Biological Assessment
Bald Eagle, Grizzly Bear, Gray Wolf,
Canada Lynx, Yellow-Billed Cuckoo, and
Water Howellia

Biological Assessment of the Milltown Reservoir Sediments Operable Unit Revised Proposed Plan and of the Surrender Application for the Milltown Hydroelectric Project (FERC No. 2543)

Prepared for

Environmental Protection Agency
Helena, Montana and the Federal Energy Regulatory Commission

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Prepared by

CH2M HILL
and

The Clark Fork and Blackfoot, L.L.C.

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CHAPTER 1

Introduction

This Biological Assessment (BA) is intended to satisfy provisions of Section 7 consultation requirements for the Environmental Protection Agency (EPA) and the Federal Energy Regulatory Commission (FERC) with the U. S. Fish and Wildlife Service (FWS) under the Endangered Species Act (ESA). In addition, this BA also is intended to fulfill intra-service FWS consultation requirements on those portions of the Proposed Action planned, administered, or funded by the FWS. This BA evaluates the potential effects on five federally listed species and on one candidate species (see Table 1), from: 1) implementing the selected remedial action and a site restoration plan at and upstream of the Milltown Reservoir Sediments Operable Unit (actions under EPA and the Natural Resource Trustees authority) and; 2) providing interim fish passage during site remediation, discontinuing certain conservation/enhancement actions once Milltown Dam is removed, and surrendering the Milltown Dam Hydroelectric Project FERC license (actions under FERC's authority).

TABLE 1
Threatened, Endangered, and Candidate Wildlife and Plant Species that may Occur Within the Assessment Area or be Impacted by the Proposed Project

Species	Scientific Name	Status	Habitat
Gray wolf	*Canis lupus*	Threatened and Experimental, Non-essential	Highly variable remote habitat near primary prey
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Near rivers and lakes
Canada lynx	*Lynx canadensis*	Threatened	Remote montane forests
Grizzly bear	*Ursus arctos horribilis*	Threatened	Remote montane forests and meadows
Water howellia	*Howellia aquatilis*	Threatened	Seasonally moist soils below 7000 feet
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate	Cottonwood / willow riparian zones

Some major purposes of the remedial action considered for this Operable Unit are to address human health risks and allow the recovery of the contaminated drinking water aquifer, and to reduce the potential impacts on aquatic life in the Clark Fork River downstream of Milltown Dam from the release of disturbed reservoir sediments and associated metals during ice sour events or, potentially, during catastrophic dam failure. The purposes of the remediation and site restoration plan are to establish a new natural channel and floodplain for the Clark Fork River within and upstream of the Operable Unit

(Figure 4), and to allow unimpeded fish passage in the Blackfoot River by removing Stimson Dam. The upstream channel reconstruction would occur in areas IV and V as shown on Figure 4. The purpose of interim fish passage is to allow upstream movements by bull trout during site remediation, while conservation/enhancement actions are intended to mitigate effects of the Milltown Dam Hydroelectric Project on bull trout. The FERC license would be surrendered by The Clark Fork and Blackfoot, L.L.C. (CFBLLC), owner of Milltown Dam, prior to the removal of Milltown Dam and associated facilities and the completion of site remediation activities.

EPA, in consultation with the Montana Department of Environmental Quality (MDEQ), selected the current proposed remedial action (known as the Revised Proposed Plan) for implementation following public review and comment on the Original Proposed Plan in 2003 and evaluation of an alternative remediation proposal from Atlantic Richfield Company (ARCO) for the Milltown Reservoir Sediments Operable Unit. The alternative proposed removing sediments in the dry using a reservoir drawdown/sediment pre-loading approach (the Revised Proposed Plan) rather than hydraulic dredging under a full reservoir pool approach (the Original Proposed Plan). Previous evaluations conducted by EPA and MDEQ that provided the basis for ultimately selecting the Revised Proposed Plan as the preferred remedial action included the evaluation of 24 alternatives in the original Feasibility Study for groundwater plume cleanup actions (ARCO 1996), 10 alternatives in the Focused Feasibility Study for scour events (ARCO 2000), and 10 alternatives in the Combined Feasibility Study for groundwater cleanup alternatives and scour events (ARCO 2001). The selected proposed remedial action is described in EPA's *Revised Proposed Cleanup Plan* (EPA 2004) and is summarized later in this BA.

Site restoration activities associated with the Proposed Action and described in this BA will be closely coordinated with site remedial activities. The site remediation/restoration area includes the Clark Fork River from the Interstate 90 Bridge, located approximately 1 mile downstream of the Milltown Dam site, upstream to near the Turah Bridge, located approximately 5 miles upstream of the Milltown Dam site. The site remediation/restoration area also includes the Blackfoot River from its mouth upstream approximately 1.25 miles to above Stimson Dam (see Figure 1). All of the site remedial activities will occur within the EPA's Milltown Operable Unit boundary (see Figure 2). Some of the restoration activities (Stimson Dam removal, which is being led by the FWS, establishing the upstream segment of a new Clark Fork River channel and floodplain) will be outside the Operable Unit boundary but within the site remediation/restoration boundary. Restoration actions are proposed upstream on the Clark Fork River approximately 3 miles above Milltown Dam and upstream on the Blackfoot River to just below Stimson Dam (described in the Draft Conceptual Restoration Plan, as amended June 2004, and referenced in the following paragraph). Removed sediments will be transported via existing railroad lines for disposal at Opportunity Ponds near Anaconda, Montana. Opportunity Ponds are within the existing Anaconda Smelter Superfund Site.

The Natural Resource Trustees (FWS, Confederated Salish and Kootenai Tribes, and State of Montana) have developed restoration plans, received public comment, and will be responsible for establishing a new river channel and floodplain through and immediately upstream of the Operable Unit. The Appendix contains the *Draft Conceptual Restoration Plan*

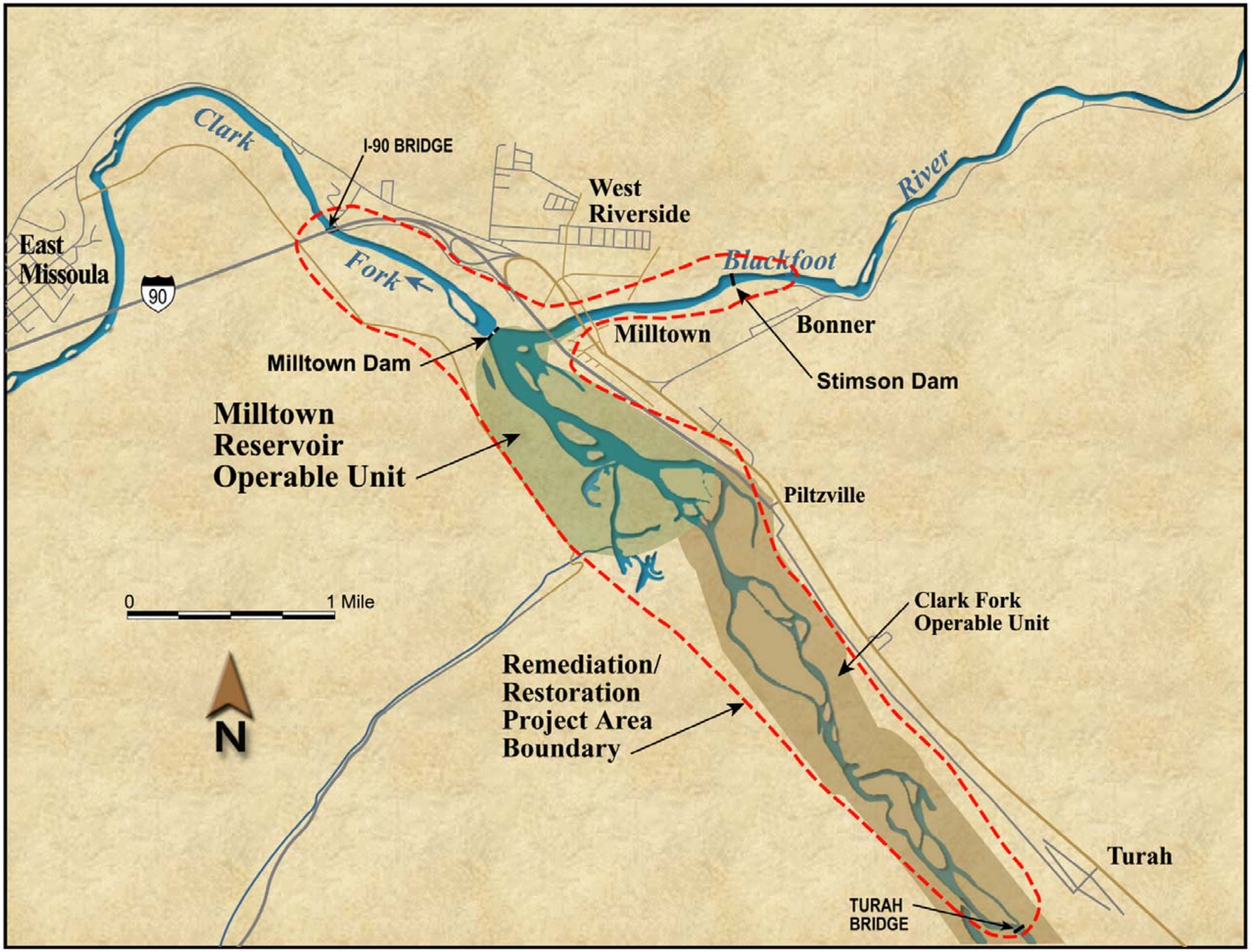

FIGURE 1
Remediation/Restoration
Project Area

Biological Assessment of the Milltown Reservoir
Sediments Operable Unit

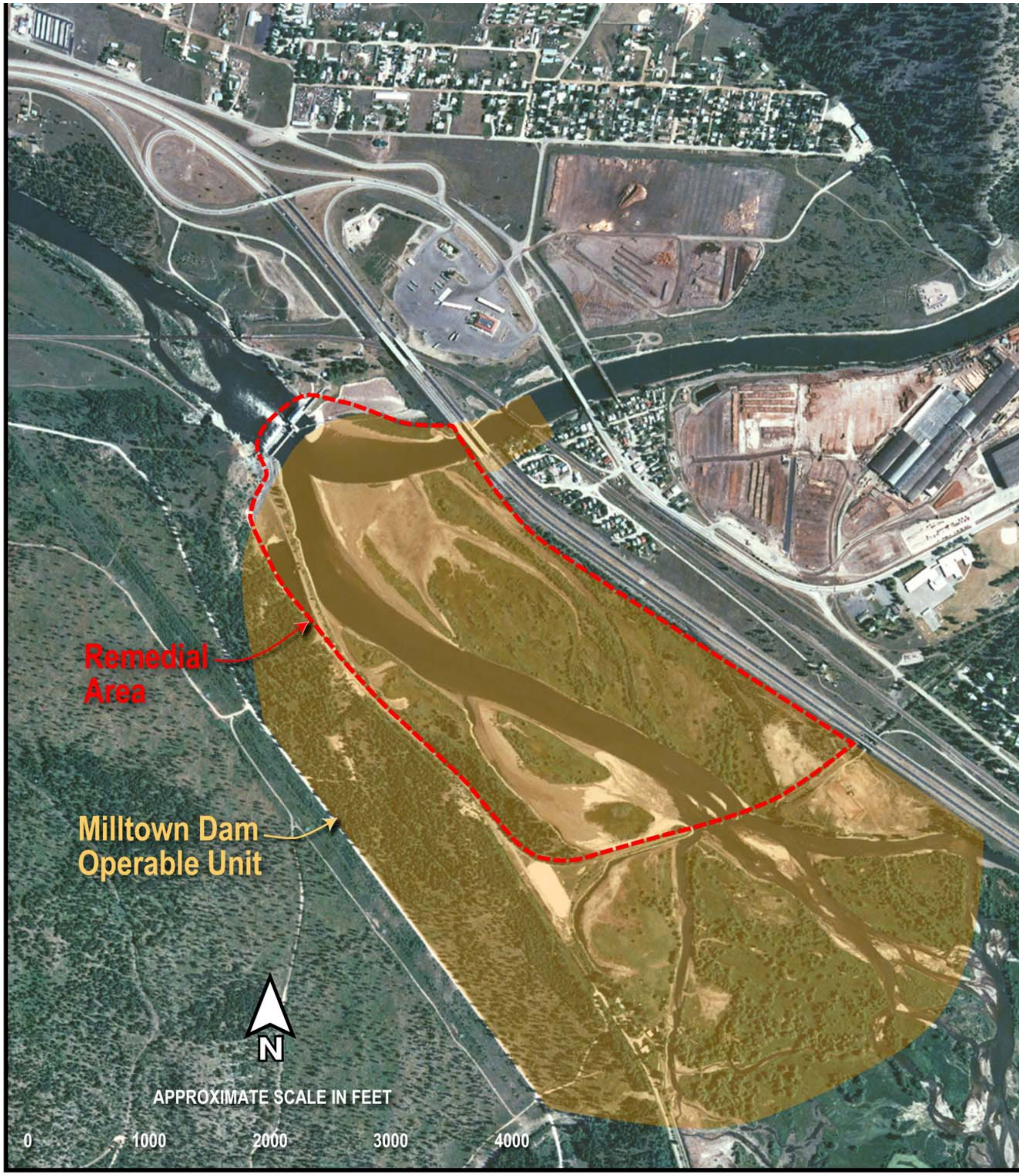

Figure 2
MILLTOWN RESERVOIR SEDIMENTS OPERABLE UNIT AND STIMSON DAM
BIOLOGICAL ASSESSMENT OF THE MILLTOWN RESERVOIR SEDIMENTS OPERABLE UNIT

for the Clark Fork River and Blackfoot River Near Milltown Dam (Water Consulting, Inc., and Rosgen 2003), as amended June 2004 in the *Amendment to the Draft Conceptual Restoration Plan for the Clark Fork River and Blackfoot River Near Milltown Dam* (State of Montana 2004). The removal of Stimson Dam is being planned as a cooperative effort through the FWS National Fish Passage Program. Site restoration activities are described in EPA's *Revised Proposed Cleanup Plan* (EPA 2004) and are summarized later in this BA.

Information presented in this BA follows the example of a bald eagle BA that was prepared to assess the effects of the *Clark Fork Operable Unit Milltown Reservoir Sediments / Clark Fork River Superfund Site* (EPA 2002a). That BA assessed potential effects on bull trout (*Salvelinus confluentus*) and bald eagles. The lower reach of the Clark Fork River, Reach C, addressed in the 2002(a) EPA BA, extends to the upstream end of Milltown Reservoir, the upper end of the area covered by this BA. A bald eagle nest located within Reach C, and less than 2 miles from the upstream end of the Milltown Reservoir Sediments Operable Unit, is addressed in this BA.

Chapter 1, Introduction, provides an overview of the project area's background and history, and discusses the purpose, need, and scope of this BA. *Chapter 2, Project Description*, describes the Proposed Action (the selected remedial action and site restoration plan). *Chapter 3, Environmental Baseline*, describes baseline conditions for the gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia, including life history, habitat requirements, and current conditions within the assessment area for this BA. *Chapter 4, Potential Effects of the Action*, discusses direct, indirect, and cumulative effects on these species that could potentially result from implementing the Proposed Action, and describes conservation measures intended to avoid or minimize the potential for adversely affecting these species and their habitats. *Chapter 5, Determination of Effects*, discusses whether or not the Proposed Action is likely to adversely affect the gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia or to destroy or adversely modify habitat.

1.1 Background and History

The Milltown Reservoir Sediments Operable Unit is located on the Clark Fork River in western Montana. This Operable Unit extends from Milltown Dam, which is at the confluence of the Clark Fork and Blackfoot Rivers, southeast 1-1/2 miles to the upstream limit of Milltown Reservoir. The City of Missoula is approximately 5 miles west of Milltown Reservoir, and the community of Milltown is immediately east of the reservoir.

Environmental investigations in 1981 by the Missoula City/County Health Department found levels of arsenic in private drinking water wells in Milltown that exceeded public health standards. It was subsequently determined that sediment from upstream mines that had accumulated in Milltown Reservoir had contributed to the formation of a groundwater arsenic plume that impacted Milltown's drinking water supply (EPA 2002b). In 1982, EPA became involved and listed the Milltown Reservoir Site on the National Priorities List (NPL) as a Superfund Site. EPA has the authority to require the implementation of remedial actions to meet requirements, and prevent hazardous sediments from threatening human health and environmental resources at Superfund Sites. The Milltown Reservoir Clark Fork River Superfund Site consists of the Milltown Reservoir Sediments Operable Unit, which is the subject of this BA, the Milltown Water Supply Operable Unit, and the Clark Fork River Operable Unit. The Milltown Water Supply Operable Unit was addressed in a previous response action to install a new drinking water system for Milltown in 1996. The Clark Fork River Operable Unit is being addressed in a separate cleanup process and in a separate BA of bull trout. The Clark Fork River Operable Unit extends from the upper limit of Milltown Reservoir upstream to Warm Springs Creek on the upper Clark Fork where it abuts the Anaconda Smelter Superfund Site and the Silver Bow Creek/Butte Area Superfund Site.

Milltown Dam was completed in 1907 and acquired by Montana Power Company (MPC) in 1929. Northwestern Energy (NWE) acquired the Milltown Project in December 2001, and transferred ownership to the current owner, The CFBLLC, in December 2002 (CFBLLC 2003). The dam is approximately 64 feet high, 668 feet long, and produces approximately 3 megawatts of power. Dam components include a right abutment concrete gravity dam (244 feet long), intake and powerhouse (126 feet long), divider block (26 feet wide), radial gate (52 feet wide), and overflow spillway (220 feet long). The powerhouse contains five Francis horizontal-flow turbines, four of which are currently in use. The spillway has 44 fixed wheel panels that maintain the reservoir water surface at a normal operating elevation of 3261.8 feet above mean sea level (amsl), except during periods of high flow. When river flows exceed the turbine capacity of approximately 1,600 cubic feet per second (cfs) (generally during spring runoff from March to July), individual spillway panels are removed to discharge water and regulate reservoir elevations. The radial gate is used to adjust spill during rapidly changing river flows, for emergency drawdown of the reservoir, and to pass debris, trap fish, and maintain reservoir operating elevations during power generation fluctuations (CFBLLC 2003).

Milltown Dam is operated as a run-of-the-river facility (outflow typically equals inflow). Reservoir water surface elevation is fairly constant (3261.8 amsl), but can be lowered 6 to 12 feet for maintenance and emergency operations. River flows downstream of Milltown Dam are generally stable except for short-term fluctuations, usually of 1 hour or less, caused by radial gate operation. Rehabilitation of Milltown Dam from 1987 to 1989 and installation of the radial gate spill structure has eliminated the need for an annual 7- to 8-foot (and sometimes up to 22-foot) draw down of Milltown Reservoir (CFBLLC 2003).

In the absence of the selected remedy, Milltown Reservoir would probably continue to occasionally be drawn down for inspection and maintenance, and possibly to help control populations of northern pike, which are a threat to bull trout (CFBLLC 2003). Effects of previous reservoir draw down include the release of reservoir sediments and increased turbidity in downstream areas, and elevated concentrations of metals in the water. The magnitude of these effects is potentially influenced by the rate, method, and duration of draw down, reservoir pool level, river discharge, occurrence of a sediment-disturbing action such as ice flow and scour, and perhaps climatic conditions. CFBLLC (2003) cited a report by ARCO (1999), which gave examples of elevated turbidity levels that varied from a threefold increase following the slow draw down of Milltown Reservoir to a 25-fold increase following the rapid draw down of the reservoir.

Since the construction of Milltown Dam, Milltown Reservoir has acted as a repository for sediment and mining wastes generated by upstream mining activities in the Clark Fork River Basin (EPA 2001a). These activities began in 1864 with placer mining in the Butte-Silver Bow Creek area, and were soon followed by mining shallow underground deposits for gold, copper, silver, and other metals. These early mining practices produced the contamination associated with the waste tailings. Subsequent practices included shaft mining and milling of deeper copper sulfide ores in the Butte and Anaconda areas beginning in the late 1880s. Improved milling practices beginning in the early 1900s with the availability of electricity, together with froth flotation and new smelting practices, resulted in increased production rates. Most mine and milling wastes, including contaminated mine and process waters associated with these wastes, were disposed of in Silver Bow Creek and other upper Clark Fork River tributaries well into the 20th century. Aerosols and particulates from smelter smokestacks further contaminated soils in the area (CH2M HILL 2000).

Disposed tailings, mine and milling wastes, and mine and process waters were transported down Silver Bow Creek, Warm Springs Creek, other affected tributaries, and the upper Clark Fork River at varying rates, depending primarily on drainage hydrology and particle size. More wastes were hydraulically transported during snowmelt runoff and major thunderstorms than during drier portions of the weather cycle, because more flow was available for conveying these wastes. Sediment transport in the system also varies with the amounts of contaminated wastes available at any time in the upstream watersheds. Sedimentation ponds built at Warm Springs (two in 1918 and a third in the late 1950s) were all somewhat effective in removing considerable quantities of streambed sediments, which altered the types and amounts of mine wastes reaching the upper Clark Fork River and Milltown Reservoir. In 1994, in a remedial action under a Record of Decision by EPA, the Warm Springs Ponds and the Mill-Willow Bypass were upgraded. Following a second Warm Springs Pond Record of Decision, water quality from the pond system has been meeting required water discharge standards most of the time (CH2M HILL 2000).

Contaminated sediments transported from upstream areas began to settle in Milltown Reservoir following the completion of Milltown Dam in 1907. In early 1908, the largest flood on record in the Clark Fork River drainage occurred as a result of rain falling on snow and frozen ground. The estimated discharge at Milltown Dam during this flood was 48,000 cfs (CFBLLC 2003). The 1908 flood is believed to have transported large quantities of contaminated sediments from upstream areas into Milltown Reservoir (CH2M HILL 2000). Later floods, storm events, and normal sediment movement during all flows transported additional quantities of mining and smelting wastes downstream to Milltown Reservoir where much settled as sediment. Today, more than 6 million cubic yards of sediments have been deposited behind Milltown Dam. Mine wastes present in these sediments contain elevated concentrations of metals and arsenic.

Erosion of the banks and bottom of Milltown Reservoir (for example, from ice scour and very high flows) can potentially disturb sediment deposits that contain arsenic, cadmium, lead, copper, and zinc (CFBLLC 2003). Increased levels of these contaminants in the Clark Fork River downstream of Milltown Dam resulting from the scour and release of disturbed reservoir sediments may occasionally result in increased risks to aquatic life (CH2M HILL 2000). Such an event occurred in February 1996. A combination of unusual meteorological events (rain on snow, ice, and frozen ground and increased river flows) and unusual operation of Milltown Dam to protect the structure caused increased river flows and thick, rafted ice to move down the Blackfoot and Clark Fork Rivers and to scour the accumulated sediments in Milltown Reservoir. This resulted in the release of disturbed sediments and associated metals to the Clark Fork River downstream of Milltown Dam. During late spring of 1997, the melting of a greater than normal snow pack caused high flows (up to 26,700 cfs) below Milltown Dam. This was approximately a 10-year event (CH2M HILL 2000).

Analyses by the U.S. Geological Survey indicated that sediment and metals were released from Milltown Reservoir during the 1996 ice scour event and the 1997 high flow event (CH2M HILL 2000). Subsequent risk assessments performed under the direction of EPA showed that during ice scour events, such as the 1996 event, copper may cause moderate risks to aquatic life from exposure to water below Milltown Dam. Normal high flow events may pose an intermittent low-level chronic risk to fish below Milltown Dam because of the combined impacts of copper and other metals in the water column, and copper in ingested macroinvertebrates. Results of analyses suggest that risks to aquatic life are low except on these types of occasions, such as the 1996 ice scour event, when concentrations of total recoverable metals, particularly copper, are extremely high. Results also indicate that arsenic and cadmium in water pose no significant risks to aquatic life downstream of Milltown Dam, and risks to aquatic life from lead and zinc are absent to low (CH2M HILL 2000). The site also poses a threat to human health because of contaminated groundwater near the reservoir.

Another baseline condition in the remediation/restoration project area reported to affect bull trout that the Proposed Action addresses is the presence of Stimson Dam. This dam is located on the Blackfoot River at the Stimson Lumber Mill approximately 1 mile upstream from Milltown Dam. In the assessment of limiting factors to bull trout, the Bull Trout Draft Recovery Plan (FWS 2002a) stated Stimson Dam may be a seasonal fish passage barrier. EPA, MDEQ, and the Natural Resource Trustees' restoration plan subsequently determined that removal of Stimson Dam is necessary to provide fish passage and eliminate physical hazards that would occur from the lower water level once Milltown Dam is removed (EPA 2004).

1.2 Purpose and Need for Biological Assessment

The purpose of the ESA is to conserve threatened and endangered animal and plant species and their ecosystems. As such, Section 7 of the ESA requires federal agencies to ensure that their actions are not likely either to jeopardize the continued existence of threatened or endangered species, or to destroy or adversely modify designated critical habitat that is essential to listed species. In addition, Section 9 of the ESA prohibits the take of any threatened or endangered species without a special permit. The purpose and need of this BA are to evaluate the potential effects on the gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia resulting from: 1) implementing the selected remedy and site restoration plan (the Proposed Action) at the Milltown Reservoir Sediments Operable Unit within the site remediation/restoration area (EPA-related actions); 2) transporting and disposing of removed sediments and surrendering the project license (FERC-related actions); and also 3) to satisfy provisions of Section 7 consultation requirements for EPA and FERC with FWS, and FWS intra-service consultation requirements under the ESA.

1.3 Scope of Biological Assessment

This BA focuses on the potential effects on the gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia from implementing the Proposed Action. All of the site remedial activities will occur within the EPA's Milltown Operable Unit boundary (see Figure 2). Some of the restoration activities (Stimson Dam removal, establishing the upstream segment of a new Clark Fork River channel and floodplain) will be outside the Operable Unit boundary but within the site remediation/restoration boundary. Removed sediments will be transported via existing railroad lines for disposal at Opportunity Ponds near Anaconda, Montana. Opportunity Ponds are within the existing Anaconda Smelter Superfund Site.

Discussions of environmental baseline conditions presented in this BA reflect the cumulative effect of all actions that have occurred in the past, plus those actions occurring now or anticipated to occur in the very near future prior to implementing the Proposed Action.

The geographic action area of this BA includes three specific areas. For purposes of analysis, the remediation/restoration area is defined to extend from 1 mile below Milltown Dam to about 7 miles upstream of the dam and upstream on the Blackfoot River to just above Stimson Dam. As described in the DCRP, amended June 2004 (see the Appendix), restoration actions are proposed upstream on the Clark Fork River approximately 3 miles above Milltown Dam and upstream on the Blackfoot River to just below Stimson Dam. The second area covered by the BA is the existing railroad /Interstate Highway 90 transportation corridor from Milltown to Opportunity Ponds near Anaconda, Montana. The third area includes Opportunity Ponds disposal site. Opportunity Ponds are within the existing Anaconda Smelter Superfund Site. Figure 3 depicts the assessment area for this BA.

1.4 Methods

Information regarding the known distribution of the species covered in this BA as well as potentially suitable habitat for those species was obtained from the Montana Natural Heritage Program (MTNHP) as data records in GIS format. Much of the background information on bald eagles presented in this BA is taken from the *Clark Fork Operable Unit Milltown Reservoir Sediments/Clark Fork River Superfund Site Biological Assessment* (EPA 2002a). That information constitutes a very important component of the present BA because: 1) the Clark Fork River portion of the current assessment area is part of the geographic area covered in EPA (2002a); 2) it provides background information on the status and characteristics of bald eagles and their habitat in the Clark Fork River upstream of Milltown Reservoir; and 3) it discusses the past, present, and future effects of sediment removal in the Clark Fork River on bald eagles upstream of Milltown Reservoir. Much of the information from that BA has been summarized in the present BA and is cited as *EPA 2002*. EPA (2002a) has been accepted by the FWS, and the content and level of detail included in that BA are appropriate for assessing the effects of the Milltown Reservoir Sediments Operable Unit

Figure 3
BULL TROUT ASSESSMENT AREA
BIOLOGICAL ASSESSMENT OF THE
MILLTOWN RESERVOIR SEDIMENTS OPERABLE UNIT

project in this BA (Downing 2003). Therefore, the sections from EPA (2002a) that describe the natural history, current conditions, and limiting factors for bald eagles occurring in the lower Clark Fork River area are presented below with appropriate changes to reflect conditions relative to this project. Project descriptions are from the *Bull Trout Biological Assessment of the Milltown Reservoir Sediments Operable Unit Revised Proposed Plan and of the Surrender Application for the Milltown Hydroelectric Project (FERC No. 2543)* (EPA and FERC 2004).

1.5 Consultation

As noted in *Section 1.2, Purpose and Need for Biological Assessment,* this BA is intended to satisfy provisions of Section 7 consultation requirements for EPA and FERC with the FWS for potential effects to the gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia, and FWS intra-service consultation requirements under the ESA. A separate BA assessed potential effects to bull trout (EPA and FERC 2004). This BA has been jointly prepared by EPA and by CFBLLC as the non-federal agency representative for FERC. CFBLLC is the current owner of the Milltown Dam Hydroelectric Project, which is located within EPA's Milltown Reservoir Sediments Superfund Site. It is anticipated that CFBLLC will submit a license surrender application for the Milltown Project to FERC, and it is anticipated that FERC will act on this license surrender application.

CFBLLC also is preparing an Environmental Report (ER) per FERC requirements as part of a parallel analysis process that addresses impacts to biological resources not covered in this BA. ER elements may include, but are not necessarily limited to, adverse impacts to species and habitats other than federally listed (if not included in the BA) and Clean Water Act (CWA) Section 401 certification. ERs may use results of analyses contained in BAs as surrogates for predicting effects on other species with somewhat similar life history requirements.

CFBLLC and EPA have jointly prepared this single BA to cover and address all actions being considered by CFBLLC and EPA for the following reasons:

- ESA consultation must be completed before CFBLLC can surrender their FERC license.
- The unique and very inter-related nature of EPA and FERC actions proposed and anticipated at the Milltown site.
- To streamline the consultation process among the FWS, EPA, and CFBLLC/FERC.
- To meet the schedules for the anticipated FERC license surrender application and EPA site remediation/restoration activities.

This consultation represents the initial broad, overarching effects analysis on the gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia initiated by the EPA for the Proposed Action at the Milltown Reservoir Sediments Operable Unit. The Proposed Action includes the implementation and completion of site remediation and restoration activities within the remediation/restoration area depicted in Figure 1. Other consultations with the FWS regarding Milltown Dam and Reservoir occurring concurrently and covered in this BA and those situations where appending this BA may be appropriate are briefly described in the following text.

Concurrent FERC Consultation. Concurrent with the EPA consultation and in anticipation of the filing of an applications for amendment of license and for surrender of license, this BA will be forwarded to the FWS as part of the consultation process the FERC is completing with the FWS on the potential effects to the gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia resulting from ongoing operations of Milltown Dam during remedial action and the required mitigation of the project site after dam removal. This BA is intended to cover both the FERC and the EPA consultation requirements with the FWS.

Concurrent FWS Intra-service Consultation. Concurrent with the EPA consultation, the FWS, in its role as a Natural Resource Trustee, is conducting intra-service consultation on the Stimson Dam removal project and the Natural Resource Trustee restoration plan for the Clark Fork and Blackfoot Rivers in the project area.

Where action-specific updates are necessary, the FWS will reinitiate intra-service consultation on the potential effects to the gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia resulting from restoration activities throughout the design and restoration process.

Future EPA Proposed Action Design Changes. Design details of the remediation and site restoration plan will be better defined during the design stage of EPA's Proposed Action. If substantive changes in the Proposed Action design or effects occur during summer 2004 or thereafter, this BA will be appended with brief action-specific updates. This assumes that actions that differ from what the current perceived Proposed Action is will likely be within (or close to) current sediment/scour predictions. If not, action-specific updates will become increasingly more developed.

Where action-specific updates are necessary, EPA will consult with the FWS on the potential effects to the gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia resulting from site remediation activities throughout the design and construction process. The FWS will determine if re-initiation of formal consultation is necessary on a case-specific basis.

CHAPTER 2

Project Description

This BA evaluates the potential effects of the Proposed Action on gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia. Figure 3 (see *Chapter 1, Introduction*) depicts the assessment area for this BA. The Proposed Action includes the Revised Proposed Plan, which is a revision of the Original Proposed Plan (*Partial Sediment Removal of the Lower Reservoir, Dam Removal, plus Groundwater Institutional Controls and Natural Attenuation within the Aquifer Plume)* proposed as the preferred action by EPA and MDEQ as the remedial action for implementation at the Milltown Reservoir Sediments Operable Unit. The Proposed Action also includes a site restoration plan, whose implementation, primarily by the State of Montana as lead Natural Resource Damage Trustee, within the Operable Unit and the remediation/ restoration project area would be coordinated with that of the Revised Proposed Plan.

The Original Proposed Plan remedial action was identified in EPA's Proposed Plan (EPA 2002) and was selected as the preferred action from 10 remedial alternatives that were evaluated. During the 90-day public comment period on the April 2003 Original Proposed Plan, EPA received a significant number of comments opposing the local sediment waste repository at Bandman Flats. EPA also received comments and a proposal from ARCO to excavate sediments using conventional mechanical excavation equipment instead of hydraulic cutterhead dredges, and to haul the removed sediments by rail and dispose of them at Opportunity Ponds rather than placing the materials in the Bandman Flats repository. Based on this proposal, evaluation of additional information from ARCO, and results of a national scientific peer review of the Revised Proposed Plan, EPA and MDEQ concluded that the proposed sediment removal methods with disposal at Opportunity Ponds could be done safely and effectively and would address the significant adverse comment on the Bandman Flats disposal area.

Major objectives of the Revised Proposed Plan are to reduce or eliminate the arsenic plume in the groundwater and related human health risks, and to reduce or eliminate the threat of contaminated sediment transport downstream and the potential for impacting the Clark Fork River and aquatic life below Milltown Dam. Major objectives of the site restoration plan are to establish a new natural channel and floodplain for the Clark Fork River through the Operable Unit and upstream in the Clark Fork and Blackfoot Rivers within the remediation/restoration project area, and to allow unimpeded fish passage in the Blackfoot River by removing Stimson Dam.

