
Biological Assessment

Biological Assessment of the Milltown Reservoir Sediments Operable Unit

Prepared for
Environmental Protection Agency
Helena, Montana

April 2003

Prepared by
CH2MHILL

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1.0 Introduction

This Biological Assessment (BA) evaluates the potential effects on bull trout (*Salvelinus confluentus*), a federally listed threatened species, and on bull trout proposed designated critical habitat from implementing the selected remedial action at the Milltown Reservoir Sediments Operable Unit. The 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 scour events or, potentially, during catastrophic dam failure. The U.S. Environmental Protection Agency (EPA) and the Montana Department of Environmental Quality (MDEQ) selected a preferred remedial action for implementation following 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 remedy is described in EPA's Proposed Plan (EPA 2002) and is summarized later in this document.

Information presented in this BA follows the example of a bull trout BA that was described by the U.S. Fish and Wildlife Service (FWS 1999) in their "Endangered Species Act Biological Assessment Workshop." Chapter 1.0, *Introduction*, provides an overview of the project area's background and history, and discusses the purpose, need, and scope of this BA. Chapter 2.0, *Project Description*, describes the Proposed Action (the selected remedial action). Chapter 3.0, *Environmental Baseline*, describes baseline conditions, including bull trout distribution, status, proposed designated critical habitat, limiting factors, life history characteristics, and habitat requirements in subbasins and associated drainages in the assessment area for this BA. Chapter 4.0, *Effects of the Action*, discusses direct, indirect, and cumulative effects on bull trout and their proposed designated critical habitat that could potentially result from implementing the Proposed Action, and describes conservation measures intended to avoid or minimize the potential for adversely affecting bull trout and their habitat. Chapter 5.0, *Determination of Effects*, discusses whether or not the Proposed Action is likely to adversely affect bull trout, or to destroy or adversely modify bull trout proposed designated critical 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 2002). In 1982, EPA became involved and listed the Milltown Reservoir Sediments Site on the National Priorities List (NPL) as a Superfund Site. EPA has the authority to require the implementation of remedial actions to prevent hazardous sediments from threatening human health and environmental resources at Superfund Sites.

The Milltown Reservoir Sediments 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 Clark Fork and Blackfoot, L.L.C. (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 3259.8 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 (3259.8 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 electrical generation load fluctuations and radial gate operation. Downstream flows can be greatly affected by changes in generation during low-flow periods, when all river flow passes through the turbines. 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).

Baseline operating conditions and factors that have the potential to influence bull trout populations or their proposed designated critical habitat downstream of, within, and upstream of the Milltown Reservoir Sediments Operable Unit include upstream and downstream passage of bull trout past Milltown Dam; draw down of Milltown Reservoir; short-duration stream flow fluctuations downstream of Milltown Dam; northern pike (*Esox*

lucius) in Milltown Reservoir; metals present in Milltown Reservoir sediments; and ice-flow events. These baseline conditions and factors were discussed by CFBLLC (2003) in their BA of the Milltown Dam Operations and are summarized below.

Upstream migrations of fluvial and adfluvial stocks of bull trout have been blocked by Milltown Dam since its construction. Permanent upstream fish passage facilities have not been added to the dam. However, MPC began operating a radial gate raceway as a trap and haul facility for upstream migrants in 1998. This trap is operated between March and early November of each year at flows up to about 7,000 cfs. At higher flows the reservoir tailwater floods the radial gate pool (CFBLLC 2003).

Downstream passage of bull trout past Milltown Dam can occur over the spillway, through the radial gate, or through the turbines. Passage over the spillway is possible when flows exceed approximately 1,600 cfs, which is generally from March to July. Vegetation grates on the turbine intakes prevent the entry and passage of larger adult and subadult fish through the turbines (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.

Northern pike, a non-native species that has been illegally introduced into Milltown Reservoir, has the potential to compete with and prey on bull trout. Northern pike have benefited from the reservoir's shallow, weedy backwaters, which provide good spawning and rearing habitat for this species. The reservoir contributes to a self-sustaining, reproducing population of northern pike, and to the recruitment of northern pike to the Clark Fork and Blackfoot Rivers (CFBLLC 2003).

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 2001). 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 in 1911, 1916, and 1959, 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 and 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 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 was estimated to be a 100-year event, and 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 rare 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).

1.2 Purpose and Need for Biological Assessment

The FWS listed the Columbia River Distinct Population Segment (DPS) of bull trout as a threatened species under the Endangered Species Act (ESA) on June 10, 1998 (Federal Register [FR] 1998). Bull trout occurring in the Clark Fork River and its tributaries are included as subpopulations (now referred to as local populations [FWS 2002]) in the Columbia River DPS. On November 1, 1999, the FWS determined threatened status for all populations of bull trout within the coterminous (lower 48) United States (FR 1999). The FWS proposed the designation of critical habitat and announced the availability of the Bull Trout Draft Recovery Plan for the Columbia River DPS on November 29, 2002 (FR 2002). The project area for this BA is proposed designated bull trout critical habitat and is located in the Upper Clark Fork Recovery Subunit (FWS 2002).

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 bull trout and on bull trout proposed designated critical habitat resulting from implementing the selected remedy (the Proposed Action) at the Milltown Reservoir Sediments Operable Unit, and to satisfy provisions of Section 7 consultation requirements with FWS under the ESA.

1.3 Scope of Biological Assessment

This BA focuses on the potential effects on bull trout and their proposed designated critical habitat from implementing the Proposed Action at the Milltown Reservoir Sediments Operable Unit. This BA also considers the potential effects on interim bull trout passage measures during dam and sediment removal activities. 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. These include direct and indirect effects on bull trout and their habitat resulting from the past and present impacts of all federal, state, and private actions and other activities in the geographic action area; anticipated effects of proposed federal projects in the geographic action area for this BA where Section 7 consultation has already occurred; and the effects of concurrent state or private actions.

The geographic action area of this BA extends beyond the boundaries of the Milltown Reservoir Sediments Operable Unit for several reasons. First, the remedial benefits and

potential short-term negative effects from implementing the Proposed Action would not be limited to just Milltown Reservoir. They would extend to aquatic life in the Clark Fork River downstream of Milltown Dam, which is downstream of the Operable Unit. Second, the migratory nature of bull trout combined with the removal of Milltown Dam would allow unimpeded movements of this species among free-flowing river reaches both upstream and downstream of the former Milltown Dam site. Third, because of these interconnected relationships, the potential exists for the Proposed Action to affect the overall abundance and well-being of bull trout and their proposed designated critical habitat in the middle and upper Clark Fork River drainages. For these reasons, the geographic action area covered by this BA includes mainstem and tributary waters that are presently used by bull trout in the middle and upper Clark Fork River drainages. These waters include the Clark Fork River and its tributaries downstream of Milltown Dam to the confluence with the Flathead River; Milltown Reservoir; the Clark Fork River and its tributaries upstream of Milltown Dam; the Blackfoot River and its tributaries; and Rock Creek and its tributaries. This geographic action area represents the bull trout assessment area for this BA.

1.4 Methods

Much of the background information presented in this BA is taken from two recently completed documents that assessed the effects of Milltown Dam and Reservoir on aquatic resources, particularly bull trout and their proposed designated critical habitat. The first document is the *Internal Draft Biological Assessment of the Milltown Dam Operations for the Period 2003 through 2010 FERC No. 2543*. That document was prepared by The Clark Fork and Blackfoot, L.L.C. (CFBLLC) as the non-Federal agency representative for the Federal Energy Regulatory Commission (FERC), and contains extensive technical information that has been reviewed by FWS. That information constitutes a very important component of the present BA because: 1) it covers the same geographic action area; 2) it provides background information on the status and characteristics of bull trout and their habitat in action area drainages; and 3) it discusses the past, present, and future effects of non-contaminant factors on bull trout populations and habitat upstream, within, and downstream of Milltown Dam and Reservoir, assuming that the dam and reservoir remain in-place. Much of the information from that Internal Draft BA has been summarized in the present BA and is cited as (CFBLLC 2003) or (in CFBLLC 2003). The FERC consultation with the FWS and this EPA consultation with the FWS will be completed concurrently.

The second document often referenced in the present BA is the *Milltown Reservoir Sediments Operable Unit Ecological Risk Assessment Addendum*. That document was prepared under the direction of the EPA and is cited as (CH2M HILL 2000). The risk assessment addendum evaluates risks to aquatic receptors in the Clark Fork River downstream from Milltown Dam based on data from the February 1996 ice scour event, the late spring 1997 high flow event, and the analysis of the effects of discharges from Milltown Reservoir during these unusual meteorological events.

Three other important documents were prepared by the U.S. Army Corps of Engineers (USACE), at the request of EPA, for use in predicting changes in water quality in the Clark Fork River at Missoula during the dredging of contaminated sediments at Milltown Reservoir and their disposal. The first is the *Estimation of Contaminant Release from Dredging*

of Clark Fork and Blackfoot River Sediments in Area 1 of Milltown Reservoir (USACE 2001). This document was prepared to predict the range of changes in water quality in the Clark Fork River at Missoula during dredging of contaminated sediments at Milltown Reservoir. The USACE compared estimated concentrations of metals in downstream surface waters against federal and state acute and chronic water quality criteria for the protection of aquatic life, and against the site-specific trout toxicity reference value (TRV) for dissolved copper at the 80 percent threshold in the Clark Fork River. This analysis provides a worst-case estimate of sediment dredging effects since it was based on the use of silt curtains, when in fact EPA's Proposed Action will employ interlocking sheet piling surrounding the entire area to be dredged.

The two other USACE documents, *Bandmann Flats Repository Sizing Analysis for Milltown Reservoir Area I Sediments* (USACE 2002a) and *Bandmann Flats Repository Effluent Analysis for Milltown Reservoir Area I Sediments* (USACE 2002b), estimate total suspended solids (TSS) and metals concentrations in effluent that would discharge from the Bandmann Flats Sediment Repository site to the Clark Fork River. USACE estimates were used to calculate expected TSS and metals levels in the Clark Fork River following mixing of repository site effluent with river water. Results of USACE analyses are presented in the effects analysis (Chapter 4) of this BA.

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 with the FWS under the ESA. This consultation represents the initial broad, overarching effects analysis initiated by the EPA for the Proposed Action at the Milltown Reservoir Sediments Operable Unit. Other consultations with the FWS regarding Milltown Dam and Reservoir either occurring concurrently with or expected to follow this BA are briefly described in the following text.

Concurrent FERC Consultation: Concurrent with this EPA consultation, the FERC is completing consultation with the FWS on the effects to bull trout and their proposed designated critical habitat from ongoing operations of Milltown Dam during remedial action, interim fish passage actions, and the required mitigation of the project site after dam removal. The FERC consultation will be completed concurrent with this EPA consultation.

Future EPA Consultation on Proposed Action Design: Design details and effects of the remedial action will be better defined during the design phase of EPA's Proposed Action. The EPA will consult with the FWS on the effects to bull trout and proposed designated critical habitat of project design features.

Future Consultation on River Restoration: Detailed river restoration actions will be proposed following the public process of EPA's Proposed Action. The USACE or other implementing party will be responsible for consulting with the FWS on the effects to bull trout and proposed designated critical habitat of river restoration actions.

2.0 Project Description

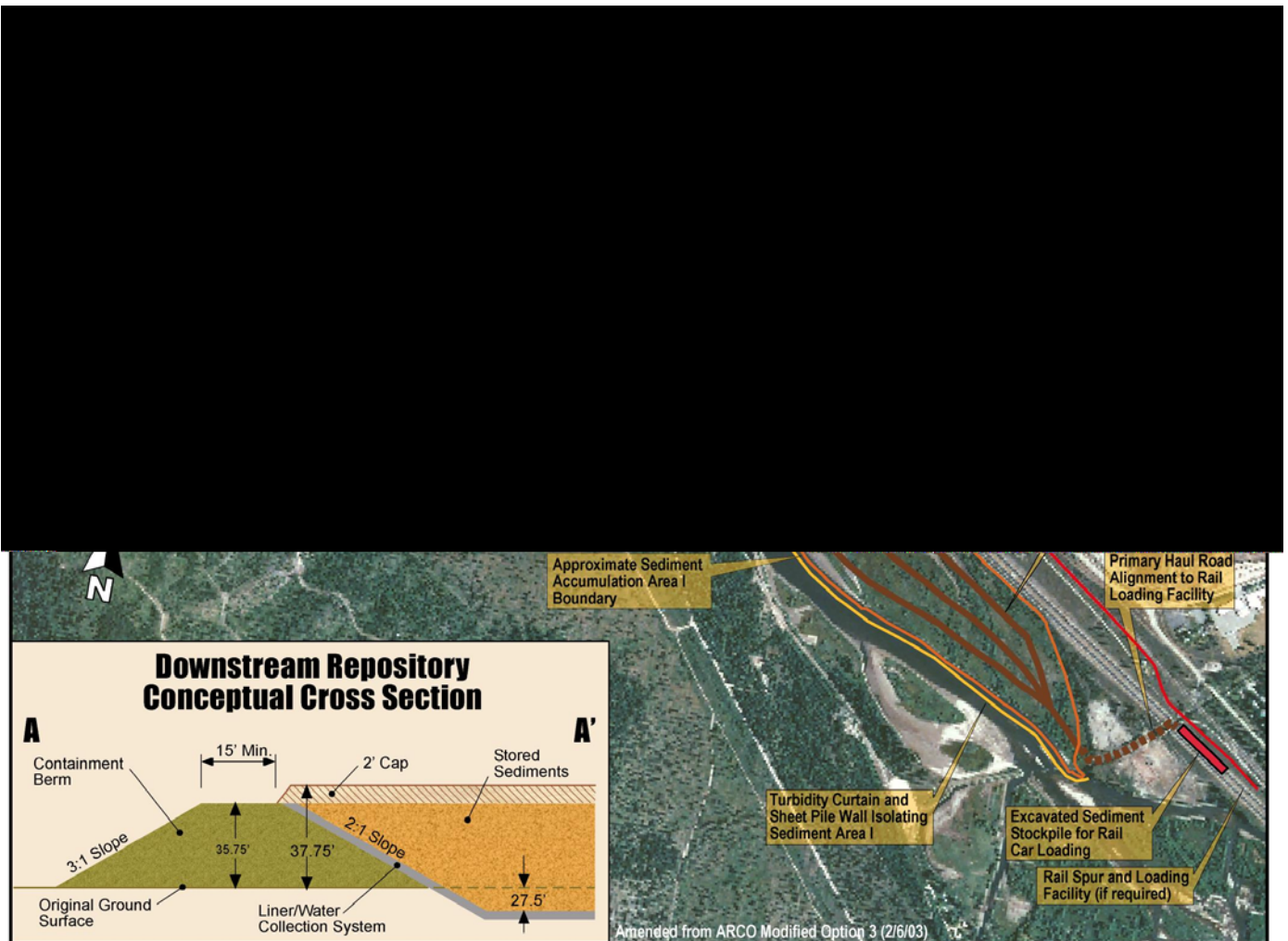
This BA evaluates the potential effects of the Proposed Action on bull trout and their proposed designated critical habitat. The Proposed Action (*Partial Sediment Removal of the Lower Reservoir, Dam Removal, plus Groundwater Institutional Controls and Natural Attenuation within the Aquifer Plume*) is the remedial action that was selected by EPA and MDEQ for implementation at the Milltown Reservoir Sediments Operable Unit. This remedial action is identified in the EPA's Proposed Plan (EPA 2002) and was selected from 10 remedial alternatives that were evaluated. The Proposed Action has two major objectives. The first objective is to reduce or eliminate the arsenic plume in the groundwater and related human health risks. The second is 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.

These two objectives will be accomplished 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. The sediments in Sediment Accumulation Area I (lower reservoir adjacent to Milltown) will be removed, while those in Sediment Areas II, III, IV, and V (the upper reservoir) will be left in place and isolated from the Clark Fork River channel. A new, geomorphologically stable river channel with 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. A decision on whether or not to leave the powerhouse as a historic structure will be determined through further discussions with the Trustees (including FWS) and the public. Four to five construction seasons are estimated to complete implementation of the Proposed Action. 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.

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. In the evaluation of potential remedies, the Proposed Action scored high in long-term effectiveness and permanence because the dam and sediment will be removed and significant ongoing maintenance will not be required. Its score for short-term effectiveness was low-moderate because of potential negative impacts on downstream aquatic life during dredging, a topic addressed in Chapter 4 of this BA. The cost of the Proposed Action would be about \$95 million. The greater Missoula area community, including local elected officials, and many other stakeholders favor the Proposed Action.

The key components of the Proposed Action and their implementation are briefly described in the following text, with details to be developed during final design. They include sediment removal and disposal, dam removal, site restoration/redevelopment, and continuation of the replacement water supply/implementation of temporary groundwater institutional controls. This section concludes with discussions of interim fish passage and

implementation of the Proposed Action. Exhibit 1 depicts major features of the Proposed Action.



2.1 Key Components of the Proposed Action

Sediment Removal, Dewatering, Transportation, and Disposal

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. Prior to removal activities, sediment in SAA-I will be isolated from the active Clark Fork and Blackfoot Rivers by a wall of interlocking sheet piling driven into the underlying alluvium, and extending around the area.

Surface sediment removal, as presently proposed, will be initiated through mechanical means such as tracked excavators or dragline to remove approximately 15 percent of the sediments (about 0.4 mcy) in SAA-I. The excavated materials will be transported to the downstream repository (located on the south side of the Clark Fork River about 4,000 feet from the primary removal) in one of the following ways: 1) directly by trucks, 2) by rail car, 3) by slurry line , or 4) by conveyor.

The remaining lower saturated sediments (about 2.2 mcy) in SAA-I (about 85 percent of the total sediment volume) will be removed predominantly by using hydraulic dredging techniques (such as cutterhead suction dredges). These dredges are suitable for removing grain sizes from saturated fine sediment to coarse, sand-sized material. Debris encountered during the dredging process will require the use of specialized equipment such as clamshell dredging, if significant quantities are encountered. Hydraulically dredged materials will be pumped as a slurry to the downstream repository. Debris and oversized materials that can not be mulched will be hauled to the repository by truck or rail prior to placement in the dredge ponds and repository.

Sediment dewatering could occur onsite, or at the disposal site after transport using a slurry pipeline. For the Proposed Action, it is anticipated that some sediment dewatering will occur in sedimentation tanks with subsequent transport by slurry pipeline to the disposal site. At some dredging sites, sediments have been dewatered using settling ponds or tanks with polymers added to the slurry to enhance settling and improve the consistency of the mix through moisture control. Given the limited space available onsite for settling ponds, it is anticipated that tanks large enough to provide adequate residence time will be employed for this task. Monitoring the chemical characteristics of the tank contents will allow additives to be amended to the mix to assist with water quality improvement (such as for pH adjustment). Effluent from removed material may be directed back into the dredge area or may be treated separately for metals and arsenic, if warranted, and discharged back into the river. At the downstream repository, excess water will be generated as slurry material is placed and consolidation occurs. It is assumed that this effluent will require some treatment prior to its final discharge.

