Chapter 7) were developed to provide a range of options to be combined into alternatives (Chapter 8). A new pond in the dry areas within the Pond 3 berms was considered in Media-Specific Action 5C. In the FS, it was not included in the preferred alternative (Alternative 3), because it would not be as cost-effective in dealing with the problems.

The selected remedy includes major improvements to Ponds 2 and 3. This plan includes elements that will accomplish all of the modifications included in the comment. A new inlet structure will be built. Most of the existing exposed contaminated soils and tailings in the dry areas of Pond 3 would either be capped as part of the tailings disposal area, or flooded by the new Pond 3 normal pool. The pond capacity would be increased to handle and treat the 100-year flood event.

One commenter (Letter 138) stated that the area in Pond 3 south of the proposed new baffle is very shallow and that the baffle may not be effective at preventing short circuiting during winter months.

Response: The proposed berm was intended to prevent short circuiting across the main portion of the pond by forcing the water to travel through the berm opening on the eastern side of the pond. This would extend the minimum flow path through the pond during all seasons. It should also be noted that the selected remedy does not include this baffle, but rather depends on increased operating capacity and greater retention times to insure that the discharge from the pond system meets the discharge criteria.

One commenter (Letter 154) would like to have seen treatability tests conducted on site to more closely represent the area/volume ratio of the ponds, ambient weather conditions, and used Silver Bow Creek water during high flow and low flow periods. Additionally, other interactions between the Silver Bow Creek sediments and the treatment process should have been characterized.

Response: The treatability study conducted in conjunction with the Phase II Remedial Investigation was designed to evaluate the physical and chemical parameters that must be controlled to maximize metal removal in a pH-controlled settling-type system. The water used in the "winter" tests was actual water from Silver Bow Creek and did contain native suspended sediment from the creek. It was recognized in the planning stages that in situ tests would provide additional information on the treatment/settling mechanisms in the ponds; however, it was felt that it would be more prudent to conduct these tests during the remedial design phase if necessary.

2.4.9 Groundwater Treatment Alternatives.

Several commenters (Letters 53, 60, 82, 101, 108, 126, 133, 135, 147, 151, 154, 155; Testimony A-7, A-14, M-4) noted a general concern that the selected remediation be protective of groundwater in the operable unit. One comment (Letter 138) recommended that the final remedy should prevent contaminated groundwater from causing surface water exceedances of Gold Book standards.

Response: The shallow aquifer below Pond 1 has been contaminated over the years by metals and other contaminants from the pond system. The trench below Pond 1 would be designed to cut off the source of contamination for this aquifer (see MSA 11 and 12 in Chapter 7 of the FS). A portion of the existing contaminated groundwater will continue to migrate downgradient toward the Clark Fork River. However, measurements made during the Remedial Investigation detected no impact to the water quality of the Clark Fork River as a result of the contaminated groundwater. Groundwater input into the Clark Fork River will not be sufficient to cause exceedances of the Gold Book standards in the future. Background information on the groundwater situation below Pond 1 can be found in the response to comments on the Groundwater portion of the Site Characterization and Problem Description Section of this Responsiveness Summary.

One commenter (Letter 67) raised several concerns regarding the impact of the Proposed Alternative on groundwater flows and contamination at the site and on the proposed method of groundwater treatment. The first set of comments dealt with the proposed construction of a trench to intercept contaminated groundwater downgradient of Pond 1. The design of the proposed trench raised the following concerns:

a. The trench will probably not be deep enough to intercept all groundwater flow.

b. A groundwater flow model was also developed to determine the effectiveness of a trench and to estimate the flow rate into the trench. This modeling effort has several deficiencies.

c. If the open trench is not cleaned regularly, it will quickly begin to fill with vegetation, windblown dirt, and sloughed sidewall material. Obviously, if the trench starts to fill, its effectiveness will be reduced.

d. The trench will intercept only that part of the existing groundwater plume near the trench. Some currently contaminated groundwater will continue to flow toward the Mill-Willow Bypass and Clark Fork.

e. The trench may dewater tailings contained in Pond 1, thereby, causing release of metals.

Response: Modeling efforts related to evaluating the feasibility of a groundwater interception trench below Pond 1 were not intended to provide all the information necessary for final design of the trench. Obviously, additional information will be necessary to address the variability of the aquifer along the entire length of the Pond 1 berm, if this technology is incorporated into the final remediation at the site. The calculations and flow models presented in FS were performed to preliminarily determine if construction of this type of trench is technically feasible and to estimate costs.

The agencies realize the presumed aquitard is not consistently at a depth less than 20 feet below ground surface in the area below Pond 1. In fact, the lateral continuity of the presumed aquitard is unknown. However, based on groundwater quality data collected from dual-completed monitoring wells and paired monitoring wells located north of Pond 1, groundwater quality improves markedly in wells completed deeper than about 15 feet below ground surface. Because the highest metals concentrations were measured in samples collected from wells completed in the upper 15 feet of the aquifer, it is presumed that most, if not all, groundwater that exceeds federal primary drinking water standards (the ARAR for groundwater) would be captured by an interception trench as presented. In addition, depending on the vertical permeability of sediments below Pond 1, the interception trench is expected to act as a groundwater discharge area where groundwater at some depth below the trench will migrate into the trench.

Groundwater flow in the area below Pond 1 was modeled to: (1) estimate conservative values of groundwater inflow to the trench; (2) estimate the effective distance downgradient from the trench at which groundwater would be captured; and (3) estimate the time it would take to capture degraded groundwater below the trench. The initial model was executed using hydraulic conductivity values calculated from slug test data. The model was revised after a pumping test was performed in a specially designed well located below the Pond 1 berm. Hydraulic conductivity values derived from the pumping test data indicated hydraulic conductivity values based on pumping test data were approximately twice as high in the shallow sand and gravel aquifer as those derived from slug test data in the area below Pond 1. Therefore, groundwater inflow rates to the interception trench were adjusted to rates ranging from approximately 2.2 to 4.6 cfs.

Wells were used to simulate the trench because this method was the most applicable for the groundwater flow model used (Prickett Lonnquist Aquifer Simulation Model, PLASM). MDHES agrees that a more representative model would include simulating the trench as a drain. Any future modeling activities are expected to be completed to provide sufficient information to support remedial design of the interception trench. These modeling activities may include using the

USGS MODFLOW groundwater flow model (or an equivalent model) that will allow simulating the interception trench as a drain. Simulating inflow to the trench using a series of wells does not change the resultant opinion offered regarding the feasibility of such a system.

A constant head boundary was used to simulate groundwater inflow from the Tertiary hills to the east to provide conservative estimates of groundwater inflow to the interception trench. A more representative boundary would likely include a constant flux boundary that would result in lower groundwater inflow rates to the interception trench. The flow model was performed to provide conservative estimates of groundwater inflow to the interception trench to evaluate the technical feasibility of such a trench. The use of a constant head boundary to represent inflow from the Tertiary hills to the east does not affect the analysis of the feasibility of implementing the interception trench below Pond 1.

Design characteristics of the interception trench will be addressed during remedial design. Of course, an open trench would accumulate silt and debris. Interception trenches are commonly used throughout the world; engineered controls designed into the trench will inhibit siltation of the drain. The trench will require periodic maintenance to remove soil and debris. The costs of this maintenance are included in the cost estimates in Chapter 8.

The agencies recognize that a portion of the degraded groundwater currently identified below Pond 1 will continue to migrate downgradient toward the Clark Fork River. The impact of inflow of groundwater from this area on the Clark Fork River is not great. The calculated time for groundwater, which exceeds primary maximum contaminant levels and which is located beyond the influence of the interception trench, to migrate into the Clark Fork River is less than 10 years. It is expected that this groundwater would not move as a slug as other influences on the chemistry of this water would be operative along its flow path (e.g.. dilution, adsorption, dispersion).

Additionally, the commenter (Letter 67) expressed concern over the impact on groundwater from dewatering presently immobilized tailings and pond bottom sediments. Important questions posed included:

a. What will be the effect of dewatering tailings and contaminated sediments that are currently immobilized in the reduced conditions of pond bottoms? Oxidation of these materials could lead to large releases of metals. As designed, the groundwater trench planned for the interior of Pond 1 will dewater tailings. This action will allow oxidation and mobilization of the reduced metals in sediments that have collected in Pond 1. As shown for the tailings in the Opportunity Ponds, the mobilization of metals can be substantial when metal-rich sediments change from reduced to oxidized conditions. The extent of this mobilization should be quantified and its effect understood. The trench below the Pond 1 berm may also dewater contaminated sediments causing a similar mobilization of metals.

b. What will the groundwater plume in both the shallow and deep aquifers be in the future? What contaminants will they contain? Will the aquifer's neutralization and metal attenuation capacities be exhausted at some point? These issues have not been addressed.

Response: Groundwater interception technologies presented in the FS were evaluated with respect to the potential for increasing metals mobility by changing the metals source environment from reducing to oxidizing conditions. The primary metals source areas of concern include Pond 1 and the area below Pond 1. The proposed groundwater interception trenches would intercept seepage from Pond 2 into Pond 1 and seepage from Pond 1 into the area below Pond 1. All intercepted water will be pumped back to Pond 3 for treatment. This system was designed in consideration of the possibility of metals releases due to changes in the geochemical environment of the bottom sediments in Pond 1 caused by dewatering. The proposed system will effectively intercept and treat metals-contaminated groundwater within this portion of the operable unit and will allow for dry closure of Pond 1. Therefore, definitive characterization of the geochemical fate of this component of the area's groundwater system is unnecessary.

Several models of dewatered tailings and the potential metals production of these areas are present both within the Warm Springs Ponds Operable Unit and the entire Silver Bow Creek CERCLA site. The best example of the long-term fate of metals production in a dewatered tailings environment is the western portion of Pond 1 and the area immediately below the Pond 1 berm in this area. The western portion of Pond 1 has been dewatered for many years; water levels have dropped below the base of the bottom sediments accumulated in the pond. Metals concentrations in groundwater in the western portion of Pond 1 and in the area below (downgradient of) this area are relatively low with no measured exceedances of maximum contaminant levels. Other examples of dewatered tailings areas exhibiting relatively low metals concentrations in subjacent groundwater have been identified in Ramsay Flats near Ramsay.

Dry closure of Pond 1 with a low permeability cap would serve to reduce vertical infiltration of precipitation recharge to the underlying groundwater system. This will further reduce the potential for metals migration vertically into the area's groundwater system.

The anticipated extent of the metals plume, which exceeds maximum contaminant levels in the area below Pond 1 following construction of the groundwater interception trench, will likely not extend downgradient of the interception trench after the system reaches equilibrium. This assumes that the aquitard separating the upper sand and gravel aquifer and the underlying sand aquifer is relatively consistent in the area and that the interception trench is capable of intercepting most or all of the shallow groundwater system. Any contaminants that are not intercepted by the trench will enter a relatively good quality groundwater environment downgradient of the trench recharged with water from the foothills east of the site and by the Mill-Willow Bypass to the west.

The issue the commenter raises about the neutralization and metal attenuation capacities of the aquifer in the area below Pond 1 is a moot point given that the proposed groundwater interception trenches will hydraulically capture metals-contaminated groundwater. EPA and MDHES believe that controlling the hydraulics of the system will serve to control the chemistry.

The commenter (Letter 67) also was concerned over the impact of the Proposed Plan on the groundwater in the Mill-Willow Bypass area. The comment states that consideration should be given to the post-remediation groundwater gradient from the Warm Springs Ponds to the Mill-Willow Bypass. If the water level in Pond 3 is increased and the elevation of the bypass is lowered by excavation of contaminated and borrow material, groundwater discharge to the bypass will likely increase. Furthermore, if Mill and Willow Creeks are diverted into Pond 3, no surface water (except during large flood events) would enter the bypass upstream of the new Pond 3 outlet, and, therefore, the FS assumes that the upper bypass will be dry. It is probable that the bypass will receive contaminated groundwater discharge from the Warm Springs and Opportunity Ponds. With no surface water entering to dilute the inflow from groundwater, water quality in the remediated upper bypass will likely be considerably worse than it is now.

Response: It is probable that increased groundwater inflow to the Mill-Willow Bypass will be realized if the water elevation in Pond 3 is raised and if the bypass channel is excavated to a greater depth. Until such time as contamination sources in Mill and Willow Creeks are removed, it is likely that one or both of these creeks will typically be diverted into Pond 3 for treatment. If both streams are diverted into the ponds, then groundwater inflow will be the only flow source in the Mill-Willow Bypass. This flow has been estimated to be 1 to 5 cfs during the Bypass removal this summer. The quality of this inflow, however, is not expected to be poor. An opportunity presented itself during the Phase II RI to empirically determine the quantity and quality of groundwater inflow to the bypass. Water in the Mill-Willow Bypass was diverted into Pond 3 via the northern channel connecting the Opportunity Pond discharges with Pond 3 during July, 1988. Synoptic flow measurements were made in the Mill-Willow Bypass channel below the point of diversion to the point where the Wildlife Ponds discharge into the bypass channel. Samples of water flowing in this reach of the bypass were also collected in conjunction with flow measurements. Analytical results from these samples indicate that the water did not exceed either chronic or acute ambient water quality criteria nor did it exceed any primary drinking water quality criteria. Data from this synoptic flow measurement episode are contained in the Phase II RI data summary report. Due to construction activities ongoing in the Bypass channel, it is not possible to directly measure the typical quality of the groundwater inflow at this time.

Another commenter (Testimony M-7) stated that it was unclear where the contamination of the second-level aquifer is coming from, and asked for more assurance that the location and source of contamination can be found and the contamination cleaned up.

Response: The primary chemical contaminants in the deeper aquifer are sulfate and manganese. These parameters are not generally associated with the potential sources at the Warm Springs Ponds. The occurrence of these parameters in the deeper aquifer is consistent with the presence of relatively high concentrations of sulfate and manganese in the groundwater in the vicinity of the Opportunity Ponds.

This suggests that the sulfate and manganese occurrence is more regional in nature and is probably the result of multiple contaminant sources and pathways of contaminant movement.

It should be noted that the ARARs established for groundwater at the Warm Springs Ponds Operable Unit do not include manganese and sulfate since these parameters are not included in the primary maximum contaminant levels established for drinking water. The sulfate and manganese contamination should be addressed as part of the Anaconda Superfund site.

2.4.10 Costs of Alternatives.

Four commenters (Letters 58, 107, 111, 136) felt that cost seemed to be the driving force in the selection of the preferred alternative, and recommended that the agencies should select a conservatively protective remedy regardless of cost. Five other commenters (Letters 101, 108, 126, 137, 154) thought that a full cost-benefit analysis should be performed to evaluate the alternatives. Several other commenters (Letters 11, 26, 34, 43) supported ARCO's plan because it was thought to accomplish the desired remediation at substantially less cost.

Response: Cost is only one of the factors used in the selection of the preferred alternative. The selection of the preferred alternative was made based on all nine of the criteria required by Superfund. These criteria include: overall protection of human health and the environment; compliance with ARARs (applicable or relevant and appropriate requirements, i.e., laws that have a bearing on the cleanup); long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; cost; community acceptance; and State acceptance. By using these criteria, the relative benefits of each of the alternatives can be compared to the cost of each alternative. It is beyond the scope of the Feasibility Study to conduct a formal cost-benefit analysis of the alternatives.

One commenter (Letter 137) suggested that the evaluation of alternatives needs to take into account the costs of damage to natural resources caused by the contamination.

Response: The ROD and selected remedy are undertaken pursuant to Section 106 of CERCLA for the purpose of protection of public health and the environment. Natural resources damage assessment issues are being dealt with under a separate process by Federal and State natural resource trustees.

2.4.11 Mill-Willow Bypass Issues.

The Preferred Plan of the FS would divert Mill and Willow Creeks into the pond system for treatment. This raised concerns in several areas. One commenter (Letter 46) stated that the preferred alternative would involve a 27 percent increase in the capacity of Pond 3 and would, therefore, increase the potential for breaching the pond. Several commenters (Letters 8, 46, 47, 48, 49, 51, 87, 115, 158; Testimony A-2, A-7) expressed concern that diverting Mill and Willow Creeks into the pond system would eliminate the fisheries on the upper portion of the creeks and the upper Clark Fork River. Another comment (Letters 78, 138, 151; Testimony M-10, M-14) stated that the sources of the contaminants in Mill and Willow Creeks should be identified and eliminated as a part of the Warm Springs Ponds Operable Unit, and that until the sources are identified and eliminated, Mill and Willow Creeks should be routed into the pond system. One commenter (Testimony A-14) suggested possibly diverting Mill and Willow Creeks into the bypass only during the high flow season, and letting them bypass the ponds at other times.

Response: EPA and MDHES are evaluating the need to route Mill and Willow Creeks into the pond system. In conjunction with the Mill-Willow Bypass Removal Action, ARCO has begun investigating the sources of contamination on Mill and Willow Creeks. It was hoped that discrete sources of contamination could be identified and readily removed. Sampling to date this summer has not confirmed that hope, although it has been discovered that perhaps Mill Creek can be bypassed without treatment through the ponds. The agencies would prefer that option over routing Mill and Willow Creeks into Pond 3. This would preserve fisheries habitat in the Bypass and still meet water quality ARARs for the site.

The diversion of Mill and Willow Creeks into the Warm Springs Ponds would increase the average annual flow into the ponds. It would not, however, increase the potential for breaching the pond berms. The flow into the ponds would be regulated by the capacity of the inlet structure. Flows above that capacity would be routed into the Mill Willow Bypass and would not enter the ponds. Thus, there is no increased potential for breaching the pond berms.

Numerous commenters (Letters 64, 66, 68, 69, 73, 74, 75, 87, 90, 98, 99, 107, 109, 117, 119, 120, 121, 128, 131, 132, 135, 139, 142, 143, 144, 145, 146, 151, 155, 157, 158, 159, 160, 161; Testimony A-7, A-13, A-14, A-15, M-5, M-10) recommended removal of tailings from the Mill-Willow Bypass during 1990 to prevent future fishkills.

Response: The agencies agree. Removal of the Mill-Willow Bypass tailings is currently underway under an Administrative Order on Consent signed by EPA and ARCO in July 1990.

One commenter (Letter 72) recommends that the agencies consider buffering low pH during storm events at several points in the operable unit to help prevent future fishkills and reduce metals migration in the upper Clark Fork River. Buffering high flows in the Mill-Willow Bypass could be a means to avoid future fishkills.

Response: Buffering pH is not a complete solution to either the fishkill or the metals migration problem. Low pH has little to do directly with the fishkill problem, which is caused by dissolution of water-soluble metal salts from the surface of tailings deposits. The salts are not dissolved by low pH water in the channel, but by rainwater; the salts are highly soluble even in neutral water.

Stopping the migration of metals contaminants to the Clark Fork River requires more than pH adjustments. The metals must be removed from the flows and deposited somewhere. That is the function of the pond treatment system, which operates on the basis of physical settling, chemical treatment (pH adjustment), and biological treatment to remove the metal contaminants from the flows.

Lime treatment at various points in the operable unit is not thought to be necessary. The flow management and treatment system included in the selected remedy would be able to treat all flows that require treatment, up to a 100-year flood. Lime treatment cannot be used as a quick fix at various stages in the flow management and treatment process. Lime treatment relies on the slow formation and settling of particles of insoluble metal hydroxides, and can only be successful in a quiescent system with a long residence time, such as provided by Pond 3.

Avoiding future fishkills is an important goal. The agencies believe that the ongoing Mill-Willow Bypass Removal and this ROD will adequately address the fishkill problem without the need to buffer pH levels in the bypass. By removing the tailings and contaminated soils from the bypass and isolating the bypass from Silver Bow Creek flows except during large floods, the fishkill problem in the bypass should be solved.

Several comments (Letters 72, 95, 138) suggested that the remedial measures, especially along the Mill-Willow Bypass, be designed to include wildlife enhancing features, such as improving the bypass habitat for trout spawning and rearing.

Response: The FS did not specifically address methods to improve the fisheries in the Mill-Willow Bypass. The primary goal of the cleanup in the bypass is to eliminate the sources of contamination that cause the fishkills. Fish habitat improvements would be desirable and may be incorporated by ARCO in the final design, either to address compliance with ARARs or to address natural resource damage claims.

1.4.12 Wetlands and Wildlife Habitat.

Two commenters (Letters 63, 138) recommended that the agencies give greater consideration to the need for and value of wetlands at the Warm Springs Ponds. Another commenter (Letter 72) thought that the risks of developing wetlands below Pond 1 outweighed the benefits because the wetlands would not remove heavy metals, and in fact, might lead to recontamination of areas that will have been remediated. In addition, the proposed periodic removal of contaminated revegetation would disrupt the functioning of the wetland and lower its usefulness to wildlife.

Response: EPA and MDHES do recognize the value of wetlands in the Warm Springs Ponds area. The preferred alternative proposed by MDHES and EPA would, on balance, create additional wetlands. Although some wetlands would be eliminated in the Pond 1 area, additional wetlands would be created in Pond 2. The development or removal of wetlands must be addressed in conjunction with other concerns, such as prevention of groundwater contamination and protection of human health. The removal of the wetlands in the Pond 1 area will help to reduce the groundwater contamination underneath and downgradient of Pond 1.

As final design plans are prepared by ARCO for the remediation of Warm Springs Ponds, EPA and MDHES will work with ARCO to identify potential opportunities for wetlands that are consistent with the requirements for the site cleanup. The agencies and ARCO are considering a wetlands system for the area below Pond 1 that would be used to treat groundwater for metals removal. While metals do not biodegrade, they would be assimilated by the aquatic vegetation in the wetland. By periodically harvesting the vegetation, metals levels in the biomass can be kept below toxic levels. Discharge from the wetland would meet the appropriate discharge standards for the operable unit.

The primary purpose for the wetlands would be to provide treatment for contaminated groundwater. Improvements to wildlife habitat would be a secondary benefit. Once established, the wetlands would be expected to operate in a fashion similar to the upper portion of Pond 2 with large areas of vegetation and wildlife habitat.

Numerous commenters suggested that the remediation plans include elements that improve wildlife habitat at the Ponds. Several commenters (Letters 45, 47, 77, 78, 87, 95, 104, 114, 148, 158; Testimony A-13, B-2, B-7) stated that the ponds are an excellent waterfowl and fisheries habitat and that this should be considered before decisions are made about pond removal and dry capping. Another commenter (Letter 139) recommended that the final remediation plan include provisions for several "hog hole" size ponds to overwinter large fish similar to those in Ponds 2 and 3. Finally, one commenter (Letter 61) criticized the Proposed Plan because it "does nothing for wildlife and fish."

Response: The CERCLA remediation process does not allow funding specifically for measures to enhance wildlife and fisheries habitat. The primary purposes of proposed remedial actions are to provide long-term protection of public health and the environment. To accomplish this, the selected remedy will reduce the risk of catastrophic failure of the pond system and improve water quality in the Clark Fork through a variety of measures.

Only Pond 1 is being considered for dry closure. It is the primary source of the groundwater contamination, and for this reason, needs to be dry closed. The primary fisheries and waterfowl habitats are located in Ponds 2 and 3. The only significant alteration to these habitats under the selected remedy would entail the flooding of the portions of Pond 2 that are currently dry. This flooding would increase waterfowl habitat.

One commenter (Letter 130) thought that monies should be given to the Department of Fish, Wildlife and Parks to purchase or enhance wildlife and public recreation areas.

Response: Compensation for contaminated areas could not come from CERCLA funds (Superfund), but would have to be obtained in a separate action from those parties responsible for the contamination. Compensation for impacts to natural resources could also be addressed separately from Superfund under the natural resource damage claims against those parties responsible for the environmental damage.

2.4.13 Statements of Preference for Alternatives.

One commenter (Letter 150) stated a preference for Alternative 1, which included in-place solidification of all tailings, contaminated sediments, and sludges, because it could be considered a permanent remedy.

Response: Alternative 1 was included in the FS because the CERCLA statutes require consideration of alternatives that utilize treatment to reduce toxicity, mobility, and volume of contamination. Treatment alternatives are to be given preference as long as costs are not excessive. Alternative 1 was included to provide a treatment alternative for comparison purposes. The estimated costs of Alternative 1, at over $1.6 billion, are considered excessive when compared against its relative benefits (see Chapter 8 of the FS for the comparison of alternatives).

Several commenters (Letters 68, 79, 115, 131, 138, 153; Testimony M-2, M-4) stated opposition to Alternative 3 because they thought it inadequately dealt with the possibility of downstream contamination due to floods. These commenters supported Alternative 2, which included an 8,000-acre-foot upstream impoundment for flood control and treatment. Letter 138 noted the need to implement a remedy that will ensure attainment of EPA Gold Book criteria in the Clark Fork River up to the 100-year flood event.

Response: By capturing nearly the entire volume of the 100-year flood in Pond 3 and providing treatment through liming and settling, the selected remedy is thought to provide adequate protection from possible contamination of the Clark Fork River due to flooding.

EPA and MDHES agree that achieving Gold Book standards up to the 100-year flood is a desirable goal, and will result in compliance with ARARs. The primary goal capturing the 100-year flood event is to limit sediment transport from Silver Bow Creek through the Mill-Willow Bypass to the Clark Fork River. This goal is to prevent recontamination of the bypass and to limit the future degradation of the Clark Fork River by continued deposition of tailings.

In conjunction with opposition to the upstream impoundment component of Alternative 3, numerous commenters (Letters 8, 11, 18, 22, 26, 34, 35, 39, 43, 48, 54, 59, 60, 63, 71, 77, 87, 94, 148, 160; Testimony A-1, A-3, A-4, A-6, A-11, B-3, M-6) expressed support for ARCO Plan 3A or a similar approach that would include many of the Plan 3A components, such as raising the Pond 3 dikes, adding improved intake structures to Pond 3, and improving wetlands, fisheries, and wildlife habitat. One commenter (Letter 95) stated a preference for the ARCO plan with minor modifications.

Response: EPA and MDHES have considered ARCO's Plan and have decided to incorporate some of ARCO's suggestions into the final remedy. The ROD provides a complete description of the new remedy, including those elements that come from ARCO's plan.

Several commenters (Letters 78, 139) felt that the RI/FS should have studied an alternative similar to ARCO's Plan, but noted that, since ARCO released their Plan independently, there is no easy way to fairly compare costs, etc. For example, since the ARCO Plan uses different assumptions than the MDHES Plan for 100-year flood, and neither includes Warm Springs Creek in their flood projections, it is difficult to compare the relative merits of the approaches.

Response: Many of the components in ARCO's Plan were included in alternatives developed in the RI/FS. However, the method of treating the 100-year flood, as proposed by ARCO, was not included in the RI/FS.

The fact that ARCO used different design assumptions does make it more difficult to compare the two plans. The Flood Modeling Study used in the preparation of the RI/FS did calculate the 100-year flood on Warm Springs Creek. The flows from Warm Springs Creek were not included as part of the flow at the inlet to the pond system simply because they join the Mill-Willow Bypass below the pond system.

A focused evaluation of ARCO's plan was conducted by EPA and MDHES and it part of the administrative record. This analysis enabled the agencies to devise and select the remedy described in the ROD, which combines portions of the original Proposed Plan and ARCO's plan.

2.4.14 Monitoring and Long-term Maintenance.

Several commenters (Letter 101, 108, 126, 138) noted that the FS does not include future monitoring plans, and expressed an interest in reviewing the monitoring plan when it is developed. Two commenters (Testimony M-9, M-10) recommended that the agencies establish flow measurement stations upstream and downstream of the ponds and that a comprehensive monitoring program be developed to gauge the effectiveness of the proposed alternatives.

Response: Monitoring plans are generally not developed in the feasibility study. These plans are normally developed during the remedial design phase after the decision is made concerning which alternative will be implemented. The public will have an opportunity to review and comment on the draft of the proposed monitoring plans once they are developed.

The FS did consider the need for monitoring, and the operations and maintenance cost estimates include allowances for such monitoring. EPA and MDHES agree that flow measurement stations are desirable for future monitoring. Flow measurement stations (including water quality monitoring) will likely be part of the long-term monitoring program to be spelled out in the monitoring plan. It should be noted that the USGS did maintain a gaging station (No. 12323750) on the Mill-Willow Bypass just upstream from the confluence with Warm Springs Creek. This gaging station was maintained from April 1972 through September 1979, and data from this station were used in the preparation of the FS.

One comment (Letters 136, 146, 147, 148) asked who will be responsible for costs associated with replacement or maintenance of the ponds in the future?

Response: ARCO will probably be responsible for these costs.

2.4.15 Miscellaneous Comments Regarding Alternatives.

One commenter (Letter 154) thought it appeared that cataclysmic events had received more attention in the FS than the slower erosional processes which "play a larger role in the transport and enrichment of toxic metals in downstream environments."

Response: The FS addresses both the cataclysmic events and the slower year-to-year processes that tend to add up to significant movement of contaminants. The alternatives developed address both types of processes. The pond treatment system, if upgraded and properly operated, will provide a valuable barrier to the erosional processes that could eventually carry the majority of the tailings remaining along Silver Bow Creek to the Clark Fork River.

ATTACHMENT TO III-A

PUBLIC COMMENT CROSS-REFERENCE

GENERAL COMMENTS	1. Remediation Approach	2. Remediation Schedule	3. Interim vs Permanent	4. Public Participation	5. Miscellaneous	SITE CHARACTERIZATION	1. Groundwater	2. Tailings/ Sediments	3. Surface Water	4. Risk Assessment	ARARs	1. Water Quality	2. Dam Safety	3. Soils Cleanup	ALTERNATIVES	1. Flood Modeling	2. Flood Control/ Treatment	3. Upstream Impoundment	4. Flood Protection	5. Earthquake Protection	6. Tailings Removal	7. Tailings Reclamation	8. Treatment In Ponds	8. Groundwater Treatment	10. Costs	11. Mill-Willow Bypass	12. Wetlands/ Wildlife	13. Alternative Preference	14. Monitoring/ Maintenance	15. Miscellaneous
1. Carol Alette	♦																													
2. Nicki Leiss																		♦												
3. Frank Komadince				♦	♦			♦	♦									♦												
4. James McNoy	♦																													
5. William Thomas																	♦													
6. Byron Dodd																						♦								
7. Nicki Leiss																		♦												
8. Charles Haeffner, ADLRA																		♦								♦		♦		
9. Nicki Leiss																					♦									
10. Connie Ternes Daniels, Opportunity Concerned Citizens																		♦												
11. Mr. & Mrs. Francis Kanduch			♦															♦							♦					
12. Al Varella				♦																										
13. Ernest & Erika Ward																		♦												
14. Kathleen Francisco				♦														♦												
15. Jack Francisco				♦														♦												
16. Donahue & Mary Ellen Crisler																		♦												
17. Terry Keyes				♦														♦												
18. Phil Kanduck																		♦										♦		
19. Nadine Paige				♦														♦												
20. Alfred Klemman			♦	♦														♦												
21. Florence Ingwerson																		♦												
22. Robert Ingwerson																		♦										♦		
23. Bob Sestrich	♦																	♦												
24. Martha Sestrich																		♦												
25. P.J Duffy					♦													♦												

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26. Shirley & Duane Culwell					◆													◆							◆			◆		
27. Mr. & Mrs. Martin Parent	◆																	◆												
26. Michael McGee				◆														◆												
29. Don Hewitt	◆																	◆												
30. John Stewart																		◆												
31. David McGee																		◆												
32. George Niland					◆													◆												
33. Raymond Deakins & Larry & Donna Swope																		◆												
34. Pete Reisenauer, Jr.			◆	◆														◆							◆			◆		
35. Peter Reisenaur				◆														◆										◆		
36. Robert Daniels				◆														◆												
37. Gilbert Fischer																		◆												
38. Stan Preshar																		◆												
39. Mr. & Mrs. Andy Anderwald			◆															◆												
40. Judy Minnehan				◆														◆												
41. Eugene Calucci	◆				◆													◆												
42. Maxine & Darrell Baker																		◆												
43. Millie Mathews			◆															◆							◆			◆		
44. Terry Spear	◆																	◆												
45. Jed Thomas	◆												◆							◆							◆			
46. Joe Roberts				◆	◆												◆									◆				
47. Melvin Stokke																◆	◆	◆		◆						◆	◆			
48. Robert Vine		◆			◆													◆								◆		◆		
49. Nicki Leiss				◆														◆								◆				
50. Nicki Leiss					◆																									

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51. F.R. Bennett, ADLRA																		♦	♦								♦				
52. Jim Keane, MT Operating Engineers Training Program						♦																									
53. Missoula Co. Comm.				♦									♦					♦		♦	♦				♦		♦				
54. Steve Antonioli																													♦		
55. Robin Richards		♦																	♦												
56. Mary Beer		♦	♦																♦	♦	♦	♦									
57. Robin Richards		♦																	♦												
58. Serge Myers																			♦			♦				♦					
59. Blonde Patrick																													♦		
60. Robert & Nita Perlman					♦																				♦				♦		
61. Jack Atcheson																												♦			
62. Laurence Siroky, DNRC														♦						♦	♦										
63. Jack Jones						♦																						♦	♦		
64. Jean Peck, SAndpoint ID, CEntral Bus. Assn.				♦									♦					♦	♦	♦	♦	♦	♦				♦				
65. City of Sandpoint, ID		♦		♦									♦																		
66. City of Kootenai, ID				♦									♦					♦	♦	♦	♦	♦	♦				♦				
67. Joe Moreland, USGS								♦					♦												♦						
68. Frank Rives		♦	♦	♦																♦	♦	♦	♦				♦		♦		
69. City of Clark Fork, ID				♦									♦					♦	♦	♦	♦	♦	♦				♦				
70. James Murry, AFL-CIO			♦			♦																									
71. Sam Worcester																			♦				♦						♦		
72. Kemper McMaster, USF & WS									♦	♦			♦		♦			♦						♦			♦	♦			
73. City of Hope, ID				♦									♦					♦	♦	♦	♦	♦	♦				♦				
74. City of East Hope, ID				♦									♦					♦	♦	♦	♦	♦	♦				♦				
75. Sandpoint, ID, Chamber of Commerce					♦								♦						♦	♦	♦	♦					♦				

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76. Anaconda Chamber of Commerce				♦														♦												
77. Terry Schoonen, Skyline Sportsmen Assn.												♦															♦	♦		
78. Michael Grayson			♦	♦													♦	♦			♦						♦			♦
79. Edgar Butler													♦					♦			♦							♦		
80. Peg Patterson																		♦												
81. James Davison, Anaconda Local Development				♦														♦												
82. Kenneth Bender																	♦							♦						♦
83. Stanley Glovan, Jr.																		♦												
84. Robin Richards	♦																													
85. Jck Duffield	♦																	♦												
86. Millie Mathews	♦		♦																											
87. Anaconda/Deer Lodge Reclamation Advocates				♦														♦								♦	♦	♦		
88. Steve Loken																					♦	♦								
89. Bernard Shaw	♦	♦	♦	♦								♦	♦				♦	♦	♦	♦	♦	♦		♦		♦				
90. Frederick Tossberg													♦					♦	♦	♦	♦					♦				
91. Wesley Wilson	♦	♦											♦						♦	♦										
92. Robert Berrison	♦																♦													
93. Bill Burnett		♦																			♦									
94. Paul & Dorothy Gambee																												♦		
95. Bob Greene																	♦									♦	♦			
96. Alice & Briggs Austin		♦																												
97. Kathy Ahlenslager		♦	♦									♦	♦				♦		♦	♦	♦									
98. J. George Hummel		♦	♦									♦	♦				♦		♦	♦	♦					♦				
99. Mark Connell												♦	♦				♦	♦	♦	♦	♦	♦				♦				
100. John Dilly	♦	♦	♦	♦								♦	♦				♦	♦	♦	♦	♦	♦		♦		♦				

GENERAL COMMENTS	1. Remediation Approach	2. Remediation Schedule	3. Interim vs Permanent	4. Public Participation	5. Miscellaneous	SITE CHARACTERIZATION	1. Groundwater	2. Tailings/ Sediments	3. Surface Water	4. Risk Assessment	ARARs	1. Water Quality	2. Dam Safety	3. Soils Cleanup	ALTERNATIVES	1. Flood Modeling	2. Flood Control/ Treatment	3. Upstream Impoundment	4. Flood Protection	5. Earthquake Protection	6. Tailings Removal	7. Tailings Reclamation	8. Treatment in Ponds	9. Groundwater Treatment	10. Costs	11. Mill-Willow Bypass	12. Wetlands/ Wildlife	13. Alternative Preference	14. Monitoring/ Maintenance	15. Miscellaneous
101. Missoula Water Quality Advisory Group	◆		◆	◆	◆					◆		◆	◆				◆	◆	◆		◆			◆	◆				◆	
102. John Roskelley												◆					◆		◆	◆	◆	◆								
103. John Wozniak																					◆									
104. Peter Forsythe												◆				◆	◆		◆	◆			◆				◆			
105. Robin Richards	◆			◆														◆												
106. Richard & Edie Smith			◆									◆	◆				◆		◆	◆	◆									
107. Jodie Canfield	◆		◆	◆	◆							◆					◆	◆			◆	◆			◆	◆				
108. Missoula City-County Board of Health	◆		◆							◆		◆	◆				◆	◆	◆		◆			◆	◆				◆	
109. Mark Story & Melissa Miller		◆	◆									◆					◆		◆	◆	◆	◆				◆				
110. Robert Daniels				◆																										
111. Ron Pierce	◆											◆	◆				◆								◆					
112. Daryl & Sherrie Parker		◆	◆									◆					◆	◆												
113. Gene Murphy, Mile Conservation Dist.				◆	◆													◆				◆								
114. John Langstaff		◆											◆						◆	◆	◆						◆			
115. John Fraley, Amer. Fisheries Society			◆									◆					◆	◆	◆	◆	◆	◆	◆			◆		◆		
116. James Greene		◆										◆	◆				◆		◆	◆	◆	◆								
117. Cody Brooks			◆																		◆	◆				◆				
118. Richard Faust, Bitterroot-Mission Sierra Club	◆	◆	◆	◆								◆	◆				◆	◆	◆	◆	◆	◆		◆		◆				
119. David Kebler	◆	◆	◆										◆					◆	◆	◆	◆				◆	◆				
120. James Daub																	◆	◆			◆	◆				◆				
121. Douglas Webber												◆					◆		◆		◆									
122. Mary Vant Hull		◆										◆					◆	◆	◆	◆										
123. E. Terrill Nobles	◆	◆	◆	◆								◆	◆				◆	◆	◆	◆	◆	◆		◆		◆				
124. Jerry Giess	◆		◆																		◆	◆								
125. Judy Evans		◆																◆	◆	◆	◆									

GENERAL COMMENTS	1. Remediation Approach	2. Remediation Schedule	3. Interim vs Permanent	4. Public Participation	5. Miscellaneous	SITE CHARACTERIZATION	1. Groundwater	2. Tailings/ Sediments	3. Surface Water	4. Risk Assessment	ARARs	1. Water Quality	2. Dam Safety	3. Soils Cleanup	ALTERNATIVES	1. Flood Modeling	2. Flood Control/ Treatment	3. Upstream Impoundment	4. Flood Protection	5. Earthquake Protection	6. Tailings Removal	7. Tailings Reclamation	8. Treatment in Ponds	9. Groundwater Treatment	10. Costs	11. Mill-Willow Bypass	12. Wetlands/ Wildlife	13. Alternative Preference	14. Monitoring/ Maintenance	15. Miscellaneous
126. City of Missoula	♦		♦	♦	♦					♦		♦	♦				♦	♦	♦	♦	♦			♦	♦				♦	
127. Brian Jameson	♦																													
128. Bonner Boundary Board of Realtors			♦									♦					♦	♦	♦	♦	♦	♦				♦				
129. William Macgregor	♦		♦	♦																	♦									
130. Chris Marchion	♦		♦		♦													♦												
131. Frank Rives		♦	♦	♦								♦	♦				♦	♦	♦	♦	♦	♦		♦		♦		♦		
132. Dick Baroni		♦										♦	♦				♦		♦	♦	♦					♦				
133. Mary Leonard			♦									♦					♦				♦			♦						
134. Paul Roos, Big Blackfoot Trout Unlimited		♦										♦	♦				♦	♦	♦	♦	♦	♦								
135. Rich Day, MT Wildlife Fed.		♦	♦									♦	♦				♦	♦	♦	♦	♦			♦		♦				
136. David Atkins			♦										♦						♦						♦				♦	
137. John Duffield																									♦					
138. Patrick Graham, DFW&P			♦						♦			♦	♦				♦	♦	♦	♦	♦		♦			♦	♦	♦	♦	
139. Tim Sullivan	♦	♦										♦					♦					♦				♦	♦			
140. Lynda Saul			♦										♦								♦	♦								
141. ARCO Coal Company (See Section 3)																														
142. Janet Ellis, MT Audobon Council		♦	♦										♦				♦		♦	♦	♦					♦				
143. Arlene Dierker	♦		♦									♦	♦				♦		♦	♦	♦	♦				♦				
144. Denise Moldroski Mott	♦											♦					♦	♦			♦					♦				
145. Kathleen McLaughlin		♦										♦	♦				♦	♦	♦	♦	♦	♦				♦				
146. Chris Kaufman, MEIC			♦									♦					♦	♦	♦	♦	♦	♦				♦			♦	
147. Scott Luchessa		♦	♦									♦	♦				♦							♦					♦	
148. Dick Solum																		♦									♦	♦	♦	
149. Ruth Watkins, Clark Fork Coalition		♦	♦										♦					♦	♦	♦	♦					♦				
150. Gary Baxter				♦																								♦		

