6 Current and Potential Future Land and Water Uses

Exhibit 2-16, *Land Use and Future Water Needs Analysis Area*, summarizes current land use in the MRSOU area. Exhibit 2-16 also summarizes potential future water needs for areas that are within or adjacent to the arsenic plume. These future water needs and how they might be addressed under groundwater ICs are discussed in more detail in Section 6.2.

6.1 Current and Anticipated Future Land Uses

The area around the MRSOU is located outside of Missoula's urban service area and consists of both zoned and unzoned land, as shown on Exhibit 2-17, *100-Year Floodway and Missoula County Zoning Map*. A majority of the developed land is zoned and the majority of the undeveloped land is unzoned. The Missoula Urban Comprehensive Plan 1998 Update shows the same land uses for Milltown as shown on Exhibit 2-16. Although the plan does not specify future land uses, it requires that zoning changes be made only after considering the impacts on human health, the environment, and the livability of the community.

Current landowners within the area of arsenic concentrations in groundwater exceeding 0.01 mg/l consist of NorthWestern Corporation, Champion International, Town Pump, Inc., Lutheran Church, Catholic Church, the interstate and railroad right-of ways, 35 homeowners and one commercial establishment in Milltown. NorthWestern Corporation's property located to the north of the Milltown Dam, identified as Area G on Exhibit 2-16, is reserved for hydroelectric reservoir and recreational use. The majority of NorthWestern Corporation's property is located within the flood plain upstream of the dam and is restricted by locally adopted flood plain regulations. As stated in the regulations, no permanent structures that would reduce the carrying capacity of the floodway may be placed in the 100-year floodway. The entire reservoir basin and flat lands south of 1-90 are located in the floodway, as are other areas adjacent to the Blackfoot and Clark Fork Rivers within the analysis area which are identified on Exhibit 2-17 as Area A.

Three landfills are located within the site area and are identified as Area C—two are onsite. Champion International Inc.'s former ash disposal landfill is located just beyond the downgradient extent of the arsenic plume area, and the Upland Disposal Site and Disposal Site No. 1 are located in the southern portion of the assessment area. These areas are designated as locations that are for the impoundment and storage of wastes; thus, future development is not reasonably anticipated and will need to be restricted to prevent damage to landfill caps.

An area of land identified as Area H on Exhibit 2-16, is located immediately to the north west of the Champion ash landfill. This area is presently being developed into a trailer park containing about 20 lots.

Town Pump, Inc., which purchased the former Stimson Lumber Company timber office property located just north of 1-90 (identified as Area 1 on Exhibit 2-16), has developed a petroleum retailing station and truck stop on the land. The interstate and railroad right-of-ways, identified as Area B are not available for development, in contrast to two areas identified as Area D, which are adjacent to right-of-ways and floodways with no access.

Area E represents a portion of Milltown containing the 35 homeowners and one commercial establishment in Milltown. The adjacent land, Area F, is referred to as “Remainder D” and may potentially be developed for residential use.

Additional existing land use in the southeast and southwest portions of the reservoir area includes open space and residential use in the Bonner Junction Community. Located northeast of I-90 are residential areas in the communities of Milltown, Bonner, Piltzville, West Riverside, and Pine Grove. The reservoir area currently supports a diverse ecosystem typical of riparian areas of western Montana. Reservoir uses, including boating, fishing, hunting, and other recreational activities, are managed by the State of Montana.

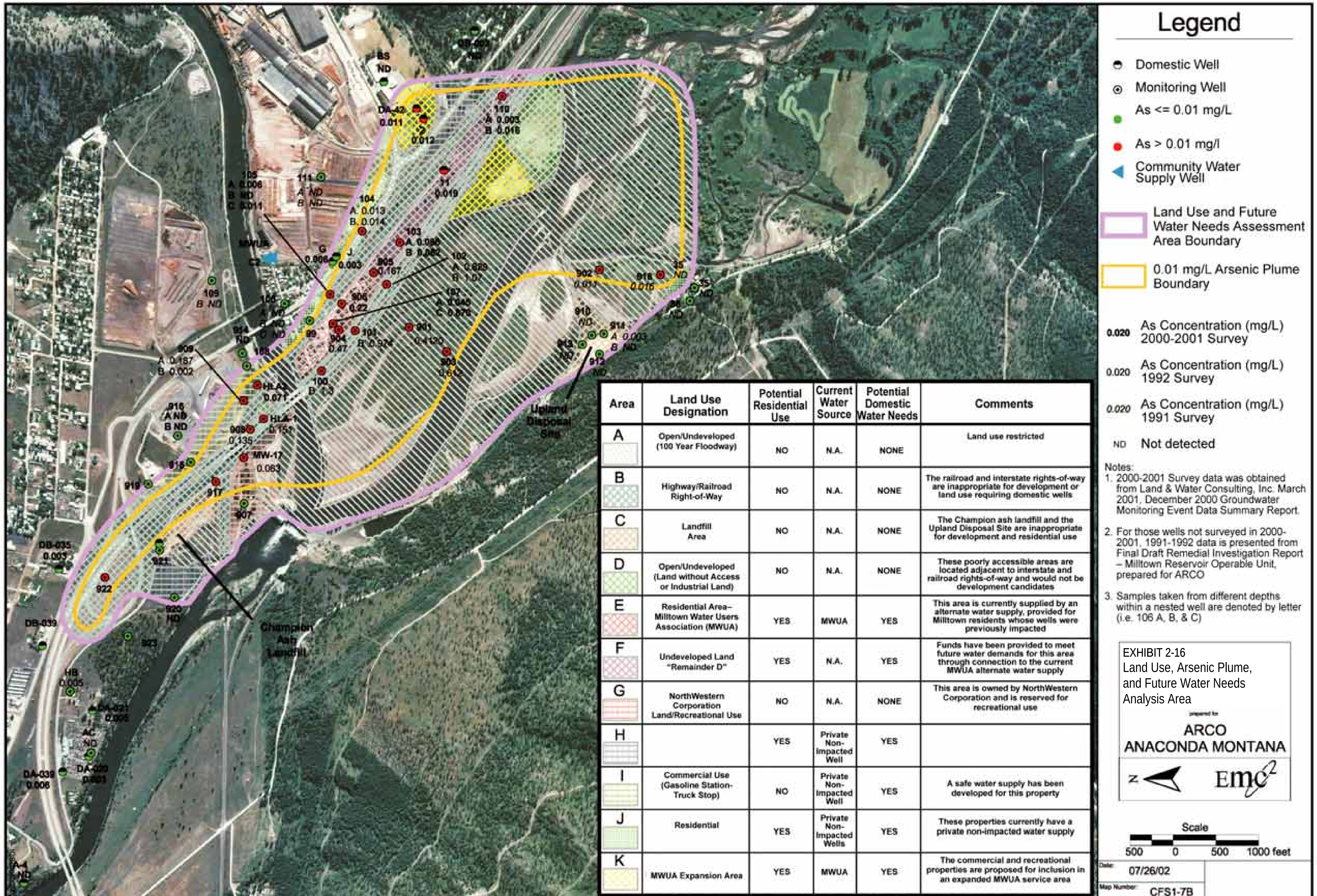
6.2 Groundwater and Surface Water Uses

To determine potential future water needs within the contaminated groundwater area, an analysis of reasonably anticipated future land use and future water needs was conducted. The assessment area, which corresponds with the proposed groundwater area around the 0.01 mg/l arsenic plume, is shown on Exhibit 2-16. Landowners within the groundwater area consist of NorthWestern Corporation, Champion International, Town Pump, Inc., the interstate and railroad right-of-ways, 35 homeowners and one commercial establishment located in Milltown. Historically, the aquifer was used as a drinking water source until the 1984 *Record of Decision* provided a temporary alternative water supply. No permanent ICs preventing groundwater use exist, and permanent ICs restricting groundwater use are opposed by Missoula County. The State classifies the aquifer as usable for drinking water, and it is also classified as a sole source aquifer.

The assessment area was divided into functional areas, shown on Exhibit 2-16 based on current and potential uses of the property to determine potential water needs. The following summarizes the land use as it pertains to future water needs for each of the functional areas.

NorthWestern Corporation’s property located to the north of the Milltown Dam and identified as Area G is reserved for recreational use. The majority of NorthWestern Corporation’s property is located within the flood plain upstream of the dam and is restricted by locally adopted flood plain regulations. Domestic water supply for these areas is possible, if the land is sold for residential development. There is an expanding need for residential land in the Missoula area.

Three landfills are located within the assessment area (Area C). The Champion International, Inc., ash landfill is located on the leading edge of the area with arsenic concentrations in groundwater exceeding 0.01 mg/l, and the Upland Disposal Site and Disposal Site #1 are located in the southern portion of the assessment area. These areas are designed as locations for the impoundment and storage of wastes; thus, future development (e.g., residential use) is not reasonably anticipated and will need to be restricted to prevent damage to caps. Therefore, no current or future water needs are projected for this area.



Area	Land Use Designation	Potential Residential Use	Current Water Source	Potential Domestic Water Needs	Comments
A	Open/Undeveloped (100 Year Floodway)	NO	N.A.	NONE	Land use restricted
B	Highway/Railroad Right-of-Way	NO	N.A.	NONE	The railroad and interstate rights-of-way are inappropriate for development or land use requiring domestic wells
C	Landfill Area	NO	N.A.	NONE	The Champion ash landfill and the Upland Disposal Site are inappropriate for development and residential use
D	Open/Undeveloped (Land without Access or Industrial Land)	NO	N.A.	NONE	These poorly accessible areas are located adjacent to interstate and railroad rights-of-way and would not be development candidates
E	Residential Area–Milltown Water Users Association (MWUA)	YES	MWUA	YES	This area is currently supplied by an alternate water supply, provided for Milltown residents whose wells were previously impacted
F	Undeveloped Land "Remainder D"	YES	N.A.	YES	Funds have been provided to meet future water demands for this area through connection to the current MWUA alternate water supply
G	NorthWestern Corporation Land/Recreational Use	NO	N.A.	NONE	This area is owned by NorthWestern Corporation and is reserved for recreational use
H		YES	Private Non-Impacted Well	YES	
I	Commercial Use (Gasoline Station-Truck Stop)	NO	Private Non-Impacted Well	YES	A safe water supply has been developed for this property
J	Residential	YES	Private Non-Impacted Wells	YES	These properties currently have a private non-impacted water supply
K	MWUA Expansion Area	YES	MWUA	YES	The commercial and recreational properties are proposed for inclusion in an expanded MWUA service area

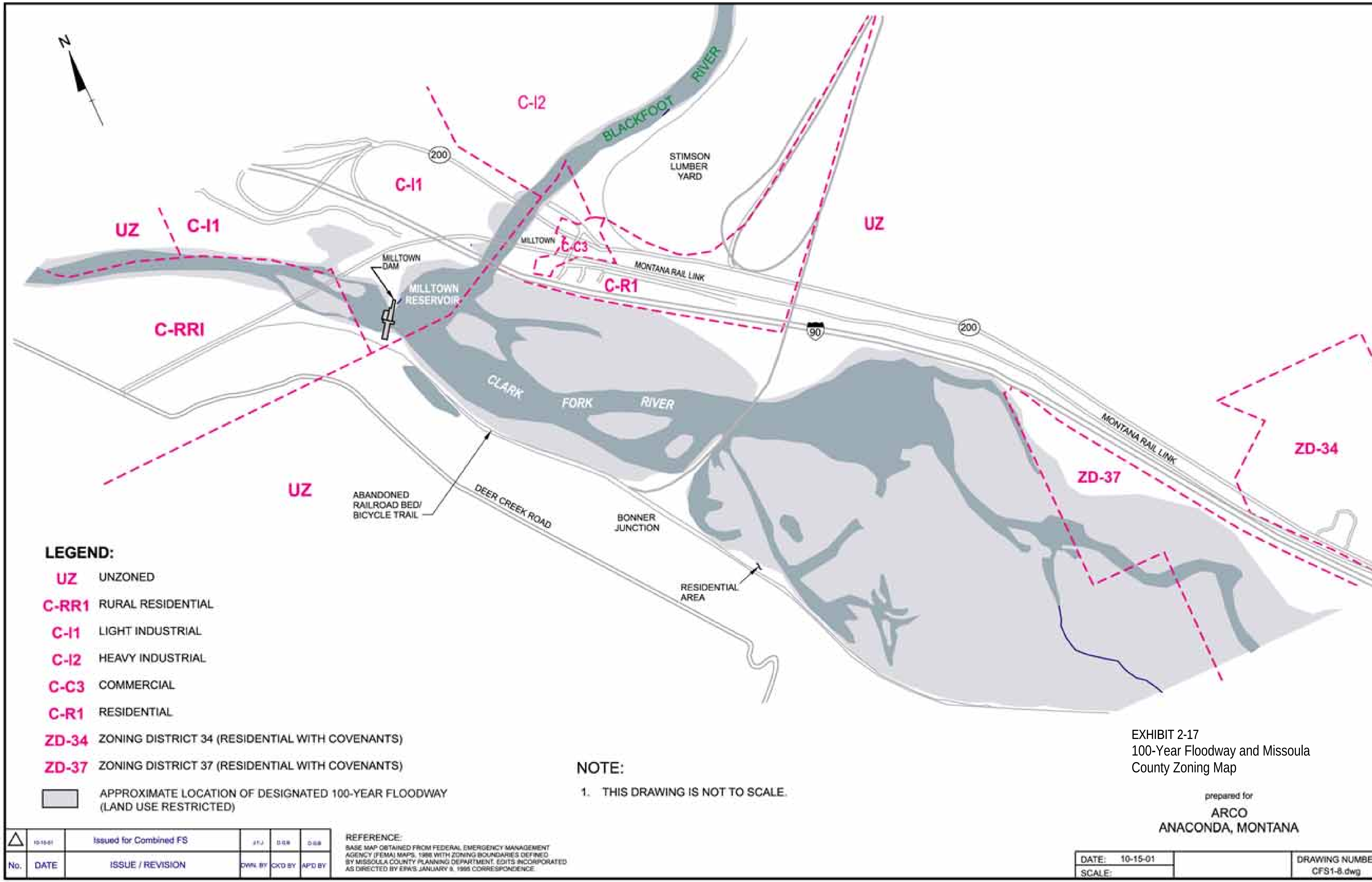


EXHIBIT 2-17
100-Year Floodway and Missoula County Zoning Map

A small undeveloped parcel of land located at, or just downgradient from, the leading edge of the 0.01 mg/l plume is delineated as Area H. This parcel is near the Champion landfill, and is presently developed as a trailer court with about 20 residential units. A community well was recently installed on the property. This well will be monitored on a regular basis in the future. Should arsenic be detected in concentrations above drinking water standards, a replacement water supply may be required.