The downstream repository site has an engineered capacity of approximately 3 mcy. Its topography, distance from the Clark Fork River channel and groundwater (greater than 50 feet), and proximity to Milltown Reservoir (4,000 feet downstream) make it an ideal local repository site. The only detracting characteristic is overland access for trucking material to the site, which would entail a route through the Bonner/Milltown community. However, access by pipeline is excellent. Routine monitoring and inspection of the pipeline will be conducted to ensure there are no adverse environmental impacts to the environment.

Restoration/Redevelopment

Channelization of the major river channels and establishment of the associated floodplains directly upgradient of Milltown Dam will be part of the planned restoration/redevelopment process. This restoration/redevelopment design will occur after a planning process that will include significant public participation involving the stakeholders, Trustees, and general public. Other actions associated with river restoration and redevelopment (for example, FERC-required mitigation and the Urban Rivers Restoration efforts) will be covered in

separate consultations, respectively, by the FERC and USACE (or other implementing party) with the FWS.

Upon completion of sediment removal, a new channel with an associated floodplain will be constructed. The new channel will align with a historic channel that runs adjacent to the Interstate. It is estimated that reconstructing the floodplain and channels consistent with the upstream template will require approximately 0.4 mcy of floodplain backfill, and construction and shaping of approximately 6,700 feet of new channel (5,400 feet of Clark Fork River channel and 1,300 feet of Blackfoot River channel). When completed, the existing Clark Fork River channel will be abandoned, backfilled, and regraded into floodplain for the new channel.

Control structures will be constructed on the Clark Fork and Blackfoot Rivers at the upstream ends of the removed/reconstructed channels to mitigate upstream headcutting associated with dam removal and the resultant drop in river base level. A number of different types of control structures could be used to mitigate the potential for head-cutting. Structures that use more natural gradients and vegetative armoring are available, and will provide a more natural-appearing channel.

It is anticipated that the reconstructed Clark Fork and Blackfoot River channels will be approximately 150 feet wide, with a typical water depth of approximately 4 feet under average flow conditions. The channel will be designed to allow for upstream fish passage, and will include places for fish to hold and rest while moving upstream. Native alluvium exposed after the removal of the overlying sediments is assumed to be acceptable as bed material for the reconstructed channels. Streambanks will be reconstructed at a bankfull height that allows for out-of-bank flow when flows exceed a 1.5- to 2-year return interval. Bank stabilization of the reconstructed channels will be necessary to maintain geomorphic stability. Stabilization could include softer bioengineering approaches using vegetation, degradable fabrics, and deformable toe protection using smaller-sized rock riprap. To minimize the amount of channel grading and floodplain backfill required, it is assumed that the centerlines of the reconstructed channels will generally follow the line of minimum elevation in the post-removal exposed alluvium surface.

Milltown Dam Removal

The objective of dam removal (spillway and radial gate) is to eliminate the existing hydraulic conditions presently contributing to the groundwater arsenic plume, and prevent continued storage of sediment from upstream sources and the potential for future sediment releases from the reservoir. Dam removal will be completed after the sediment removal and channelization/control structure construction work. Removal of the dam will presumably be staged to coincide with low flow periods (July through March) to minimize sediment discharge potential. It is estimated that one construction season will be needed to complete dam removal. A decision on whether or not to leave the powerhouse and divider block structure with some erosion prevention enhancements as the remaining structure and a historic feature will be determined through further discussions with the Trustees (including FWS) and the public.

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
- Make contingency funds available to reconfigure, expand, or update replacement water supplies
- Establish a temporary controlled groundwater area to ban future wells within or immediately adjacent to the arsenic plume
- Continue and expand 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 bull trout or their proposed designated critical habitat and are not discussed further in this BA.

2.2 Interim Fish Passage

Interim upstream fish passage measures will be provided during site remediation activities by the owners of the facility as designated and required by the FERC license. Interim fish passage measures will remain in effect until all construction work has been completed and fish can move unimpeded upstream and downstream past the former Milltown Dam site. EPA anticipates that most hydraulic dredging of sediments (approximately 85 percent of the time) will be done at full pool level and should not affect interim upstream fish passage measures. EPA will consult with the MDFWP and FWS in attempts to optimize upstream fish passage during the time when dredging is conducted at less than full pool level.

2.3 Implementation of the Proposed Action

The basic approach to implementing the Proposed Action is as follows:

- Accommodations for interim fish passage
- Issue Record of Decision (ROD)
- Implement public planning process for restoration/redevelopment conceptual design
- Complete preliminary and final design packages, which will include a detailed work breakdown structure with schedule addressing:
 - Acquisition of all environmental permits
 - Design of solid waste repositories
 - Sediment isolation, removal, loading and conveyance facilities
 - Water management plans; water treatment facilities (if warranted)
 - Water quality monitoring programs
 - Design of new channel/floodplain/control structures and preparation of plans and specifications for construction

The following text describes what is needed to implement the Proposed Action. As noted previously, additional actions associated with river restoration and redevelopment (for example, FERC-required mitigation and the Urban Rivers Restoration efforts) will be covered in separate consultations, respectively, by the FERC and USACE (or other implementing party) with the FWS. A potential sequence of events for implementation of the design and construction of the EPA's project might proceed as follows:

- Construct waste repository, slurry pipeline, dry material loading and unloading rail facilities.
- Concurrently install sheet pile walls around SAA-I and prepare waste excavation area and removed sediment staging area.
- Initiate the early stages of a water quality monitoring plan for both the Clark Fork River and the Milltown alluvial aquifer.
- Excavate sediments mechanically, by hydraulic dredge, or by a combination of technologies as needed.
- Transport sediments to a soil repository.
- Construct a new channel for the Clark Fork River in alignment with the historic channel; construct control structures at appropriate locations along the Blackfoot and Clark Fork Rivers. Upon completion, redirect the Clark Fork River into the new channel.
- Backfill the old channel and finish re-contouring/stabilizing the new floodplain.
- Remove the spillway and radial gate portion of the dam. The powerhouse will remain as a historic structure or be removed, as determined through further discussions with the Trustees (including FWS) and the public.

It is assumed that the Proposed Action may need to include some of the groundwater institutional controls, at least as a temporary measure, during and immediately after construction.

A key technical issue in implementing the Proposed Action will be to control, contain, and prevent the transport of sediment during dredging and removal activities to protect downstream water quality and aquatic resources. The sediment management program that will be implemented to accomplish this considers OSWER Directive 9285.6-08, *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites*.

As described in the preceding text, a number of actions intended to minimize or avoid the potential for adversely affecting bull trout, their proposed critical habitat, and water quality will be implemented during sediment removal/isolation/disposal, dam removal, and site restoration/redevelopment activities. These actions include a combination of construction practices, BMPs, and sediment management principles that could be applied during site remediation to control, contain, and prevent the downstream transport of sediment and associated metals. Included in these measures are: 1) installation of a sheet piling system to isolate the primary dredge area from the active river; 2) use of silt curtains outside the sheet piling system, where appropriate, to reduce sediment and dissolved metals release; 3) dredge water treatment, if necessary, to reduce dissolved metals loadings from dredge pond or sedimentation tank discharge; 4) reservoir pool elevation control to reduce scouring during low-flow periods or to pass sediment through the reservoir during high-flow

periods; 5) production rate controls to reduce sediment and dissolved metals transport if unacceptable impacts are occurring; and 6) sequencing of activities to reduce impacts.

An important part of the sediment management program will be to monitor before, during, and after sediment remediation to assess and document remedy effectiveness. Pre-remedial monitoring will use results of water quality and biological programs that are currently and regularly being conducted on the Clark Fork River in the vicinity of Milltown Dam and Reservoir to help describe project area baseline conditions prior to dam removal. These programs include water quality monitoring by the U.S. Geological Survey (USGS) and annual fisheries censuses and routine macroinvertebrate surveys by the MDFWP.

To assess and document remedy effectiveness, water quality and biological studies will be conducted during and after site remediation activities to monitor for potential adverse effects on aquatic habitat and organisms. A water quality monitoring station that continuously monitors turbidity will be employed on the Clark Fork River downstream of the Milltown Dam site at the Deer Creek Bridge, while total suspended solids (TSS) and dissolved and total recoverable metals sampling will be conducted on a daily basis. Analytical turnaround time will be minimized to the extent possible. In addition, a predictive relationship between turbidity and TSS will be confirmed early on, if possible, to further expedite data interpretation and identify any potential concerns. Temporary construction standards that EPA believes are protective of human health and acute impacts to the downstream fishery, bull trout, and proposed designated critical habitat have been established and will apply to the river during the construction process. The point of compliance (POC) for these standards would be at the Deer Creek Bridge located about one mile downstream of Milltown Dam to allow complete mixing of river water before sampling. Additional BMPs and control actions would be considered if these standards were exceeded or if in-situ bioassays (caged fish) indicated the need. Table 1 lists the construction standards established for this project during discussions with the State.

TABLE 1
Milltown Reservoir Sediment Site Proposed Temporary Construction Related Water Quality Standards

Copper—80% of the TRV (dissolved)	25 µg/L	short-term (1 hour)
Zinc—Acute FWQC (dissolved)	117 µg/ L	short-term (1 hour)
Lead— Acute FWQC (dissolved)	65 µg/ L	short-term (1 hour)
FDWS (dissolved)	15 µg/ L	long-term (30-day average)
Arsenic— Acute FWQC (dissolved)	340 µg/ L	short-term (1 hour)
FDWS (dissolved)	10 µg/ L	long-term (30-day average)
Iron—FWQC (dissolved)	1,000 µg/ L	short-term (1 hour)
Total Suspended Solids (TSS)	550 mg/ L	short-term (1 day)
	170 mg/L	mid-term (1 week)
	86 mg/L	long-term (1 season)

*All hardness related FWQC values assume a hardness of 100 mg/L.

TRV = Toxicity Reference Value (developed by EPA based on trout toxicity tests using Clark Fork River water and a hardness of 100 mg/L). 80 percent of the TRV for dissolved copper approved by State for use as a construction standard.

FWQC = Federal Water Quality Criteria.

FDWS = Federal Drinking Water Standard.

EPA will attempt to correlate turbidity readings with TSS to allow instantaneous estimation of the TSS level and, potentially, allowing a faster response in mitigating TSS exceedances if exceedances occur.

Biological monitoring programs developed cooperatively and implemented by EPA in consultation with MDFWP and FWS that document the composition and abundance of fish and benthic invertebrate communities will be conducted downstream of Milltown Dam and Reservoir to assess whether or not site remediation activities appear to be affecting these communities. Similar fisheries and benthic invertebrate monitoring programs will be conducted concurrently at control stations to account for any possible background effects on aquatic communities in the Clark Fork River.

Another water quality/biological monitoring tool that may be used is live car bioassays. Studies could potentially be conducted in the Clark Fork River upstream and downstream of the Milltown Dam and Reservoir site using juvenile trout as indicators of water quality conditions. Care would have to be exercised when selecting holding locations for the live cars to avoid potential fish stress or mortalities from factors such as excessive water velocity or lack of cover.

Results of the monitoring programs will be used in an iterative risk assessment-feedback framework to determine if biological resources are being protected, and, if not, what additional management measures are practical to protect bull trout, their proposed designated critical habitat, and other aquatic resources. It should be noted that specific design of the potential mitigation measures outlined above needs to occur during the design process. EPA plans to consult closely with the FWS and the other Trustees during this design process to finalize an effective and practical mitigation plan .

3.0 Environmental Baseline

This chapter describes the existing baseline conditions for bull trout 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 4.0, *Effects of the Action*. The description of existing conditions begins with an overview of the assessment area and bull trout distribution, status, limiting factors, life history characteristics, and habitat requirements. The overview concludes with a summary description of proposed designated critical habitat for bull trout (FR 2002) and the Bull Trout Draft Recovery Plan (FWS 2002) in the assessment area. The overview discussion is followed by more specific discussions of bull trout distribution, status, limiting factors, and life history characteristics in subbasins and associated drainages within the assessment area.

The assessment area subbasins discussed in this BA generally align with the recent proposed designations of critical habitat subunits and bull trout core areas by the FWS (2002, FR 2002). These subbasins correspond to major subpopulations of bull trout within the Columbia River DPS of bull trout previously identified by FWS (FR 1998). They include the upper Clark Fork River, middle Clark Fork River, and Blackfoot River subbasins. The Blackfoot River subbasin covers the Clearwater River/Chain Lakes watershed, which has recently been identified as a bull trout core area and proposed as a critical habitat subunit separate from the larger Blackfoot River drainage (FWS 2002, FR 2002). Bull trout in the Rock Creek drainage that empties to the Clark Fork River near Clinton are discussed under a separate heading because of their relative abundance in this particular drainage. This drainage also has recently been identified as a separate bull trout core area and proposed as a critical habitat subunit (FWS 2002, FR 2002). Even though it is within the upper Clark Fork River subbasin, conditions affecting bull trout in Milltown Reservoir are discussed under a separate heading because of the prominence of Milltown Reservoir in this BA.

Information on bull trout in the three subbasins (and in the Rock Creek drainage) has been summarized from detailed descriptions presented by CFBLLC (2003), which were based on locally derived bull trout information gathered and reported by numerous researchers. Many of the references cited in the following text are the same references that are cited by CFBLLC (2003) in the Milltown Dam Operations Internal Draft BA. The discussion of Milltown Reservoir summarizes results of previous environmental assessments (CH2M HILL 2000) that evaluated the potential effects of contaminants present in the reservoir on aquatic receptors in and downstream of the reservoir, including bull trout where data are available.

3.1 Bull Trout Overview

3.1.1 Assessment Area Characteristics

The bull trout assessment area is in the east-central headwaters of the Columbia River in the Rocky Mountains. Based on historical and current bull trout use, the assessment area consists of the Clark Fork River basin upstream of the Flathead River, not including the

Bitterroot River. The Montana Bull Trout Recovery Team (MBTRT 2000) reported that historically, bull trout in the Pend Oreille/Clark Fork drainage probably formed a large metapopulation because there were no migratory barriers upstream of Albeni Falls. Milltown Dam, together with other dams on the lower Clark Fork River, have blocked upstream fish movements and fragmented this historical bull trout range. The Flathead Indians called the area near the confluence of the Clark Fork and Big Blackfoot Rivers “Ai e tem,” which roughly translates as, “more bull trout,” compared to Rattlesnake Creek, whose name meant “many bull trout” (Taylor and Malouf 1976). The Blackfoot and Clark Fork watersheds, with a combined drainage area of about 8,000 square miles, form the west central region of the state of Montana (Bonneville Power Administration 1965).

Fisheries resources in the assessment area were described by several early investigators (Evermann 1892, Gilbert and Evermann 1895). Nine species of fish were reported in western Montana, including bull trout, westslope cutthroat trout (*Oncorhynchus clarki lewisi*), peamouth (*Mylocheilus caurinus*), mountain whitefish (*Prosopium williamsoni*), redbside shiner (*Richardsonius balteatus*), northern pikeminnow (*Ptychocheilus oregonensis*), longnose dace (*Rhinichthys cataractae*), largescale sucker (*Catostomus macrocheilus*), and slimy sculpin (*Cottus cognatus*) (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 trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), and brook trout (*Salvelinus fontinalis*). In addition, naturally reproducing populations of northern pike, a non-native species illegally introduced into Milltown Reservoir, occur in the assessment area. Combinations of human-caused changes in vegetative cover, land and water use, habitat loss, introduced fish species, angler harvest, and decline in water quality have impacted bull trout abundance in western Montana (CFBLLC 2003).

3.1.2 Distribution, Status, and Limiting Factors

Bull trout are distributed throughout the Columbia River Basin, including its headwaters in Montana and Canada (FR 1998). This native species is present in northwestern and western Montana within two major drainages of the Columbia River Basin—the Kootenai River drainage and the Clark Fork River drainage (MBTRT 2000). Bull trout in the Clark Fork River drainage have been physically separated from the rest of the Columbia River population for at least 10,000 years by Albeni Falls—and now Albeni Falls Dam in Idaho, which is 26 miles below Lake Pend Oreille. Historically there were no barriers to fish movement above Albeni Falls, thus the Pend Oreille and Clark Fork drainages formed a large metapopulation of bull trout—perhaps the largest in this species’ historic range. Historically, bull trout migrated from Lake Pend Oreille upstream past Missoula, and also probably migrated up the Flathead, Bitterroot, and Blackfoot Rivers (MBTRT 2000).

Bull trout have generally declined in abundance in the Columbia River Basin and currently occupy only about 45 percent of their historical range (FR 1998, Quigley and Arbelbide 1997). Factors contributing to the overall decline of bull trout include habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, and the introduction of non-native species (FR 1998). The Columbia River DPS of bull trout, which is represented by 141 subpopulations—including those in the

Clark Fork River and its tributaries, was listed as a threatened species under the ESA in 1998 (FR 1998). The FWS has identified 75 of the 141 bull trout subpopulations in the Columbia River DPS as being at risk of extinction from naturally occurring events because of the currently depressed status of these subpopulations (FWS and National Marine Fisheries Service [NMFS] 2000). Remaining important strongholds of bull trout in the Columbia River Basin are generally found in large areas of adjacent connected habitats. These areas include the upper Clark Fork and Flathead Rivers in Montana, the Snake River Basin in the central Idaho mountains, and the Blue Mountains in Washington and Oregon (FR 1998).

Three subpopulations of the Columbia River DPS of bull trout are present in the bull trout assessment area for the Milltown Reservoir Sediments Operable Unit. They are the middle Clark Fork River subpopulation, the upper Clark Fork River subpopulation, and the Blackfoot River subpopulation (FWS 1998). The middle Clark Fork River subpopulation of bull trout occurs in the mainstem Clark Fork River between Thompson Falls Dam and Milltown Dam, and in tributaries to this reach of the Clark Fork, including the lower Flathead River upstream to Kerr Dam – but excluding the Bitterroot River drainage, which supports a separate bull trout subpopulation. The Thompson Falls, Milltown, and Kerr Dams each block upstream fish passage. FWS (1998) stated that the migratory form of bull trout, which was historically common in the middle Clark Fork River, is now rare because of extreme habitat fragmentation. Remaining resident forms of bull trout are present in various tributaries to this reach of the Clark Fork River (FWS 1998).

The upper Clark Fork River subpopulation of bull trout occurs in the mainstem Clark Fork River and tributaries upstream of Milltown Dam, except for the Blackfoot River. Bull trout present in the Blackfoot River, which empties into the Clark Fork River at Milltown Dam, and in its tributaries are part of the Blackfoot River subpopulation. FWS (1998) stated that the migratory form of bull trout was probably historically distributed throughout the upper Clark Fork River drainage. However, today, bull trout in the upper Clark Fork River subpopulation are primarily restricted to resident forms in the headwaters of relatively pristine tributaries and generally are either rare or extinct, except in the Rock Creek drainage basin (CFBLLC 2003). Bull trout were historically widely distributed in the Blackfoot River Basin, but are now extinct in a number of this basin's tributaries and are represented by a single subpopulation. The Blackfoot River Basin is one of the few drainages in Montana where fluvial bull trout are the dominant life history form. Bull trout adfluvial migrant and resident forms also are present in the Blackfoot River subpopulation (CFBLLC 2003). Fluvial bull trout migrate between larger rivers and small streams, while adfluvial bull trout migrate between lakes and tributary streams.