	151. Peter Nielsen, Clark Fork Coalition	152. Tom FRance, National Wildlife Fed.	153. Land Lindbergh	154. James O'Toole	155. Sherri Johnson	156. Dan Ueland, Headwaters RC & D	157. Kim Reineking, West Slope Trout Unlimited	158. Melvin Stokke	159. Don & Rebecca Holland	160. D.R. Stoecker	161. Claude Rosenberg, Jr.	162. Judith Carnes
GENERAL COMMENTS												
1. Remediation Approach	•			•			•					
2. Remediation Schedule	•		•	•	•				•		•	
3. Interim vs Permanent	•	•										
4. Public Participation	•											
5. Miscellaneous												
SITE CHARACTERIZATION												
1. Groundwater												
2. Tailings/ Sediments				•								
3. Surface Water												
4. Risk Assessment				•								
ARARs												
1. Water Quality	•		•	•	•				•		•	
2. Dam Safety	•	•										
3. Soils Cleanup												
ALTERNATIVES												
1. Flood Modeling				•								
2. Flood Control/ Treatment	•		•	•	•				•		•	
3. Upstream Impoundment	•			•		•		•		•	•	
4. Flood Protection	•	•	•				•	•	•			
5. Earthquake Protection	•	•	•				•	•	•	•	•	
6. Tailings Removal	•			•	•				•		•	
7. Tailings Reclamation	•				•				•			•
8. Treatment in Ponds												
9. Groundwater Treatment	•			•	•			•				
10. Costs				•								
11. Mill-Willow Bypass	•				•		•	•	•	•	•	
12. Wetlands/ Wildlife								•				
13. Alternative Preference			•							•		
14. Monitoring/ Maintenance												
15. Miscellaneous												

	GENERAL COMMENTS 1. Remediation Approach	2. Remediation Schedule	3. Interim vs Permanent	4. Public Participation	5. Miscellaneous	SITE CHARACTERIZATION	1. Groundwater	2. Tailings/ Sediments	3. Surface Water	4. Risk Assessment	ARARs	1. Water Quality	2. Dam Safety	3. Soils Cleanup	ALTERNATIVES	1. Flood Modeling	2. Flood Control/ Treatment	3. Upstream Impoundment	4. Flood Protection	5. Earthquake Protection	6. Tailings Removal	7. Tailings Reclamation	8. Treatment in Ponds	9. Groundwater Treatment	10. Costs	11. Mill-Willow Bypass	12. Wetlands/ Wildlife	13. Alternative Preference	14. Monitoring/ Maintenance	15. Miscellaneous
BUTTE HEARING																														
B-1. Jim Keane					◆																									
B-2. Bill Holdorf		◆																									◆			
B-3. Bill Williams				◆						◆								◆										◆		
B-4. Fritz Daily		◆	◆	◆																										
B-5. Richard Jalusso																		◆				◆								
B-6. Darcy DeLong	◆																	◆												
B-7. Mr. Dupuis					◆																						◆			
B-8. Jimmy Shea				◆	◆																									
B-9. Floyd Bossard																		◆												
B-10. Ole Ueland	◆			◆																										
MISSOULA HEARING																														
M-1. Gardner Dunn		◆							◆			◆					◆		◆	◆		◆								
M-2. Robert Sarkisian									◆										◆									◆		
M-3. Andry Rayner	◆								◆			◆	◆				◆	◆	◆	◆	◆	◆								
M-4. John Mercer												◆												◆				◆		
M-5. Tim Williamson		◆	◆	◆								◆	◆								◆					◆				
M-6. Bill Williams				◆						◆								◆										◆		
M-7. Ellen Knight			◆	◆								◆					◆		◆	◆				◆						
M-8. Tina Reinicke-Schmaus			◆	◆						◆		◆					◆				◆									
M-9. James Rockosh	◆		◆									◆					◆				◆								◆	
M-10. Vicki Watson	◆	◆	◆	◆								◆	◆			◆	◆		◆		◆					◆			◆	
M-11. Brad Martin			◆	◆								◆	◆				◆				◆									
M-12. Ritch Doyle				◆																										

GENERAL COMMENTS	1. Remediation Approach	2. Remediation Schedule	3. Interim vs Permanent	4. Public Participation	5. Miscellaneous	SITE CHARACTERIZATION	1. Groundwater	2. Tailings/ Sediments	3. Surface Water	4. Risk Assessment	ARARs	1. Water Quality	2. Dam Safety	3. Soils Cleanup	ALTERNATIVES	1. Flood Modeling	2. Flood Control/ Treatment	3. Upstream Impoundment	4. Flood Protection	5. Earthquake Protection	6. Tailings Removal	7. Tailings Reclamation	8. Treatment in Ponds	9. Groundwater Treatment	10. Costs	11. Mill-Willow Bypass	12. Wetlands/ Wildlife	13. Alternative Preference	14. Monitoring/ Maintenance	15. Miscellaneous
M-13. Linda Helding			◆		◆							◆	◆				◆	◆	◆							◆				
M-14. Jim O'Toole																◆					◆									
M-15. Jim Carlson			◆									◆	◆				◆		◆	◆	◆									
M-16. Barry Dutton				◆																										
ANACONDA HEARING																														
A-1. Nicki Leiss					◆													◆										◆		
A-2. Connie Ternes Daniels	◆			◆														◆					◆			◆				
A-3. Bill Williams				◆						◆								◆										◆		
A-4. Al Clark					◆																							◆		
A-5. Frank Bennett				◆																										
A-6. Chuck Haeffner				◆														◆										◆		
A-7. Gene Vuckovich				◆														◆	◆	◆				◆		◆				
A-8. Mel Stokke				◆	◆																									
A-9. Terry Spear	◆																◆	◆												
A-10. Robert Daniels																		◆												
A-11. Mick Fuller																		◆										◆		
A-12. Red Menahan	◆			◆																										
A-13. Jerry Gallegher																							◆			◆	◆			
A-14. Mike Grayson				◆												◆		◆	◆	◆				◆		◆				
A-15. Bruce Farling	◆		◆	◆								◆	◆				◆		◆	◆	◆	◆			◆	◆				
A-16. Robin Richards	◆																	◆												

PART B - RESPONSES TO ARCO COMMENTS

NOTE: The response to ARCO comments will be formatted in the exact outline of the Feasibility Study to permit direct responses to specific comments.

CHAPTER 1.0
INTRODUCTION

No comments

CHAPTER 2.0
RESPONSES TO ARCO COMMENTS, CHAPTER 2.0
SITE DESCRIPTION AND CONTAMINATION CHARACTERISTICS

2.1 SITE BACKGROUND

Comment: This comment states that the responsibility for administering the Warm Springs Ponds is inaccurately described in the FS, because the FS fails to note that the Warm Springs Ponds are a regulated facility under the Montana Pollutant Discharge Elimination System (MPDES).

Response: The intent of this section of the FS was to provide a general description of the background and history of the Warm Springs Ponds. It is recognized that ARCO holds an MPDES permit for discharges from Pond 2, and that the MDHES Water Quality Bureau administers regulation of ARCO's compliance with the provisions of the MPDES permit. The permit will continue to be required for the Pond 2 discharge.

2.2 SITE DESCRIPTION

2.2.1 Physiography/Demography

No comments.

2.2.2 Climate

No comments.

2.2.3 Geology

No comments.

2.2.4 Soils

Comment: This comment states that soils within the Warm Springs Ponds Operable Unit have not been affected by smelter wastes, waste rock, and leach pond deposits and that there is no information to indicate that waste rock, leach pond deposits, or smelter wastes exist within the operable unit.

Response: Smelter wastes associated with historic discharges from the Opportunity Ponds into the Warm Springs Ponds are identifiable adjacent to the two channels connecting the sites (SS-23 and SS-24, Figure 2-6 of the FS). It is known that the Opportunity Ponds were used in conjunction with the waste streams emanating from the Anaconda Smelter; hence, the deposits present within the Warm Springs Ponds Operable Unit adjacent to the channel connecting the two sites are presumed to be associated with wastes derived from this source. Direct evidence of leach pond deposits and waste rock within the operable unit is lacking. The terms were used in a generic sense to relay to the reader that the site has been affected by waste material related to mining, milling, and smelting activities in the Butte and Anaconda areas.

2.2.5 Surface Hydrology

Comment: This comment questions the value of 700 cfs as the capacity of the Pond 3 inlet structure and states that the actual inlet structure capacity is 1,400 cfs. It also notes that plugging of the structure can cause washout of the fuse plug at less than 1,400 cfs.

Response: Calculation of the inlet structure capacity (Silver Bow Creek Flood Modeling Study, CH2M HILL, 1988) indicated a maximum flow rate of approximately 900 cfs under ideal conditions. This estimate was downrated to 700 cfs to account for plugging, age, and actual field conditions. Plugging that causes premature washout of the fuse plug is noted on page 7-26 of the FS.

2.2.6 Ground Water Hydrogeology

No comments.

2.2.7 Land Use

1. Comment: This comment states that the description of land use within the operable unit is incomplete because the principal land use (water treatment and mining waste disposal) is not specifically identified.

   Response: As stated on page 2-5 of the FS, the Warm Springs Ponds were originally developed to control the amount of sediment and tailings carried into the Clark Fork River from Silver Bow Creek. Page 2-6 of the FS indicates the ponds were not used as a water treatment unit until 1967 when Pond 3 was converted from a sedimentation pond into a treatment pond. Currently, a principal use of the area is for water treatment. Other principal uses are recreational and occupational uses, associated with fishing, hunting, and wildlife management.

2. Comment: This comment states that the area and volume of contaminated soils provided in Table 2-2 are not representative of actual soils conditions below a depth of 1 inch, the maximum depth investigated. The volumes for contaminated soils should be based on contaminant action levels or a representative sampling methodology.

   Response: The areas and volumes of tailings and contaminated soils presented in Table 2-2 were not based on contaminant action levels nor were they presented as such. The areas and volumes are values estimated through evaluation of data collected during the Phase II

Remedial Investigation (RI) of the Warm Springs Ponds Operable Unit.

As stated in the Phase II RI Data Summary Report and in the FS, calculation of the areal extent of contaminated material in these areas was based on field mapping of denuded areas characteristic of exposed tailing deposits, and through evaluation of both X-ray fluorescence (XRF) spectrometer data and laboratory data for arsenic, copper, zinc, and iron in soil samples collected in conjunction with the RIs. Samples from areas exhibiting arsenic, copper, zinc, or iron greater than 50 percent above the levels in adjacent areas were classified as contaminated. Hand-auger borings were made through these areas to det~rmine thickness of the deposits. It is not true that the "maximum depth investigated" was one inch. Thicknesses of those areas determined to contain tailings and contaminated soils were identified visually by lithologic color change; this break typically correlated with decreases of 30 to 50 percent in XRF and laboratory data for copper, zinc, arsenic, and iron.

A total of 115 sites were sampled in three portions of the Warm Springs Ponds Operable Unit during the Phase II RI. Numerous samples were collected at these sites to characterize materials chemistry with depth. Sampling methodologies used during the RI were standardized and completed in accordance with the project sampling and analysis plan. In addition, more than 50 hand-augered boreholes were drilled in material adjacent to the Mill-Willow Bypass to aid in visually determining thicknesses of tailing deposits and contaminated soils. These data were incorporated into a field map showing the areal extent of various materials identified in the bypass area.

This method of site characterization provided reasonable estimates of the volumes of contaminated materials and provided a basis for cost estimates for the various remedial alternatives. Detailed field characterization of the areas and volumes of materials that exceed contaminant action levels (to be established in conjunction with the ROD) will have to be completed during the design investigation phase.

2.3 NATURE AND EXTENT OF CONTAMINATION

1. Comment: This comment states that Figure 2-1 should include identification of the current MPDES compliance point at Pond 2 and the Wildlife Ponds point of discharge into the Mill-Willow Bypass.

   Response: The intent of Figure 2-1, as indicated by its title, was to illustrate conceptually the pathways of contaminant migration within the Warm Springs Ponds Operable Unit. The surface water media and Warm Spring Ponds operation are described in detail in the surface water section of Chapter 2 (beginning on page 2-35) and in Figure 2-3.

2. Comment: This comment describes Figure 2-1 "as a diagram that is used to show the areas of contamination and migration pathways associated with the four contaminated media: (1) pond bottom sediments, (2) surface water, (3) tailings deposits and contaminated soils, and (4) ground water." The comment states that Figure 2-1 is incomplete because certain deposits of tailings and contaminated soils are not shown in the figure.

   Response: The intent of Figure 2-1 was to conceptually illustrate contaminant migration pathways at the Warm Springs Ponds Operable Unit. The figure was not intended or prepared to identify locations of all contaminant source areas within the operable unit.

2.3.1 Sediments, Tailings, and Soils

1. Comment. The comment states that, based on the volume and area indicated for contaminated soils present both adjacent to and underlying the tailings deposits along the Mill-Willow Bypass, the average thickness of contaminated soils is approximately 2.4 feet. The comment goes on to state that the estimate of extent and volume of contaminated soils cannot be independently evaluated for the following four reasons:

   a. Because analytical data for soils are combined with analytical data for tailings deposits, it is not possible to determine which analytical data were used to identify contaminated soils versus tailings deposits and uncontaminated soils.

   b. The FS does not specifically define "contaminated soil." The criteria used are not provided in either the FS or the Phase II RI.

   c. Analytical and XRF data results are limited to samples of soils and tailings deposits collected only from depths ranging between 0 and 1 inch, and cannot indicate soils conditions below that depth.

   d. Figures are not provided in the FS and Phase II RI that specifically identify the location of the 33 acres of contaminated soils along the Mill-Willow Bypass.

Response: XRF and laboratory analyses of surface samples were used to define the areal extent of tailing and contaminated soils. Hand-auger borings were used to estimate associated thicknesses and, therefore, volume of contaminated materials. The estimates of volumes of tailings and contaminated soils developed for the FS are suitable for the purposes of a FS and provide a reasonable basis on which remedial technologies and associated costs can be evaluated. Additional data on contaminated soils and tailings may be necessary to refine area and volume estimates in support of remedial design, once the preferred alternative for the site has been selected and contaminant action levels have been established for site soils. See the response to Section 2.2.7, Comment 2, for a more detailed discussion regarding criteria used to define contaminated soil and estimate volumes and acreages of contaminated soils within the operable unit. The field map mentioned in the response to Comment 2 under Section 2.2.7 shows the areas of contamination at the bypass area.

2. Comment: This comment states that XRF data are useful only as a general indicator of metal concentrations in soil and tailings, and that, if XRF data are to be used for other purposes, rigorous Quality Assurance/Quality Control (QA/QC) procedures should be used.

Response: XRF data collected at the Warm Springs Ponds Operable Unit have been used only as a general indicator of metal concentrations in soils and tailings. Quantitative soils and tailings data collected during the Phase II RI at the Warm Springs Ponds included laboratory analyses of collected samples and field measurements and observations. These data were used in conjunction with the qualitative XRF data to characterize site conditions relative to the needs of the FS process. Thus, the uses of XRF data in the FS are appropriate to its level of accuracy. Additional quantitative data may be necessary to support remedial design once the preferred alternative is selected after contaminant action levels are established.

2.3.2 Surface Water

1. Comment: This comment notes that the Silver Bow Creek 100-year flood is sometimes listed as having a peak flow of 4,000 cfs and sometimes as having a peak flow of 4,900 cfs.

   Response: The 100-year flood on Silver Bow Creek alone was calculated to be 4,000 cfs. The 100-year flood on Silver Bow, Mill, and Willow Creeks combined was calculated to be 4,900 cfs.

2. Comment: This comment states that an independent analysis performed by ARCO (1989a) using U.S. Geological Survey (USGS) methodology indicates that the peak flows are 3,300 cfs (Silver Bow Creek alone) and 4,000 cfs (Silver Bow, Mill, and Willow Creeks combined).

   Response: The issues presented in this comment were discussed during meetings with ARCO. Because of the uniqueness of hydrological analysis, several approaches are possible to provide quantitative results on flooding values for a basin. Because ARCO used a different approach, the results of the two studies were somewhat different. See the response to Section 4.1.1, Comment 3, for additional detail.

3. Comment: This comment questions the value of 146,000 cfs for the PMF on Silver Bow Creek. An independent flood analysis by ARCO concludes that the best estimate for the Silver Bow Creek PMF is approximately 80,000 cfs.

Response: There are a number of reasons why ARCO's calculations produced a PMF value that is low compared to the 146,000 cfs calculated by CH2M HILL. These reasons include an incorrect value used by ESA for the peak one-hour rainfall amount and incorrect assumptions of snow pack prior to the PMP. See the response to Section 4.1.1, Comment 4, for a complete response to this comment.

4. Comment: The value of 700 cfs cited as the capacity of the intake structure to Pond 3 is incorrect (page 2-39). The actual capacity is 1,400 cfs, which is nearly equivalent to a 10-year flood event for Silver Bow Creek. Page 2-39 should be corrected to indicate that the actual capacity of the intake structure is 1,400 cfs.

   Response: Calculation of the inlet structure capacity (Silver Bow Creek Flood Modeling Study, CH2M HILL, 1988) indicated a maximum flow rate of approximately 900 cfs under ideal conditions. This estimate was downrated to 700 cfs to account for plugging, age, and actual field conditions.

5. Comment: This comment states that the FS improperly applied "chronic freshwater aquatic standards" and "primary drinking water standards" to data collected in the ponds. The comment further states that the surface water quality standards are not applicable within the boundaries of the Warm Springs Ponds Operable Unit (ARM 16.20.615), and that improper application of MDHES water quality regulations has resulted in inappropriate and misleading statements in the FS.

   Response: The FS report cannot and does not attempt to "apply" water quality standards to the data collected at the Warm Springs

Ponds. Only the regulatory agencies can do that through the permitting processes and through the ROD process for the operable unit. The discussion on page 2-57 of the FS was not intended to imply that any water quality standards were violated at the Warm Springs Ponds, but rather to give the reader a sense of the contaminant levels in the ponds compared to the chronic freshwater and primary drinking water standards.

6. Comment: Paragraph 3, page 2-57, indicates that flow in the Mill-Willow Bypass exhibits an increase in hardness, sulfate, and zinc concentrations between its head and its confluence with the Pond 2 discharge. The increase in concentrations of these parameters is attributed solely to ground water inflow, based on synoptic flow measurements and a specific conductance survey completed during base flow conditions. The comment states that ground water inflow to the bypass is not necessarily the only source and notes that the increases in certain chemical constituents may be due, in part, to direct contact of surface flows with sediments along the 3.5-mile reach of the bypass.

Response: The sediments along the bypass were not considered a potential major source for measured increases in hardness, sulfate, and zinc concentrations. The statement in the FS should have been that ground water is the primary source of increases in concentrations of these parameters. Two types of data were used in reaching this conclusion: sampling completed in the bypass during July 1988, when all surface water in the bypass was being diverted into Pond 3; and sampling of monitoring wells located adjacent to the Mill-Willow Bypass.

Samples of water in the bypass were collected below the point of diversion of the surface water in the bypass into Pond 3 at Surface Water Station SS-18C (Figure 2-2, Phase II RI Data Summary Report). Water sampled at this site was ground water inflow to the otherwise dry channel; the sampled water had flowed along the bypass channel for only a short distance. The concentrations of total, dissolved, and acid soluble zinc in this sample were 112, 67, and 200 $\mu g/l$, respectively. In comparison, surface water in the Mill-Willow Bypass, above the point of diversion sampled 2 days later, exhibited concentrations of total, dissolved, and acid soluble zinc of 18, 13, and 77 $\mu g/l$, respectively. Likewise, the hardness concentration in the sample collected at SS-18C, below the diversion, was 644 mg/l as compared to a hardness concentration at SS-18 of 181 mg/l.

Ground water quality data collected during the Phase II RI at various locations along the Mill-Willow Bypass indicate that zinc and sulfate concentrations in ground water are considerably higher than concentrations in surface water in the bypass, measured at its head. For example, zinc concentrations in monitoring wells located adjacent to the bypass ranged from 13 to 1,250 $\mu g/l$ as compared to average total and dissolved zinc concentrations measured at SS-18 during the Phase I RI of 45 and 28 $\mu g/l$, respectively. Sulfate concentrations in monitoring wells located adjacent to the bypass ranged from 60 to 1,190 mg/l, as compared to an average concentration in surface water at SS-18 of 53 mg/l.

The foregoing data, combined with an evaluation of the water table map of the Warm Springs Ponds Operable Unit (Figure 2-12, FS), strongly suggest that ground water inflow is the primary source of increases in hardness, zinc, and sulfate. Other sources may contribute to the measured increases in parameter specific concentrations, but the magnitude of these contributions is probably relatively small.

7. Comment: This comment states that data from the FS and the RI indicate that upstream sources, other than dissolved metals from tailings deposits, appear to have a substantial impact on pond system chemistry. The data show that the greatest variability over a 24-hour period for non-metal parameters, including algae, occurs in the pond inflow. The greatest magnitude in algae, and in the nutrients which feed algae, are found in Silver Bow Creek upstream of the ponds. The investigation attributes these findings to varying inputs to the creek, including the Butte Sewage Treatment Plant and other unspecified sources. In addition, large variability in copper and zinc concentrations over a 24-hour period are found in the pond inflow, indicating a varying source.

   The comment states that two factors (metals loading and nutrient supply) are especially critical in controlling Warm Springs Ponds system performance for removal of metal contaminants, but they are not addressed in the FS. The comment suggests that source control restrictions on industries, municipalities, and other upstream point source contributors may be necessary to assure that the Warm Springs Ponds can maintain consistent compliance with the surface water ARARs.

   The comment concludes that "if the WSP system is managed as a treatment unit for other upstream sources, ARARs which are otherwise legal requirements for development of discharge limitations for effluent from the WSP treatment system should be waived in light of the technical impracticability of treating surface waters exhibiting highly variable quality characteristics. A waiver under such circumstances is appropriate. Section 121 (4)(c) of CERCLA. For example, if the nutrient supply is not controlled then seasonal excursions in pH (standard measure of the hydrogen ion concentration) above 9.5 must be expected. The same holds true for metals. If the WSP system is subjected to inflows exhibiting a wide variation in metals concentrations, maintaining consistent water quality in the outflow may be an impossible task."

Response: EPA and MDHES disagree with this comment in all of the technical points it makes. None of the data from the RI indicate that the changes in nutrient levels entering the pond system have ever led to an upset in the pond system processes or a violation of a water quality standard at the outlet. On the contrary, higher nutrient inputs would likely only assist in the treatment occurring in the pond by increasing biologic growth.

Pond 3 is a very large reservoir. Daily fluctuations in inputs, of either metals or pH, have little or no measurable effect on the effluent levels of metals or pH. The volume of the pond smoothes out such small oscillations, primarily through mixing within the pond. (The average retention time for Pond 3, with Silver Bow Creek flows only, is 27 days.) This is why large fluctuations are seen only in the creek upstream of the pond and not in the pond itself. To suggest that "maintaining consistent water quality in the outflow may be an impossible task" for the reasons given in this comment is insupportable. In fact, ARCO has continually emphasized that its alternative Plan 3A can adequately treat a Silver Bow Creek flood.

8. Comment: The FS should identify the fresh water aquatic standards used to develop Tables 2-10 and 2-11.

Response: References for the standards used for Tables 2-10 and 2-11 are presented at the bottom of each table.

2.3.3 Ground Water

1. Comment: The last paragraph of the Physical Characterization subsection (page 2-76) indicates that ground water discharge into the Mill-Willow Bypass includes 2.5 cfs from the Warm Springs Ponds or east side, and 0.7 cfs from the west side. The FS should include a detailed explanation of the methodology used to derive these discharge rates. The methodology used is not presented in Appendix A, or in either of the Phase I and Phase II RI reports. Without an explanation of how these discharges were calculated, there is no way to independently evaluate the method used or the results. In addition, an explanation should be included to clarify what synoptic flow measurement method was used to enable the investigators to confirm the contribution of ground water inflow from either side of the bypass channel. Such measurements are best suited for estimating total inflow to a channel. They are not suitable for discriminating between the inflow contribution from alternate sources of ground water discharge. An independent evaluation of the reported synoptic flow measurement results was not performed because information, such as field notes, data and calculations, are not included in the FS, Phase I RI or Phase II RI reports. All field notes, data and calculations, which are the basis for such conclusory statements in the FS, should be referenced and provided within the Appendix to the FS report.

Response: The rate of ground water inflow to the Mill-Willow Bypass was estimated using empirical methods and direct analytical calculations. Empirical methods provide more reliable estimates of ground water inflow to the bypass channel than analytical methods. In fact, direct analytical calculations were performed by essentially back-calculating to those inflow rates derived empirically.

Six synoptic flow measurements were completed in the Mill-Willow Bypass channel on July 11, 1988, when surface water in the Mill-Willow Bypass was diverted into Pond 3 at the North Opportunity siphon channel. Because all flow in the bypass downstream of the diversion was attributable to ground water inflow (with the exception of flow from the Wildlife Ponds), the synoptic flow measurements likely represent the most accurate estimate of ground water inflow to the bypass channel.

Surface discharge was measured in the Mill-Willow Bypass at five stations located approximately equidistant from one another extending from the North Opportunity discharge channel to a station located approximately midway along Pond 2 (SS-18E). An additional discharge measurement was completed at the Wildlife Ponds discharge. Results of these measurements indicated the total ground water inflow to the bypass channel was approximately 2.57 cfs. (Discharge measurement notes are available on request.)

Ground water inflow to the Mill-Willow Bypass from the west was estimated by performing direct analytical calculations. Because analytical calculations require specific data and numerous assumptions, the empirical ground water inflow estimates were used as a calibration tool. Direct analytical calculations using Darcy's

Law for ground water flux in an unconfined aquifer require the following information:

- Hydraulic conductivity of unconsolidated material adjacent and subjacent to the bypass channel

- Ground water gradient to the bypass channel

- Effective depth of ground water seepage

Initially, direct analytical calculations were performed using hydraulic conductivity values of approximately 55 feet per day (fpd) derived from slug test data of monitoring wells located adjacent to the bypass. The ground water gradient to the bypass channel from the east was measured by completing a level survey at five locations along the Mill-Willow Bypass using pond elevations, static water levels in monitoring wells, and water levels in the bypass channel. Ground water gradients measured to the Mill-Willow Bypass from the east ranged from 3.7 percent (adjacent to the Wildlife Ponds) to 1.1 percent (adjacent to Pond 2). The ground water gradient south of Pond 3 near monitoring well WSP-GW-08 was measured to slope from the Mill-Willow Bypass to Silver Bow Creek.

An average ground water gradient of 0.6 percent to the bypass from the west was used for the entire area along the western side of the bypass channel; this water is derived from the Opportunity Ponds area. The 0.6 percent value was derived from water level data collected by TetraTech (Geochemistry Report, July, 1986, Document Control No. TTB 160, FO) during a ground water investigation at the Opportunity Ponds.

Using ground water gradients measured at the five surveyed cross sections, a hydraulic conductivity of 55 fpd, and an effective seepage depth below the bypass channel of 10 feet (a depth at which all ground water seeps into the channel), total ground water inflow to the Mill-Willow Bypass from the east was estimated at 2.5 cfs. The rate of ground water inflow to the Mill-Willow Bypass from the west was estimated as 0.7 cfs using the hydraulic conductivity value of 55 fpd, an average ground water gradient of 0.6 percent, and an effective seepage depth of 10 feet below the base of the bypass channel.

Ground water inflow rates to the Mill-Willow Bypass were recalculated after completion of a pumping test in monitoring well WSP-GW-07, located adjacent to the bypass. Pumping test data collected at well WSP-GW-07 resulted in a hydraulic conductivity value of approximately 270 fpd. Using a hydraulic conductivity of 270 fpd and the same assumptions used previously, resulted in a total ground water inflow rate to the bypass channel of approximately 15 cfs. Based on the synoptic flow measurements, a ground water inflow rate of 15 cfs was determined to be excessive. Therefore, an effective seepage depth below the bypass channel of 1 foot was used, resulting in similar groundwater inflow rates as those measured empirically.

Ground water inflow rates were calculated for the Mill-Willow Bypass to provide data with which to evaluate the feasibility of constructing a ground water interception trench along the bypass channel. Remedial alternatives developed for the bypass channel do not include construction of this type of interception trench, because it was determined that the quality of ground water entering the Mill-Willow Bypass does not exceed Gold Book criteria (see response to Public Comment 84.)

2. Comment: Page 2-87 of the FS indicates that ground water discharge to the Mill-Willow Bypass results in a 30 percent increase in metal loadings along the bypass during baseflow conditions (13 cfs). The comment asks for an explanation of how the estimated increase in metal loadings and baseflow value were determined and the data used. The comment also asks whether the increase in metal loadings includes potential increases resulting from surface water flow contact with sediments along the channel.

Response: EPA and MDHES believe that ground water inflow to the Mill-Willow Bypass is the primary source for increases in metals concentrations in surface water in the bypass under base flow condition. See response to Section 2.3.2, Comment 6, for more detail.

The figure of 30 percent stated in the FS to describe the increase in metals loading in the bypass due to ground water inflow was an approximate value to describe metals data gathered during both the Phase I and Phase II RIs. A summary of parameter-specific metals load increases between the head and the mouth of the Mill-Willow Bypass is contained in the Phase I RI (MultiTech, 1987; Appendix C) in Table 3-19. This table was produced using data from low flow sampling episodes to characterize the impact of ground water inflow on the bypass. Additional data that indicate the magnitude of metals load increase along the bypass from ground water inflow were collected in conjunction with a seepage run conducted during the Phase II RI in July 1988 when surface water in the bypass was diverted into Pond 3. The 30 percent figure is conservatively low; actual load increases along the bypass for several parameters (e.g. sulfate and zinc) were greater than 100 percent.

2.3.4 Air

No comments.

2.4 PREVIOUS STUDIES OF REMEDIAL ACTIONS

No comments.

CHAPTER 3.0

RESPONSES TO ARCO COMMENTS, CHAPTER 3.0 SUMMARY OF THE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND THE PUBLIC HEALTH AND ENVIRONMENTAL ASSESSMENT

3.1 APPLICABLE OR RELEVANT APPROPRIATE REQUIREMENTS

General Approach to ARARs

Attachment 1 to the Record of Decision contains the final list of applicable or relevant and appropriate cleanup standards, standards of control, and other substantive requirements, criteria, or limitations (ARARs) for the Record of Decision, as well as a list of documents or other sources of information which are To Be Considered during the remedy selection or during implementation of the remedy. EPA has identified the list based upon the statutory provisions addressing ARARs found in CERCLA, particularly section 121(d) of CERCLA, 42 U.S.C. s^{s}§ 9621(d); the new National Contingency Plan, 40 CFR Part 300 (1990); the preambles to the proposed NCP and the final NCP, 53 Fed. Reg. 51394 et seq. (December 21, 1988) and 55 Fed. Reg. 8666 et seq. (March 8, 1990) respectively; EPA guidance documents regarding ARARs entitled "Compliance With Other Laws Manual: Parts 1 and 2" (OSWER Dir # 9234.1-01 and 92341.02 respectively).

ARARs are cleanup standards, standards of control, and other substantive requirements, criteria or limitations under federal environmental or State environmental and siting laws that are applicable or relevant and appropriate to a site cleanup action. They are divided into contaminant-specific, location-specific, and action-specific categories. ARARs and TBCs are further defined and explained in 40 CFR s^{s}§ 300.400(g). Compliance with ARARs is a mandatory requirement, unless an appropriate waiver is granted. 40 CFR s^{s}§s^{s}§ 300.430(e)(9)(iii)(B); 300.430(f)(i)(A); and .300.430(f)(ii)(B).

The new NCP was issued after the Feasibility Study for the Warm Springs Ponds operable unit was released. EPA has used the regulations found in the final NCP to formulate the ROD and to identify the final list of ARARs. Definitions of "applicable" and "relevant and appropriate" found in the new NCP at
40 CFR s^s§ 300.05 were used in this identification. The criteria for determining "relevant and appropriate" requirements found at 40 CFR s^s§ 300.400(g)(2), were used where pertinent.

The primary commentor on ARARs was the Atlantic Richfield Company, the potentially responsible party (PRP) identified for this action. These responses to ARCO's comments follow the comments contained in ARCO's document entitled "Re¨iew Comments Silver Bow Creek Investigation Feasibility Study for the Warm Springs Ponds Operable Unit", dated January, 1990, Chapter 3.

1. Comment: ARAR's only pertain to on-site remedial actions.

   Response: EPA agrees with this comment.

2. Comment: Only substantive requirements can be ARARs.

   Response: EPA agrees with this comment, and will use the current guidance in determining which promulgated provisions are substantive ARARs. See the Preamble to the final NCP, 55 FR 8756 - 8757, for a discussion of the distinction between substantive and administrative and procedural requirements. EPA notes that certain State procedural and administrative requirements have been listed as TBCs, because they will be useful in aiding agency personnel in determining the adequacy of deliverables and other activities during remedial design and remedial action implementation.

3. Comment: TBCs are not ARARs.

Response: TBCs are defined in 40 CFR s^s§ 300.400(g)(3), and their use is discussed in the preambles to the proposed and final NCP. 53 FR 51440; 55 FR 8744 - 8745. Basically, TBCs are used to examine the risk to human health and the environment at a site, including the level of risk at a site without remediation and the appropriate cleanup levels to be achieved at a site. TBCs can also be used as cleanup levels themselves, when there are no existing promulgated levels. TBCs are also used to develop and examine an ongoing remedy, such as using RCRA closure guidance to aid agency personnel in reviewing design plans and specifications for a given remedial action.

4. Comment: ARARs need only be obtained at the completion of a remedial action, not during remedial action.

Response: EPA disagrees with this statement. As stated in 40 CFR s^s§ 300.435(b)(2), appropriate ARARS must be met during the implementation of the remedial action (the RD/RA stage), as well as on completion of the remedial action. EPA believes that this interpretation will ensure that remedial actions will be carried out in a sound and safe manner. The discussion at 55 FR 8755 - 8756 elaborates further on EPA's rationale for this position. EPA also notes that removal actions must also meet ARARs to the extent practicable.

The ARARs list, Attachment 1 to the ROD, attempts to define in a clear manner which ARARs are to be complied with during the RD/RA phase, which are to be complied with at the completion of the RD/RA stage and thereafter, and which are to be complied with in both circumstances.

5. Comment: Variances, exceptions, exemptions and waivers may be ARARs.

Response: EPA agrees with this statement.

6. Comment: Where two or more requirements are potential ARARs, the agency must select the most appropriate requirement for the site, not necessarily the most stringent.

Response: EPA disagrees with this statement. ARCO is confusing the initial determination of relevance and appropriateness with a final decision on compliance. As the preamble to the final NCP states, "CERCLA requires that remedial actions comply with all requirements that are applicable or relevant and appropriate. Therefore, remedial action has to comply with the most stringent requirement that is an ARAR to ensure that all ARARs are attained. . . . (T)he degree of stringency of a requirement is not relevant to the determination of whether it is an ARAR at a site and must be attained (except for state ARARS)." 55 FR 8741.

7. Comment: Location-specific ARARs primarily contain administrative requirements which are not ARARs.

Response: Location specific ARARs contain both consultative and other administrative provisions and substantive provisions. Only the substantive provisions are ARARs, but often, it is appropriate and helpful to consult with the agency with expertise in the particular area of concern, to determine the exact nature of the substantive provisions of the ARAR. For example, compliance with the Endangered Species Act requires, in some circumstances, mitigative measures to be undertaken during construction on site. The U.S. Fish and Wildlife Service is experienced in addressing these concerns, and will often be consulted by EPA in determining what exact mitigative measures should be undertaken for a particular site cleanup.

8. Comment: ARARs must be promulgated and effective as of the date of the Record of Decision.

Response: EPA generally agrees with this statement. ARARs are "frozen" at the signing on the ROD. One exception to this general policy occurs when a component of the remedy was not identified when the ROD is signed. EPA reserves its rights to identify ARARs at the time the component is identified, in such a situation. Additionally, EPA will consider ARARs promulgated after the date of the ROD during the five-year reviews. EPA will look at the new ARARs in determining whether the remedy remains protective of human health and the environment.

9. Comment: General goals and policies contained in statutes and regulations are not ARARs.

Response: General goals which are not specific and directive in intent, such as general legislative findings or statements of public policy, are not ARARS. However, if general goals are specific and directive in intent, and otherwise meet the ARAR criteria, they can be ARARs. The preamble to the final NCP specifically list State anti-degradation laws as goals which can be ARARs. If goals are further refined by specific regulations, those regulations will determine compliance with the goal. This concept is further addressed in 55 FR 8746 - 8747.

10. Comment: Only environmental laws and regulations may be ARARS.

Response: Federal environmental promulgated standards, and State environmental and siting standards are eligible for ARAR identification. Worker safety and public health and safety laws and regulations fit into this description, and are contained in the final ARARs list for this ROD. ARAR guidance specifically lists such laws and regulations.

11. Comment: It was improper to compare existing water quality standards within the Warm Springs Ponds with water quality standards.

    Response: Although the Ponds themselves are not classified as waters subject to the State's water classification scheme under the Montana Water Quality Act and accompanying regulations, comparison of the existing water quality within the Ponds to water quality standards provides a useful way to evaluate the health of the Ponds system. The Ponds are not only industrial treatment ponds, but are the home of various fish ai .l wildlife. Superfund's mandate is to protect the environment, including fish and wildlife, regardless of the location. The ARARs standards based on water quality standards are identified for water discharged from the Ponds and for surface water outside of the Ponds only.

12. Comment: Public water supply standards for ground and surface waters are not appropriate for the ground and surface water at the Ponds.

    Response: As more fully explained in the response to Appendix B comments, the ground water within the operable unit is potentially a drinking water source, pursuant to Montana's ground water classification scheme and EPA's guidance on ground water remediation. Therefore, MCLs, which protect public health, are the appropriate standards for ground water, and should be met at the waste unit boundary. Establishing these standards at the waste unit boundary will also protect the Clark Fork River from contamination from the ground water plume. Using public health standards for surface water is a moot point at this site, given the existence of applicable water quality standards for the surface water compliance points. This is further explained in the appendix B response to comments.

13. Comment: The point of compliance for surface water ARARs should be at the confluence of the Mill-Willow Bypass and Warm Springs Creek.

Response: As explained further in the response to comments on Appendix B, there are two points of compliance for surface water standards. One will be at the point of discharge from Pond 2, for the point source discharge. This is consistent with the Clean Water Act and the State's Water Quality Act. In addition, compliance for ambient standards nust be obtained just above the confluence of Mill-Willow Bypass and Warm Springs Creek, the second compliance point. This will enable the agencies to judge the adequacy of the remedy in meeting these standards without interference from contamination from Warm Springs Creek. Warm Springs Creek will be cleaned up through other activities of the Clark Fork Superfund project. Eventually, all surface water, including the Mill-Willow Bypass, mill and Willow Creeks, the Warm Springs Creek, and the Clark Fork River will be required to meet appropriate ARARs.

14. Comment: An MPDES water permit should not be required for the Pond 2 discharge.

Response: EPA agrees that the discharge is an "on-site" regulated activity, and is not subject to administrative permit requirements. Although not required by CERCLA, EPA notes that the activity was a pre-existing permitted activity, and continuing to renew and comply with the permit would ensure effective post cleanup monitoring, and maintain consistency within the State's MPDES program. Therefore, EPA encourages the continued application for and issuance of the permit by ARCO.

EPA notes that the permit requirements will be identical to the ARAR requirements identified by this ROD, and that obtaining the permit renewal will not substantilly increase ARCO's costs at the site.

15. Comment: RCRA Subtitle C standards should never be relevant and appropriate standards for mining waste which is excluded from RCRA subtitle C regulation through the Bevill amendment, and should not be identified for this particular site.

    Response: As explained further in the response to comments on Appendix B, EPA agrees that RCRA requirements are not applicable to the cleanup activities at the site, but does find that certain selected RCRA requirements are relevant and appropriate to certain activities at the site. Because it has been demonstrated that the waste at the site has and continues to cause problems to surface water, ground water, and human health at the site, and because the waste has been or will be gathered in discrete units, certain of the RCRA subtitle C standards are relevant and appropriate to the site. This selective use of RCRA subtitle C standards for mining waste is permitted and described in EPA guidance and the preamble to the new NCP. CERCLA Compliance with Other Laws Manual: Part II, pp. 6-2 - 6-4; 55 FR 8763 - 8764.