These objectives will be accomplished in part by removing the primary source sediment area; removing Milltown Dam to reduce the hydraulic head driving contaminants into the adjacent drinking water aquifer and to prevent future impoundment of new sediments; and allowing natural attenuation processes to restore the aquifer over time. Figure 4 presents the Key Sediment Accumulation Areas. The sediments in Sediment Accumulation Area I (SAA 1) (lower reservoir adjacent to Milltown) will be removed, while those in SAA II, III,

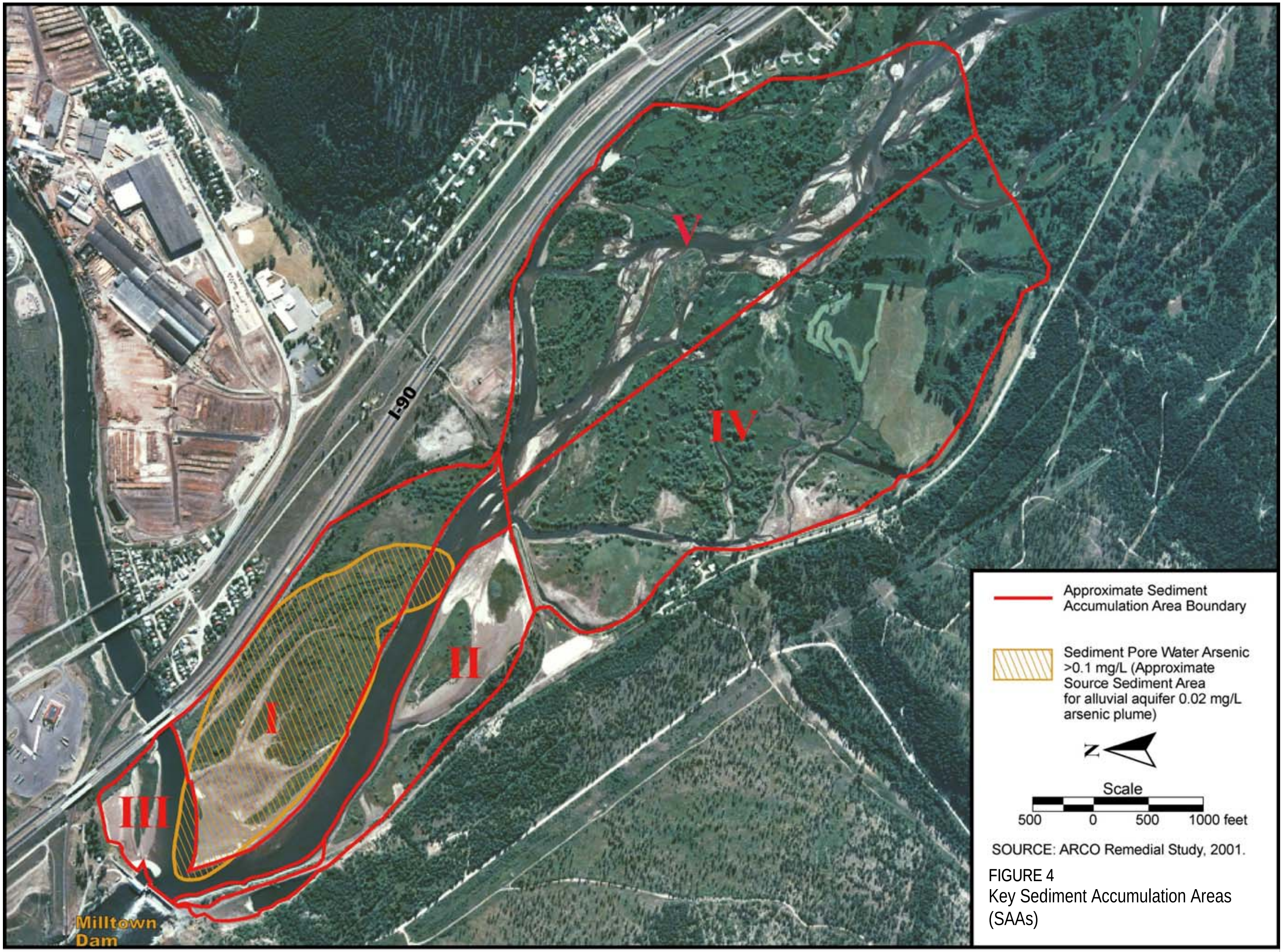

FIGURE 4
Key Sediment Accumulation Areas (SAAs)

IV, and V (the upper reservoir) will be left in place and isolated from the Clark Fork River channel. In addition, a new, geomorphologically stable river channel with natural floodplains for lateral stability will be designed, constructed, and vegetated to provide adequate stability against erosion. The Proposed Action includes decommissioning Milltown Dam and leaving the river free-flowing. The spillway, radial gate, divider block, powerhouse, and north (right) abutment will be removed. Stimson Dam will also be removed leaving the Blackfoot River free-flowing as well. Approximately 4 years are estimated to complete implementation of the Proposed Action following the Record of Decision and preparation of final designs.

Dam removal with lower reservoir sediment removal and channel reconstruction was selected as the preferred remedy (now termed the Proposed Action) by EPA Region 8 because it offers the best opportunity for long-term protection of human and environmental health. Compared to the Original Proposed Plan, benefits of the Revised Proposed Plan include easier implementibility, shorter construction time, use of an existing waste repository, no loss of undisturbed productive land, better long-term waste management, less risk to the local groundwater supply, fewer impacts to the local community, and stronger public support. Potential effects of the Revised Proposed Plan are addressed in *Chapter 4, Effects of the Action*, of this BA.

The key components of the Proposed Action and their implementation are briefly described in the following text. Details on these key components will be developed during final design and refined, as needed, during the actual implementation of site remediation and site restoration activities. Refinement will involve information feedback on the effectiveness and effects of different remedial actions, adaptive management to identify methods and modify activities to more efficiently achieve stated project objectives, and a decision-making process that considers and minimizes the potential for adverse effects on the environment while achieving site remediation and restoration goals. These key components include bypass channel construction; dam removal; sediment removal, transportation, and disposal; site restoration/redevelopment; replacement water supply program/temporary groundwater institutional controls; protective measures; and monitoring. This section concludes with discussions of interim fish passage past Milltown Dam and implementation of the Proposed Action. Figure 5 depicts major features of the Proposed Action.

2.1 Key Components of the Proposed Action

2.1.1 Bypass Channel Construction

Prior to sediment and dam removal activities, sediment in SAA-I will be isolated from the active Clark Fork and Blackfoot Rivers by a temporary bypass channel and a wall of interlocking sheet piling or equivalent driven into the underlying alluvium (Figure 6). The conceptual design of the bypass channel shown in Figure 6 is subject to change during the remedial design process. The bypass channel will be constructed adjacent to Interstate 90, with the exact location to be determined during final construction design. Before the construction of the bypass begins, the reservoir water level would be lowered using the existing radial gate. Conventional excavation equipment (excavators and draglines) would be used to excavate the bypass channel. The excavated materials would be stacked on the south side of the channel and allowed to drain. These materials would be loaded into rail cars and hauled to Opportunity Ponds after the bypass and a rail spur are completed. The upstream end of the bypass channel will contain a 5-foot-high fish-passable drop structure to allow upstream and downstream movement of fish past the sediment removal area (Figure 6). The bypass channel and drop structure will be maintained in proper working order throughout this facility's approximately three years of use.

2.1.2 Dam Removal

2.1.2.1 Milltown Dam Removal

Drawdown of the Milltown Reservoir pool level and removal of Milltown Dam would be done in three stages to minimize scouring:

- **Stage 1.** Use the existing radial gate to lower the water level.
- **Stage 2.** Modify the powerhouse inlets to low level outlets by removing the turbines.
- **Stage 3.** Remove the spillway, radial gate, divider block, powerhouse, and north (right) abutment.

Coffer dams will be used to isolate portions of the dam during this removal sequencing.

The ongoing operation of the Milltown Project by CFBLLC would include the reservoir drawdown currently scheduled to begin in December 2004. CFBLLC anticipates that this initial action and subsequent actions to be carried out by CFBLLC involving Milltown Dam removal would occur through a FERC license amendment. The "normal operations" of Milltown Dam would essentially cease with the beginning of the Stage 1 drawdown. *Section 2.3, Implementation of the Proposed Action*, lists the anticipated sequencing of tasks associated with remediation/restoration activities and Milltown Dam removal.

2.1.2.2 Timing of Milltown Dam Removal

EPA, MDEQ, and the Trustees believe that the timing of the Milltown Dam removal is very important in minimizing the impact to downstream aquatic life and users. To minimize downstream impacts and allow the earliest possible fish passage and recovery from impacts, EPA is proposing removal of the dam during the winter and spring months immediately after the SAA-1 sediments are isolated and the Clark Fork River is routed into the bypass channel. After the dam is removed, the resulting reduction of the river level will facilitate the natural draining of the sediments. Once achieved, this minimum river level will be maintained throughout the construction period.

2.1.2.3 Stimson Dam Removal

Another necessary, coordinated action is the removal of the Stimson Dam located on the Blackfoot River, 1 mile upstream of the Milltown Dam. Although not specifically a remediation element of the project, EPA, MDEQ, and the Trustees have determined that the removal of this dam is necessary to provide fish passage and eliminate physical hazards that would occur from the lower water level once the Milltown Dam is removed. The Stimson Dam would be removed before the Milltown Dam is removed. The removal of the Stimson Dam is not a FERC action.

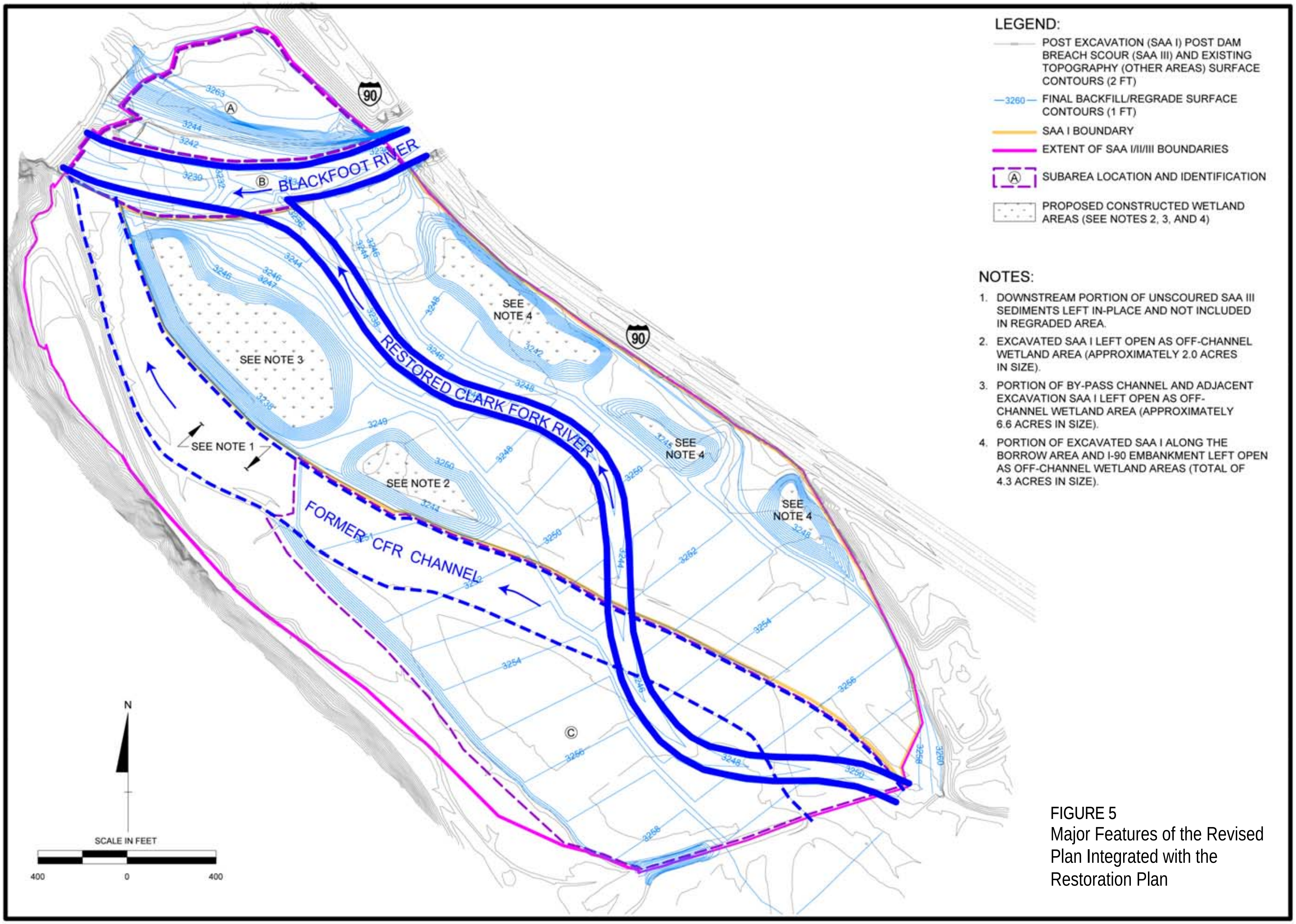

FIGURE 5
Major Features of the Revised Plan Integrated with the Restoration Plan

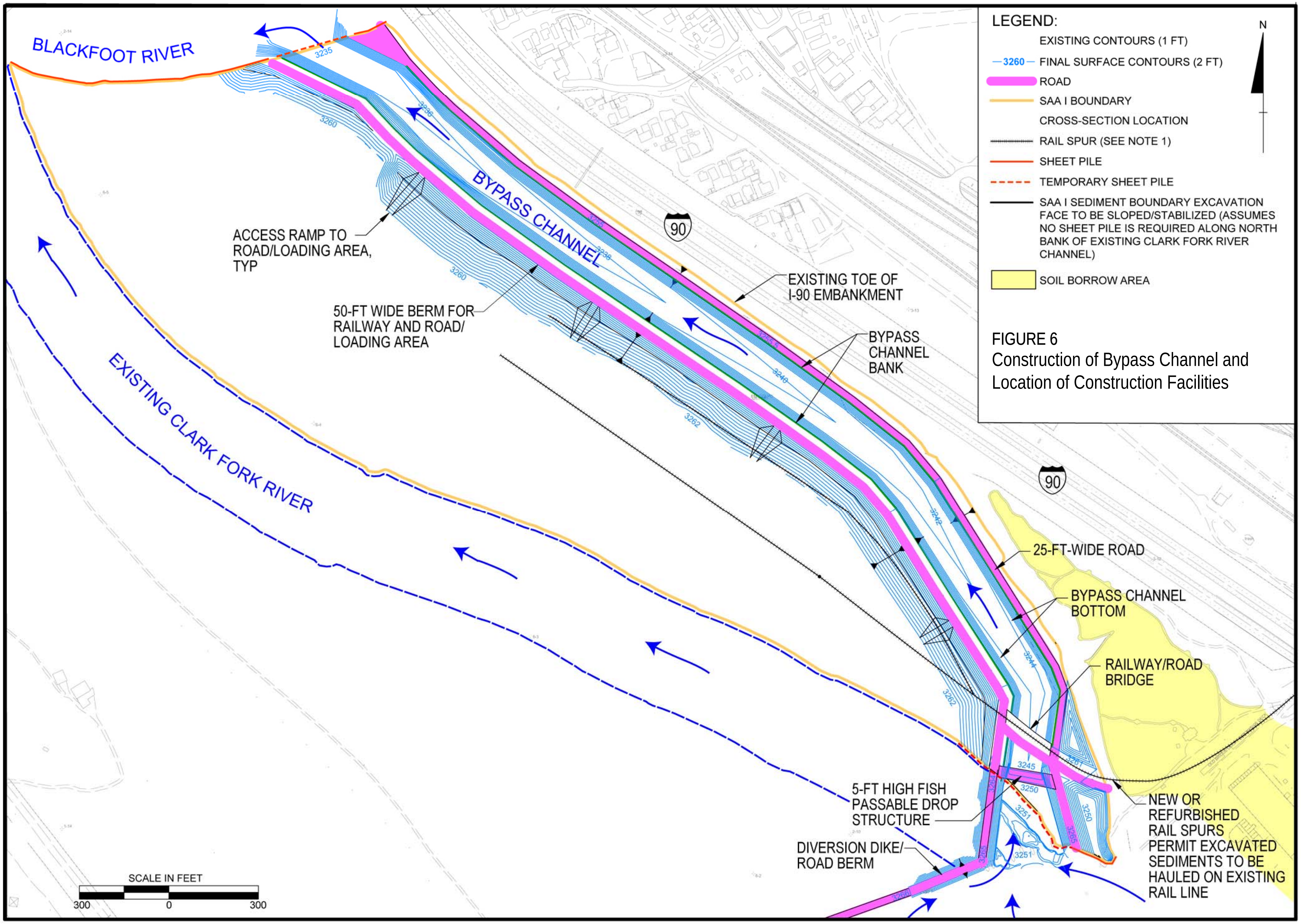

FIGURE 6
Construction of Bypass Channel and Location of Construction Facilities

2.1.3 Sediment Removal

Removal of the source sediment is the foundation of the Proposed Action. Sediment residing in Sediment Accumulation Area I (SAA-I, 2.6 million cubic yards [mcy]) constitutes the target of the removal (ARCO 2002). The sediment deposition area comprising SAA-I is approximately 4,300 feet long by an average of 800 feet wide and forms an elongated wedge of partially submerged land bounded by the Clark Fork River to the southwest, Duck Bridge to the south, Interstate 90 to the east, and the Blackfoot River channel to the north. This area is oriented southeast to northwest (closest to Milltown Dam) within Milltown Reservoir.

Sediment thickness increases in the same orientation from approximately 14 feet in the south, to 20 to 25 feet in the north.

2.1.3.1 Pre-Loading

If required, sediment removal will use an approach called "pre-loading" to facilitate consolidation of existing soft sediments. Pre-loading means importing and placing a layer of clean fill material over the sediments in SAA-I. Alternatively, sufficient consolidation enhancement may be achieved through dewatering of the existing sediments without the need for additional pre-load. The purpose of the pre-load is to force the underlying sediment to consolidate and release excess water to the previously lowered reservoir channel areas. This makes soft material, such as sediment, more stable for the operation of large equipment that will be needed for the excavation. If pre-loading is used, EPA expects the clean fill will come from a local source and will be hauled across the Clark Fork River bypass to the pre-load area via rail car or haul road. Specific pre-load needs will be designated during the design process.

2.1.3.2 Sediment Excavation

The excavation process will use large excavators working a linear face to optimize production and minimize the area of exposed groundwater. The area will be backfilled following excavation. The timing of backfilling will be dependent on many factors, including, but not necessarily limited to, weather, operational considerations, completion of floodplain/channel design, and groundwater inflow. The first excavator will remove the pre-load materials and create blending areas ahead of the sediment excavation operation. Pre-load material described above will also be loaded into trucks and used as backfill in areas where the sediment has been excavated. Concurrently, other excavators will remove the sediment, place it on an adjacent area where the pre-load material has been removed, and let it drain, if necessary. EPA anticipates that, even after spillway and radial gate removal, a small portion of the sediment will remain below the water table. This sediment will be stacked and allowed to drain naturally, mechanically dewatered, or mixed with drier sediment to improve its consistency, and the blended materials will be loaded into trucks and transported to the staging area by the rail spur.

2.1.3.3 Dewatering

Dewatering of the lower sediments within SAA-I may be necessary if the sediments do not free-drain completely. For the proposed cleanup, EPA anticipates that some sediment dewatering will occur. An estimate of sediment pore water quality using sediment drainage test data collected by EPA during the 2002 drawdown indicates that discharge of pore water into the Clark Fork River would not raise the river dissolved arsenic and copper concentrations above EPA's temporary construction standards. However, monitoring will be conducted and, if the impacts of returning excavation water to the river are found to be harmful or temporary standards are expected to be exceeded, the water will be treated before being discharged to the river.

2.1.4 Transportation and Disposal

At a new rail staging and loadout area located between the bypass channel adjacent to Interstate 90 and the Clark Fork River, the sediment will be placed into rail cars. Rail transport will be provided by two trains of 50 to 60 gondola rail cars each. The rail cars will be transported each night to Opportunity Ponds, so a train full of empty cars will be onsite for loading each morning. Figure 6 shows the location of the rail spur near Milltown. Opportunity Ponds are near Anaconda, some 90 miles upstream (south) of the Milltown site.

At least some (and possibly a large portion) of the large wood and rock encountered during excavation may be stored onsite for use during restoration, provided it is not contaminated. This would not require additional transport. Large or woody debris encountered during excavation that is not used during site restoration may require additional handling and processing to reduce its size so it can be transported by rail to Opportunity Ponds or it may be disposed of in local landfills. Long-term operation and maintenance of the transported materials at Opportunity Ponds will be the responsibility of ARCO as part of its obligations within the Anaconda Smelter Superfund Site.

There are currently 16 trains per day (8 round trips) traveling between Bonner and Garrison Junction. (Werner 2004). Bonner is just upstream of Milltown Dam and Garrison is about 70 miles upstream of Bonner. Opportunity is about 20 to 30 miles upstream of Garrison. The proposed project would have one train making 2 trips per day (1 with cars full going to Opportunity disposal site and 1 with cars empty returning from Opportunity disposal site. The total number of trains per day would increase from 16 to 18 (about 12.5 percent).

2.1.5 Restoration

Upon completion of sediment removal, a new floodplain and channel will be constructed. The original channel and floodplain design, which reflected a highly engineered channel with a narrow 100-year floodplain within the remediation/restoration project area, will be replaced with a design consistent with the Trustees Draft Conceptual Restoration Plan (DCRP), as amended June 2004. The Appendix contains a copy of the amended DCRP. The amended DCRP proposes a more natural floodplain and channel design than in the Original Proposed Plan that will benefit fish and wildlife as well as local recreational use. The removal of the entire dam—including the powerhouse, divider block, and right abutment—allows for a wider, more natural channel and floodplain.

The following objectives will be addressed in the Amended Conceptual Restoration Plan (Water Consulting, Inc., and Rosgen 2003, State of Montana 2004):

- Restore the confluence of the Blackfoot and Clark Fork Rivers, the Clark Fork River upstream approximately 3 miles above Milltown Dam, and the Blackfoot River to just downstream of Stimson Dam to a naturally functioning, stable system appropriate for the geomorphic setting.

- Use native materials, to the extent practicable, for stabilizing channel, banks, and floodplains to improve water quality by reducing bank erosion of contaminated sediments.
- Provide adequate channel and floodplain capacity to accommodate sediment transport and channel dynamics appropriate for the geomorphic setting.
- Provide high-quality habitat for fish and wildlife, including continuous upstream and downstream migration for all native and cold water fishes.
- Provide high-quality wetlands and riparian communities, where feasible and appropriate for the proposed stream type.
- Improve visual and aesthetic values through natural channel design, revegetation, and the use of native plants and materials.
- Minimize habitats that will promote non-native, undesirable fish species.
- Supplement revegetation activities proposed by remedy to increase floodplain vegetation diversity.
- Provide increased recreational opportunities compatible with other restoration goals, such as river boating and fishing.

2.1.6 Replacement Water Supply Program/Temporary Groundwater Institutional Controls

Temporary groundwater institutional controls will be necessary during and immediately after construction to address potential human health risks by limiting the use of the groundwater until the aquifer recovers through natural attenuation. Groundwater institutional controls during construction and until the aquifer recovers (4 to 10 years after dam removal) include the following:

- Provide continued funding for maintaining the existing replacement water supply for Milltown residents (this requirement is presently being met through ARCO’s settlement with the Milltown Water Users Association)
- Make contingency funds available to reconfigure, expand, or update replacement water supplies (this requirement is presently being met through ARCO’s settlement with the Milltown Water Users Association)
- Establish a temporary controlled groundwater area to ban future wells within or immediately adjacent to the arsenic plume, if required
- Continue the ongoing groundwater monitoring program to track changes in groundwater quality as the project is implemented and aquifer recovery occurs

None of these groundwater-related activities will impact species covered in this BA and are not discussed further in this BA.

2.1.7 Protective Measures

2.1.7.1 Control of Sediment Releases

An important factor in EPA's and MDEQ's consideration of whether to issue a Revised Proposed Plan was the evaluation of the potential downstream impact of scoured sediments. Of particular concern was the volume of scoured sediments released and the downstream concentration of metals, arsenic, and TSS; the potential downstream impact of these sediments; methods for controlling and mitigating these potential impacts; and monitoring during and after cleanup activities. Conservative input assumptions were used in sediment scour modeling calculations so the values reported represent the upper range of sediment transport that is expected to occur during construction. The following section briefly describes these issues. For additional details concerning these issues please see *Final Technical Memorandum – Milltown Reservoir Dry Removal Scour Evaluation* (Envirocon 2004) on the EPA Milltown web site or in EPA's Administrative Record. In summary:

- Modeling estimates that approximately 478,000 tons (406,000 cy) of additional sediment will be scoured from the Milltown Reservoir during the 4-year construction period.
- The concentrations of dissolved metals moving downstream during construction are projected to be similar to those seen during normal high flow events.
- EPA expects little or no effect on downstream aquatic life resulting from metals released during construction. The release of high levels of TSS could have a temporary negative impact on aquatic life.
- Sediment releases should not pollute downstream drinking water supplies because of the expected low concentrations of dissolved arsenic being released.
- Deposition of sediment should not cause problems to downstream public infrastructure. There is a potential for some temporary problems at irrigation intakes where coarse particles may settle out and constrict intakes. These areas will be monitored and problems will be corrected. The majority of the sediment will be transported downstream, mixed with other channel sediment, and ultimately deposited in downstream reservoirs. The amount released from Milltown as a result of construction activities is relatively small when compared to the amounts entering downstream reservoirs on a routine basis.
- As further described below under *Controls and Mitigation Measures*, several key engineering controls and best management practices (BMPs) will be used to protect downstream water quality. This will be accomplished by isolating the most highly contaminated sediments with sheet piling and a bypass channel, and carefully planning the timing and sequence of reservoir drawdown and dam removal. Equipment will be available to clean out downstream irrigation intakes to ensure they are not constricted.
- The Clark Fork River downstream of Milltown Dam will be monitored during and after remediation. Monitoring will include daily water quality sampling and possibly caged fish exposure studies, as well as seasonal or annual measurements of fish and benthic (bottom-dwelling) macroinvertebrates communities. Details of the final monitoring program design will be clearly defined prior to implementation of site remediation/restoration activities.

Protective measures to control sediment releases resulting from Clark Fork River and Blackfoot River channel and floodplain restoration as described in the DCRP, as amended June 2004, and methods to monitor possible effects are also important components of the Proposed Action and include the following:

- The Natural Resource Trustees and specifically the State of Montana have completed restoration projects of this type in the past and will use appropriate BMPs to control sediment delivery and reduce total suspended solids/sediment (TSS) concentrations in the Clark Fork and Blackfoot Rivers during and immediately following completion of construction activities. BMPs that will be employed will be defined in the Final Restoration Plan and will include the following: conducting most channel and floodplain reconstruction activities (for example, re-establishing meanders) in the "dry" to the extent possible (outside of the temporary bypass channel); minimizing construction during rainy or wet periods to reduce the potential for soil erosion and runoff to the temporary bypass channel; using sediment barriers and filters to minimize sediment delivery to flowing water; revegetating disturbed areas adjacent to the reconstructed river channels as soon as possible to minimize the potential for soil erosion, sediment delivery, and elevated TSS levels in the new river channels; and using other BMPs as appropriate.
- Restoration plan monitoring would consist primarily of measuring restored channel conditions, including stability and performance, using permanent cross sections, longitudinal profiles, elevation measurements, and photo points in representative habitat types (pools, runs, riffles); measuring vegetation composition, cover, and other parameters (including noxious weed presence) in treated and untreated reaches; and conducting fish population monitoring, possibly including radio-telemetry tracking studies of bull trout. Monitoring will be defined in the Final Restoration Plan and will be in addition to monitoring associated with the site remediation activities described above.

2.1.7.2 Controls and Mitigation Measures

Several key engineering controls and construction BMPs will be used to minimize the scour and release of reservoir channel sediment and associated metals during construction activities to protect downstream water quality.

The major planned engineering controls include the isolation of the SAA-1 sediments using a sheet pile and bypass channel system (See Figure 6). This system should be highly effective in reducing the potential for scouring. This system reduces total scouring from about 1.2 million tons of sediment to about 478,000 tons, and reduces the amount of highly contaminated sediment scoured from the reservoir from a projected 400,000 tons to 0 tons. Additional BMPs (such as silt curtains, coffer dams, flood control berms, and grading of stream banks) will also be developed during cleanup design and construction.

Another important aspect of mitigating and reducing potential downstream impacts is the timing and sequencing of reservoir drawdown and dam removal. To minimize downstream impacts and allow the earliest possible fish passage and recovery, EPA and MDEQ propose dam removal during the winter and spring months immediately after the SAA–1 sediments are isolated and the Clark Fork River is routed into the bypass channel. Stimson Dam would be removed first and Milltown Dam would then be removed. By timing the reservoir drawdown and dam removal in late winter/early spring, most sediment would be scoured during spring run-off and before the major irrigation withdrawals and the summer/early fall recreational season. There is also a potential for intake gate elevation control to try to bypass the sand fraction past irrigation intakes. Excavation equipment will also be dedicated to ensure that gates are not constricted by sand deposition. EPA and MDEQ plan to work closely with irrigators to ensure that negative impacts are minimized.

2.1.8 Upstream Channel Reconstruction

The upstream end of the restoration area (areas IV and V on Figure 4) will be reconstructed to a predominantly single thread channel with the existing channels converted to discontinuous wetlands with excavated gravel and soil from the new channel alignment. The channel will be constructed so that the proposed floodplain elevations will match the existing floodplain elevations and established floodplain vegetation. The new channel will have hydraulic and meander geometry appropriate for the geomorphic setting and size of the river. Channel gradient will be about 0.0013 foot per foot over the total channel length. Whenever possible, the new channel will be constructed to re-activate abandoned oxbows and meanders.

To maintain a consistent grade, the downstream portion of the reach will need to be constructed so that the floodplain has a lower elevation. At the downstream end of the reach, the floodplain will be lowered by up to four (4) feet to maintain a relatively consistent stream gradient through the reach. The width of the floodplain will gradually be reduced from greater than 2,000 feet to about 900 feet at the downstream end of the reach. The narrowing of the floodplain will continue downstream into the lower reach to create a smooth transition during large flood events.

The transition to a lower elevation floodplain will be similar to historic conditions and will also greatly reduce the amount of fill required by lowering the entrance elevation into the lower reach. Initial calculations indicate that the cuts and fills will balance in the upstream portion of this reach, but the lower portion will result in an excess of about 170,000 cubic yards of fill. Any excess excavated material could be used to fill the floodplains in the lower reach. Any material with contaminant concentrations in excess of desired amounts will be treated to meet the objectives. Whenever possible, existing vegetation will be salvaged and transplanted to the new floodplain elevation.

Any new channel construction will require bank stabilization and grade control until the vegetation can mature. Bank stabilization is necessary not only for proper function of the designed channel, but also especially important in this reach to minimize the amount of contaminated sediments that will be incorporated into the system through bank erosion. Most of the proposed grade and bank stabilization will be accomplished with structures constructed predominantly of wood, such as root wad/log vane combinations with rock "J" hooks and root wad debris jam clusters. Some of the grade control will be accomplished with armored pool tail out structures composed of the largest rock found in the bed. The number of structures are calculated based on structure size, gradient, and stream meander geometry. The grade control structures are designed to match the pool-to-pool spacing common in single thread channels. These structures are designed to function naturally in this geomorphic setting and match the natural stream aesthetics. Fish passage and habitat enhancement are also designed into these structures.

The existing wetlands along the southern portion of this reach will not be graded. It is anticipated that these wetlands and old channels will remain at the low terrace elevation and will be fed by subsurface water from adjacent hill slopes. These wetlands will likely be intermittent with less surface water supplied from the main channel. The existing stream channels will be filled intermittently, leaving sections of unfilled channel that will be converted to shallow wetlands. These wetlands will receive water during flood events and when the water table is higher than the bottom elevation of the old channels. To minimize the potential for colonization by undesirable non-native plant species, these wetlands would remain isolated.

2.1.9 Monitoring

An important part of the cleanup proposal is the monitoring program during and after remediation. Monitoring will be conducted to assess the effectiveness of engineering controls and other BMPs used during remediation activities and site cleanup in preventing exceedences of the temporary construction-related water quality standards. These monitoring results will be used to determine whether or not additional cost-effective controls and mitigation measures can be implemented if the temporary construction-related TSS and metals standards are exceeded. Monitoring also will be conducted to assess remedy effectiveness by comparing monitoring results to historical water quality values and biological conditions prior to the removal of Milltown Dam. In addition, monitoring will provide an opportunity to compare modeled TSS and metals concentrations with actual concentrations as early as possible during site remediation, specifically during the predicted peak concentrations in Stage 1.

A detailed ongoing monitoring program will be developed that includes water quality and biological studies conducted during and after site remediation activities to assess any adverse effects on aquatic habitat and organisms.

The water quality monitoring station will include the following:

- Continuous monitoring of turbidity on the Clark Fork River downstream of the Milltown Dam Site at the Deer Creek Bridge
- Daily sampling of TSS and dissolved and total recoverable metals using standard EPA protocols

In addition, EPA and MDEQ have established temporary construction standards (performance standards) for the river to protect human health and prevent acute impacts to the downstream fishery and bull trout. The Superfund point of compliance for these standards is proposed at Deer Creek Bridge, located about 2.8 miles downstream of Milltown Dam and the site of a current U.S. Geological Survey (USGS) sampling station (Station No. 12340500). This monitoring point will allow direct comparison to historic levels and is downstream far enough to account for the effect of any contaminated groundwater recharge back into the river. Additional BMPs and control actions will be considered if these standards are exceeded.

Seasonal or annual measurements of fish and benthic macroinvertebrate communities will be used to assess longer-term impacts. Results from these monitoring activities will be used to adjust construction activities or BMPs to avoid acute impacts on fish. In addition to the surface water quality monitoring, groundwater quality in the Milltown area and at key downstream locations will be monitored. Although negative impacts to groundwater used for drinking water are not expected, EPA is committed to remedy any problems related to drinking water that might occur.

As discussed previously, restoration plan monitoring would consist primarily of measuring restored channel conditions, including stability and performance, in representative habitat types (pools, runs, riffles); measuring vegetation composition, cover, and other parameters (including noxious weed presence); and conducting fish population monitoring and possibly radio-telemetry tracking of bull trout. Monitoring will be defined in the Final Conceptual Restoration Plan and will be in addition to monitoring associated with the site remediation activities described above.

2.2 Implementation of the Proposed Action

Table 2 summarizes the basic approach and potential schedule for implementation of the Proposed Action and is immediately followed by a list of the anticipated sequencing of remediation and restoration actions. This schedule reflects the current Envirocon SOW but is subject to change based on public participation activities, final design components and sequencing, and yearly variations in hydrologic conditions.