The State of Montana has listed bull trout as a species of concern and, in 1993, initiated a bull trout restoration planning effort. This effort involved a collaborative, interdisciplinary team known as the Montana Bull Trout Restoration Team (MBTRT) with representatives from federal and state agencies, Native American tribes, the private timber industry, and environmental groups; a Montana Bull Trout Scientific Group (MBTSG) to provide technical expertise; and public participation while developing a restoration plan for bull trout in Montana. This planning effort completed status reviews for 12 major conservation areas in Montana, including the middle Clark Fork, upper Clark Fork, and Blackfoot River drainages (MBTSG 1995a, 1995b, and 1996), and a recovery plan titled, *Restoration Plan for Bull Trout in the Clark Fork River Basin and Kootenai River Basin, Montana* (MBTRT 2000). These reports are

cited by CFBLLC (2003) as providing a thorough compendium of bull trout knowledge for the interested reader. As noted previously, the FWS listed the Columbia River DPS of bull trout as a threatened species under the ESA on June 10, 1998 (FR 1998).

3.1.3 Life History Characteristics and Habitat Requirements

Three life history forms of bull trout – fluvial, adfluvial, and resident – occur in the Clark Fork River Basin upstream of the Flathead River (CFBLLC 2003). The Flathead River’s confluence with the Clark Fork River marks the downstream boundary of the bull trout assessment area for this BA. Fluvial (migrate between larger rivers and smaller streams) and adfluvial (migrate between lakes and tributary streams) bull trout generally spawn during early to mid-fall in smaller, low-order tributaries and rear as juveniles for 1 to 4 years before migrating to larger rivers or lakes where they rear to adulthood and overwinter (FR 1998, CFBLLC 2003). Resident, non-migratory bull trout are generally found in headwater streams; are often isolated from other stocks of bull trout by physical barriers; and typically spawn, rear, and complete their life cycle using a single stream or nearby streams (FR 1998).

Bull trout have relatively narrow, specific habitat requirements compared to many of the other salmonid species. These requirements are referred to generally as the four Cs and include the following:

- **Clean Habitat** – This consists of high-quality water with clean gravel riffles and low levels of fine sediment. Bull trout require clean gravels for spawning, and appear to select areas with groundwater upwelling in which to build their spawning redds (Watson and Hillman 1997). Increased sediment delivery to drainages beyond background levels can adversely affect bull trout habitat and survival of incubating eggs (FR 1998).
- **Cold Habitat** – Bull trout thrive in cold waters and can be harmed by water temperatures above about 61°F (Selong et al. 1998). Optimum or preferred thermal conditions for bull trout vary by life stage, but are within the overall water temperature range of about 39 to 55°F (Rieman and McIntyre 1993, EPA 1997).
- **Complex Habitat** – This refers to the degree of habitat diversity and amount of high quality cover. It may include all or some of the following components: high levels of shade, undercut banks, a deep boulder-strewn channel, and abundant woody debris in the stream channel (MBTRT 2000, Selong et al. 1998). Bull trout are strongly associated with these components of habitat diversity and abundant cover (FWS and NMFS 2000).
- **Connected Habitat** – Contiguous migratory corridors within and between larger rivers and smaller streams during different seasons and stream flows are necessary to maintain migratory populations of bull trout, and the upstream and downstream routes and movements of adults and juveniles. Migratory corridors also allow for the dispersal of resident bull trout in the recolonization of recovering habitat (FWS and NMFS 2000).

3.1.4 Proposed Designated Critical Habitat and Draft Recovery Plan

The FWS proposed the designation of critical habitat for the Columbia River DPS on November 29, 2002 (FR 2002). The assessment area for this BA is proposed designated bull

trout critical habitat. To be proposed as critical habitat, an area had to provide one or more of the following three components (FR 2002):

- Spawning, rearing, foraging, or overwintering habitat to support existing bull trout local populations
- Movement corridors necessary for maintaining migratory life history forms, and/or
- Suitable and historically occupied habitat that is essential for recovering existing local populations that have declined, or that is needed to reestablish local populations required for recovery

The FWS (FR 2002) listed nine physical and biological features essential to the conservation of bull trout that were used in identifying critical habitat areas. These features are known as primary constituent elements (PCEs) and were determined from studies of bull trout habitat requirements, life history characteristics, and population biology. The FWS (2002) stated that an area does not have to include all nine of the PCEs to qualify for designation as critical habitat. The nine PCEs are:

1. Permanent clean water having low levels of contaminants such that normal reproduction, growth, and survival are not inhibited
2. Proper water temperatures ranging from 36 to 59°F. With adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will vary depending on bull trout life history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence
3. Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures
4. Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine substrate less than 0.25 inch in diameter and minimal substrate embeddedness are characteristic of these conditions
5. A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, a hydrograph that demonstrates the ability to support bull trout populations
6. Springs, seeps, groundwater sources, and subsurface water connectivity to contribute to water quality and quantity
7. Migratory corridors with minimal physical, biological, or chemical barriers between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows
8. An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish
9. Few or no predatory, interbreeding, or competitive nonnative species present

Subbasin discussions later in this chapter describe instances where PCE conditions are degraded and appear to be limiting bull trout success.

The assessment area for this BA is located in proposed Critical Habitat Unit 2: Clark Fork River Basin (FR 2002). Within this critical habitat unit, portions of the assessment area are located within five smaller critical habitat subunits (CHSUs). The Clark Fork River and its tributary watersheds from the confluence with the Flathead River upstream to the base of Milltown Dam, except for the Bitterroot River drainage, are in the Middle Clark Fork River CHSU. A total of 386 miles on 28 streams is proposed for designation as critical habitat in this subunit. The mainstem Clark Fork in this CHSU provides historically occupied bull trout foraging, migratory, and overwintering (FMO) habitat that is currently occupied but at very low abundance levels. Mainstem tributaries in the Middle Clark Fork River CHSU provide FMO habitat and/or spawning and rearing habitat for bull trout (FR 2002).

The Upper Clark Fork River CHSU includes the entire Clark Fork River upstream from Milltown Dam except for the Blackfoot River, Clearwater River, and Rock Creek drainages, which are in separate CHSUs. A total of 301 miles on 13 streams is proposed for designation as critical habitat in the Upper Clark Fork River subunit. The mainstem Clark Fork in this CHSU provides FMO habitat for bull trout while tributary watersheds provide FMO habitat and/or spawning and rearing habitat for bull trout. This area is important in providing for the maintenance of existing populations and the migratory life history form essential to the long term conservation of bull trout (FR 2002).

The Blackfoot River CHSU and the Clearwater River and Lake Chain CHSU, which are all within the Blackfoot River Subbasin, provide FMO, spawning, and rearing habitat for bull trout. A total of 270 miles on 12 streams in the Blackfoot River CHSU is proposed as designated critical habitat for bull trout. Totals of 97 miles on 9 streams and 3,608 acres in seven lakes in the Clearwater River and Lake Chain CHSU are proposed for designation as critical habitat (FR 2002).

The Rock Creek CHSU includes the entire Rock Creek watershed. Mainstem Rock Creek provides FMO habitat while its tributaries provide spawning and rearing habitat for bull trout. A total of 302 miles on 28 streams is proposed for designation as critical habitat in this subunit (FR 2002). The Federal Register (2002) provides detailed legal descriptions on the location, reaches, and habitat present in drainages within each of the above CHSUs that have been proposed as bull trout critical habitat.

The FWS also announced the availability of the Bull Trout Draft Recovery Plan for the Columbia River DPS on November 29, 2002 (FR 2002). This plan provides information on local bull trout populations and habitat, and recommends actions for their recovery. The assessment area for this BA is within the Upper Clark Fork Recovery Subunit (FWS 2002). This subunit includes the entire Clark Fork River Basin in Montana upstream of the confluence with the Flathead River. Within this recovery subunit, portions of the assessment area are located within five smaller bull trout core areas that align with the CHSUs described above. These core areas are Clark Fork River Section 2 (downstream of Milltown Dam), Clark Fork River Section 1 (upstream of Milltown Dam), Blackfoot River, Clearwater River/Chain Lakes, and Rock Creek (FWS 2002). These core areas and CHSUs generally align with the subbasins and bull trout subpopulations previously described by the FWS (1998) and discussed in the following text in this BA.

3.2 Upper Clark Fork River and Tributaries

3.2.1 Subbasin Characteristics

The upper Clark Fork River extends from Milltown Dam upstream 120 miles to the confluence of Warm Springs and Silver Bow Creeks. Mean annual flow of the upper Clark Fork River varies from 276 cfs at the City of Deer Lodge to 1,272 cfs at the Turah Bridge, 7 miles above Milltown Dam (USGS 1999). Mean annual flow of the Clark Fork River below Milltown Dam for the period 1929 to 1999 is 2,977 cfs (USGS 1999).

Major tributaries to the upper Clark Fork River are Flint Creek, Warm Springs Creek, and Rock Creek, and the Little Blackfoot and Blackfoot Rivers. Surface flows are used primarily for irrigation, municipal and industrial wastewater dilution, stock watering, light industry, hydroelectric power generation, and habitat for trout fisheries. Major land uses are agriculture/ranching, silviculture, mining, residential development, and recreation. Flows in the lower reaches of tributaries in the upper portion of the upper Clark Fork River (from Drummond upstream) are frequently intermittent during the summer because of water diversion for agricultural use. Human-made physical barriers to fish migration and intermittent flows are common in the lower reaches of tributaries in the lower portion of the upper Clark Fork River (from Drummond downstream) (CFBLLC 2003).

Fishery resources in the upper Clark Fork River have been severely impacted by extensive poor practices in mining, municipal wastewater treatment, agriculture, transportation systems, and silviculture. An instream flow reservation for maintaining fishery resources in the upper Clark Fork River basin is pending (CFBLLC 2003). Bull trout are limited to headwater areas of streams and are primarily of the resident life form, except for populations in Rock Creek and the Blackfoot River. Headwater populations of bull trout are isolated from one another because of human-created barriers to fish movement (MBTSG 1995a).

3.2.2 Bull Trout Distribution, Status, and Limiting Factors

Historically, fluvial bull trout probably occurred throughout the upper Clark Fork River subbasin (MBTRT 2000). Currently, however, bull trout populations in this subbasin are highly depressed except in the Blackfoot River and Rock Creek drainages (discussed separately in Sections 3.4 and 3.5, respectively; MBTSG 1995a). Radio telemetry data for bull trout trapped below and released above Milltown Dam show they use the mainstem Clark Fork River between the Blackfoot River and Rock Creek (Swanberg 1996, Schmetterling 2000). Bull trout are rare farther upstream in the mainstem Clark Fork River between Rock Creek and Warm Springs Creek. Populations of bull trout identified in tributaries to the upper Clark Fork River include those in the Little Blackfoot River, Rock (Clinton), Harvey, Barker, Cable, Dog, Twin Lakes, Warm Springs, Lost, Foster, Racetrack, Schwartz, Flint, Boulder, South Boulder, and Copper Creeks. Bull trout populations in these tributaries are considered to be stable or declining (MBTSG 1995a, Montana River Information System [MRIS] 2000).

MBTSG evaluated risks to bull trout in the upper Clark Fork River based on the degree a risk factor was presumed to contribute to past and current declines, as well as the future restoration potential of bull trout (CFBLLC 2003). High risk factors include current and

historic water pollution associated with mining; stream dewatering for agriculture; interactions with non-native fish species; degraded stream and riparian habitat from grazing, roads, forestry, municipal wastewater treatment, and highways; high water temperatures from several sources; habitat fragmentation caused by the previously listed risks; and Milltown Dam (MBTSG 1995a, MBTRT 2000). Risk factors are being addressed through regional restoration activities in the upper Clark Fork River basin. These activities include the remedial action (Proposed Action) being addressed in this BA, other Superfund remedial actions that would be implemented in adjacent Operable Units, State Natural Resources Damage Assessment restoration expenditures, and other restoration programs. The goal of these restoration activities is to restore injured resources to a baseline condition. However, the degree of risk reduction to bull trout from completing these restoration activities is unknown (CFBLLC 2003). It is unknown whether any components of the Milltown Project Fisheries Protection, Mitigation, and Enhancement (PM&E) Plan will be continued once the Proposed Action is implemented.

Re-establishing populations of fluvial bull trout in the upper Clark Fork River subbasin is a key component of restoring the upper Clark Fork River subpopulation of bull trout. Fluvial bull trout use the mainstem of large river systems to over-winter, rear as sub-adults, and migrate, as well as escape from and survive catastrophic events that occur in smaller tributary drainages (MBTSG 1995a, MBTRT 2000).

3.2.3 Bull Trout Life History Characteristics

Currently, bull trout in the upper Clark Fork River subbasin are primarily restricted to tributary streams. Exceptions are Rock Creek (near Clinton) and the Blackfoot River, which are discussed later in this section. “Resident” bull trout spend their lives in the tributary stream. Some migratory bull trout travel through the upper Clark Fork River from Milltown Reservoir to Rock Creek (Swanberg 1996, Schmetterling 2000). However, they are rarely found farther upstream in the mainstem upper Clark Fork River. Juvenile bull trout that were found in stomachs of northern pike in May and June of 2000, together with winter catches of bull trout by anglers in Milltown Reservoir, also indicate use of the reservoir by migratory and over-wintering bull trout. Juvenile bull trout in Milltown Reservoir are probably migrants from the Blackfoot River tributaries and Rock Creek or its tributaries. Radio telemetry tracking of bull trout captured below and released upstream of Milltown Dam during normal spawning migrations showed upstream movements into tributaries of the Blackfoot River and Rock Creek (CFBLLC 2003).

3.2.4 Summary

Bull trout are rarely observed in the mainstem Clark Fork River upstream of Rock Creek. This river reach has water quality and habitat limitations that currently exceed bull trout tolerances (CFBLLC 2003). Other populations of bull trout in this subbasin occur in isolated tributaries to the upper Clark Fork River and in the Rock Creek drainage. Preservation and expansion of existing populations, which have been described as stable or declining, are key to restoring the upper Clark Fork River bull trout subpopulation. Bull trout in the upper Clark Fork River subbasin will continue to be vulnerable to further declines caused by random environmental disturbances, reduced genetic integrity, and low population levels (CFBLLC 2003).

3.3 Middle Clark Fork River and Tributaries

3.3.1 Subbasin Characteristics

The middle Clark Fork River extends from Milltown Dam downstream 119 miles to the Flathead River (BPA 1965). Mean annual flow of the middle Clark Fork River downstream of the St. Regis River (period of record 1930 to present) is 7,253 cfs (USGS 1999). The Bitterroot River, with a mean annual flow of 4,864 cfs, is the largest tributary to the middle Clark Fork River.

The Clark Fork River flows through a deeply entrenched channel from Milltown Dam to Missoula. The river channel and floodplain through Missoula have been extensively altered by the Army Corps of Engineers flood control levees that were built in the 1960s. The river braids and accesses its floodplain at the west edge of Missoula, where the Bitterroot River enters the Clark Fork. Surface waters in the middle Clark Fork River basin are used primarily for irrigation, municipal and industrial water discharge dilution, stock watering, hydroelectric power generation, recreational floating, and habitat for trout fisheries. The major land uses are agriculture, silviculture, and municipal and residential development (CFBLLC 2003).

Rainbow trout are the most abundant salmonid in the middle Clark Fork with fewer numbers of brown trout, westslope cutthroat trout, and bull trout present (Berg 1991). Densities of rainbow trout varied from 170 to 681 catchable fish (greater than 8 inches long) per mile of river (Berg 1992). High growth rates of rainbow trout in the middle Clark Fork River compared to other large streams in western Montana indicate adequate food and space for good growth (Berg 1992, Chapman 1966). Other fish species present in the middle Clark Fork River include brook trout, mountain whitefish, peamouth, northern pikeminnow, longnose dace, redbside shiner, longnose sucker (*Catostomus catostomus*), largescale sucker, and slimy sculpin, as well as the non-native northern pike, largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), yellow perch (*Perca flavescens*), and pumpkinseed (*Lepomis gibbosus*). Westslope cutthroat trout and brook trout were the most widely distributed fish species in 11 of 13 tributaries sampled in the middle Clark Fork River basin during the mid-1980s (Berg 1986).

3.3.2 Bull Trout Distribution, Status, and Limiting Factors

The current distribution of bull trout in the middle Clark Fork River subbasin is greatly reduced from historic levels. Core areas presently supporting key life history functions for bull trout populations in this subbasin are Fish, Trout, Cedar, Petty, Mission, Post, Fishtrap, Albert, and Rattlesnake Creeks, the St. Regis River, and the West Fork of the Thompson River. Areas used seasonally by bull trout for key life history functions include the Thompson, Flathead, and Clark Fork Rivers (CFBLLC 2003).

Primary risks to the middle Clark Fork River subpopulation of bull trout are mainstem dams, which limit this species' migrations, and historic and potential water quality degradation from agricultural and timber harvest practices (MBTSG 1996). Five hydroelectric dams have fragmented and isolated the Clark Fork and Flathead River systems. Other factors that have contributed to bull trout decline in the middle Clark Fork

River subbasins include illegal introductions of non-native fish, fish management, mining, dam operations, transportation systems, and illegal harvest (MBTSG 1996).

Water temperatures in the middle Clark Fork River annually exceed the preferred temperature range for bull trout during portions of July and August. During periods of high water temperatures, bull trout are found in the middle Clark Fork River in thermal plumes of coldwater tributaries or groundwater inflow areas (Swanberg 1997, Peters 1983). Natural or irrigation-related intermittent-flow reaches occur in the summer in most of the smaller tributaries to the middle Clark Fork. Physical barriers to fish migration resulting from channel alterations, transportation systems, or irrigation dams also occur in many of the smaller tributaries (CFBLLC 2003).

In June 1984, the Montana Department of Fish, Wildlife, and Parks (MDFWP) collected 39 bull trout with lengths ranging from 8 to 31 inches in a 13.7-mile-long section of the middle Clark Fork River near Superior, Montana. Bull trout density was 2.8 fish per mile in this river section (CFBLLC 2003). MDFWP also collected two bull trout downstream of Milltown Dam in June 1984. In 1999, MDFWP estimated that bull trout density downstream of Milltown Dam was two fish per river mile (Schmetterling and Knotek 1999 unpublished data, in CFBLLC 2003).