16. Comment: The State's Strip and Underground Mine Reclamation Act and Surface Mining Control and Reclamation Act are not relevant and appropriate to this action.

    Response: EPA agrees with the State's identification of SUMRA and SMCRA regulations concerning revegetation of excavated or capped areas as relevant and appropriate requirements for this action. These requirements are designed to ensure a stable, long lasting, and permanent revegetated cover over mining wastes, and that is a goal of the Superfund program. A more detailed analysis of this issue is presented in the response to comments on Appendix B.

17. Comment: Mixing zones should be established for the ground water and surface water point source discharge ARARs.

Response: Mixing zones are given under the State's regulatory statutes in the discretion of the State. The State has advised EPA that such zones are inappropriate for this action and should not be given. In addition, mixing zones for ground water discharge are not in accordance with NCP regulations and EPA groundwater remediation guidance. Setting compliance at the waste unit boundary for ground water and at the point of discharge for the Pond 2 discharge will ensure adequate protection of human health and the environment, by reducing potential and actual exposure to contaminants in areas outside of the Ponds themselves.

18. Comment: A water hardness of 175 mg/l is appropriate for setting hardness based concentration limits for the WSP discharge. If use of a different hardness value is warranted, the surface water ARARs will be adjusted accordingly.

Response: The current hardness based ARARs are set at 100 mg/l. EPA and the State will continue to evaluate information concerning the Ponds to determine if this is appropriate under the State Water Quality Act and implementing regulations.

19. Comment: Federal water quality criteria for arsenic are not based on current scientific data, and should not be used here.

Response: The arsenic number identified for surface water is based upon the State's adoption of water quality standards (WQS). WQS are applicable to the water, and EPA has no discretion to ignore the number. It is only when FWQC are used as relevant and appropriate ARARs that EPA has discretion to accept or reject numeric standards, based on designated use or invalid scientific basis.

In any case, the WQS for arsenic has been waived by EPA as unachieveable, and a replacement number based on the State's antidegradation statute and regulations has been established.

20. Comment: ARCO agrees that it is appropriate to waive mercury and arsenic water quality standards. ARCO disagrees with the replacement criteria identified for mercury and arsenic.

Response: EPA is waiving mercury and arsenic WQS for the point source discharge and the ambient surface water based upon technical impracticability from an engineering perspective, pursuant to 42 U.S.C. s^{s}§ 9621(d)(4)(C), and on the basis that this is an interim action, 42 U.S.C. s^{s}§ 9621(d)(4)(A). Mercury is waived because the number is below current detection limits. Arsenic is waived because the number is not achievable using current technology. EPA and the State identify replacement numbers of those waived standards as follows:

Mercury 0.2 ug/l
Arsenic 0.02 mg/l

The mercury number is based upon the current detection limit for mercury, according to current agency standards. Waiving standards on this basis, and using replacement standards based on the detection limit, is endorsed by current guidance. EPA disagrees with ARCO that the current Pond discharge standard of 0.001 mg/l is sufficiently protective of human health and the environment. The 0.2 ug/l standard is nearer the water quality standard, and is the agencies' determination of what is protective.

The replacement standard for arsenic is based on the State's antidegradation statute and regulations. Currently, water quality in the Clark Fork River is at or below 0.02 mg/l for arsenic. Waiving the WQS and establishing a number above this standard, such as ARCO's suggestion of 0.05 mg/l, would violate the State's antidegradation statute. To comply with the antidegradation ARARs and to ensure protection of human health and the environment, the 0.02 ug/l standard is the more appropriate replacement standard.

21. Comment: ARCO disagrees that the surface water ARAR for iron, 0.3 mg/l, is appropriate.

    Response: EPA retains the iron standard in its final list of ARARs. The standard is a secondary Drinking Water Standard, and is also protective of environmental and aesthetic concerns. Achievement of the standard for other contaminants, which are environmentally based, should result in compliance with this standard at no extra cost to ARCO or the agency.

22. Comment: The pH standard for the pond discharge should be kept at the current permit level of 9.5, to ensure that pH dependent treatment can work with optimal results within the Ponds.

    Response: EPA agrees with this comment, and will retain the current 9.5 maximum pH standard for the point source discharge standards.

23. Comment: The designation of the berms throughout the Pond system as high hazard dams through the State's Dam Safety Act is improper. Pond 1 is not a dam, as defined in the Dam Safety Act.

Response: The State's regulations are clear in stating that any classification of a dam a high hazard by the Corps of Engineers is grounds for automatic qualification as high hazard pursuant to State law. The variation is criteria between the Corps' designation and the State's normal, independent classification is irrelevant to this automatic classification.

Pond 1 is a dam, as defined under the Dam Safety Act, because it does impound and divert water. The sources of this water are various, but that does not impact the primary purpose of wet portions of Pond 1, which is to impound water. Even if the 50-acre feet capacity were changed, these standards would still be relevant and appropriate for Pond 1, given the site specific circumstances at the operable unit.

24. Comment: The selected design floods for determining the appropriate fraction PMF standard should be further explained.

Response: Other parts of this responsiveness summary address design floods, and the exact nature of the PMF determination for the berms. EPA and the State have determined that a 0.05 PMF standard is the applicable standard for all Ponds within the operable unit.

3.2 PUBLIC HEALTH AND ENVIRONMENTAL ASSESSMENT SUMMARY

Some of the issues addressed in this chapter that relate to human health assessments are addressed in more detail in Appendix A.

ARCO raised a number of comments about the data and methodology used to calculate baseline risk and cleanup levels at the site. Responses to those specific points are given here. However, as explained in the ROD, the selection of final cleanup levels in soils sediments, tailings at the site is deferred at this time. EPA will continue to evaluate risk issues, and intends to present a final cleanup number at a later date.

3.2.1 Introduction

No comments.

3.2.2 Site Setting

1. Comment: This comment questions why days with precipitation greater than 0.01 inch (limited dust generation) during the summer were not accounted for in the exposure assessment and resulting estimation of risk through the dust inhalation pathway.

   Response: Exclusion of summer precipitation days only affects the inhalation pathway as days in which precipitation exceeds 0.01 inch are less likely to generate dust but are assumed to have no effect on ingestion of soil from hand-to-mouth activity. In the risk assessment it was acknowledged that precipitation greater than 0.01 inch would affect dust generation and, therefore, days in which dust would be inhaled from outdoor sources, but did not adjust exposure days in an effort to remain conservative.

   However, the effects of precipitation days was evaluated for the scenario considered by the agencies to be applicable. Intake calculations and risks were recalculated discounting the average number of days in which precipitation is greater than 0.01 inch in the months of May, June, and July.

These months account for 46 percent of the annual precipitation. There are an average of 101.5 days in the year when precipitation exceeds 0.01 inches or about 47 days in the months of May through July. Since three months contain 92 total days, about half have rainfall greater than 0.01 inch (51.1 percent).

For the recreational scenario, it was assumed in the risk assessment that 16 days in May, June, and July would be used for fishing at the ponds. If precipitation greater than 0.01 inch occurred on approximately 50 percent of these days, 8 days may have rain greater than 0.01 inch reducing the potential for inhalation of dust while at the ponds. The split fishing season from mid-August through September yields an additional 12 days available for fishing or other recreational activities at the ponds when dust could be generated. In addition, there are approximately 4 days in the hunting season without snow on the ground. A total of 24 days are available for dust generation and recreational use of the ponds.

When this reduced exposure frequency accounting for summer rainfall is used in conjunction with the inhalation intake (as presented in the risk assessment), the excess lifetime cancer risk that results from using the revised parameters is not different from that obtained in the risk assessment, 1×10^{-7}.

For the occupational scenario, 120 days of dust exposure are possible if you account for precipitation in the months of May, June, and July (60 work days, half of which could experience rainfall greater than

0.01 inch), as compared with the 150 days of exposure used in the risk assessment. If this new exposure duration is used in conjunction with maximum and average inhalation rates and the estimated annual dust concentration (from dust modeling done for the risk assessment), the resulting excess lifetime cancer risk through occupational exposure at the ponds is 9×10^{-7} using average inhalation rates and 2×10^{-6} using maximum inhalation rates. The average risk changed slightly, from 1×10^{-6} to 9×10^{-7}, while the maximum risk did not change from that in the risk assessment, 2×10^{-6}.

2. Comment: This comment states that population stability of the area has been omitted from discussion.

   Response: An extensive discussion on the population and demographics of the area is presented in Chapter 2 of the risk assessment. ARCO acknowledged, in the executive summary of the review comments, the discussion of decreasing population presented in the FS.

3.2.3 Nature and Extent of Contamination

1. Comment: This comment identified a statement made in the risk assessment as misleading to the reader, and stated that the comment indicated concentrations of contaminants at the site posed a threat to human health and the environment. The comment also states that concentrations of many constituents were below detection limits.

   Response: The statement identified is: "Site investigations to date indicate inorganic constituents in groundwater (particularly shallow groundwater immediately downgradient of Pond 1), surface water (although contaminant concentrations decrease in pond outflow as compared to inflow from Silver Bow Creek), sediments and exposed tailings, and biological tissue (liver only) at concentrations above background level."

This statement was meant as a simple summary statement. The statement does not mention human health or the environment, nor does it attempt to draw inferences to health implications of concentrations greater than background.

Detailed discussions of constituent concentrations are found in the full risk assessment. Chapter 3 of the risk assessment presents the frequency of detection for each constituent analyzed in each medium. Tables in Chapter 3 indicate the majority of the constituents analyzed were detected at concentrations greater than the detection limit.

2. Comment: This comment states that the term "biological tissue" is vague.

   Response: The agencies agree. The use of the terms fish tissue, edible fish tissue, waterfowl tissue, waterfowl breast tissue, or edible waterfowl tissue would have been more descriptive than biological tissue.

3.2.4 Exposure Assessment

1. Comment: This comment requests more information on contaminant migration mechanisms. The comment states that wind direction and

magnitude and drinking water well locations are not included in the referenced figure.

Response: Contaminant migration mechanisms are discussed in more detail in Chapter 4 of the full risk assessment. All details could not be included in the summary of the risk assessment as presented in the FS.

Both wind direction and magnitude and the location of drinking water wells in the vicinity of the ponds are shown on Figure 3-1 of the FS.

2. Comment: This comment questions the inclusion in the risk assessment of waterfowl and fish tissue at the site in which contaminant concentrations were similar to concentrations of constituents in media found in other areas.

Response: The risk assessment is not looking at incremental risk over what may be called natural background. The assessment is analyzing risk from constituents at the site, in whatever media they are detected and at whatever the concentration. The determination of risk through exposure to multiple media would not be complete without inclusion of all media potentially affected by contaminants where exposure could occur, regardless of the concentration of constituents. Whether or not contaminant concentrations in media at the site are equal to concentrations elsewhere is irrelevant to whether or not there is a health risk. It should be noted that cleanup concentrations were not based on the inclusion of this media, but strictly on soil ingestion by humans.

3. Comment: This comment questions the additivity of exposure pathways.

Response: EPA guidance stresses the importance of analyzing multiple exposure pathways (EPA, 1989b). It is conceivable that an individual could be exposed to each pathway within a developed scenario, although unlikely that the individual would experience exposure to the maximum concentration of contaminants in each pathway. The risk assessment provided a range of possible risk; the maximum possible risk is used to provide an upper limit to the possible risk. The risk assessment is not concerned with risk obtained from any media other than that which could or is affected by contaminants found at the site.

4. Comment: This comment questions the use of the potential future residential scenario in the risk assessment.

Response: EPA policy requires that risk to public health be estimated using conservative assumptions. Residential land use is associated with the greatest exposures and is therefore, the most conservative choice to make for estimating future land use of a site. EPA believes that such a scenario is within the reasonable maximum exposure possible at the site, and therefore is appropriately included in the baseline risk assessment. The residential scenario provided an upper bound estimate of the potential risk that could be incurred.

In the ROD, MDHES and EPA have made risk management decisions based on occupational use of the site which does occur and will continue into the future. Institutional controls to prevent future residential development are necessary. Cleanup of contaminants through active measures is and will be based on risks other than future residential risks.

5. Comment: This comment states that the only realistic future use of the site is continued use of the area for wildlife management.

   Response: The agencies agree that continued use of the area for wildlife management is a realistic use of the area. However, it is not the only possible use.

6. Comment: This comment states that land use restrictions should have been considered in the assessment as a means of restricting human exposure to contaminated media.

   Response: The purpose of the baseline risk assessment is to determine the potential risk to human health and the environment given that no action is taken at the site to remediate the contamination. Land use restrictions, deed restrictions, and zoning ordinance are all considered as remedial actions taken to prevent contact with contaminants at the site.

7. Comment: This comment states that the risk assessment used poor judgement in the selection of exposure assumptions for the recreational scenario.

   Response: Assumptions used in the assessment were based on discussions with Montana State Fish and Parks personnel, Montana residents, and best professional judgement because site-specific surveys were not available. The 41 days per year (164 hours per year) spent at the ponds for recreational activities does not seem unreasonable. It represents approximately 4 percent of the "free" time available each year (considering 8 hours per day are spent sleeping and 8 hours per week day are spent working).

The Exposure Factors Handbook cited by ARCO in its comment was not available when the assessment was being prepared. It has been subsequently reviewed. Results of a recreational fishing frequency survey included in the Handbook indicated more than 50 percent of the fishermen interviewed fish weekly, while 13 percent fish daily. This survey was conducted in a relatively urban area. It is not unreasonable to assume that fishermen at this particular operable unit, may fish the ponds twice a week during the limited fishing season available.

In addition, activity patterns presented for males 18 to 24 years; 25 to 44 years; 45 to 64 years; and older than 65 years showed that active leisure accounted for 9 hours/week (standard deviation (sd) of 10.7); 5 hours/week (sd 5.66); 6 hours/week (sd 7.8); and 7 hours/week (sd 11.3), respectively, for the listed age groups (EPA, 1989a). In a rural setting, fishing or other recreational use of the ponds could account for a large portion of time spent at active leisure activities. Activity patterns will also vary with the season, with potentially greater levels of activity during the nonsnow months.

8. Comment: This comment states that intake values are not consistent with the values and methodology of the EPA 1989 Exposure Factors Handbook (EFH).

Response: The EPA 1989 EFH was not available when the assessment was conducted. Ingestion rates in the EFH represent averages; 100 mg/day as a reasonable maximum may be appropriate (Porter, 1989). See the response to Section 3.2.4, Comment 9. The assessment followed the guidance of the Superfund Public Health Evaluation Manual (EPA, 1986a), which was the existing guidance at the time the assessment was prepared. EPA will continue to evaluate risk based on currently available guidance and literature, as it prepares to decide a final cleanup action level for the site.

9. Comment: This comment questions the selection of soil ingestion values and lack of activity pattern data in the risk assessment.

Response: A range of soil ingestion values were used in the assessment as EPA standardized soil ingestion rates (Porter, 1989) were not available when this assessment was initially prepared. Best professional judgement was used in the selection of soil ingestion rates from data available in the literature. Data for adults are extremely limited. Professional judgement, site-specific data, and conversations with persons living near and working on the site were used for selecting other assumptions necessary to derive exposure values. Prior to the completion of the assessment, a memorandum from EPA Assistant Administrator J. Winston Porter, was sent to EPA Regional offices early in 1989, which recommended a standardized soil ingestion rate (Porter 1989). A daily ingestion rate of 200 mg of soil for the ages 0 to 6 years and 100 mg of soil for ages 6 years and older was given in this memorandum. These ingestion rates were not used in the assessment as it was nearing completion at the time the rates were provided. If these EPA standardized rates were used along with current EPA suggested exposure parameters (EPA 1990) selected to mimic human activity patterns, the following would result:

For the Recreational Scenario, if the assumption is made that recreationists spend 4 hours per day (out of 16 hours available in the day assuming 8 hours of sleep) at the ponds, the contribution of soil at the ponds (from a contaminated source) is 100 mg/day x 4/16 or 25 mg/day. It is then assumed that an individual would obtain 25 mg/day of soil from the ponds each of the 41 days visited, except for the 9 days during the winter when snow could be on the ground. (However, it is possible to ingest soil, even if it is raining.) These altered parameters are used in the revised intake equations along with an altered life expectancy of 75 years (EPA 1990) instead of the 70 years used in the PHEA. If this intake is used in conjunction with the maximum and average exposure point concentrations of the risk assessment, the resulting risk is 4 x 10^{-6} using average exposure point concentrations and 1 x 10^{-5} using maximum exposure point concentrations.

In the Occupational Scenario, workers spend 8 hours per day at the ponds, 5 days per week, over a 40 year work life. A 40 year duration of employment is used in these revised calculations instead of the 30 years used in the PHEA as EPA (1990) recommended 40 years as the upper bound exposure duration. As adults, using the soil intake factors of the Porter memo and additional factors of the intake equation from the new EPA guidance (1989), the total daily soil intake from the ponds would be 50 mg/day (100 mg/day * 8 exposure hours/16 hours out of a total of 24 hours available for soils ingestion each day). Workers are assumed to spend 250 days per year on the job. Five months of the year the ground is covered with snow, making ingestion of soil more difficult. During those 5 months, approximately 100 days are work days. Subtracting the 100 snow cover days from the 250 work days results in 150 days of potential exposure to soil (as was previously stated, soil can be ingested, even during rainy days). If these altered parameters are used in the revised intake equations along with an altered life expectancy of 75 years (EPA 1990) instead of the 70 years used in the PHEA. The slope factor for arsenic is currently reported as 1.65 $(mg/kg/day)^{-1}$ (as opposed to the value of 1.5 $(mg/kg/day)^{-1}$ which was used in the PHEA). Using the maximum concentration of each constituent detected in soils to which workers could be exposed, the resulting excess lifetime cancer risk due to the presence of carcinogenic compounds in soils is 2×10^{-4}. Using average exposure point concentrations the resulting excess lifetime cancer risk due to the presence of carcinogenic compounds in soils is 9×10^{-5}. EPA is continuing to evaluate these assumptions and will explain its choice when it proposes and selects a final action level.

EPA (1989) currently recommends using the 95th upper confidence interval on the arithmetic mean for exposure point concentrations. Because of the limited data available for statistical use and the potential for the upper 95th confidence interval on that data to be greater than the maximum value detected, the maximum concentration is appropriate to use as the exposure point concentration.

The excess lifetime cancer risk is driven by arsenic. Although beryllium is now included in the calculation of risk (an oral slope factor is now available that was not available when the PHEA was compiled), it does not influence the total excess lifetime cancer risk.

Lead is not included in the estimate of potential excess lifetime cancer risk or the analysis of potential noncarcinogenic health impacts. This is because the EPA has not established a slope factor or reference dose with which to evaluate the potential effects of lead in a manner similar to other compounds. Recent data indicate lead is a potential carcinogen. It has been rated as a B_2 carcinogen through ingestion and inhalation by EPA, but a slope factor has not been assigned. In addition, lead exhibits detrimental health effects other than cancer. As such, a reference dose for lead would be expected. However, reference doses are based on the principle of a threshold effect, which means there is a level of exposure which will not illicit a detrimental effect. EPA believes there is no threshold for lead exposure; that all exposures to lead will result in some detrimental health effect.

As has been demonstrated by the above calculations, altering the exposure parameters to match activities patterns and adjusting the intake parameter to meet EPA standardized values does not significantly influence the resulting risk range.

10. Comment: This comment states the value used for incidental ingestion of surface water is arbitrary.

    Response: As was previously stated, when standardized intake values were not available for a potential pathway of exposure, best professional judgement was used in conjunction with any available literature that dealt with the medium of exposure to select a reasonable intake and an upper bound intake.

11. Comment: This comment questions the use of the Industrial Source Complex (ISC) model for determining dust concentrations at receptor locations.

Response: The Industrial Source Complex model was recommended by EPA as the appropriate model to use for estimating dust concentrations at the Warm Springs Ponds. The methodology used in the analysis is a standard approach.

3.2.5 Risk Assessment

1. Comment: This comment questions the representativeness of risks presented in the assessment to the actual risks of the site.

   Response: Risk are presented in the FS as a range from most probable to maximum plausible. The upper bound estimates likely overestimate actual risk. It is anticipated that the actual risk from the site would be represented within the range of risk presented in the assessment.

2. Comment: This comment questions the use of aquatic water quality criteria in determining potential impacts to the aquatic ecosystem at the site. The comment states that remedial actions will improve conditions at the site and potential impacts will not occur.

   Response: The baseline risk assessment evaluates the potential impacts, if no actions are taken at the site. It is, therefore, inappropriate to evaluate the potential for impacts, if remedial actions are taken at the site to improve current conditions.

   Chronic effects most often are manifested at the species population level rather than the individual level. Chronic effects can include decreased survival, because of physiological stress that makes a species less competitive; restricted development of eggs or unviable sperm; reduction in a food source for a species and gradual population decline. All of these can affect the growth, reproduction and mortality of a species. The risk assessment did not unequivocally state that these impacts will occur, but that chronic stress can and likely would manifest itself in these forms.

3.2.6 Uncertainities and Limitations

Comment: This comment states that specific issues that add uncertainty to the assessment were not evaluated. Further, it questions whether uncertainties and limitations were accounted for during the interpretation of the risk assessment.

Response: Specific sources of uncertainty and their qualitative magnitude were discussed in the full risk assessment presented in Appendix A of the FS. Limitations and uncertainties were considered by the risk managers during the decision making process in selecting the proposed cleanup levels used in the FS.

3.3 RISK-BASED CLEANUP GOALS DEVELOPMENT

3.3.1 Cleanup Goal Calculation Methodology

1. Comment: This comment questions the proposed soil cleanup concentration for arsenic and proposes an alternative methodology with a resulting cleanup goal of 10,000 ppm arsenic in soils.

   Response: The cleanup goal of 10,000 ppm calculated by ARCO is inappropriate for a number of reasons. For purposes of discussion, the ARCO calculation is compared to the current calculation, using current guidance, shown below.

   Basic Equation:

   $$R = C \times HIF \times SF$$

   $$C = R/(HIF \times SF)$$

   where:

R = Risk

C = Chemical concentration (mg/kg)

HIF = Human intake factor (kg/kg/day)

SF = Slope factor $(mg/kg/day)^{-1}$

Current MDHES Calculation (Occupational Scenario Intakes):

R = 1.0E-4

HIF = 50 mg/day x 150/365 days/yr x 40/75 yr x 10^{-6} kg/mg x 1/70kg

= 1.6E-7 kg/kg/day

SF = 1.65 $(mg/kg/day)^{-1}$

C_s = 380 mg/kg

ARCO Calculation

R = 1.0E-4

HIF = 5 mg/day x 150/365 days/yr x 30/75 yr x 0.5 x 10^{-6} kg/mg x 1 / 7 0 kg

= 6.3E-9 kg/kg/day

SF = 1.75 $(mg/kg/day)^{-1}$

C_s = 9,100 mg/kg

Comparison of these calculations reveals several areas of difference. First, ARCO assumes that workers ingest only 5 mg/day of sediment. This is in conflict with recent EPA guidance on soil ingestion (Porter 1989). Second, ARCOs inclusion of a factor of 0.5 for "absorption of arsenic from soil" is not appropriate, since there are no reliable data to show that in the absorption of arsenic in pond sediments is less than that of arsenic not mixed in soil (see response to Comment #67 for a further discussion of absorption of arsenic). Third, the SF of 1.75 used by ARCO is based on the same data and calculations as the value of 1.65 used by the agencies, with the difference being the result of differences in rounding. If the value of 1.75 was used, the calculated clean-up goal would be lower, not higher.

With respect to the assertions that any cleanup level calculated as above will be over protective because (a) arsenic-induced skin cancers are typically nonlethal, and (b) the dose response curve is nonlinear, these issues are addressed in subsequent responses.

2. Comment: This comment questions the toxicity information used for arsenic in that it does not account for the nonlethality of the type of cancer associated with arsenic. It also questions that the risk presented in the assessment due to arsenic was not adjusted downward as suggested by the EPA administrator. (Thomas, 1988).

Response: The assessment did adjust the cancer toxicity value available for arsenic at the time of the assessment by an order of magnitude, as suggested by Thomas (1988), prior to use in the assessment. The Thomas (1988) memo states that it is the toxicity values that should be adjusted, not the resulting risk as suggested by this comment. At the time of the assessment, the published cancer potency factor for arsenic was 15 mg/kg-day^{-1}. This cancer potency factor was adjusted to 1.5 mg/kg-day^{-1} for use in the risk assessment and has since been adjusted to 1.65(mg/kg-day)$^{-1}$.

It is agreed that arsenic-induced skin cancers have a low mortality rate when properly treated, and this information is indicated in the toxicological assessment for arsenic. However, just because skin cancer is rarely lethal does not make it acceptable. Indeed, modern treatment technologies have reduced the death rates of a number of cancers (Hodgkin's, thyroid, breast, uterine, testicular), but this is not cited as a reason for accepting an increase in the incidence of these cancers. Moreover, there is a growing body of evidence that ingestion of arsenic increases the risk of more deadly internal cancers, as well as skin cancer (Chen et al 1985; Chen et al. 1986; Chen et al. 1988; EPA, 1988).

In any event, treatment of arsenic-induced skin cancer may in some cases be uncomfortable or painful, especially if treatment is not timely, and costs both time and money. EPA does not consider that the nonlethal nature of arsenic induced skin cancers justifies acceptance of a higher than usual risk from this contaminant.

It is also agreed that the low mortality of arsenic-induced cancers can be weighed in the risk interpretation and risk management process. However, the risk assessment can only present information to be used in risk management decisions.

Furthermore, risk assessment, in general, does not consider lethality in developing potency factors and, thus, does not estimate mortality associated with cancer. Rather, it is an estimate of the potential excess lifetime cancer incidence associated with exposure to carcinogenic agents.

3. Comment: This comment questions the cleanup concentration selected for lead. ARCO suggests the methodology developed by the Society for Environmental Geochemistry and Health (SEGH) is best for deriving cleanup levels. Using this methodology, ARCO has proposed a cleanup level of 6,000 ppm lead.

Response: EPA believes that the SEGH method has merit, but that any calculated soil cleanup level is very dependent upon the input parameters used. The input values selected by ARCO are all highly debatable, and certainly cannot be characterized as "conservative" (p. 3-5 of ARCO's comments). A much different outcome results when more appropriately conservative values are used:

1. Target blood lead level. ARCO selects 25 μg/dl based on the Center for Disease Control 1985 level recommended for medical intervention. As discussed in subsequent responses (Appendix A, Section 6.2.1, Comment 1)), it is incompatible with current medical thinking to characterize 25 μg/dl as a "health protective blood level" for children. Although there is considerable debate concerning what value (if any) is safe, for illustrative purposes a target of 10 μg/dl will be used. Such a value (or even lower) is suggested by a number of recent studies (Davis and Svendsgaard 1987; Bellinger et al. 1989; Chaney et al. 1989). In addition, the assumption inherent in the SEGH method that soil may contribute the entire difference between background and maximum allowable blood lead is questionable.

2. Baseline blood lead level. ARCO's calculated number of 2.24 μg/dl could not be replicated based on the description of its derivation provided by ARCO. An attempt to use the method suggested by ARCO resulted in a geometric mean baseline of 3.42 μg/dl with an upper 95th percentile value of 6.1 μg/dl.

3. Blood lead:soil lead slope. ARCO used a value of 2.0 (μg/dl)/(1,000 ppm) based on averaging an undocumented value of 1.8 with a value of 2.2 derived from a mining study (see response to Appendix A, Section 6.1.2 comment). Using the mining study value of 2.2, which is the default value for the disaggregate model, is more appropriate.

4. Geometric standard deviation. ARCO uses 1.42 for the geometric standard deviation, which is the value identified by EPA (1989c, p. III-6) as the midpoint of the range for children living near a point source of lead. Since exposure to mining wastes is not a point source

of lead, it is more appropriate to use the high end of the range, a value of 1.53, as identified by EPA (1989c).

5. Number of standard deviations. ARCO correctly uses N = 1.64 to calculate the upper 95th percentile of blood lead levels. It should be noted, however, that this procedure accounts for human variability in the blood lead level caused by a uniform source of lead, but does not provide any margin of error for human variability in the sensitivity to the toxic effects of lead.

Using the above reasonable values yields a soil lead cleanup level of 708 ppm, rather than 6,000 ppm. If the background blood lead level were set at the upper 95th percentile, rather than the geometric mean (6.1 instead of 3.42), the calculated soil cleanup level would be less than zero. These calculations illustrate that the output of the SEGH model can range from 6,000 ppm to less than zero as the input parameters are adjusted from more liberal to more health conservative. It is precisely this uncertainty and variability that justifies using the OSWER Directive (No. 9355-02 dated September 7, 1989) as guidance in establishing soil cleanup levels based on site specific considerations.

The comment continues with the provision of Attachment 6, which presents the methodologies and assumptions ARCO used to generate cleanup concentrations.

Response: ARCO's contention that the future residential use scenario is not appropriate is addressed in the response to Section 3.2.4, Comment 4. As stated in response to Appendix A, Section 6.2.1, Comment 1, the agencies agree that in general, adults would probably receive a lower dose of lead at a given soil level than would children. However, the quantitative statements made by ARCO are not supported:

1. Soil ingestion rates. Soil ingestion rates in both children and adults depend upon many factors and a reliable quantitative evaluation of the ratio of adult to child soil ingestion is not possible from available data (refer to response to Appendix A, Section 6.2.1, Comment #1).

2. Absorption of lead. ARCO is internally inconsistent in its citation of absorption (30 percent for children and 10 percent for adults, and then a reference to 25 percent on page A-21). This inconsistency reflects variability in the data and the influence of factors such as age and nutritional status. Thus, a single ratio such as 3 is not supported by the data.

3. Lead retention. ARCO did not attempt to quantify this difference.

4. Slope value. ARCO's quantification of this difference as a factor of 3 to 6 is not referenced here, but on p. A-23 is attributed to a personal communication from Bornschein or coworkers. Such preliminary and undocumented statements do not provide reliable estimates.

5. Target blood lead level. ARCO's use of OSHA values of 40 or 30 $\mu g/dl$ are inappropriate and internally inconsistent with the acknowledged need to protect pregnant women (p A-22). In addition, EPA (1989c) identified middle-aged men as a sensitive subpopulation, based on studies showing a correlation between blood lead and elevated blood pressure with no apparent threshold down to 7 $\mu g/dl$ (Pirkle et al. 1985).

In summary, present data do not provide a reliable quantitative method to convert cleanup goals calculated for children using the SEGH method to cleanup levels protective for adults. In addition, it should be noted that ignoring exposure to soil lead through inhalation of dust by attributing it to "background" is not appropriate. All lead exposures due to site contamination must be evaluated.

3.3.2 Potential Cleanup Goals For the Operable Unit

1. Comment: This comment questions the placement of the section "Risk-Based Cleanup Goals Development" in the FS.

   Response: This section provides background on the development of the risk based cleanup goals that were presented in the ARARs section. The agencies believe this is a necessary and important discussion.

2. Comment: This comment states that the risk estimates, as altered by ARCO, did not provide an adequate basis for requiring or determining cleanup goals for the site.

   Response: The requirements for and determination of cleanup goals at the site is a decision made by the MDHES and EPA and will be made according to the NCP, EPA guidance, and sound scientific judgment.

CHAPTER 4.0
RESPONSES TO ARCO COMMENTS, CHAPTER 4.0
PROBLEM DEFINITION

4.1 ENVIRONMENTAL AND HUMAN HEALTH PROBLEMS

4.1.1 MEDIA 1 - POND BOTTOM SEDIMENTS

1. Comment: The dams should not have been listed as high hazard. Inflow design floods have not been adequately documented.

   Response: Montana law states that dams which are ranked as high hazard dams by the U.S. Corps of Engineers automatically are treated as high hazard dams under Montana dam safety law and regulation. That ranking was done for the Warm Springs Ponds dams.

   Additionally, dams which contain the volume and hazardous substance content of the Warm Springs Ponds dams should be treated as extremely hazardous, for protection of human health and the environment.

2. Comment: The comment indicates that two reports (ESA, 1987, and CH2M HILL, 1988) are described in the FS as having reached similar conclusions, without stating clearly what the similar conclusions were. It further indicates that the only point of clear concurrence is that some degree of upgrading of the flood routing capacity of the ponds/bypass is necessary.

   Response: As indicated in the comment, the point of concurrence between the two reports is that some degree of upgrading the berms is required.

3. Comment: The comment agrees that the use of the 100-year flood in the FS as the primary flood for design is acceptable. However, the comment states that the method used for estimating flood discharge by CH2M HILL is not acceptable. The comment further states that a regional analysis method relating flood frequency to basin characteristics (as used by ARCO) is a more appropriate method than the simulation model used by CH2M HILL.

Response: There are several items contained in this comment that have been discussed in meetings and correspondence with ARCO throughout the hydrologic analyses of the Silver Bow Creek studies. ARCO has developed its own procedures and analyses on the hydrology of the Silver Bow Creek Site. Some differences still exist between the studies conducted by ARCO and by CH2M HILL.

Because of the uniqueness of a hydrologic analysis, several methods exist that will provide quantitative results on flooding values for any basin. Because different approaches are possible, there is potential for different parties to use different assumptions to derive parameters that are needed in a flood modelling study. Because of such differences, ARCO's values, methods of analyses, and procedures were somewhat different than the procedures used by CH2M HILL. The result is that ARCO's study predicts a 100-year flood with a peak flow of 3,300 cfs and a total 5-day volume of 12,500 acre-feet, while CH2M HILL's study predicts a peak flow of 4,000 cfs and a total 5-day volume of 13,000 acre-feet.

A meeting was held on August 2 and 3, 1990, between ESA Consultants (ARCO's technical advisors) and CH2M HILL to discuss design issues, including the hydrology of the 100-year event. At this meeting, it was agreed that the most important parameter of the 100-year flood is the design volume of runoff, because this governs the amount of flow that will be treated and the design parameters for the Pond 3 berms. The difference between volumes predicted by the two models is minimal; however, ARCO agreed to use the storm hydrograph and resultant volume of 13,000 acre-feet predicted by the CH2M HILL model in order to be conservative. It was also agreed to use ARCO's peak flow of 3,300 cfs as the design peak flow for the inlet structure to Pond 3 to reduce scour and resuspension concerns within the pond system.

The increase in the design volume of the 100-year event of 500 acre-feet (from 12,500 to 13,000 acre-feet) means that the total outlet design flow from Pond 3 will have to be increased from the 700 cfs indicated in ARCO's plan 3A to approximately 750 cfs. This is required to avoid exceeding the total allowable storage capacity of Pond 3 of 12,500 acre-feet.

4. Comment: The comment notes that the PMF was included in the flood modeling study because it is the standard design flood that is considered in dam safety rules. Although the approach of using the HEC-1 flood simulation model is appropriate for calculating the PMF, some assumptions made by CH2M HILL are not appropriate. Critical errors were made in the development of the maximum precipitation (PMP) and in the amount of snow on the ground at the time of the PMF. The comment concludes that, by modifying the input parameters to what would be ARCO's best estimate, the PMF would be 80,000 cfs rather than the 146,500 cfs estimated by CH2M HILL.

Response: The items contained in this comment have been discussed in meetings with ARCO, ESA (ARCO's technical consultant), CH2M HILL, MDHES, EPA, and others. The following are responses that were given in detail to ARCO as a result of various meetings concerning the flood modeling study and particularly the calculation of the PMF.

As discussed during the meetings, there are two very important items during the PMP. One of these is the timing of the maximum 1-hour peak and the other is the amount of rainfall during that time. ESA used a peak 1-hour rainfall amount of 1.07 inches. This value is less than the calculated 100-year, 1-hour rainfall. Also values of 1.1 and 1.2 inches in less than 1 hour have been recorded at the Butte Airport climatological recording station.

CH2M HILL used a value of 1.67 inches for the peak 1-hour rainfall during the PMP. This value was obtained using Hydrometeorological Report No. 43 (HMR 43) and procedures suggested by the National Oceanic and Atmospheric Administration (NOAA) Precipitation Frequency Atlas of the Western United States. In comparing these values with procedures suggested in HMR 55A, the 1.67 inches for the peak hour rainfall would be low. The value of 1.07 inches used by ESA is not correct for use as the peak 1-hour value for the PMP.

ARCO states in the comment that "CH2M HILL's PMP was calculated through the summation of a convergence component and an orographic (evaluation dependent) component. However, in the FS, an orographic adjustment factor was applied to both components, yielding an erroneously high PMP in some parts of the basin and that this single error increased the PMF estimate in the FS to 146,500 cfs, instead of 123,000." This is not correct in that ARCO used 1.07 inches for the peak 1-hour precipitation instead of 1.67 as used by CH2M HILL, and the reduction in the peak 1-hour value is alone responsible for the 23,500 cfs reduction in the PMF calculated by ARCO.

Concerning the orographic factor being applied to both the convergence and orographic component of the PMP, this factor yielded results that, even though they were lower, were consistent with HMR 55. Even though

HMR 43 applies directly to the Silver Bow Creek drainage, HMR 55 should not be overlooked. Since the Silver Bow Creek drainage is bordered on three sides by the Continental Divide, the procedures and values contained both in HMR 43 and HMR 55 were reviewed. HMR 55 has now been revised and republished as HMR 55A. During the work on revising HMR 55A, there were concerns that developed with HMR 43. The current status is that HMR 55A has been republished and accepted by all agencies, and HMR 43 is being revised. The values that are now contained in HMR 43 will be increased for the Silver Bow Creek drainage and will more closely agree with the values contained in the new HMR 55A.

Since the two reports were in discussion during the flood modeling study, EPA and MDHES requested in September 1989 (after the draft version of the flood modeling report was published) that values for the PMF be calculated using both HMR 43 and HMR 55A reports as they now exist. This is the reason for the "range" in PMF flows, as shown in the final flood modeling report published in November 1989. After the review and comments by ARCO and others, EPA and MDHES believe that the value to be used for the PMF should be 146,500 cfs.

Another concern raised by ARCO is the assumption of a snow water content of 4 inches for the elevation zone between 5,000 and 6,000 feet. As previously addressed in a response letter to ARCO, along with the timing and amount of the peak hourly rainfall value, this is one of the most significant items in determining the PMF. An important point concerning this value is that during the June 1908 flood event, newspaper records give account of all power lines being down in Butte due to heavy snows. Also, the newspaper account mentioned 9 inches of snow on the ground. By definition, a PMF is estimated utilizing "critical conditions" for hydrologic factors within a watershed. After researching historical data, it was felt that the factors leading up to the June 1908 flood conditions were "critical." Based on these accounts, and additional snow records in the drainage basin, 4 inches of snow water content in the 5,000- to 6,000-foot elevation is a very reasonable value.

An additional concern raised by ARCO in the comment is that if the snowfall occurs immediately prior to the PMP, so that it has not melted, then it is probably part of the PMP storm event and should be subtracted from that event. The Butte area experienced 19 days of precipitation prior to the June 6, 1908, flood. The PMP, as used for the flood modeling study, only lasts 72 hours. There could be a "critical" set of conditions leading up to the PMP, as has and did occur in the 1908 storm. These conditions leading up to the PMP should not be subtracted out of the PMP.

Comment: Page 10 Paragraph 5: Because of the lack of data, both spatial and temporal, numerous assumptions were made about precipitation distribution during calibration events. For example, for the winter storm calibrations, the FMS states that "precipitation data were available for low elevation stations, but no data existed for the upper elevation stations where the runoff was originating."

Response: ARCO interpreted the meaning of this paragraph differently than intended. As shown in the flood modeling report the upper elevation stations where the runoff was originating refers to the spring storm calibration and not the winter storm calibration. Runoff from upper elevations would occur during spring storms whereas runoff from the lower elevations only would occur during the winter where there is an area of frozen ground and elevations low enough so that the precipitation would not be "soaked in" by the existing snowpack.

Comment: Page 16 Paragraph 1: The FMS provides few details of the method followed to develop temporal distribution other than the comment that "the distribution of the PMP was arranged in 1-hour increments following the procedure outlined in NOAA Atlas 2."

Response: The amount of the PMP was calculated in 1-hour increments following the procedures as outlined in NOAA Atlas 2. The temporal distribution was arranged using HMR43 and HMR55A. The Figure 5 that is in Attachment 5 shows only CH2M HILL's hyetograph. The PMP hyetograph determined for this review at the bottom of the page is in error. As previously discussed, ARCO did not use the samr peak hourly value as CH2M HILL, (1.67 inches) but only used 1.07 inches. The presentation in Figure 5 is not correct.

Comment: Page 17 Paragraph 1, Item 4. Summary and Conclusions. Holding all other criteria of the HEC-1 simulation model the same as in the FMS, while using the PMP illustrated in Figure 5, the peak discharge for a PMF flood event would be approximately 120,000 cfs, rather than 145,000 cfs which is presented in the FMS.

Response: The minimal value should be 129,000 cfs and not 120,000 cfs. This lower value was incorrectly calculated by ARCO.