TABLE 2
Schedule for Implementation of the Proposed Action

Year	Activity
Late 2004	Record of Decision
2004 – 2005	Planning/remedial design, acquire environmental permits
2004 – 2005	Anticipated FERC license surrender regulatory activities
2005	Infrastructure construction (sheet pile, bypass channel, rail spurs, etc.)
Late 2005	Stimson Dam removal
2005 – 2006	Channel stabilization and revegetation activities (restoration): Blackfoot River Reach (lower segment) 1 (dependent on dam removal)
2006	Milltown Dam removal (remediation and restoration elements)
2006 – 2007	Sediment removal, backfilling, regrading: Clark Fork River Reach 3
2007 or later	Channel stabilization and revegetation activities (restoration): Clark Fork River Reach 4 and Blackfoot River Reach 2
2007 – 2008	Channel stabilization and revegetation activities (restoration): Clark Fork River Reaches 2 and 3
2009	Channel stabilization and revegetation activities (restoration): Clark Fork River Reach 1 and Blackfoot River Reach (upper segment) 1
2009	Future redevelopment activities
2009	Future operation and maintenance and 5-year reviews

The remediation and restoration actions necessary to construct the Proposed Action are described in *Chapter 2, Section 2.1, Key Components of the Proposed Action,* and summarized according to their anticipated sequencing as follows:

- Initiate the water quality and biological monitoring programs for the Clark Fork River and the water quality monitoring program for the Milltown alluvial aquifer.
- Lower the Milltown Reservoir water level by using the existing radial gate.
- Excavate the temporary bypass channel with conventional excavation equipment. Stack excavated materials on the south side of the channel to drain.
- Further isolate SAA-1 sediments through the use of interlocking sheet piling, riprap, or other means.
- Construct a 5-foot-high fish-passable drop structure at the upper end of the bypass channel.
- Construct a rail spur and sediment loading area between the bypass channel and the Clark Fork River.
- Route the Clark Fork River through the temporary bypass channel.
- Further lower Milltown Reservoir water levels by removing turbines and converting powerhouse inlets to low-level outlets.
- Remove Stimson Dam.
- At Milltown Dam, remove the spillway, radial gate, divider block, powerhouse, and north (right) abutment. Use coffer dams to isolate portions of the dam during this removal sequencing.
- Pre-load the sediments in SAA-I with up to 9 feet of clean fill to consolidate the sediments, forcing the release of excess water.
- Excavate the pre-load material and the sediment using large excavators working a linear face to optimize production and minimize the area of exposed groundwater. Pre-load material will also be loaded into trucks and used as backfill in areas where the sediment has been excavated.
- Dewater lower sediments within SAA-I as required.
- At the new rail staging and loadout area located between the temporary bypass channel and the Clark Fork River, place sediment into rail cars. The rail cars will be transported each night to Opportunity Ponds.
- Begin constructing a new floodplain and channel at the confluence of the Clark Fork and Blackfoot Rivers (see the DCRP, as amended June 2004, in the Appendix for a detailed discussion of the river channel and floodplain restoration plan). Continue constructing a new floodplain and channel at and upstream of the confluence of the Clark Fork and Blackfoot Rivers as indicated in Table 2 (see the amended DCRP in the Appendix for a detailed discussion). Finish constructing a new floodplain and channel at the confluence of the Clark Fork and Blackfoot Rivers and in upstream reaches as indicated in Table 2

(see the amended DCRP in the Appendix for a detailed discussion). Upon completion, redirect the Clark Fork River from the temporary bypass channel into the new channel.

- Backfill the temporary bypass channel and finish re-contouring, stabilizing, and re-vegetating the new floodplain.

Final designs for these remediation and restoration activities will include detailed work breakdown structures and schedules. Final designs will be prepared following issuance of the Record of Decision and concurrent with the acquisition of required environmental permits. It is assumed that the Proposed Action also may need to include some of the groundwater institutional controls (discussed previously), at least as a temporary measure, during and immediately after construction.

CHAPTER 3

Environmental Baseline

This chapter describes the existing baseline conditions for the gray wolf, bald eagle, Canada lynx, grizzly bear, yellow-billed cuckoo, and water howellia and their habitat in the assessment area (the geographic action area) for this BA. These descriptions provide the basis for assessing the potential effects of implementing the Proposed Action in *Chapter 4, Effects of the Action*. For each species the description of existing conditions covers the species status, known species and habitat distribution, life history characteristics, and habitat requirements.

3.1 Gray Wolf

3.1.1 Species Status

This species was listed as endangered on March 11, 1967. A revised recovery plan was approved by FWS in 1987 (FWS 1987). It identified a recovered wolf population as being at least 10 breeding pairs of wolves, for 3 consecutive years, in each of three recovery areas (northwestern Montana, central Idaho, and Yellowstone National Park). A population of this size distributed among the three recovery areas would be comprised of about 300 wolves. The plan recommended natural recovery in Montana and Idaho. If two wolf packs did not become established in central Idaho within 5 years, the plan recommended that conservation measures other than natural recovery be considered. The plan recommended use of the ESA's Section 10(j) Authority to reintroduce experimental wolves. By establishing a nonessential experimental population, more liberal management practices could be implemented to address potential negative impacts or concerns regarding the reintroduction. The Final Environmental Impact Statement (EIS) was filed with the EPA on May 4, 1994, and the Notice of Availability (NOA) was published on May 9, 1994. The assessment area includes four counties. According to the Helena, Montana, FWS web site, each includes populations of both listed threatened wolves and experimental, non-essential wolves (http://ecos.fws.gov/tess_public/TESSWebpageUsaLists?state=MT).

3.1.2 Life History and Habitat Requirements

The gray wolf has no particular habitat preference and is highly adaptable to a variety of habitats. The gray wolf does, however, require areas with low human population, low road density, and high prey density. Prey are ideally large, wild ungulates. Wolves live in dens or caves and are known to use the same den year after year. Wolf packs usually live within a specific territory ranging in size from 50 to more than 1,000 square miles, depending upon availability of prey and seasonal prey movements. Summer home ranges are generally smaller than the winter ranges.

Gray wolves are highly social and predominantly live in packs with a dominance hierarchy. Some wolves, known as lone wolves, remain alone but rarely rear pups. Packs usually consist of two to eight members and include a mating dominant pair (alpha pair), their offspring, and other non-breeding adults. Wolves begin mating around 2 to 3 years of age and are known to establish mates for life. Within a pack, only the dominant male/female mate and rear offspring. Mating typically occurs from February through March in the north and gestation lasts approximately 2 months. Females give birth to an average of five pups in the early spring (March and late May through early June). Pups depend on their mother's milk for the first 4 to 5 weeks after birth and emerge from the den in about 3 weeks. Young and parents vacate the den when the pups are about 3 months old. Rearing of young is a shared responsibility among the pack, and, after weaning, the pups are fed regurgitated meat brought by the pack members. Pups are practically full grown at 7 to 9 months of age and begin traveling with the adults. Although some offspring remain with the pack, at the age of 1 or 2 years, young wolves often leave the pack to find their own mate and begin another pack. In doing so, they can travel as far as 500 miles from their home.

Wolves are good hunters and wide-ranging predators. They can travel extensive distances after prey and can also attain speeds as high as 45 mile per hour for short distances. Gray wolves prefer to hunt ungulates, but when ungulate populations are low or seasonally unavailable, wolves are also known to eat beaver, snowshoe hare, rodents, and carrion. Carcasses of animals killed by wolves support a number of species including ravens, foxes, wolverines, vultures, and even bears and bald eagles. Wolves also help to regulate the balance between ungulates and their food supply. For example, riparian areas in parts of Yellowstone National Park are now recovering from years of overuse by elk because wolves keep elk from congregating in riparian zones. This indirectly supports smaller herbivores such as beavers and small rodents and song birds by increasing their available food supply and habitat.

3.1.3 Current Condition of Gray Wolves and Habitat Suitability in the Assessment Area

No occurrences of gray wolves are known within the entire assessment area (MTNHP database). The nearest pack locations include one about 20 miles to the west/southwest of Milltown, 20 miles to the east/northeast of Milltown, about 7.5 miles east of Deer Lodge along the railroad /Interstate Highway transportation corridor, and about 10 miles southwest of Opportunity Ponds. Given the size of wolf pack territories and the wide-ranging nature of the species, wolves could occasionally move through the assessment area including crossing the transportation corridor.

3.1.4 Factors Limiting Gray Wolves in the Assessment Area

The critical components of habitat suitable for gray wolves are the presence of a suitable prey base and relatively low levels of human activity. Wolves require high ungulate populations, secluded denning and rendezvous sites, and large remote areas with low potential for human interactions.

None of these conditions occur in the remediation/restoration area or at Opportunity Ponds. Both areas are largely developed and flanked by existing railroad lines and highways. The existing transportation corridor that will be used to transport the removed sediment is a major east-west route that is heavily traveled by cars, trucks, and trains. Several thousand vehicles and 16 trains currently use the Interstate Highway along the transportation route every day. While wolves undoubtedly cross this corridor, there is no suitable habitat in the immediate corridor area.

Wolf packs are sensitive to human disturbance and development within approximately 1 mile of wolf dens or rendezvous sites, resulting in potential adverse effects on gray wolf populations. Disturbances near dens during the denning season may cause dens to be abandoned. Younger pups can die if dens are abandoned because they cannot regulate their own body temperature. There are no suitable denning or rendezvous sites within or immediately adjacent to the assessment area.

3.2 Bald Eagle

As previously noted, much of the information presented in Chapter 3 of this BA is taken directly from the bald eagle BA that was prepared to assess the effects of the *Clark Fork Operable Unit Milltown Reservoir Sediments / Clark Fork River Superfund Site* (EPA 2002a).

3.2.1 Species Status

Bald eagles were listed as endangered throughout most of their range in the 48 contiguous states on March 11, 1967 (32 CFR 4001). Federal protection as an endangered species was extended to bald eagles in Montana on February 14, 1978 (43CFR 6233) (BOR 1994). Its recovery allowed a reclassification to threatened on July 12, 1995 (60 CFR 35999 36010).

3.2.2 Life History

The average life span of an adult bald eagle is about 30 to 50 years. Breeding usually first occurs at the age of 6 or 7 years (BOR 1994), and breeding pairs will stay together for as long as both are alive (EPA 1993). In Montana, nest building, courtship, and egg laying/incubation occur from February through the end of May. Clutch sizes range from one to three eggs, with an average of two (Terres 1991). The egg incubation period is usually around 34 to 36 days, and fledging generally occurs 70 to 98 days after hatching (Gough 1998). Hatching, rearing, and fledging generally take place from June through August (BOR 1994). After approximately 4 months of age, the eaglets are on their own. Immature birds are mainly brown and most do not acquire the characteristic white head and tail 5 or 6 years of age.

3.2.3 Habitat Requirements

3.2.3.1 Feeding

Bald eagles feed primarily on fish and carrion and take advantage of whatever food source is most plentiful and easy to capture or scavenge (EPA 1993). Most eagles consume a diet consisting primarily of fish, with lesser quantities of waterfowl, carrion, and small mammals (muskrats, squirrels, rabbits) (Gough, et al. 1998). Consequently, most bald eagles select home ranges near large bodies of water such as lakes, rivers, or wetlands. Availability of unobstructed perches and open flight paths to feeding areas are important in habitat selection (Polite and Pratt 2002, BOR 1994). Perches are generally located at the edge of forest stands, near foraging areas, or near the nest tree and have panoramic views of surrounding areas. For perching, they generally need large trees along rivers with good visibility, preferably snags.

3.2.3.2 Wintering Habitat

Critical winter habitat is located near food sources, such as lower elevation lakes and rivers that do not freeze, and uplands with nearby big game winter range. During the winter, when surface waters are frozen over, eagles either move to lower elevations, migrate to the south, or forage in upland areas that support wintering big game animals where they consume carrion (EPA 1993). Wintering areas must also have adequate perch sites and sheltered roost sites. Foraging distances have been reported to range from 3 to 7 miles from nest and roost sites (EPA 1993).

3.2.3.3 Night Roosts

During the nesting season, eagles will roost in large trees near the nest. Immature birds may congregate in large trees near water bodies with suitable food supplies. Protected deep ravines with large trees are often used as night roosts, especially during the winter when large numbers of birds may congregate. Human activity may be a major factor limiting bald eagle distribution on wintering areas (Steenhof 1978).

3.2.3.4 Nesting

Bald eagles are closely associated with lakes and large rivers in open areas, forests, and mountains. They nest near open water in late-successional forest with many perches or nest sites, and low levels of human disturbance (McGarigal, et al. 1991; Wright and Escano 1986). The nest site is usually within 1/4 to 1 mile of open water with less than 5 percent of the shoreline typically developed within 1 mile.

Nests are usually built in large trees between 50 and 200 feet above ground (Polite and Pratt 2002). In the absence of disturbances, the same nest site may be used by a breeding pair for many years (EPA 1993). Nests can range from 7 to 8 feet across and up to 12 feet deep. They are constructed with sticks and lined with soft materials, including mosses, pine needles, grasses, and feathers (Terres 1991). Because of the size and weight of the nest, a large tree with sturdy branches and an open-branched structure is usually selected (EPA 1993, Polite and Pratt 2002). The species of tree is not as important for nest site selection as height, size, and structure.

3.2.3.5 Home Range Size and Density

During the breeding period, the density of breeding pairs in the greater Yellowstone ecosystem (including areas of northwest Wyoming, southwest Montana, and northeast Idaho) has been observed to range from 0.026 to 0.045 pairs per kilometer of shoreline (Swenson et al. 1986). This corresponds to an average density of about one nest per 15 to 25 miles of shoreline. The minimum distances reported between nests ranged from 0.6 mile in Alaska to 10 miles in Washington (Polite and Pratt 2002). During the breeding period, the home range of the bald eagle has been reported to be around 13.5 square miles, while it is somewhat smaller (about 7 square miles) in winter (EPA 1993).

3.2.4 Current Condition of Bald Eagles in the Assessment Area

3.2.4.1 Opportunity Ponds Disposal Area

No bald eagle nests exist within 10 miles of Opportunity Ponds (MTNHP database) and no bald eagles would be expected to use this area.

3.2.4.2 Clark Fork River Transportation Corridor

As noted earlier, the Clark Fork BA (EPA 2002a) includes the reach of the Clark Fork River immediately upstream of Milltown Reservoir, which is the upper end of the assessment area for this BA. EPA (2002a) compared the breeding density and nesting success of bald eagle use along the Clark Fork River with other bald eagle populations in nearby areas to assess whether ongoing river contamination or other factors were adversely affecting bald eagles. This information is presented in the following text to provide an overview of the status of bald eagles along the Clark Fork River since little is known either about the nest immediately upstream of Milltown Reservoir or of the foraging habits of the birds using that nest.

Breeding Pairs in the Larger Clark Fork River Assessment Area

The MTNHP database identified 10 bald eagle nests along the Clark Fork River adjacent to the transportation corridor. This is in addition to the two nests within and at the upper end of the site remediation/restoration area. The transportation corridor adjacent to these nests is a major east-west route that is heavily traveled by several thousand cars and trucks and 16 trains daily.

Bald eagle nest locations in the upper Clark Fork River watershed and surrounding area were identified based on a survey conducted by the Montana Natural Heritage Program in 1999. Eight nests were reported in the watershed and surrounding area at that time. Based on a shoreline distance of 120 miles (193 kilometers), this corresponds to an average nest density of about 0.041 nests per kilometer of shoreline, which is within the range of nest densities (0.026 to 0.045 nests per kilometer of shoreline) reported for bald eagles in this region of the country by Swenson et al. (1986).

Nest Success in the Larger Clark Fork Assessment Area

EPA (2002a) summarized the status, brood size, and success of bald eagle nests in the assessment area for Zone 7 of the Bald Eagle Recovery Management Zone (including the Clark Fork River Basin) established by FWS (1986) and throughout Montana during the period 1994 to 2001. EPA (2002a) reported that the number of active nests tended to increase over time for both areas. The average brood size (1.9 young per active nest) and success of bald eagle nests (95 percent) in the upper Clark Fork River are above the averages observed for the state of Montana and within the Zone 7 Bald Eagle Recovery Management Zone (brood size of 1.5 young per active nest and 80 percent nest success). This indicates that the ability of bald eagles to successfully reproduce is similar to what would be expected for bald eagles in the region or in the rest of Montana. In addition, the success rate and average brood size in the upper Clark Fork assessment area exceed the values of 65 percent success rate and 1.0 young per nest identified by the Montana Bald Eagle Management Plan (BOR 1994) as one set of criteria for de-listing the bird from its federally Threatened status.

Conclusion Regarding Current Conditions in the Larger Clark Fork Assessment Area

Based on the observed density of breeding pairs (or nests) on the upper Clark Fork River and the success of these nests in producing offspring, EPA (2002a) concluded that the bald eagle population in the assessment area is similar to bald eagle populations in similar reference areas, and is not substantially impacted by any area-specific factors.

3.2.4.3 Current Conditions for Bald Eagles in the Milltown Assessment Area

One active bald eagle nest is located about 3/4-mile upstream (southeast) of the upper end of Milltown Reservoir, which is also the upper end of the sediment removal project area. Kristi DuBois, Montana Department of Fish, Wildlife, and Parks, confirmed the nest location and the presence of two chicks during an over-flight conducted on April 24, 2003. Sam Milodragovich of Northwest Energy, the current owner of Milltown Dam, also confirmed the presence of two chicks and indicated that the nest has been active at its current location for several years (Milodragovich 2003). No data concerning the success rate and productivity of this nest are available. A review of recent aerial photographs suggests that there is no direct line of sight from the nest location to most, but not all, of the sediment cleanup area. Most of the direct line of sight is blocked by cottonwood trees.

Milodragovich has observed eagles foraging in both Milltown Reservoir and in the Clark Fork River upstream. No studies of this specific nesting pair have been conducted to date. Winter activity is limited to open parts of the river, as the reservoir freezes each winter. Wintering bald eagles apparently forage in different parts of the river in response to ice formation (Milodragovich 2003). Northwest Energy is planning to conduct regular observations of the eagle pair nesting above Milltown Reservoir to determine primary use areas. This information will be useful so that the guidelines in the Montana Bald Eagle Management Plan can be followed during construction.

There is a second active bald eagle nest about 7 miles upstream of Milltown Dam. This is about 1.5 to 2 miles upstream of the upper end of SAA IV and V (Figure 4) through which a new river channel will be constructed. The new channel is to extend about 3 miles upstream of the dam, as described in the June 2004 amendment to the DCRP (see Appendix).

Fisheries resources (bald eagle prey) in the assessment area were described by several early investigators (Evermann 1892, Gilbert and Evermann 1895). Several species of fish that are suitable as prey for bald eagles are present in the reservoir, the river, or both. Native fish among these include bull trout (*Salvelinus confluentus*), westslope cutthroat trout *(Oncorhynchus clarki lewisi),* mountain whitefish *(Prosopium williamsoni),* northern pikeminnow (*Ptychocheilus oregonensis*), longnose sucker (*Catostomus catostomus),* and largescale sucker (*C. macrocheilus*) (McPhail and Lindsay 1970). Today, species of native salmonids and introduced salmonids co-exist over most of the assessment area, particularly in the larger river systems. The introduced salmonids frequently are the most abundant species among trout populations. Introduced trout species in the assessment area include rainbow/redband trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), and brook trout (*Salvelinus fontinalis*). In addition, naturally reproducing populations of northern pike (*Esox lucius*), a non-native species illegally introduced into Milltown Reservoir, occur in the assessment area.

Current Conditions for Bald Eagles on the Blackfoot River Near the Assessment Area

The MTNHP database indicates that three bald eagle nests exist on the Blackfoot River about 7.5, 8.5, and 10 miles upstream of Milltown. None of the remediation or restoration activities will occur within 5 miles of any of these nests. Therefore, there would be no effects and these nests are not discussed further.

3.2.5 Potential Factors Limiting Bald Eagles in the Assessment Area

Information is presented for both assessment areas even though the focus of this BA is the Milltown Assessment Area. This is because information from the Upper Clark Fork Assessment Area is pertinent to assessing current conditions and potential impacts of the Milltown project on bald eagles.

No studies were located on factors that may currently be limiting bald eagle populations in the Upper Clark Fork Assessment Area (EPA 2002a) or the Milltown Assessment Area. Some potentially relevant factors are discussed below.

3.2.5.1 Human Disturbances

Human activity and disturbances impact the presence of bald eagles. They are almost never found in areas of heavy human use, and will reach maximum densities only in areas with minimal human activity (EPA 1993, BOR 1994). Eagle responses to human activities may range from spatial or temporal avoidance of the disturbing activity to total reproductive failure and abandonment of breeding areas (BOR 1994). Eagles are the most sensitive to human activity early in the nesting cycle. In Montana, these activities generally occur during the period of February 1 through May 15 (BOR 1994).

In general, human activity along the upper Clark Fork River is moderate, consisting mainly of ranching and recreational use. These human activities may tend to limit the occurrence of bald eagles in the assessment area, although this does not appear to be a major factor at present. The immediate area around the bald eagle nest upstream of Milltown Reservoir is subject to similar uses. The area in the immediate vicinity of the nest is grazed by livestock and a local road is located approximately 750 feet south of the nest site. The nearest developed home site is approximately 1,200 feet north-northwest of the nest. Additional houses and Interstate Highway 90 are located across the Clark Fork River approximately 3,000 feet east of the nest.

3.2.5.2 Food Availability

Food availability has been reported as an important factor for nest site selection and presence of bald eagles (BOR 1994). As discussed in EPA (2001b), a variety of aquatic and terrestrial wildlife occur in the Clark Fork River Operable Unit—including fish, birds, and small and large mammals. All are potential food source for bald eagles. With regard to fish (the main food item), the density of trout in the upper Clark Fork River is lower than expected for other similar streams (EPA 2001b), but the total density of fish, including whitefish, is likely more than sufficient to support bald eagle feeding requirements (EPA 2002a). This is supported by the finding (discussed above) that current nest densities along the upper Clark Fork River are within a range expected for this region of the country. This suggests that the availability of food is not currently a factor that is limiting bald eagle populations in the Clark Fork Assessment Area. Because bald eagles have nested at the site near Milltown Reservoir for several years, it is likely that food availability is not a limiting factor for this pair of eagles either.

3.2.5.3 Chemical Contamination

Bald eagles may potentially be exposed to chemical contamination by several pathways, the most important of which is likely to be ingestion of prey that have accumulated chemical contaminants in their tissues. While elevated levels of some inorganic chemicals can be detected in the tissues of fish in the Clark Fork Assessment Area, especially in the upper reaches farthest from Milltown, predicted Hazard Quotient (HQ) values for the bald eagle are below a level of concern for all inorganic chemicals considered at all reaches of the upper Clark Fork River (EPA 2001b). These findings suggest that hazards to the eagle from oral exposure to mining-related contaminants are likely to be minimal. Based on this, mining-related chemical contamination is not likely to substantially limit bald eagles in the Clark Fork Assessment Area. No reasons are known for reaching a different conclusion for the eagles nesting and foraging at or near Milltown Reservoir.

3.3 Grizzly Bear

3.3.1 Species Status

The grizzly bear was listed by the FWS as threatened under the ESA on July 28, 1975, for the 48 contiguous states. Seven ecosystems were identified or are being considered as suitable for grizzly bear populations and include Yellowstone (northwestern Wyoming, southwestern Montana, and eastern Idaho), Northern Continental Divide (Montana), Cabinet-Yaak (northwestern Montana), Bitterroot (central Idaho and western Montana), Selkirks (Idaho and eastern Washington), the North Cascades (Washington), and the San Juan Mountains (Colorado). All ecosystems but the Bitterroot and San Juan ecosystems currently support grizzly bear populations.

The recovery priority for the grizzly bear is 6C, indicating a subspecies with a high threat and high recovery potential that is or may be in conflict with economic activity. The original recovery plan for the grizzly bear was approved on January 29, 1982, by the FWS. The grizzly bear recovery plan was revised in 1995. Three parameters were identified as key indicators of population status and include the following:

- Sufficient reproduction to offset the existing levels of human-caused mortality
- Adequate distribution of breeding animals throughout the area
- A limit on total human-caused mortality (related to first and second parameters)

3.3.2 Life History and Habitat Requirements

Grizzly bears require large areas of undisturbed habitat. Females tend to have smaller ranges (50 to 300 square miles) while males need larger areas (200 to 500 square miles). Overlapping of ranges is not uncommon. Most existing grizzly bear habitat is characterized by contiguous, relatively undisturbed mountainous habitat with a high level of topographic and vegetative diversity. Grizzlies prefer open meadows and avalanche chutes in the spring and timberlands with berry bushes in late summer and fall. Winter hibernation requires access to high elevation areas where deep snow accumulates.

Grizzly bears hibernate from November through April. Males usually emerge from the den in March or April while females emerge in late April and May. They begin searching for their dens in early fall and typically select sites in the high and remote north-facing slopes where deep snow will serve as insulation and they are unlikely to be disturbed by humans or other animals.

Grizzly bears have one of the lowest reproductive rates of any land mammal. Although mating season is from May through July, the embryos do not typically begin developing until the female begins to hibernate, usually sometime in November. One to four cubs are usually born in January. Initially cubs are blind, hairless, and weigh 1 pound or less. Cubs feed on their mother's milk for almost 1 year and remain with her for another 2 to 3 years until they reach breeding maturity at approximately 4.5 to 5.5 years of age. Females only breed every 3 or more years and begin breeding between 3.5 to 8.5 years of age. Males become sexually mature at approximately 4.5 years. Grizzly bears usually live to be 15 to 20 years of age, and few survive past 30 years.

The grizzly bear's diet primarily consists of green vegetation, wild fruits and berries, nuts, and bulbs or roots. Insects also make up a large part of their diet. Most of the meat consumed by grizzly bears comes from animal carcasses of big game animals; however, grizzlies are sometimes known to prey on elk or moose calves or other small animals. During the cutthroat spawning season in the Yellowstone ecosystem, fish can account for up to 90 percent of the diet.

3.3.3 Current Condition of Grizzly Bears in the Assessment Area

The only grizzly bear occurrences or suitable habitat reported by MTNHP are about 10 miles north of Milltown. This area is the southernmost tip of the Northern Continental Divide Recovery Area, which extends through Glacier National Park into Canada (FWS 2004). The next closest area supporting grizzly bears is the Greater Yellowstone Ecosystem, about 120 miles southeast of Anaconda. No movement of grizzly bears between these two recovery areas (the assessment area location) is known.

3.3.4 Factors Limiting Grizzly Bears in the Assessment Area

A large impact on historical and current grizzly bear populations is habitat degradation/fragmentation resulting from rural or recreational development, road building, and energy and mineral exploration. These activities and associated motorized access and increased human presence in remote areas cause habitat fragmentation, leaving grizzly bears with reduced or divided ranges. Habitat degradation and fragmentation also lead to reduced diversity and other adverse impacts to native vegetation. Maintaining native vegetation throughout areas of grizzly bear habitat is essential for providing individual bears with adequate cover and food sources. Disruption of corridors linking populations from different ecosystems, particularly in valley bottoms and riparian areas, is a major problem. These corridors are important for maintaining genetic diversity among populations and for foraging.

All of these factors that limit grizzly bear occurrence and render habitats unsuitable are present in the assessment area. Both the restoration area and Opportunity Ponds are largely developed and flanked by existing railroad lines and highways. The existing transportation corridor that will be used to transport the removed sediment is a major east-west route that is heavily traveled by cars, trucks, and trains. Several thousand vehicles and 16 trains currently use the Interstate along the transportation route every day.

3.4 Canada Lynx

3.4.1 Species Status

The Canada lynx was listed as a threatened species March 24, 2000. On December 26, 2002, the District Court for the District of Columbia issued a decision that enjoins the FWS from issuing "written concurrence[s]" on actions proposed by federal agencies that "may affect, but are not likely to adversely affect" Canada lynx. That decision has now been lifted.

3.4.2 Life History and Habitat Requirements

Portions of the following text are from the NatureServe (2004) web site. Lynx breed in late winter-early spring in North America and adult females produce one litter every 1 to 2 years. Young stay with the mother until the next mating season or longer. Some females give birth as yearlings, but their pregnancy rate is lower than that of older females (Brainerd 1985). Prey scarcity suppresses breeding and may result in mortality of nearly all young (Brand and Keith 1979).

Home range increases, and individuals may become nomadic, when prey is scarce (Ward and Krebs 1985, Saunders 1963, Mech 1980). Long distance dispersal movements of up to several hundred kilometers have been recorded. Population density usually is less than 10 (locally up to 20) per 100 square kilometers, depending on prey availability. Mean densities range between 2 and 9 per 100 square kilometers (McCord and Cardoza 1982).

Foraging habitat for lynx has typically been described in terms of suitability for their primary prey, snowshoe hares. Hares use young conifer stands that are densely stocked with seedlings or saplings, tall enough to provide browse for snowshoe hares above typical winter snow depth (Koehler and Brittel 1990). Buskirk et al. (1999) suggested that snowshoe hare abundance should be high in both sapling and old, "gap phase" forests, where tree mortality and snag loss created gaps in the canopy that allowed increased understory production. Thus, foraging habitat could be defined as either sapling or old forest structures with high densities of small-diameter stems 1 to 3 meters high.

Denning habitat is defined by the presence of ground-level structures that provide security and cover for kittens. Suitable structures are often found in old and mature forests with substantial amounts of coarse woody debris; however, it may also be provided in early successional forests where windthrow and snags are present (Aubry et al. 1999). Other forest structural stages, such as closed-canopy mid-age to mature forests with little understory cover, are generally not selected for either foraging or denning, but may serve as travel habitat (Koehler and Brittell 1990). Lynx may avoid recent clearcuts that are more than 100 m wide because they lack sufficient cover (Koehler 1990). Such areas may also not be recolonized by prey species (mainly snowshoe hares) until as much as 20 to 25 years after harvest (Koehler and Brittell 1990).

3.4.3 Current Condition of Canada Lynx in the Assessment Area

At the scale at which the data were provided, the MTNHP database indicates that suitable lynx habitat is extensive in the vicinity of the Milltown remediation/restoration area and along the first 25 miles of the transportation corridor southeast of Milltown. Mountainous areas on either side of the rest of the corridor are also indicated as suitable habitat. It also shows several individual lynx occurrences within a 20-mile-wide corridor centered on the restoration site, transportation corridor, and disposal site.

3.4.4 Factors Limiting Canada Lynx in the Assessment Area

The immediate Milltown remediation/restoration area and lower elevation surrounding lands do not include suitable lynx habitat. Milltown Reservoir includes open water and emergent wetlands and the upstream remediation/restoration area consists of braided river channels, gravel bars, and open riparian forests. None of these habitats are preferred by lynx. Similarly, neither the transportation corridor nor Opportunity Ponds provide suitable lynx habitat. The presence of apparently suitable lynx habitat on both sides of the existing transportation corridor combined with the occasional individual occurrences suggest that lynx may occasionally travel across the corridor.

3.5 Yellow-Billed Cuckoo

3.5.1 Species Status

The FWS received a petition dated February 2, 1998, to list the yellow-billed cuckoo as an endangered species. The petitioners stated that "habitat loss, overgrazing, tamarisk invasion of riparian areas, river management, logging, and pesticides have caused declines in yellow-billed cuckoo." The 90-day finding dated February 17, 2000 (65 FR 33), found that the petition presented substantial scientific and commercial information to indicate that the listing of the yellow-billed cuckoo may be warranted. In that finding, the FWS indicated that the factors noted by the petitioners may have caused loss, degradation, and fragmentation of riparian habitat in the western U.S., and that loss of wintering habitat may be adversely affecting the cuckoo. In July 2001, the FWS announced a 12-month finding for a petition to list the yellow-billed cuckoo as threatened or endangered in the western U.S. They determined that listing the yellow-billed cuckoo was warranted but precluded by higher priority species. The Western Distinct Population Segment (DPS) of the yellow-billed cuckoo was given status as a candidate species by the FWS.

3.5.2 Life History and Habitat Requirements

This species may go unnoticed because it is slow-moving and prefers dense vegetation. In the West, it favors areas with a dense understory of willow (*Salix* spp.) combined with mature cottonwoods (*Populus* spp.) and generally within 325 feet of slow or standing water (Gaines 1974; Gaines 1977; Gaines and Laymon 1984). The yellow-billed cuckoo is also known to use non-riparian, dense vegetation such as wooded parks, cemeteries, farmsteads, tree islands, Great Basin shrub-steppe, and high elevation willow thickets (Finch 1992; DeGraff et al. 1991). It feeds on insects, mostly caterpillars, but also beetles, fall webworms, cicadas, and fruit (especially berries). Breeding often coincides with the appearance of massive numbers of cicadas, caterpillars, or other large insects (Ehrlich et al. 1992).

At the local level, population densities of yellow-billed cuckoos may be highly variable (Eaton 1988). Research indicates that large, localized influxes of yellow-billed cuckoos are linked to changes in food supply and increased insect abundance (Groschupf 1987). Populations seem to fluctuate dramatically in response to fluctuations in caterpillar abundance. These fluctuations are erratic, but not necessarily cyclic (Kingery 1981).

Erratic population fluctuations mean that population estimates made over short-term periods (1 to 2 years) are not particularly reliable (Groschupf 1987), but even population densities based on long-term data may be underestimated. This is attributable to this bird's quiet demeanor and furtive behavior, which makes this species relatively easy to overlook when it is not singing. Conventional observation, mist netting (Rappole et al. 1993), or listening-post techniques are inadequate for estimating density; counting responses to playback is preferable (Hamilton and Hamilton 1965).

In California, Gaines (1974) defined habitat as willow and cottonwood forests below 4265 feet elevation, greater than 25 acres in extent, and wider than 325 feet. Laymon and Halterman (1987) concluded that sites greater than 200 acres in extent and wider than 1,950 feet were optimal (100 percent occupancy); sites 101 to 200 acres in extent and wider than 650 feet were suitable (58.8 percent); sites 50 to 100 acres in extent and 325 to 650 feet wide were marginal (9.5 percent); and sites less than 38 acres in extent and less than 325 feet wide were unsuitable. During a 4-year study on the Sacramento River, Halterman (1991) found that habitat patch area, the extent of habitat in a 5-mile section of river, and presence of low woody vegetation were the most important variables in explaining the distribution of cuckoos. These variables combined explained 46 percent of the variation observed in the distribution of breeding pairs.

Microhabitat requirements are also important. Nesting groves at the South Fork Kern River are characterized by higher canopy closure, higher foliage volume, intermediate basal area, and intermediate tree height when compared to random sites (Laymon et al. 1997). Sites with less than 40 percent canopy closure are unsuitable, those with 40 to 65 percent are marginal to suitable, and those with greater than 65 percent are optimal (Laymon and Halterman 1989).

3.5.3 Current Condition of Yellow-billed Cuckoo in the Assessment Area

The MTNHP database did not show any cuckoo observations within the assessment area. No suitable habitat exists in the Milltown Reservoir area or at Opportunity Ponds. Suitable habitat may exist along parts of the Clark Fork River adjacent to the transportation corridor. Review of aerial and oblique photographs of the restoration reach show generally scattered cottonwoods with little willow understory except immediately along the active channels. This does not constitute preferred cuckoo habitat.

3.5.4 Potential Factors Limiting Yellow-billed Cuckoos in the Assessment Area

The primary cause for the decline of yellow-billed cuckoo populations in the western United States is riparian habitat loss, degradation, and fragmentation. One of the primary factors adversely affecting riparian habitat that has resulted in the cuckoo population decline is habitat degradation from livestock grazing (FWS 2002b). Yellow-billed cuckoos are believed to be more sensitive to habitat loss than other riparian obligate species because of specific factors that influence successful nesting. Most successful nesting territories have a combination of dense willow understory where the nest is placed and a cottonwood overstory that is used for foraging. Habitat blocks greater than 37 acres are preferred and even larger patches provide better habitat (Halterman 1991; Laymon et al. 1997). The direct loss of riparian habitat is a major threat to the survival of yellow-billed cuckoo populations because this bird depends upon large expanses of specific types of riparian habitat for successfully nesting. Estimates indicate that 70 to 90 percent of North American riparian ecosystems have been destroyed by human activities (Ohmart and Anderson 1986). Additionally, as much as 80 percent of the remaining fragments are dominated by human use and are likely to be in unsatisfactory condition (Almand and Krohn 1978).

Heavy livestock use of riparian areas substantially degrades suitable nesting habitat for cuckoos. Foraging cattle reduce the density of willow and other shrubs, and eliminate cottonwood and willow reproduction both by feeding on seedlings and by modifying habitat through soil compaction or other means Klebenow and Oakleaf 1984, Ohmart 1994, Reichenbacher 1984, Taylor and Littlefield 1986). Over time, the elimination of willow and cottonwood regeneration results in decadent overstories composed of dying cottonwood with no new recruitment in the understory to replace them (Klebenow and Oakleaf 1984, Reichenbacher 1984, Stromberg 1993, Taylor and Littlefield 1986). Cattle impacts are typically most severe in riparian areas because available water, shade, and forage causes cattle to congregate in riparian areas. Skovlin (1984) estimated that cattle spend 5 to 30 times longer in riparian habitats than adjacent uplands based on areal extent. As a result, heavily grazed western riparian areas are often deficient in willow understory and nearly devoid of young overstory-sustaining cottonwoods. This both degrades current habitat value and prevents development of suitable habitat in the future.

Virtually all of the land in the Clark Fork valley river bottom throughout the assessment area is privately owned. Most of the river bottom land that has not been cleared for agriculture are likely heavily grazed by cows, as this is the normal practice on private western riparian lands. The resulting deficient willow understory, as seen in photographs, and degraded overstory provide very poor quality cuckoo habitat.

3.6 Water Howellia

3.6.1 Species Status

Water howellia (*Howellia aquatilis*) was listed by the FWS as threatened throughout its entire range (including Washington, Oregon, California, Idaho, and Montana) on July 14, 1994 (59 FR 35860-35864).

3.6.2 Life History

Water howellia belongs to the Bellflower Family (Campanulaceae). It is an annual aquatic plant with both submerged and floating stems that grows to 10 to 60 centimeters (4 to 24 inches) in height. Stems are fragile with many branches. Leaves are simple, narrow, and usually alternate. Some leaves may be opposite or whorled. Stems and leaves are smooth with no hairs or spines.

Plants begin active growth March to May. This species has two flowering mechanisms. Submerged stems produce single flowers underwater in the leaf axils. These submerged flowers are cleistogamous because they never open and are self-pollinated. Cleistogamous flowers bloom first, usually starting in late June. Stems that grow to the water surface produce small white flowers in terminal clusters on the surface of the water. Surface-blooming flowers open to allow pollination and are called chasmogamous. Chasmogamous flowers bloom later in the summer than cleistogamous flowers (from late July through early

August). Fruits are capsules that enclose up to five large, elongated seeds. Flowering and fruit development can continue well into the summer months, depending on weather patterns.

Seed germination appears to occur in the fall with plants over-wintering as seedlings. Water howellia reproduces entirely from seed, and germination only occurs when ponds dry out and the seeds are exposed to air (Lesica 1990, 1992). Since water howellia is an annual plant, populations vary in annual abundance, and the size of a population is affected by the extent of drying the previous growing season (Lesica 1992; Roe and Shelly 1992). Exceptionally wet or dry seasons have a detrimental effect on plant numbers the following year. The length of time seeds remain viable is unknown. However, seeds that remain in the soil longer than 8 months have shown decreased rates of germination and vigor (Lesica 1992).

3.6.3 Habitat Requirements

Howellia has very specific habitat requirements and has been rare throughout the period since botanical records have been kept. It is extremely limited throughout its range, occurring in ephemeral ponds and at the margins of permanent ponds, which in most cases are glacial potholes (Shapley and Lesica 1997). Water howellia is an aquatic plant that inhabits small pothole ponds or quiet waters of retired river oxbows. Although most of the ponds in which howellia is found are of glacial origin, the Idaho site, one Washington site, and the Swan River Oxbow in Montana are located in fluvial environments. A critical feature of howellia habitat is that the ponds dependably dry out, at least in part, by the end of the growing season. Most have no outlet and thus depend on inputs from precipitation, over-bank flooding and groundwater, although the relative importance of each is not clear (Lichthardt and Moseley 2000).

Sites with howellia usually have firm, consolidated clay and organic sediments bottoms (Shelley and Moseley 1988; Lichthardt and Moseley 2000). Soils are rich in organic matter and frequently contain partially decomposed leaves, stems, and wood. Since howellia apparently requires exposure to air to germinate and inundation for growth in the spring, this species is restricted to the zone within wetlands that is seasonally inundated, but which dries out in late summer or early fall. This annual inundation may be an important factor in keeping competing vegetation from becoming too well established. This zone of hydrology is often impacted by water development, diversions, dams, and levee construction.

Aquatic sites with water howellia are partially surrounded by broadleaf deciduous trees. Examples include black cottonwood (*Populus trichocarpa*) and/or quaking aspen (*Populus tremuloides*) in Montana, and Oregon ash (*Fraxinus latifolia*) or Oregon white oak (*Quercus garryana*) in Washington. In Montana, howellia typically grows in association with inflated sedge (*Carex vesicaria*), water parsnip (*Sium suave*), and/or water horsetail (*Equisetum fluviatile*). In Idaho, howellia is found in a small pond in a cutoff river channel, in a broad valley bottom surrounded by low, forested hills. Rangewide, ponds or old oxbows are generally filled by spring rains or snowmelt run-off, which usually dry by the end of the growing season. This species occurs at elevations from 10 feet in Washington to 4420 feet in Montana (Shelly and Moseley 1988).

3.6.4 Current Conditions for Water Howellia in the Assessment Area

Existing Montana populations of water howellia are mainly clustered in the Swan River Valley on the Flathead National Forest, which is north of the assessment area. Historically, before the Milltown Dam affected the hydrology of these rivers, it is possible that howellia could have occurred in old oxbows and floodplains of the Clark Fork and Blackfoot Rivers, but it has never been described for these rivers. No populations are currently known to occur within the assessment area or upstream on the Clark Fork River (Heidel 2004). Waters with altered hydrology or topography are not considered suitable habitat for this species.

Known populations of water howellia in Missoula County are in the extreme northern part of the county (Heidel 2004). Shelly (2004) does not think there is suitable habitat for howellia in the assessment area or vicinity. He states that it requires specialized habitats that have a reliable yearly cycle of spring recharge followed by drawdown in the late summer or fall. These drawdowns and associated drying of the habitat are critical for seed germination for this species. Neither reliable drawdowns or suitable substrates are likely in the assessment area. The substrates in the wetlands where it occurs (mostly small, glacially formed pothole ponds) are rather firm and consolidated, not a likely scenario in the assessment area either. Shelly believes that the likelihood of howellia in the assessment area is low as a result, but no formal surveys have been done there.

3.6.5 Potential Factors Limiting Water Howellia in the Assessment Area

The FWS lists the most significant threats to this species as loss of wetland habitat and habitat changes (FWS 1994). The most significant threats and management concerns are changes in wetland hydrology, increases in weedy species (for example, reed canarygrass) and the threat of invasion by noxious weeds (for example, purple loosestrife), livestock grazing, and timber harvest activities on adjacent uplands. The latter activity can result in sediment releases that can cause ponds and oxbows to fill.

The life cycle of howellia is closely tied to the hydrology of the ephemeral ponds that comprise its habitat. Viability of annual plants, such as howellia, are dependent in the short term on hydrologic conditions necessary for seed production and germination. Long-term survival of metapopulations may depend on the density and diversity of ponds available (Lesica 1992). Habitat management for howellia requires better understanding of pond hydrology and geometry (Shapley and Lesica 1997) and the effects of exotic species, such as reed canarygrass, that are invading ponds and wetlands with howellia (Lesica 1997).

Genetic variability is low for howellia across its range (Lesica *et al*. 1988). The species may represent a single genotype that is narrowly adapted to specific habitat conditions. Populations vary widely in size from year to year, and very wet or very dry seasons can have a detrimental effect on abundance. The large fluctuations in annual numbers and low genetic variability indicate that isolated populations may be vulnerable to extirpation. Perhaps populations near the larger “population centers” may be inherently more resilient.

CHAPTER 4

Effects of the Action

This chapter assesses the potential direct, indirect, and cumulative effects on listed and candidate species that would result from implementing the Proposed Action. Short-term effects are those expected to occur during the active remediation and restoration phases of the project. Long-term effects are those effects expected following the completion of site remediation and restoration activities. Short-term effects would be temporary while long-term effects would extend indefinitely into the future.

4.1 Gray Wolf

No suitable denning or rendezvous sites or other suitable habitat exist within or immediately adjacent to the assessment area. Daily train traffic within the transportation corridor will increase by 12.5 percent from 16 to 18 one-way trips. On average, one train would pass every 1.33 hours instead of the current rate of one train every 1.5 hours. The increase would slightly increase the possibility that the occasional wolf crossing the transportation corridor would be struck by a train. However, the frequency of truck and car traffic on I-90 is much higher than the frequency of train traffic, with a much higher likelihood that a wolf crossing the transportation corridor would be struck and killed.

4.2 Bald Eagle

4.2.1 Short-term Direct and Indirect Effects

A bald eagle nest is located about 3/4-mile upstream of the upper end of the Milltown Reservoir sediment removal area. Therefore, eagles using this nest could forage downstream into the project area as well as upstream along the Clark Fork River. The Montana Bald Eagle Management Plan (MBEMP) (BOR 1994) specifies certain management zone restrictions within a 2.5-mile radius of active bald eagle nests. Given the location of the nest, this distance would include the entire Milltown Operable Unit as well as upstream portions of the river where the channel is to be re-constructed. Eagles nesting at a second site about 7 miles upstream of Milltown Dam may also forage in the river section that will be re-constructed.

Remediation activities are expected to last approximately 5 years, but could take longer depending on actual site-specific conditions and circumstances. These activities will consist of sediment removal and isolation, dam removal, and river channel and floodplain reconstruction. An estimated 8 to 10 years are needed to complete the entire project, which includes planning and design phases, infrastructure and remediation work, dam removal, and site restoration. The most likely short-term adverse effects of the proposed remedy on the two pairs of bald eagles nesting upstream of Milltown Reservoir are the following:

- Disturbance of normal foraging behavior in the reservoir (one nesting pair and possibly other bald eagles) and nearby sections of the river (both pairs) by the presence of humans and machinery at the reservoir and in the floodplain
- Displacement of other bald eagles that may forage at Milltown Reservoir during the 5-year construction period, and
- Possible abandonment of one or both nests because of activities at the reservoir and channel and floodplain restoration activities. The likelihood of nest abandonment is higher for the pair nesting 3/4-mile upstream of Milltown Reservoir because of more remediation/restoration activities in the vicinity of this nest.

Eagle responses to human disturbance may range from simple avoidance (in space or time) to total reproductive failure and abandonment of breeding areas (BOR 1994). Eagles are the most sensitive to human activity during nest building, egg laying, and egg incubation, an interval that typically runs from early February to the end of May (BOR 1994). Eagles are moderately sensitive during the rearing period (May through August), and relatively insensitive after fledging (BOR 1994).

In order to minimize human disturbances to breeding eagle pairs, the Montana Bald Eagle Management Plan (BOR 1994) establishes *de facto* management plans for each active nest. In brief, the area around each nest is divided into three concentric zones, and the plan specifies the types of activities than should not occur within each zone. These prohibited activities are shown in Table 3.

TABLE 3
Montana Bald Eagle Management Plan Recommendations to Avoid Disturbance of Bald Eagles

Zone	Zone Description	Zone Management Recommendations
1	Within 1/4-mile radius area of an active nest or a nest that has been active within the past 5 years.	High intensity activities (heavy equipment use, blasting, logging, or concentrated recreation) should not occur during the nesting season. Additional human activity (above existing levels) should not occur from initiation of nest site selection to one month after hatching (unless activity is consistent with bald eagle conservation).
2	1/2-mile radius area of active nest or all nest sites in a breeding area that have been active within 5 years	High intensity activities (heavy equipment use, blasting, logging, or concentrated recreation) should not occur during the nesting season. Permanent developments should not be constructed. Structures (such as overhead utility lines) should not be constructed; existing structures posing risk of injury or death should be removed or modified.
3	All suitable foraging habitat within 2-1/2 miles of all nest sites in the breeding area that have been active within 5 years.	Human activities (including permanent developments) should be designed and regulated to minimize disturbance and avoid conflicts with key use areas. Human activity should not reach a level where cumulative effects decrease habitat suitability. Habitat alterations should ensure prey base and important habitat components (perch trees) are maintained or enhanced. Structures posing a hazard should be located/designed to minimize or avoid risk to eagles or their prey.

4.2.1.1 Nest Located 3/4-Mile Upstream of Milltown Reservoir

Restoration activities (new channel construction) will occur within 500 to 1,000 feet of the nest located 3/4-mile upstream of the reservoir (within MBEMP Zone 1 for this nest). Management Zone 1 includes areas within 1/4-mile of a nest site used within the last 5 years. Recommended activity restrictions in Zone 1 include eliminating all sources of disturbance including high-intensity activities such as heavy equipment use, blasting, logging, or concentrated recreation during the nesting season; permanent developments; and structures (such as overhead utility lines) that pose a risk of injury or death. No new structures should be constructed and existing ones should be removed or modified. However, heavy construction will occur within MBEMP Zone 1 for this nest site as part of the restoration project.

Restoration activities (new channel construction) will also occur within MBEMP Zone 2 for this nest. Management Zone 2 includes areas from within 1/4 to 1/2 mile of a nest site used within the last 5 years. Recommended activity restrictions in Zone 2 include restrictions on high intensity activities (heavy equipment use, blasting, logging or concentrated recreation) during the nesting season; permanent developments; and structures (such as overhead utility lines) that pose a risk of injury or death. Heavy construction will also occur within MBEMP Zone 2 for this nest site as part of the restoration project.

Management Zone 3 extends from 0.5 to 2.5 miles from nests active within the last 5 years, and would include the entire Milltown Dam and Reservoir area. Zone 3 recommendations state that human activities (including permanent developments) should be designed and regulated to minimize disturbance and avoid conflicts with key use areas (which are not known for this pair of eagles) and human activity should not reach a level where cumulative effects decrease habitat suitability. No permanent structures will be developed within 2.5 miles of this nest as a result of the project. Human activity and heavy machinery operation for both remediation and restoration activities will occur within Zone 3 for this nest site. Some portion of this activity may be visually screened from the actual nest site by vegetation. At the very least, channel restoration activities would be visible to eagles flying above the tree canopy. It is not known if the actual nest tree will be directly affected by construction. The quality of this nest site will be degraded, possibly to the point of rendering it of no value to bald eagles throughout much of the construction period.

4.2.1.2 Nest Approximately 7 Miles Upstream of Milltown Dam

This nest, known as the Allen Creek nest, is located about 4 to 7 miles upstream of new channel construction to be undertaken as part of the restoration action. Management Zone 3 extends from 1/2 to 2-1/2 miles from nests active within the last 5 years, and would therefore not include any of the new channel construction area. The likelihood of nest abandonment resulting from construction is relatively low at this nest. However, the birds nesting here may be displaced from foraging areas during construction.

4.2.2 Long-term Direct and Indirect Effects

4.2.2.1 Fish Availability for Bald Eagles in Milltown Reservoir

Northern pike, one of several potential prey species available to bald eagles in Milltown Reservoir, are highly piscivorous. Virtually any smaller fish constitutes potential prey of the northern pike. The shallow, weedy backwater areas of Milltown Reservoir provide very suitable spawning and rearing habitat for northern pike and have probably contributed to the success of this species in the impoundment (CFBLLC 2003). Northern pike have been observed in both the Clark Fork and Blackfoot Rivers, but neither of these drainages provides suitable spawning or rearing habitat for this species (CFBLLC 2003). The reservoir also provides suitable habitat for other bald eagle prey species including largescale and longnose suckers, which occur in both rivers and lakes. Northern pike prey on these fish species as well as others that occur in the reservoir. Removal of Milltown Dam and channelization of the Clark Fork and Blackfoot Rivers under the Proposed Action would eliminate reservoir habitat and shallow, weedy backwater areas preferred by northern pike for spawning and rearing, and would restore it to riverine habitat more suitable for a cold water fishery. It is anticipated that numbers of northern pike would eventually decline to very low levels because of habitat limitations in the restored Clark Fork River.

Removal of Milltown Dam would provide bull trout and other migratory fish species unimpeded upstream access from the middle reach to the upper reach of the Clark Fork River and its tributaries. These species would have access to spawning sites in areas upstream of the dam and uninterrupted migration corridors to upstream habitat for uses other than spawning (CFBLLC 2003). CFBLLC (2003) also suggested bull trout would benefit from increased upstream movements and productivity by other species, such as largescale sucker. CFBLLC (2003) stated that the potential contribution of spawn from largescale sucker, the abundance of juvenile suckers as a food source for bull trout, and the general food resources spawning suckers could provide to areas upstream of Milltown Dam are probably large. These beneficial effects would represent an enhancement of the food base of several potential bald eagle prey species.

No data are available to permit a comparison of prey biomass available to bald eagles in Milltown Reservoir versus the Clark Fork River. Therefore, it is not possible to say if the future river fishery will provide more or less available prey for bald eagles. However, while the prey species composition will change, the riverine prey base is apparently currently sufficient to support several bald eagle nests along the Clark Fork River upstream of Milltown Reservoir (EPA 2002a). Furthermore, the Milltown Reservoir reach of the Clark Fork River represents between 7 and 17 percent of the length of the river available for foraging by the pair of eagles that nests upstream of the reservoir (based on a foraging range of 3 to 7 miles). Finally, the reservoir reach will not be eliminated as a bald eagle foraging area over the long-term, but rather changed from an impoundment to a free-flowing river.

4.2.3 Cumulative Effects

Cumulative effects under ESA regulations are defined as those effects of future non-federal (state, local government, or private) activities that are reasonably certain to occur during the course of project activity and within the area of the federal action (the Proposed Action in this BA) subject to consultation. For the Proposed Action, the reasonably foreseeable future is defined to be the estimated 5 years that would be required for significant remedial activities at Milltown Dam and Reservoir and the Clark Fork River. Future federal actions are subject to the consultation requirements established in Section 7 of the ESA and, therefore, are not considered cumulative to the Proposed Action. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time (40 CFR 1508.7).

CFBLLC (2003) concluded in their analysis of potential cumulative effects that no new water management practices that could potentially affect bull trout (a listed threatened species) are likely to occur without FWS or MDFWP review and approval. They added that no new industrial or wastewater facilities are anticipated in the Milltown Project area in the next 6 years. However, they discussed the probable continuing development of rural areas, primarily for single family residences. In Missoula County and neighboring counties such development has occurred over the past decade. CFBLLC (2003) stated that many of these developments have been in floodplains and on benches adjacent to the middle and upper Clark Fork River, the Blackfoot River, and Rock Creek. CFBLLC (2003) concluded that such developments would continue. Increased human presence along the major rivers of western Montana may render some nesting, roosting, or foraging areas unsuitable for bald eagles in the future.

CFBLLC (2003) stated that no new mining projects or significant new grazing programs on private lands beyond existing grazing activities are anticipated in the Milltown project area in the next 6 years. Any construction or significant maintenance of transportation or conveyance systems in the project area, such as highways, railroads, and pipelines, would require state and federal permits, which would trigger reviews by the FWS and MDFWP. These reviews and the expected adherence to the restrictions in the Montana Bald Eagle Management Plan (BOR 1994) should eliminate or at least minimize the potential for adverse effects on bald eagles.

The upper Clark Fork River in western Montana has been impacted by historical releases of mine wastes from milling and smelting operations that occurred mainly in Butte and Anaconda. Based on the findings that some bank and overbank deposits of mine waste are phytotoxic and serve as a source of intermittent releases that could cause acute lethality in aquatic receptors, the EPA developed a proposed remedy to address and minimize these impacts along the upper Clark Fork River. In brief, the proposed plan calls for a combination of removal and in-place treatment of contaminated mining wastes and soils, along with extensive stream bank stabilization, followed by best management practices on the land to protect these remedies. This action is planned mainly for the uppermost reach of the upper Clark Fork River about 77 river miles upstream of Milltown Reservoir. EPA (2002a) concluded that the remediation actions along the upper Clark Fork River may affect, but would likely not adversely affect bald eagles. Considering the distance between the upper Clark Fork and Milltown project sites, no cumulative effects on bald eagles would result from these projects.

4.2.4 Conservation Actions

All active and former bald eagle nest sites will be identified by a qualified biologist prior to the start of construction activities. Construction will not be initiated within 1/2-mile of active bald eagle nests or nests that have been active within the last 5 years between February 1 and the end of May (BOR 1994) to reduce the potential that active nests will be abandoned.

4.3 Grizzly Bear

All of the historical and current factors that limit grizzly bear occurrence and render habitats unsuitable are present in the assessment area. Based on the conditions present in the assessment area and the distribution of grizzly bears, they are not expected to occur anywhere in the assessment area.

4.4 Canada Lynx

No suitable lynx habitat exists within the immediate Milltown remediation/restoration area, the transportation corridor, or at Opportunity Ponds. The presence of apparently suitable lynx habitat in the higher elevation mountains on both sides of the existing transportation corridor combined with the occasional individual occurrences suggest that lynx may occasionally travel across the corridor. Daily train traffic within the transportation corridor will increase by 12.5 percent from 16 to 18 one-way trips. On average, there one train would pass every 1.33 hours instead of the current rate of one train every 1.5 hours. The increase would slightly increase the possibility that the occasional lynx crossing the transportation corridor would be struck by a train. However, the frequency of truck and car traffic on I-90 is much higher than the frequency of train traffic, with a much higher likelihood that a lynx crossing the transportation corridor would be struck and killed. The incremental increase in the potential that a lynx crossing the transportation corridor would be struck and injured or killed by a train associated with the remediation/restoration action will be extremely low considering the levels of existing train and highway traffic along the corridor and the expected increase in the frequency of passing trains.

4.5 Yellow-billed Cuckoo

Riparian areas within the Clark Fork floodplain are privately owned and are likely heavily grazed by cows, as this is the normal practice on private western riparian lands. The resulting deficient willow understory, as observed in the site photographs, and degraded overstory provide very poor quality cuckoo habitat. No cuckoos are known to use the area (MTNHP database).

4.6 Water Howellia

This plant is not known to occur within the assessment area. Formal surveys have not been done for the area (Shelly 2004).

CHAPTER 5

Determination of Effects

5.1 Gray Wolf

The FWS established a dichotomous key to help in making ESA determinations of effect for listed species. The application of this key to this Proposed Action is presented below.

Step 1. Are there any listed or proposed species present in the watershed?

> ***Yes.*** *Gray wolves are a listed species in the watershed.*

Step 2. Will the Proposed Action have any effect whatsoever (including small effects, beneficial effects, and adverse effects)?

> ***Yes.*** *The Proposed Action may slightly increase the current potential that a wolf crossing the transportation corridor would be killed by a train.*

Step 3. Does the Proposed Action have the potential to result in "take" of any listed or proposed species?

> ***Yes.*** *Transporting excavated sediments would slightly increase the current potential that a wolf crossing the transportation corridor would be killed by a train. There would be no population level effects on gray wolves in Montana and recovery of the species would not be jeopardized.*

Step 4. Does the Proposed Action have the potential to cause any adverse effect on any listed or proposed species habitat?

> ***Yes.*** *Transporting excavated sediments would slightly increase the current potential that a wolf crossing the transportation corridor would be killed by a train. There would be no population level effects on gray wolves in Montana and recovery of the species would not be jeopardized.*

Based on this dichotomous key, the determination of effects of this Proposed Action on gray wolves at the population level is:

MAY AFFECT, NOT LIKELY TO ADVERSLEY AFFECT

5.2 Bald Eagle

The assessment of potential effects in Chapter 4 concluded that implementation of the Proposed Action could have short-term adverse effects because of displacement of eagles from some foraging areas and possible abandonment of an active nest. No long-term adverse effects were identified. The potential adverse effects would not be expected to be substantive in terms of bald eagle populations along the Clark Fork River or in western Montana.

However, there is a relatively high likelihood that remedial and restoration actions could result in some displacement of individual bald eagles from foraging areas at Milltown Reservoir and in the Blackfoot and Clark Fork Rivers. Restoration activities could result in the abandonment of one nest along the Clark Fork River. This could result in an incidental take of a listed species at the level of the individual from nest failure/abandonment and displacement from construction activities. Remedial activities would occur within the MBEMP nest Zone 3 during the critical period, and restoration activities would occur in Zones 1, 2, and 3 during this period. These activities would not follow guidelines adopted by the FWS and Montana to protect bald eagles.

The FWS established a dichotomous key to help in making ESA determinations of effect for listed species. The application of this key to this Proposed Action is presented below.

Step 1. Are there any listed or proposed species present in the watershed?

> ***Yes.*** *Bald eagles are a listed species in the watershed.*

Step 2. Will the Proposed Action have any effect whatsoever (including small effects, beneficial effects, and adverse effects)?

> ***Yes.*** *The Proposed Action may have indirect short-term adverse effects by displacing individual eagles from foraging at Milltown Reservoir, likely human disturbance, and likely abandonment of one nesting pair and possibly disturbance of a second nesting pair.*

Step 3. Does the Proposed Action have the potential to result in "take" of any listed or proposed species?

> ***Yes.*** *The proposed remedial/restoration activities have the potential to cause direct injury or harm to bald eagles in the form of nest abandonment, which is considered to be an incidental take of a listed species. Conservation measures will reduce this possibility but it cannot be eliminated. There would be no population level effects on bald eagles in Montana and recovery of the species would not be jeopardized.*

Step 4. Does the Proposed Action have the potential to cause any adverse effect on any listed or proposed species habitat?

> ***Yes.*** *The Proposed Action is specifically designed to improve the aquatic habitat in Milltown Reservoir. However, individual foraging and nesting bald eagles may be adversely affected by construction activities. There would be no population level effects on bald eagles in Montana and recovery of the species would not be jeopardized. A separate BA assessed potential impacts of the Proposed Action on bull trout, another threatened species.*

Based on this dichotomous key, the determination of effects of this Proposed Action on the individual bald eagles nesting nearest to Milltown Dam is:

MAY AFFECT, LIKELY TO ADVERSLEY AFFECT

5.3 Grizzly Bear

The FWS established a dichotomous key to help in making ESA determinations of effect for listed species. The application of this key to this Proposed Action is presented below.

Step 1. Are there any listed or proposed species present in the watershed?

> ***Yes.*** *Grizzly bears are a listed species in the watershed.*

Step 2. Will the Proposed Action have any effect whatsoever (including small effects, beneficial effects, and adverse effects)?

> ***No.*** *The Proposed Action would have no direct or indirect effects on grizzly bears.*

Step 3. Does the Proposed Action have the potential to result in "take" of any listed or proposed species?

> ***No.*** *The proposed remedial/restoration activities have no potential to cause any direct or indirect injury or harm to grizzly bears.*

Step 4. Does the Proposed Action have the potential to cause any adverse effect on any listed or proposed species habitat?

> ***No.*** *The Proposed Action will have no potential to cause any adverse effect on grizzly bears.*

Based on this dichotomous key, the determination of effects of this Proposed Action on grizzly bears is:

NO EFFECT

5.4 Canada Lynx

The FWS established a dichotomous key to help in making ESA determinations of effect for listed species. The application of this key to this Proposed Action is presented below.

Step 1. Are there any listed or proposed species present in the watershed?

> ***Yes.*** *Canada lynx are a listed species in the watershed.*

Step 2. Will the Proposed Action have any effect whatsoever (including small effects, beneficial effects, and adverse effects)?

> ***Yes.*** *The Proposed Action may slightly increase the current potential that a lynx crossing the transportation corridor would be killed by a train.*

Step 3. Does the Proposed Action have the potential to result in "take" of any listed or proposed species?

> ***Yes.*** *Transporting excavated sediments would slightly increase the current potential that a lynx crossing the transportation corridor would be killed by a train. The incremental increase in the potential that a lynx crossing the transportation corridor would be struck and injured or killed by a train associated with the remediation/restoration action will be extremely low considering the levels of existing train and highway traffic along the corridor and the*

expected increase in the frequency of passing trains. There would be no population level effects on Canada lynx in Montana and recovery of the species would not be jeopardized.

Step 4. Does the Proposed Action have the potential to cause any adverse effect on any listed or proposed species habitat?

> ***Yes.*** *Transporting excavated sediments would slightly increase the current potential that a lynx crossing the transportation corridor would be killed by a train. There would be no population level effects on Canada lynx in Montana and recovery of the species would not be jeopardized.*

Based on this dichotomous key, the determination of effects of this Proposed Action on Canada lynx at the population level is:

MAY AFFECT, NOT LIKELY TO ADVERSLEY AFFECT

5.5 Yellow-billed Cuckoo

The FWS established a dichotomous key to help in making ESA determinations of effect for listed species. The application of this key to this Proposed Action is presented below.

Step 1. Are there any listed or proposed species present in the watershed?

> ***No.*** *Yellow-billed cuckoos are not known to currently occur in the watershed.*

Step 2. Will the Proposed Action have any effect whatsoever (including small effects, beneficial effects, and adverse effects)?

> ***No.*** *It appears that there is no potential for adverse effects on cuckoos.*

Step 3. Does the Proposed Action have the potential to result in "take" of any listed or proposed species?

> ***No.*** *The proposed remedial/restoration activities have no potential to result in a take of cuckoos.*

Step 4. Does the Proposed Action have the potential to cause any adverse effect on any listed or proposed species habitat?

> ***No.*** *The proposed remedial/restoration activities have no potential to adversely affect cuckoos.*

Based on this dichotomous key, the determination of effects of this Proposed Action on yellow-billed cuckoos is:

NO EFFECT

5.6 Water Howellia

The FWS established a dichotomous key to help in making ESA determinations of effect for listed species. The application of this key to this Proposed Action is presented below.

Step 1. Are there any listed or proposed species present in the watershed?

> ***No.*** *Water howellia is not known to currently occur in the watershed*

Step 2. Will the Proposed Action have any effect whatsoever (including small effects, beneficial effects, and adverse effects)?

> ***No.*** *It appears that there is no potential for adverse effects on water howellia.*

Step 3. Does the Proposed Action have the potential to result in "take" of any listed or proposed species?

> ***No.*** *The proposed remedial/restoration activities have no potential to result in a take of water howellia.*

Step 4. Does the Proposed Action have the potential to cause any adverse effect on any listed or proposed species habitat?

> ***No.*** *The proposed remedial/restoration activities have no potential to adversely affect water howellia.*

Based on this dichotomous key, the determination of effects of this Proposed Action on water howellia is:

NO EFFECT

CHAPTER 6

Literature Cited

BOR. 1994. *Montana Bald Eagle Management Plan.* 2nd Edition. U.S. Department of Interior, Bureau of Reclamation, Montana Projects Office. Billings, Montana.

Alamand, J. D. and W. B. Krohn. 1978. "The Position of the Bureau of Land Management on the Protection and Management of Riparian Ecosystems." *In:* Johnson, R. R. and J. F. McCormick [tech. coords.], Strategies for Protection and Management of Floodplain Wetlands and other Riparian Ecosystems: Proc. of the symposium. USDA Forest Service Gen. Tech. Rep. WO-12., Washington, D.C., 410 pp.

ARCO. See Atlantic Richfield Company.

Atlantic Richfield Company. 1996. *Milltown Reservoir Sediments NPL Site: Milltown Reservoir Operable Unit–Draft Feasibility Study Report.* Prepared by Pioneer Technical Services, Inc.: Butte, Montana.

__________. 1998. *Milltown Reservoir Sediments NPL Site, Clark Fork River Operable Unit, Revised Draft Final Remedial Investigation Report.* Prepared by Schafer and Associates.

__________. 1999. *Milltown Reservoir Sediments Operable Unit, Milltown Surface Water Quality, Total Recoverable Metals, Suspended Sediment and Discharge Analysis.* Prepared by Land and Water Consultants, Inc., Anaconda, Montana.

__________. 2000. *Milltown Reservoir Sediments Site Draft Focused Feasibility Study.* Prepared by EMC^2, Bozeman, Montana.

__________. 2001. *Milltown Reservoir Sediments Site Draft Combined Feasibility Study.* Prepared by EMC2, Bozeman, Montana.

__________. 2002. "Milltown Reservoir Cost Group Meeting Handouts." April 5, 2002.

Aubry, K. B., G. M. Koehler, and J. R. Squires. 1999. "Ecology of Canada Lynx in Southern Boreal Forests." In Ruggiero, L. F., K. B. Aubry, S. W. Buskirk, et al., tech. eds. *The Scientific Basis for Lynx Conservation in the Contiguous United States.* General Technical Report. RMRS-GTR-30. Ogden, Utah: US Dept. Agriculture, Forest Service, Rocky Mountain Research Station.

Brainerd, S. M. 1985. "Reproductive Ecology of Bobcats and Lynx in Western Montana." M.S. thesis. University of Montana, Missoula. 85 pp.

Brand, C. J., L. B. Keith, and C. A. Fischer. 1976. "Lynx Responses to Changing Snowshoe Hare Densities in Central Alberta." *Journal of Wildlife Management.* 40(3):416-428.

Buskirk, S. W., L. F. Ruggiero, K. B. Aubry, D. E. Pearson, J. R. Squires, and K. S. McKelvey. 1999. "Comparative Ecology of Lynx in North America. " Chapter 14 *In* Ruggiero, L.F., K. B. Aubry, S. W. Buskirk, et al., tech. eds. *The Scientific Basis for Lynx Conservation in the Contiguous United States*. USDA Forest Service, Rocky Mountain Research Station. General Technical Report RMS-GTR-30. Ogden, Utah.

CFBLLC. See The Clark Fork and Blackfoot, LLC.

CH2M HILL. 2000. *Milltown Reservoir Sediments Operable Unit Ecological Risk Assessment Addendum*. Prepared for U.S. Environmental Protection Agency, Region 8. April 2000.

DeGraaf, R. M., V. E. Scott, R. H. Hamre, L. Ernst, and S. H. Anderson. 1991. *Forest and Rangeland Birds of the United States, Natural History and Habitat Use*. USDA Forest Service Agricultural Handbook 688. 625 pp.

Downing, Dan (FWS). 2003. Personal communication with Chuck Blair (CH2M HILL), April 17, 2003.

Eaton, S. W. 1988. "Yellow Billed Cuckoo." Pages 198-199 in: *The Atlas of Breeding Birds of New York State*. Cornell Univ. Press, Ithaca, NY.

Envirocon 2004. *Final Technical Memorandum, Milltown Reservoir Dry Removal Scour Evaluation: Milltown Reservoir Scour during Area I Sediment and Dam Removal Evaluation*. Prepared by EMC^{2}and Land and Water Consulting, Inc. for Envirocon. May.

EPA. See U.S. Environmental Protection Agency.

Erlich, P. E., D. S. Dobkin, and D. Wheye. 1992. *Birds in Jeopardy*. *The Imperiled and Extinct Birds of the United States and Canada, including Hawaii and Puerto Rico*. Stanford University Press, Stanford, California.

Evermann, B. 1892. *A Reconnaissance of the Streams and Lakes of Western Montana and Northeastern Wyoming.* Bull. U.S. Fish Commission, (1891), 11:3-60.

Finch, D. M. 1992. *Threatened, Endangered, and Vulnerable Species of Terrestrial Vertebrates in the Rocky Mountain Region*. USDA Forest Service. GTR-RM-215.

FWS. See U.S. Fish and Wildlife Service.

Gaines, D. 1974. *Distribution, Density, and Habitat Requirements of the Yellow-billed Cuckoo in the Sacramento Valley: 1972-1973*. California Department of Fish and Game, Nongame Wildlife Investigations, W-54-R Progress Report.

Gaines, D. 1977. *Current Status and Habitat Requirements of the Yellow-billed Cuckoo in California*. 1977 Endangered Wildlife Program, Nongame Wildlife Investigations, California Department of Fish and Game.

Gaines, D. and S. A. Laymon. 1984. *Decline, Status and Preservation of the Yellow-billed Cuckoo in California*. Western Birds 15:49- 80.

Gilbert, C. and B. W. Evermann. 1895. *A Report Upon Investigations in the Columbia River Basin with Descriptions of Four New Species of Fishes.* Bull. U.S. Fish Commission. (1894), 14:169-208.

Gough, G. A., J. R. Sauer, and M. Iliff. 1998. *Patuxent Bird Identification Infocenter*. Version 97.1. Patuxent Wildlife Research Center. Laurel, Maryland. http://www.mbr-pwrc.usgs.gov/Infocenter/infocenter.html. Accessed October 22, 2002.

Groschupf, K. 1987. *Status of the Yellow-Billed Cuckoo (Coccyzus americanus occidentalis) in Arizona and West Texas*. FWS Rep. 20181-86-00731. Phoenix, Arizona.

Halterman, M. D. 1991. "Distribution and Habitat Use of the Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) on the Sacramento River, California, 1987-1990." M.S. Thesis, California State University, Chico.

Hamilton, W. J., III and M. E. Hamilton. 1965. *Breeding Characteristics of Yellow-billed Cuckoos in Arizona*. Proceedings of the California Academy of Science. 32:405-432.

Heidel, B. 2004. Personal communication with Judy Ferguson (CH2M HILL). August 9.

Kingery, H. E. 1981. "1980: The Year of the Cuckoo." *C. F. O. Journal.* 15(3):86-87.

Klebenow, D. and B. Oakleaf. 1981. "Historical Avifaunal Changes in the Riparian Zone of the Truckee River, Nevada." Paper presented at the California Riparian Systems Conference (University of California, Davis, September 17-19, 1981).

Koehler, G. M. 1990. "Population and Habitat Characteristics of Lynx and Showshoe Hares in North Central Washington." *Canadian Journal of Zoology*. 68: 845-851.

Koehler, G. M., and J. D. Brittell. 1990. "Managing Spruce-Fir Habitat for Lynx and Snowshoe Hares." *Journal of Forestry*. 88: 10-14.

Laymon, S. A. and M. D. Halterman. 1987. "Can the Western Subspecies of Yellow-billed Cuckoo be Saved from Extinction?" *Western Birds.* 18:19-25.

Laymon, S. A. and M. D. Halterman. 1989. *A Proposed Habitat Management Plan for Yellow-Billed Cuckoos in California*. USDA Forest Service, Gen. Tech. Rep. PSW-110.

Laymon, S. A., P. L. Williams, and M. D. Halterman. 1997. *Breeding Status of the Yellow-billed Cuckoo in the South Fork Kern River Valley, Kern County, California: Summary Report 1985 -1996*. Administrative Report. USDA Forest Service, Cannell Meadow Ranger District, Sequoia National Forest.

Lesica, P. 1990. "Habitat Requirements, Germination Behavior and Seed Bank Dynamics of Howellia aquatilis in the Swan Valley, Montana." Unpublished report to the Flathead National Forest. Conservation Biology Research, Helena, Montana, 44 p. plus appendix.

Lesica, P. 1992. *Autecology of the Endangered Plant Howellia aquatilis: Implications for Management and Reserve Design*. Ecological Applications 2: 411-421.

Lesica, P. 1997. *Spread of Phalaris arundinacea Adversely Impacts the Endangered Plant Howellia aquatilis*. Great Basin Naturalist 57(4): 366-368.

Lesica, P., R. F. Leary, F. W. Allendorf and D. E. Bilderback. 1988. "Lack of Genetic Diversity Within and Among Populations of an Endangered Plant, *Howellia aquatilis*." *Conservation Biology*. 2(3):275-282.

Lichthardt, J., and R. K. Moseley. 2000. "Ecological Assessment of *Howellia aquatilis* Habitat at the Harvard-Palouse River Flood Plain Site, Idaho." Conservation Data Center, Idaho Department of Fish and Game, unpublished report prepared for Idaho Department of Parks and Recreation. 14 p. plus appendices.

McCord, C. M., and J. E. Cardoza. 1982. Bobcat and Lynx. Pp. 728-766. In: Chapman, J.A., and Feldhamer, G.A. (eds.). *Wild Mammals of North America: Biology, Management, and Economics*. Johns Hopkins Univ. Press, Baltimore, Maryland.

McGarigal, K., R. G. Anthony, and F. B. Isaacs. 1991. *Interactions of Humans and Bald Eagles on the Columbia River Estuary*. Wildl. Monogr. V:115. 47 pp.

McPhail, J. D. and C. C. Lindsay. 1970. *Freshwater Fishes of Northwestern Canada and Alaska.* Bull. 173. Fisheries Research Board of Canada, Ottawa, Canada. 381 p.

Mech, L. D. 1980. "Age, Sex, Reproduction, Spatial Organization of Lynxes Colonizing Northeastern Minnesota." *Journal of Mammalogy*. 61:261-267.

Milodragovich, Sam (Northwest Energy). 2003. Personal communication with Chuck Blair (CH2M HILL), April 23.

NatureServe Explorer. 2004. NatureServe Explorer: An online encyclopedia of life (web application). Version 1.8. NatureServe, Arlington, Virginia. http://www.natureserve.org/explorer (accessed January 13).

Ohmart, R. D. 1994. "The Effects of Human-Induced Changes on the Avifauna of Western Riparian Habitats." *Studies in Avian Biology*. 15: 273-285.

Ohmart, R. D. and B. W. Anderson. 1986. Chapter 9: Riparian Habitats. *In*: Cooperider, A. Y., R. J. Boyd, and H. R. Stuart [eds.], Inventory and Monitoring of Wildlife Habitat. USDI Bureau of Land Management Service Center, Denver, Colorado. xviii, 858 pp.

Polite, C. and J. Pratt. 2002. Bald Eagle. *California Wildlife Habitat Relationships System*. California Department of Fish and Game, California Interagency Wildlife Task Group. http://www.dfg.ca.gov/whdab/B113.html. Accessed October 15.

Rappole, J. H., W. J. McShea, and J. Vega-Rivera. 1993. "Evaluation of Two Survey Methods in Upland Avian Breeding Communities." *Journal of Field Ornithology*. 64(1):55-70.

Reichenbacher, F. W. 1984. *Ecology and Evolution of Southwestern Riparian Plant Communities*. Desert Plants 6(1): 15-22.

Roe, L. S. and J. S. Shelly. 1992. "Update to the Status Review of Howellia aquatilis." Unpublished report to the Flathead National Forest. Montana Natural Heritage Program, Helena, Montana. 51 p.

Saunders, J. K. 1963. “Movements and Activities of the Lynx in Newfoundland.” *Journal of Wildlife Management*. 27(3):390-400.

Shapley, M. and P. Lesica. 1997. “Howellia aquatilis (Water Howellia) Ponds of the Swan Valley: Conceptual Hydrologic Models And Ecological Implications.” Unpublished report to the U.S. Fish and Wildlife Service, Denver, Colorado. Montana Natural Heritage Program, Helena. 44 p.

Shelly, S. (U.S. Forest Service). 2004. Personal communication with Judy Ferguson, CH2M HILL on August 9.

Shelly, J. S. and R. K. Moseley. 1988. *Report on the Conservation Status of Howellia aquatilis, a Candidate Threatened Species*. Idaho Department of Fish and Game, Conservation Data Center, Boise. 166 p.

Skovlin, J. M. 1984. “Impacts of Grazing on Wetlands and Riparian Habitat: A Review of Our Knowledge.” In *Developing Strategies for Rangeland Management*, a report prepared by the Committee on Developing Strategies for Rangeland Management. National Research Council/National Academy of Sciences. Westview Press. Boulder, Colorado.

State of Montana. 2004*. Amendment to the Draft Conceptual Restoration Plan for the Clark Fork River and Blackfoot River Near Milltown Dam*. Prepared by: State of Montana Natural Resource Damage Program and Department of Fish, Wildlife, and Parks. June 9, 2004.

Steenhof, K. 1978. *Management of Wintering Bald Eagles*. U.S. Fish and Wildlife Service. FWS/OBS-78/79. 59 pp.

Stromberg, J. C. 1993. *Fremont Cottonwood-Gooding Willow Riparian Forests: A Review of their Ecology, Threats and Recovery Potential*. Journal of the Arizona-Nevada Academy of Science 26(3): 97-110.

Swenson, J. E., K. L. Alt, and R. L. Eng. 1986. *Ecology of Bald Eagles in the Greater Yellowstone Ecosystem*. Wildl. Monogr. V95:1-46.

Taylor, D. M. 2000. “Status of the Yellow-Billed Cuckoo in Idaho. “ *Western Birds.* 31:252-254.

Taylor, D. M. and C. D. Littlefield. 1986. “Willow Flycatcher and Yellow Warbler Response to Cattle Grazing.” *Journal of Range Management.* 39(3): 254-258.

Terres, J. 1991. *The Audubon Society Encyclopedia of North American Birds*. Wings Books. New York, New York.

The Clark Fork and Blackfoot, LLC. 2003. *Draft (Not for Public Review) Biological Assessment of the Milltown Dam Operations for the Period 2003 through 2010.* FERC No. 2543. Prepared by The Clark Fork and Blackfoot, LLC, Butte, Montana, as the non-Federal agency representative for: Federal Energy Regulatory Commission, Washington, D.C. February 10, 2003. USACE. See U.S. Army Corps of Engineers.

U.S. Environmental Protection Agency. 1993. *Wildlife Exposure Factors Handbook*. Volumes I and II. United States Environmental Protection Agency, Office of Research and Development. EPA/600/R-93/187a and b.

__________. 2001a. *Milltown Reservoir Sediments Superfund Site: A Summary of Cleanup Options.* U.S. EPA Region 8—Montana Office, Helena—July 2001.

__________. 2001b. *Clark Fork River Ecological Risk Assessment.* October 2001. Prepared for U.S. Environmental Protection Agency Region 8 by Syracuse Research Corporation. October, 2001.

__________. 2002a. *Biological Assessment, Assessment of Effect of Proposed Remedial Action on Threatened or Endangered Species Clark Fork Operable Unit Milltown Reservoir Sediments / Clark Fork River Superfund Site Montana.* EPA Region 8, Denver Office.

__________. 2002b. "Presentation Package: Milltown Reservoir Operable Unit of the Milltown Reservoir Sediments, Superfund Site." EPA Region 8, Montana Office. Internal Draft.

__________. 2003. *Biological Assessment of the Milltown Reservoir Sediments Operable Unit*. Prepared for U.S. Environmental Protection Agency Region 8 by CH2M HILL. April 2003.

__________. 2004. *Superfund Program Revised Proposed Clean-up Plan: Milltown Reservoir Operable Unit of the Milltown Reservoir/Clark Fork River Superfund Site*. Region 8, Montana Office. May.

U.S. Environmental Protection Agency and Federal Energy Regulatory Commission. 2004. *Bull Trout Biological Assessment of the Milltown Reservoir Sediments Operable Unit Revised Proposed Plan and of the Surrender Application for the Milltown Hydroelectric Project (FERC No. 2543).* Prepared by CH2M HILL and the Clark Fork and Blackfoot, L.L.C.

U.S. Fish and Wildlife Service. 1986. *Recovery Plan for the Pacific Bald Eagle*. FWS, Portland, Oregon. (as cited in BOR 1994).

__________. 1987. *Northern Rocky Mountain Wolf Recovery Plan*. FWS, Denver. 119pp.

__________. 1994. Final rule. 50 CFR Part 17. Endangered and Threatened Wildlife and Plants: The Plant water howellia (*Howellia aquatilis*), determined to be a threatened species. Federal Register 59(134): 35860-35864.

__________. 1998. *Klamath River and Columbia River Bull Trout Population Segments: Status Summary and Supporting Documents Lists.* Prepared by Bull Trout Listing Team, FWS.

__________. 2002b. *Bull Trout (Salvelinus confluentus) Draft Recovery Plan. Region 1, Portland, Oregon.*

__________. 2002b. *Threatened, Endangered, Proposed and Candidate Species: Biological Information and Guidance*. U.S. Fish and Wildlife Service, Snake River Basin Office, Dept. of Interior. Boise, Idaho. August.

_________. 2004. http://mountain-prairie.fws.gov/species/mammals/grizzly.continental.html.

FWS. See U.S. Fish and Wildlife Service.

Ward, R. M. P., and C. J. Krebs. 1985. "Behavioural Responses of Lynx to Declining Snowshoe Hare Abundance." *Canadian Journal of Zoology*. 63:2817-2824.

Water Consulting, Inc., and D. Rosgen. 2003. *Draft Conceptual Restoration Plan for the Clark Fork River and Blackfoot River Near Milltown Dam*.

Werner, Steve (Montana Rail Line). 2004. Personal communication with Russ Forba (EPA), August 2.

Wright, M. and R. E. F. Escano. 1986. *Montana Bald Eagle Nesting Habitat Macro-Habitat Description*. USDA, Forest Service, Missoula, Montana. 24 pp. Plus appendices.

Appendix

Draft Conceptual Restoration Plan for the Clark Fork River and Blackfoot River Near Milltown Dam and June 2004 Amendment to the Draft Conceptual Restoration Plan for the Clark Fork River and Blackfoot River Near Milltown Dam

DRAFT CONCEPTUAL RESTORATION PLAN FOR THE CLARK FORK RIVER AND BLACKFOOT RIVER NEAR MILLTOWN DAM

PREPARED FOR:

State of Montana, Natural Resource Damage Program and Department of Fish, Wildlife and Parks, in consultation with the U.S. Fish and Wildlife Service and Confederated Salish and Kootenai Tribes.

PREPARED BY:

Water Consulting, Inc.
P.O. Box 981
Hamilton, MT 59840

Mr. Dave Rosgen
Wildland Hydrology
11210 North County Road 19
Ft. Collins, CO 80525

Photo Courtesy of the Atlantic Richfield Company

DRAFT CONCEPTUAL RESTORATION PLAN FOR THE CLARK FORK RIVER AND BLACKFOOT RIVER NEAR MILLTOWN DAM

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DRAFT CONCEPTUAL RESTORATION PLAN FOR THE CLARK FORK RIVER AND BLACKFOOT RIVER NEAR MILLTOWN DAM

1.0 INTRODUCTION (GOALS AND OBJECTIVES)

The State of Montana in consultation with other trustees, including the U.S. Fish and Wildlife Service and the Confederated Salish and Kootenai Tribes, contracted with Water Consulting, Inc. and Wildland Hydrology, Inc. to prepare a Conceptual Restoration Plan (CRP) and detailed cost estimate for restoration activities associated with the Milltown Reservoir Sediments Operable Unit. The CRP will integrate with and supplement Environmental Protection Agency's (EPA) Proposed Plan for removing Milltown dam and some of the polluted sediments deposited upstream of the dam.

It is contemplated that, due to time limitations and lack of site-specific data, the development of a complete restoration plan will be conducted in phases.

Phase 1 is this Conceptual Restoration Plan (CRP); this is a broad scale plan to provide restoration concepts, draft plan views and elevation information. The level of detail is adequate to provide the best possible cost estimate based on existing information.

Phase 2 would refine and validate the CRP with additional field data, analyses and surveys, including: additional topographic surveys; sediment entrainment data; bridge pier scour analyses; reference reach selection and data collection (Rosgen Levels 1 through 4 data); regional hydrologic analyses (using ongoing USGS work); field validation of proposed plan view and profile; ice potential and scour analysis; and peer review of potential recreational boating designs.

Phase 3 would be the final design phase, which will provide detailed design drawings and information adequate to permit and implement the project. This phase will include erosion control, revegetation, monitoring, maintenance, refined cost estimates, materials, equipment, implementation details and FEMA floodplain map revision analyses.

<u>OBJECTIVES OF THE CRP</u>

The following objectives will be addressed in the CRP:

- Restore the confluence of the Blackfoot and Clark Fork Rivers to a naturally functioning, stable system appropriate for the geomorphic setting;
- Use native materials, to the extent practicable, for stabilizing channel, banks and floodplains to improve water quality by reducing bank erosion of contaminated sediments;

- Provide adequate channel and floodplain capacity to accommodate sediment transport and channel dynamics appropriate for the geomorphic setting;
- Provide high quality habitat for fish and wildlife, including continuous upstream and downstream migration for all native and coldwater fishes;
- Provide high quality wetlands and riparian communities, where feasible and appropriate for the proposed streamtype;
- Improve visual and aesthetic values through natural channel design, revegetation and the use of native plants and materials;
- Assess the pros and cons of removing or relocating the powerhouse and other dam structures not removed by remedy, with consideration of cost and integrity of remediation and restoration. Also consider the risk of damage to the restored reaches due to backwater effects during floods;
- Minimize habitats that will promote non-native, undesirable fish species;
- Supplement revegetation activities proposed by remedy to increase floodplain vegetation diversity; and
- Provide increased recreational opportunities compatible with other restoration goals, such as river boating and fishing.

This CRP differs from the EPA's proposed plan for remediation in that the concept of natural channel design techniques are used to create a stream system that includes an active channel designed to accommodate the normal annual high flow (bankfull discharge) and a floodplain that fits the geomorphic setting to accommodate flood flows. The traditional method employs standard engineering techniques that include an armored channel that will accommodate the 100-year flood within the channel banks. Natural channel design (NCD) aims to restore natural channel stability, or dynamic equilibrium and habitat to impaired streams (Brown, et al. 2001). Streams in dynamic equilibrium are generally more biologically productive, providing higher quality and more complex habitat than altered or unstable streams. When properly applied, NCD methods provide a robust, widely tested, and well-accepted approach to the design of natural channels that successively achieve habitat and geomorphic restoration objectives while functioning during extreme flood events (Schmetterling and Pierce, 1999). NCD is the foundation for developing a naturally stable channel design and meeting habitat restoration objectives.

The Rosgen Stream Classification System (RSCS) and reach characterization techniques are core to this methodology and in its rudimentary form, categorize streams into one of eight primary stream types (Rosgen, 1996; Bain and Stevenson, 1999). However, the RSCS is only an initial step to a complex protocol for temporally evaluating geomorphic stability, sediment availability and transport competency, and riparian condition. Geomorphic indicators (bankfull channel), prediction (reference reaches and dimensionless ratios), and method validation (regional curves) define naturally functioning channels. NCD focuses on restoring geomorphic characteristics while incorporating fish habitat structures composed of native materials in natural arrays that better replicate native salmonid habitat as necessary for restoring inland native fish populations.

For additional information on NCD, including Brown, et.al. (2001) and Rosgen (1998), refer to Appendix 9.

2.0 GEOMORPHIC OVERVIEW, REACH DELINEATION AND DESCRIPTIONS

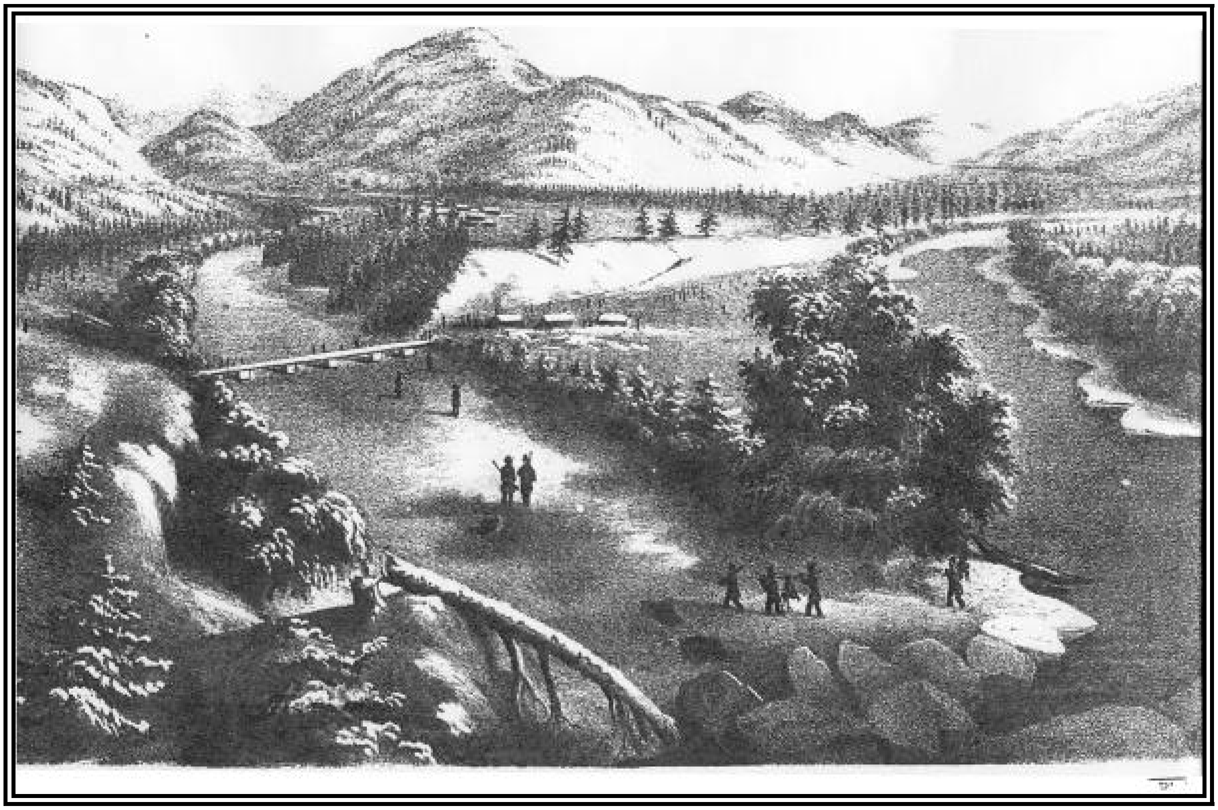
This section will describe the extents and limits of the project area, discuss the geomorphic setting, and provide an evaluation of the direct and indirect effects of Milltown dam. The extent of upstream effects of the Stimson diversion dam will also be discussed.

2.1 GEOMORPHIC OVERVIEW

The Clark Fork River System is formed in a broad, low gradient, alluvial valley with a wide floodplain and adjacent terraces. Stream types in this setting tend to be C4 channels characterized by riffle-pool morphology and wide, flat, densely vegetated floodplains adjacent to the channels (Rosgen, 1996). These streams are highly sinuous, with bank stability related to dense rooting of shrubs and trees along the stream banks. Bed materials are predominantly gravel with some component of cobble and sand. These channels are highly prone to increased bank erosion and sediment supply when the vegetation is disturbed or the channel modified. The Clark Fork River just upstream from the confluence would naturally transition from a C4 channel to a B3c channel as the valley narrows due to confinement by the rock outcrop near the Milltown dam and the glacial outwash terrace from the Blackfoot River. Step-pool morphology and moderate width, sloping flood prone areas adjacent to the river characterize B3c stream types. A well-vegetated flood prone area allows for flood flows to spread out twice the width of the active channel, dissipating energy over a wider surface. The “c” designation indicates that the gradient is very low, in this case less than 0.005 ft./ft. B3c stream types have a low gradient, low sinuosity and tend to be very stable. Bed materials are predominantly large cobble, with some component of small boulder and gravel.

The Blackfoot River system and valley is dominated by glacial landforms, including moraines, glacial outwash terraces and lake sediments. In the lower Blackfoot River area near the confluence of the two rivers, the river has carved a fairly narrow valley through Belt series bedrock formations and either bedrock or coarse glacial outwash terraces that bound the Blackfoot River. Predominant stream types in this setting are B3c and F3 where the river has incised into the outwash terraces. F3 stream types are characterized by riffle-pool morphology and are deeply incised into a gentle gradient valley, which means that these streams do not have an adjacent floodplain. During a flood event, all the flow is contained within a narrow corridor rather than spreading out onto a floodplain. F3 stream types can be very stable in an un-altered condition. Sinuosity in this case is low, width:depth ratios are high and gradient is about 0.002 ft./ft. Bed materials are predominantly cobble, with some component of small boulder and gravel.

Where the two rivers converge, the valley narrows, confining the river between steep valley walls and coarse glacial outwash terraces. Historically, the Clark Fork River downstream from the confluence would naturally shift to a B3c or an F3 streamtype, depending on the degree of incision into the terrace. Stream gradient is about 0.002 ft./ft. The historic drawing of the confluence of the Clark Fork and Blackfoot Rivers during the winter of 1861-1862 provides a depiction of the confluence area before the Dam and railroads were constructed. Whether this depiction is accurate is not certain; however, evaluation of this drawing indicates that both rivers were B3c type streams at the confluence. The Clark Fork valley appears to widen farther upstream in the drawing, with the River becoming less entrenched and more a C streamtype. A high glacial outwash terrace is also prominent at the confluence of the two rivers.



2.2 UPSTREAM AND DOWNSTREAM LIMITS OF THE DIRECT AND INDIRECT EFFECTS OF MILLTOWN DAM

In order to effectively determine the components and costs necessary to restore the site, it is appropriate to stratify the project area into river reaches that have similar characteristics and restoration potential. One of the criteria that is necessary to determine costs and extent of treatment area is to evaluate where the upstream and downstream limits of the direct and indirect effects of Milltown dam. River reaches will be further stratified in the next section. For Milltown dam, all available survey data, aerial photos, the Federal Emergency Management Agency (FEMA), Flood Insurance Rate Maps (FIRM) (Aug. 1988) and field reviews were used to determine where the upstream extent of the backwater deposition. Specifically, the upstream limit of the effects of Milltown dam was determined from:

- The change in gradient (valley, streambed and flood profile) caused by the backwater effect of the dam during a large flood stage, such as the 1908 flood;
- The change in valley morphology and floodplain from a narrower floodplain with terraces to a broader floodplain with no terraces caused by backwater deposition burying the historic floodplains;
- The change in vegetation from coniferous species more common on the low terrace to deciduous species more common on the floodplain; and
- The uppermost extent of Sediment Accumulation Areas IV and V.

While it is not possible to determine the exact point on the Clark Fork River where the upstream effects of the dam end with the limited existing information, all four criteria placed the endpoint for the disturbance in a zone that was about 3,000 feet in length. The zone occurred from about 10,000 feet to about 13,000 feet upstream from the dam. For the limited purposes of this analysis and cost estimate, the upper limit of the backwater effects of the dam was selected at approximately the midpoint in this range at about 11,500 feet upstream from the dam. The actual upstream extent of the backwater deposition could be upstream or downstream by as much as 1,500 feet.

Please refer to Figure 2, Appendix 1 for a display of the designated upstream limit of the backwater effect of the Milltown dam compared to Sediment Accumulation Areas IV and V. This designated upstream limit will be a reach break point as described in Section 2.3. Refer to Section 2.4 for a more detailed description of processes associated with backwater deposition and the effects on individual reaches.

The effects of Milltown dam do not end at the dam structure, but also extend downstream on the Clark Fork River for a certain distance. It is not possible to determine the actual downstream extent of the influence of the dam with the limited available data and analyses. However, for the purposes of restoration, it is recommended that the restoration effort extend downstream to a stable point, as described in the next paragraph.

When combined with the river water that flows over the spillway, the large bay created by releases through the turbine gates creates a channel that is about twice as wide as the normal dimensions for the lower Clark Fork River. The river splits into two channels around an island that is probably the result of sediment deposition at the downstream end of the large pool where the two flow paths converge. The island and split channels could also be influenced by the railroad crossing downstream from Milltown dam. The overly wide area extends downstream past the railroad crossing to the point that the two channels converge. Just downstream from the point of convergence, the river transitions into a stable F type channel that appears to be functioning adequately at a point about 2,800 feet upstream from the I-90 bridge. For the limited purposes of this analysis and cost estimate, this point was selected as the downstream extent of the effects of the Milltown Dam.

In summary, the downstream effects include channel scour and over-widening from releases of water from the spillway and through the turbines. The island and split channels formed downstream from the dam are most likely the result of the release patterns. The effect appears to end by Station 28+00. Also, the dam most likely traps and stores bedload sediment during normal high flow periods, which generally leads to a coarsening of the bed (increasing the particle size distribution) by causing the gravels to be scoured out of the reach without being replaced by upstream sources. This can influence habitat and productivity by reducing the amount of fine gravels that would be resident in the system.

The upstream extent of the backwater effects from Milltown dam on the Blackfoot River was determined based on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) longitudinal profile at larger flood stages and field reviews of the lower river. The FEMA profile indicates a distinct drop in water surface elevation at the Stimson diversion dam indicating a backwater effect from the diversion dam. Downstream from the Stimson diversion dam, the water surface is essentially flat at larger flood stages, indicating that the backwater effect from Milltown dam ends at the Stimson diversion dam. For this reason, the reach break on the Blackfoot River will be just downstream from the Stimson diversion dam.

There are other considerations that could influence the decision to include some of the costs of restoration of the Blackfoot River (BFR) upstream from Stimson diversion dam with the lower reach of the BFR. First, with Milltown dam removed, the Stimson diversion dam becomes a fish barrier year round. At present, the Stimson diversion dam may be a barrier only part of the year and therefore, removal of Milltown dam will have an effect on the upper BFR reach. Secondly, the drop in water surface elevation after Milltown dam is removed will create additional head (or drop) over Stimson diversion dam, which will increase the potential for scour and undercutting of the diversion dam. This increase in head could threaten the integrity of the Stimson diversion dam. Therefore, the Stimson diversion dam may be at an increased risk of failure following removal of Milltown dam.

2.3 REACH DELINEATION OF RIVERS IN PROJECT AREA

The two rivers were delineated into reaches based on five criteria: 1) geomorphic setting of rivers; 2) potential streamtype for restoration; 3) degree of detailed information; 4) the upstream extent of the direct or indirect influence of Milltown dam, which was covered in Section 2.2.; and 5) the nearest stable point or unchanging feature upstream and downstream from the primary project area as described in the following discussion. Figure 1, Appendix 1 displays the selected reach delineations for the project area.

The rivers were divided into the following reaches:

- CFR 1 – Clark Fork from just upstream from the I-90 bridge upstream to the confluence of the rivers. The straight-line valley length of this reach is approximately 5,250 feet.
- CFR 2 - Clark Fork from the confluence upstream to approximately the Duck Bridge grade. The valley length of this reach is approximately 3,850 feet.
- CFR 3 – Clark Fork from Duck Bridge upstream to the upper most extent of the backwater deposition caused by Milltown dam as described in Section 2.2. The valley length of this reach is approximately 7,000 feet.

- CFR 4 - Clark Fork from Reach 3 upstream to include the Turah Bridge (and the nearest stable point). The valley length of this reach is approximately 15,400 feet.
- BFR 1 – Blackfoot from the confluence upstream to the Stimson diversion dam, as described in Section 2.2. The valley length of this reach is approximately 5,650 feet.
- BFR 2 – Blackfoot from Stimson diversion dam upstream until the backwater effect of diversion dam and channel constriction diminishes. Refer to Section 2.4, BFR2, for a description of the upstream endpoint. The valley length of this reach is approximately 6,500 feet.

See Appendix 2 for photographs of each of these reaches.

For a stream restoration project to be successful, it is important to start the restoration at the upstream extent of the unstable reach or altered reach of river. This is important to minimize the risk that the river will change its location or channel upstream from the project and enter the project at an inappropriate location. There are many case examples of the consequences of failing to extend the restoration upstream to a stable point or some other feature that will not change. Therefore, to minimize the risk of severe damage or failure of a restoration effort, a stable or unchanging feature must be identified. Since the Clark Fork River has highly altered in some reaches extending upstream to Deerlodge, MT, there was a need to identify some closer upstream endpoint. The Turah Bridge was selected as the upstream point because it is likely to remain in place in the future to provide access to private lands on the south side of the valley. As described in Section 2.4, the Clark Fork River is relatively unstable and highly altered upstream from Milltown dam all the way to the Turah Bridge. The bridge section can provide a relatively stable section from which to link the proposed restoration effort. Therefore, Reach CFR 4 is delineated as the upstream extent of the backwater effects of Milltown dam upstream to approximately the Turah Bridge.

As described in Section 2.2, downstream from Milltown dam, the stable endpoint for the restoration effort would be about 2800 feet upstream from the I-90 Bridge. However, for consistency in linking all the data sources together, the reach CFR 1 was extended downstream to the upstream edge of the I-90 bridge. For the remainder of the CRP, the upstream edge of I-90 bridge is labeled as Station 0+00 on the proposed longitudinal profile. There are no restoration treatments proposed for the 2800 feet between the I-90 bridge and Station 28+00.

A similar logic is applied to the Blackfoot River for Reach BFR 2. As described in Section 2.2, there is a backwater effect from the Stimson diversion dam also and the diversion dam is at an increased risk of damage or failure with the removal of Milltown dam. It would also become a fish migration barrier during most flow periods. Because of these factors and the need to extend the restoration up to a stable, upstream point, Reach BFR 2 was delineated and continues upstream to a stable point as discussed in Section 2.4, BFR 2.

2.4 EXISTING AND POTENTIAL RESTORED CONDITIONS

The physical configurations of the two rivers have been highly modified by Milltown Dam and the deposit of industrial mining and other sediments, and to a lesser degree by other upstream influences. The Blackfoot River is directly affected by encroachment from Highway 200, fills at the Stimson lumber mill, the Stimson diversion dam, highway bridges and the backwater effect caused by Milltown dam. The result is that the lower Blackfoot River downstream from the Stimson diversion dam is in the backwater of Milltown dam and is an F type channel. Upstream from Stimson diversion dam, the channel varies between an F channel and a B3c channel due to backwater sediment deposition and artificial elevation of the channel bed. The Clark Fork River is directly affected by similar impacts, in addition to encroachment and channelization by railroad grades.

The potential streamtype used for restoration is the most probable streamtype given the geomorphic and valley setting modified by the limitations imposed by human-caused or other influences that are not subject to change. For example, the most probable historic streamtype for a segment of river being evaluated may be a C type channel, but because of encroachment by a highway fill, the potential streamtype may be changed to a B type channel in a narrower valley. If more than one potential streamtype is possible, usually the most stable and productive streamtype is selected that will meet the objectives of the project.

CFR 1

Milltown dam is in the upstream end of this reach and affects the channel both upstream and downstream, as described in Section 2.2. Historically, this channel would most likely have been a B3c streamtype in a fairly narrow valley bounded by a high glacial outwash terrace on the north and a bedrock valley wall to the south. The river transitions into a stable F3 streamtype between the dam and the I-90 bridge downstream. The existing channel is overly wide due to river flows being split between the spillway and turbine outlets. The large bay downstream from the dam is about twice as wide as the normal channel dimensions. The island that has formed downstream between the dam and the railroad crossing is a stable feature, but probably did not occur before the dam was constructed. However, the split channel presents some opportunities for side channel habitat and additional recreational experience. For these reasons, the proposed streamtype for the area between the confluence and the F3 type channel is a B3c with a diverging side channel that is less than 30 percent of the river flow during bankfull conditions. The valley gradient for this reach would be a constant 0.002 ft./ft. over a distance of about 5,250 feet.

CFR 2

Before Milltown dam was constructed, this reach was most likely a transition zone between the wider valley and C type stream channel upstream to a narrower B type channel for some distance upstream from the confluence, as described in Section 2.1. A brief analysis was conducted for other valley transition reaches on the Blackfoot River, Clark Fork River and Rock Creek in similar geomorphic settings. The objective was to determine the potential length of the transition zone between a C type stream and a B type stream under natural conditions. Five transition reaches were located and evaluated for valley and channel characteristics. That information was used to determine that the transition zone for the CFR and BFR confluence area should be about 3,000 foot long. The meander geometry also changes somewhat in transition zones, and those values were calculated and used in the proposed plan view design (refer to Sheet CFR 2, Appendix 4).

The existing conditions were created shortly after Milltown dam was constructed. The dam created backwater conditions (ponding of the water, which reduces gradient and energy available for transporting sediment) extending upstream into Reach CFR 3. During the large flood of 1908, tremendous loads of sediment were deposited in the backwater zone upstream from the dam. The deposition filled existing channels, causing the river to create new channels in the path of least resistance. With no vegetation to stabilize the banks and a lower overall gradient, the channels tend to convert to a braided condition. During subsequent high flow years, the deposition progressed upstream, which reduces the gradient and energy available for moving sediment. The stream responds to the decrease in energy by filling the existing channel with bedload sediment and creating new channels in a similar fashion. The backwater effect of the Milltown dam was compounded by the Duck Bridge railroad crossing, which was a valley constriction and also created backwater conditions during large floods. The end result is a completely flat, braided plain that extends upstream into Reach CFR 3.
With the dam and contaminated sediments removed from Area I, the opportunity would exist to create a setting similar to the historic conditions. The proposed streamtype for CFR 2 is a C4 channel transitioning into a B3c channel. The valley gradient would increase from about 0.002 ft./ft. upstream from the Duck Bridge grade to about 0.005 ft./ft. in reach CFR 2. The valley length for Reach CFR 2 is about 3,850 feet.

<u>CFR 3</u>

This reach was most likely a C4 channel historically with a wide, densely vegetated floodplain bounded by terraces. The existing situation is affected by backwater deposition from the Milltown Dam during flood events and the resultant channel system has changed into a braided D4 type system as discussed for Reach CFR 2. Sediment deposition has occurred for several thousand feet upstream, which has buried the historic terraces. The deposition and backwater from the dam has formed extensive wetlands, however, and vegetation communities have probably shifted from a mix of coniferous forests on the terraces and deciduous vegetation on the floodplain to predominantly deciduous and wetland vegetative types. The lower 2,200 feet of floodplain is essentially flat, corresponding to the normal high water conditions for the dam.

The potential streamtype in the area is a predominantly single thread C4 channel with off-channel wetlands supported by subsurface flows from adjacent hill slopes. The lower 2,200 feet of the channel and floodplain will need to be reconstructed at a lower elevation to prevent a flat discontinuity in the channel and valley gradient. The floodplain should span the belt width of the channel (width between the lateral extents of opposing meanders measured perpendicular to the slope of the valley). In other words, the valley gradient should remain at a constant 0.002 ft./ft. over a distance of about 7,000 feet. The floodplain should narrow gradually between the upstream and downstream segments.

<u>CFR 4</u>

This reach is similar to CFR 3 except that it is upstream of the backwater deposition and effects of Milltown dam. The historic streamtype was most likely a C4 streamtype; however, channelization and encroachment from the highway and railroad grades have altered the channel and valley bottom significantly. Other influences include agriculture, grazing, timber removal, commercial, and residential development. Several sub-reaches of the Clark Fork within Reach

CFR 4 have responded to increased sediment supply and bank erosion by converting to a braided D4 type channel. These braided channels are typically highly unstable with bank erosion occurring on one or both banks almost continually along its length. High width:depth ratios reduce sediment transport capacity and in many cases D4 channels are in an aggrading trend (stream bed is elevated due to sediment deposition). The existing channel varies from C4 stream types to reaches of D4 and F4 stream types where the channel is either braiding or confined by berms, respectively. The potential streamtype is a C4 channel and can be created by re-activating abandoned meanders linked by new channel segments constructed to the appropriate dimensions. Overall floodplain width, belt width should remain unchanged and valley gradient will remain at about 0.003 ft./ft. over a distance of about 15,400 feet.

BFR 1

The lower Blackfoot River was most likely a B3c channel upstream from the confluence before the Milltown dam was constructed. The glacial outwash terraces that confined the later extent of the floodplain remain, although the terraces are now highly developed for industrial, commercial, and residential land uses. The existing channel is affected by backwater conditions from the Milltown dam as well as five major highway and railway bridges. With the Milltown dam removed, the width between the terraces is sufficient to re-create a B3c channel type, similar to historic conditions. The five bridges complicate restoration, but would not prevent the conversion back to a B3c streamtype. The original gradient is unknown, but without reconstructing the bridges, the final gradient of the River will be dictated by the depth of the bridge piers and the allowable scour depth. The gradient would remain consistent at about 0.002 ft./ft. upstream from the Highway 200 Bridge, but would steepen to about 0.005 ft./ft. downstream to the confluence. For these reasons, the potential streamtype for BFR 1 is a B3c streamtype. A narrow, sloping flood prone area could be created by reshaping the channel cross section and redefining the thalweg. The valley length of this reach is about 5,650 feet.

BFR 2

The upper Blackfoot River reach was most likely similar to the lower reach and was probably a B3c channel type. The dominant streamtype upstream from BFR 2 is a B3c channel type with the exception of reaches that have encroachment from road systems. These reaches are usually F3 stream types. The existing conditions are highly altered by the Stimson diversion dam, a large fill along the mill encroaching into the river, sediment deposition created by backwater conditions related to the fill and the dam, and highway encroachments. With Stimson diversion dam and the fill removed, the potential streamtype for the entire reach would be a B3c channel. Like Reach BFR 1, the channel could be reshaped into a narrower channel with a sloping flood prone area adjacent to the channel. Overall valley gradient is about 0.003 ft./ft. over a distance of about 6,500 feet.

The upstream extent of Reach BFR 2 was determined using the FEMA FIRM profiles and a field review intended to document channel depositional features that could be related to backwater effects of the Stimson diversion dam and the channel fill constricting the river just upstream from the dam. Upstream from the Stimson diversion dam, the point where the depositional features start to disappear is approximately the same point where the flood profile gradient begins to steepen (Cross section U on the FEMA profile). Apparently, the backwater effect of the Stimson diversion dam, in conjunction with the channel constriction just upstream from the dam, affects the river during large floods for approximately 6,500 feet upstream. An actual ending point could not be determined with the limited data available. In addition, other effects make the exact point difficult to determine, such as the constriction of the channel in several places from Highway 200 upstream from the Stimson diversion dam. For the limited purposes of this CRP, a point about 6,500 linear feet upstream from Stimson diversion dam will be used as the upstream terminus of Reach BFR 2.

3.0 HYDROLOGY AND FLOOD SERIES ANALYSIS

This section will summarize the hydrology of the project area and provide an estimation of the bankfull discharge and flood characteristics for the two rivers.

3.1 GENERAL DESCRIPTION

The watershed area upstream of Milltown dam encompasses 5,984 square miles (3,829,760 acres), with elevations ranging from 3,218 feet at the Milltown dam powerhouse to over 8,000 feet at both the Blackfoot River and Clark Fork River sub-watershed divides. The Clark Fork River watershed is located west of the Continental Divide with most of the headwater streams originating along the Continental Divide. The Blackfoot River sub-watershed has relatively high mean annual precipitation ranging from 16 inches at the confluence with the Clark Fork River to 60 inches at the watershed divide (USDA Soil Conservation Service, 1990). The Clark Fork River sub-watershed has a lower mean annual precipitation ranging from 14 inches near Milltown dam to 50 inches at the divide (USDA Soil Conservation Service, 1990). A majority of the precipitation in both sub-watersheds occurs as snow that typically melts between April and June producing snowmelt runoff dominated hydrographs.

USGS gauging stations provide historical flow information for the Blackfoot River and the Clark Fork River both upstream and downstream of the project area. Discharge on the Blackfoot River is slightly regulated by Nevada Creek Reservoir and is affected by the appropriation of surface water for the irrigation of approximately 20,000 acres. Discharge on the Clark Fork River above Milltown dam is somewhat regulated by the Warm Springs Ponds on Silver Bow Creek near Anaconda and Georgetown Lake on Flint Creek and is affected by the appropriation of surface water for the irrigation of approximately 100,000 acres. Discharge on the Clark Fork River above Milltown dam is heavily regulated with diurnal fluctuations and is affected by the appropriation of surface water for the irrigation of approximately 120,000 acres.

3.2 HYDROGRAPH DISCUSSION

Mean daily discharge values from the pertinent USGS stream flow gauging stations were reviewed to evaluate the timing, magnitude, and duration of peak and base flow discharges. In addition to providing important data for channel design, this information was used to forecast stream flow conditions that will likely be experienced during the implementation phase of this project.

Based on data available for the periods of record, the Blackfoot River typically flows less than 700 cfs from September through March with baseflow (discharge less than 600 cfs) discharge occurring from mid-December through early February. Discharge typically exceeds 5,000 cfs from mid-May through mid-June with peak flows occurring in early June. The Clark Fork River at Turah Bridge typically flows less than 1,000 cfs from July through March and experiences baseflow (discharge less than 700 cfs) conditions from early August through early September, and from mid-to-late December. Flows on the Clark Fork River at Turah Bridge typically exceed 2,000 cfs from early May through late June with peak flows occurring in early June. The Clark Fork River above Missoula typically flows less than 2,000 cfs from July into March with baseflow conditions (discharge less than 1,500 cfs) from mid August through early October, and from early December through February. Flows on the Clark Fork River below the confluence typically exceed 8,000 cfs from mid-May through late June with the highest flow typically occurring during the first week of June. Low flow conditions in the Clark Fork River in August and September are related to surface water appropriations and diversions for a variety of beneficial uses.

BANKFULL DISCHARGE ANALYSIS

The bankfull discharge is the most frequently re-occurring flow associated with moving sediment, forming and shaping bars, and maintaining the main morphological characteristics of natural stream channels (Rosgen, 1994). Bankfull discharge is associated with a momentary maximum flow, which, on average, has a recurrence interval of 1.5-1.8 years as determined using a flood frequency analysis (Dunne and Leopold, 1978). WCI performed a detailed analysis to calibrate bankfull discharge for the Blackfoot River and the Clark Fork River upstream and downstream of the confluence with the Blackfoot River. The first analytical method determined bankfull discharges using both past USGS flood frequency analyses and USGS regional equations (Omang, 1992). The second analytical method determined bankfull discharges using historical gage data and applied six different statistical approaches. In most cases, the error factor was less than 15%. The bankfull discharge results are a first estimation and will require further validation during consecutive design phases of this project. The following table summarizes the bankfull discharge for specific reaches in the project area.

TABLE 1
THE PREDICTED BANKFULL DISCHARGE (CFS), RANGE, AND MARGIN OF ERROR FOR THE CLARK FORK RIVER (UPSTREAM OF THE CONFLUENCE), BLACKFOOT RIVER (UPSTREAM OF THE CONFLUENCE), AND THE CLARK FORK RIVER (DOWNSTREAM OF THE CONFLUENCE).

	CLARK FORK RIVER (UPSTREAM OF CONFLUENCE)	**BLACKFOOT RIVER (UPSTREAM OF CONFLUENCE)**	**CLARK FORK RIVER (DOWNSTREAM OF CONFLUENCE)**
Bankfull Discharge	3,300	7,400	10,600
Margin of Error	± 320	± 740	± 1,060
Range	2,880 – 3,530	6,660 – 8,140	9,540 – 11,660

<u>Flood Series Analysis</u>

A detailed flood frequency analysis using historical gage data and several statistical distributions was performed to determine discharges associated with selected recurrence intervals. Statistical analyses included normal distribution, log-normal distribution, gumbel distribution, extreme value distribution, and log-Pearson III distribution. Analyses were performed for the four pertinent USGS Gages, including: 1) the Blackfoot River near Bonner (#12340000); 2) the Clark Fork River at Clinton (#12331900); 3) the Clark Fork River at Turah Bridge (#1234550); and 4) the Clark Fork River above Missoula (#12340500). The periods of record for each gage are 68 years, 14 years, 16 years, and 72 years, respectively. The following table summarizes the discharge values produced by applying the statistical method with the highest correlation coefficients for the individual USGS stream flow gages.

TABLE 2
The predicted discharge (cfs) for selected recurrence intervals using the statistical method with the highest correlation coefficient.

USGS Gaging Station	**Discharge associated with Recurrence Interval (cfs)**						
	$Q_{1.5}$	Q_2	Q_5	Q_{10}	Q_{20}	Q_{50}	Q_{100}
Clark Fork-Upstream	3,500	4,740	8,210	10,930	13,850	18,080	21,600
Blackfoot River	6,350	8,500	12,650	15,570	18,490	22,430	25,520
Clark Fork-Downstream	11,500	14,460	22,040	27,480	32,980	40,480	46,400

As summarized in Table 2, the predicted bankfull discharges for the Clark Fork at Turah Bridge, the Clark Fork River near Missoula, and the Blackfoot River near Bonner were 3,500, 6,350, and 11,500 cfs, respectively. When compared to the predicted bankfull discharges presented in Table 1, the $Q_{1.5}$ estimate is within 15 percent of the predicted bankfull discharge, which further validates the prediction.

4.0 CHANNEL DIMENSIONS AND HYDRAULIC ANALYSIS

This section will predict the preliminary proposed channel dimensions to be used in the conceptual design. Channel design dimensions and meander geometry relationships are presented along with hydraulic calibration of the dimensions.

4.1 Channel and Floodplain Dimensions

4.1.1 Overview

Natural channel design requires that the active channel be sized to accommodate the bankfull discharge and an adequate vegetated floodplain (or flood prone area) be constructed to convey flood flows of higher magnitude. The geomorphology of this area suggests that a single thread channel of both C (riffle/pool dominant habitat) and B (riffle/step pool dominant habitat) stream types, depending on the slope and degree of entrenchment or width of available floodplain, are appropriate.

Channel design parameters and dimensions include the bankfull discharge, width, mean depth, maximum depth, scour depth, cross-sectional area, and the width:depth ratio. Design dimensions are developed through a rigorous process that includes analog based hydraulic modeling (i.e. HEC-RAS), analytical field calibration (i.e. reference reach surveys), and empirical approaches (i.e. regional curves). For this level of design, a brief field review was conducted to measure existing bankfull widths in nearby undisturbed ("reference") sections, but no detailed channel surveys or hydraulic modeling of existing conditions was conducted. Channel dimensions for both riffle and pool habitat features have been developed for each reach. The bankfull discharge, depth, channel roughness, and slope all serve to determine the necessary cross-sectional area for a reach. An iterative process of refinement allows for the design channel to produce in-channel shear stresses sufficient to maintain sediment entrainment. Pool dimensions have been tailored to provide deep pool habitat with cover that is critical for over wintering and over summering for large and small fish, including bull trout.

4.1.2 CHANNEL DIMENSIONS

Three sets of channel dimensions for the Clark Fork River have been developed and are summarized in Tables 3 and 4. Detailed cross-section templates for each set of channel dimensions are included in Appendix 3. In the upper portion of the project area upstream of Duck Bridge, slope and floodplain availability allow for a designed C4 stream type with corresponding channel characteristics and dimensions noted in Table 3. From The Duck Bridge downstream to the confluence with the Blackfoot River, the Clark Fork River transitions from a C4 channel type to a B3 type (refer to Section 2.4 for a more detailed discussion on this transition). B3 channel type design dimensions for the Clark Fork River from The Duck Bridge downstream to the confluence with the Blackfoot River are summarized in Table 3.

TABLE 3: Design dimensions for Reaches CFR3 and CFR4 of the Clark Fork River (upstream of the Duck Bridge).

CLARK FORK RIVER (UPSTREAM OF DUCK BRIDGE) BANKFULL CHANNEL DESIGN DIMENSIONS C4 STREAM TYPE		
PARAMETER/FEATURE	**POOL**	**RIFFLE**
Discharge	3,300 cfs	3,300 cfs
Width	156 ± 10 ft	130 ± 10 ft
Mean Depth	4.8 ft	5.8 ft
Max. Depth	14.5 ft	7.2 ft
Scour Depth	20.3 ft	8.7 ft
Cross-Sectional Area	860 ft^2	750 ft^2
Width/Depth Ratio	N/A	22.4

TABLE 4: Design dimensions Reach CFR2 of the Clark Fork River (upstream of the confluence).

CLARK FORK RIVER (UPSTREAM OF CONFLUENCE) BANKFULL CHANNEL DESIGN DIMENSIONS B3 STREAM TYPE		
PARAMETER/FEATURE	**POOL**	**RIFFLE**
Discharge	3,300 cfs	3,300 cfs
Width	140 ± 10 ft	125 ± 10 ft
Mean Depth	4.4 ft	4.8 ft
Max. Depth	12.0 ft	6.0 ft
Scour Depth	15.4 ft	7.7 ft
Cross-Sectional Area	690 ft^2	600 ft^2
Width/Depth Ratio	N/A	26.0

One set of channel dimensions for the Blackfoot River was developed and is presented in Table 5. These B3 channel type dimensions are suitable for both Reach BFR1 and Reach BFR2 of the Blackfoot River.

TABLE 5: Design dimensions for Reaches BFR1 and BFR2 of the Blackfoot River.

BLACKFOOT RIVER (UPSTREAM OF CONFLUENCE) BANKFULL CHANNEL DESIGN DIMENSIONS B3 STREAM TYPE		
PARAMETER/FEATURE	**POOL**	**RIFFLE**
Discharge	7,400 cfs	7,400 cfs
Width	195 ± 10 ft	175 ± 5 ft
Mean Depth	6.0 ft	6.6 ft
Max. Depth	16.5 ft	8.6 ft
Scour Depth	21.2 ft	10.6 ft
Cross-Sectional Area	1,335 ft^2	1160 ft^2
Width/Depth Ratio	N/A	26.5

A final set of channel dimensions for the Clark Fork River downstream of the confluence with the Blackfoot River was developed and is summarized in Table 6. The B3 channel type dimensions are suitable for Reach One of the Clark Fork River.

TABLE 6: Design dimensions for Reach CFR1 of the Clark Fork River (downstream of the confluence).

CLARK FORK RIVER (DOWNSTREAM OF CONFLUENCE) BANKFULL CHANNEL DESIGN DIMENSIONS B3 STREAM TYPE		
PARAMETER/FEATURE	**POOL**	**RIFFLE**
Discharge	10,600 cfs	10,600 cfs
Width	235 ± 5 ft	215 ± 5 ft
Mean Depth	8.3 ft	9.2 ft
Max. Depth	20.2 ft	11.5 ft
Scour Depth	29.4 ft	14.7 ft
Cross-Sectional Area	2270 ft^2	1,970 ft^2
Width/Depth Ratio	N/A	23.4

All cross-sectional design parameters for riffle habitats are summarized in Table 7. Riffle sections are compared because most parameters are based on a bankfull width at a stable riffle section and these sections tend to be the most hydraulically consistent. It may be noted that the width, depth and cross sectional area is less for the B3c reach of the CFR 2 than the C4 reach of CFR 4. This decrease in size is due to the increase in gradient for CFR 2, which increases velocity and necessitates a reduction in channel capacity to maintain a channel that just contains the bankfull discharge.

TABLE 7: Summary table of bankfull channel design dimension (riffle habitat features) for all reaches.

SUMMARY OF BANKFULL CHANNEL DESIGN DIMENSIONS RIFFLE HABITAT DIMENSIONS				
PARAMETER/FEATURE	**CLARK FORK RIVER**	**CLARK FORK RIVER**	**BLACKFOOT RIVER**	**CLARK FORK RIVER**
	REACHES CFR3 & 4	**REACH CFR2**	**REACHES BFR1 & 2**	**REACH CFR1**
Stream Type	C4	B3	B3	B3
Discharge	3,300 cfs	3,300 cfs	7,400 cfs	10,600 cfs
Width	130 ± 10 ft	125 ± 10 ft	175 ± 5 ft	215 ± 5 ft
Mean Depth	5.8 ft	4.8 ft	6.6 ft	9.2 ft
Max. Depth	7.2 ft	6.0 ft	8.6 ft	11.5 ft
Scour Depth	8.7 ft	7.7 ft	10.6 ft	14.7 ft
Cross-Sectional Area	750 ft^2	600 ft^2	1,160 ft^2	1,970 ft^2
Width/Depth Ratio	22.4	26.0	26.5	23.4

4.2 PLAN FORM GEOMETRY

Plan view geometry and characteristics are also a function of the bankfull discharge and the bankfull design width. The most probable channel patterns for the project area reaches were determined from empirical models developed by Leopold et al (1964), Williams (1986), Rosgen (1996), and WCI's reference reach database. Plan view design parameters were calculated for the individual project reaches and are summarized in Table 8. Bankfull channel parameters included the design sinuosity, meander length range, curvature radii, and step frequency. The design belt width, a floodplain characteristic, is also included.

TABLE 8: Summary table of plan form channel and floodplain design dimension for all reaches.

SUMMARY BY REACHES BANKFULL CHANNEL DESIGN DIMENSIONS				
	CLARK FORK RIVER	**CLARK FORK RIVER**	**BLACKFOOT RIVER**	**CLARK FORK RIVER**
PARAMETER/FEATURE	**REACHES 2, 3 & 4**	**REACH 2**	**REACHES 1 & 2**	**REACH 1**
Stream Type	C4	B3	B3	B3
Design Sinuosity	1.5	1.3	1.3	1.3
Meander Length Range	1,500 ± 250 ft (1,250–1,750)	1,560 ± 250 ft (1,310–1,810)	2,100 ± 350 ft (1,750–2,450)	
Radius of Curvature Range	455 ± 130 ft (325–585)	455 ± 130 ft (325–585)	610 ± 175 ft (1,750–2,450)	
Step Frequency Range	N.A.	4-5* Wbf (520-650)	4-5*Wbf (700-875)	4-5*Wbf (860-1,075)
Meander width ratio Belt width Range	4-20 (520-2,600)	2-6 (260-780)	2-5 (350-875)	

The empirical models provided a range of values for channel pattern attributes rather than specific values for channel pattern. All values will be validated in Phase 2 (refer to Section 5.8). The channel patterns and locations may be adjusted to account for the final condition of the valley bottom following reservoir sediment removal. Where feasible, the new channel will be constructed to incorporate established existing vegetation to provide bank stability and habitat, beneficial characteristics for rehabilitating the constructed reaches.

4.3 HYDRAULIC ANALYSIS

WCI performed several different preliminary hydraulic analyses during the development of each set of design dimensions. This analysis focused on three independent techniques. First, hydraulic geometries were developed at the pertinent gage station that provided initial information regarding the relationship of cross-sectional area, width, hydraulic radius, mean depth, and wetted perimeter to the bankfull discharge. This type of relational information was then used and extrapolated to develop the first revision of the design dimensions. WCI then utilized information from FEMA regarding water surface slopes, predicted bankfull discharge, and the preliminary design dimensions for each reach as input into a hydraulic modeling software called WinXSPro (USDA, 1998). This analysis is one-dimensional (cross-sectional) in nature and was iteratively used to refine the each reach's design dimensions to insure that it had the correct cross-sectional geometry to convey the bankfull discharge. Finally, WCI developed a preliminary two-dimensional hydraulic method using HECRAS (hydraulic modeling software developed by the U.S. Army Corps of Engineers). This analysis was critical in further refining the preliminary channel and floodplain design dimensions to insure that the design channel is capable of conveying the discharge and sediment that the watershed naturally produces. Design dimensions of the active bankfull channel were refined throughout this process to focus on in-channel conveyance of the bankfull discharge. Less interest and effort was placed on developing detailed stage height relationships for large magnitude flood events.

Further analyses will be required during Phase 2 and Phase 3, as further described in Sections 5.8 and 5.9.

5.0 PROPOSED RESTORATION STRATEGY AND RECOMMENDATIONS

5.1 COMPARISON OF EPA'S PROPOSED PLAN TO THE CRP

For the development of this CRP it is assumed that EPA's Proposed Plan for the Milltown Reservoir Sediments Operable Unit will include the following remedial actions, a derivation of the Feasibility Study Alternative 7A2:

1. Sediments from Area I will be removed to an elevation that represents the level of the buried alluvium. These sediments will be removed from the site and transported to a repository west of the reservoir.
2. Area III channel sediments will be left in place out of the 100-year floodplain. The sheet pile used to isolate Area 1 sediments will be removed or left in place and cut off below ground surface.
3. The Milltown dam spillway and radial gate structures will be removed to allow construction of a channel designed to carry the 100-year flood. Other dam structures, the powerhouse, divider block, and north abutment wall will be left in place.
4. Grade control will be established on the Clark Fork River in the area of Duck Bridge and on the Blackfoot River near the interstate 90 overpass.
5. A river channel will be excavated into the alluvium. The channel on the Clark Fork River will be capable of carrying the 100-year flood within it's banks. The streambanks will be a rip-rap type bank throughout the Area 1 and extending through the removed dam. The confluence of the Clark Fork River and Blackfoot River will be established upstream of the present dam location.
6. The floodplain of the Clark Fork River will be backfilled to re-establish a floodplain and proper grade. The floodplain will be re-vegetated with grasses.

EPA's proposed plan includes all of Reach CFR 2 and parts of Reaches CFR 1 and BFR 1. As noted in previous sections, Reaches CFR 1 extends further downstream and BFR 1 extends further upstream. As discussed on Section 2.2 through 2.4, CFR 3 includes that portion of the Clark Fork River that is directly affected by Milltown dam. CFR 4 and BFR 2 are included to extend the CRP to the nearest stable point.

The proposed restoration strategy coordinates with some of these treatments, modifies or enhances other treatments and replaces some treatments altogether to fit the Natural Channel Design (NCD) concept. A brief comparison of the two approaches is provided in the following discussion, identified by the same bullet number as used above. Complete details of the proposed restoration plan are included in the Sections 5.2 through 5.4.

1. This action is assumed to be fully implemented and is unchanged in the CRP.
2. The CRP proposes to remove all sheet piling.
3. The CRP proposes to remove all dam structures, including the powerhouse, divider block, and north abutment wall while re-grading the entire area into channel and floodplain. Because of the historical nature of the powerhouse, it may be appropriate to build a replica of the powerhouse on site out of the floodplain. Parts of the powerhouse, such as the generators, could be relocated on the replica.
4. The CRP proposes grade control throughout all reaches with the use of many different kinds of structures designed to benefit natural channel processes, fish habitat, fish passage, flood plain function, boating and other resource goals. Descriptions of the proposed structures are in Section 5.2 through 5.4. No single, massive grade control structures are planned, as proposed in the EPA proposed remediation plan.
5. The CRP proposes to excavate the new channel into the alluvium, where necessary, but the channel will be designed to carry the bankfull discharge (1.5-year flood), rather than the 100-year flood. The Natural Channel Design concept used in the CRP promotes the design of a channel that can accommodate the normal annual high flow within the active channel. A floodplain or flood prone area is designed adjacent to the active channel to accommodate a whole range of flood flows including the 100-year flood. Stream banks would be stabilized using a much softer approach, using rock and log structures designed to meet the objectives outlined in Section 1.0, specifically, minimal streambank erosion of areas containing significant levels of contamination. No rip-rap or armored banks are proposed in the CRP. The confluence of the two rivers would be established upstream from the present dam location, but would be slightly downstream of the confluence proposed in the EPA proposed plan.
6. The floodplain of the Clark Fork River will be backfilled to the grade necessary to re-establish a floodplain or flood prone area appropriate for the geomorphic setting. This floodplain or flood prone area would be activated during most years to some degree, rather than only above the 100-year flood as in the EPA proposed plan. Revegetation treatments proposed in the CRP are much more aggressive and intensive to promote true restoration of the floodplain and riparian areas in order to meet the established objectives. EPA's proposed plan includes only grasses, with no discussion of how the natural riparian species would re-colonize the site. The CRP augments the planting of grasses

with a full complement riparian, upland and wetland species designed to replace the habitats that occupied the site prior to dam construction. Refer to Section 5.4.5 for a description of all revegetation treatments proposed in the CRP.

The CRP utilizes the natural channel design (NCD) concept, which aims to restore natural channel stability, or dynamic equilibrium, and habitat to impaired streams. When properly applied, NCD methods provide a robust, widely tested, and well-accepted approach to the design of natural channels that successively achieve habitat and geomorphic restoration objectives while functioning during extreme flood events (Schmetterling and Pierce, 1999). NCD is the foundation for developing a naturally stable channel design and meeting habitat restoration objectives. NCD focuses on restoring geomorphic characteristics while incorporating fish habitat structures composed of native materials in natural arrays that better replicate native salmonid habitat as necessary for restoring inland native fish populations. Additional information on NCD can be found in Appendix 9.

5.2 PLAN VIEW, LONGITUDINAL PROFILE, CROSS SECTIONS

All available data sources were used to develop the plan view alignments, longitudinal profiles and cross sections. Data sources included the FEMA FIRM maps (1988), Land and Water Consulting, Inc. cross-section data (1998), aerial photogrammetric base map by Horizons, Inc. (2000), and the Sediment ISOPAC Map (Titan Environment, 1995, geo-referenced by EMC^2 in 2002). All data were geo-referenced to NAD, 1983, and NAVD 1988.

The data was generally adequate for a conceptual level design, but large data gaps existed, particularly in Reaches CFR 3 and 4. The plan view was developed using standard channel and meander geometry dimensions as described in Section 4. The channel plan view is considered conceptual at this point due to very limited data. The detailed plan view alignments can be validated and updated during Phase 2 of the design process.

The longitudinal profile was developed with the objective of keying the proposed floodplain to existing floodplains and vegetated features. Valley gradients were kept as constant as possible to minimize potential problems associated with sudden changes in gradient. The proposed gradient is shown as a water surface profile at bankfull stage and a consistent bed profile that is parallel to the water surface profile. The bed gradient is not intended to illustrate pool, riffle, run and glide habitats, but rather to indicate the elevation of the grade control at any point in the profile. More detailed profiles can be developed during Phase 2 of the design process.

For the Clark Fork River Reaches, the valley gradient is illustrated rather than the stream profile. There is enough uncertainty in the plan view of the proposed C type channel and a high sinuosity so that the profile could vary significantly. For this reason, the valley profile is illustrated with the understanding that the channel gradient can be calculated by dividing the total change in elevation by the total channel length. The Blackfoot River system had much less uncertainty and also a very low sinuosity, so the channel gradient is shown in this case. In other words, there is little difference between the valley profile and the channel profile for the Blackfoot River. Refer to Appendix 7 for displays of the longitudinal profiles.

Cross sections were developed using the template channel geometry and dimensions overlain on the existing land surface or the surface predicted to exist after sediment removal. There is a high level of uncertainty associated with the post-sediment removal land surface, so the channel cross sections are considered conceptual. Floodplains were designed to minimize cuts or fills and to meet the minimum criteria in most cases.

5.3 PROPOSED CHANNEL FEATURES, STRUCTURES AND DETAILS

This section will summarize the proposed channel features and quantities. For more detailed estimates of the number of structures, cut and fill volumes and quantities, refer to the cost estimate sheets included in Appendix 6. Most features discussed in this section are displayed on the Plan View Sheets in Appendix 4.

TABLE 9
PROPOSED CHANNEL AND REACH DIMENSIONS

CHARACTERISTIC	REACH						
	BFR-1	BFR-2	CFR-1	CFR-2		CFR-3	CFR-4
Proposed Stream Type	B3c	B3c	B3c	B3c	C4	C4	C4
Entrenchment	1.7	2.0	1.2	3-9	3-9	9-19	4-8
Width/Depth	26	26	23	22	26	22	22
Valley Length (ft)	5650	6500	5250	3850		7000	15400
Stream Length (ft)	6100	7600	5500	4300		10400	19400
Sinuosity	1.1	1.2	1.04	1.1	1.3	1.48	1.3
Stream Gradient (mean)	0.002-0.005	0.002	0.002	0.005	0.004	0.0013	0.0024
Valley Gradient (mean)	0.002-0.005	0.002	0.002	0.006	0.006	0.002	0.003
Belt Width (ft)	300-350	300-350	225-700	400-1200		1000-1400	500-800
Meander Width Ratio	2-5	2-5	1.2	2-5	4-20	4-20	4-20

5.3.1 CFR 1 AND POWERHOUSE

The proposed channel is a $B3_c$ channel with a mean gradient of about 0.002 ft./ft. The minimum flood prone width for this channel is about 500 feet compared to a width of about 250 feet available with only the spillway and radial gates removed. The limited width created by removing only the spillway and radial gate necessitates removing all the dam structures, including the powerhouse, divider block and north abutment wall to create an adequate floodplain. If the powerhouse and associated structures were to be left in place, this CRP should not be implemented. In order to secure the physical and biological functions as well as a stable self-maintaining channel, which are objectives of this project, all dam structures must be removed or relocated out of the flood prone area. Specifically, the reasons the powerhouse and associated structures need to be removed are as follows:

- With the powerhouse in place, the limited width of the flood prone area would create a severe constriction, which will cause backwater deposition (excess sediment deposition/ aggradation) during even moderate flood events (see Appendix 2, Photo 5 – CFR 1). Plan View Sheet CFR 1 in Appendix 4 and the cross section sheet in Appendix 7 illustrate the approximate floodplain needed for a five-year return interval flood (about 22,000 cfs) without creating backwater deposition. The floodplain width for a five-year return interval flood is about 330 feet (extending about half way through the powerhouse structure).

- A 100-year return interval flood would be about 46,000 cfs, which would require a flood prone width of at least 500 feet to minimize the risk of creating backwater effect. Naturally stable B_3 stream types have an entrenchment ratio of up to 2.2 (flood prone width/ bankfull width) at an elevation two times maximum bankfull depth. With the powerhouse in place, a major flood would create backwater conditions that would bury the entire channel and some of the floodplain with large cobble and small boulder sized bedload sediment.

- Following each major flood, within the area affected by backwater deposition, all structures would be filled with sediment. This would increase the risk that the floodwaters would attempt to flank structures and create new channels.

- Excessive maintenance would be required after even small floods. Maintenance would include channel and floodplain excavation and disposal of the gravel; reconstructing structures; and complete revegetation. The maintenance would add a large cost to the project after each flood, which would continue indefinitely into the future.

- Aquatic habitat would be damaged following flood events as a result of sediment deposition and the subsequent maintenance.

- The constriction would increase velocity during all flood events, which would likely preclude fish migration during that period.

- The constriction and backwater would result in increased flood stage upstream from the powerhouse as well as increased shear stress and scour at the constriction and immediately downstream.

- The sudden expansion downstream from the constriction would create back-eddy erosion on the stream banks downstream from the constriction.

In summary, this CRP is designed to achieve all the objectives outlined in Section 1.0. The design is predicated on the removal of the spillway, powerhouse and all associated structures. Without removing all of the dam structures, the CRP will not be successful, the objectives will not be met and the CRP should not be implemented.

With the powerhouse and north abutment wall removed, the flood prone area on the north side would be filled and graded at the appropriate elevation. Some of the Area III sediments on the northeast side of the confluence would be needed to grade the bay where the turbines discharge into a floodplain. The island downstream between the Milltown dam and railroad bridge would remain with part of the flows routed through the side channel (less than 30 percent during bankfull conditions). The side channel presents some opportunities for fish habitat and additional recreational experience. Initial calculations suggest that cuts and fills will balance in reach CFR 1.

Downstream from the railroad crossing the side channel converges with the main channel. At this point, the river transitions into a stable F3 type channel. No additional work is proposed at this time between the I-90 bridge (Station 0+00) and Station 28+00 in CFR 1. The railroad bridge has an adequate span to accommodate the channel and flood prone area. A “W” weir or similar structure would need to be designed in Phase 3 to route the flows between the bridge piers to maximize sediment transport efficiency and minimize scour. Details of bridge construction are not known at this time.

Structures proposed in this reach would serve multiple functions: grade control and step pool morphology; bank stabilization; fish habitat complexity and river floating. Because this reach has a step-pool morphology and it is a large river, the structures would be constructed primarily of large rock, but large woody debris and root wads would be incorporated into all structures for habitat. Refer to Section 5.4 for descriptions and illustrations of the proposed structures. The detail sheet in Appendix 5 is an example of how a combination of these structures could be placed in this reach. Proposed structures include “J” Hook vanes, cross vane, single and double wing deflectors, converging roller eddy composites and converging rock clusters. This reach would be completely reshaped in to a steeper overall gradient and flows the channel will be narrower and deeper than the existing conditions. Shear stresses would also be greater on fresh fill material used to construct the channel and banks. Grade control and bank stabilization structures would need to be constructed at the proposed density and frequency to prevent channel down cutting and bank erosion until the natural sorting can take place and the revegetation matures. These structures are designed to allow fish passage upstream and downstream at most flow conditions present when the fish are conditioned to move. Also, river boating opportunities are enhanced with the proposed structures. Rock structures constructed with large rock are appropriate in this geomorphic setting with the south bank occurring on a bedrock outcrop.

5.3.2 CFR 2

As described in Section 2.4, this reach would be constructed to a C4 stream type in the upper half of the reach, transitioning into B3c streamtype for the lower half of the reach. Floodplain widths would also transition from about 1,000 feet wide at the Duck Bridge grade to about 300 feet near the confluence. Stream gradient would range from about 0.004 ft./ft. in the upstream C4 stream type portion to about 0.005 ft./ft. in the lower B3c stream type portion.

Area III sediments with low contaminate concentrations would be graded to fill some of the volume created by the removal Area I sediment. The Area II sediments would be suitable for building floodplains and terraces. Also, since the Duck Bridge grade on the south side creates a constriction on the floodplain during major floods, the fill should be excavated down to floodplain elevation and used as fill for the low areas. Removing the Duck Bridge fill will allow a smooth transition from a wider floodplain to a narrower floodplain that will eliminate rapid constriction during major floods. After these areas are re-graded, there would be a deficit of about 336,000 cubic yards of fill material that would need to be imported to the Reach. Coarse cobble and gravel should be imported to construct the channel and banks throughout the reach. Excess excavated material from Reach BFR 2 would be ideal for this application because it is clean and has about the correct size composition.

The Area III sediments that currently have relatively high contamination concentrations would be re-graded slightly to provide drainage, and revegetated in place. This area can be described as the existing CFR channel bed, from the existing confluence upstream, to a point opposite Station 80+00 on the proposed channel alignment (Sheet CFR 2 in Appendix 4). This is at about the transition point between the B3c and C4 channel types. The floodplain narrows significantly at this point. Under the remediation plan, the sheet piling that was placed along the north bank of the CFR during the Area I sediment removal would be cut down to just below the finished grade where the high contamination sediment is to remain in place. Under this CRP, all of the sheet piling would be removed. The floodplain would be graded up to this existing elevation at about a 4:1 slope. This area would be higher in elevation than the 500-year flood level and would be isolated from any flood by deep fills and gentle, revegetated slopes. Sheet CFR 2 in Appendix 4 and Example cross-section in Appendix 7 illustrate the treatments in this reach.

Structures proposed for the downstream $B3_c$ portion of this reach are primarily rock grade control and bank stabilization structures similar to Reach CFR 1. The gradient is steeper in this reach than in either the upstream or downstream reaches. Most of the new channel would be constructed on fresh fill that would not have the natural sorting and grade control of an existing river. To prevent the potential for down cutting and bank erosion that would take place without the structures, fairly high densities of structures are proposed. The detail sheet in Appendix 5 is an example of the types and placements for the proposed structures in CFR 2. The grade control structures are design to create a step-pool morphology and that would allow fish passage upstream and downstream. Also, river boating opportunities are enhanced with the proposed structures. These structures would replace rip-rap and “soft” bank stabilization proposed in the EPA remediation plan.

The upstream C4 portion of the reach would be stabilized with primarily large wood structures such as root wad/log vanes combination structures with rock J hook and large woody debris jam structures. Refer to Section 5.4 for descriptions and illustrations of the proposed structures. These structures are necessary for grade control and bank stabilization until the bed material can become naturally armored and bank vegetation matures. A rock “sill” is proposed at the upstream end of this reach, approximately where the Duck Bridge fill is to be removed to ensure that the newly constructed floodplain remains secure until the vegetation matures. The sill would be constructed at floodplain grade and is basically a trench excavated into the floodplain about three (3) feet deep and filled with large rock. The sill is capped with sod so that it is not visible. This sill could be incorporated into a foundation for a trail or link into proposed bridge abutments.

A footbridge has been proposed in the vicinity of the Duck Bridge grade to connect trails on the north and south sides of the Clark Fork valley. Proposed design criteria for the footbridge are included in Section 5.5. An aggressive revegetation plan is proposed for all reaches following construction to re-create the riparian and upland habitats that were present prior to dam construction. The proposed revegetation treatments are summarized in Section 5.4.5.

5.3.3 CFR 3

The upstream end of Reach 3 would be reconstructed to a predominantly single thread C4 channel with the existing channels converted to discontinuous wetlands with excavated gravel and soil from the new channel alignment. The channel would be constructed so that the proposed floodplain elevations would match the existing floodplain elevations and established floodplain vegetation. The new channel would have hydraulic and meander geometry appropriate for the geomorphic setting and size of the river. Channel gradient would be about 0.0013 ft./ft. over the total channel length. Whenever possible, the new channel would channel would be constructed to re-activate abandoned oxbows and meanders.

To maintain a consistent grade, the downstream portion of the reach would need to be constructed so that the floodplain would be excavated to a lower elevation. At the downstream end of the reach, the floodplain would be lowered by up to four (4) feet to maintain a relatively consistent stream gradient through the reach. The width of the floodplain would gradually be reduced from greater than 2,000 feet to about 900 feet at the downstream end of the reach. The narrowing of the floodplain would continue downstream into reach CFR 2 to create a smooth transition during large flood events.

The transition to a lower elevation floodplain would be similar to historic conditions and would also greatly reduce the amount of fill required in CFR 2 by lowering the entrance elevation into the reach. Initial calculations indicate that the cuts and fills would balance in the upstream portion of this reach, but the lower portion would result in an excess of about 170,000 cubic yards of fill. Any excess excavated material could be used to fill the floodplains in Reach CFR 2. Any material with contaminant concentrations in excess of desired amounts would be treated to meet the objectives. Whenever possible, existing vegetation would be salvaged and transplanted to the new floodplain elevation. Refer to Section 5.4.5 for the revegetation details.

Any new channel construction would require bank stabilization and grade control until the vegetation can mature. Bank stabilization is necessary not only for proper function of the designed channel, but also especially important in this reach to minimize the amount of contaminated sediments that would be incorporated into the system through bank erosion. Most of the proposed grade and bank stabilization would be accomplished with structures constructed predominantly of wood, such as root wad/log vane combinations with rock “J” hooks and root wad debris jam clusters. Some of the grade control could be accomplished with armored pool tail out structures composed of the largest rock found in the bed (D84-D100 size clast). The number of structures are calculated based on structure size, gradient and stream meander geometry. The grade control structures are designed to match the pool-to-pool spacing common in C4 channels. These structures are designed to function naturally in this geomorphic setting and match the natural stream aesthetics. Fish passage and habitat enhancement are also designed into these structures. Refer to Section 5.4 for more detailed discussion of the structures.

The existing wetlands along the southern portion of this reach would not be graded. It is anticipated that these wetlands and old channels will remain at the low terrace elevation and would be fed by subsurface water from adjacent hill slopes. These wetlands would likely be intermittent with less surface water supplied from the main channel. The existing stream channels would be filled intermittently, leaving sections of unfilled channel that will be converted to shallow wetlands. These wetlands would receive water during flood events and when the water table was higher than the bottom elevation of the old channels. To minimize the potential for colonization by undesirable non-native fish species, these wetlands would remain isolated.

5.3.4 CFR 4

This reach would be converted from a braided D4 channel with intermittent F4 reaches to a C4 channel in the same manner as the upstream end of Reach CFR 3, with the new channel floodplain at the same elevation as the existing floodplain features. Like Reach CFR 3, the existing channels would be filled intermittently, or plugged, with excavated material from the new channel locations. Initial calculations indicate that cuts and fills would balance throughout this reach.

The average stream gradient through this reach would be about 0.002 ft./ft. Proposed structures in this reach would be primarily constructed of large wood similar to the upper end of Reach 3. The same types of structures would be constructed in similar locations. The purpose of the structures is for bank stabilization and grade control until natural processes can take over. The number of structures was calculated based on a representative reach of about 2,000 feet of channel where structures were designed in at the appropriate spacing and intervals. The density of structures was extrapolated to the remainder of the Reach. Structure spacing is variable depending on meander geometry, structure type and the pool-to-pool spacing appropriate for the reach.

There would be a short reach of B3c channel constructed through the Turah Bridge section and a rock “W” weir structure constructed at the bridge to effectively transport water and sediment through the bridge section. Refer to Section 5.4 for descriptions and examples of structures.

5.3.5 BFR 1

This reach would be converted from an F4 channel with backwater conditions to a B3c channel with step pool morphology and a narrow, well-vegetated flood prone area. This would be accomplished by reshaping the existing bed material to narrow and deepen the thalweg and grading excess material up to form a sloping flood prone area. Upstream of the Highway 200 Bridge the gradient is about 0.002 ft./ft. The gradient would steepen to about 0.005 ft./ft. downstream of the Highway 200 Bridge. Initial calculations indicate that cuts and fills balance in this reach.

There are two abandoned piers in the river at the old Highway 200 Bridge crossing that need to be removed to improve channel stability. Most of the bridge spans are adequate to span the active channel and flood prone area, but the railroad bridge is skewed enough to reduce the effective capacity to pass flood flows. A series of rock “W” weirs (one weir at each bridge) would be necessary to split the active channel around the piers while maintaining hydraulic function. These “W” weirs also prevent scour around piers and will pass fish effectively. River boating rafters also tend to enjoy the hydraulic conditions promoted by “W” weirs. Section 5.4 includes details and examples of proposed structures. Refer to Section 5.4.6 for a more detailed discussion of the bridge recommendations.

Other channel structures would be similar to those on the CFR reaches 1 and 2, with rock steps constructed to stabilize the grade and promote fish passage as well as river boating. The detail sheet in Appendix 5 is an example of how a combination of these structures could be placed in this reach.

5.3.6 BFR 2

As discussed in previous sections, the key to restoration in this reach is to remove the Stimson diversion dam and the fill that is encroaching into the river just upstream from the dam. Without removing both features, there is limited opportunity to eliminate the backwater conditions and sediment deposition that has occurred upstream. This constriction, along with the Stimson diversion dam creates a backwater condition that causes sediment deposition and aggradation to occur for at least 6,500 feet upstream. Within the fill that is constricting the river, Stimson diversion dam has a small lagoon and a building of unknown purpose. The building may need to be replaced at some other location. This and removal of the fill would require landowner cooperation and approval.

Also, as noted previously, the Stimson diversion dam is in poor condition and following removal of Milltown dam, would become a fish barrier and should be removed. This reach would be converted from B3c channel with a high width:depth (w:d) ratio and an F4 channel in places to a B3c channel with a lower w:d ratio and a narrow, well vegetated flood prone area. Much of the deposited sediment can be reshaped to create the appropriate channel and flood plain dimensions, but an excess of about 277,000 cubic yards of sediment should be removed and possibly exported to CFR 2. Some of this material is located at the channel constriction and immediately upstream. The clean gravel and cobble sediment would be ideal for the steeper B channel reach of CFR 2. If the material were not exported to CFR 2, there would be additional costs associated with transportation and disposal.

The abandoned railroad bridge piers at about Station 88+00 should also be removed to improve sediment transport and channel stability in this reach. Structures proposed for this reach would be similar to reach BFR 1 and would be constructed primarily of large rock to stabilize the grade and promote fish passage as well as river boating. The detail sheet in Appendix 5 is an example of how a combination of these structures could be placed in this reach. These structures would be consistent with the morphology of the BFR in this canyon reach.

5.4 CHANNEL CONSTRUCTION AND RESTORATION TECHNIQUES

5.4.1 CHANNEL CONSTRUCTION

The CFR and BFR channels would be constructed to the proper cross-section dimensions, planforms, and profiles in order to convey the flows and transport the sediment made available by the watershed. The restored channels would be designed to minimize near-term lateral channel migration while allowing long-term channel adjustment within the respective floodplains. The proposed channel alignments include constructing new channel reaches and modifying existing channel sections. Reconstructing the channels in the project area will improve the amount of fish habitat in the project area, increase the amount of river-floodplain edge, and reduce the energy gradient. The combination of bank stabilization and grade control structures will limit bank erosion in areas with contaminated sediments left in place to slow erosion rates over time. All structures ultimately rely on an aggressive revegetation plan that would result in a vigorous, dense riparian community that would promote long-term bank stability and floodplain stability.

Natural channel design techniques would be employed and include constructing a two-stage channel to accommodate the predicted hydrograph conditions. A two-stage channel includes a bankfull channel to convey the average annual flood and sediment (bankfull flow) and a floodplain designed to accommodate flows of greater magnitude, including the 100-year flood. Channel-floodplain interaction would reduce in-channel water velocities, shear stress, and bank erosion. Constructed floodplains would serve to moderate flood peaks, store fine sediment, and increase late-season base flows in the respective project reaches.

For new channel reaches, the channel would be built in conjunction with the new floodplain construction following removal and disposal of the polluted sediments. In modified channel reaches where new channel excavation is not necessary, the channel cross-section dimensions, plan form and profile would be shaped to the appropriate design dimensions. The designed channel pattern will minimize backwater macrohabitats that provide preferred habitat for introduced northern pike.

Bank stabilization, grade control, step-pool, and fish habitat structures would be constructed using native materials and would be designed to mimic naturally occurring habitat arrays found in stable stream reaches (Table 10). Rootwads, large woody debris jams, and vegetation would be used for bank stabilization. Grade control structures including cross-vanes, “W” weirs, rock and log straight vanes, and rock and log “J” hook vanes would also provide valuable bank protection. These structures are designed work in concert to provide a complete array of habitat features in a channel system. For example, a log “J” hook vanes might be designed in proximity to a large woody debris jam to provide all the habitat components in a relatively short distance. Higher gradient B stream type reaches on the lower reaches of the Blackfoot and Clark Fork Rivers would be constructed with additional grade control structures designed as low stage steps to create step-pool morphology, including single and double wing deflectors, convergent roller structures, and convergent rock clusters. Descriptions of these structures are included in the following sections.

The proposed structures would be constructed to maximize fish habitat complexity while providing for upstream and downstream fish passage for all native and coldwater fish species. Structures promote flow convergence to increase water depths and diversify channel hydraulics during low flow periods. Flow convergence will also maintain sediment transport competency and pool scour during elevated flows. Deeper pools typically sustain greater numbers of individuals and species of fish compared to shallow pools with less habitat complexity. Large woody debris is also incorporated into structure design to increase fish habitat diversity. The proposed grade control structures are favored by the river boaters to enhance diversity and recreational opportunity. The structures are also designed to mimic natural structures to fit in with the geomorphic setting, thus enhancing aesthetics.

The selected structures have been successfully employed in streams throughout Montana, Idaho, Utah, Oregon, Washington, and Colorado. Structures are sized on a site-specific basis in accordance with the bankfull channel dimensions and the bankfull discharge. Results from project monitoring programs suggest the benefits of the proposed structures to both fisheries and channel stability (WCI *unpublished data*; Schmetterling and Pierce 1999).

TABLE 10

PROPOSED FISH HABITAT, GRADE CONTROL, BANK STABILIZATION, RIVER BOATING STRUCTURES AND DERIVED BENEFITS TO FISH.

STRUCTURE	MATERIALS	PURPOSE	BENEFITS TO FISH
Rootwad Revetments	Logs and Rootwads	Dissipate energy directed at stream bank, fish habitat	Overhead cover, insect production, interstices for YOY and juvenile fish
Large Woody Debris Jams	Logs, rootwads, small woody debris	Dissipate energy, provide bank protection	Overhead cover, flow break, debris collector, diverse habitat
Straight and "J" Hook Vanes	Logs and Rock	Reduce near bank shear stress, enhance channel margin complexity, grade control	Create deep pool habitat critical cover for adult over wintering and summer refuge
Cross-vanes	Rock	Grade control and scour pool formation	Create deep pool habitat and sort gravel for spawning
"W" weirs	Rock	Grade control and scour pool formation	Create deep pool habitat and sort gravel for spawning
Vegetation Transplants	Vegetation	Provide long-term bank stability, organic material source, and stream shading	Overhead natural cover, stabilize banks, insect production, and increased bank and habitat complexity

5.4.2 BANK STABILIZATION STRUCTURES

Bank stabilization structures are necessary for maintaining bank integrity on restored stream reaches until planted vegetation is capable of providing natural bank stabilization. Structures are expected to last for a limited period of time until vegetation provides bank stability in perpetuity. Bank stabilization structures also serve to diversify available fish habitat. Prescribed structures provide overhead cover, flow path complexity, interstitial hiding spaces, and visual separation for fish. Species and age-classes typically segregate according to these microhabitat attributes to reduce inter-size-classes and inter-species interactions. In the Reaches CFR 3 and 4, large wood based structures would be the dominant bank stabilization structures. These structures include rootwad/log vane "J" hook combinations, rootwad composites and large woody debris jams. Constructed with whole cottonwoods, conifers and other native riparian species, structures would emulate naturally occurring habitat arrays. Materials would project varying distances from the bank to deflect scouring eddies away from the bank as well as to diversify fish habitat around the structures. The following section outlines the prescribed structures.

ROOTWAD REVETMENTS

The purpose of bank placed rootwads is to dissipate water velocities and shear stress in the near-bank region until dense riparian vegetation becomes established. A secondary function and benefit of these structures is the diverse fish habitat that is created. Single rootwad structures would consist of a footer log, anchor rocks, and rootwad. Spacing between rootwads would depend on their position relative to other structures. Rootwads would often be used to complement other structures to increase the amount of bank protection provided by the complementary structure. Each rootwad revetment would have two to four mature willow transplants with attached root masses placed around the point of streambank intersection. Additional plantings would also be completed to improve the long-term natural bank stability. Complementary woody debris would be added to the rootwad revetments to increase fish habitat and bank protection.

LARGE WOODY DEBRIS JAMS

Large woody debris jams are constructed to mimic naturally occurring woody jams that typically form in the lower 1/3rd of meander arcs. Natural jams form over time as high water events overtop the lower portion of the meander, depositing wood on the floodplain. Large wood traps smaller materials, increasing the volume of the jam. Jams create diverse aquatic and overhead habitat for fish, riparian habitat for mammals, and perches for birds. Sizable jams provide bank protection and may create protected growing areas for vegetation.

Constructed woody debris jams are built with several large trees, various sizes of rootwads, small diameter woody material, and large anchor rocks. The large trees are tied into the bank and anchored with large rocks. Other woody material is interlaced among the large key trees to create a diverse array of woody material. Several rootwads and logs are extended out into the channel to diversify the local aquatic environment. Overtime the jams are expected to grow in size as the jam captures other woody debris transported during high water.

5.4.3 GRADE CONTROL STRUCTURES

Various grade control structures are prescribed for the restoration project. Grade control structure types and locations would vary according to specific project reaches and project goals. For example, the upstream part of the Reach CFR 2 would include cross-vanes and "J" hook vanes using a combination of large woody debris and large rock. Other structures that would provide river boating opportunities in addition to grade control would be constructed in the downstream B stream type reaches planned for the lower Clark Fork and Blackfoot River segments. Structures will effectively address bed stability concerns and provide enhanced river boating recreation opportunities where appropriate.

The grade control structures maintain the designed channel profile elevations in addition to addressing fish passage and habitat needs. Fish passage concerns are addressed by the design of the prescribed grade control structures. Each structure typically concentrates flows to the thalweg, or deepest portion of the channel. Focusing flows in this manner sustains a deeper low flow water column providing better connectivity during late season base flows.

Structures are also designed to improve flow convergence and sediment transport during high flows. Vane arm gradient and angle from the bank affect the hydraulic head the structures create. A steeper vane arm gradient results in greater hydraulic acceleration over the structure and into the pool created by the structure. This acceleration is necessary for maintaining sediment transport through the pool and subsequently, the depth of the pool. The vane arm gradient and arm length also affect the degree of bank protection created by the grade control structure. A longer, flatter vane arm protects a greater bank distance than a short, steep vane arm.

Rootwads and other large woody debris are typically incorporated into the grade control structure to increase the habitat diversity in the pool. Woody materials are anchored in between or below the vane arms. Material positioning influences vane hydraulics and pool scour, creating a range of aquatic habitats in the project area.

The designed structures would allow for fish passage. Fish passage is typically a concern during base flows when portions of the stream may become disconnected if the streambed is too wide and the water too shallow. Each grade control structure would be designed to have no more than 0.5 ft. to 1.0 ft. of drop (water surface from the structure throat to the water surface downstream) during base flow conditions. Gaps between structure rocks would also allow fish passage from the pool downstream, upstream through the structure. During the majority of the hydrograph, water depths over the vane structures would be sufficient for all species and most age classes to navigate the structures. Fish have been observed inhabiting feeding positions on the downstream sides of vane throats where the flow is focused. During high flows, fish will likely seek refuge in the deep, complex pools. Although the water accelerates over the vane structure, water velocities should not exceed the burst swim speeds of most fish species given the short distance of accelerated velocities.

The hydraulic drop created by the structures also appears to attract spawning salmonids. The hydraulic formed by the vertical distance between the upstream water surface and the downstream water surface increases the flow water through the gravel on the upstream side of the vane arms. Pool tailouts downstream of the structures are also attractive spawning areas for trout. The combination of optimal gravel sizes, the short distance to deep water, and enhanced inter-gravel flow make pool tailouts downstream from grade control structures optimal spawning areas for salmonids.

LOG AND ROCK STRAIGHT VANES

Straight vanes are built as log or rock vanes. These structures tie into the bank at approximately the bankfull elevation and intersect the channel bed at a point upstream. The slope and length of the vane are determined according to the local channel conditions and purpose of the structure (i.e. bank stabilization versus habitat creation). Straight vanes function by deflecting the high velocity thalweg away from the streambank thereby decreasing the near-bank shear stress. Log vanes are generally preferred over rock vanes as log vanes are less costly (in terms of materials and construction time) and are more natural in appearance. Rock vanes are typically used if large logs are not available or when the long-term stabilization of the channel at the specific location is a necessity.

LOG AND ROCK "J" HOOK VANES

"J" hook vanes are similar to straight vanes except that a log or rock "J" hook is added to the straight vane. The "J" hook concentrates the thalweg more than the straight vane. "J" hooks are typically preferred for this reason. While providing protection for the constructed streambank bank and channel, this structure also allows for efficient transport of bedload and suspended sediment. "J" hook vanes provide grade control and are also used to help maintain extended pool lengths in meanders. Footer rocks are placed below the predicted scour depth to prevent undermining of the structure during high flows. Logs of sufficient size may be used in place of large rock where possible. Log vanes are typically less expensive and easier to install than rock vanes, though they are less permanent than rock structures.

ROCK CROSS-VANES

Cross vanes provide long-term grade control in reconstructed stream channels. Natural channels maintain grade control through undulations in the bed profile (riffle-pool sequences). It is necessary to include some sort of grade control in reconstructed channels due to the non-sorted nature of channel material (gravel, cobble, and sand) following construction. The streambed is unarmored following construction. Cross-vanes would be built according to design channel dimensions and include footer rocks to prevent undermining of the structure during high flows. Constructed scour pools below the cross vane structure will enhance fish habitat and create pools for over-wintering of the resident fishery.

ROCK "W" WEIRS

The design of the "W" weir is similar to the cross-vane in that both sides are vanes directed from the approximate bankfull elevation upstream to a point where the vane intersects the channel bed. The "W" weir divides the river into fourths with the vane arms intersecting the bed at ¼ and ¾s of the channel width (Rosgen 2001). The center portion of the structure rises in the downstream direction to form a "W" looking from upstream to downstream. The multiple vane arms and center structure increase the number of flows paths, diversifying aquatic habitat around the structure. “W” weirs maintain deep pools in a similar manner to the aforementioned vanes and cross-vane.

COBBLE PATCHES

Natural stream channels sort and transport bed material in a manner that provides for natural grade control. In some areas of the project, channel materials would be sorted during construction to generate material ranging from the $D_{84} – D_{100}$ of the channel bed material (the largest material that is generally not transported). Additional materials may be imported to the project site depending on the availability of on-site materials. These materials would be placed in the designed bed profile to provide grade control at pool tailouts. Cobble patches may also be used in lieu of cross-vanes where additional grade control is not necessary.

TABLE 11

PROPOSED STRUCTURES DESIGNED TO PROVIDE GRADE CONTROL AND STEP POOL MORPHOLOGY ON THE LOWER CLARK FORK AND BLACKFOOT RIVERS. ALSO FISHERIES BENEFITS ARE INCLUDED.

STRUCTURE	MATERIALS	BOATING BENEFIT	FISHERIES BENEFIT
Converging Rock Clusters	Rock	Diversify flow paths and create complex currents	Diverse flow paths
Converging Roller Eddy with Rock Vane	Rock	Diversify flow paths and create complex currents, create eddies, deflect thalweg to center channel	Diverse flow paths and backwater resting areas
Converging Roller Eddy with Rootwad	Rock	Diversify flow paths and create complex currents, create eddies, rootwad bank protection	Diverse flow paths and backwater resting areas
Double Wing Deflectors	Rock with cobble fill material	Flow acceleration and eddy backwater creation	Diverse flow paths, deep pool habitat, and backwater resting areas
Single Wing Deflector	Rock with cobble fill material	Flow acceleration, complex currents, and eddy creation	Diverse flow paths, deep pool habitat, and backwater resting areas
Random Rock Cover	Rock	Diversify flow paths and create complex currents	Diverse flow paths

5.4.4 ADDITIONAL GRADE CONTROL STRUCTURES

Mr. Dave Rosgen, P.H. has developed a suite of six structures that create the step-pool effect on larger B type stream systems to stabilize the streambed and dissipate energy. These structures also produce dynamic hydraulics preferred by river boaters (Table 11). These structures are planned for the higher gradient B stream type sections of the lower Clark Fork and Blackfoot Rivers (CFR 1, CFR 2 and BFR 1) where the channel profiles are somewhat steeper, the valleys narrower, and the channel pattern is slightly straighter. The combination of these conditions would allow a channel design that maintains channel and bed stability, sediment transport, flow conveyance, fish habitat and passage, as well as recreational boating opportunities. The prescribed structures would require large rock and woody debris similar to the aforementioned grade control and bank stabilization structures.

CONVERGING ROCK CLUSTERS

This structure is comprised of multiple boulder clusters that create diverse flow paths. The structure emulates a series of natural rock outcroppings. Fish habitat would be enhanced by the structures and fish passage would not be affected.

CONVERGING ROLLER EDDY WITH ROCK VANE

The structure is built with at least two rock downstream-facing offsetting vane arms. The arms deflect the flow back and forth and create eddy backwaters on the downstream side of each arm. A standard rock cross vane is positioned downstream of the rock arms. The vane deflects the thalweg back towards the middle of the channel. The structure would allow fish passage at all flow levels.

CONVERGING ROLLER EDDY WITH ROOTWAD

This structure performs similarly to the aforementioned structure except that the rock vane is replaced with a large rootwad. The rootwad creates local scour and enhanced fish habitat. The structure would allow fish passage at all flow levels.

DOUBLE WING DEFLECTORS

The double wing deflectors are placed across from each on the channel margins. The structures are built with large rock in-filled with finer material. The double wing deflectors concentrate the flow to the middle of the channel with a subsequent acceleration of water between the narrowed channel. The elevated water velocities increase the shear stress and scour potential. A large deep pool is typically maintained downstream of the double wing deflectors. The pool would provide fish habitat and would allow fish passage at all flow levels.

SINGLE WING DEFLECTORS

Single wing deflectors are offset from each other in a reach of the channel. The current deflects back and forth across the channel between the deflectors. The structures are built with large rock in-filled with finer material. The deflectors concentrate the flow to the middle of the channel with a subsequent acceleration of water between the narrowed channel. The elevated water velocities increase the shear stress and scour potential. A large deep pool is typically maintained downstream of the double wing deflectors. The pool would provide fish habitat, and the structure would allow fish passage at all flow levels. Large eddy backwaters form on the downstream sides of the deflectors, providing resting areas for both boaters and fish.

RANDOM ROCK COVER

Similar to the converging boulder clusters, the random rock cover diversifies the channel and flow paths. Boulder clusters offer obstacles for boaters and create variable currents for fish. The structures are expected to provide diverse fish habitat without affecting fish passage.

In summary, the proposed channel construction and prescribed structures are designed to emulate natural systems. The designed two-stage channels would be constructed according to the geomorphic setting, valley type, infrastructure considerations, and recreation objectives. The designed channels will convey the flows and transport the sediment made available by the Blackfoot River and Clark Fork River watersheds. The bankfull channel will convey approximately the 1.5-year to 1.8-year events while larger flows will access the adjacent floodplain. Bank stabilization, grade control, and river boating structures would benefit the resident and migratory fisheries by providing local habitat and reconnecting migration routes currently severed by Milltown dam. The prescribed structures would not impede upstream or downstream fish migration for the targeted native and coldwater sport fish species.

5.4.5 SUMMARY OF RE-VEGETATION PLAN

The proposed EPA's remediation plan proposes to revegetated disturbed areas with only grasses. To restore the area to a condition similar to pre-dam construction, with all riparian, upland and wetland components functioning in concert, the remediation plan must be supplemented with an aggressive revegetation plan. The importance of a practical and cost effective revegetation plan and the diligent implementation of that plan cannot be overstated nor over-emphasized. The revegetation activities will be key to the success of the overall project and ultimately meeting the objectives established for this CRP. Natural channel design concepts rely on effective revegetation and existing vegetation to provide long-term bank stability, provide energy dissipation and sediment storage on floodplains, provide shade and long-term woody debris recruitment for aquatic habitat and desired aesthetics.

By design, this revegetation plan is conceptual in nature and provides the foundation for a comprehensive, site-specific plan and prescriptions that would be developed once the overall stream restoration project design is finalized. The treatments, techniques and plant materials are described in general terms and apply to broad geomorphic areas.

This revegetation plan was developed to meet multiple objectives including:

- Re-establishment of a native plant community;
- Mitigate surface erosion and associated off-site impacts;
- Restore a healthy, diverse and viable edaphic (soil) environment;
- Provide for slope and bank stability while minimizing maintenance;

- Re-establish/enhance terrestrial, riparian and aquatic habitat for dependent species;
- Inhibit the establishment of undesirable plant species including noxious weeds; and
- Post-project visuals and esthetics.

This revegetation plan initiates the processes that provide for a diverse, resilient and self-sustaining native plant communities and ecosystems. No revegetation plan is capable of precisely replicating the pre-disturbance native plant communities. Depending on the existing vegetation and the successional stage of the plant community it may not be practical, desirable or even possible to do so. This plan "jump-starts" the recovery of the complex ecologic interactions and reintroduces biological diversity to the project area following restoration activities.

Under this CRP, plant densities and species would be site specific for each of the following treatment areas:

- Stream banks: All stream banks would receive some level of revegetation. Banks along straight reaches and along the "inside" banks of meanders would be treated but to a lesser degree than the higher energy banks. The "outside" banks of meanders require a more rigorous revegetation treatment due to their exposure to high energy and shear stresses during period of high stream flows;
- Abandoned channels: Those sections of active channel that would no longer exist following channel realignment;
- Floodplain: Includes that area outside the active channel that is inundated during flood flows;
- Wetlands: This includes areas of standing water in abandoned channels that are retained after construction of the new channel. They would be converted into a wetland ecosystem with water depths less than four feet;
- Terraces and Uplands: These are the xeric or drier areas at a higher elevation than the adjacent floodplain;
- Other disturbed sites are areas that are disturbed as a result of construction activity such as access routes, borrow sites, etc.; and
- Existing riprap placed along banks during previous efforts to stabilize the stream banks. Vegetation will increase bank stability, provide habitat and improve esthetics.

These geomorphic categories will help ensure that areas of different moisture regimes would be planted with appropriate species thus increasing the survival rate throughout the project area. Following is a brief summary of the re-vegetation plan.

WOODY VEGETATION:

Trees and shrubs used at the Milltown site would be containerized native plants with an established root system. The plants would be grown in a 3-inch diameter by 14-inch long (minimum) up to 36-inch long container. Wetland species would be grown in six cubic inch containers. Cuttings would be limited to native willow species harvested from on-site and/or adjacent areas. They would average 40 inches in length. Cuttings would be planted so the basal end is submerged in or very near groundwater for the majority of the year, this would increase their survival rate.

An expandable stinger or a ripper-type attachment would be used to install plants. Photographs of the planting equipment and projects where this technology has been used are in Appendix 10. Prior use of this technology has resulted in increased survivability at harsh sites and is particularly suited to Montana as many areas are moisture limited for the majority of the year. This equipment is capable of consistently getting plants and cuttings deep into the soil where there is more available moisture than conventional means. This method relies on fewer laborers, decreased logistics, and additional costs associated with large planting crews. In addition, containerized plants would be inoculated with a diversity of beneficial soil microbes to improve tree and shrub vigor and increase survival rates.

GRASS SEED

The revegetation effort would also include three to four native seed mixes that would be specific to landform and edaphic conditions. A quality organic fertilizer would be applied to all disturbed areas to increase initial vigor of grass establishment. Disturbed soils would be inoculated with a diversity of beneficial soil microbes to further stimulate vegetation. A quality wood-fiber mulch with tackifier and/or straw would be applied on the surface of disturbed areas to help retain soil moisture, lower surface temperatures and control on-site erosion. Hydro mulching is the preferred application method for seeding this project. Since the hydro mulching process seeds, fertilizes and mulches in one step, it is more time effective than other methods of seeding grasses that may require up to three different passes with a machine or laborer.

EROSION CONTROL:

In the majority of the Milltown project area, mulching/hydro mulching would suffice for erosion control needs. Areas that are sloped and may erode would be treated more aggressively to alleviate soil losses. Control measures would include: erosion control blanket, straw, either spread or use the bale whole, and soil tackifying agents as deemed necessary.

5.5 BRIDGE RECOMMENDATIONS

Existing bridges in the project area were evaluated to determine the potential limitations posed on the conceptual restoration plan. The seven bridges in the project area are the Interstate 90 East Bridge, the Interstate 90 West Bridge, the Burlington Northern Railroad Bridge, the State Highway 200 Bridge the old State Highway 200 Bridge (foot travel only), the County Road Bridge at Turah and the railroad bridge downstream from Milltown dam. The first five of these structures span the Blackfoot River in Reach BFR1, while the Turah Bridge is in Reach CFR 4. The railroad bridge downstream from Milltown dam is in Reach CFR 1. Plans were obtained for the Interstate 90 Bridges only. Plans for the other bridges could be acquired and reviewed as part of Phase 2. A brief field review of the bridges was conducted to photograph the structures, measure span lengths and identify pier locations.

Due to the existing over-widened condition of the Blackfoot River, all five bridges could adequately span the proposed minimum 245-foot floodplain width of the Blackfoot River without creating a backwater affect. In addition, adequate freeboard is available for all five bridges during a 100-year flood event. However, each bridge contains one or more piers that would likely fall within the proposed bankfull channel. Piers located in the bankfull channel could be subjected to scour and debris accumulation during ice flows or flood events. For this reason, a scour and ice flow analysis is proposed as part of Phase 2.

The Turah Bridge appears to have an adequate span for the upper Clark Fork, but channel changes and modifications upstream have resulted in an over-widened and unstable braided condition. There is one pier in the active channel presently.

The railroad bridge in CFR 1 has an adequate span to accommodate the channel and flood prone area. A "W" weir or similar structure would need to be designed in Phase 3 to route the flows between the bridge piers to maximize sediment transport efficiency and minimize scour. Details of bridge construction are not known at this time.

Ideally, bridge piers should be located outside of the bankfull channel. Since modifications to the bridge structures are not part of the scope of this project, other alternatives were explored. To mitigate the possible effects of pier scour, hydraulic structures such as "W" weirs are recommended and included in the conceptual restoration plan. Refer to the plan view alignment sheets for the proposed locations of these structures. "W" weirs are designed to split the flow around a pier thus creating an area of lower shear stress and reduced scour at the pier. Moreover, "W" weirs provide grade control and habitat complexity. In addition to installing hydraulic structures to mitigate pier scour, it is recommended that any abandoned piers or abutments within the bankfull channel be removed. The old State Highway 200 Bridge contains two abandoned piers that should be removed to increase the efficiency of the proposed channel and decrease unnecessary pier scour.

Photo 5.1
The Old Highway 200 Bridge

(Note the two abandoned piers that are recommended for removal.)

To account for the change in channel gradient that will be caused by removal of the dam, the longitudinal bed profile of the Blackfoot River may have to be adjusted in the vicinity of the five bridges. Due to the limited available information, it was difficult to determine the exact change in bed elevation that would be required. However, it is estimated that the change in bed elevation could be between one and three feet at the bridge locations. Regardless, future proposed bridge scours studies identified in Phase 2 would be required to determine pier foundation depths and, if necessary, limit the change in bed elevation at the pier locations.

Photo 5.2
Example of a "W" weir

In addition to examining existing bridges, efforts were made to identify a potential location for a new pedestrian bridge within the project area. It is assumed that this bridge would be used for non-motorized traffic, such as pedestrians and cyclists. One potential location is the site of the old Duck Bridge (refer to Plan view sheet CFR 2 in Appendix 4). Due to encroachment on the floodplain, the old approach embankments associated with this bridge have been recommended for removal. A new pedestrian bridge should be designed to span the bankfull width of the Clark Fork (130 ft.) at this location to minimize disruption of the flows and sediment transport in the active channel. The bridge piers should be outside the active channel and there should be some floodplain available within the bridge span. This will greatly reduce the risk of scour and adverse affects on the channel and recreational boating. These criteria would result in a minimum bridge span of approximately 170 feet. Since the floodplain at this location is approximately 800 foot in width, the pathway leading to the bridge could be set at floodplain grade, while the bridge and its approaches could be set at least three (3) feet above the 100-year flood elevation to allow clearance for debris during floods.

Several options are available for bridge types. It is estimated that costs could be between $200,000 and $400,000 for a pre-fabricated pedestrian bridge. Please refer to the detail sheet in Appendix 7 for a conceptual cross section of the proposed pedestrian bridge.

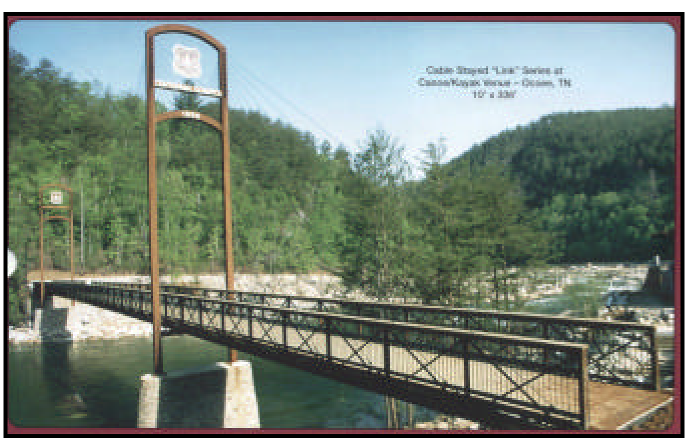


Photo 5.3
Example of a Cable Stay Pedestrian Bridge

(Note that the piers are located outside of the bankfull channel and the bridge spans part of the floodplain.)

5.6 TIMELINE AND CONSTRUCTION SEQUENCING

TIMELINE

Due to the size and complexity of this project, it is recommended that the following phased construction approach be used. To the extent possible, efforts have been made to link the river restoration construction phases with the major components of the dam removal and sediment removal activities.

Year 1	Phase 2 begin
Year 2	Phase 2 end, Phase 2 Design/permitting Begin
Year 3	Phase 3 Design end / Begin sediment removal/ Construct the upper half of CFR4
Year 4	Continue sediment removal / Construct the lower half of CFR4
Year 5	Continue sediment removal/ Construct upper half of CFR3
Year 6	Complete sediment removal/ Construct lower 1/2 of CFR3 and lower 1/2 of BFR2
Year 7	Construct upper half of BFR2, and CFR2
Year 8	Construct, upper half of BFR1
Year 9	Remove spillway/Begin construction of CFR1
Year 10	Remove Powerhouse/Construct lower half of BFR1/Complete CFR1
Year 11	Rebuild replica of Powerhouse on site above the floodplain.

Since Reach CFR4 is beyond the impacts of the dam and the most upstream reach, it is the most flexible reach. CFR4 could be constructed as early as year 3, or after the construction of the other reaches. The upper half of Reach CFR3 is similar to CFR4 and could be constructed as early as year 3 or after the construction of the other reaches. The excess sediment generated in the lower half of CFR3 is planned for floodplain fill material in CFR2, so it cannot be constructed until at least part of the sediment removal in CFR2 is complete. Likewise, if the excess sediment generated in BFR2 is to be used for floodplain fill material in CFR2, it could not be constructed until most of the sediment removal in CFR2 is complete. The lower part of BFR2, the upper part of BFR1, and CFR2 should be constructed after sediment removal is complete but prior to dam removal so as not to create a fish barrier with Stimson diversion dam. Removal of the spillway and diversion of the water through the Power House should allow the construction of CFR1 to commence. Once CFR1 is complete, the flow can be diverted into the new CFR1 channel and the Power House can be removed and the lower half of BFR1 can be completed.

Typically, it is recommended that construction begin at the upstream end of the project and proceed downstream. Having the dam in place during the construction of the upper reaches will provide a means to minimize passing turbid waters downstream.

CONSTRUCTION SEQUENCING

WCI has developed a construction-sequencing plan based on the project design and past experience with projects of similar scope and complexity. The complete construction sequencing is too detailed for this conceptual design, but is available upon request. General steps for the sequencing are listed below.

Task 1: Construction Staking

Task 2: Sort and Distribute Materials in Project Area

Task 3: Construct Water Diversions

Task 4: Initial Channel Shaping and Excavation

Task 5: Structure Placement for Bank Stabilization and Habitat Creation

Task 6: Final Channel Shaping

Task 7: Reintroduce Water into the New Channel

Task 8: Reclamation of Diversion Channels and Floodplain Construction

Task 9: Revegetation of all Disturbed Areas

Task 10. Cleanup of Construction Areas

5.7 PHASE 2 NEEDS

The following items would be necessary to validate the CRP and collect the necessary data to proceed with a final design.

- Develop Digital Terrain Model using survey of existing ground and photogrammetric mapping
- Bridge Analysis- scour and ice potential determination
- Sediment Entrainment Analysis
- Refine Draft Channel Dimensions
- Finalize Flood Series Analysis
- Evaluate Land or Easement Purchase (Note: These costs not included in Restoration Plan Cost Estimate.)
- Evaluate whether restoration or design conforms with remedial action requirements.

5.8 PHASE 3 FINAL DESIGN NEEDS

During completion of Phase 2, final design could be initiated. The design tasks listed here are associated only with the plans and treatments of the CRP and would replace similar design tasks in EPA's proposed remediation plan associated with channel construction in the Area I sediment removal area. The design tasks associated with the remainder of EPA's proposed remediation plan would need to be completed. The design tasks listed in the following section would most likely be completed on a reach-by-reach basis about two years before the construction is scheduled. Tasks included under the Final Design phase include, but are not necessarily limited to the following:

- Finalize plan view pattern, longitudinal profile, and cross-section dimensions;
- Ground truth proposed alignment with Technical Review Committee;
- Develop proposed Digital Terrain Model;
- Calculate earthwork and develop construction heap flow charts;
- Perform channel and floodway modeling (HEC-RAS);
- Specify material types, quantities, and dimensions by reach;
- Engineer bank stabilization, grade control, fish habitat, and recreational in-channel structures;
- Prepare detail sheets for all major design components, including longitudinal profile, plan view pattern, channel cross-sections, and proposed structures and revegetation components;
- Prepare construction sequencing report, including equipment specifications;
- Prepare water quality mitigation and dewatering plans for construction; and
- Prepare and submit CLOMR/LOMR to the Federal Emergency Management Agency and Missoula County Floodplain Administrator.

The final design report would include all appurtenant analyses used to complement the final design report and detail sheets.

5.9 MONITORING NEEDS

The proposed EPA remediation plan includes monitoring for groundwater, surface water (quality and quantity) and biological conditions. It is assumed that the proposed monitoring will accomplish all of the needs for those resources. The CRP introduces several concepts that will also require monitoring to determine performance of the treatments in meeting the objectives and to initiate maintenance, if needed, to bring the performance into compliance with the objectives. The proposed monitoring for the CRP would be in addition to that monitoring proposed in the EPA remediation plan. It would primarily consist of monitoring the channel conditions, including stability and performance, and would occur on the first year of implementation one reach and on every other subsequent over a period of 10 years. The proposed monitoring has been developed over the last several years to meet the requirements of the permitting agencies. In other words, the permitting agencies will require monitoring similar to the proposed plan for the river restoration to be permitted.

To monitor the channel condition, permanent cross-sections and longitudinal profile (LP) stations would be established. Cross-sections would be located in multiple representative pool, riffle, and run habitats. A channel survey, pebble count, and photo point would be completed at each cross-section. The LP stations would be established at channel habitat feature transitions (top or riffle, pool) to quantify channel feature changes. Bank pins would also be installed at selected locations in project and untreated reaches to compare bank erosion and sediment input rates.

Elevation measurements and photo points would also be completed for each structure. Measuring structure and bed elevations over time would improve the understanding of sediment transport, energy dissipation, and habitat maintenance created by the structures.

Vegetation monitoring would include evaluating treated and untreated reaches for relevant attributes such as vegetation composition and cover, utilization, shrub and tree regeneration, and coarse woody debris. Perhaps one, tenth-acre plot placed in representative sites of each project area would provide a sufficient sample. Noting the presence and abundance of noxious vegetation, particularly where weeds have been treated with this project, would be essential to the vegetation-monitoring program.

One of the restoration goals is to improve fish habitat and fish passage through the project areas. The fish population-monitoring program should focus on sampling the project areas. Montana Fish, Wildlife & Parks may also opt to continue with on going radio telemetry studies designed to track native bull trout and westslope cutthroat trout.

At this time, the proposed monitoring program is still in the planning phase. The preceding recommendations are based on standard monitoring techniques. A monitoring program would be critical for evaluating restoration success. Specific monitoring is usually developed during the design and permitting phase of a project.

5.10 MAINTENANCE NEEDS

A maintenance regime would be implemented to address re-vegetation, structure and channel adjustments that may occur following project construction. The proposed maintenance plan includes assessing the project areas 1, 3, 5, 7, and 10 years after the completion of the projects. The maintenance budget would be one percent of the project cost weighted by the length of the project reach. Maintenance may include reconstructing failed structures, adding additional structures, additional vegetation planting, noxious weed treatments or channel modifications.

6.0 COST ANALYSIS

This section will present the data sources, cost assumptions and unit costs for proposed treatments. Actual cost estimates are included in Appendix 6. The cost estimates do not include those costs already covered by the EPA's Proposed Plan for remediation. As discussed in Section 5, some of the EPA's proposed treatments are not necessary, or used in this CRP. The exact cost differences are not possible to determine, however, by comparing the cost estimates presented in Appendix 6 with those from the EPA proposed remediation plan, this differences may be estimated.

This section includes a discussion of how the costs were developed for the restoration cost estimate. More specifically, general information related to cost sources, assumptions, unit costs and contingencies is provided.

It is recognized that landowner cooperation and approval will be necessary in order to assure the success of this restoration project. These cost estimates, however, do not include the costs of land or easements, which may be necessary or appropriate to facilitate the project. These cost estimates also do not include the costs of building a replica of the powerhouse, although this is also contemplated as part of this plan.

6.1 COST DISCUSSION FOR CHANNEL AND STRUCTURE PROPOSALS

SOURCES OF INFORMATION

The Option 3 Cost Estimate prepared by the USACE was used as a baseline for WCI's restoration cost estimate for reach CFR2 and portions of reaches CFR1 and BFR1. WCI's estimate includes costs for three additional reaches, BFR2, CFR3 and CFR4 as well as the remainder of reaches BFR 1 and CFR1. As discussed in Section 2.0, it was determined that the construction of the additional reaches is essential to providing a long-term, comprehensive restoration plan.

Other available information used for the restoration cost estimate included the Draft Sediment/Dam Removal Cost Estimate Report for the Milltown Reservoir Site prepared by EMC[2] dated August 13, 2002. From this report, a topographic map of the site after sediment removal was obtained and used to estimate cut/fill quantities for the restoration cost estimate. In addition, the Clark Fork and Blackfoot Rivers Channel Cross-Section Surveys by Land and Water Consulting, Inc. dated February 1997 was also used to estimate cut/fill quantities. Estimates for re-vegetation and structures were based on WCI's experience with projects on rivers of similar size and complexity.

Whenever possible, unit costs estimated with the USACE Tri-Service Cost Engineering System (TRACES) Project MLTN21 (12/02) were used in the CRP cost estimation. The summary of costs provided by the USACE Government Estimate Total Costs for Option 3- Cost Estimate (12/2002) was used to as a pattern to provide the estimated costs for the CRP.

The Focused Feasibility Study (FFS, June 2001) estimates the total cost for removing Milltown Dam, powerhouse and all associated structures at $5,096,085 without contingency; this cost was used in the CRP Cost Estimate because the CRP calls for the removal of all these structures. The cost of removing the dam spillway and radial gate, along with some of the mitigation measures necessary to remove the spillway, are included in the EPA remediation plan. Therefore, it is recognized that there is some duplication of costs in the two plans, which can be accounted for if the two plans are integrated as one plan.

ASSUMPTIONS AND UNIT COSTS

Unit costs for earthwork were divided into three categories and derived from the USACE estimate. A unit cost of $3.93/cy was deemed appropriate for on-site (localized) cut and fill earthwork within a reach. The unit cost was derived from USACE unit costs for excavation of $3.32/cy plus grading at an additional $0.61/cy, for a total of $3.93/cy. This is consistent with construction costs on past restoration projects managed by WCI. A unit cost of $3.10/cy was applied to the quantity of fill that must be imported to those reaches that have a net deficit of material. This cost was taken directly from the USACE estimate and is based on similar assumptions. A unit cost of $3.32/cy was applied to the quantity of excess fill that must be excavated and exported from those reaches that have a net surplus of material. This cost was taken directly from the USACE estimate and is based on similar assumptions as well. When excess gravel is taken from one site and hauled to another site and graded, as is the case with excess from CFR 3 hauled to CFR 2, the costs are additive; i.e. $3.32/cy to excavate and load plus $3.10 to haul and grade equals $6.42/cy total.

In two reaches, the unit costs for earthwork deviate from unit costs applied to the other reaches. For Reach CFR 2, the cost of grading the Area III sediments to construct the floodplain in the same reach, lower unit costs were applied. In this case, the unit cost of $2.71/cy that was used for growth medium grading from the USACE estimate was used for CFR 2. For CFR 3, due to the uncertainty of toxic sediment location concentrations, all unit earthwork costs in this reach were increased by 25% to account for the possibility of additional soil treatments and/or material handling costs.

An additional line item was added to the cost of CFR 1 to account for the cost of removing the powerhouse and related structures. This cost was taken directly from the Dam Removal Cost Estimate prepared by USACE as referenced in Section 6.1.

Structure costs were determined based on the total quantity of materials that would be required for each type of structures multiplied by the estimated number of structures in each Reach. Since a good rock source exists close to the project area, it was assumed that transportation costs would be lower than normal. However, large rock is expensive to quarry and transport to the site. It is estimated that the average cost for rock delivered to the site would be $40/ cubic yard. This unit cost is based on WCI's past experience with the average cost for rock from the same quarry hauled less than five miles.

The other material that would need to be transported to the site would be large wood. A total quantity of trees was determined and an average cost of obtaining and transporting those trees to the site was estimated. An average cost of $125 per standard tree and $250 per large tree was used in the cost evaluation. This unit cost is the average cost for WCI projects over the last two years for gathering and transporting whole trees. The actual cost can vary greatly depending on availability of the trees and distance to transport.

Equipment time was also estimated for each structure and multiplied by the number of structures in each reach. The total costs for materials and equipment time was determined and summarized for each reach. An example of a cost analysis sheet for each structure is in Appendix 8.

Staking and survey costs are estimated by WCI's Professional Land Surveyor (PLS), with experience in surveying and staking projects of this size. Erosion control fencing used unit costs from the USACE TRACES cost estimate (12/2002). Mobilization and cleanup was estimated using the number of pieces of equipment times an average cost of $500 per piece for a typical mobilization into and out of a project site. Cleanup was assumed to be double the demobilization cost. The Project Management, Phase 3 Final design, Construction Oversight and Permitting used the USACE cost percentages based on total project size. WCI personnel estimated Construction Oversight and Design separately and the results were similar to the USACE percentages, lending validation of the assumptions.

WCI professionals who perform data collection and prepare monitoring plans for rivers of this size estimated the Phase 2 task costs and monitoring requirements for each reach. These estimates are based on actual estimates of the tasks to be completed. The details of the actual cost estimates are available upon request.

Maintenance costs are assumed to be one percent of the total project cost every other year for five years following the project implementation. This assumption is valid based on WCI's past experience in implementing projects on rivers of this size.
Miscellaneous costs were usually the most difficult to determine, usually because little information is know about the design or construction of item in question. For example, an estimate of $25,000 was assumed for moving the building of unknown purpose in reach BFR 2. This cost is only an assumption without knowing the purpose of the building or how far it may need to be moved. These cost items are useful more as a placeholder to be validated in Phase 2 and 3 of the CRP. Most of the items have a very small cost when compared to the total cost for the completing the reach and would be covered by the contingency. Where miscellaneous costs can be validated, it is noted in the individual cost estimate for the reach.

6.2 RE-VEGETATION COST REFERENCES AND ASSUMPTIONS

STRATIFICATION OF PROJECT AREA

The project area has been subdivided on the basis of geomorphic setting and re-vegetation treatment differentiation. The stratifications include streambanks, floodplains, wetlands, alluvial depositional areas, Holocene terraces and other disturbed upland areas. The proposed re-vegetation prescription "package" for each subdivision has unique attributes. The individual areas where delineated through a combination of aerial photo interpretation and post-construction landscape position associated with the conceptual design. Another category was "other disturbed upland areas" to account for constructed slopes, borrow sites, roadways, etc. These areas were determined based on professional experience with previous large river restoration projects.

AREA TO BE TREATED

The areas to be treated within each of the geomorphic landforms were determined by comparing the existing vegetation conditions to the anticipated post-construction conditions. For example, in areas where the channel was going to be relocated from its present location the resulting "abandoned channel" would be void of vegetation and the soils would have low inherent fertility and be course-textured with low water holding capacity. Based on native plant community of typical undisturbed lands with similar characteristics the re-vegetation prescription was developed. AutoCAD was utilized to determine the acreage of the landforms within each of the stream reaches. The acreage was multiplied by the desired tree/acre stocking to determine the total number of containerized plants and cuttings required. The actual acreage for each land type is included in the cost estimates for each project reach.

<u>CONTAINERIZED PLANT MATERIALS AND CUTTINGS</u>

The costs for containerized plants and cuttings are based on WCI's considerable re-vegetation experience and use of state-of –the –art planting equipment and technology. The cost estimate for plant materials was $11 per containerized plant, $9.00 for wetland plants and $3.50 for cutting. The numbers of plants and cuttings in a given prescription is based on the desired spacing. For example, a 10' x 10' spacing requires 436 plants per acre. The cost per plant and cutting are consistent with other large projects and includes seed collection and seedling propagation, inoculating the containerized plants with beneficial soil microbes, mobilization of plants and equipment, and installing the plants/cuttings. The greatest success rate for the cuttings is attained with two cuttings per planting hole. The costs also include the re-vegetation of sites previously considered to be "unplantable" such as riprap, cobble, etc.

<u>TRANSPLANTS AND SOD</u>

Strategically placed sod mats are effective for armoring constructed stream banks and abandoned channels, and provide "instant" vegetation. Transplants of woody plant placed in and around stream bank structures add to structure stabilization.

The cost includes both the salvage sod and transplants during construction activities and importing these materials from dedicated collection areas. The area to be treated with sod and/or transplants was calculated from AutoCAD generated data. The length of bank to be sodded was converted to acres for consistent costing. The cost of $3,250 per acre is based on WCI's records and includes mobilization, harvesting, transporting and placement of the sod/transplants. The cost of temporarily storing and caring for sod and transplants is also included.

<u>SEEDING</u>

The seed mix consisting of native species would be applied at a rate that provides a surface coverage of approximately 90 - 100 seeds per square foot. The numbers of seeds per pound varies considerable by species; therefore, the actual quantity of seed needed is dependent on the final mixes approved for the project. All seed mixes would be certified as being noxious weed free. Native seed mixes vary but average around $8 per pound with an application rate of about 25 pounds per acre.

Depending on terrain and access the seed would be applied by a combination of manual and mechanical techniques. A non-persistent "nurse" or "cover" crop would be seeded in some areas to facilitate the establishment of the native species.

<u>HYDROMULCHING</u>

Hydromulching is a very effective method of uniformly applying seed, mulch, fertilized, tackifier, soil organisms and other soil amendments and would be used extensively to accomplish the revegetation. The water-based slurry is sprayed directly on disturbed sites. Hydromulching is also an effective at controlling localized erosion. The inoculants would closely replicate local microbial populations. The organic fertilizer would provide a long-term source of nutrients and add humus to the soil. The costing includes high quality wood fiber mulch and organic based tackifier. The cost of $2,100 per acre includes mobilization, all products and application. Acreages were calculated using AutoCAD.

INVASIVE VEGETATION INCLUDING NOXIOUS WEEDS

Noxious weeds and other invasive vegetation are well established within the project area and, despite recommended mitigation efforts, it is inevitable that weeds would establish to some degree within areas disturbed by construction activities. A post-construction herbicide treatment program of disturbed areas would be necessary. Annual treatments over the three to five years following project completion would be required. The costs are based on an aggressive program of all disturbed areas and are based on industry standards. Post-treatment monitoring will be the best indicator of mitigation measures and control treatments. Monitoring will validate the accuracy of the cost estimated. The cost of treating noxious weeds is included in the semi-annual maintenance cost estimate discussed in Section 5.10.

6.3 CONTINGENCY

The restoration cost estimates were prepared without existing detailed ground surveys or a definitive ground surface after the excavation of reservoir sediments. Since approximately 55% of the restoration cost estimate is earthwork and is highly dependent on information developed by others, there is a significant level of uncertainty with the cost estimate. Up to this point, several assumptions and contingencies have been applied to the estimates and information used by WCI. Therefore, a contingency of 25% has been applied to WCI's estimate. For projects with significant uncertainty and limited information such as this, a contingency of 15% to 35% is not uncommon. For example, the MCACES cost estimate (EMC2, 10/31/2000) uses a contingency of 35% for the Dam removal costs. That document states that for feasibility/reconnaissance lever estimates, a contingency of 25% is normally used.

7.0 REFERENCES

Bain, M.B., and N.J. Stevenson, editors. 1999. Aquatic habitat assessment: common methods. American Fisheries Society. Bethesda, Maryland. 213 pp.

Brown, C.M., G.T. Decker, R.W. Pierce, and T.M. Brandt. 2001. Applying natural channel design philosophy to the restoration of inland native fish habitat. Proceedings of the Practical Approaches for Conserving Native Inland Fishes of the West. Missoula, Montana June 2001. 3 pp.

Dunne, T. and L.B. Leopold, 1978. Water in Environmental Planning. W.H. Freeman and Co., San Francisco, CA. 818 pp.

Leopold, L.B., M.G. Wolman, and J.P. Miller. 1964. Fluvial Processes in Geomorphology. Freeman, San Francisco, CA. 522 pp.

Omang, R.J. 1992. Analysis of the Magnitude and Frequency of Floods and the Peak Flow Gaging Network in Montana. U.S. Geological Survey Water Resources Investigations Report 92-4048. Helena, MT.

Rosgen, D.L. 2001. The Cross-Vane, W-Weir and J-Hook Vane Structures…Their Description, Design and Application for Stream Stabilization and River Restoration. Wildland Hydrology, Inc. 22 pp.

Rosgen, Dave. 1998. The Reference Reach – a Blueprint for Natural Channel Design, Pagosa Springs, CO. 8 pp.

Rosgen, D., and Silvey, H.L. 1996. Applied River Morphology, Wildland Hydrology, Pagosa Springs, CO.USLC Catalog No. 96-60962.365.

Rosgen, D.L. 1994. A classification of Natural Rivers, Catena, Vol. 22: 169-199. Elsevier, Science, B.V. Amsterdam.

Schmetterling, D.A, and R.W. Pierce. 1999. Success of instream habitat structures after a 50-year flood in Gold Creek, Montana. Restoration Ecology 7(4): 369-375.

USDA Soil Conservation Service, 1990. Hydrology of Upper Clark Fork River Drainage. Bozeman, MT.

USDA Soil Conservation Service, 1990. Hydrology of Blackfoot River Drainage. Bozeman, MT.

USDA Forest Service, Rocky Mountain Experiment Station, 1998. WinXSPRO, A Channel Cross Section Analyzer. Ft Collins, CO. 97 pp.

Williams, G.P. 1986. River Meanders and Channel Size. Journal of Hydrology 88: 147-164.

AMENDMENT TO THE DRAFT CONCEPTUAL RESTORATION PLAN FOR THE CLARK FORK RIVER AND BLACKFOOT RIVER NEAR MILLTOWN DAM

Prepared By:

State of Montana
Natural Resource Damage Program
And
Department of Fish, Wildlife, and Parks

June 9, 2004

AMENDMENT TO DRAFT CONCEPTUAL RESTORATION PLAN FOR THE CLARK FORK RIVER AND BLACKFOOT RIVER NEAR MILLTOWN DAM

The State of Montana, in consultation with the U.S. Fish and Wildlife Service (USFWS) and the Confederated Salish and Kootenai Tribes (CSKT), has prepared this amendment to the *Draft Conceptual Restoration Plan for the Blackfoot River and Clark Fork River Near Milltown Dam* (*DCRP*). The *DCRP* was released for public review and comment in May 2003. Under this Amendment, the restoration actions outlined in the *DCRP* will be separated into three restoration projects. The restoration plan, as described in the *DCRP*, for the four river reaches, CFR1, CFR2, CFR3 and BFR1, will be undertaken concurrently with EPA's remedial action and will comprise one restoration project. The restoration plans for the other two reaches, the CFR4 and BFR2, will make up the other two projects and need not be undertaken concurrently with the remedial action. This amendment to the *DCRP* is necessary and appropriate as a result of the following: (1) comments received during the public review period; (2) the "Stipulation" filed with the federal bankruptcy court in Delaware, which contemplates integration of the restoration work with remediation at the Milltown site; (3) additional restoration design and cost information; and (4) EPA's revised proposed remediation plan, which was released on May 17, 2004. Further changes in the *DCRP* are expected once the Phase II data collection, analyses and design process is completed by early 2005.

The Stipulation that was reached between the State of Montana, the United States, the CSKT, the Atlantic Richfield Company (ARCO), and the NorthWestern Corporation (NWC) (collectively "the Parties") contemplates the integration and synchronous completion of the *DCRP* and remediation within the remediation project area.[1] This area extends upstream from Milltown Dam to Duck Bridge on the Clark Fork River and to the Interstate 90 Bridge on the Blackfoot River. In this area, EPA proposes to require ARCO and NWC to remove contaminated sediments, to complete certain reclamation actions, and to remove the Milltown Dam spillway and radial gate. The Stipulation and the revised proposed remediation plan further contemplate, as a result of integrating the restoration and remediation plans, the removal of the dam's powerhouse, divider block, and north abutment, and the grading of a floodplain and excavation of a new Clark Fork River channel to the specifications of the *DCRP*. (See the attached figure from the revised proposed remediation plan.)

The separation of restoration actions into three projects is necessary for efficiency, cost savings, and technical integrity and in order to coordinate and integrate restoration with remediation. The four river reaches, CFR1, CFR2, CFR3 and BFR1, are partially or entirely within the remediation project area and encompass the area directly affected by the dam. Accordingly, restoring these reaches separately is also consistent with the decommissioning of the dam under the FERC process. The estimated cost for implementing the *DCRP* within these

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[1] The Stipulation remains subject to: (1) approval by the bankruptcy court; (2) the successful completion and agreement among the Parties of a consent decree that incorporations the terms of the Stipulation; (3) approval of the consent decree, after public comment, by the federal district court in Montana; and (4) the approval by the Federal Energy Regulatory Commission (FERC) hydropower dam license surrender application, which would presumably seek approval of the terms of the consent decree that are relevant to dam decommissioning.

four reaches has been reduced from $27.5 million to approximately $11.5 million. This reduced estimate resulted from new cost estimates provided by ARCO's contractor Envirocon and the State's consultants, and cost savings to be achieved by integrating the restoration and remediation actions. Of this $11.5 million, NWC in the Stipulation has agreed to pay $3.9 million for restoration within the remediation project area. With this payment from NWC and the cost savings derived from integration of the two plans, the net restoration cost to the State within the remediation project area is expected to be zero. The net cost to the State for restoration work in the portions of CFR1, CFR3 and BFR1 outside of the remediation project area is expected to be approximately $7.6 million. The revised, estimated restoration costs for the four reaches are as follows:

PROJECT: Milltown Draft Conceptual Restoration Plan					**DATE: Revised 5/17/04**
DESCRIPTION: Revised Restoration Costs for Four Reaches					
REACH	BFR 1	CFR 1	CFR2	CFR 3	TOTAL
Within Remediation Work Area	**$526,970**	**$532,692**	**$2,863,606**	**$0**	**$3,923,268**
Outside Remediation Work Area	**$1,640,590**	**$1,118,836**	**$0**	**$4,818,942**	**$7,578,368**
TOTAL	**$2,167,560**	**$1,651,528**	**$2,863,606**	**$4,818,942**	**$11,501,636**

In order to complete the restoration work in CFR1, CFR2, CFR3 and BFR1, the Phase II data collection effort will focus on selection of the appropriate upstream location on each river to begin the restoration work. It will be necessary to select locations that are stable (i.e., not moving over time) in order to protect the stability of the downstream restoration work. The Phase II data collection and analysis will include portions of all of the reaches originally proposed for restoration in the *DCRP* in order to determine the risks of delaying or not extending restoration into or throughout CFR4 and BFR2.

The Trustees still intend that CFR4 and BFR2 be restored to the extent appropriate based upon the goals and objectives set forth in the *DCRP*. However, as the *DCRP* recognized, it is not necessary to coordinate the restoration of CFR4 and BFR2 with remediation; thus, there is more flexibility in the scheduling, design, and implementation of their restoration. Furthermore, technical comments were received during the public comment period that question the level of restoration proposed for CFR4 and BFR2, and suggest that these reaches, particularly CFR4, are currently relatively stable, with well-established vegetation and habitat. There are also access and other legal uncertainties involving these reaches, particularly BFR2. During the Phase II process, the State and other Trustees will refine the conceptual design and further address the need for restoration work in these two reaches. Restoration work deemed necessary or appropriate in BFR2 and CFR4 will be most likely implemented after completion of restoration work in the four lower reaches.

Removal of Stimson Dam, which is located in BFR2, is necessary to ensure fish passage up the Blackfoot River. It is understood that the USFWS will lead a separate project that will remove Stimson Dam in coordination with EPA's remediation and the State's restoration actions. Consequently, by this amendment, the State is deleting that portion of the *DCRP* that provides for the removal of Stimson Dam. The current schedule contemplates that Stimson Dam will be removed prior to the removal of Milltown Dam. Otherwise, removal of Milltown Dam would lower the water level at the Stimson Dam causing it to become a fish passage barrier and to become unstable.

The combined restoration costs for CFR4 and BFR2, estimated in the *DCRP* at approximately $11 million, will likely be reduced after the completion of the Phase II process, including a closer examination of the level of work that may be necessary in these reaches. Restoration of BFR2 and CFR4 may be funded through the normal UCFRB Restoration Fund grant process or from other sources. Any work in these two reaches would be coordinated with the restoration work in the lower reaches.

The following is a revised schedule for the restoration work described in the *DCRP*:

Revised Milltown Restoration Plan Schedule

Reach	Year Work to Begin
BFR 1 (lower)	2005/06, dependent on dam removal
CFR3	2007
CFR2*	2008
CFR1*	2009
BFR1 (upper)	2009
BFR2	2007 or later
CFR4	2007 or later

*This Schedule is dependent on remediation work being completed within the remediation project area.

For more information regarding this amendment to the *DCRP*, please contact:

Doug Martin
Montana Natural Resource Damage Program
P.O. Box 201425
Helena, MT 59620-1425
(406) 444-0205
dougmartin@state.mt.us

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