Creel census results for the Clark Fork River from Rock Creek to the Flathead River (135.8 miles) during the 1995 fishing season showed that approximately 1 percent (1,477 fish) of the total catch of 147,691 fish were bull trout (Peters and Schmetterling 1996). The density estimate of about 10 bull trout per river mile is high compared to a previous estimate of 1.2 bull trout per river mile (Peters 1985, in CFBLLC 2003). The catch of 1,477 bull trout and the correspondingly high density estimate may reflect multiple captures of individual fish—possibly because of their relatively high catchability, as well as angler misidentification of bull trout (CFBLLC 2003).

3.3.3 Bull Trout Life History Characteristics

Fluvial and adfluvial forms of bull trout occur in the middle Clark Fork River from Milltown Dam downstream to the Flathead River (CFBLLC 2003). Anglers caught large fluvial bull trout near the mouths of Petty, Fish, Rattlesnake, and Trout Creeks during the 1980s, and MDFWP biologists have confirmed migrations of fluvial bull trout into Rattlesnake Creek up to the Mountain Water Supply dam and fish passage barrier (Schmetterling and Swanberg 1998 unpublished data, in CFBLLC 2003).

Bull trout have been found in 8 of 14 primary tributary streams to the middle Clark Fork River, including Rattlesnake, Petty, Cedar, Albert, Grant, Tamarack, and Fish Creeks and the St. Regis River (CFBLLC 2003). In addition to these locations, an angler reported catching a subadult bull trout in Ninemile Creek in the mid-1990s, a concentration of spawning bull trout was reported in Cache Creek in the early 1970s, and fluvial bull trout have been observed spawning in Montana Creek and in North Fork of Fish, West Fork of Fish, and Straight Creeks. In 1980, 26 bull trout between 5 and 22 inches long were captured in Fish Creek near Beaver Slough (CFBLLC 2003).

3.3.4 Summary

Bull trout were historically widely distributed throughout the middle Clark Fork River subbasin via a network of complex and connected habitats that included large streams, Pend Oreille and Flathead Lakes, and numerous tributaries. Monitoring of bull trout populations in the middle Clark Fork River subbasin has been limited; however, MDFWP reassigned a biologist to this segment of the Clark Fork River in 1999, which should improve opportunities for future evaluations. Research by MDFWP in this river reach since 1999 has not revealed any additional decline or improvement in bull trout status (CFBLLC 2003).

3.4 Blackfoot River and Tributaries

3.4.1 Subbasin Characteristics

The Blackfoot River flows 132 miles from the Continental Divide near Rogers Pass to its confluence with the upper Clark Fork River immediately upstream of Milltown Dam. Its mean annual flow is 1,598 cfs near Bonner, Montana, for the period of record (1898 to 1999) (USGS 1999). The Blackfoot River subbasin contains 1,900 miles of perennial streams capable of supporting fish (Pierce and Schmetterling 1999).

Tributaries to the Blackfoot River can be grouped as occurring east of the Clearwater River, west of the Clearwater River, or south of the Blackfoot River. Tributaries east of the Clearwater River begin in high alpine basins, flow south through glaciated valleys and vast coniferous forests, then enter prairie and agricultural land. Tributaries west of the Clearwater River have valley and stream types similar to those from the east, but they do not enter glacial outwash or morainal deposits in the Blackfoot Valley and are not greatly influenced by groundwater. South of the Blackfoot River, the Garnet Mountain Range is formed from two mountain blocks divided by the Nevada Creek Valley. This range is much lower in elevation than the northern side of the valley, and its drainages are smaller and yield much less water than streams to the north (Pierce et al. 1997).

Approximately 56 percent of the land in the Blackfoot River subbasin is publicly owned (U.S. Forest Service, Bureau of Land Management, and State of Montana), and 44 percent is privately owned (approximately half of which belongs to Plum Creek Timber Company). Public lands and Plum Creek Timber Company properties account for most of the forested mountainous areas, while the other private ownership occupies the foothills and valleys (CFBLLC 2003).

Twelve native fish species, 12 introduced fish species, and hybrids of westslope cutthroat x rainbow trout, Yellowstone cutthroat x westslope cutthroat trout, brook x brown trout, and bull x brook trout occur in the Blackfoot River drainage (Pierce et al. 1997). The native species are bull trout, westslope cutthroat trout, mountain whitefish, northern pikeminnow, longnose sucker, largescale sucker, slimy sculpin, mottled sculpin (*Cottus bairdi*), peamouth, pygmy whitefish (*Prosopium coulteri*), reidside shiner, and longnose dace. Introduced species include rainbow trout, brown trout, brook trout, Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), Arctic grayling (*Thymallus arcticus*), kokanee salmon (*Oncorhynchus nerka*), northern pike, pumpkinseed, largemouth bass, walleye (*Stizostedion vitreum*), white sucker (*Catostomus commersoni*), and fathead minnow (*Pimephales promelas*). Depending on the reach of the Blackfoot River, the most abundant trout species are westslope cutthroat trout, brook

trout, brown trout, and rainbow trout. Key bull trout habitat present in the Blackfoot River includes year-round rearing habitat for subadult life stages, wintering habitat for subadult and mature life stages, year-round habitat for adults, and a year-round migration corridor (CFBLLC 2003).

Three major problems were identified in basin-wide fishery evaluations conducted in 1988 and 1989 (Peters 1990). They included tributary stream degradation from numerous causes; mining wastes entering the headwaters; and over-harvest of fish by anglers. Changes in fishing regulations beginning in 1990 by the Montana Fish and Game Commission addressed initial over-harvest concerns. Low numbers of bull trout and westslope cutthroat trout were provided additional protection (prior to bull trout being federally listed as a threatened species) with a no-harvest limit throughout the drainage. Degraded tributary streams were initially addressed through the Blackfoot River Restoration Project, which began in 1990. Restoration activities continue today. The Big Blackfoot Chapter of Trout Unlimited, the Montana Department of Fish, Wildlife, and Parks, FWS-Partners for Fish and Wildlife, and private landowners in the Blackfoot River Valley continue to work cooperatively restoring degraded habitats. These groups are actively involved in river, range, and riparian restoration; wetland conservation; promoting best management practices (BMPs) for all land management activities; conservation easements; and education.

3.4.2 Bull Trout Distribution, Status, and Limiting Factors

Historically, bull trout were probably widely distributed throughout the Blackfoot River subbasin. Evermann (1892) stated that in the 1890s, bull trout were common in most of the larger rivers of the Columbia River drainage in Montana, including the Blackfoot River. Long-distance migrations of bull trout similar to those that would have been necessary to achieve reported historical movements in the Clark Fork River have been documented in the Flathead River, Montana and in the Salmon River, Idaho. In the Middle Fork Salmon River, for example, bull trout migrate up to 201 miles (Bjornn and Mallet 1964, in CFBLLC 2003).

Today, two apparently geographically separate, but genetically identical populations of bull trout occur in the Blackfoot River subbasin—one in the headwaters from Alice Creek to Nevada Creek, and the other from the North Fork of the Blackfoot River downstream into the Clark Fork River. Poor water quality in the mainstem Blackfoot River from Nevada Creek to the North Fork of the Blackfoot River is the only known potential barrier separating these two populations of bull trout (CFBLLC 2003).

The Blackfoot River supports one of the better populations of fluvial bull trout within this species' range. However, fisheries investigations over the past two decades have revealed low population densities throughout the drainage and loss of some known spawning populations (Peters 1985, Peters and Spoon 1989, Peters 1990, Pierce et al. 1997, in CFBLLC 2003). The MBTSG (1995b) status report concluded that bull trout status in the Blackfoot River drainage appears to be "precarious." The MBTSG identified seven core areas in this drainage that provided the best remaining spawning opportunities for bull trout. In 1996, 88 percent of known fluvial bull trout spawning occurred in only three tributary streams: Monture Creek, the North Fork of the Blackfoot River, and Copper Creek. Six additional tributaries provided limited spawning opportunities for fluvial fish (Pierce et al. 1997, Pierce and Podner 2000, in CFBLLC 2003).

Data suggest a trend of improved bull trout status in several subbasin drainages. From 1989 to 2000, bull trout redd counts increased from 10 to 86 in Monture Creek and from 7 to 123 in the North Fork of the Blackfoot River (Pierce and Podner 2000 and Pierce et al. 2001, in CFBLLC 2003). Juvenile bull trout populations also have increased substantively in both of these drainages. In Copper Creek, redd counts have remained stable throughout the same time period. Substantive increases in spawning activity have not been observed in secondary spawning streams (CFBLLC 2003).

Bull trout were found throughout most of the upper Blackfoot River drainage during investigations conducted in 1996, with the highest densities in Copper Creek (Hillman and Chapman 1996, in CFBLLC 2003); however, much of the Blackfoot and Landers Fork channel in the area was characterized as unstable, aggraded, and with habitat limitations, including a lack of instream cover. Pierce and Podner (2000, in CFBLLC 2003) reported that single-pass electrofishing catches of bull trout ranging from 2.4 to 8.5 inches long varied from 21 to 185 fish per river mile in the area.

High risk factors to bull trout sustainability in the Blackfoot River drainage include: mining, introduced fish species, habitat degradation from poor forest practices, poor grazing practices, rural residential development and detrimental water management practices, fish management activities, and habitat fragmentation caused by dams, road-crossing structures (e.g., culverts), and poor water and habitat quality (CFBLLC 2003). Actual and potential mining risks to bull trout in the Blackfoot River drainage are primarily associated with past mining activities in the basin (MBTSG 1995b).

Key bull trout habitats have been altered by many different activities in the Blackfoot River subbasin (CFBLLC 2003). Forestry practices have improved greatly over the last several decades. However, historical practices and some current practices interrupted long-term natural cycles key to bull trout habitat requirements. For instance, loss of and reduced recruitment of large woody debris and changes in stream channel morphology can result in increased maximum water temperatures, and the loss of other key habitat features. These conditions do not change immediately in response to a change in management practices, and without intervention may take centuries to recover (CFBLLC 2003). Poor grazing practices can alter streamside vegetation, stream channel morphology, and many other bull trout habitat requirements for extended recovery periods without intervention. Water management practices may be one of the most underestimated causes of impacts on bull trout in the Blackfoot River subbasin, because of fish entrainment and mortality in irrigation systems and blockage of bull trout movements (Pierce et al. 1997, in CFBLLC 2003). Residential development can adversely impact bull trout in many ways, including urbanization of stream banks, nutrient loading, altered hydrology, and changing valley and land use patterns.

Widespread forest canopy removal, loss of streamside shading vegetation, widened stream channels, and warm irrigation return flows have altered the historical temperature regimes in the Blackfoot and Clark Fork River drainages (CFBLLC 2003). The magnitude of temperature increases is unknown because of the lack of historical temperature data, but it is expected at some level to have contributed to temperature regimes in the Blackfoot and Clark Fork rivers that now exceed the preferred temperature range of bull trout. These water temperature alterations may be critical to the persistence of bull trout (Pierce et al. 1997, in CFBLLC 2003).

Reiman and McIntyre (1993) believe bull trout distribution is limited to areas where water temperatures are maintained at less than 59°F. Daily maximum water temperatures at five monitoring stations in the Blackfoot River exceeded 60°F annually from 1994 through 1996 (CFBLLC 2003). Water temperatures that exceed the preferred temperature of bull trout may cause high mortality rates (Selong et al. 1998). Crowding of bull trout in thermal refuges also exposes the fish to added competition, stress, predation, and illegal harvest (CFBLLC 2003).

Man-made structures that impede movements of migratory species pose a significant risk to fluvial bull trout in the Blackfoot River drainage. The Milltown Project, Inez fish barrier, and Rainy Lake fish barrier are three examples of barriers to bull trout movement (CFBLLC 2003). The Milltown PM&E Plan began trapping and hauling bull trout over Milltown Dam in 1999. However, in most years trapping bull trout during their spawning migrations on the descending limb of the hydrograph is not possible with the existing facility. Improperly designed road-crossing structures, poor water quality, and long sections of poor habitat also have impeded movements of bull trout in the Blackfoot River drainage (CFBLLC 2003).

Introduced fish species (brook, brown, and rainbow trout) represent risks to bull trout through hybridization (brook trout), predation, and competition (CFBLLC 2003). Fish management activities by MDFWP, including fish stocking and fishing regulations, also may pose a risk to bull trout. Fishing regulations for rainbow and brown trout were designed to meet the goal of maximizing numbers of adult-sized fish. It is unknown whether this action has a positive or negative impact on bull trout (CFBLLC 2003).

Non-compliance with a no-keep limit and with a no-intentional-fishing regulation for bull trout causes losses of bull trout in the Blackfoot River. A creel census completed in 1999 found that 8.2 percent of bull trout caught by anglers were harvested in the Blackfoot River (Schmetterling and Bohneman 2000). Angler inability to correctly identify bull trout contributes to this illegal harvest. Only 44 percent of anglers surveyed in west-central Montana correctly identified bull trout (Schmetterling and Long 1999).

Many bull trout restoration activities have been implemented in the Blackfoot River subbasin by several government agencies, private organizations, and individual landowners (CFBLLC 2003). Restoration efforts have occurred in five of the seven core areas in this subbasin and in other streams that historically supported bull trout (Pierce et al. 1997, Pierce and Schmetterling 1999, Pierce and Podner 2000, in CFBLLC 2003). Restoration activities have included placing fish screens on irrigation canal intakes, modifying riparian livestock management practices, removing barriers to fish movement, restoring habitat and controlling erosion, increasing stream flows, protecting spawning areas, and establishing perpetual conservation easements for managing land surfaces (CFBLLC 2003).

3.4.3 Bull Trout Life History Characteristics

Bull trout in the Blackfoot River drainage exhibit all three life history forms. Fluvial bull trout are most common, completing their life cycle in the Blackfoot River, Clark Fork River, and second or third order tributaries to the Blackfoot River (Pierce et al. 1997, in CFBLLC 2003). Bull trout in the upper Blackfoot River begin their upstream spawning migration in late July, later than bull trout in the lower Blackfoot River. Upper Blackfoot River fish migrate a much shorter distance than lower river fish, perhaps explaining the later migratory movements. Both groups of fish use spawning tributaries for approximately 64 to

67 days on average (Swanberg and Burns 1997). Adfluvial bull trout are present in the Clearwater drainage and lakes, and have recently been described as representing a separate core area within the Blackfoot River subbasin (FWS 2002, FR 2002). Bull trout in the Clearwater/Chain Lakes core area spawn and rear in tributaries, otherwise residing as subadults and adults in the lakes (CFBLLC 2003).

Adult bull trout exhibit two types of downstream migratory behavior following spawning. Bull trout in the North Fork of the Blackfoot move downstream slowly throughout the winter. Fish from other tributary streams return rapidly to the exact location they occupied in the spring prior to their spawning migration. An intermittent river reach downstream of spawning areas in the North Fork of the Blackfoot, together with local adaptation by bull trout, may explain the delayed downstream movements of bull trout adults in the North Fork (CFBLLC 2003). In addition to these movements, 8 percent of bull trout radio-tagged in the Blackfoot River moved downstream of Milltown Dam during the summer. These fish were larger than the non-migratory fish that remained in the mainstem over the summer. Bull trout that moved over Milltown Dam were probably sexually mature (Swanberg 1997).

Bull trout eggs incubate in stream gravels of spawning redds over the winter. Fry emerge the following spring generally from March to May, depending on local conditions (Weaver and White 1985, Weaver and Fraley 1991, Pierce et al. 1997, in CFBLLC 2003). Juvenile bull trout appear to have multiple strategies for survival, most commonly dispersing in spawning streams, or moving to non-spawning streams (Peters 1990, Pierce et al. 1997, Pierce and Schmetterling 1999, Pierce and Podner 2000, in CFBLLC 2003). Juveniles also disperse downstream as young-of-the-year from spawning tributaries into non-spawning tributaries.

3.4.4 Summary

Densities of adult and subadult bull trout in the lower Blackfoot River have been relatively low for the past decade. There have been substantive increases in the numbers of spawning and rearing juvenile bull trout in two key spawning streams – the North Fork of the Blackfoot and Monture Creek. In addition, pioneering of juvenile fish into currently unoccupied but historical spawning streams could eventually result in range expansion. Bull trout are a long-lived species, requiring from 5 to 7 years before females reach sexual maturity. Thus, long time periods are needed to fully understand current bull trout activities and trends. The lower Blackfoot River bull trout population with only two major spawning sites, and the upper Blackfoot River bull trout population with only one major spawning site remain at risk. In addition, bull trout spawning in some of the historically significant spawning streams that are tributary to the Blackfoot River, such as Belmont and Gold Creeks, may be lost because of very low population densities (CFBLLC 2003).

3.5 Rock Creek and Tributaries

3.5.1 Subbasin Characteristics

Rock Creek is 51 miles long and empties into the upper Clark Fork River near the town of Clinton. Mean annual flow of Rock Creek near its mouth is 542 cfs for the period of record (1973 to 1999). The headwater reaches of Rock Creek consist of its four main forks (West,

East, Ross, and Middle). The East Fork has an irrigation dam approximately 7 miles upstream of its confluence with the Middle Fork. Land uses important to this subbasin include watershed maintenance, silviculture, livestock forage production, hunting, fishing, hiking, mining, and sightseeing. Land ownership in the Rock Creek subbasin is 83 percent public and 17 percent private (MBTSG 1995a).

3.5.2 Bull Trout Distribution, Status, and Limiting Factors

Bull trout occur in all sections of the Rock Creek drainage, but are more common in the upper portion of the drainage (upstream of Welcome Creek). Tributaries known to contain bull trout include Gilbert, Brewster, Ranch, Spring, Welcome, Butte Cabin, Wahlquist, Cinnamon Bear, Cougar, Hogback, Wyman, Alder, Stoney, Little Stoney, Upper Willow, West Fork, Sand Basin, Boles, Moose Meadow, Middle Fork, Ross Fork, East Fork, Copper, Meadow, Carpp, and Meyers Creeks. The ability of migratory bull trout to access these tributary streams has contributed to the Rock Creek drainage's status as a bull trout stronghold (CFBLLC 2003).

Annual redd counts in key reference spawning reaches have been used to monitor bull trout populations in the Rock Creek drainage. From 1996 through 1999, the total annual count of bull trout redds in the Rock Creek drainage varied from 363 to 670 redds (CFBLLC 2003). Total annual redd counts in key reference spawning reaches of mainstem tributaries ranged from 110 to 168 redds during this same time. Wyman Gulch, Welcome, Ranch, Alder, Stony, and Little Stony Creeks consistently had the most redds counted among the mainstem reference tributaries (Reiland and Gerdes 2000 unpublished data, in CFBLLC 2003). The Middle Fork of Rock Creek and contributing tributary streams, including Carpp, Copper, and Meyers Creeks, consistently had the highest redd counts in the drainage (CFBLLC 2003).