5. Comment: The comment questions some of the assumptions used and conclusions reached in the section that deals with the ability of the pond berms to withstand earthquake damage. It points out several details regarding the specific locations of the Warm Springs Ponds relative to subdivisions of the Intermountain Seismic Belt.

Response: The comment does not disagree with the conclusion of the FS that the berms are susceptible to damage by earthquakes, or that modifications of the berms to withstand earthquakes is required. As clearly stated in the FS, the initial look into the earthquake potential for the area is not definitive. A detailed earthquake study will be required as part of the design phase. The earthquake study should take into account all data and reports developed recently.

6. Comment: The comment notes that no reference was provided for a study by ESA for Anaconda Minerals Company.

Response: No published report was available. The paragraph in question described preliminary study results given to EPA and MDHES, by Roger Hail of ESA, during a meeting with ARCO and ESA.

7. Comment: The comment notes that the studies ARCO has performed to date do not specifically examine the earthquake stability of the berms as they currently exist, and that the FS misrepresents ARCO's studies in this regard.

Response: EPA and MDHES appreciate the clarification regarding the conclusions of the studies. The understanding by EPA and MDHES of the work done to date was based on statements made by ARCO's engineers during a meeting held with ARCO and its consultants during the development of the FS.

8. Comment: The statement that the pond berms may fail at accelerations from 0.05 to 0.07g appears unreasonable. The FS may be confusing pseudo-static earthquake coefficients with ground accelerations.

Response: The comment is correct. The 0.05 and 0.07 are pseudo-static earthquake coefficients used in the stability analysis. These coefficients are comparable to peak ground accelerations of 0.10 to 0.14g, using 0.50 for the ratio of peak ground surface acceleration to pseudo-static earthquake coefficient. Ratios of 0.40 to 0.67 are generally used to reduce the peak ground surface accelerations to pseudo-static earthquake coefficients.

The conclusion of the FS remains unchanged: the berms are susceptible to earthquake damage and require modifications to improve their earthquake stability. This conclusion is not in contention. ARCO's own plan calls for upgrades to the berms to improve their earthquake stability.

9. Comment: This comment presented further considerations that will need to be taken into account when the detailed earthquake study is performed.

   Response: EPA and MDHES, while not agreeing or disagreeing with the presentations made in this comment, believe they should be deferred until the detailed earthquake study called for in the FS, and apparently allowed for in Comment 7 above, is undertaken.

10. Comment: The comment states that the discussions of the possible consequences of a failure of the pond berms during an earthquake should be deleted from the FS because there is insufficient data and analyses to support such discussions.

    Response: EPA and MDHES disagree. It is appropriate for the FS to include indications of the possible consequences of a failure of the berms so the public can appreciate the hazard the berms pose. EPA and MDHES also disagree with the apparent statement that the FS should have included detailed analyses of earthquake failure scenarios. The purpose of the FS is not to determine the exact consequences that would occur if the berms fail during an earthquake, but only to determine whether a threat of a release exists, and to describe the potential consequences of such a release.

A more detailed study of the likely failure scenarios would perhaps be appropriate if the level of protection required for the berms were in dispute. But, in fact, ARCO's own Alternative Plan 3A includes upgrading the berms to withstand a maximum credible earthquake (once the MCE is determined); exactly the same standard of protection included in the Proposed Plan. Because neither the need to modify the berms to improve their earthquake stability, nor the level of earthquake they should be able to withstand is in dispute, detailed modeling of the likely failure scenarios is not warranted and would only delay actions to upgrade the berms.

In any event, EPA and MDHES continue to believe, based on historical experience with other tailings ponds, that the potential exists for the tailings to contaminate an extensive area downstream if released from the ponds by earthquake failure.

4.1.2 Media 2 - Surface Water

1. Comment: The comment states that the FS should include all available data in its entirety that was used in establishing the likely causative mechanism for the fishkills. The comment implies that some data are missing, but does not indicate what information is missing.

   Response: The argument developed by EPA and MDHES in determining the most likely cause of the fishkills is presented in the FS in some detail. The data relied on are either presented in the FS or in the RI reports.

2. Comment: The comment questions the method used to calculate the average metals loads in the Mill-Willow Bypass.

Response: The comment is correct in how the loading should have been calculated. However, EPA and MDHES believe this is now a moot point since ARCO has proposed to, and would presumably agree to, remove the sources of the metals loads in Mill and Willow Creeks as an alternative to routing their flows into the pond system for treatment. EPA and MDHES believe this would be a more appropriate approach to the problem. The FS did not explore the option of source removal, because the sources lie outside the limits of the operable unit. Data to determine the extent of the sources and the potential costs of their removal were not available during the preparation of the FS. See also the response to Comment 5, Section 8.3.2.

3. Comment: This comment questions the contribution of Mill and Willow Creeks to the contamination leaving the operable unit and the need to divert Mill-Willow flows into the pond system. The comment also questions the use of total metal analyses rather than dissolved metals for calculations of loadings.

Response: The text on page 4-29 of the FS would have been clearer if it had stated that the Mill and Willow Creeks contribute a significant portion of the total metals reaching the Clark Fork River from Silver Bow Creek. The comment is correct that the examples presented are for total metal analysis. However, the use of total metals concentrations is appropriate, because the harm to aquatic life caused by the metals is due to both dissolved and undissolved copper; and the standard for copper is based on acid soluble copper, not on dissolved copper only. Also, see responses to Section 7.5.1, Comments 3 and 4.

4.1.3 Media 3- Tailings Deposits and Contaminated Soils

Comment: This comment questions the methods used to calculate the volumes of contaminated soils in the FS.

Response: XRF and laboratory analyses of surface samples were used to define the areal extent of tailings and contaminated soils. Hand-auger borings were used to estimate associated thicknesses and, therefore, volumes of contaminated materials. The estimates of volumes of tailing and contaminated soils developed for the FS are suitable for the purposes of a FS and provide a reasonable basis on which remedial technologies and associated costs can be evaluated. Additional data on contaminated soils and tailings may be necessary to refine area and volume estimates in support of remedial design, once the preferred alternative for the site has been selected and contaminant action levels have been established in the ROD for site soils. The field map mentioned in the response to Section 2.2.7, Comment 2, shows the areas of contamination at the bypass area. See the response to Section 2.2.7, Comment 2, for a more detailed discussion of criteria used to define contaminated soil and estimate volumes and the acreages of contaminated soils within the operable unit.

4.1.3 Media 4 - Ground Water

Comment: The comment states that the FS is wrong in implying that the groundwater discharge to the Clark Fork River (estimated to be approximately 1 cubic foot per second) is a problem.

Response: The comment is correct that the discharge of 1 cubic foot per second of groundwater into the much larger flow of the Clark Fork River may not cause a measurable impact on water quality in the river. This section of the FS was written only to record the findings of the RI.

4.2 RELATION TO THE ENVIRONMENTAL CONCERNS FOR THE WHOLE SITE

4.2.1 Pond Bottom Sediment

1. Comment: The comment states that the FS is wrong in asserting that the problem of upgrading the pond berms to withstand floods and earthquakes is not affected by approaches that might be taken in the future to remedy upstream issues, and then goes on to state that this error caused MDHES to overlook a common approach to upgrading the berms and addressing upstream issues, namely ARCO's own proposal of raising the Pond 2 and Pond 3 berms and using these ponds to settle tailings out of flood flows.

   Response: EPA and MDHES disagree with the initial statement of comment. Upstream issues do not affect reasonable designs for upgrading the pond berms to withstand earthquakes and floods. EPA and MDHES agree, however, that certain elements of ARCO Alternative 3A have sufficient merit to be incorporated into the selected alternative in the ROD. For a detailed discussion of how the EPA and MDHES Alternative 3 and the ARCO Alternative 3A have been combined into the ROD's selected alternative, see the response to Section 7.5.

2. Comment: The comment states that the FS should either evaluate the impacts of damage from flood or earthquakes or not assert that the failure of the ponds during a flood or earthquake "would have a large, potentially catastrophic impact on the Clark Fork River, possibly as far as the Milltown Reservoir, which is also a Superfund site,...approximately 145 river miles from Butte, [which] already contains tailings from the Butte Area." The comment also states that the FS should assert that the tailings have accumulated in the Milltown Reservoir over the past century "through normal sediment transport."

Response: EPA and MDHES are concerned that failure of the berms would have large impacts on the Clark Fork River, and that those impacts could potentially be catastrophic to the life forms in the river and could extend well down river, possibly as far as Milltown Reservoir. The EPA and MDHES have considered the possibility of conducting an incremental risk assessment of potential pond failure, but have concluded that such studies would be too costly and time consuming, and would not be definitive enough to warrant the effort. EPA and MDHES note that they are in agreement with ARCO in the need to protect the ponds to withstand the MCE and the 0.5 PMF.

4.2.2 Surface Water

Comment: This comment repeats the point of other comments on earlier sections of the FS in stating that remedial alternatives for the Warm Springs Ponds Operable Unit must take into consideration upstream source controls, which will be part of an integrated remedy for the Silver Bow Creek Site.

Response: It is beyond the scope of the FS for the Warm Springs Ponds Operable Unit to explore, in detail, upstream source controls. If it had become apparent during the FS that upstream source controls must be part of any logical solutions to the problems at the operable unit, then it would have been necessary to redefine the operable unit, reconsider the objectives, and develop different alternatives.

The remedial action at the Warm Springs Ponds will be the first action along Silver Bow Creek because of the need to provide immediate protection from potential earthquake or flood events. The implemented action must be capable of providing adequate handling and treatment of Silver Bow Creek and potentially Mill/Willow Creek sediments and waters for the near term.

That action must realistically assume that upstream improvements will not take place for some years. When remediation activities upstream are underway or in place, then it will be appropriate to revisit, and perhaps revise appropriately, the Warm Springs Pond treatment system.

4.2.3 Tailings Deposits and Contaminated Soils

Comment: This comment refers the reader to the comment in Section 4.2.2 regarding surface water, apparently intending that it be applied to this medium.

Response: See the response to Section 4.2.2, which details the EPA and MDHES position regarding upstream source controls.

4.2.4 Groundwater

Comment: The comment states that ARCO agrees that groundwater contamination in the operable unit does not pose a problem for areas outside the operable unit.

Response: The section of the FS to which this comment refers is not meant to imply that the groundwater contamination in the operable unit does not pose a problem for areas outside of the operable unit. Rather, the point is made that selecting and designing a remediation for the groundwater contamination can be done independently of any problems outside of the operable unit. This is true because the contamination is largely caused by the contaminated materials in the operable unit, and because the means exist to solve the problem by actions taken within the operable unit.

CHAPTER 5.0

RESPONSES TO ARCO COMMENTS, CHAPTER 5.0
IDENTIFYING REMEDIAL OBJECTIVES
AND GENERAL RESPONSE ACTIONS

5.1 STATUTORY AND REGULATORY REQUIREMENTS

No comments.

5.2 REMEDIAL ACTION OBJECTIVES

1. Comment: Inflow design floods and surface water standards were not correctly identified.

   Response: These issues are addressed in the response to Appendix B or Chapter 3 or 4 responses.

2. Comment: The comment states that reducing the migration of upstream tailings is not an objective for this operable unit, but that the existence of this concern is only an acknowledgement that successful remediation of the Warm Springs Ponds Operable Unit is dependent on implementation of source controls upstream.

   Response: As discussed in response to Comments 4.2.2 and 4.2.3, source controls upstream are not considered appropriate remedial objectives for this operable unit. However, the point of this objective is to reduce migration of upper Silver Bow Creek and Mill/Willow Creek tailings to the upper Clark Fork River and the cleaned Mill-Willow Bypass. The remedial objective is appropriate. Note that both Alternative 3 and ARCO Alternative 3A propose to intercept most tailing migration from Silver Bow Creek.

5.2.1 Pond Bottom Sediments

Comment: ARCO states that the MDNRC dam safety rules do not address, and do not apply to the pond bottom sediments, and notes that the FS states that "the dam safety rules are established primarily for dams containing only water and not contaminated sediments."

Response: EPA and MDHES disagree with the comment. The dam safety rules are intended to address the more limited problem of a dam breach releasing only uncontaminated water. The FS goes on to note that because the dam safety rules were not developed to deal with the more hazardous situation of a dam releasing contaminated water and contaminated sediments, they may not be sufficiently protective in this situation, and more stringent standards may be needed. EPA and MDHES have evaluated the standards, and determined that a 0.5 PMF standard for all berms within the operable unit is the appropriate ARAR standard, and is necessary to adequately protect human health and the environment.

5.2.2 Surface Water

Comment: The comment states that the FS appears to imply that compliance with the water quality standards will improve aquatic life, and goes on to state that directly below the Warm Springs Ponds outlet, aquatic life has acclimated to the existing water quality conditions and is thriving and that the only problem is the periodic fishkills.

Response: EPA and MDHES disagree with the comment. EPA and MDHES believe that exceedances of the ambient water quality criteria (AWQC) are assumed to have negative impacts on the aquatic life in the streams, and that compliance with the water quality standards will improve aquatic life. The aquatic water quality criteria were established after careful investigation of the levels of contaminants that various aquatic life forms can tolerate without chronic or acute impacts. EPA and MDHES know of no site-specific study of the stream conditions immediately downstream of the outlet that would indicate the populations of the species currently there exist in the proportions and levels that they would if the water quality levels were not exceeded. CERCLA establishes ARARs as requirements that Superfund remediations must meet, and the water quality standards are ARARs for this operable unit.

5.2.3 Tailings Deposits and Contaminated Soils

Comment: The justification for the cleanup levels is not well documented, and the levels do not bear a clear relationship with actual site hazards.

Response: Detailed responses to ARCO's comments regarding risk assessment are contained in other parts of this responsiveness summary. EPA has determined that a risk is posed at the site by the contaminants and conditions present, and has selected an interim remedy for this site. EPA notes that a decision on final cleanup levels is deferred, pending further evaluation by EPA of the appropriate scenario and methodology and recent EPA guidance on risk assessments.

5.2.4Ground Water

Comment: Restoration of the ground water at the site is not appropriate, given site conditions.

Response: EPA and MDHES classify the aquifer as a Class II aquifer. MCL standards are relevant and appropriate standards for the site as the

ARCO comments admits, and must be met. Institutional controls are useful to prevent ingestion or exposure until cleanup occurs, but institutional controls are not generally considered permanent or reliable and should not generally be used as a replacement for active cleanup measures, are explained in the preamble to the NCP.

5.3 GENERAL RESPONSE ACTIONS

1. Comment: The comment states that the process and criteria used in selecting the general response actions should be given, along with a description of each general response action.

   Response: The criteria and process used to select the general response actions are those specified in the RI/FS guidance document. Descriptions of the general response actions are given in Table C-1, in which the meaning and scope of each general response action is revealed by the remedial technologies and process options listed under it. The reasons for eliminating possible general response actions are also noted in Table C-1.

2. Comment: The comment points out that the FS speaks of both "Treatment" and "In situ Treatment," and asks the difference. The comment also requests that access controls be included in Table 5-2.

   Response: Treatment includes those process options listed for it. In situ treatment includes many of the same process options. The difference is that in situ treatment is applied to the contaminated medium where it exists, without removing it from its current containment for treatment. The in situ treatment of the pond bottom sludges developed for Alternative 1 in the FS is an example of in situ treatment, since it would not require removal of the sediments for treatment.

Access controls have been considered remedial technologies under the General Response Action category "Institutional Controls," which is included in Table 5-2. The two access controls considered are flooding and fencing. Please see Table C-1 for more detail. EPA and MDHES regret the confusion caused by including access controls as a separate general response action in Tables 6-1 and 6-2.

3. Comment: The comment states that the FS should more clearly distinguish between the east-west berms and the north-south berms surrounding the ponds.

   Response: EPA and MDHES agree that there are some distinctions, but believes the FS is sufficiently clear on this point. Briefly, the most important distinction is that the north-south berms along the bypass would have to be raised to protect the ponds from being damaged by a flood along the Mill-Willow Bypass, while most of the east-west berms would not have to be raised for this purpose. Most of the other discussions of the berms, particularly regarding the need to upgrade the berms to withstand earthquakes, apply to both the north-south and the east-west berms. The raising of the Pond 3 berms to contain and treat the 100-year flood event also applies to both the north-south and the east-west basins.

5.4 INSTITUTIONAL CONTROLS

1. Comment: ARCO generally criticizes statements made concerning the use of institutional controls at this site.

   Response: The Feasibility Study section quoted by ARCO is a fair, general summary of current EPA policy regarding the use of institutional controls. EPA agrees that institutional controls may supplement long term remedial action, as well as provide short term protection. However, the NCP preamble states clearly that institutional controls should not be used as the sole component of a remedy, except in extreme circumstances. This was the general thrust of the FS and the State's institutional controls memorandum.

EPA notes that institutional controls for this ROD have been identified, both for short term management, and as supplements to engineering controls. The implementation of institutional controls regarding land use will focus the selection of final cleanup action levels on occupational, recreational, current residential, and environmental scenarios.

2. Comment: Skepticism over the use of local, county, or state governments to maintain and enforce institutional control is unwarranted.response: Before zoning or easement institutional controls can be accepted, EPA believes that concerns such as permanence and enforceability must be carefully examined. The willingness of local, county, or state governments to adopt and administer appropriate laws and programs and the financial ability to administer these properly are key components. EPA will continue to examine these issues carefully as it considers institutional controls at the Clark Fork Basin sites, and other sites.

5.5 AREAS AND VOLUMES OF CONTAMINATED MEDIA

Comment: The comment states that the estimates of tailings and contaminated soils used in the FS are not accurate enough to justify the necessity or selection of remedial actions in the FS.

Response: EPA and MDHES disagree with the comment. The areas identified as containing the tailings and contaminated soils are indicated on Figures ES-1 and 2-2. The estimates of volumes were made using standard techniques, and are believed to be sufficiently accurate to allow cost estimating that falls within the accuracy range specified by EPA for feasibility studies. See the response to Comment 1 in Section 2.3.1 for a discussion of the methods used to develop the estimates.

CHAPTER 6.0

RESPONSES TO ARCO COMMENTS, CHAPTER 6.0
IDENTIFYING A RANGE OF MEDIA-SPECIFIC ACTIONS

6.1 ALTERNATIVES IDENTIFICATION PROCESS

No comments.

6.1.1 Remedial Technologies and Process Options

1. Comment: This comment points out that Access Controls are listed differently in the two tables that summarize the screening of remedial technologies and process options (Tables 6-1 and C-1).

   Response: EPA and MDHES regret the confusion caused by minor inconsistencies in the tables, generally typographical or editing errors. These inconsistencies did not have an impact on the conclusions reached or the alternatives developed for the operable unit. The tables were constructed to summarize what was done and were not a determining factor in the actual screening.

2. Comment: "See Appendix C regarding inconsistent and/or inappropriate selection and screening of remedial technologies and process options."

   Response: ARCO's comments on Appendix C are addressed in the response to Appendix C of this Responsiveness Summary. There are six comments, each of which is individually addressed.

Response: The two tables have been checked, and no instance of a remedial technology or process option being dropped between the tables could be identified. This comment may have arisen from the fact that Table 6-2 is divided into separate sections addressing each of the four media. Some remedial technologies and process options retained in the screening step summarized in Table C-1 were retained for use with only one or some of the four media. In such cases (of which there are many), the technology or process option was not repeated under all four media, but instead only under those to which it may potentially be relevant.

4. Comment: The comment states that the remedial technologies and process options screening appeared to be subjective, and in some cases inconsistent. Two specific examples are given.

- Comment: "Institutional Controls" was screened out for the pond bottom sediments medium, but not for the other media.

  Response: No institutional or access control was identified that would be useful in preventing the release of the pond bottom sediments during earthquakes or floods, which is the remedial objective for the pond bottom sediments.

- Comment: The remedial technology "Sediment Control Barriers" and its two process options ("Capping Barriers" and "Settling Basins/Ponds") were screened out, in spite of the fact that settling ponds are the current containment method being used for the pond bottom sediments.

  Response: The comment is correct in a sense. The process option "Settling Basins/Ponds" is screened out. The reason is that the sediments are already contained in such ponds, and thus this process option is not needed in describing new actions that would be taken but that would leave the sediments where they are. It was not considered to be worthwhile to propose moving the pond bottom sediments to new settling basins or ponds at this time. So this process option was not needed.

5. Comment: This comment notes that in Table 6-2, a general response action is indicated as screened out, although one if its remedial technologies is retained.

   Response: Table 6-2 contains an editorial error. The "treatment" general response action was actually retained.

6.1.2 Selecting Representative Process Options

1. Comment: This comment repeats the idea that Institutional/Access Controls should have been retained to address flood and earthquake stabilization of the pond berms.

   Response: No institutional or access control was identified that would be useful in preventing the release of the pond bottom sediments during earthquakes or floods, which is the remedial objective for the pond bottom sediments.

2. Comment: This comment refers to the use of institutional controls in the development of alternatives.

Response: The use of institutional controls at the site is addressed in other sections of the Responsiveness Summary, and certain institutional controls are identified as part of the selected remedial action.

3&4. Comment: These comments indicate minor inconsistencies in the screening tables.

Response: To be consistent with Table 6-3, the remedial technology listed as "Landfill" in Table 6-2 should have been listed as "Land Disposal." The media "Surface Water" and "Groundwater" in the titles of Table 6-2 should have been listed as "Contaminated Surface Water" and "Contaminated Groundwater."

6.1.3 Assembling Media-Specific Actions

1. Comment: This comment asks the methodology used in assembling media specific actions, and the goals that were the guiding principle in assembling the media-specific actions.

Response: Media-specific actions were assembled to represent feasible approaches to addressing the problems identified at the operable unit. Feasibility in this context has the meaning given to it by the RI/FS guidance document for this phase of the FS process: a combination of implementability, effectiveness, and cost.

The guidance given in the RI/FS guidance document on the development of alternatives indicates that "Alternatives [or media-specific actions] should be developed that will provide decision makers with an appropriate range of options..."; that they should be "viable or appropriate alternatives for addressing site problems;" that they should "represent a range of treatment and containment combinations, as appropriate"; and that, "To assemble alternatives [or media specific actions], general response actions should be combined using different technology types and different volumes of media and/or areas of the site." This guidance does not give detailed procedures or narrow criteria by which the media-specific actions should be assembled. In light of the rather general guidance given in the guidance document, the objective for this FS was to put together media-specific actions that would represent the range of alternatives that would ultimately prove to be implementable and effective; specifically, the goal was to not leave out of the media-specific actions viable alternatives for the individual media that might prove to be implementable and effective. Cost was to be determined and evaluated in detail at later stages in the process.

The media-specific actions are, necessarily, rather broad in scope. Being, as they are, combinations of remedial technologies and process options, which are themselves broad concepts, the media-specific actions are broadly drawn. It is clear on inspection that the media-specific actions assembled in the FS provide no details; each represents a range of possible approaches. For example, ARCO's proposed alternative is contained, in concept, within the media-specific actions assembled in the FS.

The goals that guided the assembling of media specific actions were the remedial objectives identified for the operable unit in Chapter 5.

2. Comment: The comment states that Figure 6-1 in the report is inadequate.

Response: EPA and MDHES disagree with the comment. The figure serves the purpose for which it is intended: to note that some interactions exist between the media at the operable unit.

3,4, 5,7. Comment: These comments point out minor inconsistencies in the screening tables.

Response: Table 6-4 should have noted for both Problems 1 and 2 that MSA 2 would require draining the pond. MSA 6 should read in all places Surface Controls/Diversion Structures. MSA 10 should note use of a non-RCRA landfill.

6. Comment: This comment repeats an earlier comment made about the distinction between the east-west berms and the north-south berms.

Response: See the response to Section 5.3, Comment 3 and Section 6.2.1, Comment 1. The north-south berms need to be raised and modified for both flood and earthquake protection. Most of the east-west berms need only be modified for earthquake protection.

8. Comment: This comment repeats the comment made in several places about the use of institutional controls to address the groundwater contamination below the Pond 1 berm.

Response: This comment is addressed in other portions of the responsiveness summary.

9. Comment: This comment repeats an earlier comment about the impacts of the groundwater discharge to the Clark Fork River.

Response: The comment that the discharge of 1 cfs to the Clark Fork River would not cause a measurable impact on water quality in the river is correct.

6.2 RANGE OF MEDIA-SPECIFIC ACTIONS

6.2.1 Pond Bottom Sediments

1. Comment: This comment states that the FS should be clarified to indicate that containment of the pond bottom sediments during floods only requires raising and armoring the north-south berms.

   Response: EPA and MDHES believe the FS is sufficiently clear regarding which berms require modifications for which purposes. The three east-west berms that originally created the ponds appear not to require raising or armoring (except in a limited area of the Pond 1 berm) to provide protection from flood erosion damage. However, the newer berm (trending northwest-southeast) at the southern end of Pond 3 will require significant modifications to provide protection from a 0.5 PMF.

2. Comment: The comment states that references should be provided on the use of the Pozzolanic In Situ Stabilization on a large scale.

   Response: See the response to Comment 1 under Section 7.2. That response briefly describes four demonstration-scale applications of this technology.

6.2.2 Surface Water

1. Comment: This comment repeats earlier comments that the need for upstream source controls must be considered as a part of developing remedies for the Warm Springs Ponds Operable Unit.

   Response: It is beyond the scope of the FS for the Warm Springs Ponds Operable Unit to investigate upstream source controls. These will be investigated during future feasibility studies. See also the response to Section 4.2.2 comments.

2. Comment: This comment repeats the general points of ARCO's proposed alternative, mainly that an improved Pond 3 can be used to contain and adequately treat flows up to the 100-year flood event.

   Response: EPA and MDHES are now developing a response for the operable unit that is a combination of elements of Alternative 3 and ARCO's proposed plan. See the response to comments in Section 7.5 for additional details.

6.2.3 Tailings Deposits and Contaminated Soils

No comments.

6.2.4 Ground Water

This comment is addressed in other portions of the Responsiveness Summary.

CHAPTER 7.0

RESPONSES TO ARCO COMMENTS, CHAPTER 7.0
DETAILED DEVELOPMENT OF THE MEDIA-SPECIFIC ACTIONS

1. Comment: See Comments 1, 2, and 3, under Section 3.1.4, for discussion regarding the correct level of required flood protection for the ponds.

   Response: See responses to Section 3.1.4, Comments 1, 2, and 3 and Appendix B. The 0.5PMF standard is the appropriate ARAR for this action, and is necessary to protect human health and the environment.

2. Comment: The statement that "a seismic factor of safety of 1.2 will also be required" (page 7-1) is incorrect. The MDNRC dam safety rules indicate that dams the size of the Warm Springs Ponds embankments must be designed in accordance with principles at least equivalent to those in TR-60, Earth Dams and Reservoirs (Soil Conservation Service, 1981). TR-60 requires that the minimum factor of safety for slope stability, when analyzed with seismic forces (i.e., pseudo-static analyses), must be either 1.0 or 1.1.

   Response: There was a error in the text. The factor of safety used for the seismic analysis was 1.0.

3. Comment: The FS should include an additional MSA option 5D in Table 7-1 for enlargement/upgrade of the existing Warm Springs Ponds system to serve as both a sedimentation and treatment facility. This option should then be developed to at least a level of detail equivalent to the other actions. See also comments in Section 6.2.2.

Response: MDHES and EPA agree that an additional MSA should have been included in the FS to address enlargement/upgrading of the existing Warm Springs Ponds. An evaluation of this concept has been performed, and it has been concluded that this concept will provide a viable alternative to those presented in the FS. See the response to Section 7.5 comment for details of this evaluation.

7.1 MEDIA-SPECIFIC ACTION 1: STABILIZE POND BERMS TO WITHSTAND FLOODS

No comments.

7.1.1 Media-Specific Action 1A: Stabilize Pond Berms To Withstand A Probable Maximum Flood

1. Comment: This comment questions the peak flow of the PMF as used in the FS (146,500 cfs) and states that the actual value of the PMF should be lower.

   Response: The PMF calculations in the Silver Bow Creek Flood Modeling Study (November 30, 1989) are correct as presented. As discussed in meetings with ARCO, ESA (ARCO's technical consultant), MDHES, EPA, CH2M HILL, and HYDMET, the assumptions used by ARCO in changing input parameters to the HEC-1 model developed by CH2M HILL were inappropriate. An independent review was conducted by USGS on development of the hydrologic parameters in the Silver Bow Creek drainage, and they stated that the HEC-1 model prepared by CH2M HILL was well-calibrated for use in the upper Clark Fork basin.

   The HEC-1 model was used for the calculation of the PMF. As discussed in the above-mentioned meeting, for PMF calculations there has to be snow in the 5,000- to 6,000-foot elevation zone. ESA assumed no snow in this elevation zone; however, during the June 1908 flood, newspaper reports discussed power lines being down due to heavy snows. Also, one report indicated 9 inches of snow on the ground in Butte and still snowing. Since, by definition, the PMF is calculated assuming all hydrologic conditions being at "critical conditions" and since there is historic evidence that snow cover has existed in the 5,000- to 6,000-foot elevation zone, it must be used during calculation of the PMF. Also, the peak 1-hour PMP value as used by ESA (1.07 inches) has been exceeded twice as recorded at the Butte airport. This would indicate there was an inappropriate assumption and calculation made in obtaining the 1.07 inches.

Based on the thorough review of the calibrated HEC-1 model by USGS and the agreement made to its accuracy, and with proper hydrologic parameters being calculated and input to the calibrated model, the estimates for the PMF are 129,000 cfs and 201,000 cfs depending upon which value for the PMP is utilized (HMR 43 or HMR 55A). It was agreed during negotiations for the 1990 Mill-Willow Bypass removal action that the design value to be used for the PMF is 140,000 cfs.

2. Comment: The assumption that the pond berms along the Mill-Willow Bypass would be raised using "imported, well-graded gravels" (page 7-6) is inappropriate. There is no reason not to use suitable natural (i.e., unprocessed) soils readily available in the immediate site vicinity.

   Response: EPA and MDHES agree with this comment. If suitable materials are available in the immediate site vicinity, they should be used in the berm construction. The cost estimates included in Appendix D assume some materials from the local vicinity could be used.

3. Comment: The FS should include other slope armoring alternatives in Footnote 4 on page 7-6, such as grouted riprap, gabions, and/or geowebs. Although these alternatives may or may not be technically suitable or cost effective for broad application at the site, they may well prove appropriate for local use. Also, the FS should use the terminology "armoring," rather than "stabilization," when discussing erosion or scour protection.

Response: Footnote 4 on page 7-6 was included to clarify the cost-estimating basis, not to provide a complete list of all possible armoring techniques. EPA and MDHES agree that "armoring" is the more technically correct term. It should be noted that it has been agreed that soil-cement is the most cost-effective method for armoring the slopes of the berms along the Mill-Willow Bypass, and soil-cement will be the armoring technique utilized.

4. Comment: The FS states that where the existing Mill-Willow Bypass would be covered by relocation of the pond embankments, the new channel would be designed with the same flow capacity as the existing channel (page 7-9). This suggests that the FS design does not consider balancing the required embankment raises with excavation of the bypass channel to the west. The FS design should evaluate the potential for improved hydraulics and substantial cost savings by balancing cutting and filling. Also, the FS should clarify whether the additional flow capacity of the bypass due to removal of tailings and contaminated soils was accounted for in the design.

Response: Detailed balancing of earthwork in the preliminary design of the Mill-Willow channel/embankment raise was not performed. Feasibility level designs need only be carried to a point such that reasonable comparative cost estimates can be performed. The EPA and MDHES agree that balancing of the earthwork between Mill-Willow excavations and embankment raises should be done as much as is feasible. This has been accomplished during the final design for the summer, 1990 Removal Action.

The increase in flow capacity as a result of contaminated soil and tailings removal in the bypass was not factored into the flood modeling during preparation of the FS. The primary reason is that the precise depth and extent of removal was not determined in sufficient detail to justify adjusting the flood modeling program. The increase in capacity resulting from contaminated soil and tailings removal was factored into revised flood modeling performed by ARCO during final design for the 1990 Removal Action.

5. Comment: The FS relies on a previous study by IECO (1981) to evaluate the effects of PMF runoff from the hills east of the Ponds. The CH2M HILL (1988) PMF model developed specifically for the Warm Springs Ponds RI/FS does not include the hills east of the ponds in the modelled area.

Response: The Silver Bow Creek Flood Modeling Study (November 1989) calculates the PMF for Silver Bow Creek to a point downstream of the Warm Springs Ponds. This includes the hills to the east of the Warm Springs Ponds. Specifically, these basins are numbered Node 30 - Subbasin P - Pond 3 Local, Node 33 - Subbasin Q - Pond 2 Local, and local drainage for Pond 1 is contained in Node 36 - Subbasin R - Cook Creek Local, as shown in the flood modeling report Figure 3, page 35. The contributing flow to the Warm Springs Ponds and subsequently into Silver Bow Creek is calculated for these subbasins during a PMF on Silver Bow Creek. The model, as calibrated and run, presents the flows from the hills to the east of the Warm Springs Ponds.

6. Comment: Table 7-2 should be amended to include the elevation corresponding to the "Storage Available within Existing Berms." Also, the data and methodology used to derive storage volumes should be described.

Response: The elevation corresponding to the available storage is the top of the berms at the lowest spot for each pond. The storage volumes are estimates based upon existing topographic mapping and bathymetric mapping.

7.1.2 Media-Specific Action 1BL Stabilize Pond Berms to Withstand Flows Less Than Probable Mwaximum Flood

1. Comment: This comment states that page 7-12 of the FS should be modified to indicate that the MDNRC dam safety rules do not specify flood flows for the protection of the ponds.

Response: While the MDNRC Dam safety rules obviously do not specify actual discharge values for each pond, the values shown are derived from applying the dam safety rules. For more detail about the development of the PMF values, refer to the responses to comments under Section 4.1.1.

2. Comment: The partial PMF values used in developing designs and cost estimates for MSA 1B should be revised to match the PMF values presented by ARCO in Section 7.1.1, Comment 1.

Response: EPA and MDHES maintain that a PMF value of 146,500 cfs is appropriate for the Silver Bow Creek drainage. Through negotiations on the Mill-Willow Bypass removal this summer, it was determined that the level of protection needed for all three ponds was 70,000 cfs, which is approximately half of the PMF noted in the FS.

3. Comment: The FS indicates on Figure 7-2 that "compacted granular fill" is assumed for berm remediation. See Comment 2 under Section 7.1.1.

   Response: EPA and MDHES agree with this comment. If suitable materials are available in the immediate site vicinity, they should be used in the berm construction. The cost estimates included in Appendix D assume some materials from the local vicinity could be used.

4. Comment: Figure 7-2 indicates that no freeboard has been allowed for the berms along the Mill-Willow Bypass. Some freeboard should be provided.

   Response: The water surface elevation shown in Figure 7-2 is incorrect. A minimum of 2 feet of freeboard should be indicated on Figure 7-2. Two feet of freeboard was assumed for quantity and cost estimating. The cost estimates in Appendix D include a minimum of 2 feet of freeboard for the berms along the Mill-Willow Bypass and for the eastern hills flood control berm.

5. Comment: The FS should provide a reference for the flood volumes included in Table 7-3.

   Response: The "Designated Flood Volumes" in Table 7-3 are percentages of the PMF values listed in IECO (1981). It should be noted that the PMF values shown in this reference are different from the PMF values prepared by ARCO. The differences are:

	IECO (1981)		ARCO (1989)	
	Peak Discharge (cfs)	Volume (ac-ft)	Peak Discharge (cfs)	Volume (ac-ft)
Pond 1	13,800	2,200	17,100	1,980
Pond 2	19,200	3,000	25,100	3,210
Pond 3	9,700	1,000	23,500	2,840

Since the PMF values listed by ARCO are generally more conservative than IECO (1981), the ARCO PMF values have been accepted by EPA and MDHES.

6. Comment: Table 7-3 should be amended to include the elevation corresponding to the "Storage Available within Existing Berms."

   Response: The elevation corresponding to the available storage is the top of the berms at the lowest spot for each pond. The storage volumes are estimates based upon existing topographic mapping and bathymetric mapping.

7.2 MEDIA-SPECIFIC ACTION 2: STABILIZE/SOLIDIFY POND SEDIMENTS

1. Comment: The FS should document and describe the existing successful applications of in situ stabilization/solidification in the United States or proposed applications of this technology that are alluded to on page 7-17, especially those involving CERCLA sites.

   Response: Perhaps the FS should have used the term "successful demonstrations." Applications of in situ stabilization/solidification that have been demonstrated in the United States include:

- In December 1988, Soliditech, Inc. of Houston, Texas, demonstrated its solidification and stabilization process, which chemically and physically immobilizes hazardous constituents contained in slurries, at the Imperial Oil Company Superfund site, an oil recycling facility in Morganville, New Jersey. During the process, the proprietary reagent URRICHEM™ was dispersed throughout the waste to micro-encapsulate hazardous compounds by crosslinking organic and inorganic particles, coating large particles, and sealing small pores and spaces. This sealing process significantly reduces leaching potential. Wastes treated during the demonstration were from three sources at the facility: contaminated soils from a marshy area, used filter-clay material from an existing waste pile, and an oily sludge from an unused storage tank. Approximately 2 to 5 cubic yards of each waste were processed in Soliditech's mobile mixing unit. Contaminants included polychlorinated biphenyls (PCBs), heavy metals, petroleum hydrocarbons, and low levels of volatile organic chemicals. Samples of untreated and treated waste were analyzed for a wide range of organic and inorganic contaminants, and other physical and chemical characteristics. Samples were also subjected to several leaching tests. The treated wastes were evaluated for strength and durability through tests such as the unconfined compressive strength test, freeze/thaw tests, wet/dry tests, and microstructural analysis. Preliminary results are not yet available.

- Chemfix Technologies, Inc. of Metairie, Louisiana, has developed a proprietary process (CHEMFIX) that stabilizes high-molecular-weight organic and inorganic constituents in waste slurries. The CHEMFIX process uses soluble silicates, silicate setting agents, and additives to crosslink with waste components to produce a stable solid matrix. The equipment utilized was capable of processing soils at a rate of up to 100 tons per hour. This technique was demonstrated at the Portland Equipment Salvage Company Superfund site in Clackamas, Oregon. The site operated as a transformer and metal-salvaging facility. The major waste contaminants are lead and copper, present at maximum concentrations between 10 and 15 percent, and PCBs present at maximum total concentrations of 2,000 to 5,000 ppm.

Several leaching and extraction tests were conducted on products of the solidification/stabilization process to indicate the long-term stability of the processed material. The toxicity characteristic leaching procedure (TCLP) extracts from processed wastes contained lead in concentrations 94 to 99 percent less than in leachate extracts of untreated wastes. The wet/dry and freeze/thaw durability tests were good, showing little or no strength loss after 12 cycles. The unconfined compressive strength at 28 days ranged from 27 to 307 psi. Permeability of the treated material ranged between 1×10^{-6} cm/sec and 6.4×10^{-7} cm/sec.

- The solidification/stabilization process developed by Hazcon, Inc. of Katy, Texas, was demonstrated at the Douglassville Superfund site, near Reading Pennsylvania, in October of 1987. This process blends contaminated soil or sludge with cement, pozzolans, and a proprietary ingredient, called Chloranan, which neutralizes the inhibiting effects of organics. The result is a concrete-like mass that contains the contaminants. The contaminated soil wastes stabilized at the Douglassville site came from six sources: one each from two large lagoons once filled with waste oil sludges and, subsequently, drained and backfilled with soil; an oily filter cake disposal area; an oil drum storage area; an oil reprocessing area; and a waste land farm.

During the field demonstration, 5 cubic yards of each waste were treated. Samples were taken from the untreated soils, the blended slurry after 7 days of curing, and core samples from the 28-day old blocks. The samples were analyzed for soil characteristics, leachability, permeability, unconfined compressive strength, microstructure changes, and contaminant levels. Samples of the treated waste will also be taken over a period of 3 to 5 years.

Results indicated that the volume of the solidified soil was approximately double that of the undisturbed waste feed, but the permeabilities of the treated soil were very low, in the range of 10^{-8} to 10^{-9} cm/sec. Durability tests results were good and no loss of strength was observed after 12 wet/dry and freeze/thaw weathering test cycles. The TCLP test showed that heavy metals were immobilized over the range of oil and grease encountered. TCLP leach tests performed on untreated and treated soils showed equivalent concentrations of volatile and semi-volatile organics in their respective leachates. In addition, special leaching tests were run that simulated leaching of the intact solidified cores.

- In cooperation with General Electric, Inc., International Waste Technologies (IWT) demonstrated its in situ stabilization/solidification process at a closed electric service shop in Hialeah, Florida, in April 1988. At that site, approximately 13,000 cubic yards of soil are contaminated with PCBs and some volatile organics and heavy metals. IWT used the Geo-Con, Inc. Deep Soil Mixing system to drill and blend waste material with IWT's patented bonding agent. The IWT process bonds organic and inorganic compounds, creating macromolecules that are highly resistant to acids and other deteriorating factors.