The Town Pump, Inc., which purchased the former Stimson Lumber Company timber office property located just north of I-90, has developed a gas station and truck stop on the land. Based on monitoring results, the groundwater well providing drinking water to this development is not impacted by the reservoir arsenic plume. Therefore, it is assumed the future water needs for this area will continue to be met through use of the existing well. However, expansion or further development of this area could lead to onsite groundwater use, which could impact the plume.

The interstate and railroad right-of-ways, identified as Area B, are unavailable for residential development. Two areas designated as Area D are located adjacent to right-of-ways and floodways and are not accessible from a public road.

Within the assessment area, three areas have been positively identified that may have future water needs. These three areas include the Montana Water Users Association (MWUA) area, "Remainder D," and the Town Pump, Inc., area. Of these areas, the 35 Milltown homeowners and one commercial establishment have been provided a replacement water supply system. The MWUA water system can be expanded under current funding to encompass the adjacent land of "Remainder D." However, the continued maintenance or expansion of this system relies on voluntary efforts by the homeowners and commercial establishment, and no ICs are currently in place. The county opposes ICs and wants the aquifer returned to its beneficial use. As noted previously, the Town Pump, Inc., area has a drinking water supply well that meets current needs. It is unknown whether increased development pressure will lead to the need for additional onsite groundwater use in this area. The undeveloped land in and around the Champion Landfill is unlikely to be developed in a fashion that would require domestic use of onsite groundwater, but this is not guaranteed.

Considerable uncertainties are associated with permanent ICs in these areas. Groundwater monitoring of the lateral and vertical extent of arsenic contamination, and stability of the area with arsenic concentrations in the groundwater exceeding 0.01 mg/l at the MRSOU, is ongoing and will continue as part of the remedy. The monitoring plan is flexible and may be modified as necessary to change the number of wells, the location of wells, and frequency of sampling in response to the monitoring results. The monitoring plan currently includes approximately 59 wells, sampled semi-annually, and is overseen by EPA and DEQ.

This potential land use description applies only to those areas presently impacted by the arsenic plume. The current arsenic plume boundary seems to be relatively stable; however, routine monitoring has occurred only over the last few years. Long-term monitoring will indicate whether or not the plume is stable under current conditions. If the plume boundary were to expand by as little as 1,000 feet, the additional areas of Milltown (about 50 lots) would also have to be placed on a replacement water supply.

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7 Summary of Site Risks

Baseline risk assessments were completed in the early 1990s for the Milltown site and consisted of the following:

1) Human health risks associated with contaminated reservoir sediments and soils, reservoir biota, and the groundwater plume (EPA 1993b).

2) Ecological risks associated with exposure to contaminants in the river sediments, reservoir biota, and surface water (EPA 1993a).

3) Human health and ecological risks downstream of the reservoir associated with catastrophic releases of sediments from the reservoir (EPA 1993c).

Subsequent agency concerns about fisheries and aquatic life as a result of the February 1996 reservoir ice jam incident resulted in the collection of additional biological, toxicological, and water quality data. EPA then conducted additional ecological evaluations of aquatic risk downstream of the reservoir. This *Ecological Baseline Risk Assessment Addendum* was completed in 2000 (EPA 2000). Human health and ecological risks are described in Sections 7.1 and 7.2, respectively.

7.1 Human Health Risks

Historically, the water in the community of Milltown was supplied by individual wells. In 1981, Missoula City/County Health Department (MCCHD) determined that four potable water wells contained water with arsenic concentrations ranging from 0.22 to 0.51 mg/l. At the time, the Federal drinking water standard for arsenic was 0.05 mg/l; it is now 0.01 mg/l. A series of investigations were undertaken and it was determined that the reservoir sediments were the source of this problem. Based on these findings, the Milltown community replacement water supply system was constructed in 1984. The system and users are described in Section 6, *Current and Potential Future Land and Water Uses.*

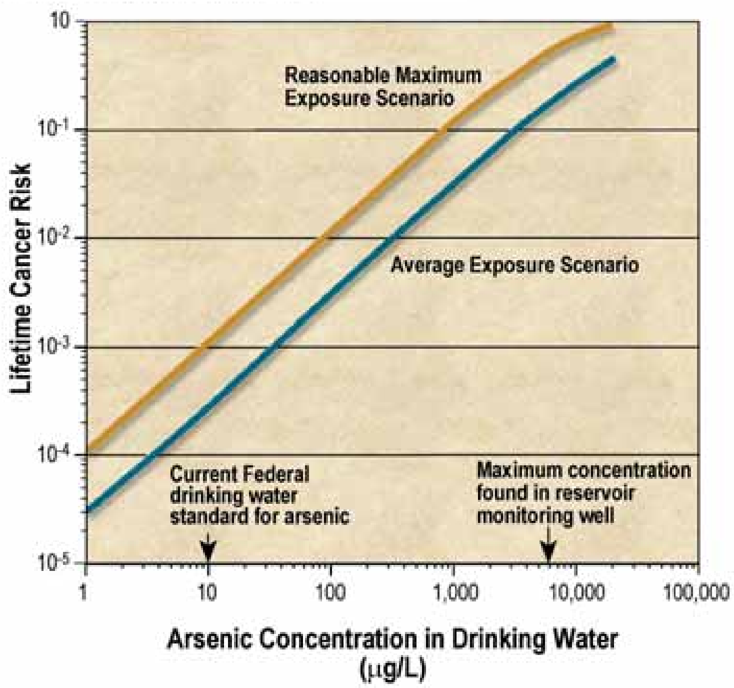
The Baseline *Human Health Risk Assessment* for the MRSOU (EPA 1993b) was prepared to assess potential risks at the site using standard EPA health risk assessment methods for residential and recreational uses. Local residents, the EPA, the State of Montana, Atlantic Richfield Company, and the MCCHD also performed surveys and supplied information on potential exposure behaviors. Where information was still incomplete after these efforts, conservative assumptions were made to quantify potential exposures so that risks to public health would not be underestimated. Components of the risk assessment included the following:

- Exposure Assessment—Calculated a daily dose of arsenic and cadmium, per body weight, as a result of exposure to impacted soils, sediments, surface water, drinking water, game, and edible plants. Doses were calculated independently for each route of exposure and each population at risk, under average and reasonable maximum exposure for current and future land-use conditions.

- Toxicity Assessment—Examined the potential for each contaminant to cause adverse effects and provided an estimate of the dose-response relationship between the extent of exposure to a particular constituent and adverse effects including non-carcinogenic and carcinogenic outcomes.
- Risk Characterization—Chemical exposure estimates were combined with toxicity reference values (TRVs) to develop quantitative cancer and non-cancer health risk estimates for exposure to contaminants associated with the MRSOU. In the risk characterization, chemical exposure estimates were combined with TRVs to develop quantitative cancer and non-cancer risk estimates.

Non-carcinogenic and carcinogenic risks within the MRSOU were estimated to be highest for ingesting impacted groundwater. These risks were found to be unacceptable. Cancer risks associated with drinking impacted groundwater with arsenic concentrations exceeding 0.010 mg/l could exceed 1 chance in 1,000 (a 10^{-3} risk), as shown on Exhibit 2-18, *Cancer Risk from Arsenic*.

EXHIBIT 2-18
Cancer Risk from Arsenic



Other exposure pathways for humans are not significant. This included residential use for existing homes near the reservoir and recreational use of the land surrounding the reservoir. If residential use of land immediately surrounding the reservoir occurred, it would be unacceptable, but this use is not considered likely. The analysis of a potential detoxification threshold for ingestion of arsenic suggested that long-term exposures at the site, other than through consumption of impacted groundwater, would not be associated with a greatly increased non-cancer and cancer risk.

7.2 Ecological Risks

7.2.1 Original Baseline Ecological Risks

The original baseline *Ecological Risk Assessment* (EPA 1993a) addressed risks to aquatic and terrestrial wildlife that may be exposed to contaminants within Milltown Reservoir. Risk to various ecosystem components was characterized by combining results from an exposure assessment with chemical-specific toxicity information. The exposure assessment identifies the various potential receptor populations exposed to contaminants in, or those mobilized from, the reservoir itself. The exposure assessment determines the routes, magnitudes, frequencies, and durations of exposure to the various contaminants. An ecological assessment was then performed to determine whether the impacts predicted by the exposure and toxicity assessments were observable on the site.

The results of these original studies indicated that minimal risk to the environment was found as a result of the existing levels of metals and arsenic contamination found in the reservoir sediments, and no acute risks were identified. The terrestrial and wetland wildlife are diverse and appear to be healthy. The ecological studies of site-wide terrestrial habitats indicated "a lack of observable impacts to terrestrial or aquatic communities, including vegetation, small mammals, muskrats and beaver, waterfowl, songbirds, and deer" (EPA 1993a). Visual observations indicated good species abundance of aquatic plants, amphibians, and healthy and diverse wetland habitats.

7.2.2 Continuing Releases Risk Assessment

The evaluations that were completed as part of the *Continuing Releases Risk Assessment* (EPA 1993c) found that concentrations of arsenic and metals in downstream surface waters and sediments were lower than typical concentrations found in the reservoir. Based on standards in place in 1993, the report found human health risks from exposures to expected concentrations of arsenic in downstream surface waters and sediments were estimated to be low. Under the current standards and current conditions, some violations of current standards are occurring. Also downstream, no risks to terrestrial receptors were predicted.

However, the risk assessment evaluated the additional risk that could be posed by future releases from the MRSOU and concluded that catastrophic failure of the dam would pose a significant risk to downstream aquatic life. Catastrophic failure would also present risks to human health and violations of current standards.

7.2.3 Addendum to Baseline Ecological Risk Assessment

Because of the potential adverse ecological effects downstream as a direct result of the February 1996 reservoir lowering / ice scour event and the corresponding increases of contaminant levels, an addendum to the earlier *Ecological Risk Assessment* was completed in April 2000 (EPA 2000). Supplemental data to the *Remedial Investigation* were also used where appropriate, including information and conclusions reached from the *Clark Fork River OU Ecological Risk Assessment* (EPA 1999).

Unacceptable risks to trout and benthic macroinvertebrates from the release or potential release of copper and zinc were estimated using multiple lines of evidence:

- Use of Hazard Quotients and Hazard Indices based on comparisons of metals in water and site specific TRVs for trout and FAWQCs for dissolved metals.
- Trout population estimates and experiments conducted by FWP that included caged fish studies conducted downstream of Milltown Reservoir, upstream of the reservoir on the two tributaries to the reservoir, and another reference stream location.
- Annual monitoring of benthic macroinvertebrate populations.
- Annual monitoring of periphyton.

Conclusions reached from this *Ecological Risk Addendum* are as follows:

- Water quality downstream, impacted by events such as the February 1996 ice scour, exceeded FAWQCs, and copper may cause a moderate acute risk to aquatic life. Such events may impact trout populations below the dam and are considered by EPA to be unacceptable. Fish population studies conducted by FWP indicated that adult rainbow and brown trout populations below the dam were reduced by 62 percent and 56 percent, respectively, between the summer of 1995 and 1996. Juvenile trout populations dropped 71 percent to 86 percent. Bull trout populations below the dam were expected to be impacted similarly because of the similar tolerance to metals. However, the number of bull trout below the dam were not high enough to make an estimate.
- Normal high flow events may pose an intermittent low level chronic risk to fish because of the combined impacts of copper and other metals in the water column and copper in ingested macroinvertebrates. EPA Region 8 has determined this risk is unacceptable.
- Montana State standards for total recoverable metals were frequently exceeded, during high flow and ice scour events.
- Arsenic and cadmium in surface water may pose low risks and risks from lead and zinc are low during high flow or ice scour events.
- There were no significant risks from exposure of benthic macroinvertebrates to metals in sediment downstream of Milltown Dam during such events, except as described in Section 5.6.2, *Fisheries and Macroinvertebrate*.

7.3 Threatened and Endangered Species

Federally listed species occurring in Montana are listed on Exhibit 2-19. Two of these species (bull trout, bald eagle) occur consistently within the MRSOU. EPA has prepared a Biological Assessment and an addendum of the effects of the selected remedy on the bull trout and the bald eagle (CH2M HILL 2004a, 2004b). USFWS, after review of EPA's Biological Assessment, prepared a Biological Opinion (2004).

Bull trout are listed as threatened under the ESA. This species raises the greatest concern for the USFWS. Risks to trout were calculated using rainbow trout as an indicator species. There is evidence that bull trout have similar sensitivity to metals as rainbow trout. Evidence also indicates bull trout are more sensitive to other stressors, such as water temperature and suspended sediments, than other trout species, particularly brown trout. The presence of the bull trout, and the low numbers of bull trout found in the reservoir and upper Clark Fork River, present a special duty for EPA to ensure the protectiveness and careful execution of the remedy here (see EPA's *Ecological Risk Assessment and Risk Management Principles for Superfund Sites,* page 3, 1999).