Water temperatures in mainstem Rock Creek can exceed 70°F during late July or early August (Schmetterling 2000 unpublished data, Carnefix and Reiland 2000, in CFBLLC 2003). Possible causes of elevated temperatures and potential adverse effects on bull trout are similar to those described for the Blackfoot River drainage. Channel braiding has occurred in significant sections of Rock Creek over the last 30 years and also can contribute to elevated temperatures. Habitat in the Middle and West Forks of Rock Creek is in poor condition, as indicated by few pools (less than 9 percent of the total available channel habitat) and sparse in-channel large woody debris (less than 1.3 pieces per mile) (Carnefix and Reiland 2000).

3.5.3 Bull Trout Life History Characteristics

Bull trout in mainstem Rock Creek exhibit resident, fluvial, and adfluvial life history forms. Adfluvial bull trout occur in East Fork Reservoir on the East Fork of Rock Creek. Fluvial and resident bull trout occur in tributaries to Rock Creek. Fluvial bull trout from Rock Creek enter tributary streams as early as April and as late as July, but for reasons apparently unrelated to spawning—perhaps as refuge from high stream flows (Carnefix and Reiland 2000). These same fish subsequently spawn in tributaries other than where they initially moved. Spawning-related movements appear to begin in mid-June. Bull trout from Rock Creek spawn in tributary streams in early September, then return to their original spring tagging locations in Rock Creek by mid-October.

Adult bull trout from Rock Creek also have been recovered downstream of Milltown Dam, as indicated by radio tracking studies (Swanberg 1996, Schmetterling 2000 unpublished data, in CFBLLC 2003). From early June to August these bull trout move to spawning areas in Welcome Creek and Copper Creek within the Rock Creek drainage (CFBLLC 2003).

Eighty percent of radio-tagged bull trout use the same or overlapping over-wintering ranges in successive years (Carnefix and Reiland 2000). Primary over-wintering habitat for bull trout consists of pools with cobble and gravel substrates and cover provided by overhanging vegetation, deep water, undercut banks, and large woody debris (CFBLLC 2003).

3.5.4 Summary

Rock Creek supports one of the best fluvial bull trout populations in the Clark Fork River basin. Numerous interconnected tributaries and relatively good habitat conditions in several tributaries provide opportunities for spawning, summer thermal refuge, and year-round rearing that contribute to the well-being of bull trout. However, habitat in some sections of Rock Creek and its tributaries is in poor condition. High water temperatures in Rock Creek during July and August limit available habitat for bull trout and also may contribute to high mortality rates subsequently observed for spawning and post-spawning fish (CFBLLC 2003).

Downstream movement of bull trout over Milltown Dam has been documented for Rock Creek fish. The magnitude of movement is difficult to evaluate because of the physical limitations on sampling fish in a river as large and complex as the Clark Fork. However, possible movements of juveniles over Milltown Dam may be a factor preventing tributaries in lower Rock Creek from showing improving trends similar to upper Rock Creek tributaries. It has not been determined if juvenile bull trout in lower Rock Creek tributaries move downstream as far as upper Rock Creek bull trout. If they do, most of the immigrating juvenile fish from the lower tributaries would travel downstream of Milltown Dam (CFBLLC 2003).

3.6 Milltown Reservoir

3.6.1 Reservoir Characteristics

Milltown Reservoir was created by the construction of Milltown Dam from 1905 to 1907. The dam is located at the confluence of the Clark Fork and Blackfoot Rivers. Milltown Reservoir has a surface area of 180 acres and an estimated current storage capacity of 820 acre-feet at the normal operating elevation of 3259.8 feet above mean sea level (Curtis 1984). Aquatic habitat in the reservoir consists of extensive areas where water is less than 4 feet deep (WISI 2000). Milltown Dam is managed as a run-of-the-river facility, which maintains a relatively stable water elevation in the reservoir. The estimated water retention time in the reservoir is 3.4 hours. An inflow of only 1,200 cfs during low-flow periods increases the estimated retention time to about 8 hours, which is equivalent to the reservoir refilling three times daily.

Dam rehabilitation work completed from 1986 to 1989 restricts reservoir draw down to about 12 feet below normal operating pool, depending on reservoir inflows. During high

water, maintenance, or emergency situations, such as the 1996 ice flow event, stanchions on the spillway can be tripped to increase spill capacity. The reservoir must be drafted at least 6 feet below normal operating elevation to reset the stanchions.

Since the construction of Milltown Dam, sediment transported by the upper Clark Fork River, the Blackfoot River, and their tributaries began settling in Milltown Reservoir. Mining activities in the Butte and Anaconda areas have released an estimated 19 million cubic yards of metals-contaminated tailings and sludge into the Clark Fork River (ARCO 1998). This material has been incorporated into the river bed, floodplain, and Milltown Reservoir (Brook and Moore 1988, and Johnson and Schmidt 1988). Harding Lawson Associates (1987) estimated that 6.6 million cubic yards of sediment have deposited in the reservoir. The concentration of metals in these sediments varies with depth of sediment, size of sediment particles, and location. Over the long term, sediment and metals input to Milltown Reservoir is balanced by output (Lambing 1998).

Bull trout in the BA assessment area are potentially exposed to dissolved and particulate contaminants associated with tailings, mine, and milling wastes that have been transported downstream from the upper Clark Fork River drainage. Bull trout can be exposed to these contaminants in the water column, in reservoir sediments, and in foods they consume (e.g., benthic invertebrates and fish). The EPA defined five contaminants in the Milltown Reservoir area as being ecological chemicals of potential concern (ECOPC) to aquatic receptors in water and sediment. The five ECOPC are arsenic, cadmium, copper, lead, and zinc (CH2M HILL 2000). Results of baseline and addendum ecological risk assessments that evaluated the potential effects of contaminants in Milltown Reservoir on aquatic receptors are summarized below. Other Milltown Dam and Reservoir-related effects on bull trout associated with upstream and downstream fish passage, reservoir habitat and drawdown, and northern pike that were discussed in previous sections of this chapter and/or in Section 1.1, *Background and History*, of Chapter 1 are noted in the following discussion.

3.6.2 Results of Milltown Reservoir Baseline Ecological Risk Assessment

Previous environmental assessments related to contaminants in Milltown Reservoir indicated low to moderate risks to aquatic receptors in Milltown Reservoir (ETI 1993) and little to no risks to aquatic receptors downstream of Milltown Dam (ETI 1994). The following italicized text, paraphrased from CH2M HILL (2000), summarizes some of the findings of the Milltown Reservoir Baseline Ecological Risk Assessment (ETI 1993) as they relate to aquatic habitat and receptors during typical meteorological conditions and normal operation of Milltown Dam. These findings help define aquatic baseline conditions in the assessment area and are valuable in assessing the potential effects of the Proposed Action on bull trout.

Biological Effects Assessment of Aquatic Habitat

Aquatic habitat in Milltown Reservoir was evaluated by sediment toxicity bioassays and toxicity tests with emergent vegetation and amphibians.

*Whole sediment samples were toxic to aquatic species. Sensitivity to sediments was ranked from most to least sensitive as *Hyalella azteca* > *Chironomus riparius* > Rainbow trout > *Daphnia magna*.*

Amphipod toxicity tests identified sediment from six of seven reservoir stations as toxic (toxicity expressed as sublethal effects with a shift to metals-tolerant taxa rather than decreased abundance or diversity, and decreased amphipod length and/or sexual maturation compared to controls).

Limited toxicity bioassays on amphibians using reservoir surface waters demonstrated no acute effects on survival or growth. Morphological effects were noted in specimens exposed to samples with elevated concentrations.

Subtle effects such as stimulation of shoot growth and of peroxidase enzyme were observed with emergent aquatic plants exposed to sediments from two of six locations tested.

Ecological Studies of Aquatic Habitat

Ecological studies of the aquatic environment consist of the benthic community structure analysis performed by FWS (Ingersoll, et al. 1993) in conjunction with the sediment toxicity studies, observations of aquatic plants and amphibians from the wildlife survey, and semiquantitative fish population studies for Milltown Reservoir.

Benthic organisms were present at all depositional stations in the reservoir. Total abundance of organisms did not correlate with concentrations of metals in the sediment samples.

Oligochaeta and Chironomidae accounted for over 90 percent of the benthic invertebrate community abundance at all stations in the reservoir. Taxa were primarily pollution tolerant; no intolerant species of Oligochaeta were collected at any stations.

Higher numbers of Chironomidae genera were present at stations with higher concentrations of metals in sediment samples. Scientific literature suggests that the numbers of Chironomidae genera increase in response to metal or organic contamination. (Note, however, that the total number of invertebrate taxa also was higher at more contaminated locations.)

Limited visual observations of aquatic plant communities suggested relatively high biomass and species diversity of emergent plants in the reservoir.

Limited visual observations of amphibians suggested good species abundance.

Fish populations in Milltown Reservoir, especially of trout, are lower than in other sections of the Clark Fork River of comparable length. Population impacts are primarily due to the effect of Milltown Dam on migration and food sources, with some contribution from exposure to metals-contaminated invertebrates as food sources.

Ecological Risks to Aquatic Habitat

Risks to the aquatic environment at Milltown Reservoir for sediment benthos and fish are summarized in the following text. The evaluation of risks to fish is limited to reservoir populations.

Sediment Benthos

Sediment benthos were assessed by evaluating and ranking results of sediment chemistry, benthic community structure, and sediment toxicity.

Samples from two of seven locations in the reservoir were classified as having elevated chemistry, toxicity, and impacted benthos, i.e., evidence of metals-induced degradation. Both these stations were also under oxidizing conditions.

Samples from another location with elevated chemistry were classified as showing no evidence of metals-induced degradation.

Samples from three locations with relatively low metals contamination were classified as toxic, but toxicity may be partially related to something other than metals, such as ammonia concentrations in pore water or the presence of polychlorinated biphenyls (PCBs) or polycyclic aromatic hydrocarbons (PAHs). ETI (1993) reported in the baseline ecological risk assessment (BERA) that the past dumping of chemical wastes into the Blackfoot River may explain a possible source of these chemical contaminants in Blackfoot River sediments.

The sample from the seventh location was classified as having metals concentrations that may be stressing the system.

Since sediment factors affecting bioavailability of metals (i.e., acid volatile sulfide [AVS], organic carbon) may have differed with seasonal sampling events, a lowering of these factors with a seasonal event may increase bioavailability of metals and potentially their adverse effects.

The overwhelming dominance of sediment benthic communities by Oligochaeta and Chironomidae is not unusual for metals-impacted benthic invertebrate communities. The correlation of a higher number of Chironomidae genera with increasing metals concentrations (i.e., Stations MR-11 and MR-19) may be explained by the intermittent disturbance hypotheses and life-history strategies in Chironomidae.

Fish

Potential factors that may contribute to decreased fish populations in Milltown Reservoir include habitat limitations, such as few riffles and lack of bank cover and woody debris, and the presence of Milltown Dam. The fishery in the Clark Fork River (CFR) upstream and downstream of Milltown Dam is impacted by year-round blockage of migrant trout (bull, cutthroat, rainbow, and brown) resulting in inaccessibility to upstream tributaries for spawning and rearing. (Note: A fish trap and haul program was implemented at Milltown Dam subsequent to the preparation of this baseline risk assessment). The reservoir caused by the dam reduced riverine habitat and may cause increased predation of juvenile trout by northern pike and northern pikeminnow residing in the reservoir, further limiting reproductive and recruitment opportunities for a trout fishery. In addition, some of the juvenile trout that try to migrate below Milltown Dam can be injured or killed when passing through the dam's turbines. The Milltown Fisheries Technical Working Group estimated that the CFR could support 894 trout per mile if river blockage due to the dam and other impacts (e.g., dewatering and blockage of spawning tributaries, streamside degradation due to agriculture, and upstream metal contamination) were removed. Present trout density in the CFR upstream of the dam is estimated at 300 trout per mile. ETI (1993) reported in the BERA that Montana Power Company (MPC) estimated that Milltown Dam is responsible for about 50 percent of the reduced trout production in that portion of the CFR (presumably upstream of Milltown Dam). Factors responsible for the remaining 50 percent reduction were not identified, but would include contaminant-related impacts.

Fish in Milltown Reservoir also may be impacted by sediment metals. Early life stages of fish in the CFR depend on macroinvertebrates as a food source. Studies by the U.S. Fish and Wildlife Service on the CFR, upstream of Milltown Reservoir, have shown that a diet of metals-contaminated invertebrates from the CFR can result in decreased growth and survival of rainbow trout (FWS 1993). Like fish populations in the CFR, fish in the reservoir also may also be exposed to contaminated macroinvertebrate food sources. Thus, the elevated metals in reservoir sediments likely

add further stress to the reservoir populations of fish, compounding the habitat impacts from the presence of Milltown Dam.

Summary of Aquatic Risks Characterization

The sediment benthos were the most studied of habitats in Milltown Reservoir. The weight of evidence from chemistry, ecology, and toxicity studies suggests that benthic invertebrate communities in the reservoir are at risk for impacts from metals-contaminated sediments at a range of ratios of simultaneously extracted copper concentrations normalized to AVS concentrations between 0.4 and 3.7, or at a range of extractable copper of 230 to 350 micrograms per gram. An imbalance in benthic invertebrate communities is associated with elevated metals contamination of sediments in oxidizing environments where AVS concentrations are low.

Fish populations in Milltown Reservoir are below the CFR carrying capacity estimated for that river segment in the absence of Milltown Dam. Fish and invertebrates in Milltown Reservoir are contaminated with metals. The consumption of contaminated diet may impart stress to trout populations, in addition to the effects of Milltown Dam on habitat availability.

Ecological Significance of Aquatic Risk Assessment Findings

For aquatic habitat, the chemical exposures in sediments and the factors governing metals bioavailability generally correlated with toxicity to benthic invertebrates and impacted benthic community structure. The correlation of increased number of genera of Chironomidae with increases in extractable metals reflects an imbalance in benthic community structure. Such an imbalance has not been as thoroughly evaluated for its effects to the local ecology. Overt effects such as decreased species diversity in the community are not apparent in Milltown Reservoir sediments.

Although the sediment ecology is imbalanced at those impacted stations, it is unknown whether other ecological parameters, such as predator-prey relationships, may subsequently be affected by this imbalance. The ecological effects of other impacts at the reservoir, such as the presence of Milltown Dam and altered fish migration and recruitment, likely play a major role in regulating the fish populations of Milltown Reservoir. ETI (1993) reported in the BERA that studies by MPC have shown the possible impact of the dam on fish populations of the reservoir, yet a variety of fish species was found in the reservoir during qualitative observations. In addition, the water-fowl survey suggested that the populations of Canada Geese and a variety of ducks are healthy and reproducing. No evidence was observed of impacted sediment invertebrates affecting the health of waterfowl in the reservoir wetland. The ecological significance of impacted benthic invertebrates in the reservoir is likely more important to the fishery population through the potential for trophic transfer of metals to those fish that consume aquatic insects.

3.6.3 Results of Milltown Reservoir Sediments Operable Unit Ecological Risk Assessment Addendum

The baseline ecological risk assessment (ETI 1993) noted that episodic high flows altered the concentrations of metals in waters of the Clark Fork River and Milltown Reservoir because of mobilization of dissolved and particulate metals in bed sediments and mobilization of dissolved metals from upstream tailings-related evaporite deposits. However, subsequent concerns about exceedences of ambient water quality criteria during the very unusual February 1996 ice scour event (when the Milltown Dam spillway was opened to prevent possible structure damage) and the spring 1997 high flow event led EPA to conclude that further evaluation of risks to ecological receptors caused by episodic events of these types

was warranted. EPA's goal for the ecological risk assessment addendum (CH2M HILL 2000) was to evaluate the potential for acute and chronic toxic effects on fish and aquatic invertebrates in the Clark Fork River downstream of Milltown Reservoir that could be caused by elevated concentrations of metals being discharged from the reservoir. The addendum noted that risks are probably greatest in the reach of the Clark Fork River immediately downstream of Milltown Dam because of additional dilution by the Bitterroot River just below Missoula.

Four sections of text from the risk assessment addendum (CH2M HILL 2000) are presented verbatim in the following italicized discussion. These sections contribute to an understanding of baseline conditions in the assessment area and are especially valuable in assessing potential effects of the Proposed Action on bull trout. The first section of text lists contaminant-related problems that were identified in the risk assessment addendum. The second section is particularly applicable to this BA because it addresses predicted hazards under baseline conditions to threatened, endangered, and sensitive fish species, including bull trout. The third section of text provides further discussion on the condition of aquatic resources in the assessment area by considering other lines of evidence. The fourth section of text presents the overall risk summary to aquatic receptors for the conditions evaluated in the risk assessment addendum.

Problems

Milltown Reservoir has received and continues to receive inputs of metals from the Clark Fork River.

Metals input varies seasonally and annually and is positively correlated with suspended solids discharge (Hornberger et al. 1997).

Suspended solids input and metals input are both positively correlated with total and peak river discharge (Hornberger et al. 1997).

Most of the metals input (particularly copper) is as total recoverable metal (Hornberger et al. 1997).

During some years there is a net accumulation of sediment measured as suspended solids and metals in Milltown Reservoir (Hornberger et al. 1997); but over the long term, input and output are balanced (Lambing 1998).

Concentrations of metals in sediment of Milltown Reservoir are greater at depth than at the sediment surface (ETI 1993).

During the ice-scour event in February 1996 and spring high flows in 1997, there were net discharges of metals and sediment from Milltown Reservoir (Lambing, 1998).

Concentrations of metals in fine-grained bed sediment in the Clark Fork River vary somewhat from year to year, but are likely to reflect long-term conditions (Hornberger et al. 1997; Dodge et al. 1997), but fine-grained sediments comprise a small part of the total bed sediments.

Aquatic receptors are exposed to higher metals concentrations in water downstream from Milltown Reservoir during episodic events (Dodge et al. 1997; Lambing 1997).

Predicted Hazard to Threatened, Endangered and Sensitive Fish Species

*As noted earlier, two species of fish in the Clark Fork River are of special concern: the bull trout (*Salvelinus confluentus*), which was listed as threatened by the US Fish and Wildlife Service on June*

10, 1998, and the westslope cutthroat trout (*Oncorhynchus clarki lewisi*), which is of special concern to the State of Montana and has recently been petitioned for listing under the Endangered Species Act. Limited data suggest that bull trout may once have been common in the upper Clark Fork River (Montana Bull Trout Scientific Group 1995). Currently, bull trout densities are low, but large adults still persist (Peters 1985).

Acute toxicities of cadmium and zinc to bull trout were tested in comparison to rainbow trout in side-by-side tests (Stratus Consulting, 1999a, 1999b,). Acute tests indicated that bull trout are similar to, or less sensitive than rainbow trout to cadmium and zinc. Chronic toxicity of cadmium was greater to bull trout at low hardness, and the tests indicated the possibility of some mortality and reduced growth at the national chronic criterion for cadmium at a hardness of 30 mg/L as Ca CO₃. A presentation (poster) of results of acute testing of effects of copper on bull trout (Hansen, et al. 1999) indicated that bull trout are less sensitive to copper than rainbow trout. Results of range-finding tests of acute toxicity of cadmium, lead, and zinc to field-collected westslope cutthroat trout and hatchery-reared westslope cutthroat and rainbow trout were reported by EVS Environmental Consultants, Inc (EVS 1998). Westslope cutthroat trout collected from a stream where some exposure to elevated metals was possible were less sensitive to all three metals than hatchery-reared westslope cutthroat or rainbow trout. Hatchery-reared westslope cutthroat trout were more sensitive to cadmium and lead and less sensitive to zinc than hatchery-reared rainbow trout were.