The major objectives of the demonstration were to evaluate the ability of the process to immobilize PCBs in the soil; determine the level of performance and reliability of the mechanical equipment being used; assess the effectiveness of the process for in situ stabilization; and to observe the integrity of the solidified soil over a period of 5 years. During the demonstration, the stabilization/solidification process was tested on two sectors totaling about 400 square feet. The soil was blended and stabilized in depths up to 18 feet. Samples of the untreated soil and the treated material were analyzed for soil characteristics, leachability, permeability, unconfined compressive strength, microstructural changes, and contaminant levels. These analyses will be repeated on borings of the treated soil to be taken one to two times a year. Preliminary results show that the mixing system achieved a homogeneous soil/reagent blend with minimal difficulties. The mass solidified at low permeability and high density, but lost its integrity during freeze/thaw cycles. Data on the effect of treatment on the mobility of PCBs is still being evaluated.

2. Comment: The FS should provide brief descriptions of the "several full-scale prototype projects" in the U.S. involving in situ stabilization, and document the success and failure of this technology (page 7-18).

   Response: The words "full scale" should not have been included in this sentence. The projects were prototypes (larger than laboratory tests, but not "full-scale") and are described in the response to Comment 1 above.

7.3 MEDIA-SPECIFIC ACTION 3: STABILIZE POND BERMS TO WITHSTAND A MAXIMUM CREDIBLE EARTHQUAKE

1. Comment: The FS should document and describe the "conceptual level stability analysis" performed to determine necessary corrective measures.

   Response: The stability analysis was performed at the conceptual level to determine preliminary designs for cost-estimating purposes. A formal stability analysis should be performed based on site-specific information prior to final design.

2. Comment: The FS states on page 7-20 that the factor of safety used for seismic loading was 1.0, while on page 7-1 it is listed as 1.2. Which is correct?

   Response: As noted in the response to Section 7.0, Comment 2, the analyses used a factor of safety of 1.0.

3. Comment: The FS should reevaluate the conclusions of the IECO (1981) report in terms of slope stability under earthquake loadings. Those conclusions were necessarily based on a now outdated assumption that the Continental Fault was the controlling source of damaging earthquakes that might impact the Warm Springs Site (see Section 4.1.1 Comment 9). The FS should be revised as necessary to accommodate the current understanding that the Continental Fault is not capable of generating significant earthquakes.

   Response: The FS was based on previous reports concerning the geology and seismicity of the area only as a basis to prepare cost estimates of the corrective measures. As stated in the FS, during the design phase the site seismicity should be reviewed in detail.

4. Comment: See Section 7.1.1, Comment 2, regarding the inefficiency of using imported granular materials for slope remediation.

   Response: EPA and MDHES agree that onsite materials may be adequate for slope remediation. See response to Section 7.1.1, Comment 2.

7.4 MEDIA-SPECIFIC ACTION 4: REMOVE AND DISPOSE OF CONTAMINATED SURFACE SOILS FROM ALONG THE MILL-WILLOW BYPASS

1. Comment: The FS assumes that it will be necessary to remove and dispose of 130,000 cubic yards of contaminated soil. This estimated soil volume is not based on action levels. The actual volumes of soils requiring remediation are not known.

   Response: The estimate of 130,000 cubic yards of contaminated soil was prepared prior to the final determination of action levels and was for use in cost estimating only. During the design phase, detailed field testing of contaminant levels was performed and detailed plans were developed for the areal extent and depths of removal. When the Mill-Willow Bypass removal is complete, the amount of tailings and contaminated soil removed will be known.

2. Comment: See Section 7.7.2.3, Comment 2, regarding the inapplicability of transporting tailings and contaminated soil to an offsite RCRA facility.

   Response: This MSA was developed to assemble alternatives that exceed the requirements of ARARs. See response to Section 7.7.2.3, Comment 2.

3. Comment: On page 7-22, the FS indicates that disposal location options for tailings and contaminated soils include "Pond 1, 2 or 3 prior to solidification or capping." In other places the FS specifies that disposal would be in Pond 1. The FS should evaluate locating two or more disposal facilities in the ponds closest to the source of the materials to be disposed.

Response: During the FS, it was determined that placing the materials in Pond 1 prior to capping was more protective of the environment, and that option was selected for cost estimating purposes. The discussion on page 7-22 should have been changed to reflect this decision for the cost estimating basis. It has since been determined during negotiations for the 1990 Mill-Willow removal that two disposal sites (one in Pond 1 and one in Pond 3) are equally protective of the environment.

7.5 MEDIA-SPECIFIC ACTION 5: IMPROVE THE POND TREATMENT SYSTEM

Comment: This comment states that the FS is deficient because it does not include ARCO's preferred alternative.

Response: The concept of raising the Pond 3 berms to contain the flood flows was one of many concepts considered during the early stages of development of MSA's for addressing upstream tailings and sediment transport. This concept was not pursued in depth, because the option of an upstream impoundment was more promising in terms of protecting human health and the environment. It was determined during preparation of the FS that a separate upstream impoundment would offer greater flexibility in terms of operation of the overall pond system. By separating the functions of flow equalization/primary sedimentation from biological/chemical treatment, the operation could be more reliable and flexible in dealing with large flood flows. In addition, providing primary sedimentation upstream of Pond 3 would extend the life of Pond 3 by capturing a considerable portion of the sediments during large runoff events.

In light of adverse reaction by ARCO and the public to the concept of an upstream impoundment, EPA and MDHES re-evaluated the concept of flood storage within Pond 3. It was concluded that utilizing Pond 3 for flood storage of the 100-year event was capable of providing protection to human health and the environment equal to an upstream impoundment.

It was also concluded upon re-evaluation that Pond 2, if upgraded as suggested by ARCO, could provide polishing and additional treatment during normal operations. These concepts were incorporated into the proposed plan included in the Record of Decision (ROD) as Alternative 3+3A. The primary flood storage and treatment features of this concept can be summarized as follows:

- Allow the ponds to remain in place; Ponds 2 and 3 will continue to function as treatment ponds.

- Raise and strengthen all pond berms to protect against dam failure in the event of major earthquakes or floods and increase volume capacity of Pond 3 to store flows up to the 100-year flood volume.

- Construct new inlet and hydraulic structures to reduce debris plugging of the Pond 3 inlet and to safely route flows in excess of the design peak flow of the 100-year flood around the ponds.

- Comprehensively upgrade the treatment capability of Ponds 2 and 3 to treat flood volumes up to the 100-year flood and construct spillways for decanting excess flood water into the bypass channel.

The EPA and MDHES still have concerns regarding the potential to resuspend pond bottom materials during high flow or high wind events and the potential effects upon the biota in the Clark Fork system, if these materials are released to the environment. Accordingly, there is a provision in the ROD requiring additional study of the potential to resuspend pond bottom materials and the effects upon the environment of any resuspension. If resuspension is shown to be a significant problem, the ROD includes provisions requiring that additional measures be taken by ARCO to mitigate the resuspension of these materials.

7.5.1 Media-Specific Action 5A: Overall Upgrade of the Pond Treatment System

1. Comment: The FS should document the data, methodology, and specific analyses used to arrive at a design maximum flow rate of 600 cfs for Pond 3. The FS should also elaborate on the potential to adjust the maximum flow rate during remediation design.

   Response: The alternatives presented in the FS were developed in sufficient detail to provide conceptual-level design numbers according to standard engineering practice. The design maximum flow rate provided (600 cfs) was developed to provide adequate detention time for metals removal based upon engineering judgment and information in the literature. Footnote 13 on page 7-24 acknowledges that the results can be adjusted during the remedial design phase of the work. The optimization of design should be based on field-scale pilot treatability testing using various flow assumptions and artificially created flood waters (since actual flood waters would not be available). As noted in the response to Comment 7.5, Pond 3 will be used for flood storage. The influent structure will be designed for a peak flow of 3,300 cfs, and the decant towers (outlet structures) will be designed for a combined peak flow of 750 cfs during the 100-year event.

2. Comment: This comment states that the federal water quality criterion for copper used in the FS (12 μg/l) is incorrect, because it is based on a hardness of 100 μl. The comment claims that the

measured average hardness in Warm Springs Ponds is 175 mg/l, and that the FWQC for copper at a hardness of 175 mg/l is 19 μg/l. The comment states that the standards for cadmium, copper, lead, and zinc should also reflect a hardness of 175 mg/l.

Response: ARCO has used the average hardness value for the Pond 2 discharge (PS-12), rather than that for the inflow to the Mill-Willow Bypass. The hardness in the ponds is not relevant, since, as ARCO has pointed out in a separate comment, the water quality standards are not currently applied to the ponds. The average hardness of water entering the Mill-Willow Bypass, as measured during the Phase I RI at Station SS-18, was 129 mg/l. This value is much closer to the stated basis for calculating the aquatic standard for copper than the 175 mg/l hardness suggested by the comment. The value of 100 mg/l hardness used in Table 7-4 was used to provide a common standard to which concentrations measured in inflow water to the Mill-Willow Bypass and Pond 2 discharge water could be compared. Use of average values or specific values and associated hardnesses does not change the conclusions that were developed from the table.

3. Comment: This comment notes that Table 7-4 shows an average copper concentration of 31 μg/l at the inlet to the Mill-Willow Bypass. The data used to calculate this value were taken from the 1987 RI (MultiTech, 1987). The data from the Phase II RI (CH2M HILL, 1989) show an average copper concentration of 13.5 μg/l entering the Mill-Willow Bypass. The more recent data indicates ambient concentrations of copper in Mill and Willow Creeks do not exceed the chronic level FWQC for aquatic life under normal flow conditions.

Response: Phase I RI surface water data are much more comprehensive than Phase II RI surface water data. The Phase I RI data collection effort was designed to characterize surface water chemistry over a variety of flow conditions, as compared to Phase II data, which were collected to characterize diurnal changes in surface water quality on a seasonal basis. Phase I data were collected during 15 sampling episodes conducted over a 9-month period, while Phase II data were collected during four 24-hour periods during September, January, April, and July. The Phase I data are more representative of site conditions than the Phase II RI data, which were collected for a different purpose. The MDHES is not aware of any major changes in the site conditions that would indicate that conditions during the Phase II RI were different from those characterized during the Phase I RI. Sampling by ARCO during 1990 in Mill and Willow Creeks has confirmed exceedances of the water quality standards in Willow Creek. See also the response to Section 7.5.1, Comment 4, below.

4. Comment: This comment, along with Comments 3 and 15 of this section, makes several points regarding the contributions of Mill and Willow Creeks to the ambient concentrations leaving the operable unit. Specifically, the comments state that the FS is in error regarding the relative contributions of Mill and Willow Creeks to the levels of contaminants in the surface water as it leaves the operable unit, and that the FS should have more clearly stated that diverting Mill and Willow Creeks into the pond system would eliminate the fisheries on those streams.

Response: The comment is correct in pointing out that the contributions of Mill and Willow Creeks to the surface water contamination may not be as large as stated in the report. ARCO has suggested that the design investigation for Warm Springs Ponds evaluate the contamination in the two creeks further, determine its sources, and evaluate source-specific actions to address the contamination, if necessary. EPA and MDHES concur with this approach.

5. Comment: The capacity of the Pond 3 inlet structure is stated to be 700 cfs in the FS. Previous studies by ARCO (ESA, 1987) have indicated that the capacity is approximately 1,400 cfs. The FS estimate of inflow capacity should either be justified or corrected.

   Response: Calculation of the inlet structure capacity (Silver Bow Creek Flood Modeling Study, CH2M HILL, 1988) indicated a maximum flow rate of approximately 900 cfs under ideal conditions. This estimate was downrated to 700 cfs to account for plugging, age, and actual field conditions.

6. Comment: Footnote 16 on page 7-29 should reference the basis for the estimated flood flows. Diversion structure facilities proposed in the FS are sized for a 100-year flood of 4,900 cfs. As was stated in Section 4.1.1 of this review, the 100-year flood on Silver Bow, Mill and Willow Creeks that should be used in the MSA for facility sizing is 4,000 cfs.

   Response: The USGS has confirmed that the HEC-1 runoff-simulation model, as prepared by CH2M HILL, is appropriate for the conditions in the upper Clark Fork basin. The peak flow calculated in the combined Mill-Willow-Silver Bow Creek system for the 100-year event was 4,900 cfs without considering any diversion into

Pond 3. See also the responses to Section 4.1.1, Comment 1, and Section 7.1.1, Comment 1.

7. Comment: ARCO believes that the comprehensive treatment pond upgrades proposed in MSA 5A will not consistently attain FWQC for surface water quality at normal flows and especially during higher flows approaching 600 cfs. A review of data from the Phase II RI (CH2M HILL, 1989) shows that during normal flows, full utilization of Pond 3 and Pond 2 volume is required to achieve FWQC for both copper and zinc. Samples taken at the effluent from both ponds showed that the additional retention time provided by Pond 2 was required to meet Gold Book criteria (EPA, 1986) for chronic aquatic life during September and January sampling events for zinc. These data indicate that the longer retention time provided by Pond 2 in series with Pond 3 was required to meet discharge criteria at pond pH levels up to 9.0 and flows ranging from 2 to 105 cfs. Treatability studies conducted as part of the Phase II RI confirmed that a large fraction of precipitated metal hydroxide particles are very small and typically require long retention times (on the order of 20 days and longer) to settle out completely.

Response: Upon evaluation of ARCO's Plan 3A, EPA and MDHES agree that Pond 2 can provide polishing and additional metals removal after the pond operating depth is increased by 2.0 feet and flows are limited to 200 cfs, as proposed by ARCO. EPA and MDHES believe, however, that Pond 2 will provide effective additional treatment only during low flow and low wind conditions. The RI data indicate that Pond 2 currently can act as a source for metals during high wind events. The degree to which Pond 2 will continue to serve as a source for metals following an increase in operating water level is unknown. Thus, as a result of further deliberation, it has been decided that the system will be designed to allow discharge directly from Pond 3 into the Mill-Willow Bypass, if required. This will allow Pond 2 to be bypassed during any conditions in which the discharge from Pond 3 is of higher water quality than the discharge from Pond 2.

8. Comment: Overall upgrades to the pond system proposed in the FS call for lime addition into a lined channel approximately 2,000 feet in length from the discharge into Pond 3. The advantage of the new channel is said to be that it will allow better mixing of lime and prevent lime and metal hydroxides from settling in the influent channel. However, current lime addition in the winter, which occurs at the intake structure to Pond 3 shows no visual evidence of lime or metal hydroxide accumulation in the creek at or below the intake structure. Lime is currently added as dry-powdered quicklime during cold weather conditions and any problems with undissolved lime accumulating in the creek would most likely occur during this time.

   Response: As stated on page 7-30 of the FS, the primary reason for channelizing the flow from the inlet structure to the ponds would be to better control the direction of the flow and to limit the interaction with tailings deposits above Pond 3. Better lime mixing is a secondary benefit of the channel. Upon re-evaluation, it has been decided that the potential benefits of a lined channel do not justify the additional expenditure, and this concept has been deleted from the Recommended Alternative (3+3A) detailed in the ROD.

9. Comment: The lime addition treatment system in the FS is conceptual. An estimated cost accuracy of +50 percent to -

30 percent cannot be met based on the level of detail provided in this process description. Also, a redundancy of 100 percent for all components of a treatment system, as assumed in the FS, is not required to provide a sufficient margin of safety.

Response: FS cost estimates are required to have a +50/-30 percent overall accuracy for each remedial alternative, taken as a whole. It is not necessary for each line item to meet this accuracy requirement. The overall cost estimates for the alternatives are designed to be order-of-magnitude estimates for comparative purposes. An order-of-magnitude estimate is defined as an approximate estimate made without detailed engineering data. The lim‹ addition system presented in the FS meets these requirements.

The 100 percent redundancy specified for the system is necessary due to the remoteness of the site, its exposure to extreme natural elements, and the continuous nature of the natural stream flow.

10. Comment: Predictions of hydroxide sludge volumes resulting from treatment by lime to pH 9 (FS, page 7-35) are based on 0.66 ml of sludge per liter of water treated. However, this value conflicts with data from lab-scale treatability studies in the Phase II RI (CH2M HILL, 1989), which show that less than 0.5 ml of sludge per liter of water will result from lime treatment at pH 9. Also the value of 0.66 ml/l does not distinguish between sludge volume resulting from hydroxide precipitation and sludge volume resulting from settling of sediments and previously suspended solids.

Response: The predicted volume of sludge generated due to lime treatment (0.66 ml/l) used in the FS is taken from the results of the barrel-scale treatability tests performed as part of the Phase II RI. The barrel-scale tests are thought to more accurately predict pond deposition rates.

The value of 0.66 ml/l (FS, page 7-35) represents the hydroxide sludge generation rate. Generation due to the settling of suspended solids and bio-solids is included in the additional 2,000 cubic yards per year identified in the text.

11. Comment: The comprehensive treatment pond upgrades presented in the FS included use of Pond 3 at its present volume with the addition of a berm partition and new influent and effluent structures. When constructed, the berm will create a relatively narrow (1,000 foot) opening to channel the full normal and flood flows through Pond 3. At the berm opening, flows will accelerate to higher velocities, resulting in resuspension of settled materials in this part of the pond. Construction of the new influent structure will narrow the full flow inlet to a single opening of only 100 feet in width. Erosion and resuspension of settled particles will occur in this area as well, especially during flood conditions.

Convergence of flows to a single discharge point will also likely cause disturbance of settled solids. The combination of new inlet and effluent structures with the proposed internal berm structure will result in a shift of the existing flow pattern across the pond. The pond will establish a new equilibrium during which lime-settled material will be redistributed and substantial quantities of precipitated metal contaminants may be discharged from the pond. In addition, the construction of the berm will cause disruption of the pond bottom sediments underneath and around the area of construction, resulting in substantial short-term discharges of metal contaminants into the Mill-Willow Bypass.

The FS contends that the new berm will reduce the chance of flows channeling through Pond 3. However, there is no evidence that channeling is currently a problem. The new berm is also said to reduce the effects of wave action caused by high winds. If winds are demonstrated to create a problem, a log boom or similar structure could be designed to work as effectively as a berm in reducing wave action.

Response: The opening at the east end of the berm would be sized to avoid resuspension of sediments in this area. The average velocity through the opening would be approximately 0.13 fps at 600 cfs. This velocity is approximately one-half of the velocity necessary to induce resuspension of the pond bottom sediments (as noted in the report of erosion potential prepared for ARCO by Simons and Associates, 1990).

The EPA and MDHES agree that the new influent structure would resuspend some sediment in the vicinity of the structure during high flows. Given the nature of this system, it is virtually impossible to design an influent structure that will not tend to resuspend some materials during higher flows. The reason is straightforward. During normal flow periods, some of the materials entrained in the flow will tend to settle out (as they reach their respective settling velocities) in a particular pattern around the influent structure. When the flows increase during runoff events, the increased velocities will cause some of these materials to resuspend. However, since these are the particles that have comparatively high settling velocities, they will merely settle out further downstream in the pond system. In other words, the sediments around any influent structure will be in a state of flux as long as influent flows vary significantly.

The convergence at the outlet structure was considered during preparation of the FS. The preliminary design was based on limiting the average approach velocity to 0.3 fps around the structure. Similar to the phenomenon noted above, however, approach velocities around the structure vary with the flow rate. Thus, there may be some unavoidable resuspension around any outlet structure during higher flows.

The agencies agree that construction of the berm would cause disturbance of the sediments in the vicinity of the berm. The construction should be scheduled during low flow periods in Silver Bow Creek to maximize the detention time to allow the disturbed sediments to resettle. The MDHES does not agree that changing flow patterns in the pond would result in "substantial quantities" of materials being discharged from the pond.

The FS did not state that "channeling" of flows was a current problem. The FS stated that the berm would help prevent short circuiting. It is a well-established design principle that maximizing the flow path in a settling basin is a desirable goal. This helps promote better settling efficiency and reduces short circuiting, especially at higher flows.

The reduction of wave action is only one aspect of the issue of wind action. The winds during a storm event tend to create currents in the ponds that are sufficient to resuspend pond bottom sediments. Reduction of these wind-induced currents is a major function of the berm across Pond 3 that could not be addressed by log booms. In addition, the long-term efficacy of log booms in ponds subject to freezing conditions is questionable.

It has been decided to delete the specific requirement for a berm across Pond 3. Instead, the Recommended Alternative (3+3A) in the ROD contains provisions to study and potentially model the effects of resuspension. The ROD also contains provisions requiring additional mitigative measures, if resuspension is demonstrated to be a problem. A berm across Pond 3 is one option that would likely be considered as a mitigative measure.

12. Comment: Upgrading the lime addition facility, as proposed in the FS, will improve water quality by maintaining a pond pH of 9. However, the Phase II RI (CH2M HILL, 1989) showed that the additional capacity of Pond 2 was still required at a pH of 9. Furthermore, routing Mill and Willow Creeks into Pond 3 for treatment will result in higher average flows through the pond requiring increased settling capacity. The comment further states that elements of ARCO Plan 3A, such as including the use of Pond 2 and expanding Pond 3, address the problem of insufficient storage capacity and retention time.

    Response: EPA and MDHES agree that use of the flood storage and treatment upgrades, provided by ARCO's Alternative 3A, would provide improved water quality equivalent to that which would be provided by MSA 5A. Thus, these upgrades have been incorporated into the Recommended Alternative (3+3A) in the ROD.

13. Comment: The comprehensive upgrade of the pond treatment in the FS as MSA 5A, even when combined with an upstream flood impoundment (MSA 6A), will not effectively treat the full 100-year flood run-off.

Response: The flood impoundment identified in MSA 6A would be sized to store up to the 100-year event, while allowing a 600-cfs bypass. Following the storm, the waters would be metered out of the upstream impoundment at a maximum rate of 600 cfs. The design capacity of the treatment system identified in MSA 5A is 600 cfs; thus, the comprehensive treatment scheme would be able to treat the full volume of a 100-year event.

14. Comment: The FS contends that the remaining treatment life of the existing Pond 3, operating under the range of conditions described in this action, is from less than 10 to approximately 80 years. The FS then concludes that a new treatment pond would be necessary if flows from Mill, Willow, and Silver Bow Creeks still required treatment. Assuming the remaining life estimate is accurate, the more appropriate approach to resolve this issue is to increase the storage of the existing Pond 3, as per the ARCO Plan.

Response: The ARCO Plan indicates that Pond 3 would operate at approximately its current water surface elevation under normal conditions. While it is true that the useful life of Pond 3 could be extended if the normal operating elevation of Pond 3 were allowed to increase over time, this would necessarily result in a associated reduction in the flood storage capacity over time. In fact, routing of floods into Pond 3 will cause it to fill with sediments much more quickly than if the majority of those sediments could be settled out in an upstream impoundment. This will cause a reduction in the useful life of Pond 3 under ARCO's Alternative 3A.

15. Comment: See Comment 4 above concerning the need to route Mill and Willow Creeks into the pond system for the treatment.

Response: See the response to Comment 4 above in which EPA and MDHES concur with ARCO's plan to investigate source control for Mill and Willow Creeks.

16. Comment: The FS should address whether the proposed internal berm in Pond 3 can be constructed without substantive additional cost, given the poor foundation conditions inherent in the pond bottom sediments.

Response: The berm across Pond 3 would likely be constructed using techniques similar to cofferdam construction in riverine environments. It would involve beginning at the existing western berm and constructing toward the east by pushing rock and gravel ahead as the berm is constructed. The dumped rock and gravel would tend to displace the pond bottom sediments until stable foundation materials are reached. It may be necessary to add additional materials in the future, if settlement occurs in portions of the berm.

To account for the foundation conditions, the cost estimates for this berm included in Appendix D of the FS assume that more material would be required than if the berm were constructed in the dry.

17. Comment: The FS must justify the need to replace the current PVC siphons feeding the Wildlife Ponds from Pond 3. ARCO is unaware

of any significant problems with the historic operation of the existing system. If significant problems are documented, the FS should provide additional detail regarding location and design of the proposed "buried pipe system" (page 7-43). The estimated cost for this design feature has not been included in Appendix D of the FS.

Response: It is not normally considered good engineering practice in installations such as this to utilize exposed inverted PVC siphons, except as temporary measures. They are subject to loss of prime, deterioration by ultraviolet rays, and potential freezing. This is, however, an insignificant issue and will not affect water quality in the Clark Fork River. It was included in the FS only because it would be a good idea to install buried piping during the stabilization of the berms. The costs were considered insignificant in comparison to the rest of the project and have been included in the contingencies.

18. Comment: The FS is deficient by not evaluating the alternative approach of raising the Pond 2 dike to increase its storage and, thereby, improve the treatment capacity and extend the remaining life of this pond.

Response: The EPA and MDHES evaluated this concept and have included it in the selected alternative (3+3A) in the ROD. See the response to the Section 7.5 comment.

19. Comment: This comment asks for the data, methodology and specific results for "the calculated detention time in Pond 2" (page 7-43).

Response: The detention time is calculated from the volume of water contained in Pond 2 at normal elevation and the average flow rate into Pond 2. At a surface elevation of 4,832 msl, the water volume of Pond 2 is 211 acre-feet (incorrectly listed in Table 2-1 as 860 acre-feet). At an average flow of 53 cfs into Pond 2, the detention time is 2 days. (Reported as 3 days in the FS).

20. Comment: The FS does not provide sufficient detail regarding the location and design of the "buried discharge system . . . to discharge the water from Pond 3 to Pond 2." (page 7-44) Also, a cost estimate for this design feature has not been included in Appendix D of the FS.

Response: The details of this system should be addressed in the design phase. It would likely consist of a concrete headwall with a slidegate, and a buried 8- to 12-inch pipe into Pond 2. The costs were considered insignificant in relationship to the overall costs and are included in the contingencies.

21. Comment: The existing inlet structure is incompatible with this proposed MSA. The existing structure and berms in the vicinity will have to be raised substantially to exclude the PMF-series floods. However, the structure does not have the physical space to accommodate such a raise. In addition, the existing wood gates are in poor condition and, without repair or replacement, could not be used to control Pond 3 inflows to a 600 cfs maximum flow. Consequently, a new structure should be built to control inflows into Pond 3.

Response: The concept shown in the FS includes raising the berms on the inside (northeast) side in the vicinity of the inlet structure. This would require extensions of the outlet pipes beneath the raised berm. However, the EPA and MDHES agree that operation of the gates under major flood conditions would be impossible using this scheme. The EPA and MDHES also agree that the condition of the existing gates may warrant their replacement, or the construction of an entirely new structure. A new structure is included in the Recommended Alternative (3+3A) in the ROD.

22. Comment: The construction of the new effluent structure proposed in the FS will be very difficult and expensive, due to the necessity of placing the structure on a sound foundation. To construct the foundation, a cofferdam will have to be built about 200 feet into the pond to protect the construction area. The pond sludge should be removed before the cofferdam is pushed into the pond to ensure an adequate foundation for the cofferdam. In addition, the existing embankment will have to be removed to allow installation of the discharge pipes. The embankment will then have to be rebuilt and most of the cofferdam removed.

This action also calls for outright abandonment of the two existing outlet structures. The structures have deteriorated concrete in some areas and several of the existing 60-inch discharge pipes show signs of duress evidenced by cracking and damaged joints.

Response: ARCO's concerns regarding difficulties in construction of the new effluent structure are valid and the same concerns were taken into account during preparation of the FS. The costs shown in Appendix D include the measures necessary to address these concerns.

If MSA 5A were to be implemented, the two existing outlet structures should be abandoned such that they could withstand the MCE. This would probably include plugging the structures and discharge pipes with concrete but the details would be evaluated during final design.

7.5.2 Media-Specific Action 5B: Less Comprehensive Upgrade of the Pond Treatment System

1. Comment: Many of the comments in Section 7.5.1 also apply to this section, as the actions are quite similar in many regards.

   Response: Comment noted.

2. Comment: This comment questions why the FS evaluates MSA 5B, which limits the treatable inflow to 210 cfs to accommodate the existing condition of Pond 2, rather than evaluating the possibility of increasing the storage capacity of Pond 2.

   Response: Media-Specific Action 5B was developed to provide a comparison to the more comprehensive upgrade (MSA 5A) for the purposes of evaluating costs against treatment efficiency. The concept was to utilize as much of the current system as possible to minimize construction costs. To include the expense involved in raising the Pond 2 berms and modifying the outlet structure would have defeated the purpose of developing a minimum cost treatment alternative.

7.5.3 Media-Specific Action 5C: Construct a New Treatment Pond

1. Comment: Comments under Section 7.5.1 and/or 7.5.2 regarding: deficiency in data, methodology and specific results to support pond sizing; the proposed lime addition system; the proposed effluent system; and the proposed internal berm also apply to this media-specific action.

   Response: See the specific responses to the appropriate technical areas in Section 7.5.1 and/or 7.5.2.

2. Comment: The FS should describe the design rationale and/or constraints that result in limiting the inflow capacity of the proposed new treatment pond to 600 cfs.

   Response: The capacity of the new treatment pond is size limited. As stated on page 7-47 of the FS, the new treatment pond would have a detention time of just under 2 days with a flow of 600 cfs. This is considered to be the minimum detention time for adequate settling.

3. Comment: This comment repeats earlier comments suggesting that the capacity of the pond treatment system could be increased per ARCO Plan 3A.

   Response: EPA and MDHES agree, with certain qualifications. See response to the Section 7.5 comment.

4. Comment: This comment repeats earlier comments concerning the need to treat flows from Mill and Willow Creeks.

Response: EPA and MDHES agree with ARCO's concept to investigate source control on Mill and Willow Creeks. See the response to Section 7.5.1, Comment 4.

7.6 MEDIA-SPECIFIC ACTION 6: CONSTRUCT AN UPSTREAM FLOOD IMPOUNDMENT/SETTLING BASIN

Comment: This comment repeats Section 7.5 comment stating that the FS should have considered ARCO's Plan 3A in terms of the upstream impoundment.

Response: EPA and MDHES agree with ARCO's basic concept to store floods in Pond 3. See the response to the Section 7.5 comment.

7.6.1 Media-Specific Action 6A: Construct an Upstream Flood Impoundment

1. Comment: The FS should provide estimates of the sediment loading anticipated at Pond 3 in the "less than 600 cfs" (page 7-52) flows to be released from the upstream flood impoundment during a 100-year flood, and the loading assuming the upstream pond is not constructed. The first estimate must include consideration of the sediment deficit (i.e., increased sediment carrying capacity) of the flows released from the flood impoundment. It is not possible to independently evaluate the contention that "the potential would be substantially reduced for future erosion of the estimated 200,000 cubic yards of tailings that exist along Silver Bow Creek between the new pond site and Pond 3" (page 7-52).

   Response: The analyses performed during the FS did not include calculations of the anticipated differences in sediment loading to Pond 3 with and without the upstream impoundment. The statement concerning potential reduction of erosion of the tailings between the new pond site and Pond 3 was based on the physical parameters of Silver Bow Creek. Even though the 600 cfs flows would be in a sediment deficit condition following release from the upstream impoundment, the potential to resuspend significant contaminated sediment is limited. This is because Silver Bow Creek at flows below 600 cfs is generally confined to its channel and would not significantly erode the tailings (which are generally outside of the channel). It should be noted that regardless of the quantity of contaminated sediments that were eroded at 600 cfs, the flows would still be diverted into Pond 3 for treatment.

2. Comment: The FS does not include the data, design assumptions, methodology and specific results of the "preliminary mass balance" performed to size the upstream flood impoundment. Without this information, an independent evaluation of the feasibility of the proposed impoundment and its operation is difficult.

   Response: The FS is a summary of numerous evaluations and calculations. Including all backup information in the FS is not necessary. The referenced calculations and backup data are available, but the need to review these calculations should be moot at this time because EPA and MDHES have decided to eliminate the upstream impoundment from the Recommended Alternative.

3. Comment: The FS is inconsistent regarding the design release rate of the proposed upstream flood impoundment. It is listed as 600 cfs in one place and "about 500 cfs" in another place.

Response: The precise release rate would be adjustable through a gated structure. The maximum release rate for design of the outlet should be at least the 600 cfs that Pond 3 can treat; but, good design practices would dictate a higher maximum release rate (say 700 or 800 cfs) for flexibility of operation.

4. Comment: The FS should define/clarify the meaning of the modifier "normal" in reference to the 100-year flood (see pages 7-52 and 7-53 of the FS).

   Response: The term "normal" should not have been used in the text. The reference should have been to the shape of the calculated hydrograph for a 100-year run-off event. It is likely that the actual flows would vary somewhat from the calculated hydrograph. The extent of variation cannot be determined without experiencing an actual flood.

5. Comment: This comment agrees that selection of the 100-year flood is appropriate as a maximum design criterion for interception of sediment carried by Silver Bow Creek, which includes tailings and/or contaminated soils.

   Response: Comment noted.

6. Comment: Subsurface investigation data from the site of the upstream flood impoundment are not available. The design of such a structure cannot be technically supported without sufficient subsurface data. The cost-effectiveness and technical feasibility of this MSA cannot be evaluated with any degree of certainty without such information.

Response: The site of the upstream flood impoundment was visited during preparation of the FS. The basic embankment section and foundation preparation were based on reasonable assumptions for the sole purpose of developing the cost estimates and would have to be verified during the design phase. Subsurface explorations and a geotechnical investigation of the site would be completed during the design of the upstream flood impoundment.

7. Comment: The FS should provide the rationale for designing the upstream flood impoundment against a full PMF (page 7-68). Based upon the applicable MDNRC dam safety criteria, a 0.5 PMF flood is the maximum appropriate design criteria.

Response: EPA and MDHES agree. The appropriate design flood for protection of the upstream impoundment embankment is 0.5 PMF. The 0.5 PMF was used in the cost estimates included in Appendix D.

8. Comment: Because Mill-Willow flows will be routed into Pond 3, a release of 600 cfs from the upstream impoundment cannot occur at all times. In fact, the flow from Mill-Willow alone may exceed the 600-cfs inflow limitation of Pond 3 during larger flood events.

Response: If Mill and/or Willow Creek flows are routed into Pond 3, the detailed design should provide a structure capable of routing Mill and Willow flows during major floods into the bypass. This would allow the treatment capacity of Pond 3 to be used primarily for treating Silver Bow Creek flows.

9. Comment: The proposed 20-foot high diversion dam would accumulate sediment and debris. The decrease of velocities behind the diversion dam would cause the coarser sediment to drop out. The FS does not address this problem.

Response: As with any diversion dam, periodic maintenance after large runoff events would be required. The O&M costs for this maintenance are included in Chapter 8 of the FS.

10. Comment: The upstream impoundment inlet structure proposed in the FS will actually pass in excess of 8,000 cfs to the reservoir at maximum water level, not the 4,000 cfs design flow cited. In addition, there is no means to shut off inflow in the event of an emergency. A structure with sluice gate control and less construction than the proposed orifices would alleviate most of the problems and should be substituted for the design in the FS.

Response: EPA and MDHES acknowledge that the inlet structure will allow more than 4,000 cfs into the upstream impoundment during flood events greater than the 100-year event. The preliminary design presented in the FS was developed primarily for cost-estimating purposes. Refinements of the FS design would be investigated during the design phase.

11. Comment: The low-level impoundment outlet incorporated in the FS design will remobilize and discharge sediment to Silver Bow Creek. A tower intake may alleviate this problem.

Response: The design of the outlet structure was developed in sufficient detail to generate the cost estimates. Alternative designs would be investigated during the design phase.

12. Comment: The spillway width in Figure 7-10 is 150 feet, while the width in Figure 7-15 is 100 feet. A 150-foot-wide spillway would be required to pass the maximum inflow, which is in excess of 8,000 cfs. Which is correct?

    Response: The 150-foot width for the spillway is correct.

13. Comment: It appears that a part of the PMF flow could escape to the back (south) side of the proposed upstream flood impoundment. If this were to happen, the south dike could be washed out, allowing the PMF flow to enter the impoundment and cause failure. Only the east dike has riprap protection. The design should be reevaluated and the FS revised as necessary, including revising the cost for this item in Appendix D.

    Response: The note shown in Figure 7-11 is incorrect. Riprap protection should be provided for the south berm also. Costs for this riprap were included in Appendix D.

7.6.2 Media-Specific Action 6B: Construct an Upstream Settling Basin

1. Comment: The FS should provide a reference or appropriate analyses to support the conclusion that a typical reduction in detention time of 40 percent is applicable to the proposed upstream settling basin.

Response: It is difficult to determine the actual efficiency of a settling basin such as this without detailed modeling studies. The reduction in detention time was used to account for the inefficiencies of the real world as opposed to ideal conditions used in theoretical Stokes' Law calculations. The 40 percent reduction in efficiency was an estimate based upon experience with similar basins. If it were necessary to determine actual removal efficiencies, detailed modeling studies would be performed during the design phase.

2. Comment: The FS concludes on page 7-70 that the spillway discharge from the upstream settling basin will carry substantially less sediment than the flow entering the basin during the 100-year flood. Given this fact, the FS must examine the potential for increased erosion and transport of sediment along Silver Bow Creek between the settling basin and Pond 3. It appears that a significant percentage of the sediment load settled out in the upstream basin would be regained as the relatively clean basin discharge flows down the intervening stretch of Silver Bow Creek. The effectiveness of this media-specific action must be reconsidered based on the results of appropriate sediment transport modelling. See also Section 7.6.1, Comment 1.

Response: EPA and MDHES agree that there is a potential to increase erosion and transport of sediment between the settling basin and Pond 3, since these flows would be in a sediment deficit condition during major flood events. The extent of the regain in sediment load and the potential contamination associated with these sediments is not known. If the decision is made to construct an upstream impoundment in the future, an evaluation should be made of the erosion potential of flows between the impoundment and

Pond 3, including the potential for dissolved metals contamination from the tailings eroded. If the evaluation indicates unacceptable erosion potential, the contaminated soils and tailings between the upstream basin and Pond 3 should be removed prior to completion of the upstream basin.

3. Comment: The FS should reference the particle size data used as a basis for concluding that the settling basin will remove approximately 80 percent of particulates from the 100-year flood flow.

   Response: Because particle size data are not available for sediments carried by an actual 100-year flood, it was necessary to estimate the sediment characteristics. The estimates were made by evaluating and averaging particle size distributions for streamside sediments collected at several points along Silver Bow Creek. The original data was developed from the "Streamside Tailings and Revegetating Studies, STARS Phase I, Appendix B, October 1989."

4. Comment: The FS should provide an estimate of the possible variation in size of the upstream settling basin which might result from optimization during design.

   Response: There are several design studies that would be required for the optimization process to determine the size of the basin. These should include as a minimum:

   - Erosion and Sediment Transport Study--This study would examine the potential of the waters released from the basin to erode and transport tailings between the basin and Pond 3. As discussed in the response to Section 7.6.2, Comment 2, these waters would be in a sediment deficit condition. The modeling should be done for a variety of flow and sediment deficit conditions to adequately define the design parameters. If this study indicated a significant potential to erode and transport these tailings, it might be necessary to remove the tailings in conjunction with the construction of the basin.

- Sediment Contamination Study--This study would examine the relationship between transported sediments and associated metals contamination. It would entail modeling sediments transported from upstream of the ponds in terms of particle size distribution against associated metals, both dissolved and total metals. The study should model several different sized storms to adequately define the design parameters.

- Basin Modeling Study--This study would model the settling efficiency of the upstream basin to determine sediment removal rates. It should be based on a model of the physical dimensions of the basin, taking into account wind-induced currents, density currents and particle size distributions. The study should include modeling of different sizes and shapes of basins to adequately define the design parameters.

The results from these studies would be evaluated together to determine the optimum size for the upstream impoundment. Since the results of these studies are not available at the present time, any estimate of the possible variation in size of the upstream impoundment would be strictly speculation.

5. Comment: Comments under Section 7.6.1 are also applicable to similar design features for the upstream settling basin.

   Response: See the responses to the specific comments in Section 7.6.1.

7.7 MEDIA-SPECIFIC ACTIONS 7, 8, 9, AND 10: ISOLATE TAILINGS DEPOSITS AND CONTAMINATED SOILS

No comments.

7.7.1 Locations of Tailings Deposits and Contaminated Soils

1. Comment: This comment states that a discussion of the locations of tailings deposits in Chapter 7 appears to be misplaced.

   Response: This discussion was placed in this section next to the discussions of possible remedial actions for the tailings and contaminated soils. These discussions could fit either in Chapter 7 or in Chapter 2.

2. Comment: This comment refers the reader to Comment 1 in Section 7.4 and Comment 1 in Section 4.1.3 regarding quantities of tailings and contaminated soils.

   Response: The responses to these specific comments are included in the respective sections.

7.7.2 Media-Specific Actions

No comments.

7.7.2.1 Media-Specific Action 7: Cap and Revegetate Tailings Deposits and Contaminated Soils

Comment: This comment asks the rationale for the proposed design of the soil cap--6 inches of tilled-in agricultural lime and 18 inches of imported soil. The comment also asks for a description of the nature and source of the imported soil, and states that local soil, if amended, should be suitable for use in capping contaminated areas.