Bull Trout

EXHIBIT 2-19
Threatened and Endangered Species in Montana

Common Name	Scientific Name	Status	Range in Montana
Black-footed Ferret	*Mustela nigripes*	E	Prairie dog complexes; eastern
Gray Wolf	*Canis lupus*	E	Forests; western
Grizzly Bear	*Ursus arctos horribilis*	T	Alpine/subalpine coniferous forest; western
Bald Eagle	*Haliaeetus leucocephalus*	T	Forested riparian; statewide
Whooping Crane	*Grus americana*	E	Wetlands; migrant statewide
Piping Plover	*Charadrius melodus*	T	Missouri River sandbars, alkaline beaches; northeastern
Least Tern	*Sterna antillarum*	E	Yellowstone, Missouri River sandbars, beaches; eastern
Pallid Sturgeon	*Scaphirhynchus albus*	E	Bottom dwelling; Missouri, Yellowstone Rivers
White Sturgeon	*Acipenser transmontanus*	E	Bottom dwelling; Kootenai River
Bull Trout	*Salvelinus confluentus*	T	West MT in cold water river, lakes
Water Howellia	*Howellia aquatilis*	T	Wetlands; Swan Valley, northwestern
Ute Ladies'-tresses	*Spiranthes diluvialis*	T	Wet meadow; Jefferson County
Canada Lynx	*Felis lynx canadensis*	T	Forested areas; western

E = Endangered, any species that is in danger of extinction throughout all or a significant portion of its range.
T = Threatened, any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
Source: Smith et al. 1998, modified

7.4 Basis for Response Action

Based on the entire administrative record, including the *Human Health Risk Assessment* and the *Ecological Risk Assessment* and *Addendum*, EPA's conclusion is that unacceptable human health and aquatic risk exists at the MRSOU. EPA, in consultation with DEQ, has determined the response action selected in this *Record of Decision* is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

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8 Remedial Action Objectives

8.1 Basis and Rationale for RAOs

EPA, in consultation with DEQ, met on numerous occasions throughout the RI/FS and *Proposed Plan* processes with local governments, residents, and other interested parties to listen to their concerns and suggestions relative to cleanup goals and objectives for the MRSOU. Their input has been captured in the development of these remedial action objectives (RAOs) presented in this section. The *Baseline Human Health Risk Assessment* (EPA 1993b), the *Baseline Ecological Risk Assessment* (EPA 1993a), and the *Milltown Ecological Risk Assessment Addendum* (EPA 2000b), and EPA's Applicable or Relevant and Appropriate Requirements (ARAR) analysis, provide numeric goals for the protection of human health and the environment; the relevant values are provided in this section. The RAOs were prepared in accordance with 40 CFR Section 300.430(e)(2)(I) of the National Contingency Plan (NCP) and are placed in the administrative record.

The RAOs are media-specific objectives for protecting human health and the environment. They address various chemicals of concern, media of concern, exposure pathways and receptors, current and likely future land and groundwater uses, and remediation goals.

The primary objectives are to protect human health and the environment, and to attain compliance with applicable or relevant and appropriate Federal and State standards, criteria, and requirements, unless a waiver is justified. Examples of practical application of these objectives include the following:

- Restore the groundwater to its beneficial use within a reasonable time period using monitored natural recovery.
- Protect downstream fish and macroinvertebrate populations from releases of contaminated reservoir sediments, which occur with ice scour and high flow events.
- Provide permanent protection against dam failure and the subsequent catastrophic release of contaminated sediments.
- Provide compliance with ESA and wetland protection through consultation with USFWS, the CSKT, and the relevant State agencies.

8.2 Specific RAOs

RAOs developed for each of the contaminated media in the MRSOU are listed below.

8.3 Groundwater

8.3.1 RAOs Overview

For groundwater, the main RAOs are as follows:

- Return contaminated groundwater to its beneficial use within a reasonable timeframe, and prevent ingestion until drinking water standards are achieved.
- Comply with State groundwater standards, including nondegradation standards.
- Prevent groundwater discharge containing arsenic and metals that would degrade surface waters.

The NCP [40 CFR § 300.430(e)(2)(i)(B) and (C)] specifies the Federal Safe Drinking Water Act (SDWA) primary Maximum Contamination Levels (MCLs) and nonzero Maximum Contaminant Levels Goals (MCLGs), and State groundwater standards as ARARs for arsenic present in the groundwater at Milltown. The current Federal standard for arsenic is 10 micrograms per liter (µg/l) and the current State groundwater standard is 20 µg/l (Exhibit 2-20, *Groundwater RGs for Human Health*).

EXHIBIT 2-20
Groundwater Remedial Goals/Performance Standards for Human Health

Chemical	MCLG*	MCL*	Montana Numeric Water Quality Standards*
Arsenic	—	10	20
Cadmium	5	5	5
Copper	1,300	1,300	1,300
Lead	0	15	15
Mercury	2	2	2
Zinc	N/A	N/A	2,000

*Dissolved concentrations in micrograms per liter (µg/l)
Source: Circular WQB-7, Montana Numeric Water Quality Standards, January 2004; Safe Drinking Water Act regulations as noted in the ARARs appendix (Appendix A)

8.4 Surface Water

8.4.1 RAOs Overview

For surface water, the main RAOs are as follows:

- Achieve compliance with surface water standards, unless a waiver is justified.
- Prevent ingestion of or direct contact with water posing an unacceptable human health risk.
- Achieve acute and chronic FAWQC.

The Clark Fork River at Milltown carries a State water quality classification of B-1. Surface water quality will be maintained to support these uses defined as follows (ARM § 17.30.607): "Waters classified B-1 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply."

The SDWA establishes MCLs and MCLGs for drinking water sources. The appropriate SDWA standards (dissolved) for contaminants of concern for surface waters at Milltown are shown below:

- Arsenic 0.01 mg/l
- Cadmium 0.005 mg/l
- Copper 1.3 mg/l
- Lead 0.015 mg/l
- Zinc 2.0 mg/l

In addition, EPA has determined that Federal AWQC (dissolved) are appropriate. Through administrative rule making, DEQ has adopted the Montana Numerical Water Quality Standards Circular WQB-7 which are also applicable standards. Water quality standards for surface water are designated as the more restrictive of either the Aquatic Life Standard or the Human Health Standard. The surface water RGs are shown in Exhibit 2-21, *Surface Water Remedial Goals for Ecological Health*, and Exhibit 2-22. The current and more restrictive standards for contaminants of concern are listed on Exhibit 2-22, *Montana Numerical Water Quality Standards Circular WQB-7 (Total Recoverable Basis)*.

EXHIBIT 2-21
Surface Water Remedial Goals for Ecological Health (measured as dissolved concentrations)

	Acute AWQC		Chronic AWQC	
	Hardness		Hardness	
Dissolved Metals (µg/l)	**100**	**200**	**100**	**200**
Arsenic	339.8	339.8	147.9	147.9
Cadmium	2.0	4.3	0.27	0.45
Copper	13	26	9.0	16
Lead	81	197	3.0	7.6
Zinc	119	215	119	215

Source: Ecological Risk Assessment Clark Fork Operable Unit, EPA 1999 Federal Ambient Water Quality Criteria (Gold Book 2002)

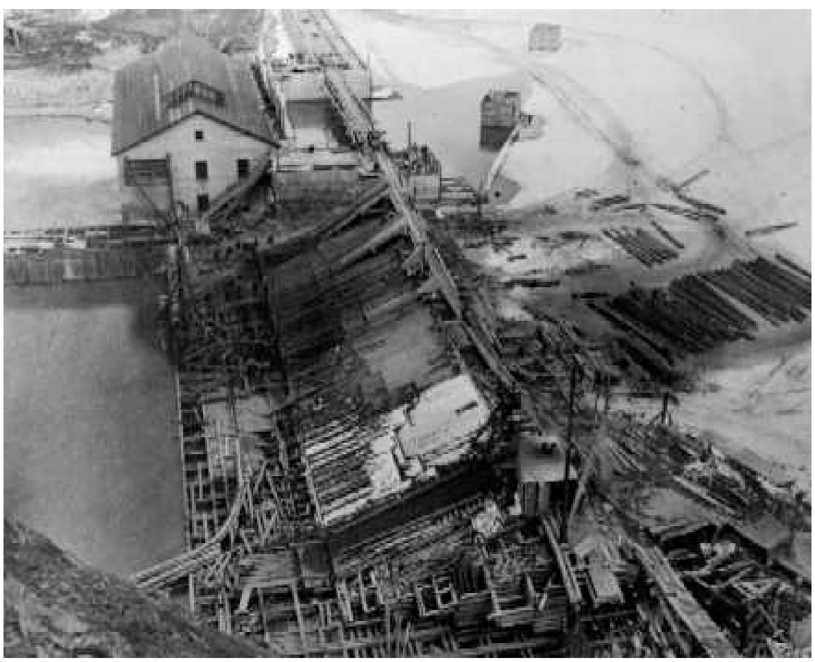
EXHIBIT 2-22
Montana Numeric Water Quality Standards Circular WQB-7 (Total Recoverable Basis)

	Acute	Chronic	Health
Arsenic	340 µg/l	150 µg/l	18 µg/l
Cadmium	2 µg/l*	0.3 µg/l*	5 µg/l
Copper	13 µg/l*	9.3 µg/l*	1,000 µg/l
Lead	82 µg/l*	3.2 µg/l*	15 µg/l
Zinc	119 µg/l*	119 µg/l*	2,000 µg/l

*Assumes at 100 mg/l hardness; standard is based on actual measured hardness at time of sampling.

In summary, the goals for the remedial actions should achieve the following:

- **Groundwater**
  - Restore the alluvial aquifer to its beneficial use as a drinking water supply by attaining the 10 µg/l dissolved arsenic performance standard. This will best be achieved by preventing the further discharge of arsenic from the reservoir sediments into the alluvial aquifer. This will allow the aquifer to restore itself through natural recovery.
- **Surface Water**
  - Attain protectiveness of fish and other aquatic species by consistently meeting State WQB-7 standards and Federal AWQC (Gold Book 2002) downstream of the reservoir.
  - Attain protectiveness of aquatic life by improving water quality downstream of the reservoir through a reduction in sediment and dissolved copper concentrations to consistently achieve values less than or equal to values presented in Exhibit 2-21.
  - Attain protectiveness of threatened and endangered species (bull trout) through application of the remedy in consultation with the USFWS.



Reconstruction of Milltown Dam following 1908 flood

9 Description of Alternatives

9.1 Background and Remedy Components for Each Alternative

Three major *Feasibility Studies* during the past 8 years evaluated various cleanup options:

- **Original Draft** *Feasibility Study* **(1996)—**Evaluated cleanup alternatives for the groundwater plume contamination to address identified human health risks. A total of 23 alternatives were considered and 8 alternatives were evaluated in detail. Evaluation of remedial alternatives followed EPA guidance and included the following: 1) Protection of human health and the environment, 2) Compliance with ARARs, 3) Long Term Effectiveness and Permanence, 4) Reduction of Toxicity, Mobility and Volume through Treatment, 5) Short Term Effectiveness, 6) Implementability, and 7) Cost. The *Feasibility Study* and *Record of Decision* were not completed at that time because of the occurrence of the ice scour event of February 1996 and resulting surface water quality impacts. A supplemental *Focused Feasibility Study* was determined to be necessary.

- *Focused Feasibility Study* **(2001)—**Evaluated the cleanup alternatives proposed to mitigate the potential risks to downstream aquatic life resulting from ice and flood sediment scouring. A total of 10 alternatives formulated to mitigate surface water impacts were evaluated in detail following standard EPA guidance. In addition, all FERC required dam upgrades and fish passage for any alternatives involving retaining the dam were considered.

- *Combined Feasibility Study* **(2002)—**The *Combined Feasibility Study* incorporated the most effective groundwater cleanup components from the original 1996 *Feasibility Study* with the alternatives proposed for controlling ice and sediment scour identified in the 2001 *Focused Feasibility Study*. Eleven final alternatives were evaluated in detail following EPA guidance and are summarized in Exhibit 2-23, *Cleanup Options Considered in the Combined Feasibility Study*. The alternatives encompassed various remedial actions for the dam, reservoir sediments and channel, and the groundwater plume. The common elements and distinguishing features among the alternatives are identified and discussed in the *Combined Feasibility Study*. The cost breakdown for each alternative (also prepared in 2002) is provided at the end of Section 9.2 in Exhibit 2-24, *Remedial Alternatives Present Value and Total Cost Summary Table*. The cost for the Selected Remedy is provided in Section 12.9, *Cost Estimate for the Selected Remedy*.