Based on a review of published studies, Chapman (1999) concluded that most salmonid species tested, including Chinook and coho salmon, brook trout, and brown trout, have an acute sensitivity to copper that is no greater than that of rainbow trout. As a result, it is reasonable to conclude that acute TRVs for the protection of rainbow trout will be protective of bull trout. Thus, the acute HQ and HI values calculated for exposure of rainbow trout to typical concentrations of copper (see Table 6-3, left section of CH2M HILL [2000]) are likely to be applicable to bull trout.

Data on the chronic toxicity of copper on rainbow trout and brook trout are more limited than for acute toxicity, and relative sensitivities are more difficult to judge. Based on the similarity in acute toxicity, it might be postulated that chronic toxicity is also likely to be similar across species. If so, the chronic HQ and HI values calculated for rainbow trout would be applicable to bull trout as well. However, Chapman (1999) noted that limited chronic toxicity tests in brook trout (Sauter et al. 1976) identify chronic toxicity values for copper that are lower than those for rainbow trout. Because brook trout are in the same genus as bull trout (*Salvelinus*), Chapman concluded that the most appropriate chronic TRV for bull trout (based on an EC20) was several-fold lower than the estimated value for rainbow trout. Based on this, chronic HQ and HI values for bull trout that would be higher than those shown in Table 6-3 of CH2M HILL (2000) by a factor of about 24 (depending on hardness), and exceedences of both the acute and the TRVs would occur with increased frequency. However, the tests performed by Sauter et al. (1976) in brook trout were at a pH of 6.6-7.1, which is considerably more acidic than most toxicity tests using rainbow trout (and more acidic than typical values found in the Clark Fork River), and this difference in test condition could account for the apparent difference in toxicity between species. This is supported by the observations of McKim et al. (1978), who performed early life-stage tests for several species of salmonid (two in the genus *Salvelinus*, one in the genus *Salmo*, and one in the genus *Oncorhynchus*), and found that both of the *Salvelinus* species were less sensitive, not more sensitive, than *Oncorhynchus* (rainbow trout). This supports the hypothesis that bull trout and rainbow trout are likely to have similar sensitivity to copper under both acute and chronic exposure conditions.

As noted above, bull trout are currently rare in the Clark Fork River, and their overall abundance in the northwest is tending to decrease as the result of a number of physical and biotic factors (Watson

and Hillman 1997, Swanberg 1997). Because of this general population decline, it is important that all individuals in the existing bull trout population be protected from risk of death or toxicity. Therefore, levels of metal exposure that may be acceptable for the protection of rainbow trout and/or brown trout populations may not be acceptable for bull trout or other species of special concern. For acute effects, the acute TRV corresponds to an LCO (ENSR 1999a), so little if any added margin of safety factor is needed here. With respect to chronic toxicity, ENSR (1999b) estimated that a factor of about 1.3-fold was adequate to extrapolate from an IC20 (the basis of the chronic TRV) to an ICO for rainbow trout. Chapman (1999) estimated that a factor of about 2 was appropriate. Based on this, HQ values for individual bull trout based on an ICO would be about 30 to 100 percent higher than those shown in Tables 6-3 and 6-4 of CH2M HILL (2000).

Because the westslope cutthroat is the same genus (*Oncorhynchus*) as rainbow trout, it is considered likely that the results for rainbow trout are applicable to this species as well. This is supported by the findings of Dwyer et al. (1995), who reported that three other species of listed salmonids (all of the genus *Oncorhynchus*) are similar in sensitivity to copper exposure as rainbow trout.

Based on these considerations, it is deemed likely that the acute hazards to the bull trout and the westslope cutthroat trout from metals in the Clark Fork River below Milltown Dam are similar to the risks estimated for rainbow trout. That is, typical concentrations are unlikely to be of concern, but both species could be subjected to stress during extraordinary occasions such as the 1996 ice scouring event.

In considering the potential hazard to bull trout from exposures in the Clark Fork River, it is important to note that this species spawns in tributaries, and most reports indicate that fish do not generally migrate from the natal stream into the mainstem until they are several years old (e.g., Fraley and Shepard 1989, Pratt 1992). The potential significance of this behavior is that, because older (migratory) fish are less sensitive to the toxic effects of metals than are fry (see TRV discussion, above), the hazard of injury or death may be overestimated by calculations based on toxicity tests in 0.4 g fry. Fish below Milltown Dam are recruited from tributaries downstream because upstream access is blocked by the dam. McPhail and Murray (1979) noted circumstantial evidence for annual out-migration of bull trout fry, and direct evidence of this phenomenon has recently been reported by Reiser et al. (1997). Thus, at least some fraction of the young-of-the-year probably do enter the mainstem, so HQ values calculated using TRVs for fry are likely to be applicable to this subpopulation. With respect to fish that do not migrate until they are older (and less sensitive), it is important to recognize that there is still a risk of some stress associated with ice-scour events. Moreover, repeated loss of migratory individuals from historic or current pulse events could ultimately result in a diminution or loss of this phenotypic behavior in the population.

An additional issue of potential concern is that bull trout, like rainbow and brown trout, are likely to have a preference for avoiding water that contains levels of metals similar to those found in the Clark Fork River (Woodward, et al. 1995). If so, this avoidance response could interfere with the normal migratory behavior of this species as individuals seek to move from tributaries into the mainstem of the Clark Fork River. (Note: The Milltown Dam Operations Internal Draft BA also noted that bull trout would probably bioaccumulate some metals more than other Clark Fork River salmonids because of their longer life expectancy (greater exposure) and piscivorous feeding habits (food chain bioaccumulation) (Moore et al. 1990, in CFBLLC 2003).

Other Lines of Evidence

Fish kills like those noted in previous years on the upper Clark Fork have not been observed below Milltown Dam. However, high flows and associated turbidity could make fish kills difficult to

observe. Data from the State of Montana (Berg 1996), indicate decreases in densities of both brown and rainbow trout below Milltown Dam between 1995 and 1996. Total catchable trout (>8 inches) decreased from 425 to 162 per mile, while the declines of juvenile brown and rainbow trout (<8 inches) were 70 and 85 percent, respectively. Several possible causes for the observed declines have been noted including, metals, sampling conditions, and physical effects of ice and sediment (R2 Resource Consultants Inc. 1998). Unpublished data provided by the State of Montana (Don Skaar, November and December 1999) indicate some recovery of trout populations in subsequent years. It should be noted that trout populations in tributaries to the Clark Fork, including the Blackfoot River and Rock Creek were also lower in 1996. The size-distribution of fish collected in 1999 shows that while the juvenile fish numbers had rebounded to 1995 levels, the adult numbers were still reduced. This may be a reflection of the reductions to juvenile fish numbers in 1996 (unpublished data from MDFWP).

During the 1997 high spring flows MDFWP exposed caged rainbow trout above and below Milltown Dam and at reference locations (Skaar and Hill, 1999 draft). During the 40-day exposure, survival, growth, and some physiological indicators were measured in the trout, and total and dissolved metals measured in the water. The results provided no clear indication that exposure to the metals had an effect on survival, growth or health of the fish. The authors suggested that effects may have been seen if smaller fry had been used, if the exposure had been longer, or if the exposure had included a dietary source of metals.

Aquatic resources in the Clark Fork River below Milltown Dam include periphyton and benthic invertebrates. The benthic invertebrates are well represented in the toxicity data base used to develop the national criteria, and are also discussed above with respect to risks from bed sediment; but plants, and periphyton in particular, are less represented in the data used to develop the national criteria. A pollution index used as part of long-term monitoring of periphyton in the Clark Fork River indicates that in the reach below Milltown Dam, periphyton are unimpaired by pollution, but showed some impairment by siltation, as did the Blackfoot River and the Clark Fork above Milltown Dam (Weber 1998). The lack of significant impairment caused by metals below Milltown Dam has been consistent from 1989 to 1998 (Weber 1999).

Long-term monitoring of benthic macro-invertebrates in the Clark Fork also suggests little to no adverse effects of metals below Milltown Dam. In August 1996 the monitoring of biotic integrity of benthic invertebrates showed no impairment by metals below Milltown Dam (McGuire 1998), or at Turah Bridge indicating that metals effects on biota living on riffles was not evident at these locations six months after the ice-scour event. A similar absence of impairment by metals was observed in 1997 and 1998, except for slight metals impairment at Turah Bridge in 1997 (McGuire 1999).

Risk Summary

During rare events, such as the 1996 ice scour event, copper may cause low to 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 due to the combined impacts of copper and other metals in the water column, and copper in ingested macroinvertebrates. Any chronic effects would be less than those that occur at Turah Bridge because of the dilution of metals by the Blackfoot River during normal high flow events. It is not known whether the slight chronic effects below the dam are sufficient to contribute to the reduced populations of trout, which may be significantly impacted by other factors including degraded habitat and the lack of passage upstream at Milltown Dam. State standards for total recoverable metals were exceeded frequently, but site-specific evidence such as macroinvertebrate population indices, levels of metals fine-grained bed sediment, absence of

observable effects of metals in caged fish studies, and general trends in trout populations suggest that risks are actually low except on rare occasions when total recoverable metals concentrations, particularly copper, are extremely high.

Arsenic and cadmium in water pose no significant risks, and risks from lead and zinc are absent to low.

There were no significant risks to benthic invertebrates from exposure to metals in sediment downstream from Milltown Dam.

Some metals, such as cadmium and lead, may potentially bioaccumulate in trout. However, the hazard quotients (HQs) calculated from metals concentrations in invertebrates below Milltown dam divided by the lowest-observed-adverse-effects concentrations (LOAECs) of metals in the diet of fish were below one. (HQs below one indicate the measured concentrations were less than the LOAEC values.) Concentrations of metals in invertebrates in 1996 (used to calculate the HQs) were somewhat higher than long-term trends for the Clark Fork River below Milltown Dam, possibly reflecting the greater fluxes of metals during 1996.

Hazard indices (HIs) calculated by combining the HQs from chronic exposure to water combined with exposure to contaminated food were slightly larger than the HQs for exposure to water only, but were still in a low to moderate risk range.

It should be noted that the analysis and risk assessment results presented for the ice scour event in February 1996 may not represent worst-case conditions, because sampling did not occur at the peak of the event.

3.6.4 General Effects of Suspended Sediment on Aquatic Resources

Results of ecological risk assessments discussed in the preceding text indicate that risks to aquatic resources within and downstream of Milltown Reservoir are typically low. Exceptions can occur during rare, high-flow events when increased concentrations of copper can cause low to moderate risks to aquatic life from exposure to water below Milltown Dam and during normal high-flow events when increased metals levels may pose an intermittent, low-level chronic risk to fish. The risk assessments did not specifically identify increased concentrations of suspended sediment or total suspended solids (TSS) during normal high-flow or rare-flow events as independently posing a risk to aquatic resources. However, it has been reported widely in the literature that increased suspended sediment concentrations can have adverse effects on aquatic organisms and result in the degradation or loss of aquatic habitat. These possible effects are briefly described in the following text, primarily for use in *Chapter 4.0, Effects of the Action*, to assess the potential effects of the Proposed Action on bull trout and on their proposed designated critical habitat.

Increased sediment delivery and/or sediment disturbance and resuspension in drainages can affect aquatic resources through the sedimentation of downstream habitat and increased levels of turbidity and suspended sediment in the water column. Increased sedimentation can cause a reduction or elimination of stream bottom habitat used by aquatic insects such as caddisflies, mayflies, and stoneflies that are important fish foods; a subsequent reduction in aquatic insect abundance and diversity; a reduction in the permeability among interstitial spaces within spawning gravels that inhibits the flow of well-oxygenated water and the removal of metabolic wastes; a subsequent reduction in spawning success, hatching success, and fish production; and a reduction in the interchange of surface and subsurface waters in

the hyporheic zone beneath the stream channel (Nelson et al. 1991). Substantially increased sedimentation can eliminate or reduce the depths of pools that provide important year-round cover for juvenile, sub-adult, and adult fish. If severe enough, increased sediment loads can cause the erosion and migration of stream channels (Chamberlin et al. 1991), and the degradation of aquatic and riparian habitat.

Elevated turbidity and suspended sediment levels caused by increased sediment delivery or disturbance can have sublethal and acute effects on fish. Nelson et al. (1991) reported that suspended sediment concentrations of 1,200 mg/L can cause mortalities in underyearling salmonids, while suspended sediment concentrations as low as 100 mg/L up to 1,000 mg/L are sometimes associated with a general reduction in fish activity, impaired feeding, reduced growth, downstream displacement, and decreased resistance to other environmental stressors. Fish and fish food production can be affected by the abrasive effects of very fine sediment on fish embryos and fry and on immature aquatic insects (Hicks et al. 1991). In addition, very turbid waters can exhibit increased temperatures because of the water's capacity to retain more heat. This can affect those fish and invertebrate species with the most restrictive cold-water or cool-water thermal requirements, such as bull trout.

Species like bull trout have relatively narrow habitat requirements, including the need for clean, cold, well-oxygenated water and gravels relatively free of sediment for spawning, egg incubation, rearing, and adult success (FWS and NMFS 2000). However, salmonids including bull trout have evolved in systems that regularly experience elevated suspended sediment levels that can last hour, days, or several weeks during flood events resulting from snowmelt or rainfall. Bjornn and Reiser (1991) reported that larger juvenile and adult trout appear to be little affected by these ephemerally high concentrations of suspended sediments that occur during most storms and snowmelt episodes.

Newcombe and Jensen (1996) summarized the acute and chronic effects of channel suspended sediment on a variety of fish species, and used these data in developing a method for synthesizing and quantitatively assessing the resulting degree of risk and impact to fish. In determining the severity of ill effect to fish, the authors stressed the importance of considering both the duration of exposure and the concentration of suspended sediment (the sediment dose). Newcombe and Jensen (1996) described four categories of severity of ill effects associated with excess suspended sediment, beginning with no effects and progressively worsening through behavioral effects, sublethal effects, and para-lethal and lethal effects. Behavioral effects include alarm reaction, abandonment of cover, and avoidance response, while sublethal effects include short-term to long-term reduction in feeding rate and success, increased rate of coughing and respiration, impaired homing, poor condition, and moderate habitat degradation. Para-lethal and lethal effects include reduced fish growth rate and density, delayed hatching, increased predation, moderate to severe habitat degradation, and stepwise incremental rates of mortality increasing from 0 to 20 percent to 80 to 100 percent.

Newcombe and Jensen (1996) used results of previous suspended sediment studies on fish to predict the severity of effect for different species' groups and life stages of fish. Because of the wide range of results of these previous studies, the predicted thresholds for different levels of severity of effect vary widely over a range of suspended sediment concentrations and durations of exposure. For example, Newcombe and Jensen's (1996) model for juvenile

and adult salmonids predicts that para-lethal effects will begin at the following suspended sediment concentrations (mg/L) and durations of exposure: 59,874 mg/L for 1 hour; 8,103 mg/L for 7 hours; 2,981 mg/L for 1 day; 403 mg/L from 6 days to 2 weeks; 148 mg/L for 7 weeks; 55 mg/L for 4 months; and 20 mg/L for 11 months. Lethal effects at a mortality rate of 0 to 20 percent for these same durations of exposure are predicted to occur at the following suspended sediment concentrations: 162,755 mg/L for 1 hour; 22,026 mg/L for 7 hours; 8,103 mg/L for 1 day; 2,981 mg/L for 6 days; 1,097 mg/L for 2 weeks; 403 mg/L for 7 weeks; and 148 mg/L for 4 months and 11 months. Mortality rates are predicted to increase as suspended sediment concentrations increase for the same durations of exposure (Newcombe and Jensen 1996). The predicted threshold for sublethal effects to juvenile and adult salmonids consists of the following suspended sediment/exposure duration relationships: 55 mg/L for 1 hour; 7 mg/L for 7 hours; 3 mg/L for 1 day and 2 days; and 1 mg/L for exposures of 6 days or longer. In discussing different possible applications of their dose-response models, Newcombe and Jensen (1996) observed that the models are only a beginning, that thresholds of sublethal and lethal effects must be known more precisely, and that research is needed on the effects of sediment particle quality, particle toxicity, and water temperature.

4.0 Effects of the Action

This chapter assesses the potential direct, indirect, and cumulative effects on bull trout and on the primary constituent elements (PCEs) of their proposed designated critical habitat that would result from implementing the Proposed Action. The nine PCEs were defined in Section 3.1.4 of this BA. Both short-term and long-term direct and indirect effects are described. Short-term effects are those effects expected during, and as a result of, the site remediation activities described in the following text. Long-term effects are those effects expected following the completion of site remediation activities. Short-term effects would be temporary while long-term effects would extend indefinitely into the future. This chapter concludes with a discussion of conservation actions that would be implemented to minimize or avoid the potential for adversely affecting bull trout or their habitat.

4.1 Short-Term Direct and Indirect Effects

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 eight to ten years are needed to complete the entire project, which includes planning and design phases, infrastructure and remediation work, dam removal, and site restoration. Potential short-term adverse effects that could result from remediation activities include increased turbidity, TSS, and metals levels downstream of Milltown Dam, disruption of the current fish trap and haul program being operated at Milltown Dam, and disruption of the current northern pike management program. Various measures will be implemented as an integral part of the Proposed Action to reduce the potential for downstream water quality and habitat degradation during site remediation activities, and also to provide interim upstream fish passage. Expected resultant effects are discussed below.

4.1.1 Interim Fish Passage

Interim upstream fish passage measures will be provided during the duration of this project by the owners (Northwestern Energy) of the facility as designated and required by the FERC permit. Specific fish passage measures will be implemented once they have been approved through the FERC consultation process with the FWS. The former owner of the facility, The Montana Power Company, initiated the present fish passage program in 1998. It is operated from approximately March through November each year, flow conditions permitting. As is presently the case, it is assumed that not all bull trout congregating at the base of Milltown Dam will be captured and passed around the dam. However, unlike existing conditions, this adverse effect would be short-term in nature and eliminated once Milltown Dam is removed. EPA anticipates that most hydraulic dredging of sediments (approximately 85 percent of the time) will be done at full pool level and should not affect interim upstream fish passage measures. EPA will consult with MDFWP and FWS in attempts to optimize upstream fish passage during the time when dredging is conducted at

less than full pool level. Interim fish passage measures will remain in effect until all site remediation work has been completed and fish can move unimpeded upstream and downstream past the former Milltown Dam site. The resultant long-term benefits to bull trout from dam removal, as well as the avoidance of potential increases in TSS and metals concentrations associated with the reservoir, are described below in the discussion of long-term effects.