Response: The use of agricultural lime was proposed to reduce the mobility of the metal contaminants in the materials that are capped. The 18 inches of cover soil is derived from the mining reclamation ARARs discussed in Appendix B of the FS. The use of the word "imported" was not meant to imply that the soil would come from a great distance, only that the cover soil would not be merely an amendment of the contaminated materials. The imported soil would be uncontaminated soil brought either from other areas within the operable unit or from nearby areas outside the operable unit.

7.7.2.2 Media-Specific Action 8: Flood Tailings Deposits and Contaminated Soils

1. Comment: The FS should document the reasons for concluding that flooding areas of tailings deposits will cause increased groundwater contamination (page 7-78).

   Response: The FS did not conclude that flooding will result in "increased" groundwater contamination. The FS stated that the continued presence of water in Pond 1 provides a source of recharge and contaminants to the shallow aquifer below Pond 1. The analyses supporting this conclusion are summarized in the FS.

2. Comment: It is our opinion that dry closure of Pond 1 will not eliminate the saturated tailings within the pond as a source of long-term groundwater contamination as is contended in the FS. The FS provides no analyses to document this contention, as discussed in Section 7.7.2.6, Comment 2.

   Response: The decision to dry close Pond 1 is primarily based on current groundwater quality conditions beneath Pond 1. Monitoring well WSP-GW-10S is located in the western-most cell of Pond 1, a considerable distance from the flooded portion of Pond 1. Tailings were penetrated at this location to a depth of approximately 10 feet, with groundwater levels ranging from 9 to 11 feet below ground surface. Dissolved arsenic concentrations measured in samples collected from monitoring well WSP-GW-10S were considerably less than MCLs of 16.8 μg/l.

   Monitoring well WSP-GW-11S was completed near the eastern-most cell of Pond 1, proximal to the flooded portion of the pond. Water levels in monitoring well WSP-GW-11S indicate that up to 3 feet of the tailings are saturated. Dissolved arsenic concentrations measured in monitoring well WSP-GW-11S were as high as 105 μg/l.

Dissolved metals concentrations measured in monitoring wells completed downgradient of Pond 1 offer additional supporting evidence that groundwater quality improves toward the western portion of Pond 1. Dissolved arsenic concentrations in monitoring well WSP-GW-03S, located north of the western portion of Pond 1, were below the laboı .tory detection limit of 2 μg/l. Dissolved arsenic concentrations measured in monitoring well WSP-GW-13S, located downgradient of the flooded portion of Pond 1, were as high as 61.2 μg/l. These data offer empirical evidence that the saturated tailings and ponded water in the eastern portion of Pond 1 are a source of metals contamination in the shallow groundwater system.

3. Comment: The FS should provide the design height of the proposed new berms across Pond 2 and Pond 3 under this action. This information is necessary to allow independent evaluation of technical feasibility and cost estimates for this feature. The FS should also describe the anticipated foundation conditions and constructability of such a berm, and accommodate these issues in the design and cost estimate.

Response: The berms will vary from 0 to approximately 18 feet in height, depending upon topography. The exact dimensions of the berms would be determined during detailed design. It should be noted that the FS is not intended to be a design document and that preliminary designs were only carried to a level of detail sufficient to perform cost estimating. It was anticipated that difficult foundation conditions would be encountered during construction of portions of these berms. These anticipated difficulties were factored into the cost estimates in Appendix D.

4. Comment: The FS should clarify whether or not the flooded Pond 2 is intended to provide physical and biologic treatment of the water discharged into the Mill-Willow Bypass. It is assumed on the basis of the information provided that either this is the case or the FS does not anticipate such discharges will violate applicable standards.

Response: Minimal flows would be maintained through Pond 2. Because of wind action, the concentrations of metals in the discharge may at times exceed the standards. However, given the low outflow from the pond, the metals in the discharge should not cause violations at the compliance point, once the small outflow from Pond 2 is mixed with the Pond 3 outflow and the Mill-Willow Bypass flows.

7.7.2.3 Media-Specific Action 9: Excavate From All Applicable Areas and Disposal In An Offsite RCRA Facility

1. Comment: This comment refers the reader to several previous comments regarding soil removal action levels.

Response: These comments are addressed in other portions of the responsiveness summary.

2. Comment: This comment states that consideration of offsite disposal of tailings and contaminated soils in a RCRA hazardous waste facility is not appropriate, because the RCRA requirements are not appropriate for mining waste management. Mining wastes are disposed of throughout the country in a manner protective of public health and the environment.

Response: This media-specific action was developed in order to assemble alternatives that exceed the requirements of ARARs. The MDHES and EPA have concluded that, while the RCRA requirements are not applicable to the wastes, certain RCRA requirements are relevant to the situation at Warm Springs Ponds, and it will be appropriate to follow them. It is not only appropriate to consider actions that exceed the requirements of ARARs, but it was required by the National Contingency Plan in effect at the time that the draft FS was completed.

3. Comment: This comment repeats earlier comments about action levels for soils. It also notes a discrepancy in the FS regarding which materials along the bypass would be removed.

Response: See the response to the comments on Chapter 3 and in Appendix A for a discussion of the risk assessment and action levels. The discrepancy concerning exposed tailings and contaminated soils is noted. The intent of the tabulated values at the bottom of page 7-83 was to include both exposed tailings and contaminated soils.

4. Comment: This comment states that removing nearly 1 million cubic yards of soils and tailings below Pond 1, exposed in Pond 2, along the Mill-Willow Bypass, and above Pond 3 for offsite disposal is not feasible or necessary, to protect human health and the environment.

   Response: The option of disposal of contaminated materials at an offsite RCRA facility was investigated to provide a cost comparison with onsite disposal. Although such disposal is feasible, EPA and MDHES agree that this action is not necessary. Thus, it is not part of the recommended alternative.

7.7.2.4 Media-Specific Action 10: Excavate from All Applicable Areas and Disposal Onsite in a Non-RCRA Facility

1. Comment: This comment notes an inconsistency in the description of Media-Specific Action 10. In Chapter 6, MSA 10 is described as including disposal in a non-RCRA facility. However, in Chapter 7, MSA 10 is described as involving disposal in a "RCRA-equivalent facility."

   Response: The comment is correct. As originally developed, MSA 10 was to involve an onsite (i.e., somewhere within the Silver Bow Creek Site) disposal facility to be developed to serve purposes other than just the Warm Springs Ponds Operable Unit. It was realized during the study that a more specific disposal option would have to be assumed in order to develop cost estimates that would allow all of the alternatives to be compared on an equal basis. Pond 1 was identified as a suitable site for disposal of materials excavated from various locations within the operable unit.

Concerns about the oxidized state of some of the sediments in Pond 1, together with the knowledge that much of the groundwater contamination below Pond 1 was a result of leaching of contaminants from Pond 1, led to the conclusion that a relatively impermeable cap would be needed to reduce the potential for infiltration, and that monitoring the groundwater below Pond 1 would be necessary to ensure that the current releases were effectively reduced. The RCRA standards were referenced for relevant and appropriate design and monitoring standards for such a situation, and the RCRA standards were adopted for the conceptual design.

Late in the preparation of the FS report, it was decided that the intent of MSA 10 would be more clear if the resulting disposal facility to be developed at Pond 1 were described as a RCRA-equivalent facility. Most of the substantive requirements that a RCRA landfill would have to meet regarding the cap and groundwater monitoring would be met by MSA 10. The Chapter 6 table mentioned in the comment should have been changed to describe the onsite disposal as being in a RCRA-equivalent facility.

2. Comment: The FS should explain and justify the rationale for excavating the tailings from all applicable areas and hauling them all to Pond 1 for capping.

Response: This media-specific action was developed to provide the decisionmakers with an alternative that would consolidate the scattered wastes into a single disposal area where they could be protected from floods, isolated by a better cap, and monitored more effectively. Since publication of the FS, it has been decided that it would be equally protective of human health and the environment to have two disposal areas: within Pond 1 and within the dry area of Pond 3. The disposal site for the 1990 Removal Action is within Pond 3. Future disposal of contaminated materials will be either within Pond 3 or Pond 1, depending upon the economics of haul distances.

3. Comment: This comment notes that the cap for Pond 1 developed as a part of MSA 10 would include a limited permeability clay layer, and that the cap appears to be designed to meet a subset of the RCRA closure requirements. The comment states that the RCRA requirements are not ARARs for this action.

Response: The MDHES and EPA have determined that the RCRA regulations do contain relevant and appropriate requirements for the actions to be taken at Warm Springs Ponds. However, upon further consideration of RCRA ARARs, EPA has determined that an impermeable cap is not appropriate for the disposal facilities, which are part of the selected remedial action.

7.7.2.5 Media-Specific Action 11: Collect Groundwater and Treat in a Wetland Below Pond No. 1

1. Comment: The FS should provide references and/or descriptions of the methodology, data, and results from which the wetlands design parameters were developed.

   Response: The design parameters used for the development of the wetland MSA represent a conservative estimate of current wetland operating parameters based upon engineering judgment and information available ir the literature on the technology. The primary limiting design factor of 1 gpm per 500 square feet of available surface area was presented on page 7-87 of the FS.

2. Comment: An arrow in Figure 7-18 suggests that Cell 2 will receive flow from the realigned Mill-Willow Bypass. If this is the case, the reason for this operation should be explained; if not, the figure should be corrected.

   Response: What appears to be an arrowhead in Figure 7-18 is a smudge on the drawing.

3. Comment: The FS incorrectly implies that the entire area below Pond 1 is covered by tailings and/or contaminated soils to a depth averaging 3-1/2 feet. A large majority of these materials are located along the historic Silver Bow Creek channel, as shown in FS Figure 2-2.

Response: The FS was not intended to imply that the entire area is covered in tailings. As noted in the comment, the figures make it clear that the tailings are concentrated in several areas. The intention of the statement on page 7-87 is to convey to the reader that the tailings deposits are substantial and not merely surface contamination. The 474,400 cubic yards of tailings and contaminated soil deposits in this 76-acre area calculates out to an average of 3.87 feet deep.

7.7.2.6 Media-Specific Action 12: Groundwater Collection In and Below Pond No. 1 With Treatment in Pond No. 3

1. Comment: The FS should describe the data, methodology, and specific results which result in the estimate of 2 cfs as the pumping rate from the combined groundwater trenches in this action (page 7-91).

   Response: The FS includes summaries of many calculations and analyses performed during its preparation. These calculations were carried to a sufficient level of detail to perform cost estimating. The calculations should be refined during remedial design based upon site-specific data to determine the design parameters for pump station and pipeline sizing.

2. Comment: The FS contends that "the groundwater collection trench at the toe of the Pond 2 berm...would be expected to...eventually drain saturated material in Pond 1 to below the base of the tailings contained in the pond" (page 7-90). The

FS should be expanded to reference or to provide appropriately detailed analyses to document this contention, including an estimate of the time required to drain below the base of the tailings. On the basis of the meager information in the FS, it is ARCO's opinion that at least the base of the tailings would remain saturated over the long-term, as is the case at nearby Opportunity Ponds.

Response: A computer modeling analysis was performed to evaluate the effects of installing a groundwater interception trench in the eastern portion of Pond 1. Results of this analysis were presented in a Technical Memorandum (Chen Northern, 1989).

The model showed that steady state conditions would be reached in the alluvial groundwater system underlying the tailings within 500 days after installation of the interception trench. During the initial 500 days, and for an unknown period of time following, the saturated tailings would gravity drain to the underlying alluvial system. The tailings would release water until the field capacity of the fine-grained tailings is reached. Vertical and horizontal permeability values of the tailings were assumed based upon experience and data from similar areas within the operable unit. Actual measurements of these permeabilities would be required in order to estimate the actual time required for the saturated tailings to completely drain.

EPA and MDHES realize that a more detailed analysis should be completed for design considerations prior to constructing the interception trench. However, based on the current conditions in the western portion of Pond 1, groundwater levels beneath the tailings are expected to drop below the base of the tailings. The volume of water draining vertically into the underlying alluvial aquifer is expected to be minimal relative to the volume of water migrating to the north in the sand and gravel aquifer.

CHAPTER 8.0

RESPONSES TO ARCO COMMENTS, CHAPTER 8.0 ASSEMBLY AND ANALYSIS OF ALTERNATIVES

8.1 DEVELOPMENT OF ALTERNATIVES

1. Comment: This comment repeats earlier comments regarding the action levels for soils assumed in the FS.

   Response: These comments are addressed in the Chapter 3.0 and Appendix A responses.

2. Comment: This comment notes an inconsistency in how onsite disposal of tailings and contaminated soils is described under some of the alternatives. It also repeats previous comments about whether or not the RCRA regulations can be considered to be ARARs for this site.

   Response: The inconsistency noted in the comment is acknowledged. The intention is that, if any of these alternatives are chosen, the tailings and contaminated soils would be disposed of in an onsite facility, and that the most likely place for such a facility is assumed, for purposes of the FS, to be Pond 1. The facility is described as a "RCRA-equivalent facility" to indicate that certain of the RCRA landfill requirements would be adopted as relevant and appropriate for the design of the cover and for the monitoring requirements for Pond 1. The Mill-Willow Bypass removal includes use of a disposal site within Pond 3.

3. Comment: This comment repeats earlier comments regarding the incorporation of institutional controls in the alternatives.

Response: See the responses to these issues in Chapter 6.0.

8.2 DETAILED ANALYSIS OF ALTERNATIVES

1. Comment: This comment notes that the discussions of the alternatives in Chapter 8 of the FS do not repeat discussions that are relevant to more than one alternative, but instead refer the reader to the initial occurrence of each point. The comment notes that this makes it more difficult to keep the alternatives straight.

   Response: ARCO's description of the structure of the FS is accurate. But, EPA and MDHES disagree that this makes it more difficult to distinguish between the alternatives. In fact, this format was chosen in order to make the differences between the alternatives more clear by focusing on the differences. The alternative approach of repeating discussions of each feature each time it occurs in an alternative is more difficult to follow; the differences between the alternatives get lost in a mass of largely repetitive discussions that tend to mask small distinctions.

8.3 INDIVIDUAL ANALYSIS OF ALTERNATIVES

1. Comment: This comment states that the upstream impoundment would result in significant changes in terrestrial and aquatic wildlife habitat, and that such changes must be addressed in the FS.

   Response: EPA and MDHES acknowledge that this action, like any of the actions discussed in the study, would have impacts on some wildlife. Due to adverse reaction by the public and ARCO, EPA and MDHES have decided not to pursue the upstream impoundment or settling basin options.

2. Comment: This comment notes that Alternatives 1 to 6 developed in the FS would have impacts on wetlands, endangered species, and historical resources.

The comment further notes that the FS should identify adverse impacts and probable costs to mitigate these impacts. Finally, the comment notes that ARCO's proposed plan would result in "no net loss of existing wetlands."

Response: It is true that the alternatives in the FS would, as ARCO's plan would, result in impacts on wetlands, endangered species, and historical resources. The required action in such cases is exactly as given in the FS: when the proposed action becomes concrete enough to determine the probable impacts (usually during the design stage), the responsible party must consult with the appropriate agencies in order to incorporate mitigative measures in the project plan or design. Until the alternative to be implemented is chosen and partially designed, the regulatory agencies will not be able to give specific guidance on the mitigative measures likely to be required.

While ARCO's plan may not, as currently conceived, result in a net loss in total wetlands, certainly some of the existing wetlands would be affected. Any of the alternatives in the FS could be designed and implemented so as to result in no net loss of total wetlands, and such a mitigative measure may be required by the responsible regulatory agencies once the remedial alternative for the operable unit is chosen and the impacts on wetlands can be determined in detail. The impacts of ARCO's plan on endangered species or historical resources are likely to be similar to those for the alternatives in the FS.

8.3.1 Alternative 1:

1. Comment: This comment repeats an earlier comment that the flood flows on Mill and Willow Creeks were not properly considered in sizing the upstream impoundment.

   Response: If Mill and/or Willow Creek flows are routed into Pond 3, the detailed design should provide a structure capable of routing Mill and Willow flows during major floods in the bypass. This would allow the treatment capacity of Pond 3 to be used primarily for treating Silver Bow Creek flows.

2. Comment: This comment points out ambiguous language in the FS that could be interpreted to imply that a 100-year life span is intended for the upstream impoundment.

   Response: EPA and MDHES acknowledge that the language was ambiguous. The intent was to state that the upstream impoundment could treat floods up to the peak flow of a 100-year flood.

3. Comment: This comment states that the FS should establish the point of compliance for the contaminated groundwater as the downgradient property boundary or other boundary based on the use of institutional controls and that the FS incorrectly implies that all MCLs are exceeded.

   Response: The point of compliance is established in the ROD. Certain MCLs are exceeded at the site.

4. Comment: This comment repeats an earlier comment about the need for the FS to include costs of wetland, endangered species, and historical resources impact mitigation.

   Response: Proposed mitigation for these resources will be developed as part of the remedial design phase. Adequacy and cost of mitigation will be evaluated at that time. For more detail, see response to Section 8.3, Comment 2.

5. Comment: ARCO concurs with the FS characterization of any flood flows on Silver Bow, Mill, and Willow Creeks in excess of the 100-year event as extreme cases for which treatment for suspended solids and dissolved metals is unjustified (page 8-29).

   Response: Comment noted.

6. Comment: This comment notes the following problems that might be associated with an upstream impoundment, such as the one included in Alternative 1.

   A. Blowing dust from the surface of any accumulated tailings, even if periodically hauled offsite.

   B. Institutional and design considerations related to periodic transport of settled tailings for disposal offsite.

   C. Potential for groundwater contamination if settled tailings are left in place.

   D. Final closure requirements.

E. Utility relocation (i.e., high-voltage power lines).

F. Creation of a contaminated area in what was previously an uncontaminated area.

G. Land acquisition (both in terms of legal issues and costs) and the resulting sacrifice of agricultural lands and the tax base they represent.

Response: These issues are no longer relevant because EPA and MDHES have decided not to pursue the concept of an upstream impoundment.

7. Comment: This comment states that costs to remove and dispose of tailings settled in the upstream impoundment should be included in the operation and maintenance costs for the alternatives.

Response: The operation and maintenance costs were estimated from the level of work that would be required to carry out all of the O&M activities related to each alternative. Allowances were made for full- and/or part-time staff at the ponds, periodically hiring a contractor to perform certain duties, and materials and other costs. Periodically removing small amounts of collected tailings and sediments from the impoundment, if necessary, could be performed within the costs estimated. Costs for removal of larger amounts of tailings from major floods were not addressed because the probability of such an event is difficult to account for in a cost estimate. These issues are no longer relevant because EPA and MDHES have decided not to pursue the concept of an upstream impoundment.

8. Comment: This comment states several reasons why ARCO believes Alternative 1 would not be implementable or reliable.

Response: While not necessarily agreeing with each point made in the comment, EPA and MDHES agree that Alternative 1 should not be selected. That is why it was not identified as the preferred alternative in the Proposed Plan.

8.3.2 Alternative 2: Exceeds the Requirements of ARARs

1. Comment: This comment repeats an earlier comment regarding sizing of the upstream impoundment.

Response: EPA and MDHES acknowledge that this action, like any of the actions discussed in the study, would have impacts on some wildlife. However, the impacts would not likely be as severe as apparently envisioned by ARCO. The primary reason is that the upstream impoundment, or settling basin, would be empty except during serious floods. The impacts of the impoundment or basin when empty would largely be only the impacts of the berms themselves. Since the area is currently privately owned grazing land, the effects on terrestrial wildlife should be minimal. Impacts on aquatic wildlife should be positive, not negative, given that the purpose of the impoundment or basin would be to improve surface water quality. EPA and MDHES have decided not to pursue the upstream impoundment or settling basin options.

2. Comment: This comment states that the inclusion of protection of the pond system from a full PMF in this alternative is not justifiable. The comment goes on to state that the appropriate level of protection to be provided for

the ponds should be "derived from an analysis of the MDNRC dam safety regulations."

Response: The purpose of a FS is to explore a range of options. It is entirely proper to examine the costs, benefits, and impacts of providing protection from the full PMF as part of one of the alternatives in the FS. EPA and MDHES agree that implementing full PMF protection would be excessive; the preferred plan included partial PMF protection. The level of protection proposed was derived from MDNRC dam safety regulations.

3. Comment: This comment repeats Section 8.3.1, Comments 6 and 7, which note potential problems with an upstream impoundment.

   Response: These issues are no longer relevant because EPA and MDHES have decided not to pursue the concept of an upstream impoundment.

4. Comment: This comment agrees with an assertion in the FS regarding the potential for recontamination of the Mill-Willow Bypass by floods over the 100-year event.

   Response: Comment noted.

5. Comment: This comment repeats previous comments regarding the effects on fisheries of diverting Mill and Willow Creek flows into Pond 3.

   Response: In response to opposition from the public and ARCO to the concept of routing the flows of these two creeks into the pond system, the selected remedy for the operable unit will not include this action. Instead, if the impacts will cause future exceedances of applicable or relevant and appropriate requirements, then action to address those exceedances, such as source control actions, will be investigated. These investigations would be conducted in conjunction with other investigations at the Anaconda Superfund site. EPA and MDHES reserve the authority to require the diversion of Mill and/or Willow Creek into the pond system for treatment. See also the responses to Section 7.5.1, Comments 3 and 4.

6. Comment: The FS estimate on page 8-49 of the total volume of tailings and contaminated soils to be excavated and hauled offsite (160,000 cubic yards) is inconsistent with the estimate given under Media-Specific Action 9 on page 7-83 (940,000 cubic yards). Also, the FS is confusing in that MSA 9 addresses removal of the tailings and sediments in Pond 2, while Alternative 2 incorporates that action, but uses wet closure to remediate Pond 2. Even when this factor is accommodated, a significant discrepancy in removal volumes still exists (i.e., 160,000 cubic yards versus 290,000 cubic yards).

   Response: The volume noted on page 8-49 is in error. The total volume of tailings and contaminated soils should have been listed as "Approximately 290,000 cubic yards . . ." on page 8-49. This is the quantity used in the cost estimates for Alternative 2 in Appendix D.

   As noted in the introduction to Chapter 8, the media-specific actions (and options) were combined to form the various alternatives. There was no intention and no requirement to limit the alternatives to discreet combinations of intact media-specific actions. Alternative 2 uses a combination of Media-Specific Actions 8 and 9 for addressing tailings and contaminated soils. Other alternatives use similar combinations of media-specific actions.

8.3.3 Alternative 3:

1. Comment: As previously discussed in Comment 1 of Section 8.3.1, the operation of the upstream settling basin ignores the Mill-Willow Creek flows. The FS should fully evaluate as an alternative source controls on Mill and Willow Creeks and enlargement of the existing Ponds 2 and 3 as proposed in the ARCO Plan. These actions would eliminate the need for an upstream impoundment and treatment of Mill-Willow Creek flows. As noted previously, the need for remediation of Mill and/or Willow Creek flows must first be documented with new data more definitive than that referenced or presented in the FS.

   Response: EPA and MDHES concur with the concept of investigating source controls. See the response to Section 8.3.1., Comment 1.

2. Comment: See Comments 1, 2, and 3 under Section 3.1.4 and Comment 4 under Section 4.1.1 regarding the inflow design flood levels proposed in the FS.

   Response: The inflow design floods have been agreed to by ARCO and EPA/MDHES as noted in the response to Section 4.1.1, Comment 4.

3. Comment: Alternative 3 would bypass, without treatment in Pond 3, the majority of the volume of a 100-year flood. As noted in Comment 5 under Section 7.6.1, we concur that the resulting surface water quality impacts from such an occurrence would be minimal, due to the significant dilution under such high flows. In any case, the ARCO Plan incorporates raises of both the existing Ponds 2 and 3 to permit treating flows from Silver Bow Creek up to the 100-year flood, as well as providing sediment trapping up to that event.

The FS should be revised to evaluate this much more efficient and cost-effective approach.

Response: EPA and MDHES concur. The Recommended Alternative in the ROD incorporates the concept of treating the 100-year flood in Pond 3.

4. Comment: The issues raised in Comments 6 and 7 under Section 8.3.1 regarding an upstream flood impoundment also apply to the upstream settling basin incorporated in Alternative 3. The only difference is the scale of the problems.

   Response: These comments are no longer valid, because EPA and MDHES have decided not to pursue an upstream impoundment.

5. Comment: See Comments 11 and 14 under Section 3.1.2 regarding the point of compliance issue and the applicability of a mixing-zone for groundwater.

   Response: These comments are addressed as other portions of the responsiveness summary.

6. Comment: See Comment 2 under Section 7.7.2.4 regarding the absence of justification for the proposed excavation and hauling of tailings and contaminated soils for on-site disposal in Pond 1.

   Response: Contaminated soils and tailings will be disposed of within both Ponds 1 and 3, as noted in the response to Section 7.7.2.4, Comment 2.

7. Comment: This comment refers to previous comments regarding RCRA as an ARAR for Warm Springs Ponds.

Response: These comments are addressed in other portions of the responsiveness summary.

8. Comment: This comment states that the FS is misleading in that it states that Alternative 3 would comply with the MDNRC dam safety regulations up to lower flow rates than Alternatives 1 and 2.

   Response: Alternative 3 is clearly identified as meeting ARARs. The intent of the sentence on page 8-55 is to: 1) state that this alternative would meet the dam safety regulations, and 2) distinguish the protection provided as being at lower levels than would be provided under Alternatives 1 and 2.

9. Comment: This comment focuses mainly on whether or not mining reclamation requirements can be considered ARARs for this operable unit. It also notes that the FS mentions the possibility of designing in-place capping actions to meet mining reclamation ARARs.

   Response: These comments are addressed in the response to comments, Chapter 3.0 and Appendix B.

10. Comment: This comment notes that failure of the berms during a flood or earthquake would be unlikely to release all of the 19 million cubic yards of toxic tailings and sludges in the ponds. The comment also repeats an earlier comment regarding the potential release scenarios for the tailings and sludges.

    Response: EPA and MDHES agree that neither a flood nor an earthquake would be likely to release 100 percent of the tailings and sludges, and believe that the FS is clear on this point in several sections. The sentence pointed out in this comment was misworded. The correct wording, which appears on page 8-42 for Alternative 2, deletes the words "release of," and reads: "The primary risk at the site, the 19 million cubic yards of sediments in the treatment ponds,..." The potential for release of a substantial fraction of the tailings and sludges should be the focus of concern, and that potential threat is not in question.

11. Comment: This comment notes an error on page 8-59, where it is stated that the tailings that collect in the upstream impoundment "could be removed" periodically, while page 8-58 states that the tailings "would be removed."

    Response: Page 8-59 should have used the phrasing "would be removed," since this is the assumption used in the cost estimates for this alternative.

8.3.4 Alternative 4: Compiles With ARARs

1. Comment: Most of the comments on Alternative 3 also apply to this alternative, since the only significant difference involves capping in-place versus removal of tailings and contaminated soils below Pond 1 and above Pond 3.

   Response: Comment noted.

2. Comment: Comment 5 under Section 8.3.3 regarding a groundwater compliance point and the applicability of a mixing-zone also applies to this alternative.

   Response: These comments are addressed elsewhere.

3. Comment: ARCO concurs that "Capping contaminated soils and tailings deposits in-place wherever possible would effectively isolate them from direct contact and limit their mobility." (page 8-66), and that this action would "isolate the material to inhibit human and environmental exposure" (page 8-69). As discussed in Comments 1 and 2 under Section 7.7.2.4 and Comment 5 below, there is no justification for any other action, except in the case of the Mill-Willow Bypass or where flooding-closure is technically more feasible and cost effective.

   Response: Comment noted.

4. Comment: This comment states that the FS does not support the conclusion that removing tailings from below Pond 1 into Pond 1 to cap and better contain them would be cheaper and more effective than leaving them in the floodplain and capping them there.

   Response: During the FS, the possibility of protecting the tailings below Pond 1 from flood erosion was considered. A soil cap could not be relied upon to provide protection from erosion due to a 0.5 PMF. The agencies do not believe that it would be appropriate to protect a capped area to only a 100-year flood. The possibility of protecting the cap with soil-cement, concrete, or riprap was briefly explored. Because of the flow rates that would exist, and the uncertainty that any of these methods would be reliable, they were not pursued further. It was obvious on brief examination that it would be cheaper and more effective to remove the tailings from the potential threat of erosion than to protect against it.

   Moving the tailings to Pond 1 as envisioned in Alternative 3 would be much less expensive. The cost for moving the tailings is estimated to be $400,000 to $500,000. This compares to a very preliminary estimate of $3 to

$4 million to provide a cap, which includes soil cement erosion protection. This estimate is based upon an assumption of 6 inches of agricultural lime, and a 24-inch cap comprised of 12 to 18 inches of clay and 6 to 12 inches of soil cement erosion protection.

5. Comment: This comment makes further points regarding the issue of capping the tailings below Pond 1 in place or moving them to Pond 1. The main point of the comment is that the tailings would pose no more risk if capped in place than if moved to Pond 1. The comment further states that the FS does not support the conclusion that operation and maintenance costs would be lower if the tailings were moved first to Pond 1, and that the savings in operation and maintenance costs cannot outweigh the costs of excavating the tailings and moving them.

Response: First, regarding what appears to be the main comment, EPA and MDHES believe that the advantages of moving the tailings to an area that would be protected from floods would be clear. EPA and MDHES believe that the added protection that would be provided by moving the tailings to a flood-protected area warrants the statement in the FS that "it would be ... more effective to move these materials to Pond 1 and cap them there, where they would be protected from floods by the pond berms."

Regarding the statement that operation and maintenance costs would be lower if the tailings were moved to Pond 1, EPA and MDHES believe that the costs of maintaining caps at the operable unit would be lower if there were fewer caps to maintain. It was not intended that this savings would independently offset the costs of moving the tailings to Pond 1. The justification for moving the tailings to Pond 1 would more likely be based on the added protection afforded by this option and on the avoided costs of the additional cap and armoring the cap against floods.

6. Comment: (This comment is numbered 8 in ARCO's comments, but no Comment 6 or 7 appears.) This comment states that the FS should provide the basis for the estimate of 325 acres of tailings below Pond 1 and above Pond 3 that would potentially require capping.

Response: The data and methods used to develop this estimate are described in Section 2. Briefly, a combination of analytical data and screening data from XRF studies was used to delineate contaminated areas. See the response in Section 2.2.7, Comment 2, and the response to Section 2.3.1, Comment 1.

8.3.5 Alternative 5:

1. Comment: This comment notes that many of the comments made for Alternatives 3 and 4 also apply to this alternative.

Response: Comment noted.

2. Comment: This comment requests an explanation of the terminology "unvegetated material" as used in describing what materials would be capped under this alternative.

Response: Unvegetated materials would be those soils, sediments, or tailings which are not revegetated adequately, according to ARAR standards identified.

3. Comment: See Comment 18 under Section 7.5.1 and Comment 2 under Section 7.5.2 regarding the inefficiency of imposing a 210 cfs treatment constraint as assumed for this alternative.

Response: The capacity of the new treatment pond is size limited. As stated on page 7-47 of the FS, the new treatment pond would have a detention time of just under 2 days with a flow of 600 cfs. This is considered to be the minimum detention time for adequate settling.

4. Comment: This comment makes several points regarding the use of wetlands treatment for the contaminated groundwater. The primary comment is that the FS notes several potential problems with the use of wetlands, but does not document those potential problems with references to experiences at other sites. The comment also questions whether it would be necessary to remove the biomass from the wetlands, and states that the sediments in the wetland would be no different, in terms of the hazards they would present, than are the other volumes of sediments (presumably in the ponds) that would be left in place. The comment suggests three additional considerations that should be taken into account in considering the use of wetlands for groundwater treatment, which are addressed below.

   Response: EPA and MDHES believe that a wetland treatment system could be used below Pond 1 for treatment of contaminated groundwater. However, there are significant problems with this option that have to be considered, and the FS properly raised these issues.

   The general discussion of use of wetlands for treatment of contaminated water is based on experience with such usage at other sites. The comment is correct that references should have been given for this discussion. All of the potential problems noted in the discussion have been observed in previous uses of wetlands, as can be seen by referring to the following:

Girts, M.A. and R.L.P. Kleinmann, Constructing Wetlands for Treatment of Mine Water, presented at the 1986 Society of Mining Engineers Fall Meeting, St. Louis, MO, September 1986.

Girts, M.A. and Robert Knight, Operations Optimization Draft, CH2M HILL, 1987.

Final Technical Report, Tasks 1 and 2, Utilization of Geothermal Effluents to Create Waterfowl Wetlands, CH2M HILL, 1980.

Chan, E., T.A. Bursztynsky, N. Hantzsche, and Y.J. Litwin, The Use of Wetlands for Water Pollution Control, EPA-600/2-82-086, U.S. EPA, 1982.

Girts, M.A. and R.L.P. Kleinmann, Constructed Wetlands for Treatment of Acid Mine Drainage: A Preliminary Review, 1988.

Howard, E.A. and T.R. Wildeman, Conceptual Design and Preliminary Cost Estimates for the Passive Treatment of Drainage from the National and Quartz Hills Tunnels, Blackhawk and Central City, Colorado, Camp Dresser and McKee, 1987.

Erickson, P.M., M.A. Girts, and J. Holbrook, Use of Constructed Wetlands for Coal Mine Drainage, presented at the National Western Mining Conference and Exhibition, Denver, Colorado, The Colorado Mining Association, February 1987.

EPA and MDHES disagree with the unqualified contention that the sediments in the wetland would pose no different hazards than the other sediments that would be left in place. The wetland would be in an unprotected area in a floodplain, unlike the sediments in the ponds, and would be subject to release and dispersal during floods. The wetland could be provided with some flood protection, at a considerable expense. The wetland concept developed in the FS does not include flood protection for the wetland, but such protection could be incorporated.

The comment specifically states that the wetlands option should be reconsidered with four points in mind:

A. The existing wildlife ponds have operated for more than 15 years and required little startup effort.

Response: The wildlife ponds are not wetlands designed for treating contaminated groundwater and are not monitored for treatment effectiveness. It is not known how long it took before the Wildlife Ponds began to yield the incidental treatment they now provide. Therefore, it is difficult to be certain of the intended point of the comment. Based on experience that has been seen at other sites where wetlands have been established for treatment of contaminated water, there is a potential for difficulties and delays while getting the wetland operating so that it can receive extracted groundwater. The FS properly pointed out this source of potential difficulty.

B. The biologic treatment [that would be provided by] wetlands is already proven by the operation of the existing ponds (Ponds 2 and 3).

Response: The functional (settling and treatment) portions of the ponds are not wetlands. Some of the biologic processes that would operate in a wetland are the same as those that likely operate in the ponds. Other processes would occur as well. A straight comparison of the wetland concept considered in the FS and the existing pond system is not meaningful.

C. Wetlands expansion is a significant national priority.

Response: Wetlands retention (or "no net loss") is a significant national priority. However, the wetlands expansion that is desired is somewhat different from the new wetland that would be constructed below Pond 1. The major difference is that the treatment wetland would be fed with contaminated water, and in time would be contaminated with toxic metals in the sedimen ; and substrate, where much of the desirable biologic activity in a wetland takes place.

D. The wetlands option would avoid the risk of, or resources and expenses to mitigate, releases of contaminants associated with the excavation and hauling required in the removal option.

Response: The wetlands option would not entirely avoid the need to move the tailings. Whether or not the tailings and contaminated soils were left in the area below Pond 1, considerable excavation, hauling, and grading of the tailings and soils in that area would be required to prepare it for construction of a wetland. Thus, the potential releases ARCO is concerned about would exist either way. Additionally, it is not clear why the risks in moving these tailings should be any greater than the risks involved in moving the tailings in the bypass, which ARCO is undertaking during the summer of 1990. The question of whether or not the tailings should be removed is driven instead by the desire to remove these materials from the floodplain where it would be expensive to adequately protect them from floods, or where they might hamper efforts to establish an effective wetland.

Comment: This comment refers the reader to a previous comment (Section 7.2.2.2, Comment 1) regarding the potential for increased groundwater contamination below Pond 1 due to wetlands remediation.

Response: The FS did not conclude that flooding will result in "increased" groundwater contamination. The FS stated that the continued presence of water in Pond 1 provides a source of recharge and contaminants to the shallow aquifer below Pond 1. The analyses supporting this conclusion are summarized in the FS.

6. Comment: This comment asks why Alternative 5 includes removal of the tailings below Pond 1 prior to construction of the wetland. ARCO states that the tailings would be in a reducing environment and would effectively be no different from the sediments left in place in other alternatives. If initial dissolution of metal salts from the oxidized metals is an expected problem, the comment suggests that a method to pump the wetlands water to the ponds prior to release could be used in the startup period.

Response: Although it might be possible to construct and operate a wetland on top of the tailings deposits, there are several reasons that it might be more advantageous to remove the tailings first. Because it seemed more likely, for the reasons given below, that the tailings would be removed, the FS assumed that they would be and incorporated this step in the conceptual design and the cost estimate.

Four reasons that it would be advantageous to remove the tailings are:

A. The tailings are in a floodplain. While it would be possible, at least in theory, to protect the wetland from flood damage, it seemed more reasonable, from an engineering value perspective, to assume that any flood damage would be repaired and not attempt instead an engineered solution to avoid such damage. That they are in a floodplain is, as pointed out above, a significant difference between the sediments that would be in the wetland and the sediments in the ponds. The sediments in the ponds are to be protected against the 0.5 PMF. The sediments in the wetland under Alternative 5 would not have such protection.

B. The tailings and other soils in the area below Pond 1 would require considerable regrading to allow construction of a wetland. The handling of the material to complete this regrading would present the same types of potentials for releases, which ARCO expresses concern about, as would excavation and hauling to Pond 1. Thus, leaving the tailings in place does not eliminate the potential for releases associated with excavation and moving of the tailings, as stated by the comment. If some of the tailings have to be disturbed, it seems that moving them out of the floodplain at the same time would be worthwhile.

C. It is not clear that establishing the wetland over large deposits of tailings would be acceptable environmentally. ARCO mentions the problem of initial dissolution of metal salts from the tailings as a potential problem. In addition to this problem, the existence of these large deposits of tailings in the wetland would have impacts on the types and quantities of species that could be established in the wetland. Also, given the large quantities of metal ions that would be in the wetland environment from the existence of the tailings, it is reasonable to assume that the potential effectiveness of the wetland system in removing low concentrations of dissolved metals from the influent groundwater would be reduced. Soluble metals from the tailings would load up the substrate. In short, the tailings represent a large source of metal contaminants that would no doubt have some negative impacts on the possibility of establishing a successful wetland. Wetland treatment technology is, as mentioned in the FS, a relatively new technology. It seemed prudent during the FS to assume that the wetland would be given the best chance of success by removing the tailings prior to construction.

D. EPA and MDHES believe that the potential exists for increased groundwater contamination if a wetland were constructed on top of the tailings deposits. Studies during the desi(ı phase may establish that the impacts would be small enough not to represent a significant threat to the environment; but, that conclusion would have to await further studies during the design phase.

7. Comment: This comment points out that a negative impact of diverting the flows of Mill and Willow Creeks into the pond system is mentioned in the FS only under Alternative 5, but should also have been mentioned for Alternatives 1 through 4.

Response: The comment is correct in part. The negative impact would exist for all alternatives that would divert Mill and Willow Creeks into the pond system. Given the format of this chapter of the FS, it should have been mentioned just once, under Alternative 1 (instead of under Alternative 5), since the impact would not differ among the alternatives.

8. Comment: This comment repeats an earlier request for references to the information used in developing the discussion of potential problems in establishing and maintaining wetlands. It also states that the magnitude of

such disadvantages should be documented so that the advantages can be weighed against the disadvantages.

Response: References are given above (Section 8.3.5, Comment 4) that describe the current state of understanding of wetlands treatment systems. The references provided describe the problems encountered in other uses of wetlands for treatment of contaminated water.

8.3.6 Alternative 6: Significant Protection of Health, Welfare, and the Environment

1. Comment: This comment refers to previous comments on the use of institutional controls in constructing remedial alternatives.

   Response: See the responses to the comments on the use of institutional controls in Chapter 3 and 6.

2. Comment: This comment repeats earlier comments regarding the adoption of ARCO's plan for modifying the existing pond system for use as a settling system during major floods.

   Response: EPA and MDHES have decided to include storage and treatment of the 100-year event into the Recommended Alternative in the ROD. See the response to the Section 7.5 comment.

3. Comment: This comment refers the reader to a previous comment (Section 7.2.2.2, Comment 1) regarding the potential for increased groundwater contamination below Pond 1 due to wetlands remediation.

Response: The point of compliance is established in the ROD. Certain MCLs are exceeded.

2. Comment: This comment repeats earlier comments regarding whether or not the RCRA regulations can be considered as ARARs for this operable unit.

   Response: These comments are addressed in the response to comments, Chapter 3.0 and Appendix B.