EXHIBIT 2-23
Cleanup Options Considered in the Combined Feasibility Study

Alternative	Action to Dam*	Action to Channel and Flood plain Sediments	Action to Groundwater Plume
1—No Further Action	Dam Safety Upgrade. Add Fish Passage.	None	Maintain Replacement Water Supply
2A—Modification of Dam and Operational Practices plus Groundwater Institutional Controls (GW ICs)	Dam Safety Upgrade. Add Fish Passage. Add Inflatable Rubber Dam (IRD).	None	Maintain Replacement Water Supply. Add Controlled GW Area
2B—Modification of Dam and Operational Practices plus GW ICs and Containment and Natural Attenuation within the Aquifer Plume	Dam Safety Upgrade. Add Fish Passage. Add IRD.	None	Add Slurry Wall, add controlled GW area, maintain replacement water supply
3A—Modification of Dam and Operational Practices with Scour Protection plus GW ICs	Dam Safety Upgrade. Add Fish Passage. Add IRD.	*Channel*: Add Soft Streambank Stabilization *Flood plain*: Add Revegetation	Maintain Replacement Water Supply. Add Controlled GW Area
3B—Modification of Dam and Operational Practices with Periodic Removal and Channelization plus GW ICs and Containment and Natural Attenuation within the Aquifer Plume	Dam Safety Upgrade. Add Fish Passage. Add IRD.	*Channel*: Do Limited Sediment Removal and Channelization with Armoring plus Periodic Sediment Removal	Add Slurry Wall, Maintain Replacement Water Supply. Add Controlled GW Area
5—Dam Removal, Partial Sediment Removal with Channelization and Leachate Collection/Treatment, plus GW ICs and Natural Attenuation within the Aquifer Plume	Dam Removal.	*Channel*: Limited Sediment Removal in Channels. Armor Channels *Flood plain*: None	Add Leachate Collection and Treatment. Maintain Replacement Water Supply. Add Controlled GW Area
6A—Modification of Dam and Operational Practices with Initial Total Sediment Removal of the Lower Reservoir and Periodic Sediment Removal Thereafter, plus GW ICs and Natural Attenuation in the Aquifer Plume	Dam Safety Upgrade. Add Fish Passage. Add IRD.	*Channel*: Removal *Flood plain*: Total Sediment Removal below Duck Bridge	Source Removal. Maintain Replacement Water Supply. Add Controlled GW Area. Natural GW Quality Improvement
6B—Modification of Dam and Operational Practices with Total Sediment Removal of the Entire Reservoir plus GW ICs and Natural Attenuation within the Aquifer Plume	Dam Safety Upgrade. Add Fish Passage. Add IRD.	*Channel*: Total Sediment Removal of Lower Reservoir *Flood plain*: Total Removal below Duck Bridge	*Same as 6A, above*
7A1—Dam Removal with Total Sediment Removal of the Lower Reservoir plus GW ICs and Natural Attenuation within the Aquifer Plume	Dam Removal.	*Same as 6B, above*	*Same as 6A, above*

EXHIBIT 2-23
Cleanup Options Considered in the Combined Feasibility Study

Alternative	Action to Dam*	Action to Channel and Flood plain Sediments	Action to Groundwater Plume
7A2—Dam Removal with Partial Sediment Removal of the Lower Reservoir plus GW ICs and Natural Attenuation within the Aquifer Plume	Dam Removal.	*Channel*: Total Sediment Removal of Lower Reservoir *Flood plain*: Total Removal of Area 1	*Same as 6A, above*
7B—Dam Removal with Total Sediment Removal of the Entire Reservoir plus GW ICs and Natural Attenuation within the Aquifer Plume	Dam Removal.	*Channel*: Sediment Removal from Entire Reservoir/Channel Reconstruction *Flood plain*: Sediment Removal	*Same as 6A, above*

*Dam modifications: upgrading the dam to withstand the probable maximum flow; installing fish ladders; and installing an inflatable rubber dam to replace the existing stanchion/flashboard assembly. It should be noted that all upgrades of the dam for safety reasons or fish passage are dictated under FERC's authority, not Superfund authority. These items (i.e., upgrades, fish passage) have been included in the FS for cost comparison only.

9.2 Combined FS Alternatives Descriptions

9.2.1 Alternative 1—No Further Action

The No Further Action Alternative involves no further engineering options, ICs, or other new measures at the MRSOU beyond those currently in place. This alternative relies on the environment and existing actions and controls to maintain or reduce metal concentrations through physical and chemical processes.

The No Further Action Alternative includes previous remedial activities completed at Milltown Reservoir / Clark Fork River Superfund Site, including existing ICs and completed remedial actions, such as the MWUA replacement water supply. Long-term ground and surface water monitoring is also included in the No Further Action Alternative. Since implementation, these actions have provided protection against an unacceptable human health risk from ingestion from the plume of the arsenic contaminated groundwater.

The No Further Action Alternative also presumes that the Milltown Dam will continue to be regulated under the FERC License (Project No. 2543). NorthWestern Corporation or its successor, as the FERC Licensee and owner of the property, is required to satisfy all current and future obligations of the present license. FERC requirements may include the following:

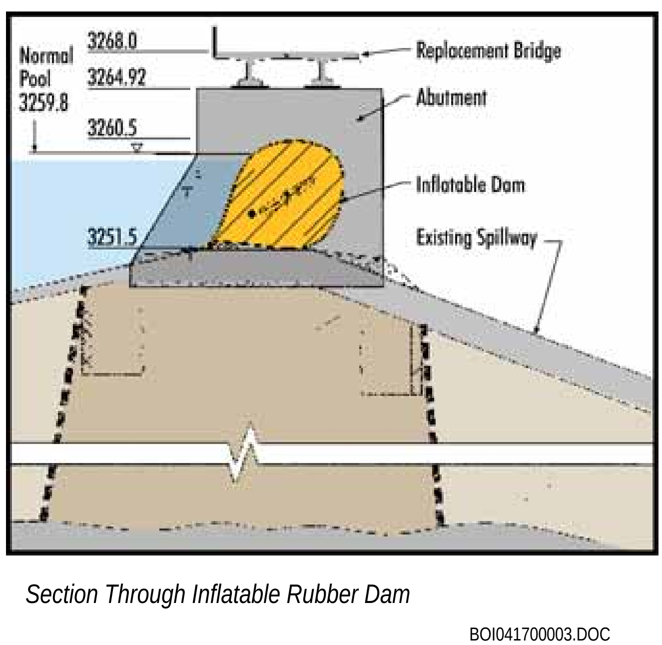
- **Enhanced fish passage around the dam—**Currently, this is being accomplished by FWP and funded by NorthWestern Corporation using a trap-and-haul method. Options for enhancing fish passage, including fish ladders or continued trap-and-haul, are currently being evaluated by FERC. EPA assumes the installation of two fish ladders to permit future fish passage.
- **Dam safety upgrades as necessary to withstand Probable Maximum Flow conditions and Maximum Credible Earthquake as recently mandated for high hazard dams—**

FERC has required NorthWestern Corporation to evaluate various potential upgrades to the dam to withstand probable maximum flow conditions and to further evaluate conditions regarding the maximum credible earthquake. FERC is presently reviewing their findings. EPA has assumed that if the dam remains for this or other alternatives, the dam will be modified to withstand probable maximum flow conditions and other actions as mandated by FERC.

9.2.2 Alternative 2A—Modification of Dam and Operational Practices plus Groundwater Institutional Controls

This alternative involves physical modifications to the dam spillway combined with enhancement of reservoir operational practices designed to mitigate the need to lower reservoir pool level to protect the dam from ice jams and to mitigate the rate or timing of sediment release. Alternative 2A also includes implementation of additional ICs to address potential risks associated with the groundwater arsenic plume. Current practices, described in Alternative 1, would be maintained for this alternative, including FERC's requirements and Milltown's replacement water supply. Dam modifications, as well as new ICs and operational practices, are listed below:

- **Dam Modifications—**Removal of the existing flashboards and replacement with an inflatable rubber dam:
  - *Removal of the Existing Flashboards—*Spillway flow control is currently maintained by a series of 44, 5-foot wide by 8-foot high panels (flashboards). A 43-foot wide by 17-foot high radial gate passes river flows through the dam during all but peak flow periods (when the flashboards are removed to pass the peak runoff). The current flashboard system is cumbersome to operate and precludes passing ice chunks greater than 8 feet across without cutting the stanchions. Removal of these flashboards would mitigate the need for rapid drawdown during an ice jam and lower the operational level of the reservoir by 8 feet. Power generation would still be possible, though less efficient.
  - *Replacement of the Flashboard Assembly with an Inflatable Rubber Dam—*The installation of an inflatable rubber dam to replace the existing stanchion / flashboard would provide improved control of reservoir pool elevation; thus, significantly reducing or eliminating ice scour of reservoir sediments. The overspill characteristic of a rubber dam, and its ability to withstand ice impact, would allow more precise control of water releases during peak flow. This would also eliminate the stanchion / flashboard system.



Section Through Inflatable Rubber Dam

- **Reservoir Operational Practices—**Reservoir operational practices can affect the quality of water released to the Clark Fork River below the dam. Specific operational practices currently in place or that could be implemented include the following:
  - *Full-pool reservoir operation* is the current NorthWestern Corporation operating policy. The reservoir is maintained at approximately 3263.5 feet above mean sea level for the most efficient power generation. Full pool operation also helps to protect existing wetlands. Operating the dam at full pool, while mitigating sediment discharge and minimizing long-term maintenance of dam structures and systems, would be best performed by replacing the stanchion / flashboard system with an inflatable rubber dam.
  - *BMPs for sediment control* include maintaining the highest practical pool elevation to promote maximum sediment settling, thereby conveying the most sediment-free water downstream. Other sediment management practices include avoiding rapid drawdown of the reservoir and allowing for controlled release of fine grained sediment during the declining limb of high flow events, thereby maximizing sediment dilution to flush the reservoir system. BMPs would be compatible with optimum power generation, except for relatively short-lived events where the pool may be drawn down for declining limb sediment release. BMPs for sediment would also favor wetland maintenance and protection.
  - *Implementing additional ICs and additional measures,* such as boating restrictions or overall prohibition of motorized craft in the reservoir, may provide enhanced protection through reduced turbidity. Restrictions could be enforced seasonally or year-round depending on the level of protection desired.
- **Additional Groundwater/Human Health Protection ICs —**Implementation of groundwater institutional controls includes providing continued funding for maintaining the existing replacement water supply; making available contingency funds to reconfigure, expand, or update replacement water supplies; and establishing a controlled groundwater area to ban future wells within or immediately adjacent to the arsenic plume. This alternative relies on the natural attenuating properties of the environment to reduce metal concentrations through physical and chemical processes. Natural arsenic attenuation mechanisms, such as dilution and adsorption, would be expected to continue to limit the extent of the groundwater plume. Several important ICs are already in effect. These include a number of public land use controls such as Missoula County land use plans, flood plain and subdivision regulations, zoning, and county development regulations for service extensions. The Missoula Valley Aquifer Protection Ordinance controls well use in the county. Private land use controls are also in place, such as access restrictions to private property near the reservoir. These existing measures substantially reduce the presence of residences and persons in the area, as well as pressure for development. Additional land use limitations could consist of dedicated land use, local ordinances, deed restrictions, conservation easements, and future agreements with landowners.

9.2.3 Alternative 2B—Modification of Dam and Operational Practices plus Groundwater Institutional Controls and Containment

Alternative 2B combines the dam outflow works and reservoir operational control modifications described in Alternative 2A and the current ICs and additional measures described in Alternative 1 with groundwater containment and ICs:

- **Groundwater Containment—**Groundwater containment would involve the use of physical barriers to restrict the migration of arsenic laden water into the alluvial aquifer beneath Milltown. To be effective, the physical barrier would need to be approximately 5,000 feet long and keyed into the bedrock, which ranges from approximately 45 to 70 feet below ground surface. Barrier effectiveness also depends on keying the west end of the containment wall into the Milltown Dam foundations. Since there may be dam safety and stability issues related to construction of the slurry wall near the dam footings, this option may not be acceptable to dam safety regulatory agencies.
- **Natural Attenuation within Aquifer Plume—**Assuming the groundwater containment measures described above reduced metals and arsenic loading to the alluvial aquifer, it would be expected that metals and arsenic concentrations in the alluvial aquifer would be reduced over time through natural attenuation. By isolating the source sediments from the aquifer, or at least reducing the degree of connection, groundwater containment would reduce the rate of continued metals loading to the aquifer system.

9.2.4 Alternative 3A—Modification of Dam and Operational Practices with Scour Protection plus Groundwater Institutional Controls

Alternative 3A includes the dam modifications and reservoir operational controls identified in Alternative 2A, the current ICs and additional dam safety and fish passage measures described in Alternative 1, and the additional groundwater ICs described in Alternative 2A. In addition, erosion/scour protection and bank stabilization methods are included in this alternative:

- **Riparian Erosion/Scour Protection—**Areas that are inundated while the reservoir is at or near high pool but exposed at low pool would be seeded or sprigged with native vegetation. These areas comprise 61 acres of the lower reservoir area. Non-native plants and grasses with greater erosion resistance properties could be included in the revegetation mix. Areas with higher potential for scour, such as streambanks or areas of concentrated flow, would be stabilized using a higher degree of protection. In some areas, hard stabilization such as riprap or gabions may be required to protect sediment from scour during peak flows.

9.2.5 Alternative 3B—Modification of Dam and Operational Practices with Channelization plus Groundwater Institutional Controls and Containment

Alternative 3B combines the dam outflow works and reservoir operational control modifications described in Alternative 2A, the current ICs and additional measures described in Alternative 1, and the groundwater containment, natural attenuation within the aquifer plume, and the ICs of Alternative 2B with channelization of surface water flow in the lower reservoir. Limited sediment removal upstream of the dam would be performed to construct and maintain Clark Fork and Blackfoot river channels with adequate capacity to convey a design flow for a 100-year storm event. Sediment removal and channelization are described below:

- **Saturated Sediment Removal—**Limited initial sediment removal (approximately 700,000 cubic yards [cy]) would be implemented to construct a channel with adequate capacity to convey a design flow for a 100-year storm event. The flow depth would require construction of 2- to 4-foot high dikes on both of the constructed channels to contain the 100-year flow within the channel. Sediment removal to create the 100-year flow channels would be performed using hydraulic dredging techniques supplemented with clamshell dredging if significant quantities of debris are encountered. Hydraulically dredged materials would be pumped in a slurry to a containment area for wet disposal or for sediment de-watering and subsequent transport to a dry disposal facility. The reservoir would be maintained at full pool levels while dredging occurred in the river channels. Re-entrainment of sediments in the river flows and turbidity concerns during construction would be addressed, to the degree practicable, using engineering controls such as silt curtains. This alternative assumes that sediment may accumulate in the channels after the initial removal requiring additional periodic removals—perhaps as frequently as every 4 years—to maintain sufficient capacity to convey the 100-year flow within the channel. Approximately two construction seasons would be necessary to complete the initial sediment removal and channel reconstruction work for Alternative 3B. Excavated sediments would require dewatering, transportation, and disposal at an off-site repository. Options for dewatering of removed sediments, transportation of sediments, and off-site disposal of sediments are described below:

  - *Sediment Transport*—Three means of transporting excavated sediments to the disposal site were evaluated: slurry pipeline, truck transport, and rail transport. The actual transportation option selected would depend on whether the sediments were to be disposed of in a "wet" or "dry" repository and the distance to potential disposal sites:

    - Potentially the most cost-effective sediment transportation option if removed by dredge is by slurry pipeline. The relatively high up-front capital investment and the need to maintain the pipeline between removal events may not be cost effective for longer distances or for smaller volume removals.

    - Overland transport via truck is another transportation option for sediments after they have been dewatered. It would require at least 35,000 round-trip truck trips with a standard road legal 20-cubic yard capacity truck with trailer, to relocate the dewatered sediments excavated during the initial excavation (assuming a 700,000 cy initial removal). Transport of sediments excavated during the periodic removal via overland truck would require at least 17,500 round-trip truck trips per event (assuming 350,000 cy per maintenance removal event). Rail transport would require approximately 8,430 rail car loads with 83-cubic yard capacity cars to relocate the dewatered sediments initially excavated to the disposal facility (assuming a 700,000 cy initial removal). Transport of sediments excavated during periodic removal via rail would require approximately 4,200 rail car loads (assuming 350,000 cy per maintenance removal). Rail transport would require construction of loading and unloading spurs and facilities.

– *Sediment Dewatering*—Sediment dewatering could occur onsite with subsequent transport by truck or rail to the disposal site, or at the disposal site after transport using a slurry pipeline. At some dredging sites, sediments have been dewatered using settling ponds with polymers added to the slurry to enhance settling. However, given the limited space available onsite for settling ponds and the relatively fine-grained nature of the Milltown sediments, it is assumed that settling ponds alone would not achieve adequate dewatering in a reasonable time. Effective sediment dewatering would require use of mechanical dewatering, using filter or belt presses, to reduce free water from the sediments prior to truck or rail transportation. Maintenance or periodic re-assembly of the dewatering facility may be required indefinitely since periodic removal of sediments may continue indefinitely. Water collected during either mechanical or passive dewatering will likely require treatment to reduce metals and arsenic concentrations prior to discharge, presumably back to the Clark Fork River.

– *Sediment Disposal*—It is assumed that sediments would be disposed of in a solid waste repository located at a suitable site in Missoula County (or to Opportunity Ponds in Deer Lodge County) in accordance with County, State, and Federal regulations. Operation of the disposal facility may be required indefinitely since periodic removal of sediments may be ongoing. Depending on the disposal option selected, the removed sediments could be mechanically dewatered and transported to the disposal facility for "dry" placement in a non-hazardous repository or the sediments could be transported via a slurry pipeline and placed "wet" in a lined "tailings pond" facility.

- **Channelization—**Channelization of the major river channels directly upgradient of the dam, along the existing Clark Fork and Blackfoot river channel alignments, would be accomplished using engineering controls such as levees, grout-filled mattresses, gabions, rock armor, or sheet piling designed for peak flow. The constructed channel would need to tie into the existing gravel riverbed. Channelization would divert flow that is currently feeding the wetland areas and concentrate flow within a primary channel. Two- to four-foot high armored dikes would need to be constructed on both sides of the Clark Fork and Blackfoot river channels to contain floodwaters during a 100-year flood event. In addition, armored levees would need to be constructed upstream of Duck Bridge to direct floodwaters from the existing braided Clark Fork River channels into the reconstructed channel. These levees would also be sized and armored to prevent overtopping or erosion.

9.2.6 Alternative 5—Dam Removal, Partial Sediment Removal with Channelization and Leachate Collection/Treatment, plus Groundwater Institutional Controls and Natural Attenuation within the Aquifer Plume

Alternative 5 includes the removal of the Milltown Reservoir Dam and a one-time sediment removal to create deeper Clark Fork and Blackfoot river channels upstream of the dam. The upstream channels would be reconstructed and armored to be compatible with the river bottom grade after dam removal and they would be sized for a 100-year storm event. In addition, leachate would be collected and treated from metals-impacted sediments left in place. Groundwater ICs would be similar to Alternative 2A, but tailored to suit this alternative, such as reducing the extent of a controlled groundwater area if leachate collection and natural attenuation were effective in decreasing the extent of the arsenic plume.

- **Sediment Removal, Transportation, Dewatering, and Disposal—**A limited one-time sediment removal (approximately 700,000 cy) would be implemented, using hydraulic cutterhead dredging, to construct a channel with adequate capacity to convey a 100-year design flow. This constructed channel will need to begin upstream of Duck Bridge and tie into the existing gravel riverbed downstream of the dam. Options for removal, transportation, dewatering, disposal, and channelization are described in Alternative 3B. Reach gradient would be increased by removal of Milltown Dam; therefore, flow depths in the reconstructed channels during a 100-year flood event would be less than what would occur under Alternative 3B.
- **Leachate Collection and Treatment—**Leachate collection / treatment involves installing interception trenches (french drains) with pumping wells (sumps) along the perimeter of the reconstructed channel to intercept groundwater percolating through impacted materials prior to discharge to the reconstructed channels. The leachate collection and treatment system would need to operate indefinitely as long as metals release from the left in place impacted sediments presents a loading risk to the Clark Fork River. The treatment system would generate sludge that would require continued disposal in a suitable facility throughout plant operation.
- **Natural Attenuation within Aquifer Plume—**Alternative 5 would be expected to reduce contaminant loading to the alluvial aquifer beneath and downgradient of Milltown through three mechanisms:
  - *Reduction in flux rate of sediment pore water entering the aquifer—*Given their hydraulic connection, the lowering of surface water levels in the reservoir as a result of dam removal would likely result in a similar amount of lowering in lower reservoir sediment water levels. Lower sediment water levels relative to water levels in the underlying aquifer would reduce or potentially reverse the current downward hydraulic gradient from the sediments into the underlying aquifer, which would reduce the flow rate of metals and arsenic impacted sediment pore water entering the aquifer.
  - *Geochemical changes that likely reduce arsenic solubility while increasing copper solubility—*The partial dewatering of the left-in-place sediments would likely reduce the relative amount of sediments exposed to the reducing conditions that geochemically favor release and transport of dissolved arsenic. However, partial sediment dewatering would likely expose additional sediments to oxidizing conditions that favor release of additional dissolved copper.
  - *Leachate collection system pumping—*In addition to preventing sediment leachate from discharging to the Clark Fork and Blackfoot rivers, active pumping of the water from the leachate collection trench system should further reduce the current hydraulic

gradient and water flux from the sediments into the aquifer beneath Milltown. Assuming the measures described above reduced loading of at least arsenic to the alluvial aquifer, it would be expected that the natural attenuation processes described in Alternative 2B would further reduce aquifer contaminant concentrations and plume extent over time.

- **Dam Removal—**Dam removal involves decommissioning of the Milltown Dam. The objective of dam removal would be to eliminate the potential for sudden releases of contaminated sediments from the reservoir and to minimize the potential for future accumulation of sediments. Dam removal would be completed after the sediment removal and channelization / drop structure construction work. Removal of the dam would be performed during low flow periods (July to March) to minimize sediment discharge potential. One to two construction seasons are estimated to complete dam removal. The USACE assumed that dam removal would involve the following:
  - Removing the non-overflow section of the dam
  - Installing a cofferdam / culvert system to pass river water around the dam
  - Installing a cofferdam upstream and downstream to allow dry work
  - Removal of the powerhouse and spillway using demolition techniques
  - Removal of the cofferdams and culvert system
  - Site grading, seeding and installation of bank protection
- **Drop Structures—**Drop structures would need to be constructed on the Clark Fork and Blackfoot rivers at the upstream ends of the removed / reconstructed channels to mitigate upstream headcutting associated with removal of the dam and the resultant drop in river base level. A number of different types of drop structures could be used to mitigate the potential for head cutting. Structures that use more natural gradients and vegetative armoring are available, and would provide a more natural appearing channel. Concrete structures that do not impede fish passage are less costly.

9.2.7 Alternative 6A—Modification of Dam and Operational Practices with Initial Total Sediment Removal of the Lower Reservoir and Periodic Sediment Removal Thereafter, plus Groundwater Institutional Controls and Natural Attenuation in the Aquifer Plume

Alternative 6A involves the initial removal and disposal of all of the metals-impacted sediments in the lower reservoir area. Alternative 6A also includes provisions for fish passage, modifications to the dam outflow works, and reservoir operational controls identified in Alternative 2A. This alternative would remove the thickest sediments, containing the highest concentration of metals. If metals-contaminated sediments re-accumulated to a degree that they represented a new risk to ground or surface water, this alternative would include future removals of re-accumulated sediments. A goal of this alternative would be to reduce or eliminate the groundwater arsenic plume by removing the source sediment area and allowing the natural attenuation processes described in Alternative 2B to restore the aquifer over time.

- **Sediment Removal, Transportation, Dewatering, and Disposal—**The initial removal of the lower reservoir sediments would total approximately 5.2 mcy of sediments. It is estimated that 2.6 mcy of sediment could re-accumulate in the reservoir in 20 years, and require subsequent removal. General options for hydraulic removal, transportation, dewatering, water treatment, and disposal, are as described in Alternative 3B. It is estimated that approximately seven construction seasons would be necessary to complete the sediment removal actions for Alternative 6A. The sediment removal area would initially become a "reservoir lake" after the removal because no backfill would be placed to replace the removed sediments. However, over time sediments would gradually re-accumulate in the removed areas as upstream sediments deposit in the slack water. It would take many decades for the reservoir to completely fill in to recreate its current sediment volume and "run of the river" reservoir planform.

9.2.8 Alternative 6B—Modification of Dam and Operational Practices with Total Sediment Removal of the Entire Reservoir plus Groundwater Institutional Controls and Natural Attenuation within the Aquifer Plume

Alternative 6B involves the removal and disposal of sediments of the entire reservoir area as well as provisions for the fish passage, modifications to the dam outflow works, and reservoir operational controls identified in Alternative 2A. This alternative would be designed to remove all of the impacted sediments within the reservoir area. In addition, if metals contaminated sediments re-accumulated to a degree where there was potential risk to ground or surface water, this alternative would include future removals of re-accumulated sediments from the lower reservoir area only. Similar to Alternative 6A, a goal of this alternative would be to reduce or eliminate the groundwater arsenic plume by removing the source sediment area and allowing the natural attenuation processes described in Alternative 2B to restore the aquifer over time. However, it is assumed that the alternative may need to include some of the groundwater ICs described in Alternative 2A at least as a temporary measure during and immediately after construction.

- **Sediment Removal, Transportation, Dewatering and Disposal—**A one-time sediment removal of the entire reservoir (8.9 mcy) would be implemented as described for Alternative 6A. Approximately 12 construction seasons would be needed to complete sediment removal. As with Alternative 6A, the 6B sediment removal area would initially be a reservoir lake that would gradually fill in as upstream sediments deposit. It is assumed that sediments re-accumulating in the upper reservoir would not be removed in a subsequent removal.

9.2.9 Alternative 7A—Dam Removal with Total Sediment Removal of the Lower Reservoir plus Groundwater Institutional Controls and Natural Attenuation within the Aquifer Plume

Alternative 7A is similar to Alternative 6A except that it includes the total decommissioning of the Milltown Dam. In addition, partial backfill would be needed to reconstruct river channels and flood plains for lateral stability and to provide adequate substrate for establishing vegetation. Also, because the dam and reservoir are removed, significant deposition of sediments from upstream would not be expected. A goal of this alternative would be to reduce or eliminate the groundwater arsenic plume by removing the source sediment area and allowing the natural attenuation processes described in Alternative 2B to restore the aquifer over time. However, it is assumed that the alternative may need to include some of the groundwater ICs described in Alternative 2A, at least as a temporary measure during and immediately after construction. Two Alternative 7A removal volume sub-options were developed, including Alternative 7A1, which assumes removal of all the reservoir sediments and reconstruction of natural channels and flood plains over the entire lower reservoir area; and Alternative 7A2, which would leave the sediments located in Area 2 in place and isolate the sediments from the Clark Fork River channel (similar to Alternative 5, but without leachate collection).

- **Sediment Removal, Transportation, Dewatering and Disposal—**Under Alternative 7A1, a one-time sediment removal of the entire lower reservoir (approximately 5.2 mcy) would be implemented as described for Alternative 6A. Options for hydraulic removal, transportation, dewatering, water treatment, and disposal would be as described for Alternative 3B. Disposal volumes, water volumes, options for mechanical removal, water treatment, transportation, and removal timeframes are similar to Alternative 6A. Under Alternative 7A2, sediment removal would be implemented as described for Alternative 7A1, except that the anticipated removal volume would be reduced to approximately 4.2 mcy. It is estimated that reconstructing the flood plain and channels in the Alternative 7A1 removal area consistent with the upstream template would require approximately 0.5 mcy of flood plain backfill, and construction and shaping of approximately 6,700 feet of new channel (5,400 feet of Clark Fork River channel and 1,300 feet of Blackfoot River channel). Required backfill quantities would be reduced to approximately 0.4 mcy. It is assumed that the reconstructed Clark Fork and Blackfoot River stream channels would be approximately 150 feet wide with a typical water depth of approximately 4 feet under average flow conditions. It is assumed that the native alluvium exposed after the removal of the overlying sediments would be acceptable as bed material for the reconstructed channels. Streambanks would be reconstructed at a bankfull height that allows for out of bank flow when flows exceed a 1.5 to 2 year return interval. Bank stabilization of the reconstructed channels would be necessary to maintain geomorphic stability. Stabilization could include softer bioengineering approaches using vegetation, degradable fabrics, and deformable toe protection using smaller-sized rock riprap. To minimize the amount of channel grading and flood plain backfill required, it is assumed that the centerlines of the reconstructed channels would generally follow the line of minimum elevation in the post-removal exposed alluvium surface.
- **Dam Removal—**As in Alternative 5, dam removal involves the partial decommissioning of the Milltown Dam (spillway only). The power house structure would be retained as a historic artifact.
- **Drop Structures—**Drop structures would be required on the Blackfoot and Clark Fork rivers at the upstream end of the lower reservoir removal area to provide a controlled drop in river water levels to mitigate the potential for upstream headcutting.

EXHIBIT 2-24
Remedial Alternatives Present Value (PV) and Total Cost Summary Table*

Remedial Alternative[1]	PV Capital Costs	PV O&M Costs	PV Site Monitoring Costs	PV Periodic Costs	Total Estimated PV Cost	Total Estimated Cost
Alternative 1[2]	$11,998,713	$3,379,859	$2,232,785	$107,903	$17,719,259	$49,795,897
Alternative 2A[2]	$13,891,487	$3,899,285	$2,232,785	$248,516	$20,272,073	$60,547,983
Alternative 2B[2]	$19,810,153	$4,653,961	$2,396,431	$285,916	$27,146,460	$72,942,798
Alternative 3A[2]	$21,951,508	$5,378,252	$2,232,785	$411,870	$29,974,415	$78,696,478
Alternative 3B[2] (to Local Wet Repository w/Slurry Transport)	$63,199,514	$6,760,876	$2,726,375	$27,130,758	$99,817,523	$365,190,244
Alternative 5 (to Local Wet Repository w/Slurry Transport)	$58,629,053	$46,964,409	$2,562,729	$377,653	$108,533,844	$425,043,546
Alternative 6A[2] (to Local Wet Repository w/Slurry Transport)	$108,448,728	$5,598,246	$3,686,007	$13,810,180	$131,543,162	$455,213,643
Alternative 6B[2] (to Local Wet Repository w/Slurry Transport)	$180,247,619	$8,389,764	$4,305,643	$10,184,941	$203,127,966	$634,893,803
Alternative 7A1 (to Local Wet Repository w/Slurry Transport)	$114,354,252	$3,682,404	$3,686,007	$325,906	$122,048,569	$193,481,287
Alternative 7A2 (to Local Wet Repository w/Slurry Transport)	$85,838,831	$3,459,977	$3,532,066	$348,565	$93,179,439	$167,838,112
Alternative 7B (to Local Wet Repository w/Slurry Transport)	$193,413,583	$6,948,819	$4,305,643	$485,342	$205,153,387	$384,597,688

Notes:

[1]Where multiple sediment transport/disposal options exist for a removal alternative, the lowest cost option is used.

[2]The Total Estimated PV Costs and Total Estimated Costs for alternatives that maintain Milltown Dam include Non-Superfund (i.e. FERC-related) Costs of $15,378,572 and $35,687,097, respectively.

* This Exhibit was prepared in August 2002 for the Draft Final Combined Feasibility Study. These costs may be somewhat out of date, but reflect the source of the bulk of the costs for each alternative, such as operations and maintenance. The current cost range for the selected remedy is presented in Section 13.?. Costs had to be revised because the selected remedy incorporates a number of sub options from various alternatives.

9.2.10 Alternative 7B—Dam Removal with Total Sediment Removal of the Entire Reservoir plus Groundwater Institutional Controls and Natural Attenuation within the Aquifer Plume

Alternative 7B is similar to Alternative 6B except it includes the total decommissioning of the Milltown Dam. In addition, partial backfill would be needed to reconstruct river channels and flood plains for lateral stability and provide adequate substrate for establishment of vegetation.

- **Sediment Removal, Transportation, Dewatering and Disposal—**Same as described for Alternative 6B.
- **Flood plain/Channel Reconstruction, Dam Removal and Drop Structures—**Flood plain / channel reconstruction and dam removal are similar to Alternative 7A1. Flood plain backfill volumes, channel / streambank reconstruction lengths and flood plain revegetation acreages would be increased in Alternative 7B to approximately 1.6 mcy, 13,420 feet (12,120 for the Clark Fork River and 1,300 feet for the Blackfoot River), and 508 acres respectively.

9.3 Expected Outcomes of Each Alternative

None of the alternatives, if implemented individually, would completely achieve all the EPA-identified RAOs, particularly meeting WQB-7 surface water quality for copper or groundwater quality for arsenic, because of continued loading from upstream, and residual sediment contamination sources left onsite. Upon implementation, Alternatives 2a through 3b would reduce the potential for sediment scour events by increasing the dam’s ability to manage flows and winter ice passage, while adding some erosion resistance to river banks. However, the contaminated sediment source material would continue to contribute dissolved arsenic to the groundwater even if the slurry cutoff wall were successful in preventing arsenic movement to the north. Alternative 5, although eliminating the reservoir pool by dam removal, would not adequately address chronic aquatic and erosional risks of source material that would remain along streambanks and in the active flood plain. Alternatives 6a and 6b enhance flow management by retaining the dam, and engage in various contaminated sediment source removal scenarios, but still retain the potential to impound contaminated soils and sediment eroded from upstream. The variations of Alternative 7, which engage dam removal and sediment source material removal as their remedial cornerstones, come closest to reducing the risks, being protective, and complying with ARARs. Groundwater RAOs would be achieved more quickly under Alternatives 5 and 7, as compared to other alternatives. Alternatives 2, 3, and 6 would potentially take the longest period of time to achieve groundwater RAOs, and may never achieve total compliance.

9.3.1 Alternative 1—No Further Action

Because no further action would be taken under this alternative, the expected outcome would be as follows:

- Contaminated sediments would continue to be eroded from the reservoir during scour conditions and transported downstream. Total and dissolved copper would be liberated to the detriment of downstream aquatic life.
- Elevated groundwater arsenic concentrations would continue for the foreseeable future as reservoir pool water drives arsenic-laden sediment pore water into the local aquifer, sustaining the existing groundwater plume. Impacted areas may improve over time, but many risks and associated affects would continue for many years.
- Human health risks from groundwater consumption would continue. The lack of ICs to prevent groundwater use would not prevent consumption despite the presence of the alternative water supply.
- Ecological impacts would be likely and ARARs would not be achieved.

9.3.2 Alternative 2A—Modification of Dam and Operational Practices plus Groundwater Institutional Controls

The emphasis of this alternative is on reservoir pool level control to protect the dam against future ice jams and to mitigate uncontrolled sediment releases. The anticipated outcomes of this alternative are as follows:

- Installation of an inflatable crest does allow more accurate management of reservoir pool stage, particularly during high flows. However, it does not address erosion of reservoir bed sediment during maintenance related drawdowns and ice scour events, nor would it reduce or eliminate the continual transport of arsenic from reservoir sediments into the local aquifer.
- Aquifer cleanup would be left to natural attenuation and ICs to limit human risk with a cleanup rate of literally decades. The objective of better control over pool elevation management would occur rapidly, but much uncertainty relative to sediment scour (and subsequent downstream impacts to aquatic life) and arsenic contamination of the local aquifer would continue, which would inhibit its beneficial use.
- Continued ecological impacts would be likely. ARARs and replacement standards would not be achieved in a timely manner.

9.3.3 Alternative 2B—Modification of Dam and Operational Practices plus Groundwater Institutional Controls and Containment

Alternative 2B embodies the attributes of 2A and adds a groundwater containment feature to help limit, or at best prevent, the flow of contaminated groundwater into the local valley aquifer. If successful, natural attenuation and dilution would be relied upon to remediate the existing groundwater plume. ICs over groundwater use would still be needed. The anticipated outcome of implementing this alternative would be as follows:

- The continued arsenic and metals loading to the aquifer would be reduced; however, the uncertainties associated with the successful construction and implementation of a slurry cutoff wall are many.
- In spite of construction of a cutoff wall, the source sediment material would remain and the generation of dissolved arsenic and metals in the sediment pore water would continue, with the fate and transport of these contaminants uncertain.
- Other concerns related to sediment scour as described as part of Alternative 2A would apply to this alternative as well. Continued ecological impacts would be likely.
- Groundwater ARARs would not be achieved in a timely manner. Surface water ARARs would be violated periodically.

9.3.4 Alternative 3A—Modification of Dam and Operational Practices with Scour Protection plus Groundwater Institutional Controls

This alternative is identical to 2A with the addition of a riparian erosion / scour protection component. The intent of the riparian erosion / scour protection component is to stabilize and protect an additional 61 acres of exposed sediment that would be susceptible to erosion during high flows. Expected outcomes associated with this alternative include the following:

- Source sediments would remain in-place. The generation of dissolved arsenic and metals from the sediments would continue to migrate into the valley aquifer. Groundwater clean-up would rely on natural attenuation and dilution to mitigate conditions over a long period of time. Groundwater ICs would prevent the use of portions of the valley aquifer as a potable water supply.
- Scouring during extreme events would continue to entrain contaminated sediment and transport it downstream. Downstream aquatic life would remain at risk during these periods.

9.3.5 Alternative 3B—Modification of Dam and Operational Practices with Channelization plus Groundwater Institutional Controls and Containment

Alternative 3B encompasses the attributes of Alternatives 1 and 2 with a channel enhancement (to contain 100 year flow) for both the Clark Fork and Blackfoot rivers near the Milltown Dam. Channelization would entail the removal of 700,000 cy of sediment and its transport to a repository. The outcome of this alternative would be as follows:

- Most of the source sediments would remain to contribute to the degradation of the local aquifer, leaving uncertain natural attenuation and dilution to mitigate the groundwater impacts.
- Some risk associated with mobilizing and transporting contaminated sediment downstream as a result of extreme hydrologic events would remain.
- Over time, upstream sediment would re-accumulate in the excavated channel sections and require periodic removal.

- The pool elevation would be managed more effectively to pass ice flows and debris during high water. However, downstream aquatic life remains at risk.
- New risk associated with the excavation and safe transport / deposition of contaminated sediment becomes a concern with this alternative.

9.3.6 Alternative 5—Dam Removal, Partial Sediment Removal with Channelization and Leachate Collection/Treatment, Plus Groundwater Institutional Controls and Natural Attenuation within the Aquifer Plume.

Partial sediment removal (700,000 cy), channelization with leachate collection and treatment, and dam removal are the primary attributes of Alternative 5. The existing groundwater plume would be remediated through natural attenuation and dilution. The outcome of this alternative would include the following:

- A free flowing river confluence would be created, with a significant volume of contaminated sediments left within the existing channel and 100-year flood plain. This residual material remains susceptible to high flow and ice scouring and remains a threat to the local aquatic system.
- The conditions contributing to the movement of contaminated pore water into the local aquifer are removed and local water tables are expected to adjust by stabilizing at lower levels. In some localized areas, particularly adjacent to the reservoir, groundwater flow direction may be altered as the channel seeks a new equilibrium elevation.
- Groundwater recharge to the Clark Fork River, in the vicinity of the reservoir and through the remaining adjacent sediment, would be intercepted and treated to prevent potentially contaminated pore water from directly entering the river.
- The potential scour of contaminated in-channel and residual flood plain sediment continue to place downstream aquatic life at risk when this sediment is mobilized in large volumes.
- Groundwater ARARs may be met more quickly under this alternative as the reservoir conditions that sustain and feed the arsenic plume are greatly reduced or eliminated.

9.3.7 Alternative 6A—Modification of Dam and Operational Practices with Initial Total Sediment Removal of the Lower Reservoir and Periodic Sediment Removal thereafter, plus Groundwater Institutional Controls and Natural Attenuation in the Aquifer Plume.

Under this alternative, the dam would remain with a new inflatable crest, the groundwater arsenic plume would be managed through ICs with natural attenuation and dilution remediating its impacts, and 5.2 mcy of reservoir sediment would be removed through dredging and transported to a repository. The outcomes associated with this alternative would include the following:

- Significant short term risks associated with implementing this large removal over a multiple construction year schedule (7 years) under uncertain hydrologic conditions.

- Potential for short term exacerbation of the groundwater arsenic plume during the sediment removal through exposure of the sediments and maintenance of constant head conditions.
- Even with the removal of this large volume of sediment, the risk of scour and transport downstream of residual contaminated sediment not being removed would remain.
- This would not be a permanent solution as the area behind the dam would refill with sediment from upstream over time.

9.3.8 Alternative 6B—Modification of Dam and Operational Practices with Total Sediment Removal of the Entire Reservoir, plus Groundwater Institutional Controls and Natural Attenuation in the Aquifer Plume.

This is the total sediment removal alternative and would involve the removal of 8.9 mcy of sediment impounded by the Milltown Dam. The expected outcomes of this alternative include the following:

- Significant short term risks associated with implementing this large removal over a multiple construction year schedule (12 years) under uncertain hydrologic conditions.
- Potential for short term exacerbation of the groundwater arsenic plume during sediment removal through exposure of the sediments and maintenance of constant head conditions.
- Contaminated groundwater would be remediated passively over a decade or so through natural attenuation and dilution. Elimination of the arsenic source for the plume would accelerate this process.
- This alternative does not propose a permanent solution. The area behind the dam would refill with sediment from upstream over time and may eventually require dredging, depending on the contaminant quality of the sediment.
- From a risk reduction/cost ratio, this alternative would not be as cost effective as some of the other alternatives.

9.3.9 Alternative 7A—Dam Removal with Total Sediment Removal of the Lower Reservoir, plus Groundwater Institutional Controls and Natural Attenuation in the Aquifer Plume.

Alternative 7A consists of dam removal and several variations of sediment removal (7A1—total removal of all sediments and reconstruction of a new Clark Fork River channel; and 7A2—isolate and remove Area 1 only (2.6 mcy) and reconstruction of a new Clark Fork River channel). The anticipated outcome of this alternative and sub-options would be as follows:

- For 7A1, significant short term risks associated with implementing this large removal over a multiple construction year schedule (7 years) under uncertain hydrologic conditions. For 7A2, the removal process could be managed into a more compact schedule (5 years) that would reduce the risk for upset resulting from the occurrence of an extreme hydrologic event.

- For 7A1, even with the removal of this large volume of sediment (5.2 mcy), the risk of scour and transport downstream of residual reservoir contaminated sediment not being removed would remain. This remains an issue for 7A2 as well (remove 2.6 mcy), although sediment with the highest copper and arsenic concentrations would be removed.
- Groundwater recovery under 7A1 may be exacerbated if the sediments are removed under full pool prior to removal of the Milltown Dam. Exposure of more sediments during the dredging process under a full pool head may result in more arsenic migrating into the local aquifer. The same outcome is less likely for 7A2, since Area 1 will be isolated and a significant proportion removed mechanically (in the dry) rather than dredged.
- Elimination of the reservoir pool and the significant source sediments should hasten the recovery of the existing arsenic plume under both sub options (from centuries to a decade or so).

9.3.10 Alternative 7B—Dam Removal with Total Sediment Removal of the Entire Reservoir, plus Groundwater Institutional Controls and Natural Attenuation in the Aquifer Plume.

Alternative 7B consists of the removal of all the sediment in the reservoir, reconstruction of a new Clark Fork River channel and flood plain, and removal of the dam. As with the other dam removal alternatives, drop structures would be utilized to prevent excessive head cutting and erosion around critical structures (such as bridge abutments) and to limit uncontrolled channel alteration upstream. The expected outcome of implementation of this alternative would be as follows:

- The method and schedule for the removal of the sediment would influence the risks to downstream aquatic life and the potential impacts to the existing arsenic groundwater plume. The longer it takes, the greater the potential for an extreme hydrologic event to influence the remedial process.
- A potential for short term exacerbation of the groundwater arsenic plume exists during the sediment removal through exposure of the sediments and maintenance of constant head conditions with in the reservoir, assuming full pool.
- Contaminated groundwater would be remediated passively over a decade or so through natural attenuation and dilution. Elimination of the arsenic source for the plume would accelerate this process.
- From a risk reduction/cost ratio, this alternative would not be as cost effective as some of the other alternatives.

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10 Comparative Analysis of Alternatives

10.1 EPA's Nine Evaluation Criteria

The NCP at 40 CFR § 300.430(e)(9)(iii) and (f)(1)(i) requires EPA to utilize and evaluate the nine criteria listed at Section (e)(9)(iii) to select a remedial action for a site. Section 300.430(f)(5) requires EPA to document how the evaluation of the nine criteria were used to select a remedy. The major objective of this activity is to evaluate the relative performance of each alternative with respect to each criteria, and consider the tradeoffs of each, selecting one, or the combination of several, as a comprehensive remedy. This helps ensure that advantages and disadvantages of each alternative are clearly understood. The nine evaluation criteria are as follows:

- **Threshold Criteria**—*Must be Addressed*
  1. Overall Protection of Human Health and the Environment
  2. Compliance with ARARs
- **Balancing Criteria**—*Must be Considered*
  3. Long-Term Effectiveness and Permanence
  4. Reduction of Toxicity, Mobility, and Volume
  5. Short-Term Effectiveness
  6. Implementability
  7. Capital and Operating and Maintenance Cost
- **Modifying Criteria**—*Must be Considered*
  8. State Acceptance
  9. Community Acceptance

A brief description of each criterion follows in the remainder of this section (10.1). Section 10.2, *Comparison of Alternatives for Each Evaluation Criteria,* contains a text description of how the alternatives compared within each evaluation criterion, including State and community acceptance. This represents EPA's final evaluation of the criteria following receipt of public comments. Next, Exhibit 2-25, *Comparative Analysis of Alternatives for the Milltown Reservoir Combined Feasibility Study*, summarizes the evaluation of the first seven criteria that were presented in the *Combined Feasibility Study* (Atlantic Richfield Company 2002c). Because this ranking was completed long before the issuance of the *Original Proposed Plan* or *Revised Proposed Plan* and associated public comment periods, the modifying criteria of State and community acceptance were not included in this analysis. Since the public comment periods, these two factors were analyzed in the *Responsiveness Summary* (Part 3 of this *Record of Decision)* and in the consideration by EPA of the public comments and in further discussions with the State.

10.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through removal, treatment, engineering controls, or ICs. Particularly, the extent to which each alternative met the following was evaluated:

- Reduces or removes the source of arsenic that is currently sustaining the Milltown groundwater arsenic plume; allows the aquifer to naturally attenuate the plume over time.
- Reduces or removes the potential for remobilization of metals-laden sediment from the reservoir (by hydraulic or mechanical ice scouring) into the downstream flow path of the Clark Fork River; contributes to the health of the aquatic life downstream of the dam.
- Reduces chronic risks to aquatic receptors; these risks are associated with copper and zinc loading, and sedimentation during annual flows.
- Contributes to the restoration of the resource in a reasonable time period (several decades for groundwater and 4 to 7 years for surface water) and maintenance of the beneficial use of both surface and groundwater.

EPA Region 8 concluded that only the alternatives that lead to permanent prevention of ice scour events best meet this criteria. Such alternatives include components calling for sediment removal and restoration of the aquifer to its beneficial use. ICs and business or regulatory decisions that would involve retaining the dam are too uncertain and unreliable to completely meet this goal.

10.1.2 Compliance with ARARs

Section 121(d) of CERCLA and NCP 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legal applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs." ARARs may be waived under CERCLA Section 121(d)(4). A complete list of ARARs and invoked waivers is included as Appendix A to this *Record of Decision*. That appendix contains appropriate definitions and descriptions of terms relevant to the ARAR identification and compliance analysis for this site. The ability of each alternative to meet the following key ARARs is highlighted in the analysis:

- **Contaminant Specific Criteria—**Considered groundwater and surface water quality criteria and the ability of each alternative to achieve water quality standards; and compliance with water quality standards under unique events, such as ice scouring.
- **Location Specific Criteria—**Federal and State solid waste and flood plain requirements, and ESA requirements were examined carefully.
- **Action Specific Criteria—**Includes Montana's Solid Waste Management Act and the proposed method for dealing with waste removal and disposal for each alternative.
- **Waived ARARs—**A waiver of the surface water quality ARARs is invoked during construction of the remedy, because the release of sediments during drawdown and excavation is unavoidable for this project. Temporary replacement standards are identified for construction activities, both for ambient concentrations and point sources.

EPA Region 8 determined that alternatives that remove dam and the most contaminated sediments meet this criteria by leading to compliance with groundwater ARARs within a reasonable timeframe. An up-front waiver of groundwater standards may not be possible at this site, since it is technically practicable to remove the sediments and remediate the groundwater within reasonable time frames to appropriate standards. Alternatives which left the dam and waste in place would not have met location specific ARARs.

10.1.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels are achieved. This criteria is an important one to the State, other Trustees, and the public, and is emphasized in the NCP and its preamble. Key issues examined under this criteria include the following:

- **Magnitude of Residual Risk—**Considered the future effects on surface water and aquatic systems (benthic macroinvertebrates and fisheries), groundwater and potable water supplies, and riparian ecosystems, especially if catastrophic releases occurred.
- **Adequacy and Reliability of Controls—**Considered the use and adequacy of perpetual dam maintenance and ICs.

EPA Region 8 concluded that dam and sediment removal alternatives best meet this criteria through avoidance of reliance on perpetual dam maintenance and upgrades, ICs, and elimination of residual risk.

10.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the technologies that may be included in a given remedy. As applied to this site, reduction in mobility and volume of contamination within the flood plain is an important balancing consideration. This criterion evaluation focused on the effectiveness of physical removal of the most highly contaminated sediment to meet the objectives of reduction or elimination of mobility and volume, and breaking contaminant transport pathways.

EPA Region 8 concluded that sediment removal options best meet this criteria, by reducing mobility of contaminants through removal of the sediments from the fluvial system. Alternatives that left waste in place did not effectively meet this criterion.

10.1.5 Short-Term Effectiveness

Short term effectiveness addresses the period of time needed to implement a remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved. Detailed issues specific to this site that were especially considered included in the following:

- **Protection of Community and Workers During Remedial Actions—**Considered the volume of materials proposed to be dealt with, the methods of transporting the materials, and the time and safety elements. Alternatives that involved total or partial removal to a local repository with trucks as a method of transporting the material were generally considered be less protective. Use of rail cars to transport to an existing repository was considered more protective in the short term.

- **Environmental Impacts of Implementation**—Addressed impacts on surface water quality, including turbidity resulting from proposed activities, and short-term impacts on the stability of the groundwater arsenic plume. Wetlands impacts were also considered.
- **Time Until Remedial Action Objectives are Achieved**—Considered how long the remedial action would take, once implemented, to achieve RAOs and performance standards. Alternatives that resulted in achievement of groundwater standards within a reasonable time met the sub-criteria used—alternatives that did not meet groundwater RAOs did not.

EPA Region 8 concluded that alternatives that allowed the dam to remain in place presented less short-term risk and less destruction of wetlands, but this is outweighed by the length of time until groundwater quality objectives and goals are met. Disposal of waste by rail haul to an existing repository had less short-term risk than truck haul to a local repository.

10.1.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Generally, factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are considered. Key issues for this site highlighted in the analysis of this criterion are as follows:

- **Technical Feasibility**—Considered ability to construct and operate the technology, time required for implementation, reliability of the technology, ability to monitor effectiveness, and ease of undertaking additional actions should they be necessary at some future date.
- **Administrative Feasibility**—Considered ability to obtain approvals and coordinate with other agencies. This included working with counties and municipalities, as well as State and federal regulatory authorities.
- **Availability of Services and Facilities**—Considered the availability of necessary equipment, specialists, materials (including backfill materials), and the availability of offsite facilities for disposal of wastes.

EPA Region 8 concluded that alternatives that allow the dam to remain in place are more implementable, but less reliable. EPA worked closely with the other governmental stakeholders, the Atlantic Richfield Company, and the USACE to plan a dam and sediment removal option that is implementable and cost effective.

10.1.7 Capital and Operating and Maintenance Cost

This criteria involved the comparison of net present worth costs for each alternative as proposed. See Exhibit 2-24, presented earlier in Section 9.2, *Combined FS Alternatives Descriptions*, for a list of projected alternative costs. Cost effectiveness was then considered, as described in NCP Section 300.430(f)(ii)(D).

It should be noted that all alternatives that involve keeping the dam in place may have considerable additional costs associated with dam safety and fish passage upgrades. Again, EPA worked closely with the governmental stakeholders, the USACE, and the Atlantic Richfield Company to maximize cost effectiveness of the Selected Remedy.

10.1.8 State and Community Acceptance

Of the nine criteria available to evaluate various cleanup alternatives for the MRSOU, the *Combined Feasibility Study* examined the first seven, which are the **threshold** and **balancing** criteria. These criteria were evaluated again after receipt of public comment and during the selection of the remedy. The remaining two criteria, State acceptance and community acceptance, are the **modifying** criteria and were carefully evaluated after the public comment period on the *Revised Proposed Plan*. It is clear that the State and community concur with EPA's Selected Remedy of dam and partial sediment removal. Part 3, *Responsiveness Summary*, of this *Record of Decision*, describes the comments received, provides EPA's responses, and illustrates support for the Selected Remedy.

Three different departments within the State of Montana are involved in the Milltown Superfund project: DEQ, FWP, and NRDP. All three departments have expressed strong support for dam and sediment removal, citing the importance of cleaning up a drinking water aquifer, providing a permanent remedy without future uncertainty, restoring the native fisheries, and returning the Clark Fork and Blackfoot rivers to a free-flowing state. Montana's Governor and Attorney General also support dam and sediment removal.

Two other Trustees at the Milltown Site, the CSKT and the USFWS, are both on record strongly in support of dam and sediment removal. The CSKT have treaty rights along the Clark Fork and Blackfoot Rivers and cite the importance of leaving a clean, healthy environment for future generations and the importance of a restored fishery as rationale for supporting dam and sediment removal. USFWS strongly supports dam and sediment removal, stating that any short term impacts are far outweighed by the long-term improvement in water quality, the fishery, and overall health of the Clark Fork River.

In addition, Missoula City and County have both passed bi-partisan, unanimous resolutions calling for dam and sediment removal as the appropriate remedial action for the Milltown OU and for the restoration of the Clark Fork and Blackfoot Rivers. Both entities strongly supported dam and sediment removal during the public comment periods.

Finally, overall community acceptance did play an important role in the selection of the Remedy. EPA received several thousand letters and postcards prior to the *Original Proposed Plan*, indicating a strong desire for dam and sediment removal at this site. After issuance of the *Original Proposed Plan*, EPA received support from approximately 88 percent of the commenters on the plan. The main concern raised by commenters was the location of the sediment repository at Bandman Flats. EPA modified its *Original Proposed Plan* in response to these comments, and issued the *Revised Proposed Plan* in 2004. EPA received comments supporting the plan from approximately 98 percent of the commenters on this plan. EPA also met with residents of Opportunity and Anaconda, Montana, where the rail-hauled waste will be disposed. EPA answered questions about the disposal plans for this area, which is on Atlantic Richfield Company-owned property and is away from residential areas in Opportunity and Anaconda. EPA also received public comment concerning wetland protection or replacement, the integration of restoration, and historical mitigation. EPA has considered all public input carefully, and has modified the Selected Remedy to address issues of public concern where possible. EPA's detailed response to all comments is contained in the *Responsiveness Summary* portion of this *Record of Decision*, Part 3.

10.2 Comparison of Alternatives for Each Evaluation Criteria

Additional detail about how the alternatives compared based on the nine evaluation criteria is provided in the remainder of this section. This analysis expands on and modifies the *Combined Feasibility Study* analysis (see Exhibit 2-25).

10.2.1 Overall Protection of Human Health and the Environment

Each alternative, except Alternative 1, included human health protection components. Alternative 1, the No Action Alternative, does not address the unacceptable risks and pathways and therefore was not considered further. Alternatives 2A, 2B, 3A, and 3B emphasize enhanced reservoir management while retaining long term ICs for groundwater use and relying on natural attenuation without any source removal. This provides a measure of overall protection; however, because it relies on ICs that are not in place or that may change in time, it does not reliably address the human health risk pathways associated with the reservoir source sediments and the arsenic contamination of groundwater. Under these alternatives, downstream aquatic life continues to be threatened by the residual risk of leaving large amounts of contaminated sediment in-place and susceptible to scour by high flows and ice formation, or by catastrophic release.

Alternatives 5, 6A, 6B, 7A1, 7A2, and 7B better met the threshold criteria of overall protectiveness. However, each of these alternatives have benefits and drawbacks as demonstrated in the *Combined Feasibility Study*. When compared to the others, Alternatives 5 and 6B provide less protection. Alternative 5 allows the source sediments to remain in-place, leaving them susceptible to scour during flooding and allowing them to potentially influence groundwater. Alternatives 6A and 6B allow a continued risk of future deposition and impoundment of contaminated sediment from upstream. Alternative 7, with dam and sediment removal options (A1, A2, B), appears to provide the best overall protection of human health and the environment. It directly addresses exposure pathways relative to arsenic in the groundwater, and scour and erosion risks associated with downstream sediment and copper loading.

10.2.2 Compliance with ARARs

Removal of the Milltown Dam and all the reservoir sediments (Alternatives 6B and 7B) presents the greatest opportunity to comply with ARARs. However, these alternatives may assume higher long-term risk of non-compliance during implementation because of the volume of material to be removed. An ARAR waiver is appropriate for construction-related violations of ARARs. Alternatives 2 through 5 would not meet groundwater ARARs, and would not likely meet location specific ARARs such as solid waste and ESA ARARs. Alternatives 2 through 7 would have similar effects on long-term surface water quality ARARs, because upstream water quality would be the dominant influence on surface water and would not change under any alternative. Alternatives 7A1 and 7A2 represent partial sediment removals and are the most likely to meet all ARARs and still remain viable from an implementability and cost effectiveness standpoint. Alternative 7A1 removes all of the lower reservoir sediment, while Alternative 7A2 only removes that portion of the sediment contributing to the groundwater plume. The unique method of sediment removal and the compressed schedule of Alternative 7A2 make it the most likely of all to meet surface water, groundwater, and solid waste ARARs.

10.2.3 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence criterion considers the expected residual risk and the ability to maintain reliable protection of human health and the environment after implementation of the remedy. Alternatives 1, 2A, 2B, 3A, 3B, and 6A leave the Milltown Dam and large volumes of contaminated sediments in place, resulting in long-term residual risk to human health and to downstream aquatic life. Because ICs and dam maintenance in perpetuity cannot be completely assured, the alternatives are considered less reliable or not permanent.

Alternatives that remove the dam and sediments provide the best long-term effectiveness and permanence. Alternative 5 removes the dam but relies on a re-excavated and armored channel to manage the erosion of source sediment. This alternative is more susceptible to mobilization of contaminated sediment during high flow events, rendering it less effective in the long-term and certainly not permanent. Alternatives 6B, 7A1, and 7B endorse the removal of the dam and the entire lower reservoir or all the reservoir sediments. The time frame for completing such large removals is significant; however, once completed these alternatives would successfully meet the need for long-term effectiveness and permanence. Alternative 7A2 requires less sediment removal in a shorter time frame. The magnitude of residual risk is most favorable for these alternatives, although each will still require the implementation of groundwater ICs, but for a shorter period time than originally predicted.

10.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives 5, 6A, 6B, 7A1, 7A2, and 7B address reduction in mobility and volume to a greater degree than other alternatives because they remove more contaminated sediment from the reservoir, where it is likely to become mobile over time. The physical removal of the sediments (the principal wastes) is a more reliable method for limiting mobility and reducing volume. The transport of the waste to Opportunity Ponds (an existing waste repository near Anaconda, Montana) for potential use as a vegetative cap under Alternative 7A2 will reduce the toxicity of this material by its upland deposition and amendment with lime and organic matter. Alternatives 1, 2A, 2B, 3A, and 3B do not reduce the toxicity, mobility, or volume as reliably as the other alternatives.

10.2.5 Short-Term Effectiveness

Large volumes of material would be removed in Alternatives 5, 6A, 6B, 7A1, and 7B. These alternatives pose a potential for greater short-term risk relative to climatic factors and hydrologic concerns (flooding, extreme ice flow events, etc.), occurrence of potential for traffic and equipment related accidents, risks to water quality during construction, risks to the stability of the flood plain, and the duration of the remedial activity before full implementation occurs. These alternatives would take a relatively longer period of time to implement. On the other hand, these alternatives would achieve groundwater performance standards more quickly. Alternative 7A2 exhibits concerns for greater short-term risk described above, but to a lesser degree because of its compressed time frame and smaller removal of sediment volume.

Alternatives 1, 2A, 2B, 3A, and 3B would have less short-term impact on the community and the environment because they are less intrusive as a remedy and retain a managed reservoir environment behind the dam to help control sediments that are liberated during the remedial activities. However, these alternatives would not achieve RAOs and associated ARARs for groundwater for centuries.

10.2.6 Implementability

Because of the large volumes of material that would be removed in Alternatives 5, 6A, 6B, 7A1, 7A2, and 7B, these alternatives are difficult to implement because they require considerable effort to coordinate with agencies, and may tax the local resources to transport excavated waste to repositories and backfill excavations. Alternatives involving local waste repositories would be difficult to implement because of the need to find appropriate land for such uses. Nevertheless, focused projects of this nature are being done and are feasible.

FERC's role in dam removal required detailed coordination activities. Alternatives 2A, 2B, 3A, and 3B would be somewhat more easily implemented because they do not require dam removal and involve less sediment removal. Enacting permanent ICs for groundwater may be administratively difficult because of the opposition to such controls by the local county government. Alternatives that leave waste in place would also require extensive coordination on dam safety upgrades.

EPA addressed some of the implementability issues associated with dam and sediment removal alternatives by 1) proposing to remove only the sediments that are most harmful to aquatic life and groundwater rather than larger areas in the original *Proposed Plan*; and 2) devising a modified version of that plan in the *Revised Proposed Plan* which eliminates the need for a local repository.

10.2.7 Cost

Alternatives 1, 2A, 2B, 3A, and 3B are least costly, but do not reliably achieve basic threshold criteria. Because of the large volumes of material that would be removed in Alternatives 5, 6A, 6B, 7A1, and 7B, they are much more costly than the other alternatives with 7B being the most costly, but they achieve significant benefits in terms of permanence. Alternatives 6A and 6B require ongoing and difficult re-dredging and maintenance activities, making these alternatives less cost effective than other removal alternatives. Alternative 7A2 falls about mid-range and is 52 percent of the cost of the most expensive alternative. Using the criteria found in NCP section 400.300(f)(ii)(D), EPA believes that Alternatives 7A1 and 7B would not be sufficiently cost effective, and that the overall effectiveness of Alternative 7A2, compared to its costs, best meets the cost effectiveness criteria.

10.2.8 State Acceptance

The State of Montana determined that removal is more protective and more fully complies with Montana ARARs than other alternatives that allow the sediments to remain in place.

DEQ believes removal of contamination offers a more permanent and effective remedy where contamination can feasibly and reliably be removed. DEQ's concerns regarding the MRSOU focus on surface and groundwater protection as well as ARAR compliance. DEQ considered public comment received on both the *Original Proposed Plan* and the *Revised Proposed Plan* prior to declaring their concurrence with the Selected Remedy. EPA has worked closely with the State in developing the Selected Remedy. The State's Concurrence Letter is provided in Appendix B.

10.2.9 Community Acceptance

In response to the *Original Proposed Plan* and *Revised Proposed Plan*, EPA received numerous comments. Approximately 88 percent of the comments on the *Original Proposed Plan* supported EPA's proposal, and 98 percent of the comments supported the *Revised Proposed Plan*. EPA values and has incorporated public input where possible and consistent with statutory and regulatory mandates and EPA guidance. The Selected Remedy has been modified in response to comments on the both *Proposed Plans*. The changes are explained in Section 12.1, *Rationale for the Selected Remedy*; Section 14, *Documentation of Significant Differences;* and in Part 3, *Responsiveness Summary*.

There has been substantial community input into this process and a large segment of the surrounding population and the City and County governments strongly urged EPA to select the dam and sediment removal option. EPA received public opposition to the proposed repository location (Bandman Flats) and the location of the rail loading area during the public comment period on the *Original Proposed Plan*. The Selected Remedy places the rail loading area down on the reservoir site, which is much more isolated from the community. EPA believes that the Selected Remedy, with its adjustments after the *Original Proposed Plan*, is strongly endorsed by the community. The Selected Remedy provides a locally acceptable waste loading area, and a disposal option that actually lessens community impacts.

The number of people who supported or did not support the proposed remedy, as well as a description of their comments, is provided in Part 3, *Responsiveness Summary*, Section 2, *Original Proposed Plan Comments and Responses*, and Section 3, *Revised Proposed Plan Comments and Responses*. The *Responsiveness Summary* also summarizes any significant concerns that people expressed following the release of both *Proposed Plans* and includes responses to those concerns by EPA and DEQ.

In summary, EPA has received strong support for a clean-up of the Milltown Sediments and restoring the Clark Fork and Blackfoot Rivers to a free flowing condition. EPA notes concerns expressed with respect to sediment release during the implementation of the remedy, and other concerns regarding the creation of a natural-appearing channel following sediment removal. EPA supports the use of a variety of remedial actions to assist with the clean-up effort and to minimize the release of sediments, including bypass channel construction, careful sequencing of construction activities, and real time monitoring of water quality. EPA worked closely with the State NRDP and other Trustees to address their concerns and to integrate restoration with remediation, which was a community concern. EPA recognizes the potential hardship on the community during clean-up activities and plans to coordinate closely with residents to formulate a successful clean-up.

10.2.10 Conclusion of Alternative/Criteria Evaluation

Alternative 7A2, with several modifications as described in the *Original Proposed Plan* and the *Revised Proposed Plan*, is identified by EPA as the Selected Remedy. The complete Selected Remedy is described in detail in Section 12 of this *Record of Decision*. The Selected Remedy meets the threshold criteria, and reflects a fair balance between long-term effectiveness and permanence, short-term effectiveness, reduction of mobility, toxicity, and volume, and implementability issues associated with these alternatives. Long-term effectiveness and permanence weighed heavily in EPA's decision to require the removal of the source sediments in Area 1. Reduction in mobility and volume associated with removal and disposal to an existing repository where the sediment's toxicity will be reduced through its possible use as a vegetative capping media also influenced the choice of the Selected Remedy. EPA carefully examined the short-term effectiveness and implementability criteria, and believes these issues can be managed under EPA's Selected Remedy. ARAR compliance will be achieved under the Selected Remedy, and a waiver of water quality standards during construction activities, accompanied with protective replacement standards, is appropriate. Removal of the source sediments and Milltown Dam, and the associated cooperative action of removal of the Stimson Dam, restores the rivers to free flow and promotes overall protectiveness and long-term effectiveness. Application of dry removal procedures to the sediments will lessen short-term safety and environmental impacts, and allow for a shorter remedial action construction period. EPA believes the Selected Remedy is cost effective and will achieve benefits and effectiveness proportional to the expected costs. EPA and DEQ aim to address public concerns regarding impacts to water quality from the remediation by constructing a bypass channel and sequencing construction activities to allow for scour and dispersion of sediments to occur during high flow periods during implementation. Finally, State acceptance was important to EPA, so coordination with the State's restoration activities was facilitated and is reflected in the Selected Remedy.

EXHIBIT 2-25
Comparative Analysis of Alternatives for the Milltown Reservoir Combined Feasibility Study

	Comparative Analysis of Remedial Alternatives*						
	Threshold Criteria		Balancing Criteria				
Alternatives	**Overall Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, and Volume Through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Capital/ Operating and Maintenance Cost**
1	Not Protective	NR	NR	NR	NR	NR	NR
2A	M-H	M	M	L-M	H	H	H
2B	M	M	M	M	M-H	M	M-H
3A	M-H	M	M	L-M	H	M-H	M-H
3B	M	M	M	M	M	M	M
5	M	M	L-M	M	M	M	L-M
6A	M	M-H	M-H	M-H	L-M	M	L-M
6B	M	M-H	M-H	M-H	L	M	L
7A	M-H	M	H	M-H	L-M	M	L-M
7B	M-H	M	H	M-H	L	L-M	L

Notes:

*Alternatives are scored based on relative achievement of the criterion compared to other alternatives using the following ranking system: L = low achievement; L-M = low to moderate achievement; M = moderate achievement; M-H = moderate to high achievement and H = high achievement; NR = Not Rated.

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11 Principal Threat Wastes

Principal threat wastes are source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or present a significant risk to human health or the environment, should exposure occur. The NCP establishes an expectation that EPA will use treatment to address principal threats posed by a site wherever practicable [NCP § 300.430(a)(1)(iii)(A)], but recognizes that treatment is not always possible. A source material is one that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or acts as a source for direct unacceptable exposure.

Arsenic in mine wastes mixed with sediment has been determined to be the principal threat to human health within the MRSOU. If people were to continue to consume the contaminated groundwater that primarily results from these sediments, both non-cancer and cancer risks from arsenic are in the range of concern (*Human Health Risk Assessment*, EPA 1993b).

The historic reservoir sediments, particularly in the area designated as Area 1, exhibit the highest concentrations of arsenic and copper, and present the major principal threat waste at the MRSOU. Geochemical conditions created by the oxidation / reduction state of saturated impounded sediments in this area results in the mobilization of dissolved arsenic and metals into sediment pore water. The contaminated pore water then flows downward through the sediments into the alluvial aquifer (groundwater). Concentrations of arsenic and metals in the reservoir sediments, if not remediated, have the potential to continue to contribute these contaminants to the local alluvial aquifer in high concentrations for hundreds to thousands of years. The historic sediments, during conditions with potential for flow-induced or mechanical scouring, have the potential to contribute high concentrations of total and dissolved copper to the river. Copper is highly toxic to aquatic life and this source and pathway present an acute risk to aquatic life in the Clark Fork River downstream of the MRSOU.

This principal threat waste contaminates a prolific aquifer and leads to the loss of the beneficial use of that aquifer as a potable water supply. Under other conditions, the principal threat wastes can be scoured and re-entrained in the downstream surface water column, resulting in significant impacts to downstream aquatic life (EPA 2000).

Section 430(a)(1)(iii)(A) and EPA guidance states EPA's expectation that principal threat wastes will be addressed with reliable "treatment." For mobile waste in areas of active fluvial deposition / flood plains associated with acute risks, such as the reservoir sediments, removal and permanent disposal outside of the 100-year flood plain is required. EPA has thus focused its most aggressive remedial actions towards these principal waste areas. These wastes may be treated at the Anaconda Site. Other areas that are addressed in this remedy, such as the impacted areas associated with zones of contaminated groundwater, present unacceptable risk conditions. EPA believes the application of ICs to these areas is an appropriate measure until the remedy has had time to mitigate conditions in these areas.

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