4.1.2 Water Quality, Habitat, and Fisheries

Chapter 3 of this BA describes potential adverse effects that elevated concentrations of TSS and some metals may have on biological resources and their habitat. A number of measures (conservation actions) will be implemented as part of the Proposed Action to avoid or minimize the potential for these kinds of impacts to occur. These conservation actions are described in Section 4.4 of this chapter. Potential water quality, habitat, and fisheries effects are discussed in the following text.

The EPA requested that the USACE generate predictions of the range of changes in water quality in the Clark Fork River at Missoula during dredging of contaminated sediments in Sediment Accumulation Area I of Milltown Reservoir. The USACE (2001) estimated concentrations of TSS and total and dissolved concentrations of arsenic, cadmium, copper, lead, and zinc for several sediment removal scenarios. These scenarios include sediment removal production rates associated with one dredge operating versus two dredges operating, and the effects of sediment removal with and without the use of BMPs. The USACE (2001) stated that a number of key factors affect water quality during sediment dredging, including the physical and chemical characteristics of sediments, dredging losses, dredging effectiveness, BMPs, river flows, water depths, and water velocities. The USACE (2001) stated, “BMPs for dredging consist primarily of the proper selection of dredge type and model, control of the dredge operation to reduce releases of resuspended material, and use of silt curtains to control losses of contaminated suspended sediments.” The USACE analysis incorporated known and estimated probability distributions for key factors at the Milltown Reservoir Sediments Operable Unit site to account for the likely variability in the system and the wide range of changes in water quality that would be expected from dredging activities during site remediation.

The USACE (2001) compared estimated concentrations of metals in downstream surface waters against federal and state acute and chronic water quality criteria for the protection of aquatic life, and against the site-specific trout toxicity reference value (TRV) for dissolved copper in the Clark Fork River. Comparison of projected contaminant concentrations during dredging against a site-specific TRV for dissolved copper is appropriate given results of previous investigations at the project site. Previous analyses suggest that risks to trout populations in the Clark Fork River downstream of Milltown Dam from elevated metals levels are low except on rare occasions, such as the 1996 ice scour event, when total recoverable metals concentrations, particularly copper, are extremely high (CH2M HILL 2000). Those previous analyses also concluded that on these rare occasions arsenic and cadmium in water pose no significant ecological risk, and risks from lead and zinc are absent to low. The EPA has determined that metals toxicity to aquatic life is caused primarily by dissolved metals and has developed site-specific trout TRVs based on toxicity tests using Clark Fork River water (CH2M HILL 2000). The site-specific trout toxicity

reference value for dissolved copper in the Clark Fork River is 37 µg/L. Dissolved copper concentrations less than this in the vicinity of Milltown Dam site are regarded as not being toxic to trout. The proposed temporary construction-related water quality standard for dissolved copper is 80 percent of the TRV at a hardness of 100 µg/L, which is equivalent to 25 µg/L.

Portions of text and two tables from the USACE (2001) report are presented as italicized text in the following discussion. The first section of text and USACE Tables 2 and 3 focus on estimated increases in water column contaminant concentrations using two dredges with BMPs in place. The second section of text contains conclusions for the USACE analysis using two dredges with and without BMPs in place. Only the analytical results of using two dredges are presented since their effects on water quality would be greater than using just one dredge. Most importantly, it should be noted that the Proposed Action will employ interlocking sheet piling surrounding the entire area to be dredged rather than silt curtains as assumed in this analysis. Potential discharge of contaminants to the river with interlocking sheet piling in place will be much less than concentrations predicted using silt curtains. Interlocking sheet piling is designed to retain disturbed water and sediment when properly installed. Some disturbed water and sediment can flow through and under silt curtains and escape to the river (USACE 2001).

Estimates of Increase in Water Column Contaminant Concentrations During Dredging with BMPs: *When effective, no increase in suspended solids concentrations can be measured outside of the silt curtains. Data on the effectiveness of silt curtains for controlling release of dissolved contaminants are not available in the literature. Reduction of dissolved contaminant losses would be a function of the reduction of the flow in the vicinity of the dredge by the silt curtain. Flow is equal to cross-sectional area times velocity. Therefore, to estimate the fraction of the stream flow passing through the enclosed area, it is necessary to estimate the fraction of the cross-sectional area of flow enclosed by the silt curtain and the reduction of velocity through the enclosed area. Next, it is necessary to estimate the dissolved concentration of contaminants within the silt curtain assuming equilibrium with the estimated total suspended solids inside the silt curtain. Finally, the dissolved concentration within the silt curtain must be mixed with the ambient water column total recoverable contaminant concentration in proportion to the flow of each to estimate the total recoverable contaminant concentration during dredging with BMPs. Three sets of example estimates of the total recoverable contaminant concentrations during dredging with BMPs are given in Table 2 for two operating dredges using average sediment total contaminant concentrations and average ambient water column total recoverable contaminant concentrations with equal flow from the Blackfoot and Clark Fork Rivers. Each set of estimates gives the predicted total recoverable contaminant concentrations for a range of velocity or flow reductions (the Velocity Fraction) through the area enclosed by silt curtains. Each set represents a different configuration or size of area enclosed by the silt curtains: 50%, 25% or 10% of the cross-sectional area (the Area Fraction) of either the Clark Fork River or Blackfoot River. The USACE (2001) analysis shows that larger areas or volumes of enclosures would tend to produce lower steady-state concentrations of TSS and higher contaminant concentrations. Contaminant concentrations would decline as the Area Fraction declines and as the Velocity Fraction declines. TSS concentrations are estimated to vary from 400 mg/L to 1,000 mg/L for the three example configurations with two operating dredges (Table 2). Similarly, three sets of example estimates of the dissolved contaminant concentrations during dredging with BMPs are given in Table 3 for two operating dredges using average sediment total contaminant concentrations, median sediment distribution coefficients, and average ambient water column dissolved contaminant concentrations with equal flow from the Blackfoot and Clark Fork Rivers. As stated previously, these*

estimates of dissolved concentrations are likely to show considerably greater increases in dissolved concentrations than is likely due to prediction of solubilization in excess of typical ranges. Nevertheless, the estimates show that under average conditions with the employment of BMPs the concentrations of contaminants should be well below the standards and criteria if the area of river enclosed by the silt curtain and the flow through and under the silt curtain are limited to the extent practicable.

TABLE 2

Example Estimates of Total Recoverable Contaminant Concentrations for Two Operating Dredges with BMPs

Velocity Fraction	Average Total Recoverable Concentrations During Dredging w/BMPs (ug/L)				
	As	Cd	Cu	Pb	Zn
Area Fraction = 0.5, TSS Concentration = 400 mg/L					
1	53.17	1.44	14.50	3.35	159.24
0.75	38.76	1.22	12.43	2.82	117.38
0.5	25.96	1.02	10.59	2.35	80.17
0.25	14.50	0.84	8.94	1.93	46.88
0.1	8.19	0.74	8.04	1.70	28.53
0.05	6.17	0.71	7.75	1.62	22.66
Area Fraction = 0.25, TSS Concentration = 700 mg/L					
1	46.58	1.27	11.95	2.67	103.86
0.75	35.15	1.13	10.95	2.41	80.66
0.5	24.39	1.00	10.01	2.17	58.82
0.25	14.24	0.87	9.13	1.94	38.24
0.1	8.43	0.80	8.62	1.81	26.44
0.05	6.53	0.78	8.46	1.77	22.59
Area Fraction = 0.1, TSS Concentration = 1000 mg/L					
1	28.38	1.05	10.38	2.24	57.05
0.75	22.32	0.99	9.99	2.14	47.48
0.5	16.40	0.93	9.62	2.04	38.14
0.25	10.63	0.87	9.25	1.94	29.03
0.1	7.23	0.83	9.03	1.88	23.67
0.05	6.11	0.82	8.96	1.87	21.90
Montana Acute Standards	360.	3.9	18.	82.	120.
Montana Chronic Standards	190.	1.1	12.	3.2	110.
Avg. Amb. TR Conc. (ug/L)	5.24	0.85	9.33	1.94	21.14

TABLE 3*Example Estimates of Dissolved Contaminant Concentrations for Two Operating Dredges with BMPs*

Velocity Fraction	Average Dissolved Concentrations During Dredging w/BMPs (ug/L)				
	As	Cd	Cu	Pb	Zn
<i>Area Fraction = 0.5, TSS Concentration = 400 mg/L</i>					
1	52.48	1.00	9.49	2.35	146.53
0.75	42.85	0.85	8.13	2.00	118.06
0.5	31.84	0.68	6.56	1.60	85.53
0.25	19.14	0.49	4.76	1.14	47.99
0.1	10.53	0.35	3.54	0.83	22.56
0.05	7.48	0.31	3.11	0.71	13.52
<i>Area Fraction = 0.25, TSS Concentration = 700 mg/L</i>					
1	45.77	0.76	6.11	1.50	89.03
0.75	36.41	0.65	5.33	1.30	69.87
0.5	26.43	0.53	4.50	1.08	49.44
0.25	15.76	0.40	3.61	0.85	27.59
0.1	8.99	0.32	3.05	0.70	13.75
0.05	6.67	0.29	2.86	0.65	9.00
<i>Area Fraction = 0.1, TSS Concentration = 1000 mg/L</i>					
1	28.96	0.52	4.26	1.01	43.10
0.75	22.80	0.45	3.86	0.91	33.37
0.5	16.64	0.39	3.46	0.81	23.65
0.25	10.48	0.32	3.06	0.70	13.92
0.1	6.78	0.29	2.82	0.64	8.08
0.05	5.55	0.27	2.74	0.62	6.14
<i>Federal Acute Criteria</i>	340.	4.3	13.	65.	120.
<i>Federal Chronic Criteria</i>	150.	2.2	9.	2.5	120.
<i>Avg. Amb. Diss. Conc. (ug/L)</i>	4.32	0.26	2.66	0.60	4.19

Conclusions: The bottom of Table 2 lists Montana acute and chronic water quality criteria (total recoverable concentrations) for the protection of aquatic life, while the bottom of Table 3 lists Federal acute and chronic water quality standards (dissolved concentrations) for the protection of aquatic life. The USACE (2001) presented and analyzed data and concluded that arsenic, cadmium, lead, and zinc concentrations during dredging with or without implementation of BMPs are not predicted to exceed the Montana acute toxicity standards. Similarly, arsenic and zinc concentrations are not predicted to

exceed the Montana chronic toxicity standards during dredging with or without BMPs. Cadmium concentrations are predicted to exceed the Montana chronic toxicity standard about 5 percent of the time when two dredges are operating without BMPs. Lead concentrations in the ambient water column are predicted to exceed Montana water quality standards for chronic toxicity to aquatic life about 10 percent of the time without dredging and about 25 percent of the time with two dredges operating without BMPs (USACE 2001). Arsenic concentrations are also not predicted to exceed the Montana WQB-7 Standard for protection of human health during dredging with or without BMPs. Copper concentrations are the only concentrations in this analysis that are predicted to exceed Montana water quality standards for acute toxicity to aquatic life. Copper concentrations in the ambient water column are predicted to exceed Montana water quality standards for acute toxicity to aquatic life about 20 percent of the time without dredging and about 43 percent of the time with two dredges operating without BMPs. Under average conditions, copper concentrations in the ambient water column are not predicted to exceed Montana water quality standards for acute toxicity to aquatic life during dredging with BMPs. Copper concentrations in the ambient water column are predicted to exceed Montana water quality standards for chronic toxicity to aquatic life about 24 percent of the time without dredging and about 57 percent of the time with two dredges operating without BMPs. Under average conditions with limited blockage of the river and flow through the dredging area, copper and lead concentrations are not predicted to exceed Montana water quality standards for chronic toxicity to aquatic life during dredging with BMPs. Based on conservative predictions of dissolved concentrations of the contaminants during dredging, the increased frequencies of exceedances of Federal water quality criteria are similar to the increased frequencies of exceedances of the Montana standards. Under average conditions with limited blockage of the river and flow through the dredging area, dissolved concentrations of copper and lead concentrations are not predicted to exceed Federal water quality criteria for chronic toxicity to aquatic life during dredging with BMPs. Concentrations of copper and lead may be elevated for short durations during times of high production, low flows, and high sediment contamination, when silt curtains are repositioned during changes in dredging location, and when debris is being mechanically removed to facilitate hydraulic dredging operations

EPA offers several additional observations regarding this USACE analysis. Given the configuration of Sediment Accumulation Area I and the fact that the entire area is expected to be isolated by a sheet piling system rather than silt curtains, the cross-sectional area would be expected to be 10 percent or less. The example estimates contained in USACE Table 2 for Area Fraction = 0.1 show that Montana acute and chronic water quality standards (total recoverable concentrations) would not be exceeded for any of the five metals with BMPs in place and two dredges operating. USACE Table 3 shows that the same is true for federal acute and chronic water quality standards (dissolved concentrations) for Area Fraction = 0.1 and two dredges operating. In addition, the Clark Fork River trout TRV of 37 ug/L for dissolved copper would not be exceeded under any of the example conditions presented in Table 3, nor would the construction-related water quality standard for dissolved copper of 25 ug/L, which is equivalent to 80 percent of the Clark Fork River trout TRV at a hardness of 100 mg/L. However, the new primary drinking water standard for dissolved arsenic of 10 ug/L would be exceeded for Area Fraction = 0.1 where Velocity Fraction exceeds approximately 0.25 with two dredges operating.

These data suggest that under average conditions with two dredges operating, BMPs in place, and no predicted exceedances of state or federal acute or chronic water quality criteria for the five metals, bull trout, their proposed designated critical habitat, and other aquatic life downstream of site remediation activities should not be adversely affected by changes in

water quality. The USACE (2001) also concluded that because of the low water-velocity regime (typically from 0.2 to 0.6 feet per second [fps] and never exceeding 1.5 fps) during the assumed dredging period, silt curtains should be highly effective in retaining disturbed suspended sediments so long as the area of river blockage is less than 25 percent of the cross-sectional area of flow. As noted in the preceding text, EPA anticipates that the work area would be 10 percent or less of the cross-sectional area of flow. In addition, interlocking sheet piling rather than silt curtains would be used to surround and isolate the entire sediment dredging area. The following text discusses river water quality and the size of the mixing zone that result from using sheet piling to isolate the entire dredging area and a dredge pond/repository site downstream to confine removed sediment.

The second water quality analysis conducted by the USACE (2002a, 2002b) for EPA estimated concentrations of TSS and dissolved metals in effluent that would be discharged from the dredge pond/sediment repository site to the Clark Fork River. Estimated effluent concentrations of TSS and dissolved metals vary depending on annual volumes of sediment removal and placement in the confined disposal facility, the annual production period, and the production flow rate and associated solids concentrations (USACE 2002a). The USACE estimated effluent concentrations based on the most probable scenario of using two 12-inch dredges for the first 2 years of sediment removal and one dredge in the third year of sediment removal, operating at 150 days per year. The USACE analysis covered three different sediment excavation depths of 30, 32, and 35 feet. The effluent discharge from the sediment repository site to the Clark Fork River was set to be 11.78 cfs from a single 24-inch pipe extending 3 feet from the bank (USACE 2002a, 2002b).

The USACE compared estimated effluent quality to construction-related water quality standards (presented in Chapter 2 of this BA). Estimated concentrations of dissolved metals in the effluent are 18.7 ug/L arsenic, less than 0.05 ug/L cadmium, 69.1 ug/L copper, 5.3 ug/L lead, and 91.9 ug/L zinc (USACE 2002b). Estimated concentrations of TSS vary from 64 to 78 mg/L, depending on sediment excavation depth, and are less than the long-term construction standard for TSS of 86 mg/L (USACE 2002A). The USACE comparison showed that only the 30-day standard for arsenic and the 1-hour standard for copper would be exceeded in effluent. The USACE determined that the effluent must be mixed with 1.5 parts of receiving (river) water for every part of effluent to meet the water quality standard for arsenic and with 1.4 parts of receiving (river) water for every part of effluent to meet the water quality standard for copper. The USACE calculated that the size of the river mixing zone at the point of effluent discharge necessary to achieve this amount of dilution would be up to approximately 13 feet long, 26 feet wide, and 3 feet deep at the 0.1 flow percentile or approximately 555 cfs. At a river flow of 1,035 cfs (occurring approximately 10 percent of the time), the USACE (2002a) calculated that the mixing zone would be up to approximately 8 feet long, 17 feet wide, and 2.6 feet deep to achieve the desired dilution.

The EPA observes that even at an extremely low river flow of 446 cfs (the 7-day minimum flow for the period of record: 1929 to the present), the effects of discharged effluent on background levels of TSS and dissolved metals when fully mixed with Clark Fork River flow would be very small. The maximum predicted increase in TSS in the river after mixing would be about 2 mg/L (assumes 446 cfs flow in the river, and maximum discharge flow and TSS concentration from the dredge pond of 11.78 cfs and 78 mg/L, respectively). Background levels of dissolved metals in the Clark Fork River at a flow of 446 cfs when fully

mixed with sediment repository effluent discharged at a rate of 11.78 cfs would increase as follows: arsenic from 4.32 to 4.69 ug/L, cadmium would remain at 0.1 ug/L, copper from 2.66 to 4.37 ug/L, lead from 0.5 to 0.6 ug/L, and zinc from 3.0 to 5.3 ug/L. As another example at a somewhat higher but still low river flow of 1,035 cfs (occurs about 10 percent of the time) and an effluent discharge rate of 11.78 cfs, TSS concentration would increase by less than 1 mg/L in the river and background levels of dissolved metals would increase as follows: arsenic from 4.32 to 4.48 ug/L, cadmium would remain at 0.1 ug/L, copper from 2.66 to 3.41 ug/L, lead would remain at 0.5 ug/L, and zinc from 3.0 to 4.0 ug/L. All resultant dissolved metals values at river flows of 446 cfs and 1,035 cfs would be well below construction-related water quality standards. In the unlikely event that the construction-related discharge standards are approached, additional dredge water treatment (lime and polymer addition) can be provided at the sedimentation tanks or at the dredge pond.