8.4 COMPARATIVE ANALYSIS OF ALTERNATIVES

1. Comment: The comment asks again why the FS concluded that excavating materials from the floodplain below Pond 1 and taking them to Pond 1 to be covered by the cap that would be placed over Pond 1 would be more protective than capping them in place.

   Response: The primary advantage would be that the capped materials would no longer be in a floodplain. Because susceptibility to flood erosion would be eliminated (assuming that the Pond 1 berms are raised and armored as necessary to provide protection from major floods), this approach would be more protective of the environment than leaving the materials in the floodplain. Additional advantages of moving the materials to Pond 1 prior to capping them include avoiding the cost of an additional cap, avoiding the cost of protecting a cap below Pond 1 from flood damage, and lower maintenance costs, since there would be less capped area at the site to maintain. See also response to Section 8.3.4, Comments 4 and 5.

2. Comment: This comment states that Alternatives 3, 4, 5, and 6 are "more or less equivalent" in effectiveness in treating the flows that would go through

the pond system, and states that the differences would be in the volumes that could be routed through the ponds, which affects the frequency of events in which flows would have to be routed around the ponds.

Response: The comment is correct in part. The concept common to the alternatives developed in the FS is that influent flows to the ponds would be limited to what the ponds could treat adequately. But, the concept of "effectiveness" includes not only the degree of treatment but also the range of flows that can be treated. In this matter, the alternatives differ. The FS properly points out these differences in effectiveness.

3. Comment: This comment repeats earlier requests foı references on previous experiences with establishing and using wetlands to treat contaminated water. This comment particularly requests references to support the notation in the FS that up to 5 years may be required to establish good operation of the wetland.

   Response: The requested references are provided in the response to Section 8.3.5, Comment 4.

4. Comment: This comment requests further basis for the annual operation and maintenance cost estimates in the FS, and asks why the operation and maintenance costs for the alternatives are so similar.

   Response: The assumptions used in developing the costs estimates are provided in Appendix D of the FS. The primary reason that the costs are so similar is that the alternatives themselves are actually quite similar in those aspects that most determine operation and maintenance costs. All of the alternatives would involve the continuing existence of miles of berms that would have to be maintained. All of the alternatives would include a surface water treatment system for the flows in Silver Bow Creek, which would require approximately equal levels of operation and maintenance costs for all of the alternatives. And nearly all of the alternatives would involve areas of contamination that are closed either by flooding, capping, or revegetation; any of these actions would require certain low levels of operation and maintenance. Thus, the primary determinants of operation and maintenance costs are very similar between the alternatives, and the estimates of operation and maintenance costs are similar.

8.4.1 Overall Protection of Human Health and the Environment

1. Comment: This comment repeats earlier comments on the use of the RCRA regulations as ARARs for this operable unit. Specifically, the comment questions the assumption that the cap used in certain areas of the site would follow certain of the RCRA requirements for caps.

   Response: These comments are addressed in the response to comments at Section 3.0, and Appendix B.

2. Comment: This comment repeats an earlier comment in Section 7.7.2.2 (Comment 1) that flooding the area below Pond 1 should not increase groundwater contamination.

   Response: The FS did not conclude that flooding will result in "increased" groundwater contamination. The FS stated that the continued presence of water in Pond 1 provides a source of recharge and contaminants to the shallow aquifer below Pond 1. The analyses supporting this conclusion are summarized in the FS. See also the response to Section 7.2.2.2, Comment 2.

3. Comment: This comment repeats earlier questions regarding the value of moving the tailings below Pond 1 to Pond 1 prior to capping them.

Response: The agencies believe there will be several advantages to moving the contaminated materials below the pond. See the responses to Section 8.3.4, Comments 4 and 5.

4. Comment: This comment questions the conclusion in the FS that water quality standards would be exceeded with increasing frequency as the maximum input rate for the pond treatment system decreases between alternatives, because smaller flood flows would be bypassed without treatment.

Response: The alternatives would allow treatment of 600 or 210 cfs in the pond system. The comment points out a difficult issue, one that was considered during the study. As flow rates increase in the creeks, the quantities of both dissolved and nondissolved metals would increase due to the runoff being contaminated with dissolved metals (see Chapter 4 of the FS) and due to greater erosion of tailings deposits along the stream banks; the deposits contain both dissolved and nondissolved metal contaminants. However, the concentrations of the dissolved and nondissolved metals contaminants would vary in ways that are difficult to predict. As noted in the FS, water quality information collected during high flow events was not available during the FS.

Some information on the effect of precipitation events on water quality are available. Three studies have been done: two are complete and were considered during the study; and the other is in draft and being reviewed by the regulatory agencies (MultiTech, 1987; CH2M HILL, 1987; CH2M HILL, 1990). All three studies revealed that during runoff precipitation events, very high concentrations of metals are released to Silver Bow Creek. The runoff study done at Ramsey Flats (as part of the treatability study for the FS) (CH2M HILL, 1987) is described on page 4-28 of the FS. It indicates that very high concentrations of metals are released to the river during runoff events. The Phase I remedial investigation for the Silver Bow Creek Site (MultiTech, 1987) showed high metals levels in the river during a rainstorm. Results from the more recent study (CH2M HILL, 1990) also show very high metals levels in the river during a high flow event.

These results indicate that the river receives additional metals loads during precipitation events. What the results do not show is the levels of metals that would be released by erosion of tailings deposits along the creek during flow events between 200 cfs and 600 cfs, or the levels of total metals that would be in the river at these flows. The reason that such data are unavailable is because, as noted in the FS, no high flow events that could be sampled and analyzed have occurred since the beginning of the remedial investigation. Given the frequency of high flow events of this size range (a probability of several years between events), it is expectable not to have such information for the FS.

Given the lack of actual high flow concentrations in the river, the FS took the approach of developing alternatives that would allow for treatment of all flows up to certain levels. This approach was taken to allow the decisionmakers to choose among a range of flows to receive treatment. As noted in the response to the Section 7.5 Comment, the EPA and MDHES have decided to utilize Pond 3 for detention and treatment of all flows up to 3,300 cfs.

8.4.2 Compliance with ARARs

No specific comments were made by ARCO in this section.

8.4.3 Long-Term Effectiveness

1. Comment: This comment states that the evaluations of residual risks in this section of the report are qualitative in nature, and that the FS should quantify such risks where feasible.

   Response: The discussions of residual risks are descriptive and comparative, as required by the RI/FS guidance document. According to the guidance document, the purpose of this section of the FS is "to **identify** the advantages and disadvantages of each alternative **relative to one another** so that the key tradeoffs the decisionmaker must balance can be identified." "The presentation of differences among the alternatives can be measured **either qualitatively or quantitatively,...**" (emphasis added). A qualitative approach was adopted because quantification of residual risks would have been difficult and the results would have been of uncertain accuracy.

2. Comment: "A reference or other documentation should be provided to support the contention that the `probability of occurrence' of a probable maximum flood is only once in several thousand years.' (page 8-108) As noted in the same sentence of the FS, `no specific return intervals are associated with probable maximum floods.' The fact is that estimation of a PMF-series flood is a wholly **deterministic** procedure, and thus a **probabilistic** estimate of its occurrence is invalid. It is of some interest to note that the Institute of Civil Engineers (ICE London, recommends using either a 0.5 PMF or a 10,000-year recurrence flood (whichever is greater) for `significant'hazard dams (National Research Council, 1985). Without saying

that a 0.5 PMF flood has a recurrence interval of 10,000 years, it is apparent that ICE views these events of at least comparable order of magnitude." (Emphasis added in the original comment).

Response: The comment has been quoted in its entirety. EPA and MDHES have examined this comment and can find no point of contention. It appears that ARCO is trying to make the same point made in the FS: while PMFs have no specific return interval associated with them, they are not likely, to occur more often than once every several thousand years on a probabilistic basis.

3. Comment: See Comment 6 under Section 8.3.5 regarding our disagreement that "eventual recontamination of soils, sediments, and groundwater" (page 8-110) would be a significant issue associated with wetlands treatment.

Response: The agencies believe there are four reasons why removal of the tailings would be advantageous. See the response to Section 8.3.5, Comment 6, for a complete explanation of those reasons.

8.4.4 Reduction of Toxicity, Mobility, and Volume

1. Comment: The comment states that the FS should provide an analysis of the advantages of Alternative 3 in reducing the mobility of contaminants in the tailings and contaminated soils compared to the advantages of Alternatives 4 and 5. The comment states that any advantage in protectiveness of Alternative 3 would be "minimal in comparison to the total costs."

Response: The FS does compare the relative advantages of the Alternative 3 versus Alternatives 4 and 5. The difference in actions for these alternatives is that under Alternative 3 the tailings and contaminated soils would be moved to Pond 1, where feasible, and capped along with the materials already in Pond 1. Under Alternative 4 or 5, the tailings would be capped and revegetated in place, where possible.

The primary advantage to ARCO in capping in place is to save the costs of excavating the tailings and soils and transporting them to Pond 1. The disadvantages are the costs of additional areas requiring caps and the additional maintenance costs for the additional caps.

As pointed out in responses to previous comments, the primary (but not the only) advantage of moving the tailings and contaminated soils below Pond 1 to Pond 1 prior to capping is that they would then be protected from release due to floods. The primary advantage in moving the soils above Pond 3 to either a consolidated location within Pond 3 or to Pond 1 is the ability to construct a well designed cap that would meet the requirements of the RCRA regulations for hazardous waste landfill caps. Capping in place (for the tailings and contaminated soils below Pond 1 or the tailings and contaminated soils above Pond 3) would not allow for carefully graded and designed caps to be constructed over all of the contaminated areas. Greater infiltration of rainfall, and/or greater potential for erosion of such caps will be a necessary consequence of capping in place, unless substantial regrading of the tailings and contaminated soils is envisioned.

MDHES and EPA have determined that the certain RCRA cap requirements are relevant and appropriate requirements for this action. A cap will provide better long-term assurance that the materials will remain isolated from the environment.

8.4.5 Short-Term Effectiveness

1. Comment: This comment repeats earlier comments regarding diverting Mill and Willow Creeks into the pond system.

   Response: In response to considerable public opposition to routing the flows of these two creeks into the pond system, the selected remedy for the operable unit will not include this action. Instead, ARCO will continue its sampling and analysis activities to determine the actual impact of these two creeks. If the impacts will cause future exceedances of applicable or relevant and appropriate requirements, then action to address those exceedances, such as source control actions, will be required as part of another operable unit. EPA and MDHES reserve this authority to require diversion of Mill and/or Willow Creeks into the pond system for treatment in the interim or long-term if required to protect the environment. See also the responses to Section 7.5.1, Comments 3 and 4.

8.4.6 Implementability, Reliability, and Constructability

1. Comment: The comment states that **technical** feasibility (emphasis in the original) is not dependent on the magnitude of the project. The commenter notes that, constructing a 50-foot-high embankment is just as feasible as constructing a 30-foot-high embankment.

   Response: EPA and MDHES agree with the comment.

2. Comment: This comment agrees with a statement in the FS that alternatives requiring less riprap are more favorable because of the apparent scarcity of riprap in the area.

Response: EPA and MDHES agree. However, the difficulty in obtaining riprap does not affect the technical feasibility of alternatives that require greater amounts of riprap.

8.4.7 Cost

1. Comment: This comment refers the reader to other comments on Appendix D of the FS.

   Response: See the response to the comments in Appendix D.

2. Comment: The comment states that the unknown foundation conditions for the upstream flood impoundment or settling basin should be mentioned in the sensitivity analysis.

   Response: It is true that site-specific studies of the area considered for the impoundment or settling basin have not been done. Such studies are not appropriate at the feasibility study stage of the Superfund process. However, the fact that site-specific studies have not been done does not mean that nothing is known about the foundation conditions in that area.

   The regional geology is fairly well known, and the probable subsurface conditions can be inferred from the known regional geology. It was assumed in the FS, based on the regional geology and field observations, that suitable foundation conditions would be found.

   Further, the type of structure considered--earthen berms with 3:1 slopes--do not ordinarily require special foundation conditions. The gravels that likely underlie the surface would probably provide excellent foundation conditions for that type of structure. The existing pond berms have been in existence for many years on foundations that are likely to be similar to those found at the proposed location. The existing pond berms are not as well designed as the new berms for an upstream flood impoundment or settling basin would have been.

CHAPTER 9.0

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APPENDIX A

RESPONSES TO ARCO COMMENTS, APPENDIX A PUBLIC HEALTH AND ENVIRONMENTAL ASSESSMENT

1.0 INTRODUCTION

No comments.

2.0 SITE SETTING

2.1 PROJECT BOUNDARIES AND LOCATION

No comments.

2.2 CLIMATE AND METEOROLOGICAL CONDITIONS

Comment: This comment questions the exclusion of summer rainfall days in the exposure assessment.

Response: See the response to Chapter 3, Section 3.2.2, Comment 1. Summer rainfall days have been included and the risks recalculated.

2.3 SITE FEATURES

No comments.

2.4 LAND USE AND THE HUMAN POPULATION

1--3. Comment: These comments discuss the potential for residential development at the ponds in light of demographic information.

Response: This issue has been discussed. See the response to Chapter 3, Section 3.2.4, Comment 4. MDHES agrees with ARCO that future residential development on the ponds is not likely to occur if appropriate institutional controls are enacted. MDHES and EPA have made further risk management decisions based on occupational use of the site which does occur and will continue into the future.

4. Comment: This comment states that the risk assessment should present QA/QC information of data obtained during the Phase I and Phase II RI.

   Response: The risk assessment was not tasked with QA/QC of data obtained during the RI. Data were validated based on the approved QA/QC plan. For a discussion of the limitations of the data, the reader is referred to the RI. See also the response to Appendix A, Section 3.0, Comment 1.

5. Comment: This comment seeks an explanation for exceedance of dissolved fraction over total fractions.

   Response: The data passed discussed in the comment were subjected to and passed the data validation required by the approved QA/QC plan. In the data used in the assessment, the parameter which exhibited this phenomenon was zinc, at two sampling locations. On Table 3-11 of the risk assessment (Appendix A of the FS) in the all-flow maximum concentration column, the dissolved concentration slightly exceeded the total concentration (570 ppm versus 550 ppm), although these two numbers are probably analytically the same. On Table 3-14 of the risk assessment, dissolved zinc concentrations exceed the total zinc concentrations for both maximum and average concentrations in the low flow samples. The limited number of occurrences of this phenomena did not warrant an extensive search for the cause. A potential explanation for an overestimate of the dissolved fraction may be the passage of colloidal material less than 0.45 μm in size, as metals may be transported on mobile colloids (Puls and Barcelona, 1989).

6. Comment: This comment requests a reference for sediment data interpretations.

   Response: Sediment contamination is discussed in the *Phase I Remedial Investigation Report* by Multitech (1987), the *Silver Bow Creek CERCLA, Data Summary* by CH2M HILL (1988), and the *Phase II Remedial Investigation Data Summary* by CH2M HILL (1989).

7. Comment: This comment requests a reference for the particle sizes given in the assessment for entrainable particles and respirable particles.

   Response: Entrainable particles as referred to in the assessment, are those 75 μm or less in size, as stated in EPA (1984a). These are particles that move by suspension and tend to follow air motions. This size, 75 μm, is the upper size limit of silt particles that can become suspended and the smallest particle size for which size analysis by dry sieving is practical.

   Respirable fraction is defined in the assessment as 9 μm or less in size. Although 10 μm or less in size is usually considered the "respirable" fraction

(EPA 1987, EPA 1984a), 9 μm was used in the assessment as it was the closest size fraction to 10 μm reported by the laboratory.

8. Comment: This comment requests a table comparing the concentrations of contaminants in "metallic salts" with surface sediment samples of the Mill-Willow Bypass.

   Response: Table 4-4 of the FS presents a summary of the Mill-Willow Bypass sediment data by material type. This table indicates concentrations of zinc and copper contaminants in metallic salts are an order of magnitude greater than typical sediment materials.

9. Comment: This comment requests a discussion of the projected total extent and volume of contaminated soils along the Mill-Willow Bypass.

   Response: The risk assessment is not concerned with estimates of the volume of contaminated soils along the Mill-Willow Bypass. The assessment did not estimate the volume nor does it mention it. The pages the comment indicates refer to what is and is not surficial contamination, not what volume of tailings are present. Volume estimates are appropriate RI/FS activities.

10. Comment: This comment states that bioconcentration of metals by fish is not unique to the Warm Springs Ponds. Comment continues with a statement that liver tissue is often higher in metals concentrations than muscle tissue.

    Response: Refer to the response to Appendix A, Section 2.5. MDHES recognizes this is a general phenomenon and not a site specific occurrence. The assessment makes a statement that higher concentrations of metals are found in liver tissue than in muscle tissue. It is not identified as a problem.

4.0 EXPOSURE ASSESSMENT

4.1 CONTAMINANT RELEASE MECHANISMS

1. Comment: This comment requests that metal deposition rates be given for the ponds, bypass, the Clark Fork River, and groundwater.

   Response: The source-receptor relationships described in Chapter 4 of the risk assessment were derived from data and discussions found in Section 4 of the FS. Repeating numerical deposition rates in the risk assessment would not provide a better understanding of the contaminant release mechanisms. Refer to Section 4 of the FS for numerical values.

2. Comment: This comment requests probabilities be determined for contaminant release mechanisms discussed in the risk assessment and the resulting aerial

distribution of contaminants from those mechanisms be determined. Comment also questions which flood event is referred to in the risk assessment.

Response: Defining the probability of a release and the aerial deposition of the resulting release was beyond the scope of the FS. Refer to Section 4 of the FS for a discussion of release scenarios.

The risk assessment refers to the 100-year flood event.

4.2 MIGRATION AND FATE

1. Comment: This comment requests data on the range of metal concentrations measured in pond outflow.

   Response: Tables with surface water data are provided in Chapter 3 of the risk assessment and in Section 2 of the FS.

2. Comment: This comment requests data on metals speciation.

   Response: Twelve groundwater samples during the Phase II RI were analyzed for arsenic III, arsenic V, and total dissolved arsenic (CH2M HILL 1989). Speciation data were not definitive and did not provide a better understanding of fate and transport of constituents at the ponds.

3. Comment: This comment states that hypothetical fate and transfer mechanisms should be so stated.

   Response: The fate and transfer mechanisms discussed in the risk assessment are termed "potential" mechanisms. The potential for transfer of contaminants between media does not comment directly on the risks, but contributes to the overall assessment. Risks are discussed in Appendix A, Section 6 of the FS.

4.3 HUMAN EXPOSURE ASSESSMENT

4.3.1 Potential Exposure Pathways

1. Comment: This comment questions the inclusion in the assessment of exposure to constituents in fish and waterfowl tissue.

   Response: Refer to the response to Chapter 3, Section 3.2.4, Comment 2. The assessment is analyzing risk from constituents at the site, in what ever media they are detected and at whatever the concentration. The determination of risk through exposure to multiple media would not be complete without inclusion of all media potentially affected by contaminants where exposure could occur, regardless of the concentration of constituents.

2. Comment: This comment questions the inclusion of fish and waterfowl in the exposure assessment. It reiterates the statement previously made on multiple pathway exposures to a single receptor and requests a reorganization of the section dealing with exposure to fish and waterfowl tissue. Comment states that the conclusions should be presented before the supporting information.

Response: As stated above, the risk assessment is not looking at incremental risk over background. Whether or not contaminant concentrations in media at the site are equal to concentrations elsewhere is irrelevant to whether or not there is a health risk from all exposure pathways of a developed scenario that is known to occur at the site. EPA guidance stresses the importance of analyzing multiple exposure pathways (EPA 1989B). It is conceivable that an individual could be exposed to each pathway within a developed scenario.
Since the analyses for other media were presented prior to the conclusions about the media, altering the format for the section dealing with fish and waterfowl would be inappropriate. The risk assessment does state (Section 6) that risk through fish ingestion could be between zero and 6 x 10^{-5} since it is a catch-and-release area, and consumption of the fish may not occur.

4.3.3 Exposure Scenarios

1. Comment: This comment requests that exposure scenarios reflect "actual data regarding activity patterns and characteristics of potentially exposed individuals" and include a quantitative estimation of probability of exposure scenarios being realized.

Response: Actual data on time and activity patterns for users of the or residents of the surrounding communities does not exist. Obtaining such data was out of the scope of the risk assessment. The risk assessment states "no data exist to determine the true frequency and duration of exposure. Therefore, assumptions have been made for these variables of exposure for each scenario based on conversations with persons who live in the Warm Springs area and are familiar with activities occurring at the ponds." Exposure scenarios were based on discussions with residents of the State of Montana and best professional judgement.

Sufficient data to quantitatively estimate the probability of events occurring was not available for the risk assessment.

2. Comment: This comment questions the assumptions of the recreational scenario.

Response: See response to Chapter 3, Section 3.2.4, Comment 7. Assumptions used in the assessment were based on discussions with Montana State Fish and Parks personnel, Montana residents and best professional judgement because site specific surveys were not available.

3. Comment: This comment questions the exposure duration times used in the assessment.

   Response: At the time the risk assessment was conducted, the guidance from EPA was to use a 70-year residential duration. Although more data are becoming available with which to refine exposure assumptions based on actual observations, current guidance (EPA, 1989b) indicates that 9 years and 30 years are average and upper-bound residence times. Longer residence times may more accurately reflect typical conditions in a rural environment.

4. Comment: This comment states that a 75-year life expectancy should be used in the risk assessment.

   Response: The risk assessment followed EPA guidance in use at the time the assessment was prepared which recommended a 70-year life span (EPA, 1986a). Current guidance suggests that either a 70-year or a 75-year life span can be used. A 70-year life span can be used by convention (EPA, 1989b) or a 75-year life span can be used as it is more representative of the present day conditions (EPA, 1989a). Revised risk estimates were based on a 75 year life span.

4.3.4 Estimation of Human Intake

1. Comment: This comment questions the soil intake values used in the risk assessment for the recreational and occupational scenarios.

   Response: See response to Chapter 3, Section 3.2.4, Comment 9. A range of soil ingestion values were used in the assessment as EPA standardized soil ingestion rates (Porter 1989) were not available when this assessment was initially prepared. Risk estimates have been revised based on the standardized intake estimates suggested in the Porter (1989) memo.

2. Comment: This comment requests that the exposure duration to soils in the occupational scenario be reduced in the winter months due to the heavy clothing worn that would reduce the amount of soil contact.

   Response: The risk assessment already assumes no contact with soils in the winter months because of snow cover.

3. Comment: This comment questions the estimates for surface water ingestion during recreational or occupational use of the ponds.

   Response: Incidental ingestion of surface water by individuals while using the ponds for recreation activities is a possibility through splashing, contact with fish, rinsing hands, etc. Best professional judgement was used in determining the intake parameter for this pathway as standardized values were not available. It is not unreasonable that approximately 6 ounces (less than a cup) of pond water could be consumed each year through incidental and unnoticed ingestion. The upper bound estimate of approximately 30 ounces per year may seem high for this pathway, however personal hygiene habits differ between individuals, and this value represents a maximum estimate. These values represent about 0.01 percent to 0.05 percent of the water ingested over a lifetime.

For occupational exposures, State employees are on the ponds every working day performing activities that include significant contact with surface water. It is not unreasonable to assume that incidental ingestion of surface water occurs. The reasonable intake value represents approximately 0.06 percent of the water ingestion over a lifetime while the upper bound intake estimate is approximately 0.4 percent of ingestion over a lifetime. These percentages assume an adult ingestion rate of 2 liters per day, which may be an underestimate for persons continuously engaged in outdoor activities.

4. Comment: This comment states that indoor air concentrations of particulate contaminants may be considerably different from outdoor air concentrations.

Response: MDHES agrees that indoor air concentrations could be considerably different from outdoor air concentrations, that the concentration of contaminated particulates in indoor air is a function of the concentration of contaminated particulates in outdoor air (A_o) and indoor house dust (S_i), as well as the concentration from indoor sources ($\bar{A}_i$), and that inhalation of particulates in indoor air is an important pathway of human exposure. However, EPA does not agree that available data are adequate to show that the numerical coefficients in the algorithm proposed by ARCO are applicable either in the general case or to the Clark Fork region. Indeed, the "detailed justification" provided in Attachment 2 makes clear that all of the quantitative values proposed in this algorithm are based on little or no data and are largely intuitive. For example, ARCO notes that if a value of 0.4 is used for the penetration factor (the coefficient of A_o) the results appear "plausible" but there is "no independent information." In addition, ARCO notes that "in a cold climate--where windows are closed much of the year--a smaller value might be appropriate," and so arbitrarily chooses a coefficient of 0.3.

With respect to the second term in the equation ($0.5\ A_i^{TSP} S_i$), ARCO notes that the "rate of which house dust is resuspended has not been systematically studied," but nonetheless proposes a coefficient of 0.5 based on one study of the effect of an outside air filter on indoor dust levels in one home, and one observation from one home in Denver during a 4-day period when outdoor concentrations of lead were low. Clearly, the results in these studies depend on a number of parameters that may not be representative of conditions at the .

There is similar uncertainty in the values for S_i and A_i^{TSP}. For example, ARCO proposes the algorithm

$$S_i = 0.15 S_o$$

for the contribution of outdoor soil (S_o) to contaminant concentration in indoor soil (S_i). This coefficient is based on one data set from a mining location in England, and there is no evidence that this coefficient is applicable to the conditions at . With respect to the term A_i^{TSP} (the concentration of dust in air), ARCO acknowledges that simple activities such as vacuuming or making a bed can increase values 4 to 50 fold, revealing that this term is highly variable and dependent on human activity. The value proposed by ARCO (55 μg/m3) is not measured, but is in fact calculated from measurements of A_i, A_o, and S_i for arsenic at Mill Creek, using the very algorithm that contains this term.

4.3.5 Exposure Point Concentrations

1. Comment: This comment states that the updated version of AP-42 should be used for wind erosion of open areas.

   Response: At the time of the emission rate calculation, the most recent AP-42 equation was not available. Therefore, emission estimates used the previous AP-42 equation. The current equation uses data that may not be readily available for this site. Its use is probably not feasible in this case.

2. Comment: This comment questions the use of 0.35 to 0.5 for reducing emissions due to surface crusting.

   Response: The 0.35 to 0.5 factor was an assumed factor. Referencing the depth of soil eroded makes several assumptions that are not clear: that no new dust was blown into the area for replenishment, and that erodible particles present are evenly distributed on the surface. Furthermore, 57 μm is a very small quantity, only three-quarters of one particulate diameter in depth. The entire section was calculated with available data, but when appropriate data were not available, conservative assumptions were made and documented in the report.

3. Comment: This comment questions the use of a factor of 0.1 for relating 1-hour estimated concentrations to annual average dust concentrations.

   Response: The methods used to determine 1-year average concentrations from the 1-hour maximum values are appropriate and standard EPA methodology (EPA, 1988).

   The available wind rose (from the Opportunity Ponds) did not discuss the length of sampling time, data quality achieved, etc. More information is required before the wind rose data could be used in modeling scenarios. Also, having 16 wind directions has no bearing on developing a "dilution factor" as suggested.

4. Comment: This comment questions why the particle settling algorithm was not used in the Industrial Source Complex (ISC) model.

Response: Information is not available to determine the particle settling velocity for use in ISC. Particles less than 75 μm were assumed in the analysis, and the fine particles were treated as gaseous emissions, a standard "worst-case" assumption.

4.4 ENVIRONMENTAL ASSESSMENT

Comment: This comment states that impacts to aquatic or terrestrial life have not been identified and no basis established for future impacts.

Response: The risk assessment does state that terrestrial and aquatic life appear to be productive and improving from past years with the re-establishment of ground dwelling animals (based on communications with Montana Department of Fish, Wildlife and Parks personnel). Chronic effects on individuals of a species is a potential. However, it is unlikely they would be measurable even if costly studies had been performed. Impacts to terrestrial organisms are difficult to determine unless they are acute or cumulative. However, chronic aquatic life criteria have been and continue to be exceeded for selected contaminants. This has been identified as a problem at the ponds, which could impact downstream aquatic life. Also identified as a potential future impact to downstream aquatic and terrestrial life is a natural disaster that may result from a breach of the dams and subsequent release of tailings and contaminated waters.

5.0 COMPARISONS TO ARARS

1. Comment: This comment states that compounds that affect the odor, color and taste of groundwater under the site are unrelated to the location of the ponds.

   Response: The presence of particulates, iron and other compounds responsible for discoloration and odor in groundwater below the site are a result of the presence of contaminants in the ponds.

2. Comment: This comment states that MCLGs should not be used in comparison to groundwater under the site as they are nonenforceable health goals.

   Response: MCLGs are concentrations of contaminants in water, which would result in no known or anticipated adverse health effects, with an adequate margin of safety to protect sensitive subpopulations. These goals are strictly health based and their comparison to groundwater quality under the site is appropriate. Their regulatory status has no relevance to their use as a comparison to water quality at the site.

3. Comment: This comment states that ARCO agrees with the statement made in the risk assessment that surface water at the site cannot be construed as a drinking water source.

Response: Comment noted.

4. Comment: This comment states that use of an assumed value for hardness (100 mg/l) for use in comparing hardness dependent criteria with measured values is inappropriate.

   Response: An assumed value of 100 mg/l hardness was used to calculate hardness dependent criteria for use in comparing a criteria to a sample value for high flow data. High flow data were the only samples in which hardness was not measured. Because spring high flow is primarily due to snow melt runoff, a value of 100 mg/l hardness is not unreasonable as hardness values for snow melt runoff are typically 50 to 60 mg/l (Heinle, 1990). The average measured hardness of all-flow data was below 200 mg/l, except for waters that are limed. Thus, the use of 100 mg/l hardness is appropriate.

5. Comment: This comment requests that ambient water quality criteria for protection of aquatic life for arsenic be removed from the risk assessment, as ARCO believes it is not valid based on current information.

   Response: The freshwater aquatic criteria for protection of aquatic life for arsenic was revised in 1985. The criteria remain in effect until revised criteria are published in the Federal Register. A 1988 document (U.S. Fish and Wildlife Service, 1988), recommends a revision downward as adverse effects on aquatic life have been demonstrated at concentrations well below the current chronic criteria of 190 $\mu g/l$.

6. Comment: This comment states that comparisons between water quality criteria and water quality as measured within the ponds are not valid as the ponds are not classified as water bodies under the state.

   Response: Comparisons between ambient water quality criteria for freshwater aquatic life and water quality as measured within the ponds are appropriate as the ponds support aquatic life and release water to the river. The classification as a water body under State law has no bearing on the surface water quality and its ability to support aquatic life in the ponds and the ponds influence on downstream aquatic life. Comparisons are valid and reasonable in the context of the risk assessment.

7. Comment: This comment questions the comparison of concentrations of arsenic detected in waterfowl breast tissue with FDA allowable levels of arsenic in swine muscle.

   Response: Specific FDA allowable levels of arsenic or other contaminants in edible waterfowl tissue were not available for comparison to the concentrations detected in waterfowl at the ponds. The purpose of the comparison was to have a reference point for what is allowable by regulation in edible animal tissue with concentrations of contaminants detected in edible tissue from waterfowl at the site. The MDHES agrees the comparison may not be appropriate.

6.0 HUMAN RISK CHARACTERIZATION

6.1 TOXICITY ASSESSMENT

6.1.1 Arsenic Toxicity

1. Comment: This comment states that the risk assessment overestimated the carcinogenic risk through exposure to arsenic by not adjusting the estimates downward by an order of magnitude.

   Response: See response to Chapter 3, Section 3.3.1, Comment 2. At the time of the assessment, the published cancer potency factor (CPF) for arsenic was 15 $(mg/kg\text{-}day)^{-1}$. This CPF was adjusted to 1.5 $(mg/kg\text{-}day)^{-1}$ for use in the risk assessment. It has been further adjusted to 1.65 $(mg/kg\text{-}day)^{-1}$ to reflect current EPA estimates.

2. Comment: This comment discusses the nonlinearities in the dose-response curve for arsenic.

   Response: The Risk Assessment Forum of EPA has carefully considered the available evidence on the epidemiology, metabolism, and genotoxicity of arsenic and its possible significance in the derivation of a cancer slope factor (EPA, 1988). All of the data reviewed by the Science Advisory Board (SAB) were available to the Forum, including the studies of Vahter and Valentine. Based on its review, the Forum concluded:

   > "While consideration of these data on the genotoxicity, metabolism, and pathology of arsenic has provided information on the possible mechanism by which arsenic may produce carcinogenic effects, a more complete understanding of these biological data in relation to carcinogenesis is needed before they can be factored with confidence into the risk assessment process."

   As more extensive data are developed on the toxicokinetics of arsenic metabolism, the mechanism of arsenic genotoxicity and carcinogenesis, and the potency of organic and inorganic forms of arsenic, these factors may be incorporated into the risk assessment for arsenic as suggested by the SAB. Until that time, it is believed that the cancer slope factor derived by the Risk Assessment Forum is the most appropriate value from the data currently available.

   Absence of observable increases in skin cancer rate in the U.S. populations (e.g., Wong et al. 1988) is not sufficient evidence that the slope factor is inappropriate, since the statistical power of these studies is too low to detect the small increases in skin cancer in the exposed populations that are predicted based on the Tseng study. Also, opinions of individual EPA staff members need not be the same as the consensus developed by the Risk Assessment Forum.

Comment: This comment continues with a discussion of differences in factors crucial to arsenic methylation and carcinogenicity between the Taiwanese population and the U.S. population. It further states that methylation detoxifies arsenic, and the potency factor for arsenic should be altered to account for these factors.

Response: Although studies in animals have shown that diets deficient in choline, methionine or protein may decrease methylation activity (Vahter and Marafante, 1988) there is no direct evidence that the Taiwanese population studied by Tseng had abnormal methylating capacity. Simply because the Taiwanese diet contained less protein and more carbohydrate than the typical U.S. diet does not show that intake of methyl donors (choline, methionine) was inadequate to support normal methylation activity. Also, there is no direct evidence that the Taiwanese population was exposed to significant levels of arsenic from nonwater sources. It should also be noted that even if the Taiwanese did have a lower "saturation point" than 200 to 250 μg/day this would only have a small effect on the dose response curve since the average daily doses for the three exposed groups were about 600, 1600, and 2,800 μg/day (based on intake of 3.5 l/day by males). Thus, the "effective" dose to a population with a "saturation" point of 200 μg/day would be about 400, 1,400, and 2,600 μg/day, while the "effective" dose to a population with 50 percent of this methylation capacity (i.e., a "saturation" point of 100 μg/day) would be 500, 1,500, and 2,700 μg/day. Slope estimates from these two populations would be very similar to each other.

While these considerations are acknowledged as possible sources of uncertainty, they do not justify quantitative revision of the cancer slope factor. If any effort were to be attempted to adjust for differences in methylating capacity between the Taiwanese population and the U.S. population, the approach suggested by ARCO is not appropriate. Such an adjustment would require specific data on the relative methylating capacity (V_{max}, K_m) between the Taiwanese population and the U.S. population, not simply a comparison of percent methylation at low dose and high dose based on the populations studied by Vahter.

3. Comment: This comment requests that the nonlethality of arsenic induced cancer be considered in the decisions regarding arsenic at the site.

Response: See response to Chapter 3, Section 3.3.1, Comment 1. MDHES recognizes the nonlethality of arsenic induced cancer. The risk assessment is not the correct forum for risk management decisions.

4. Comment: This comment discusses the bioavailability of arsenic and indicates that risks in the FS are overestimated by using 100 percent absorption.

   Response: The MDHES agrees that bioavailability of arsenic (and other metals) is a relevant issue, and that metals in soil may be less bioavailable than metals dissolved in water. However, bioavailability is a site-specific term that depends on the physical and chemical form of the arsenic and on the nature of the soil at the site. Thus, detailed site-specific physical-chemical data and or site-specific tests of bioavailability are needed in order to estimate this parameter. Arsenic speciation was not evaluated in soils or sediments at the site. In the absence of such data, it is necessary and prudent to assume that arsenic in soil is as bioavailable as the form of arsenic involved in those studies used to derive the oral and inhalation slope factors. If "continuing investigations" provide convincing data to justify a reduction in bioavailability, EPA will consider this and act accordingly. In the meantime, it is not appropriate to use an absorption fraction of 50 percent to account for bioavailability for several reasons. First, the data cited do not indicate that humans absorb only 50 percent of ingested inorganic arsenic, only that 50 percent is excreted in the urine. Indeed, most studies suggest that humans absorb nearly all ingested inorganic arsenic (EPA, 1984b). Second, the results of the pilot study (Johnson et al. 1989) are based on only one animal per test group, and clearly are not adequate to establish 10 to 20 percent as a reliable estimate of arsenic uptake from soil. Moreover, it is not clear that the soil sample selected for study is representative of the sediment of . Also, the relevant data item is not how much is absorbed per se, but the ratio of the gastrointestinal absorption of arsenic in sediment from compared to the gastrointestinal absorption of arsenic in the water consumed by the Taiwanese population studied by Tseng.

6.1.2 Lead Toxicity

1. Comment: This comment questions the methodology used in the derivation of clean-up levels for lead in soils. Specifically, it questions the 500 to 1,000 ppm recommended target cleanup level for Superfund sites.

   Response: See response to Chapter 3, Section 3.3.1, Comment 2. EPA believes that the method suggested by ARCO has merit. However, the ARCO suggested method is dependent upon the input parameters used (as all models) and the values selected by ARCO for use in the model are debatable and not conservative.

   Comment: This comment continues with a presentation of a figure (A6-1) that relates a soil concentration of 10,000 ppm to a 25 μg/dl blood lead.

   Response: Figure A6-1 is incorrectly characterized both here and in its legend as presenting the relationship between soil lead concentration and blood lead in the upper 95th percentile. In fact, Figure A6-1 shows the slope for blood lead in the geometric mean (50th percentile, N=0) population, but the zero soil lead intercept (background blood lead) appears to be the upper 95th percentile (3.98 μg/dl). As stated correctly by ARCO elsewhere, using their parameters, a soil level of 6,000 ppm, but not 10,000 ppm corresponds to 25 μg/dl for the upper 95th percentile.

Comment: This comment continues by stating that the Integrated Uptake/Biokinetic (IU/BK) model used by EPA to estimate cleanup levels for lead can be modified to reflect parameters used in the SEGH method. Further, this modified IU/BK model can be used to validate the SEGH model with gastrointestinal absorption factors included.

Response: The EPA believes that the IU/BK model is basically sound and has used this model in a number of instances. The form of the model presented by ARCO is in error because the partitioning of a daily soil ingestion rate among indoor dust and outdoor soil assumes that soil ingestion occurs at a constant rate throughout 24 hours. It is more appropriate to use the time spent outdoors as a percentage of waking hours or perhaps playing hours, but even this is overly simplistic.

It is also important to note that: (1) in the form of the equation presented here, with gastrointestinal absorption explicitly included, the biokinetic slope factors must be in the units of μg/dl per μg/day absorbed (EPA 1989c, p. IV-9), and (2) the absorption and slope factor terms may be a complex function of age, nutritional status, background blood lead level, etc. (EPA, 1989c, p. A-18, p. IV-6).

As for the SEGH model, the results of the equation are very dependent upon the input parameters used and the data needed to apply the IU/BK model are essentially the same as needed for the SEGH model. However, the IU/BK model predicts blood lead levels as a function of soil lead levels, but this is not sufficient to establish soil cleanup levels. It is by no means clear that the IU/BK model can validate the SEGH model or is any more appropriate than the SEGH model in instances where site-specific data are insufficient.

2. Comment: This comment questions the range of slopes relating soil/dust lead concentrations to blood lead levels presented in the FS (0.6 to 6.8 μg/dl per 1,000 ppm increase in soil/dust lead) and discusses the bioavailability of lead.

Response: The FS statement concerning the wide range in slopes (0.6 to 6.8) relating soil/dust lead concentrations to blood lead levels correctly summarizes the findings of a number of studies, as described in EPA (1986b, p.11-151). ARCO's statement that slopes at mining and smelting sites are at the low end of this range is not correct, since the slope of 6.8 is from a reliable study at a smelter site (Angle and McIntire 1982). Based on available data, EPA (1989c) has concluded that a slope of 2.2 is a reasonable average value, and that a slope of 6.8 is a reasonable upper bound (p. V-10). ARCO states that the slope at mining sites is about 2, and that lead in soil at mining sites is less bioavailable and has less influence on blood lead levels than at nonmining sites (smelters, other urban areas). If so, this implies that a slope higher than 2.2 could be appropriate at smelter and other nonmining sites. This would be consistent with the fact that the slope calculated from toxicokinetic parameters is about 5, and that empirical estimates are expected to yield lower-than-actual slopes due to the effects of confounding factors (EPA, 1989c, p. V-14).

ARCO states that Gradient Corporation analysis identified slope factors from two studies of mining sites. However, concerning the Park City Utah study, Gradient states: "Because no soil lead concentrations are available for individual children, a slope value cannot be calculated." Thus, this slope of 1.8 is completely undocumented. The other cited mining study, from Telluride Colorado (Bornschein et al. 1988), presents a slope of 3.7 for soil lead values between 100 and 1,000 ppm and a slope of 2.2 for soil lead values between 500 to 1,000 ppm. Thus, in agreement with other studies, the calculated slope depends upon the soil lead concentration, among other factors. The cited Bornschein et al. (1988) slope of 2.2 for 500 to 1,000 ppm is in fact the average value for the disaggregate slope suggested by EPA (1989c), based on Stark et al. (1982). However, this agreement is coincidental and does not indicate that there is a single value for this slope that can be used without uncertainty.

3. Comment: This comment questions a statement in the FS that blood lead levels of 10-15 μg/dl are of concern in young children.

   Response: The statement made in the FS is accurate; ARCO is incorrect in stating that blood lead levels of 10-15 μg/dl are not of concern in children. Such concern can be found even in the selected references cited by ARCO:

   1. David and Svendsgaard (1987). This review summarized studies linking prenatal lead exposure with adverse outcomes, but did not, as implied by ARCO, dismiss concern about postnatal exposure. The conclusions of this paper were: "There can now be little doubt that exposure to lead, even at blood levels as low as 10-15 $\mu g\ dl^{-1}$ and possibly lower, is linked with undesirable developmental outcomes in human fetuses and children" (p. 299).

   2. Bellinger et al. (1989). ARCO selectively summarized the results of this study for middle-class children. These investigators found that prenatal exposure above 6 μg/dl and postnatal blood levels higher than 10 μg/dl were associated with neurological deficits in lower-class children.

   3. Chaney et al. (1989). [Cited by ARCO on p. A-22 and p. 16 of Attachment 4.] This article states "...the mean Pb-B of children 0.5 to 5 year olds in 1976-1980 was greater than 15 μg/dl, the level currently believed

to be at or above the threshold for adverse effects of ingested Pb on neurologic development of children" (p.123). This article also concludes "We interpret these data that soil must be less than or equal to 150 mg Pb/kg in order to prevent excessive Pb absorption in children."

Thus, although it may be correct that fetuses are more sensitive than infants and children to a given blood lead level, it is certainly not correct to characterize 25 μg/dl as a "health protective blood lead level" (ARCO Attachment 6, p. 3 and p. ES-8) for infants and children. Furthermore, ARCOs reliance on the Centers for Disease Control (CDC) guideline of 25 μg/dl is inappropriate for two reasons. First, the CDC did not identify this as the no-effect level, but as the level of sensitivity of the erythrocyte protoporphyrin (EP) screening test which utilizes capillary blood. The CDC stated: "Although the biologic threshold for lead toxicity, as manifested by increasing EP levels, is less than 20 μg/dl, the criteria for a screening program have to take into account additional factors: (1) acceptability, sensitivity, and specificity of the screening procedure; (2) cost-effectiveness; and (3) the feasibility of effective intervention and follow-up" (DHHS, 1985). Second, this recommendation is five years old and a number of more recent publications have reported effects at PbB levels lower than 25 μg/dl (Bellinger et al. 1989; Fulton et al. 1987; McMichael et al. 1988; Needleman 1989). The Clean Air Scientific Advisory Committee to EPA concluded that blood lead levels of 10 to 15 μg/dl in children are associated with the onset of subtle biomedically adverse effects (ATSDR, 1988). Indeed, the CDC is currently considering a downward revision of their guideline. Although there is no consensus among researchers, many investigators believe that if a target blood lead level for children were to be selected, it would be 10 μg/dl or lower.

The MDHES agrees that in principal, adults (including pregnant women) would in many instances receive a lower dose of lead at a given soil level than would children. However, quantitative evaluation of the magnitude of the difference is not possible with current data, and the 6.5 fold factor cited by ARCO cannot be evaluated because it is based on a personal communication from Bornschein or coworkers in 1989. ARCO's quantitative conclusion that a soil lead level that protects young children will also protect fetuses goes beyond currently available data.

4. Comment: This comment disputes the FS presentation of background blood levels in United States children of 16 μg/dl.

Response: The baseline blood lead level is indeed dropping in the United States and EPA has estimated that the geometric mean blood lead level for 2-year-old children in 1990 will be 4.2 to 5.2 μg/dl (EPA, 1989c). The following attempt was made to replicate the value of 2.24 μg/dl due to nonsoil sources based on the description of the method provided by ARCO. The following is a summary of the steps involved in that attempt.

1. Table 5-1 of EPA (1989c, p. V-9) was used as the basic source of numbers.

2. Values in that table for ingested dust and inhaled air were dependent upon the air lead content and the lowest air content in the table was 0.25 μg/mg/m3. Since ARCO stated that a site-specific value of 0.1 μg/m3 ambient lead was used (Attachment 6, p. 3), corresponding levels for ingested dust (0.6) and inhaled air (0.2) were extrapolated from the table.

3. Corresponding totals were 1.9 for nonsoil/dust and 0.7 for soil/dust sources, or a 73 percent contribution from nonsoil/dust sources.

4. The geometric mean of 4.2 and 5.2 μg/dl was calculated (4.67 μg/dl) and multiplied by 73 percent to yield 3.42 μg/dl as a background lead level. This value is more than 50 percent higher than the value provided by ARCO.

5. The upper 95th percentile background using a geometric standard deviation of 1.42 was calculated to be 6.1 μg/dl.

Thus, although baseline blood lead levels are declining in the United States, these calculations illustrate that sufficient information is not presently available to make a quantitative evaluation of the appropriate value.

6.2 MECHANISMS OF QUANTIFYING RISK

No comments.

6.3 RISK ESTIMATES

Comment: This comment disputes the conservative nature of the risk estimates provided in the FS.

Response: Estimates of risk are, in general, conservative. EPA has determined this is an appropriate approach for protection of the public health. As several responses have shown, when intake assumptions or exposure factors are altered, little change in the risk results.

Risk estimates between 10^{-4} to 10^{-7} are not considered "acceptable" by EPA, but rather a target risk range.

7.0 ENVIRONMENTAL RISK CHARACTERIZATION

7.1 QUALITATIVE ENVIRONMENTAL RISKS

Comment: This comment implies the environmental assessment fosters misconceptions about actual environmental risks.

Response: The risk assessment does not present misleading information. The description of a potentially stressed ecosystem does not state nor imply that these conditions are occurring at the ponds. No data are available on the status of the ecosystem at the ponds with which to determine if any adverse conditions currently exist. From all outward appearances, the ecosystem of the ponds is stable and improving. However, subtle effects cannot be ascertained by casual observation, and lack of data prevents accurate prediction of future effects.

As has been previously stated, the risk assessment did not imply that bioconcentration of metals in fish and algae is unique to the ponds.

Lack of diversity in an aquatic ecosystem is commonly associated with stressed conditions. MDHES agrees that many explanations are possible. No data exist with which to evaluate this condition.

8.0 UNCERTAINTIES AND LIMITATIONS

Comment: This comment states that assumptions and parameters used in the risk assessment exhibit a bias toward overestimating the risk.

Response: It is EPA policy to provide conservative estimates of risk in order to protect the public health. The risk estimates are provided as a range of values, with the maximum plausible intending to provide an upper bound that actual risk will not exceed.

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APPENDIX B

RESPONSES TO ARCO COMMENTS APPENDIX B, DETERMINATION OF ARARs

1. Comment: ARCO has outlined a variety of sources and methods for analyzing ARARS, and has given definitions of key terms used in ARAR analysis.

Response: Attachment 1 to the Record of Decision contains the final list of applicable or relevant and appropriate cleanup standards, standards of control, and other substantive requirements, criteria, or limitations (ARARs) for the Record of Decision, as well as a list of documents or other sources of information which are To Be Considered during the remedy selection or during implementation of the remedy. EPA has identified the list based upon the statutory provisions addressing ARARs found in CERCLA, particularly section 121(d) of CERCLA, 42 U.S.C. §9621(d); the new National Contingency Plan, 40 CFR Part 300 (1990); the preambles to the proposed NCP and the final NCP, 53 Fed. Reg. 51394 _et seq._ (December 21, 1988) and 55 Fed. Reg. 8666 _et seq._ (March 8, 1990) respectively; EPA guidance documents regarding ARARs entitled "Compliance With Other Laws Manual: Parts 1 and 2" (OSWER Dir # 9234.1-01 and 92341.02 respectively).

Definitions for "applicable" and "relevant and appropriate" are now promulgated in the new NCP, 40 CFR § 300.5. Those definitions are used by EPA in its identification of final ARARs. Discussions of "substantive", "administrative", and "promulgated" occurs in the preambles to the proposed and new NCP, and in the ARAR guidance. All of those discussion were used by EPA in its identification of the final ARARs.

2. Comment: Comments found on pages B-2 - B-9 of ARCO's comments, addressing general ARAR issues are responded to in the responsiveness Summary, Chapter 3.

Comments on Action Specific ARARs

A. Surface Water

3. Comment: ARCO disagrees with the identification of the State's nondegradation statute and regulations, MCA § 75-5-303 and ARM § 16.20.702, because it is a general policy, and because it applies only to new sources and is not relevant and appropriate.

Response: Statutes and regulations that contain general goals can be ARARs, if they are directive in intent and promulgated. Non-degradation statutes such as this one are specifically cited by EPA as probable ARARs, even though they may be characterized as general goals. 55 FR 8746 - 8747, 53 FR 51438.

EPA agrees that the nondegradation statute is not applicable to the site, because the statute addresses new sources of water pollution. However, the statute is intended to regulate pollution to the same medium as this cleanup (water), addresses the same substances and activities, places, and structures (pollution from point sources), and is generally designed to protect human health and the environment from unnecessary pollution. It is therefore relevant and appropriate for the site and this cleanup action.

EPA notes that compliance with the specific numeric standards established for the point source discharge and ambient water at the site will achieve compliance with this ARAR.

4. Comment: Water quality standards and federal water quality criteria, or numeric standards from the Safe Drinking Water Act and the Montana Public Water Supply Act for human health should not be identified for the surface water ARARs, because the Clark Fork River is not designated as a drinking water source. Instead, only standards and criteria for protection of the aquatic environment, or protection for humans who eat fish should be used.

Response: The State of Montana has adopted all Gold Book Criteria, including criteria protecting public health, as applicable water quality standards for the Clark Fork River, Mill Creek, and Willow Creek, among other surface water bodies within the State. The adoption of those standards is not dependent on the designated use of the particular stream. Therefore, the Gold Book Criteria values for protection of human health through ingestion are the applicable standards for the site surface water outside of the Ponds, and for the discharge from the Ponds into those surface waters.

ARCO's citations to EPA guidance and preamble language discussion of this issue are addressed to determining when to use federal water quality criteria as relevant and appropriate requirements. As the same preamble discussions and the guidance make clear, when state water quality standards exist for a given site, and they are equivalent to or more stringent than the federal water quality criteria, those applicable standards should be identified. 55 FR 8754 - 8755.

Additionally, both Mill and Willow Creeks, which will run through the Bypass, are designated as potential drinking water sources. Therefore, identification of the drinking water standards from the Gold Book Criteria for this action is appropriate.

MCLs for drinking water are not as stringent as the State's standards. Therefore, the identification of those standards here is a moot issue. EPA and MDHES reserve the right to identify these standards for surface water bodies in the Clark Fork Basin, as appropriate.

As a practical matter, use of these contested standards does little to change the final selection of numeric standards for the discharge or for the surface water compliance point. Only arsenic and mercury standards for drinking water are below the standards for aquatic or fish consumption. Both of those standards are waived as for this action, and higher replacement criteria identified.

5. Comment: Point source discharge requirements for the Pond 2 discharge should not be set at water quality standards. Instead, site specific criteria and other factors outlined in ARM s^{s}§s^{s}§ 16.20.622 and 16.20.631, and the mixing zone discussed at 16.20.634, should be sued to set discharge limits which will meet water quality standards in the ambient water.

Response: The factors cited by ARCO may be used to set a point source discharge, but their use is not mandatory. The MDHES Solid and Hazardous Bureau consulted with the MDHES Water Quality Bureau, who is the agency assigned with the administration of the Water Quality Act, and the factors outlined by ARCO were determined to be inappropriate. Using the appropriate water quality standards as the end-of-pipe point source discharge was determined to be the appropriate way to ensure that ambient water quality standards will be met at the beginning of the Clark Fork River, since the point source discharge from Pond 2 will be a primary source of water to the Clark Fork River. This will also protect the waters within the Bypass, where sensitive fish populations and hatcheries are likely to exist.

6. Comment: The point source discharge standards established at 40 CFR Section 440.104, and discussed at ARM s^{s}§ 16.20.631 are not relevant and appropriate or applicable to the conditions found at the Warm Springs Ponds operable unit.

Response: These standards are not applicable to the discharge, but EPA continues to believe that the standards are relevant and appropriate. The standards are developed for mining and dressing effluent from copper, lead, zinc, gold, silver, or molybdenum ores. These contaminants are the same contaminants found at the Warm Springs Ponds and other operable units with the Clark Fork Basin project. In addition, the technology on which these standards were developed is essentially settling and treatment, which is similar to the Warm Springs Pond system. Therefore, the standards are relevant and appropriate for the Warm Springs Ponds system.

These standards are less stringent that the water quality standards for the Pond discharges discussed earlier. Therefore, the water quality standards are the only point source discharge standards listed in the final list of ARARs.

7. Comment: Monitoring and reporting requirements set forth in 40 CFR s^{s}§ 122.41 and best management practices of 40 CFR s^{s}§ 125.100 are not ARARs, because they are not substantive requirements.

Response: Monitoring requirements are not administrative, but substantive. 55 FR 8757. Best Management practices too are substantive requirements, which are similar to action specific ARARs and will ensure compliance with the numeric limitations of the Pond 2 point source discharge. Therefore, these remain as identified ARARs.

As noted elsewhere, the point source discharge from Pond 2 should continue to be subject to the existing MPDES permit. That permit, which will correspond with the identified

ARARs, including the best management practices and the monitoring requirements, will ensure approriate monitoring and reporting for the Pond discharge.

B. Ground Water

8. Comment: A mixing zone should be established to determine the ground water point of compliance, and the appropriate point is at the property boundary rather than the waste unit boundary.

Response: Granting a mixing zone for ground water compliance is entirely within the discretion of the administering agency, under State law, ARM s^{s}§ 16.20.634. EPA, in consultation with the MDHES, has determined that such a zone would not be appropriate here, because the ground water below the Pond 1 waste unit should be available for public use and other uses, and because establishing the point of compliance at the waste unit boundary rather is consistent with current EPA guidance.

9. Comment: MCA s^{s}§ 85-2-504 should not be an ARAR because it is a general statute from a non-environmental statute.

Response: EPA agrees that this statute is too general to be considered an ARAR.

10. Comment: MCA s^{s}§ 85-2-505 should not be an ARAR because it is a general statute from a non-environmental statute.

Response: This statute establishes certain directive conditions concerning the drilling of ground water wells, to protect the spread of contamination during construction of a well. This is obviously addressed to prevent pollution and contamination, and is therefore an environmental standard. Ground water wells will be required at the site, to measure compliance with the ground water standards. Therefore, these requirements are applicable requirements to any drilling which must occur at the site during or after remedial action.

11. Comment: Ground Water Pollution Control Regulations and standards, which incorporate federal MCLs, should not be ARARs for ground water, because there is no public water supply system in the area, and because use of the aquifer as a ground water supply is unlikely.

Response: The State has classified the aquifer at the operable unit as a Class II aquifer, potentially suitable for public use. This classification corresponds with EPa guidance, which directs that potentially usable aquifers should be restored to potential use as part of Superfund cleanups. EPA's guidance is based upon Congress' clear concern for the protection of ground water, as evidenced in CERCLA and other environmental laws. Therefore, MCL standards are identified as the relevant and appropriate ARARs for the site. EPA agrees that these standards are not applicable.

12. Comment: The State's nondegradation regulations and statute are not ARARs because they are general goals, and because the aquifer is not likely to be used, and because the aquifer is already degraded.

Response: Statutes and regulations that contain general goals can be ARARs, if they are directive in intent and promulgated. Non-degradation statutes such as this one are specifically cited by EPA as probable ARARs, even though they may be characterized as general goals. 55 FR 8746 - 8747, 53 FR 51438.

The State interprets its statute to be applicable here, because it prevents the spreading of existing plumes of groundwater plumes, as well as the creation of new plumes. EPA defers to this interpretation by the State. EPA notes that compliance with the MCL standards identified for this action will result in compliance with these ARARs.

As previously explained, this aquifer is potentially usable as a drinking water source, and should be cleaned up to appropriate standards.

C. Air

13. Comment: MCA s[s]§ 75-2-102 is a general policy statement that should not be an ARAR.

Response: This statute is direct in nature, in part, and is appropriately identified as an ARAR.

14. Comment: Lead and PM-10 ambient standards should be identified as federal standards, using appropriate 40 CFR Part 50 citations, rather than state citations, because the State standards are not more stringent.

Response: When State programs are delegated or authorized, the appropriate citation should be to the State standard, although the ARAR is considered to be a federal ARAR. 55 FR 8742. Attainment with these ARARs will be determined by the methodologies described in 40 CFR Part 50, since these are the most definitive and up-to-date methods available.

15. Comment: The standards for sulfur dioxide and particulate matter found at 16.8.925 are not ARARs, because they were formulated for major stationary sources, and no such source is expected or present at the operable unit.

Response: EPA agrees with this comment, and has dropped these standards from the final list.

16. Comment: MCA s^s§s^s§ 50-70-102 and 113 are general policies which should not be ARARs.

Response: EPA agrees that section 102 is general and should not be an ARAR. EPA believes section 113 is directive and specific in nature, and should be retained. Section 113 is implemented by specific numeric limitations found at cited regulations.

17. Comment: State regulations pursuant to the State's health Noise and Air Contaminant Regulations are not part of an authorized program, and should not be state ARARs.

Response: EPA agrees that the State's OSHA equivalent program has not been approved and authorized, and is therefore not more stringent, where the State standards are duplicative of the federal OSHA standards. For those standards, EPA has identified the federal regulations and standards. However, the State has promulgated occupational health standards for lead and arsenic that are not duplicated by the federal program. These standards are applicable standards, are more stringent than federal standards, and are identified as State standards in the final list.

EPA notes that nose regulations do not address contaminants, pollutants or hazardous substances, and are therefore not ARARs, in a strict sense. Those State standards are listed in the other laws section of Attachment 1, and should be complied with during the remedial action implementation and thereafter.

II. Location ARARs

18. Comment: MCA s^s§s^s§ 76-5-102 is a general goals statute,and should not be considered an ARAR.

Response: This section is directive in nature, and is identified as an ARAR. This approach is explained above.

19. Comment: Only substantive portions of MCA s^s§ 76-5-402 are ARARs.

Response: EPA agrees with this comment.

20. Comment: MCA s^s§s^s§ 76-5-1101 and 1102 are general goals which should not be ARARs, and is administrative in nature.

Response: These statutes are of a directive nature, and are therefore legitimate ARARs. EPA agrees that only substantive portions of the statutes are ARARs.

21. Comment: Only substantive portions of ARM s^{s}§ 36.15.216 are ARARs - administrative and permit requirements should not be identified as ARARs.

Response: EPA agrees with this statement. Only substantive requirements of this regulation are identified.

22. Comment: Only certain portions of ARM s^{s}§ 36.15.606 should be identified as relevant and appropriate.

Response: EPA believes that all portions of the regulation are relevant and appropriate, because they address situations similar to the situation at the Warm Springs Ponds, namely strengthening Pond 3 to hold a 100 year flood flow, and doing appropriate reconstruction of the Mill-Willow Bypass. It should be noted that the ROD is expected to comply with this provision, as currently understood and designed.

23. Comment: Only substantive portions of ARM s^{s}§ 36.15.801 are substantive and therefore ARARs.

Response: EPA agrees with this statement, and has identified only substantive portions of this regulation as ARARs.

24. Comment: MCA s^{s}§ 75-7-102 is a general goal and should not be an ARAR.

Response: This section is directive in nature, and is a valid ARAR, as explained above.

25. Comment: ARM s^{s}§ 36.2.404 should not require a permit for this action, pursuant to the permit exemption of section 121(e)(4) of CERCLA.

Response: EPA agrees that the permit exemption applies to berm strengthening, and permit requirements should not be identified as ARARs. These criteria have been identified as TBCs, to aid the agencies in evaluating this project as it proceeds through the RD/RA process.

26. Comment: MCA s^{s}§ 87-5-501 is a general policy that should not be an ARAR.

Response: EPA agrees with this comment and has not identified this as an ARAR in the final list.

27. Comment: Only the substantive portions of federal locations specific requirements should be ARARs.

Response: EPA agrees that only substantive requirements emanating from the location specific requirements described in the FS are ARARs. However, EPA described the consultation processes for these statutes in the FS, to demonstrate how it would identify substantive requirements for location-specific ARARs. See section 7 of the response to comments, Chapter 3. The final ARARs list identifies substantive requirements only for these ARARs.

III. Action ARARs

A. Dam Construction

28. Comment: MCA s^{s}§s^{s}§ 85-15-207 and 208 are general policy statements and should not be ARARs.

Response: These statutory provisions are directive in nature, and are included as ARARs in the final list.

29. Comment: ARCO agrees that ARM s^{s}§ 36.14.501 is an ARAR.

Response: This key ARAR is listed in the final ARAR list. All berms within the operable unit are classified as high hazard, and this ARAR is applicable to all of them. The most important portion of this provision is the need to strengthen berms to the MCE standard.

30. Comment: ARCO agrees that s^{s}§ 36.14.502 is an ARAR.

Response: This key ARAR is listed in the final list. Upon further review of this ARAR, and further consultation with the Department of Natural Resources and Conservation, who administers the Dam Safety Act and its regulations, it has been determined that the provision will require all berms within the operable unit to meet the 0.5 PMF standard. This is based on the inflow design flood expected for the Ponds, and the fact that the Ponds are in a series, and therefore the highest standard must be applied to all three.

31. Comment: Revegetation and reclamation requirements identified by the State, pursuant to the Strip and Underground Mine Act and implementing regulations, are not relevant and appropriate, because the use of those standards, designed to address coal and uranium mine reclamation, is not well suited to the characteristics at the Warm Springs Ponds operable unit.

Response: The current ROD will require excavation of some contaminated soils, sediments, and tailings (within the Mill-Willow Bypass and elsewhere), consolidation of that material into two disposal facilities, and covering of certain contaminated soils and sediments in place with appropriate clean fill. All of these area are subject to the revegetation requirements identified by the State.

The contaminated soils, sediments, and tailings at issue within this operable unit are the result of several years of downstream transport of metals ore mining in Butte and Anaconda, including processing, bonification, and extraction waste. The Ponds and surrounding areas are similar to settling ponds used in the mining industry to capture and separate contaminants from waste water, before that water enters a surface water body.

EPA has compared the site activities and conditions with the regulations cited by the State, using the criteria found at
40 CFR s^{s}§ 300.400(g)(2). The SUMRA regulations purpose is to ensure that revegatation and reclamation activities are done in such a manner that they are permanent and long lasting, such that cover of mining wastes remains despite adverse weather conditions or other factors. That is also the purpose of this Superfund remedial action - to provide permanent protection against the further release of contaminants found at the site, especially those located in the disposal area. The substances addressed by the requirements is different than that found at the site (coal and uranium waste as opposed to hard rock mine waste), but the substances are not unrelated. Both concern metals contamination as opposed to organic chemical contamination, and both seek to protect against phytotoxic effect and human health exposure. Both the regulations and the Superfund cleanup regulate reclamation and revegetation after mining disturbance, and both concern soils replacement. Both look to restor the affected area to the fullest possible post-mining use, such as human exposure and wildlife habitat.

Therefore, EPA has concluded that these requirements are relevant and appropriate, and has listed many of the requirements identified by the State in the FS in the final ARAR list.

EPA has examined this issue carefully, and has dropped certain of the State's identified ARARs in this area. These include general policy statements, administrative requirements, and standards which did not fit sensibly in applying the standards to the planned cleanup.

32. Comment: MCA s^{s}§s^{s}§ 75-5-101 and -605 are general policy statements that should not be ARARs.

Response: EPA agrees with this statement, and has dropped these requirements from the final ARAR list.

33. Comment: The point source discharge from Pond 2 of the Warm Springs Pond operable unit should not be subject to a continuing permit pursuant to the State's Water Quality Act, because it is an on-site response action exempt from permit requirements, pursuant to section 121(e)(4) of CERCLA, 42 U.S.C. s^{s}§ 9621(e)(4). The discharge should be considered "on-site" even though the discharge will enter waters off of the site eventually.

Response: EPA agrees that the discharge is an "on-site" discharge, but disagrees that the

MPDES permit which has existed for the site for several years should be suddenly discontinued. ARCO correctly points out that EPA's discussions of "on-site" ave specifically described situations such as this, as being on-site despite the downstream transport of contaminants. EPA accepts this rationale, and finds that this point source discharge, and other point source discharges which may be effected or created by Superfund actions along Clark Fork Basin Rivers, are "on-site" and therefore exempt from local, State, and federal permits, as long a substantive standards within ARAR determinations are met.

Neertheless, EPA believes that the existing permit should be continued at the site, in the interest of ensuring adequate monitoring and reporting and in the interest of maintaining consistency within the State's MPDES program.

Therefore, the point source discharge from Pond 2 which will result after completion of this remedial action should continue to be permitted under the State Water Quality Act. Numeric standards for the discharge and other substantive standards are identified in the final ARAR list, and the State's reissued permit will reflect these same requirements. ARCO will be required to apply for the permit in the same manner as any permitted under the Water Quality Act.

34. Comment: ARM s[s]§ 16.20.633 should not be an ARAR because it is a general goal.

Response: Section 16.20.633 is directive in nature, and is therefore an appropriate ARAR. Compliance with the numeric standards for the point source discharge will achieve compliance with this ARAR.

35. Comment: ARM s[s]§ 16.20.904 is not an ARAR because it is administrative in nature.

Response: EPA agrees that this is not an ARAR, but notes, as explained above, that a permit renewal must be obtained by ARCO for the Pond 2 discharge, according to these and other applicable procedures.

36. Comment: MCA s[s]§s[s]§ 75-6-112 is a general policy goal and is not relevant and appropriate, because the Clark Fork River is not a public water supply.

Response: The statute is directive in nature and is therefore appropriate for use as an ARAR. EPA agrees that the Clark Fork River is not designated for public water use, so subsection(1) has been eliminated from the list. However, subsection 2 discusses the discharge of pollutants to any State waters, and therefore its proscriptions are relevant and appropriate to this action. Compliance with the numeric standards for the point source discharge will achieve compliance with this ARAR.

37. Comment: ARM s[s]§ 16.20.1016 should not be an ARAR because it is a general policy.

Response: Certain provisions of this regulation are directive and substantive, and are included in the final ARAR list.

38. Comment: ARM s[s]§ 16.44.702 is not relevant and appropriate, because RCRA regulations should not be considered at this site.

Response: As more fully explained below, EPA believes that certain RCRA standards are relevant and appropriate for the site cleanup. Accordingly, EPA has identified the standards at 40 CFR s[s]§ 264.97 only from the 40 CFR Part 264, subpart F regulations as relevant and appropriate here (these standards are incorporated by reference in ARM s[s]§ 16.44.702). Other portions of the subpart F regulations are not identified in the final list. In addition, these standards may be applied at the site in a manner which treats all of the units at the site as one cluster of units. This limited use of RCRA is sensible in view of the ground water contamination problems already present here, and the need for dequate monitoring to determine further ground water contamination from the Ponds, and to monitor compliance with the contamination-specific ground water ARARs identified for this site. These specific requirements are relevant and appropriate for the site.

Montana and EPA Hazardous Waste Management Requirements

39. Comment: ARCO objects generally to the use of any statutes or regulations to from the Montana hazardous Waste Management Act or the federal Resource Conversation and Recovery Act (RCRA) as ARARs as applicable or relevant and appropriate. ARCO contends that much of the waste at the operable unit is bonification or extraction waste, which is specifically excluded from regulation under RCRA by the Bevill Amendment, 42 U.S.C. s[s]§ 9601(b)(III)(A)(ii). Further, ARCO does not think that use of RCRA can be justified at this site as relevant and appropriate requirements.

Response: EPA agrees that RCRA is not applicable to the wastes found at the operable unit. However, EPA believes that certain RCRA requirements as relevant and appropriate requirements applied to certain waste within this and other Clark Fork Basin Superfund sites is warranted.
Use of RCRA standards for mining waste sites is endorsed in the Guidance and in the new NCP. Although EPA has concluded that application of all RCRA requirements to all mining waste across the country is not warranted, and has therefore exempted mining extraction and beneficiation waste from the RCRA Subtitle C regulatory scheme, the guidance and preamble to the new NCP note that this does not the prevent the case-by-case use of some RCRA requirements as relevant and appropriate, if the site conditions warrant it. 55 FR 8763 - 8764; Guidance Part II at 6-4.

At this site, two disposal facilities will be created, and two treatment ponds will be substantially upgraded for continued use. These facilities will contain substantial quantities

of waste, which is contaminated with high levels of arsenic, lead, cadmium, zinc, and copper. The remedial investigation for the site has demonstrated that ground water contamination is already a source of release for these contaminants. The risk assessment for demonstrates that unrestricted exposure to these contaminants would present a risk to human health and the environment. The sudden release of contaminants of this waste into the surrounding rivers has probably caused fish kills, and would cause catastrophic damage to the environment and to human health. EPA believes that these site conditions sufficiently distinguishes the operable unit from the general wastes studied in EPA's RCRA determination document, and that comparison of these conditions to the RCRA statute and regulations discussed below meets the relevant and appropriate criteria given in
40 CFR s^{s}§ 300.400(g)(2).

Given these site conditions, EPA believes it is reasonable and within its discretion to use certain, limited RCRA standards to control operation of the active Ponds, and to ensure adequate disposal of wastes within the two disposal facilities. For the active Ponds, these standards require design to prevent overtopping and to prevent massive failure. 40 CFR s^{s}§ 264.221(f)and (g). For the disposal areas, waste must be drained of free liquids and stabilized, and the facilities must be designed to minimize maintenance, and minimize or eliminate further releases to the ground water or surface waters or the atmosphere to the extent necessary. The dirt cover must be designed to function with minimum maintenance, promote drainage and minimize erosion or abrasion, and accommodate settling and subsidence. This does not require the facilities to be lined with impermeable liners or capped with an impermeable cap, which the normal RCRA closure would require.
40 CFR s^{s}§ 264.228(a)(2)(iii)(B)(C)and (D). Limited ground water monitoring after closure is required as described above. Finally, survey plats to local land use planning authorities, and deed notices must be submitted for the disposal units. 40 CFR s^{s}§s^{s}§ 264.116 and .119. These requirements are but a very small portion of the total number of RCRA operational and post closure requirements which could possibly have been identified, and make sense under the conditions at the site.

Operation and Maintenance plans for this site will need to include appropriate post closure care for the disposal areas. Eventually, the active Ponds will be discontinued as treatment facilities and Silver Bow Creek will be routed directly into the Bypass and the Clark Fork River. Appropriate care and maintenance of the ponds as wetlands and wildlife ponds should be required in the operation and maintenance plans.

EPA notes that specific regulations governing extraction and beneficiation waste disposal and post disposal care are being developed pursuant to Subtitle D of RCRA. Until those standards are promulgated, EPA believes that the use of limited RCRA Subtitle C requirements for certain wastes only is warranted.

Solid Waste Requirements.

40. Comment: MCA s^{s}§s^{s}§ 75-10-202, -212, and -214 are general goals which should not be ARARs.

Response: EPA agrees that sections 202 and 212 are general statements of legislative intent or enforcement provisions, and should not be an ARARs. Section 214 are directive in nature, and are included in the final ARAR list. Only certain provisions of ARM s[s]§s[s]§ 16.44.505 and .523 are listed in the final ARARs list, as relevant and appropriate requirements.

Air Quality Requirements

41. Comment: MCA s[s]§ 75-2-102, and ARM s[s]§ 16.8.1427 should not be ARARs, because they are general in nature or do not address expected conditions at the site.

Response: EPA agrees with this comment and has not included these requirements in the final list. In addition, EPA has not included ARM s[s]§ 16.8.1103 in the final list, because no new or altered sources are expected for this action.

Safety and Health Conditions

42. Comment: MCA s[s]§ 50-71-201 is not an environmental law and is a general statement, and should not be an ARAR.

Response: EPA believes that this provision is addressed to the protection of human health and the environment, at least in part, and is directive in nature. Therefore, it is included in the final list of ARARs.

43. Comment: MCA s[s]§s[s]§ 50-778-202, -203, -204, and -307 are administrative requirements and should not be ARARs.

Response: Substantive provisions similar to action ARARs are included in these statutory provisions, and these requirements have been identified as ARARs in the final list, to the extent they are applicable requirements.

44. Comment: Provision of the Montana Water Development Program Act, the Natural Streambed and Land Preservation Act of 1975, and the Montana Streambed Protection Act which address water rights are not environmental laws, and should not be ARARs.

Response: EPA agrees that these provision do not meet the definitions of ARARs, and has listed them in the Other Laws section of the ARARs list.

45. Comment: Federal Surface Mining Control and Reclamation Act provisions are not well suited to this site, and should not be ARARs.

Response: Use of these standards at CERCLA mining sites is endorsed in EPA's guidance documents. CERCLA Compliance with Other Laws Manual: Part II, pp. 6-1 - 6-3. The requirements are intended to ensure that reclamation and revegetation actions are long lasting and permanent. This is the same purpose as the CERCLA cleanup. For these reasons, the requirements are well suited to the cleanup at this operable unit, and are relevant and appropriate.

46. Comment: The State of Montana's TBC List contains non-promulgated standards, which should not be considered ARARs.

Response: Non-promulgated standards are appropriately listed in the TBC list for consideration by the agencies considering the remedy selection. If promulgated standards do not exist for the listed standards, the TBC standards can be selected as remediation goals for the cleanup. 55 FR 8744. Here, promulgated standards exist^d for the contaminants of concern, and TBC criteria were not selected. EPA and the State will continue to list such criteria, and continue to consider their selection if appropriate.

47. Comment: MCLGs should not be listed, as MCLs are sufficiently protective.

Response: Although EPA's proposed NCP, cited by ARCO, agreed with this position, EPA's final NCP changed this position. Promulgated MCLGs which are not zero will be identified as ARARs at Superfund sites. 55 FR 8750 - 8753. 40 CFR s§ 300.430(e)(2)(i)(B). Here, no promulgated MCLGs exist for the contaminants of concern. Should MCLGs be appropriate for other sites, EPA and the State may list them in final ARARs lists.

48. Comment: The State's non-comprehensive list of other laws is improper, because CERCLA preempts all other laws, and only ARARs should be required for Superfund cleanups.

Response: EPA agrees that CERCLA preempts State and federal environmental or siting laws, and that ARARs are the only method for assertion of these laws at a Superfund cleanup. 55 FR 8741 - 8742. (The State of Montana disagrees with this position). However, it is unclear of the relation of other, non-environmental laws to Superfund cleanups. In the face of this lack of clarity. EPA has listed certain of the State's non-environmental laws which should be complied with during the cleanup. The laws listed should be able to be complied with little difficulty. EPA's listing of these laws in no way prevents EPA from arguing about the exact applicability of non-environmental laws in the future.

EPA agrees that the permit exemption of section 121(e)(4) exempts CERCLA remedial and removal actions from all permits, except as limited in the manner explained above.

APPENDIX C

RESPONSES TO ARCO COMMENTS, APPENDIX C INITIAL SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

1. Comment: This comment notes that nine general response actions were identified in the FS, and asks what the basis was for their identification.

   Response: The nine general response actions were all the general response actions that could be identified as being relevant to the problems enumerated for the operable unit. They were taken from a list of general response actions developed for Superfund feasibility studies. The entire list is included in the left-hand column of Table C-1.

2. Comment: This comment states that increasing the volumes of the ponds was not included as a general response action.

   Response: The comment reflects a misunderstanding of the nature of general response actions. As can be seen by looking at any of the general response actions in Table C-1, they are very general in nature and not so specific as to identify increasing the pond volumes for the purposes indicated. Instead, general response actions are very general approaches that could be taken, without any specific approach being preferred over others.

   In fact, the more specific approach mentioned by ARCO is represented both in Table C-1, where its general response actions would be "Treatment" and "Containment" (of the stream flows), and in Table 5-2, where it would be included in the general response actions described as "Treat the stream flow (in this case, improve or replace the current treatment system) (Treatment)" and "Provide a settling basin to reduce the flow rates and allow for settling (Containment)." Increasing the volume of Pond 3 to improve its treatment capacity and to use it as the settling basin would be included within these concepts.

3. Comment: This comment repeats an earlier comment regarding the difference between the general response actions "Treatment" and "In Situ Treatment".

   Response: This comment is addressed in the Chapter 5 responses.

4. Comment: This comment notes that coagulation and flocculation were screened out in Appendix C because of the volumes of water that would have to be treated. The comment suggests that these process options should not have been screened out, and that Pond 2 could be used as a polishing step with the use of such settling aids.

Response: The agencies believe that it was reasonable to screen out these two process options. However, if ARCO wants to incorporate the use of such compounds in the selected remedy, pay their costs over the long-term, and accept the shortening of the life of Pond 3 that would be involved, MDHES may be able to agree to their use. However, the use of Pond 2 as a treatment unit, even with the use of settling aids, appears unacceptable without major modifications to the pond.

5. Comment: This comment notes that "Chemical Sealants or Stabilizers" was screened out, and that it should have been retained because such substances can be used during remediation and for temporary stabilizations of surface contaminants.

   Response: The agencies disagree with the comment. Process options useful only as aids during the remediation are not the interest of this screening step, which is to identify process options that can be used to attain the remedial action objectives over the long-term. Process options that would only be used during the construction phase of the remediation are generally screened out.

   Use of chemical sealants or stabilizers to reduce mobility of surface contaminants would not be useful in meeting any of the identified remedial action objectives.

6. Comment: This comment notes that the process option "Organic Agents/Polymers/Foams" was retained even though it is similar to "Chemical Sealants/Stabilizers," which was screened out.

   Response: The comment is correct. "Organic Agents/Polymers/Foams" should have been screened out.

APPENDIX D

RESPONSES TO ARCO COMMENTS, APPENDIX D
COST ANALYSIS FOR REMEDIAL ALTERNATIVES

ARCO prepared several pages of comments on the cost-effectiveness of the alternatives and the CERCLA requirements for cost-effectiveness, as well as several pages of comments on the cost estimates included in the FS. The discussions of the CERCLA process and cost-effectiveness requirements do not require a response. EPA does not agree with the comments, and believes that the CERCLA statute and the NCP provide adequate criteria on the use of cost in remedy selection.

The comments on the cost estimates generally deal with minor inconsistencies in the backup information for the estimates and requests for additional informatic ı on hauling distances and other matters that determine the unit costs. None of the comments suggests that the estimates for the alternatives fail to meet the objective standard of the RI/FS guidance document, which is that the cost estimates should be within +50 percent and -30 percent of the actual cost that would be incurred to complete the remediation as scoped in the conceptual design developed for each alternative. As noted in the responses to the Chapter 8 comments, this requirement does not apply to individual line items, or even to the individual MSAs. It applies only to the overall cost estimates for the complete alternatives.

Many of the comments made by ARCO are more in the mode of comments that might be made on an "engineer's estimate," which is a very different kind of cost estimate prepared for a final design. The designs in the FS are conceptual only, as is appropriate when dealing with several conceptual approaches. Once a general approach is agreed upon and a ROD is signed for the operable unit, a specific detailed design can be developed, and accurate cost estimates prepared. It would be a waste of resources to prepare detailed designs and accurate cost estimates for all six alternatives in the FS.

Many of the ARCO's comments are either correct, or potentially correct. But, there is no indication that modifying the cost estimates as suggested in the comments would affect the selection of the remedy for the operable unit. Some of the comments, if implemented, would increase the cost estimates, and some would decrease the estimates. The result would be to make the estimates more accurate and reliable than the Superfund process requires, but not to greatly change the overall cost estimates.

The MDHES included a sensitivity analysis in the FS to determine which cost items had the potential to significantly affect the overall cost estimates. The conclusion that can be drawn from the sensitivity analysis is that few of the line items have this potential. All of the alternatives include upgrading the berms, cleaning up the Mill-Willow Bypass, and upgrading the pond treatment system. These are substantial costs that tend to dominate in the total estimates. Minor discrepancies in estimating the costs for these items do not affect the comparative analysis that the cost estimates are used for, because such discrepancies are common to all of the action alternatives. Also, because these items are such a large portion of the total costs for each of the alternatives, the potential for other cost items to put the estimates outside the required +50 percent to -30 percent range is limited; their small size does not allow them to have a large overall effect.

The individual comments made by ARCO have been considered, but separate responses are not included in this responsiveness summary.