Potential effects on fish resulting from elevated TSS concentrations can vary from behavioral and sublethal effects at relatively low TSS levels to paraethal and lethal effects at considerably higher TSS levels (Newcomb and Jensen 1996). Temporary construction-related TSS standards for the Proposed Action (550 mg/L for 1 day, 170 mg/L for 1 week, 86 mg/L for 1 season) are more conservative (protective) than concentrations identified by Newcomb and Jensen (1996) at which paraethal and lethal effects to fish are predicted to occur. Also, as noted previously, TSS concentration in the dredge pond water prior to being discharged and mixed with Clark Fork River water would be less than the long-term construction standard of 86 mg/L. While TSS concentrations for the construction standards would not be expected to result in lethal or paraethal effects to fish, they could be associated with behavioral and sublethal effects to fish. Behavioral effects include alarm reaction, abandonment of cover, and avoidance response. Sublethal effects include short-term to long-term reduction in feeding rate and success, increased rate of coughing and respiration, impaired homing, poor condition, and moderate habitat degradation (Newcomb and Jensen 1996). If these project-related TSS effects occur they would be limited to the mixing zone, which was described previously, because resultant TSS concentrations outside the mixing zone are predicted to be within 1 to 2 mg/L of river TSS background levels. Water quality and biological monitoring plans for the Proposed Action that were described in Chapter 2 will be used to determine whether TSS construction standards are being exceeded or aquatic organisms are being impacted so that corrective measures can be implemented if necessary. It is expected that any resultant TSS effects to bull trout and their proposed critical habitat would be very localized and manifested at behavioral and sublethal effects levels.

EPA believes that the most likely periods for adverse impacts on the fishery, including bull trout and their proposed critical habitat, are when the sheet piling system is installed and removed, during reservoir drawdowns, during and immediately after dam removal, when silt curtains are relocated, and during post-dam removal river restoration activities. During these periods, TSS and metals concentrations would likely increase for short periods of time, possibly resulting in temporary adverse effects on aquatic organisms, including bull trout and their habitat. Bull trout exposed to these potential short-term increases in metals and suspended sediment levels would probably consist of adults and perhaps fish 2 or more years of age who have moved into the mainstem Clark Fork from tributaries where they were spawned and reared. The magnitude of this potential short-term risk is unknown and would depend on the contaminant concentrations as well as exposure duration. It also

presumes that fish would remain in place rather than seek to avoid the affected area. *Section 3.6, Milltown Reservoir*, in Chapter 3 discussed the severity of risk to fish depending on metals concentrations and suspended sediment dose. Any resultant short-term risks would be temporary in nature and should abate with the re-establishment of additional BMPs. They risks would not be expected to result in long-term adverse effects on bull trout or their proposed critical habitat. Their potential for occurrence would be eliminated after sediment removal activities are completed.

4.2 Long-Term Direct and Indirect Effects

Implementation of the Proposed Action would be expected to have an overall, long-term beneficial effect on bull trout and their proposed designated critical habitat. The Proposed Action would provide long-term benefits by eliminating a number of factors associated with Milltown Dam and Reservoir (such as fish passage barrier, reservoir sediments, modified natural hydrograph, and northern pike) that have been identified as adversely affecting bull trout and their habitat (CFBLLC 2003). These benefits would be realized both upstream and downstream of the present location of Milltown Dam, and would extend indefinitely into the future. They would directly and indirectly contribute to the recovery of bull trout subpopulations and to improved conditions for the PCEs associated with proposed critical habitat in the middle and upper reaches of the Clark Fork River. In addition, it is expected that any residual adverse short-term effects would be outweighed by the long-term benefits expected to accrue to bull trout (and other aquatic resources) and bull trout proposed critical habitat after remediation activities have been completed.

The following discussion of adverse effects associated with Milltown Dam and Reservoir has been summarized from detailed descriptions presented by CFBLLC (2003), many of which were based on locally derived information gathered and reported by numerous researchers. Many of the references cited are the same references cited by CFBLLC (2003) in the Milltown Dam Operations Internal Draft BA. Implementation of the Proposed Action would eliminate the potential for existing adverse effects to continue and provide long-term benefits to bull trout and their proposed designated critical habitat in the ways described below.

4.2.1 Upstream Fish Passage

Milltown Dam blocks upstream movements of bull trout and other fish species. CFBLLC's fish trap and haul program has realized some success since its implementation in 1998. As an example, nine bull trout were captured in 36 days of trapping at the dam between June 16 and November 3, 2000 (CFBLLC 2003). CFBLLC (2003) cautioned that numbers of bull trout captured in the radial gate pool at Milltown Dam for passage upstream should be considered as conservative estimates of actual fish run size. Removal of Milltown Dam under the Proposed Action would restore PCE #7 (migratory corridor). This would provide bull trout unimpeded upstream access from the middle reach to the upper reach of the Clark Fork River and its tributaries. Bull trout would have access to key spawning sites in areas upstream of the dam and uninterrupted migration corridors to upstream habitat for uses other than spawning [for example, seasonal feeding areas (PCE #8, abundant food base) and cold water refugia (PCE # 2, thermal refugia)] (CFBLLC 2003). An additional benefit is that young bull trout spawned by adults over-wintering in the middle reach of the

Clark Fork, but reproducing in the upper reach, could potentially emigrate downstream and contribute to bull trout populations below the dam site. Mature adults could subsequently return to their natal stream to spawn, thereby protecting or reestablishing and possibly connecting unique genetic and behavioral traits associated with a number of specific small bull trout local populations upstream of the dam site. 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 PCE #8 (abundant food base).

CFBLLC (2003) cited MTBRT (2000) concluding that the recovery of bull trout in Rock Creek, the Clark Fork River, and the Blackfoot River depends on increased numbers of spawning fish in more tributaries with broader geographical representation. Dam removal would contribute to accomplishing three primary objectives of the Clark Fork River restoration plan for bull trout as well as several major goals and objectives of the FWS Bull Trout Draft Recovery Plan (MBTRT 2000, FWS 2002, CFBLLC 2003). These are: 1) protecting existing populations in core areas and maintaining genetic diversity in those remaining populations; 2) maintaining and restoring connectivity among historically connected areas; and 3) restoring and maintaining connectivity between historically connected restoration conservation areas.

4.2.2 Downstream Fish Passage

Milltown Dam constrains, but does not completely block, the downstream passage of bull trout. Downstream movements of bull trout through the reservoir and past the dam consist of emigrating juvenile bull trout, return spawning bull trout, and returns of migrating bull trout whose movements are not associated with spawning. CFBLLC (2003) reported three primary routes exist for downstream fish passage past the dam, including over the spillway, through the radial gate, and through the generation turbines. CFBLLC (2003) reported there are five kinds of adverse effects the Milltown Project can have on downstream movements of bull trout. These are manifested as impacts on various PCEs for bull trout proposed critical habitat and include: 1) failure to find passage downstream of the dam (PCE #7); 2) physical harm in passing through the turbines, over the spillway, or through the radial gate in returning to over-wintering habitat downstream of the dam (PCE #7); 3) possible increased predation by larger fish downstream of the dam on individuals stunned while moving over or through the dam (PCE #9); 4) increased predation/competition by northern pike on emigrating juveniles moving through Milltown Reservoir (PCE #9, discussed further in Section 4.2.5); and 5) impingement on spillway panels and/or vegetation grates (PCE #7). All of these factors potentially adversely affect bull trout populations and PCEs for proposed critical habitat upstream and downstream of Milltown Dam. Removal of Milltown Dam under the Proposed Action would eliminate the potential for these adverse effects to occur. Their elimination would ultimately benefit bull trout and proposed critical habitat in the middle and upper Clark Fork River and tributaries in many of the same ways described for providing upstream passage and would contribute to the recovery of this species and its habitat.

4.2.3 Reservoir Sediments, Drawdown, and Ice Scour Events

The potential adverse effects on downstream aquatic resources, including bull trout and their proposed critical habitat, from increased TSS and metals levels during reservoir drawdown and the scour and release of sediments during unusual meteorological events was described previously in this BA. *Section 3.6, Milltown Reservoir*, discussed in detail the results of ecological risk assessments directed at characterizing potential effects and degree of risk to aquatic life from increased metals and TSS levels under such circumstances. That assessment concluded that typical downstream concentrations of contaminants derived from Milltown Reservoir sediments are unlikely to be of concern, but that bull trout, as well as westslope cutthroat trout, could be subjected to stress during extraordinary occasions such as the 1996 ice scouring event (CH2M HILL 2000). The range of adverse effects could conceivably vary from acute under extreme meteorological conditions to possibly very subtle chronic effects at other times. Removal and isolation of Milltown Reservoir sediments under the Proposed Action would eliminate the potential for any such adverse effects to occur in the future. These beneficial effects would represent an enhancement of PCE #1 (permanent waters with low levels of contaminants) and PCE #4 (reduced substrate fines and embeddedness) and the restoration of PCE #7 (migratory corridor). This would remove a long-standing potential threat to bull trout and proposed critical habitat and, together with other remedial activities that would be carried out under the Proposed Action, would contribute to the recovery of this species and its habitat.

4.2.4 Natural Hydrograph

Operation of the Milltown Project can result in short-duration fluctuations in reservoir discharge and flow in the Clark Fork River downstream of Milltown Dam (CFBLLC 2003). These events typically last no longer than 1 hour, but can modify the natural hydrograph by suddenly doubling river flows during the base flow period (July to March) or reducing river flows by approximately 50 percent just downstream of Milltown Dam. Depending on the time of year, the frequency of such fluctuations ranges from approximately twice per week to once per month (CFBLLC 2003). Flow fluctuations such as these may potentially affect bull trout and their proposed critical habitat by affecting the abundance of aquatic insects and other benthic invertebrates, which are often important fish foods. Bull trout and their habitat also may be affected if sudden increases in reservoir discharges contribute to increased levels of suspended solids and metals downstream in the river. CFBLLC (2003) concluded that these short-duration flow fluctuations have affected bull trout and their proposed critical habitat by modifying the natural hydrograph of the Clark Fork River, and possibly by reducing macroinvertebrate productivity and forage availability for bull trout. CFBLLC (2003) also concluded that the potential release of low-level contaminants from Milltown Reservoir is not likely to affect bull trout growth or survival. Removal of Milltown Dam and removal and isolation of Milltown Reservoir sediments under the Proposed Action would eliminate the potential for these adverse effects. Their elimination would benefit bull trout and their proposed critical habitat through the enhancement of PCE # 1 (low contaminant levels), PCE #5 (restore natural hydrograph), and PCE # 8 (abundant food base).

4.2.5 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). As discussed previously, northern pike have the potential to adversely affect bull trout and PCE #9 in the reservoir and where they co-occur in the rivers by preying on bull trout and by competing with bull trout for food. Northern pike and bull trout are both highly piscivorous and can exhibit similar food preferences. CFBLLC (2003) concluded in their analysis that northern pike in Milltown Reservoir are a direct source of mortality for bull trout and potentially affect the maintenance of existing bull trout populations using the Clark Fork River. 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 restore it to riverine habitat more suitable for bull trout. 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. Bull trout, PCE #8 (food base), and PCE #9 (predation) would be enhanced and benefit from declining numbers of northern pike in the project area. These effects, like the other beneficial long-term effects discussed previously, would contribute to the recovery of bull trout and their habitat.

4.3 Cumulative Effects

Cumulative effects under Endangered Species Act (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. 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), in the *Milltown Dam Operations Internal Draft BA*, summarized broad risk categories in the general area of Milltown Dam and Reservoir that can interact with bull trout because of their highly mobile nature and affect species survivability and the condition of PCEs for proposed designated critical habitat. These broad risk categories include environmental instability, introduced fish species, barriers to fish movements, habitat quality, and population attributes. Specific risks associated with these categories include legal and illegal introductions of fish, water management, municipal and industrial waste water dilution, irrigation diversions, rural and industrial development, mining, grazing practices, forestry practices, transportation systems, and recreational development. The potential cumulative effects of each were described by CFBLLC (2003) and are briefly summarized below.

Requests to legally introduce new fish within the range of bull trout are reviewed by the MDFWP and the U.S. Fish and Wildlife Service (FWS). CFBLLC (2003) stated that new legal introductions of fish in bull trout range would probably not be approved by these agencies, therefore limiting the potential for impacting bull trout and PCEs. The effects of illegal fish introductions on bull trout can not be predicted because such acts are random, and the species, location, and probability of introduction are unknown (CFBLLC 2003).

CFBLLC (2003) concluded in their analysis of potential cumulative effects that no new water management practices that could potentially affect bull trout or proposed critical habitat 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, but that their potential effects on bull trout could probably not be measured.

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. CFBLLC (2003) also recognized the recently completed Native Fish Habitat Conservation Plan by Plum Creek Timber Company, in consultation with FWS and the National Marine Fisheries Service (NMFS), and special management actions by the Montana Division of Forestry would prevent or minimize forestry-related adverse effects on bull trout. In addition, any construction or 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 USFWS and MDFWP. These reviews should eliminate or minimize the potential for adversely affecting bull trout or proposed designated critical habitat.

CFBLLC (2003), in their review of possible cumulative effects in the Milltown Project area, concluded that recreational use and the development of recreational facilities in the Milltown Project area are not expected to increase significantly in the next 6 years to levels that would potentially affect bull trout or proposed designated critical habitat.

4.4 Conservation Actions

The Proposed Action described in Chapter 2 of this BA essentially consists of a series of actions that will individually and collectively contribute to the long-term conservation and recovery of bull trout subpopulations and their proposed designated critical habitat in the middle and upper reaches of the Clark Fork River, the Blackfoot River, and Rock Creek. Conservation actions that will be implemented to remediate existing problems associated with Milltown Dam and Reservoir include the removal and isolation of Milltown Reservoir sediments, the removal of Milltown Dam, and the rechannelization of the Clark Fork and Blackfoot Rivers. As described in Section 4.2 of this chapter, these actions will result in long-term benefits and contribute to the recovery of bull trout and their proposed critical habitat by eliminating a series of existing adverse or potentially adverse effects associated with

upstream and downstream fish passage past Milltown Dam, contaminated sediments present in Milltown Reservoir and their release downstream of Milltown Dam, and the occurrence of northern pike in Milltown Reservoir.

Two additional conservation actions intended to minimize or avoid the potential for adversely affecting bull trout and proposed designated critical habitat will be implemented during sediment removal/isolation, dam removal, and channelization activities. These actions also were described in *Chapter 2, Project Description*, and their effectiveness assessed in Section 4.1 of this chapter. The first additional conservation action is the interim upstream fish passage program implemented by CFBLLC in accordance with their FERC license. Interim fish passage measures will remain in effect until all site remediation work has been completed and bull trout can move unimpeded upstream and downstream past the former Milltown Dam site. The second additional conservation action consists of implementing a number of measures to avoid or minimize the potential for degradation of water quality and proposed designated critical habitat during site remediation activities. Water quality and biological monitoring programs will be conducted in an iterative risk assessment-feedback framework to determine if biological resources are being protected, and, if not, what additional management measures are practical to protect bull trout, their proposed critical habitat, and other aquatic resources.

CFBLLC (2003) noted that restoration plans for bull trout rely upon the recovery of migratory life history forms in an interconnected system of large rivers and their tributary streams. Implementation of the conservation actions within the framework of the Proposed Action described in this BA will contribute to the restoration and recovery of bull trout and to improvement in the quality of PCEs associated with bull trout proposed critical habitat in the middle and upper Clark Fork River, Blackfoot River, Rock Creek, and their tributaries.

5.0 Determination of Effects

The assessment of potential effects in Chapter 4 concluded that implementation of the Proposed Action would be expected to have an overall, long-term beneficial effect on bull trout and their proposed designated critical habitat. The Proposed Action would provide long-term benefits by eliminating and/or improving a number of factors and conditions associated with Milltown Dam and Reservoir, such as fish passage barrier, reservoir sediments, modified natural hydrograph, and reservoir habitat for northern pike, that have been identified as adversely affecting bull trout and PCEs for their proposed critical habitat (CFBLLC 2003). These expected benefits would be realized both upstream and downstream of the present location of the Milltown Dam site, would extend indefinitely into the future, and would directly and indirectly contribute to the recovery of bull trout subpopulations and their proposed critical habitat in the middle and upper reaches of the Clark Fork River and its tributaries.

Despite these overall expected benefits, there is a potential for two types of short-term adverse effects on bull trout and their proposed critical habitat while implementing the Proposed Action. The first type of effect would be associated with providing interim upstream fish passage during site remediation activities. It is likely that not all bull trout accumulating below Milltown Dam will be captured and transported around the dam. However, unlike existing conditions, this adverse effect would be short-term in nature and eliminated once Milltown Dam is removed.

The second type of short-term effect would be associated with site remediation activities. TSS and metals concentrations would likely increase for short periods of time as described in Section 4.1, possibly resulting in some adverse effects on bull trout and their proposed critical habitat. Any resultant short-term risks and effects would be temporary in nature and should abate with completion of the specific activity or establishment of additional BMPs. They would not be expected to result in long-term adverse effects on bull trout or on bull trout proposed critical habitat.

The potential adverse effects described above would not be expected to be substantive in terms of bull trout subpopulations or proposed critical habitat within the Middle and Upper Clark Fork River CHSUs. In addition, it is expected that any residual adverse short-term effects would be outweighed by the long-term benefits expected to accrue to bull trout and their proposed critical habitat once remediation activities have been completed. However, there is the possibility that remedial actions could result in some incidental take of individual bull trout, which is a federally listed species, and some short-term adverse impacts to proposed bull trout critical habitat, which also is subject to provisions of the ESA. Therefore, the appropriate finding under the ESA with respect to the Proposed Action is that it “May Affect, Is Likely To Adversely Affect” bull trout and bull trout proposed designated critical habitat on a short-term basis during construction. The Proposed Action would not result in the “Destruction or Adverse Modification” of proposed designated critical habitat for bull trout because of the short-term and limited extent of the expected adverse impacts and the magnitude of beneficial effects. As discussed above, the overall

long-term effect of the Proposed Action will be to benefit and contribute to the recovery of bull trout subpopulations and their proposed designated critical habitat in the middle and upper Clark Fork River, the Blackfoot River, Rock Creek, and their tributaries.

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7.0 List of Acronyms

amsl	above mean sea level
ARCO	Atlantic Richfield Company
AVS	acid volatile sulfide
BA	Biological Assessment
BERA	baseline ecological risk assessment
BMPs	best management practices
CFBLLC	Clark Fork and Blackfoot, L.L.C.
CFR	Clark Fork River
cfs	cubic feet per second
CHSU	critical habitat subunits
DPS	Distinct Population Segment
ECOPC	ecological chemicals of potential concern
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FDWS	Federal Drinking Water Standard
FERC	Federal Energy Regulatory Commission
FMO	foraging, migratory, and overwintering
FR	Federal Register
FWQC	Federal Water Quality Criteria
FWS	U.S. Fish and Wildlife Service
HQs	hazard quotients
LOAECs	lowest-observed-adverse-effects concentrations
MBTRT	Montana Bull Trout Recovery Team
mcy	million cubic yards
MDEQ	Montana Department of Environmental Quality
MDFWP	Montana Department of Fish, Wildlife, and Parks

mg/L	milligrams per liter
MPC	Montana Power Company
MRIS	Montana River Information System
NMFS	National Marine Fisheries Service
NPL	National Priorities List
NWE	Northwestern Energy
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCEs	primary constituent elements
PM&E	Protection, Mitigation, and Enhancement
POC	point of compliance
ROD	Record of Decision
SAA	Sediment Accumulation Area
TRV	toxicity reference value
TSS	total suspended solids
ug/L	micrograms per liter
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey