

Boulder River Watershed Total Maximum Daily Loads



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TABLE OF CONTENTS

Section 1.0 Executive Summary 7

Section 2.0 Watershed Characterization 11

 2.1 Physical Characteristics 11

 2.1.1 Location 11

 2.1.2 Topography 11

 2.1.3 Climate 13

 2.1.4 Hydrology 14

 2.1.5 Geology 17

 2.1.6 Soils 20

 2.1.7 Land Use and Land Cover 22

 2.2 Cultural Characteristics 24

 2.2.1 Population 24

 2.2.2 Land Ownership 24

 2.2.3 Recreation 27

 2.3 Biological Resources 27

 2.3.1 Fisheries 27

 2.3.2 Threatened and Endangered Species 29

Section 3.0 TMDL Regulatory Framework and Water Quality Standards 31

 3.1 TMDL Regulatory Requirements 31

 3.2 Water Bodies and Pollutants of Concern 32

 3.3 Applicable Water Quality Standards 36

 3.3.1 Classification and Beneficial Uses 36

 3.3.2 Standards 37

Section 4.0 Pollutant Assessment and Status 41

 4.1 Introduction 41

 4.2 Assessment Framework 42

 4.3 East Boulder River Segment MT43B004_141 (Sediment) 43

 4.4 East Boulder River Segments MT43B004_141 and MT43B004_142 (Chlorophyll-*a*/Nutrients) 43

 4.5 Boulder River Segments MT43B004_131, MT43B004_132, MT43B004_133, MT43B004_134, & MT43B005_010 (Metals) 44

 4.5.1 Metals Sources 44

 4.5.2 Metals Water Quality Targets 45

 4.5.3 Water Quality Targets Evaluation 47

 4.5.4 Boulder River Metals Summary 64

 4.6 Monitoring Recommendations 65

 4.6.1 Sediment, Flow and Habitat Monitoring & Assessment 65

 4.6.2 Nutrient Monitoring & Assessment 67

 4.6.3 Metals Monitoring & Assessment 68

Section 5.0 Boulder River Metals TMDLs and Allocations 71

 5.1 Source Characterization and Assessment 71

 5.1.1 Natural Sources 72

 5.1.2 Point Sources 72

 5.1.3 Non-point Sources 76

5.1.4 Source Assessment Summary	76
5.2 TMDLs and Load Allocations	76
5.2.1 Total Maximum Daily Loads	77
5.2.2 Allocations	78
5.2.3 Seasonality and Margin of Safety	83
5.3 Monitoring Strategy	84
5.4 Restoration Strategy	84
5.4.1 General Restoration & Remediation Funding Options	84
5.4.2 General Restoration & Remediation Priorities	86
5.5 Adaptive Management Strategy	86
Section 6.0 Public Involvement	89
Section 7.0 References	91
Acronyms	101
Appendix A – Responses to Public Comments	A-1
Appendix B – Planning Considerations	B-1
Appendix C – Boulder TMDL Metals Limit Calculations and Assumptions	C-1

LIST OF TABLES

Table 1-1. Summary of TMDL Elements for the Boulder River TMDL Planning Area 8

Table 2-1. NRCS Soil Mapping Units in the Boulder River Watershed 20

Table 2-2. Fish Species, Location, And Relative Abundance 28

Table 3-1. Impaired Uses from both 1996 and 2006 303(d) Lists..... 34

Table 3-2. 1996 303(d) List Information for the Boulder River TMDL Planning Area 35

Table 3-3. 2006 303(d) List Information for the Boulder River TMDL Planning Area. 35

Table 3-4. Montana Surface Water Classifications and Designated Beneficial Uses 37

Table 3-5. Applicable Rules for Sediment-Related Pollutants 39

Table 3-6. Montana Numeric Surface Water Quality Standards for Metals..... 40

Table 4-1. 2006 303(d) listings in the Boulder Watershed TMDL Planning Area..... 41

Table 4-2. Water quality criteria for metals at 25 mg/L hardness 45

Table 4-3. Metals water quality targets for the Boulder River TMDL Planning Area (values in ug/L)..... 46

Table 4-4. Screening level criteria for sediment metals concentrations 47

Table 4-5. Sediment water quality metals data, Boulder River segment MT43B004_131 49

Table 4-6. Water quality metals data, Boulder River segment MT43B004_131 51

Table 4-7. Sediment water quality metals data, Boulder River segment MT43B004_132 53

Table 4-8. Water quality metals data, Boulder River segment MT43B004_132 55

Table 4-9. Sediment water quality metals data, Boulder River segment MT43B004_133 58

Table 4-10. Water quality metals data, Boulder River segment MT43B004_133 60

Table 4-11. Sediment water quality metals data, Boulder River segment MT43B004_134 61

Table 4-12. Water quality metals data, Boulder River segment MT43B004_134 63

Table 4-13. Boulder River metals impairment summary..... 64

Table 5-1. Adit Discharge Data from Yager and Poorman Sites..... 74

Table 5-2. Surface Water Samples and Estimated Load from Yager Site..... 74

Table 5-3. Boulder River TMDLs 76

Table 5-4. High Flow TMDL (1500 cfs, 25 mg/l hardness)..... 77

Table 5-5. Low Flow TMDL (38 cfs, 100 mg/l hardness)..... 78

Table 5-6. City of Big Timber MPDES Permit MT-0020753: Metals waste load allocations... 80

Table 5-7. Stillwater Mining Company permit MT-0026808: Metals waste load allocations ... 81

Table 5-8. High Flow TMDL and Allocations: Boulder River Segment MT43B004_132..... 81

Table 5-9. Low Flow TMDL and Allocations: Boulder River Segment MT43B004_132 81

Table 5-10. High Flow TMDL and Allocations: Boulder River Segment MT43B004_131 82

Table 5-11. Low Flow TMDL and Allocations: Boulder River Segment MT43B004_131 82

LIST OF FIGURES

Figure 2-1. Boulder River watershed overview map 12

Figure 2-2. Minimum and maximum temperatures, Big Timber, Montana 13

Figure 2-3. Average monthly precipitation, Big Timber, Montana 13

Figure 2-4. Historic flow data for Boulder River at Big Timber, Montana 15

Figure 2-5. Typical hydrograph - Boulder River at Big Timber based on average daily flows
1947 - 2001 16

Figure 2-6. Boulder River watershed general geology map 18

Figure 2-7. Boulder River watershed historic mining map 19

Figure 2-8. Boulder River watershed STATSGO soils map 21

Figure 2-9. Boulder River watershed land cover/land use map 23

Figure 2-10. Land ownership in the Boulder Watershed 25

Figure 2-11. Boulder River watershed land ownership map 26

Figure 3-1. Water body Segments in the Boulder TMDL Planning Area 33

Figure 4-1. Boulder River metals sampling locations (1992-2006) 48

Figure 4-2. Boulder river hydrograph 69

Figure 5-1. MPDES Permit Locations in the Boulder River Watershed 75

SECTION 1.0

EXECUTIVE SUMMARY

The Boulder River watershed is a forested drainage encompassing approximately 528 square miles. Half of the watershed's area lies within the Absaroka-Beartooth Wilderness. The Boulder River Watershed (also referred to in this document as the Boulder Total Maximum Daily Load Planning Area, or TPA) is one of more than 90 TMDL planning areas in the State of Montana in which water quality is currently or was previously listed as impaired. In each of these TMDL planning areas, the State of Montana is required to develop TMDLs to reduce pollutant loading and eliminate other negative impacts to water quality in impaired water bodies. This document focuses on metals related water quality impairments in the Boulder TMDL Planning Area (TPA) and presents a review of data on streams with verified metals impairments followed by all necessary metals TMDLs.

The primary objective is to develop an approach to restore and maintain the physical, chemical, and biological integrity of streams in the sub-basin so they will support all uses identified in state water quality standards. The uses include drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply. Clean Water Act objectives include restoration and maintenance of these watershed attributes for all of these uses. The Clean Water Act also requires the development of TMDLs that, when implemented, will result in conditions that support all beneficial uses. Fishery and associated aquatic life, recreation, or drinking water uses are usually the most sensitive uses in the Boulder watershed when developing TMDLs.

A TMDL is a pollutant budget identifying the maximum amount of a particular pollutant that a water body can assimilate without causing applicable water quality standards to be exceeded. Section 303 of the Federal Clean Water Act and the Montana Water Quality Act (Section 75-5-703) require development of TMDLs for impaired water bodies that do not meet Montana water quality standards. Section 303(d) also requires identification of impaired water bodies on a list, referred to as the 303(d) list. This 303(d) list is updated every two years and submitted to the U.S. Environmental Protection Agency (U.S. EPA) by the Montana Department of Environmental Quality (DEQ).

The document structure provides specific sections that address TMDL components and watershed restoration. **Sections 1.0 through 3.0** provide background information about the Boulder River watershed, Montana's water quality standards, and Montana's 303(d) listings. **Section 4.0** provides a review of data for water body segments requiring TMDLs, and **Section 5.0** provides all necessary metals TMDLs for water bodies with verified impairments and provides a framework restoration strategy for addressing known impairments.

Table 1-1 provides a brief summary of how each of these waterbodies is addressed within the TMDL document.

Table 1-1. Summary of TMDL Elements for the Boulder River TMDL Planning Area

Waterbodies & Pollutants of Concern (2006 303(d) list)	East Boulder River MT43B004_141	Sedimentation/Siltation Chlorophyll- <i>a</i>
	East Boulder River MT43B004_142	Chlorophyll- <i>a</i>
	Boulder River MT43B004_131	Copper Iron Lead Silver
	Boulder River MT43B004_132	Chromium Nickel Nitrate/Nitrite Total Kjeldahl Nitrogen
	Boulder River MT43B004_133	Phosphorous (Total) Nitrate/Nitrite Total Kjeldahl Nitrogen Excess Algal Growth
	Boulder River MT43B004_134	Copper Lead
Impaired Beneficial Uses	East Boulder River MT43B004_141	Aquatic life Cold Water Fishery Contact Recreation
	East Boulder River MT43B004_142	Aquatic life Cold Water Fishery Contact Recreation
	Boulder River MT43B004_131	Aquatic life Cold Water Fishery Contact Recreation
	Boulder River MT43B004_132	Aquatic life Cold Water Fishery
	Boulder River MT43B004_133	Aquatic life Cold Water Fishery Contact Recreation
	Boulder River MT43B004_134	Aquatic life Cold Water Fishery Drinking Water
Pollutant Sources	<ul style="list-style-type: none"> • Irrigated crop production • Impacts from abandoned mine lands • Flow Alterations from water diversions • Unknown sources 	

Table 1-1. Summary of TMDL Elements for the Boulder River TMDL Planning Area

Water Quality Targets	<p>Metals Targets</p> <ul style="list-style-type: none"> • Targets are the adopted State of Montana water quality criteria for metals as defined in Circular DEQ-7.
Required TMDLs	<p>Metals TMDLs</p> <ul style="list-style-type: none"> • TMDLs prepared include the following metals TMDLs for the Boulder River: <ul style="list-style-type: none"> ○ Boulder River MT43B004_131: Lead, Copper, Iron ○ Boulder River MT43B004_132: Lead, Copper, Iron ○ Boulder River MT43B004_133: Lead, Copper, Iron ○ Boulder River MT43B004_134: Lead, Copper, Iron ○ Basin Creek MT43B005_010: Lead, Copper, Iron • The TMDL is an equation based on water hardness and stream flow
Allocations	<ul style="list-style-type: none"> • Waste load allocations are provided for existing MPDES permitted discharges: MT-0026808 (Stillwater Mining Company) and MT-0020753 (City of Big Timber). • A composite waste load allocation is provided for the combined load from abandoned mining and other non-point sources.
Restoration Strategies	<ul style="list-style-type: none"> • Utilize state and federal programs in place to reclaim abandoned mines • Detailed surface water sampling plan to better quantify metals loading rates and mechanisms • Utilize an adaptive management approach in restoration activities
Margin of Safety	<ul style="list-style-type: none"> • The Margins of Safety for copper, lead, and iron are implicit because the analyses are conservative. • The chronic criteria were used in calculating allocations • 25 mg/L hardness value was used in the wasteload allocations • An adaptive management approach will be used to implement reductions that work towards attainment of in-stream standards.
Seasonal Considerations	<ul style="list-style-type: none"> • Metals targets and loads were calculated based on high flow, low hardness events, ensuring year-round attainment

SECTION 2.0 WATERSHED CHARACTERIZATION

2.1 Physical Characteristics

2.1.1 Location

The Boulder River watershed comprises approximately 528 square miles in Sweet Grass and Park counties in south-central Montana. Approximately one-half of the watershed lies within the Absaroka-Beartooth Wilderness Area (ABWA). The watershed drains the East Boulder, West Boulder, and Lake Plateaus, and drains headwater areas at an elevation of up to approximately 11,300 feet on Mount Douglas to the northeast down to the mouth at the Yellowstone at an elevation of approximately 4,000 feet.

The Boulder River Watershed comprises a portion of the Upper Yellowstone 4th field Hydrologic Unit Code sub-basin (HUC No. 10070002) and contains two 5th field watersheds (**Figure 2-1**):

- HUC 10070002090 Includes the West Boulder and Main Boulder below the mouth of the West Boulder River and associated tributaries, including:
 - Davis Creek
 - Falls Creek

- HUC 10070002080 Includes the East Boulder and the Main Boulder above its confluence with the West Boulder and associated tributaries, including:
 - Elk Creek
 - Dry Fork Creek
 - Brownlee Creek
 - Graham Creek
 - Great Falls Creek
 - Speculator Creek
 - Hawley Creek
 - Fourmile Creek
 - Meat Rack Creek
 - Bridge Creek
 - East Fork Boulder River
 - Rainbow Creek

2.1.2 Topography

Figure 2-1 shows the general topography of the Boulder River Watershed. The southern portion of the watershed is typically steep mountainous and heavily forested terrain, and lies within the ABWA at elevations above 5,000 feet. The northern portion of the watershed, below the National Forest Boundaries is primarily wider, flatter alluvial valleys and foothills.

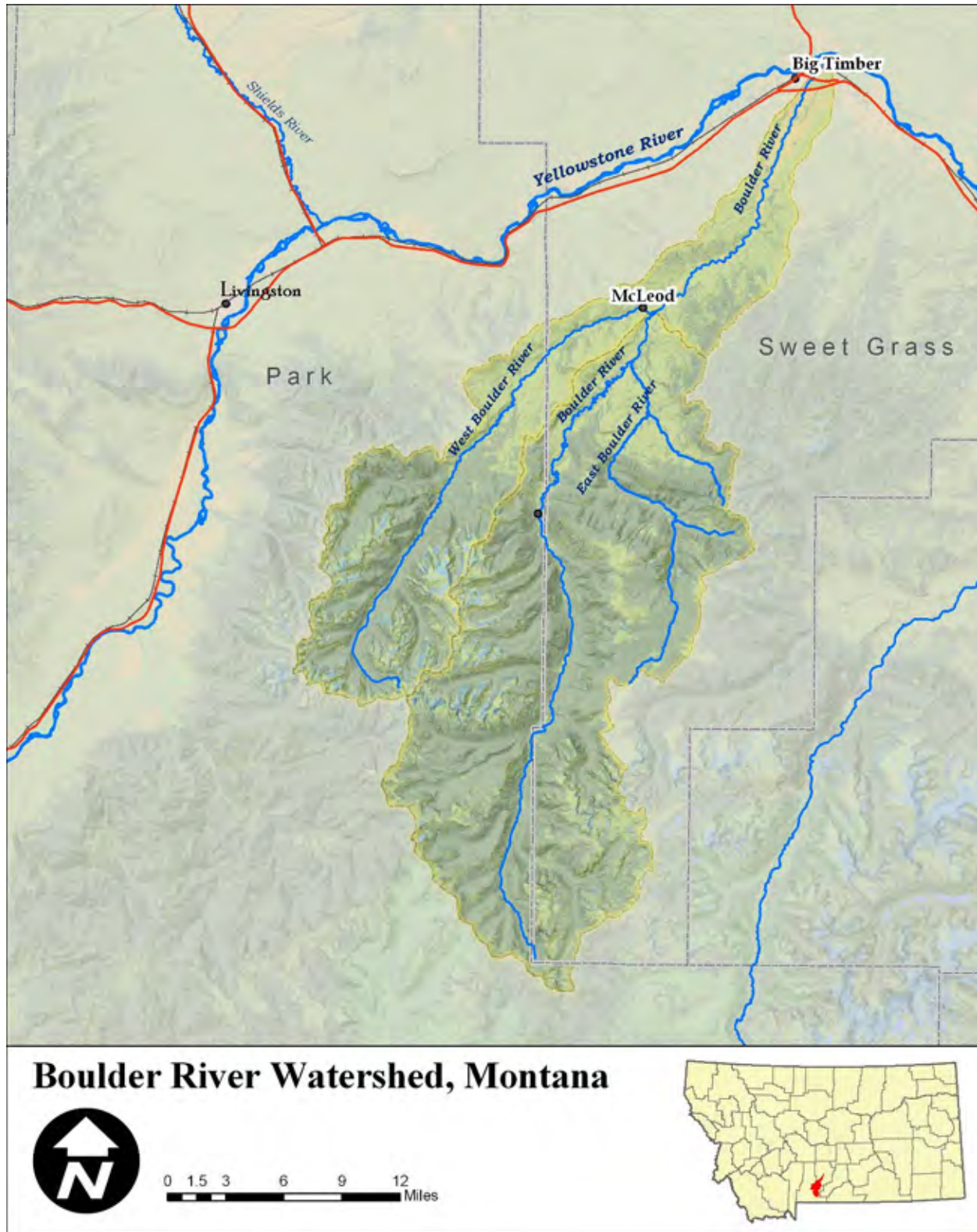


Figure 2-1. Boulder River watershed overview map

2.1.3 Climate

The Western Regional Climate Center provides data for several weather stations in Montana, including data collected from 1894 to 2003 in Big Timber, Montana. **Figure 2-2**, shows average minimum and maximum air temperatures and temperature extremes for Big Timber. In general, average daytime high temperatures range from the lower 30s in January and February to the 80s in late July. Average low temperatures range from the teens in the winter to the 50s in July.

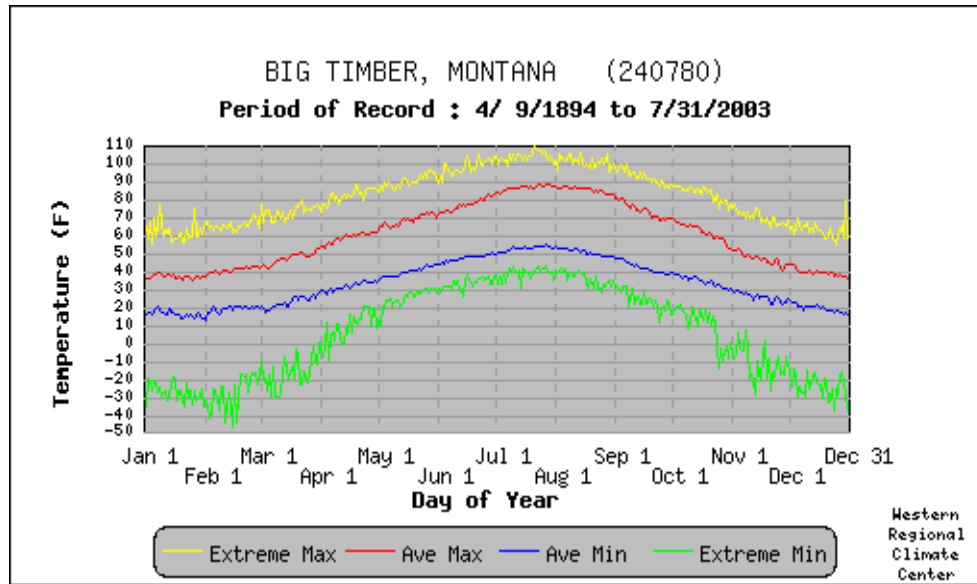


Figure 2-2. Minimum and maximum temperatures, Big Timber, Montana

Precipitation data is also summarized by the Western Regional Climate Center for Big Timber. **Figure 2-3** shows average monthly precipitation (in inches) for Big Timber from 1961-1990. The lower elevation Boulder River corridor receives approximately 15 inches of precipitation per year, while the headwaters for the Boulder River watershed generally receive 40 to 55 inches of annual precipitation.

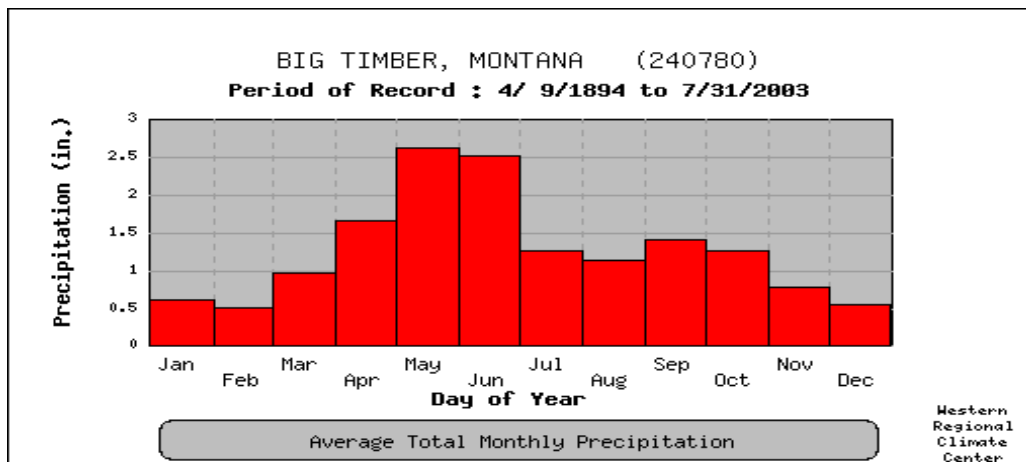


Figure 2-3. Average monthly precipitation, Big Timber, Montana

The National Oceanic and Atmospheric Administration (NOAA) collects data from three Snowpack Telemetry (SNOTEL) Stations located within the Boulder watershed. These SNOTEL stations are:

- Box Canyon, at an elevation of 6,699 feet
- Monument Peak, at an elevation of 8,852 feet
- Placer Basin, at an elevation of 8,829 feet

These stations are maintained and monitored by the Natural Resources Conservation Service (NRCS). Average annual precipitation at the Placer Basin site over the past 30 years is approximately 40 inches (including snow-water-equivalent values).

2.1.4 Hydrology

The United States Geologic Survey (USGS) National Water Information System (NWIS) online database lists five historical surface water flow gages and one current surface water flow gage in the Boulder watershed. Three of these stations occur on the main stem of the Boulder:

- USGS 06197500: Boulder River near Contact, Montana (historic site)
- USGS 06199500: Boulder River near McLeod, Montana (historic site)
- USGS 06200000: Boulder River at Big Timber, Montana (current site)

Two historic sites were located on the West Boulder River:

- USGS 06198500: West Fork Boulder River near Bruffeys, Montana
- USGS 06199000: West Boulder River at McLeod, Montana

One historic site was located on the East Boulder:

- USGS 06198000: East Boulder River near McLeod

Figure 2-4 shows flows for station USGS 06200000 for the Boulder River at Big Timber from 1947 through 2001.

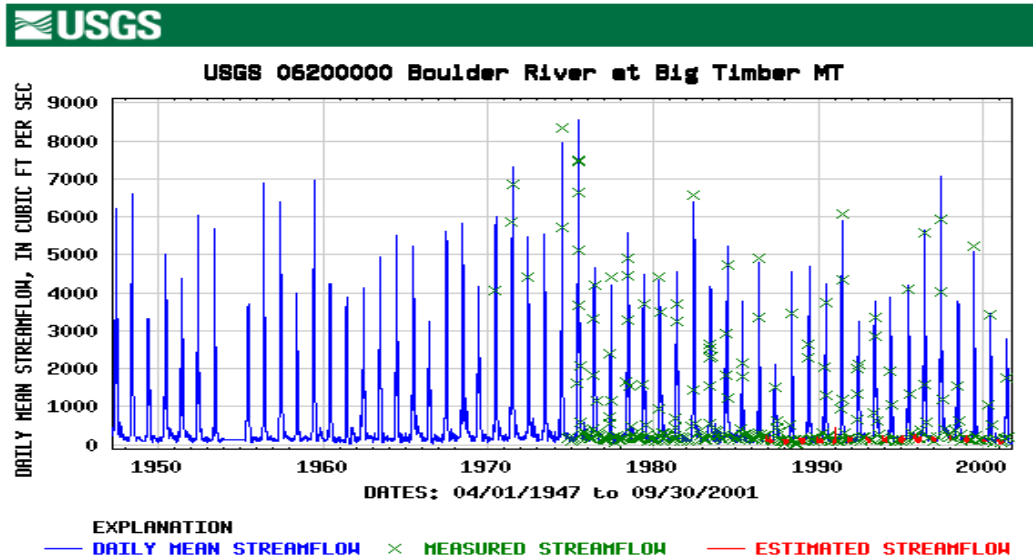


Figure 2-4. Historic flow data for Boulder River at Big Timber, Montana

Figure 2-5 shows a typical seasonal hydrograph for station USGS 06200000 compiled from average daily flows for a 54-year period of record from 1947 through 2001. Both the rising and falling limbs of the hydrograph are very steep, showing that runoff events in the Spring are intense and irrigation withdrawals and diminishing snowpacks in early summer cause steep reductions in flow.

Peak flows are typically in late May in response to rainfall and snowmelt events and average about 3,000 cubic feet per second. Flows diminish sharply through June and July in response to diminished snow pack and extensive irrigation uptakes upstream of Big Timber. By mid-July, base flows of approximately 200 cubic feet per second (cfs) are reached, with little change until the following spring’s runoff.

Streamflow data has been collected in the watershed by USGS at various sites since the early 1900s. The longest running and most current data has been collected at the USGS site located near Big Timber (USGS Site 06200000). Data were available for this site from the USGS WATSTORE database for streamflow data collected from 1947 through 2001.

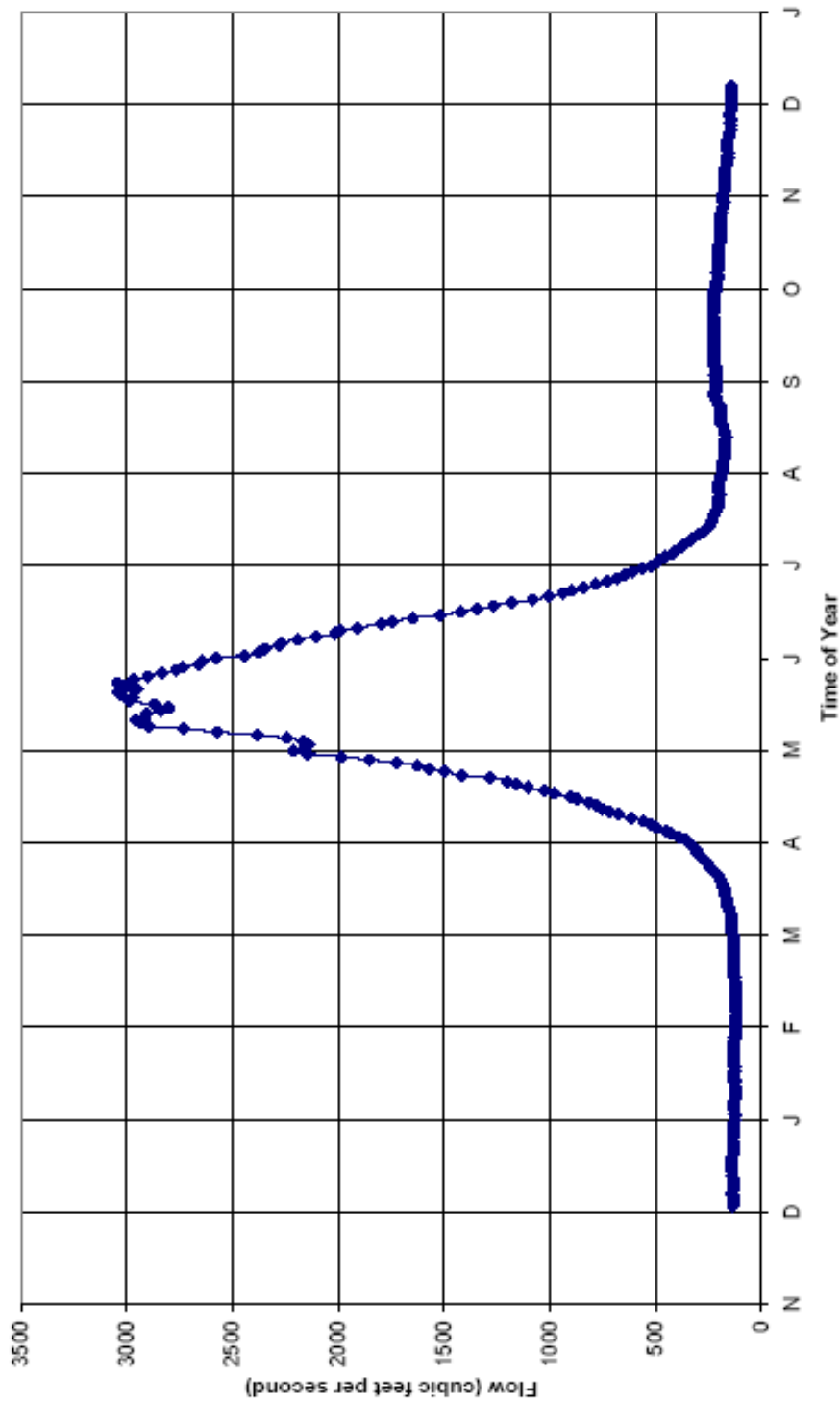


Figure 2-5. Typical hydrograph - Boulder River at Big Timber based on average daily flows 1947 - 2001

Minimum discharges usually occur during late summer when irrigation diversion is greatest. More recent data indicate the present drought in Montana. In 1999, discharge was very similar to average, with slightly below average flows in the late summer and early fall of that year. However, in 2000 and particularly in 2001, stream flow as measured at Big Timber was well below average for the Boulder River. Peak flows reached only 2,181 and 1,484 cfs in 2000 and 2001 respectively, and streamflow dropped as low as 25.5 cfs in August 2001 (DeArment 2003).

2.1.5 Geology

USGS geologic mapping shows the primary geology within the Boulder River Watershed (**Figure 2-6**). Uplifted Precambrian gneiss and schist comprise the upper watershed, and Paleozoic sedimentary rocks dominate the lower reaches below Contact. Tertiary volcanoclastics cap the Precambrian rock in the extreme upper watershed, and unconsolidated glacial deposits and alluvium drape lower portions of the watershed.

Abandoned mines are located throughout the watershed (**Figure 2-7**). Three Priority Abandoned Mine sites are located in the Independence Mining District in the Basin Creek drainage; the Poorman/Emma Mine, the Yager/Daisy Mine and a mine identified as NW SE Section 22 Mine.

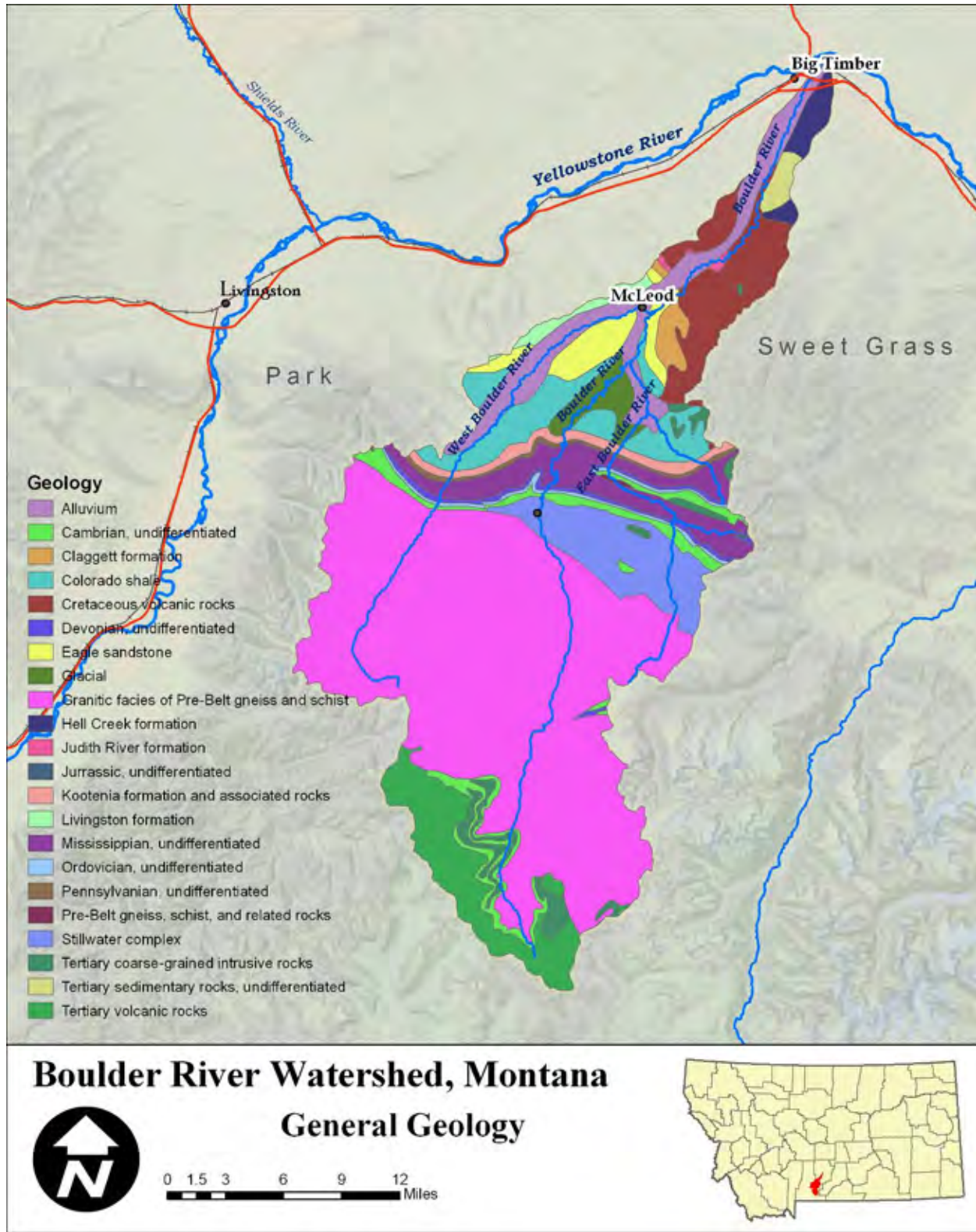


Figure 2-6. Boulder River watershed general geology map

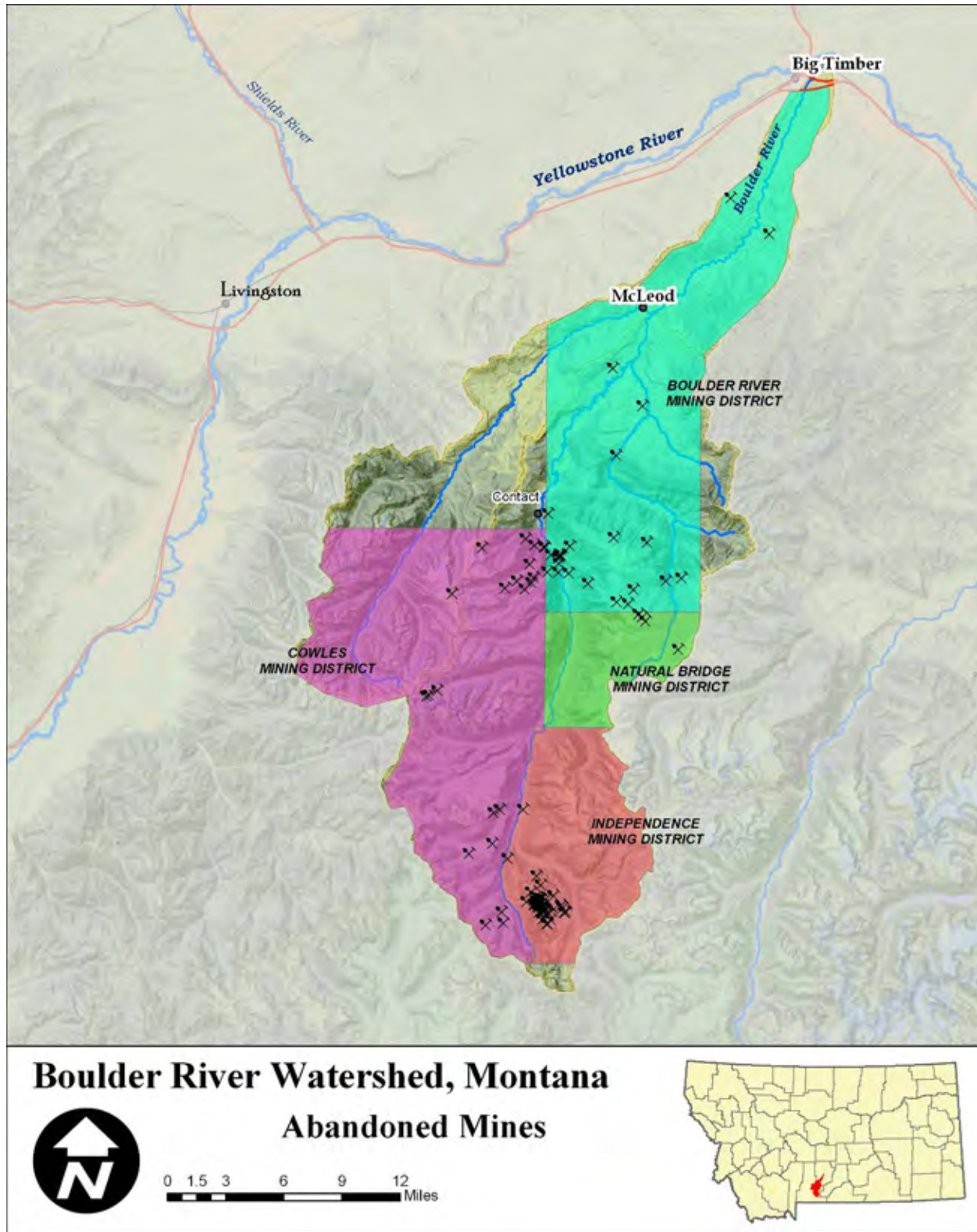


Figure 2-7. Boulder River watershed historic mining map

2.1.6 Soils

Fourteen NRCS soil mapping units occur within the Boulder River Watershed (**Figure 2-8 and Table 2-1**). Soils of the upper watershed are predominantly outcrops and shallow soils derived of calcarious and non-calcarious decomposed rock and conifer detritus, while lower watershed soils are typically deeper loamy alluvial soils.

Table 2-1. NRCS Soil Mapping Units in the Boulder River Watershed

NRCS Soil Mapping Unit	Acres	% of Area
Shadow-Garlet-Macfarlane	95,069	28.1
Rock Outcrop-Rubble Land-Cowood	72,627	21.5
Absarokee-Hilger-Big Timber	37,687	11.2
Prospect-Sublette-Teton	25,645	7.6
Shadow-Comad-Rock Outcrop	17,013	5.0
Havre-Ryell-Harlem	16,489	4.9
Shadow-Garlet-Water	15,079	4.5
Whitefish-Gallatin-Helmville	14,539	4.3
Rock Outcrop-Water-Rubble Land	13,541	4.0
Helmville-Whitore-Tropal	11,329	3.4
Sweetgrass-Hilger-Fairfield	8,254	2.4
Mirror-Bross-Vasquez	5,861	1.7
Tigeron-Garlet-Worock	4,032	1.2
Worock-Garlet-Rock Outcrop	733	0.2
TOTAL	337,898	100.0

Soils across the planning area vary with local geology, topographic relief, and climate. Soils on flood plains and terraces are more than 60 inches deep and formed in loamy material deposited by water. All other soils vary in depth from less than 20 inches to more than 60 inches. Soils on lower elevations uplands and terraces were transported by wind or water or were formed from igneous and metamorphic rocks. Soils on the higher elevation uplands form in water deposited materials or from metamorphic rock. Soils on mountains are formed mainly from glacial till or bedrock.

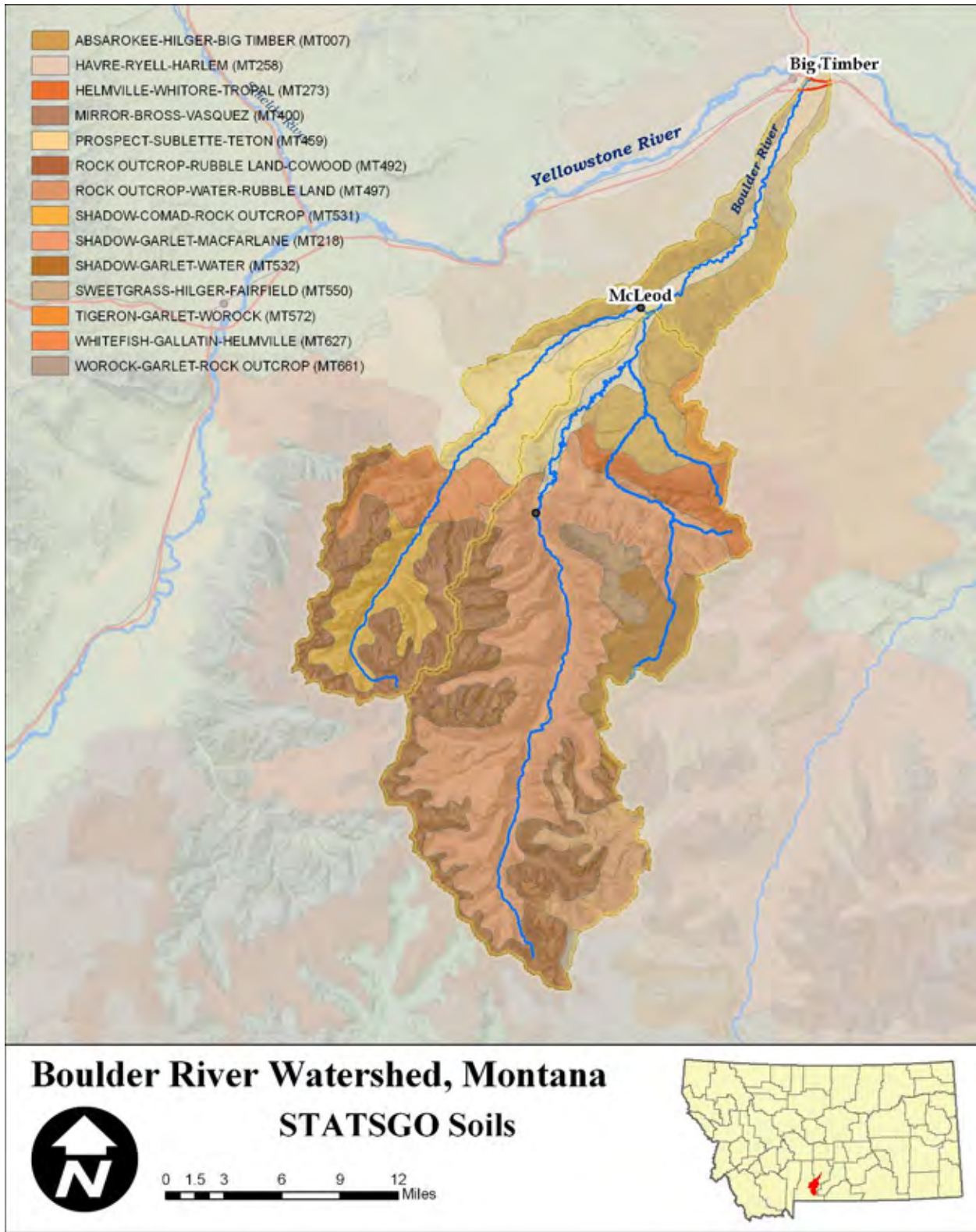


Figure 2-8. Boulder River watershed STATSGO soils map

2.1.7 Land Use and Land Cover

A simplified vegetation cover in the watershed is shown in **Figure 2-9** and is dominated by alpine forest and grasslands. In general, coniferous trees dominate the plant communities upstream of Natural Bridge while grasslands dominate below.

Several noxious weeds have been identified in the watershed and are a threat to streambank stability when they transplant native riparian vegetation. Spotted knapweed, sulfur cinquefoil, and leafy spurge have been observed.

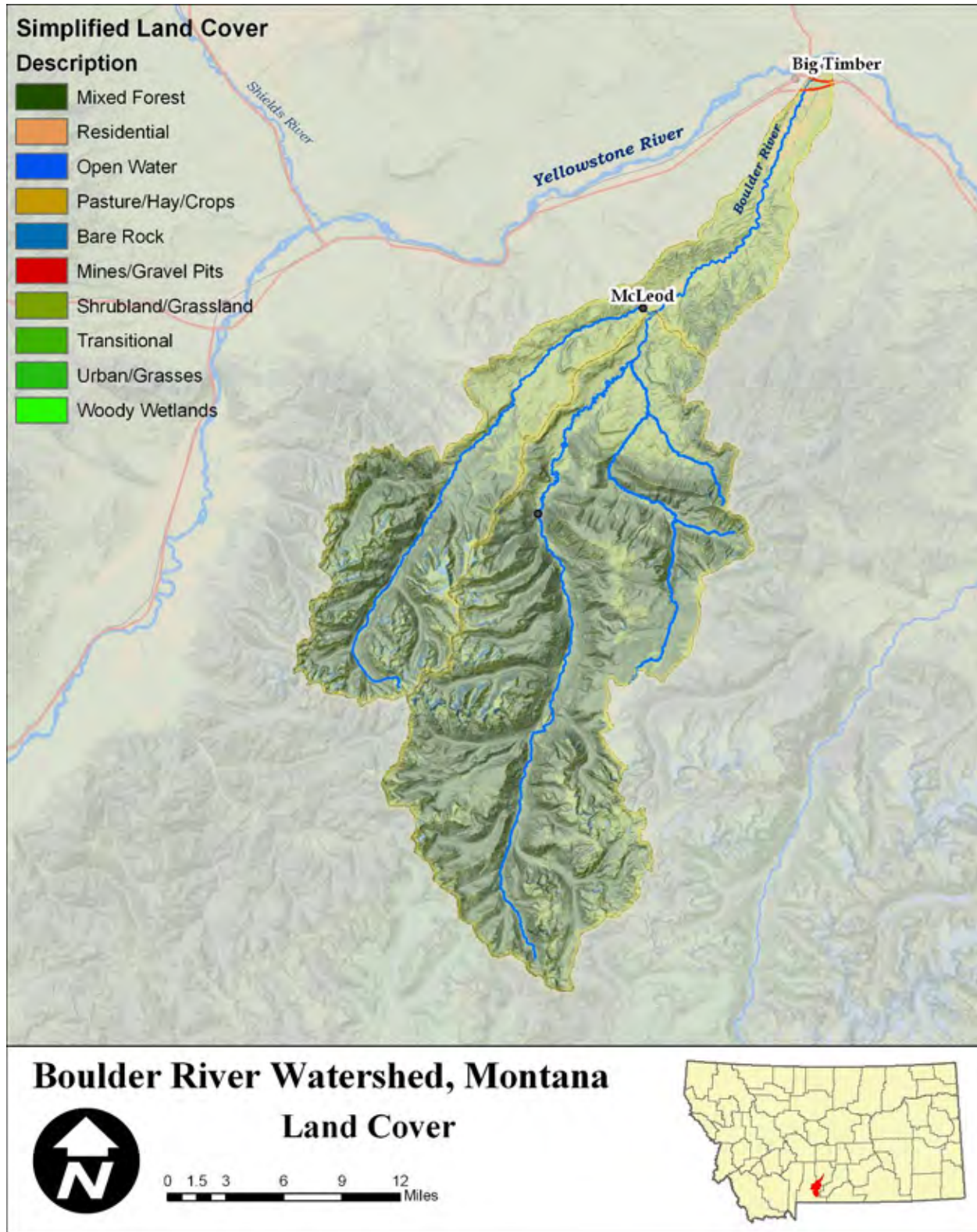


Figure 2-9. Boulder River watershed land cover/land use map

2.2 Cultural Characteristics

2.2.1 Population

Population statistics for the Boulder River watershed were compiled from the NRIS database. Population data are from the 1990 and 2000 United States Census Data. Based on the referenced sources, 1857 people lived within the Boulder River watershed in 1990. In 2000, a population of 1832 people was reported showing a slight decline in population.

Big Timber, the largest town in the watershed, has a population of approximately 1650 residents, not all of which reside within the Boulder River watershed. Most of the rural residents in the watershed live in the northern portion of the area and are involved in agriculture. The southern portion of the watershed is primarily United States Forest Service (USFS) Lands within the ABWA.

2.2.2 Land Ownership

Land ownership information was compiled from the NRIS database and the Montana Cadastral Mapping Project database. Ownership, by category, is shown in **Figure 2-10** and displayed in **Figure 2-11**. The USFS is by far the largest landowner in the Boulder River watershed, holding a total of approximately 388 square miles of the watershed, or approximately 74%. Bureau of Land Management (BLM) holds about 4.4 square miles (less than 1%), the State of Montana holds about 9.5 square miles (less than 2%), with the remaining 122 square miles (23%) privately owned.

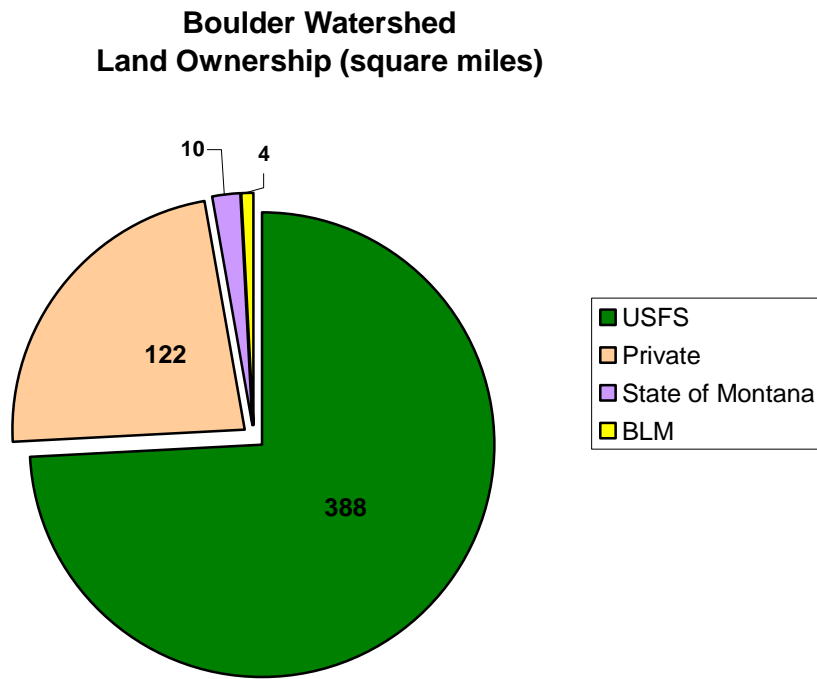


Figure 2-10. Land ownership in the Boulder Watershed

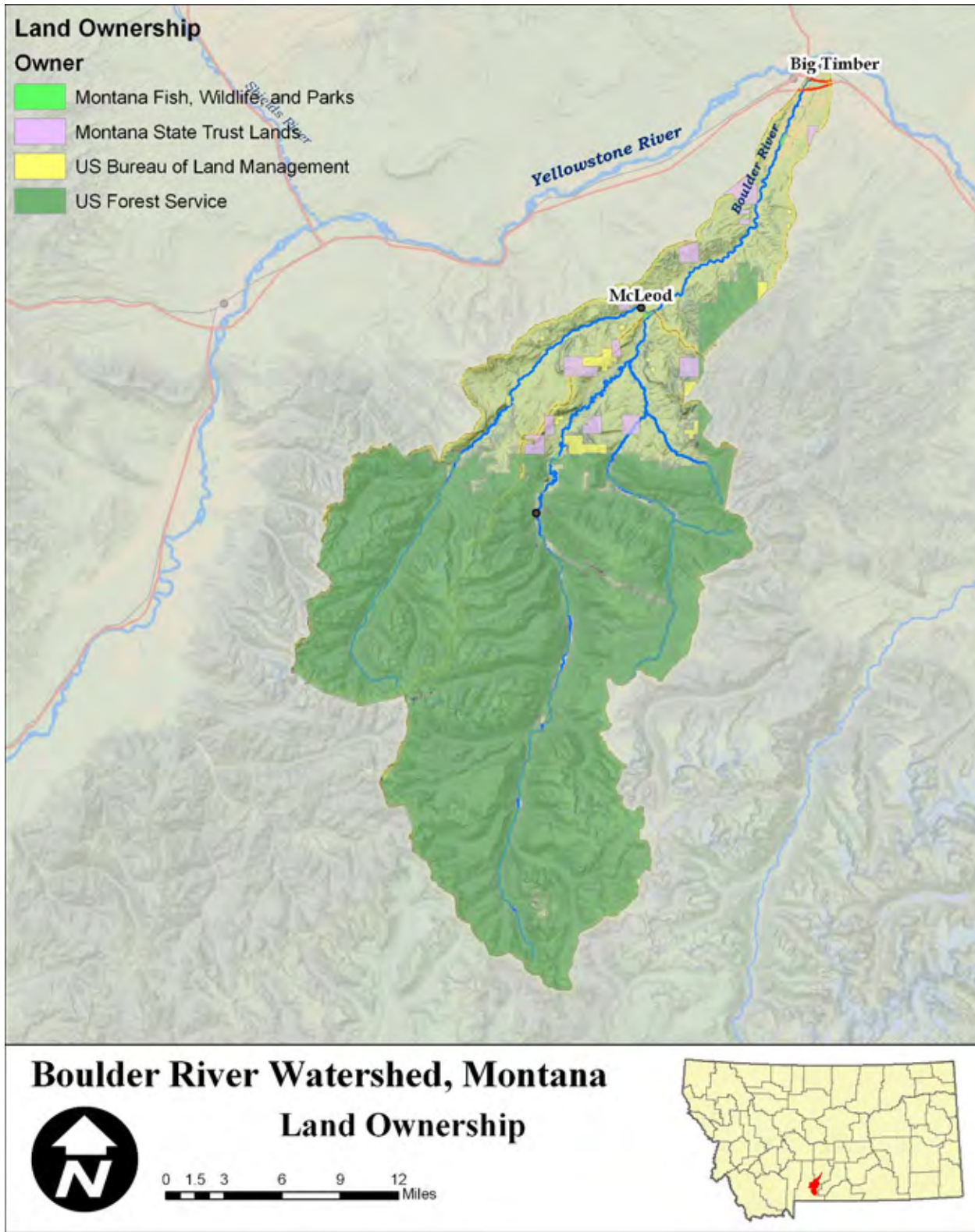


Figure 2-11. Boulder River watershed land ownership map

2.2.3 Recreation

As reported by the Statewide Comprehensive Outdoor Recreation Plan (SCORP) task force, tourism is the second largest industry behind agriculture in Montana. Outdoor recreation made up 75 % of the activities reported by non-resident travelers to Montana from 2000 to 2001 (MFISH). Popular recreational activities within the Boulder River watershed include hunting, fishing, golf, camping, hiking, horseback riding, bicycling, rafting, and skiing, among others. Coldwater fisheries are an important feature of the recreation in the Boulder River Watershed.

Montana Department of Fish, Wildlife, and Parks (MFWP), considers the Boulder River and its tributaries to provide excellent opportunities for wild trout fishing and other year around opportunities (ECON, 1992), and has designated most of the mainstem of the Boulder a blue-ribbon or Class 1 fishery (FWP website). Anglers and other recreational users have considerable access to the Upper Boulder and East Boulder Rivers primarily at fishing access sites, campgrounds, and within Forest Service boundaries. The West Boulder and Lower Boulder are less accessible due to extensive private ownership along the streams.

2.3 Biological Resources

Nearly half of the Boulder River watershed is included in the ABWA, which borders Yellowstone National Park to the south. This area contains some of the most unique and pristine alpine habitat in the world and is home to a diverse and ecologically unique population of wildlife. The biological resources of the area are a major draw for area residents as well as tourists. Biological resources include the cold-water fisheries, big-game and rare large mammals, upland game birds, waterfowl, raptors and songbirds, and fur-bearers, as well as other numerous small mammals and rodents.

2.3.1 Fisheries

The Montana Fisheries Information System (MFISH) contains information on fish species in Montana's rivers. Fish species found in the Boulder River and its tributaries, relative abundance, and stream reaches in which they occur are shown in **Table 2-2**. Abundance estimates range from abundant to common to rare.

Table 2-2. Fish Species, Location, And Relative Abundance

Species	Stream reach in river miles from the mouth of stream	Abundance
Main Boulder		
Brook Trout	37.2 to 42.2	Abundant
	42.2 to 47.6	Rare
Brown Trout	0 to 37.2	Abundant
Longnose Dace	0 to 22.9	Common
Longnose Sucker	0 to 37.2	Abundant
Mottled Sculpin	0 to 22.9	Common
Mountain Sucker	0 to 22.9	Common
Mountain Whitefish	0 to 37.2	Abundant
Rainbow Trout	0 to 50.1	Common
	51.9 to 56.2	Rare
Yellowstone Cutthroat Trout	52.2 to 65.2	Rare
	0 to 11.3 East Fork of Main Boulder	Abundant
East Boulder River		
Brook Trout	0 to 6.1	Rare
Brown Trout	0 to 12.2	Common
	12.2 to 15.7	Rare
Longnose Dace	0 to 3.1	Rare
Mottled Sculpin	0 to 6.1	Abundant
Mountain Sucker	0 to 3.1	Rare
Mountain Whitefish	0 to 3.1	Rare
Rainbow Trout	0 to 12.2	Abundant
	12.2 to 13.6	Common
	13.6 to 15.7	Rare
Yellowstone Cutthroat Trout	15.6 to 22.8	Abundant Common
West Boulder River		
Brown Trout	0 to 24.1	Common
Longnose Dace	0 to 16.9	Rare
Longnose Sucker	0 to 16.9	Common
Mottled Sculpin	0 to 16.9	Rare
Mountain Whitefish	0 to 24.1	Common
Rainbow/Cutthroat Hybrid	0 to 24.1	Rare
Yellowstone Cutthroat Trout	16.9 to 25	Common

In addition to the above data, in 2001 and 2003 fish population surveys were conducted the East Boulder River by the USFS. Data collected showed healthy trout populations of brown, rainbow, brook, and Yellowstone cutthroat trout (GEI consultants, 2003), with rainbow trout being the

most abundant species in the upper Boulder watershed. Yellowstone cutthroat trout were present primarily in the upper most sampling sites.

The Dewatered Streams List was compiled by the FWP in 1991 to identify streams that have had a periodic or chronic reduction in streamflow to a point that leads to unsuitable stream habitat for fish. Chronic dewatering refers to streams that are dewatered in virtually all years, and periodic dewatering refers to streams that are dewatered in drought or water-short years. Within the Boulder River watershed, chronic dewatering has been reported (in the MFISH database) for the lowest 5 miles of Boulder River.

2.3.2 Threatened and Endangered Species

The Montana Natural Heritage Program (MNHP) compiles information on species that are endangered or threatened in Montana. Nearly half of the watershed is a designated wilderness area which borders Yellowstone National Park to the south. A diverse population of species inhabits this pristine area, often with healthy populations found in few other places. MNHP-listed species for Sweetgrass and Park Counties include listed threatened species such as the bald eagle, the grizzly bear, and the Canada lynx. The black-footed ferret is a listed endangered species, while the black-tailed prairie dog is a candidate for threatened or endangered status. MNHP also list the gray wolf as a non-essential experimental population in the area.

SECTION 3.0

TMDL REGULATORY FRAMEWORK AND WATER QUALITY STANDARDS

Section 3.0 presents the status of all 303(d) listed water bodies in the Boulder Watershed TMDL Planning Area (i.e., which water bodies are listed as impaired or threatened and for which pollutants). This is followed by a summary of the applicable water quality standards.

3.1 TMDL Regulatory Requirements

Section 303(d) of the Federal Clean Water Act (CWA) requires states to identify water bodies within its boundaries that do not meet state water quality standards. States track these impaired or threatened water bodies through the 303(d) List, a component of Montana’s Water Quality Integrated Report. State law identifies that a methodology for determining the impairment status of each water body is used for consistency and the actual methodology is identified in Appendix A of Montana’s Water Quality Integrated Report.

Under Montana State Law, an "impaired water body" is defined as a water body or stream segment for which sufficient credible data show that the water body or stream segment is failing to achieve compliance with applicable water quality standards (Montana Water Quality Act; Section 75-5-103(11)). A “threatened water body” is defined as a water body or stream segment for which sufficient credible data and calculated increases in loads show that the water body or stream segment is fully supporting its designated uses but threatened for a particular designated use because of either (a) proposed sources that are not subject to pollution prevention or control actions required by a discharge permit, the nondegradation provisions, or reasonable land, soil, and water conservation practices; or (b) documented adverse pollution trends (Montana Water Quality Act; Section 75-5-103(31)). State Law and section 303 of the CWA require states to develop all necessary TMDLs for impaired or threatened water bodies.

TMDLs are developed for pollutants. These are water quality impairments that can be quantified and a load can be calculated. Riparian degradation and habitat alteration are not pollutants but are considered pollution-related impairments, and thereby do not require TMDLs. Additionally, flow alteration and dewatering are impairment issues related to water quantity and when viewed alone are not subject to a TMDL. However, sediment-related impairments may be related to stream energy and flow conditions. Likewise, riparian degradation and habitat alteration when considered alone do not require a TMDL, yet are often linked to pollutant loading and may exacerbate and contribute to the loading and influence of a pollutant in a stream. As such, flow and habitat conditions are often considered when conducting TMDL analysis.

A TMDL is a pollutant budget for a water body identifying the maximum amount of the pollutant that a water body can assimilate without causing applicable water quality standards to be exceeded. TMDLs are often expressed in terms of an amount, or load, of a particular pollutant (expressed in units of mass per time such as pounds per day). TMDLs must account for loads/impacts from point and nonpoint sources in addition to natural background sources and

must incorporate a margin of safety and consider influences of seasonality on analysis and compliance with water quality standards.

To satisfy the Federal Clean Water Act and Montana State Law, Total Maximum Daily Loads are developed for each water body-pollutant combination identified on the state's list of impaired or threatened waters (303(d) List). State Law (Administrative Rules of Montana 75-5-703(8)) also directs Montana DEQ to "...support a voluntary program of reasonable land, soil, and water conservation practices to achieve compliance with water quality standards for nonpoint source activities for water bodies that are subject to a TMDL..." This is an important directive that is reflected in the overall TMDL development and implementation strategy within this plan. It is important to note that water quality protection measures are not considered voluntary where such measures are already a requirement under existing Federal, State, or Local regulations.

3.2 Water Bodies and Pollutants of Concern

The assessment of streams, lakes, and wetlands to identify impaired waters for inclusion on Montana's Water Quality Integrated Report (IR) is an important step in a process intended to ensure that all water bodies in the state will have water quality adequate to support all of their classified beneficial uses. The process has been developed and shaped by legal mandates, water quality standards, the tools and techniques of water quality monitoring, the availability of information, and the funds and administrative resources that can be devoted to assessment efforts.

The impairment causes and sources determination included on the 1996 303(d) List was based on data that showed impairments, however many determinations were based on professional judgment and involved limited data. Since the development of the 1996 303(d) List, the Montana Department of Environmental Quality has instituted procedures that more fully assess and identify impaired waters. This procedure, the Sufficient Credible Data Assessment & Beneficial Use-Support Determinations (SCD/BUD) Process, conducted by the Montana Department of Environmental Quality in response to legal requirements stipulated in MCA 75-5-702, resulted in updates to the 1996 303(d) listing. Consequently, impaired uses, causes, and sources on the 2006 303(d) List may differ from the original 1996 listings as a result of the data review and associated list revisions.

While the 2006 303(d) List is now Montana's most current list, and is based on more thorough data review and analysis than the 1996 list, a ruling by the U.S. District Court (CV97-35-M-DWM) on September 21, 2000, required that the State of Montana must complete all necessary TMDLs for waters listed as impaired or threatened on the 1996 303(d) List. Where new data has resulted in changes to the 303(d) listing status for 1996-listed waters through the State's SCD/BUD process, the DEQ will complete TMDLs based on updated impairments status resulting from this new information.

Water bodies reviewed by the State's SCD/BUD process fall into 5 categories. The level of beneficial use support for the listed waters can be as fully supporting all designated beneficial uses (F), threatened (T), partially support (P), not supporting (N), and lacking sufficient credible data (X). The Beneficial Use-Support Determination for the 303(d) listed streams in the Boulder

River TMDL Planning Area is provided in **Table 3-1**. A map of segment locations is given in **Figure 3-1**.

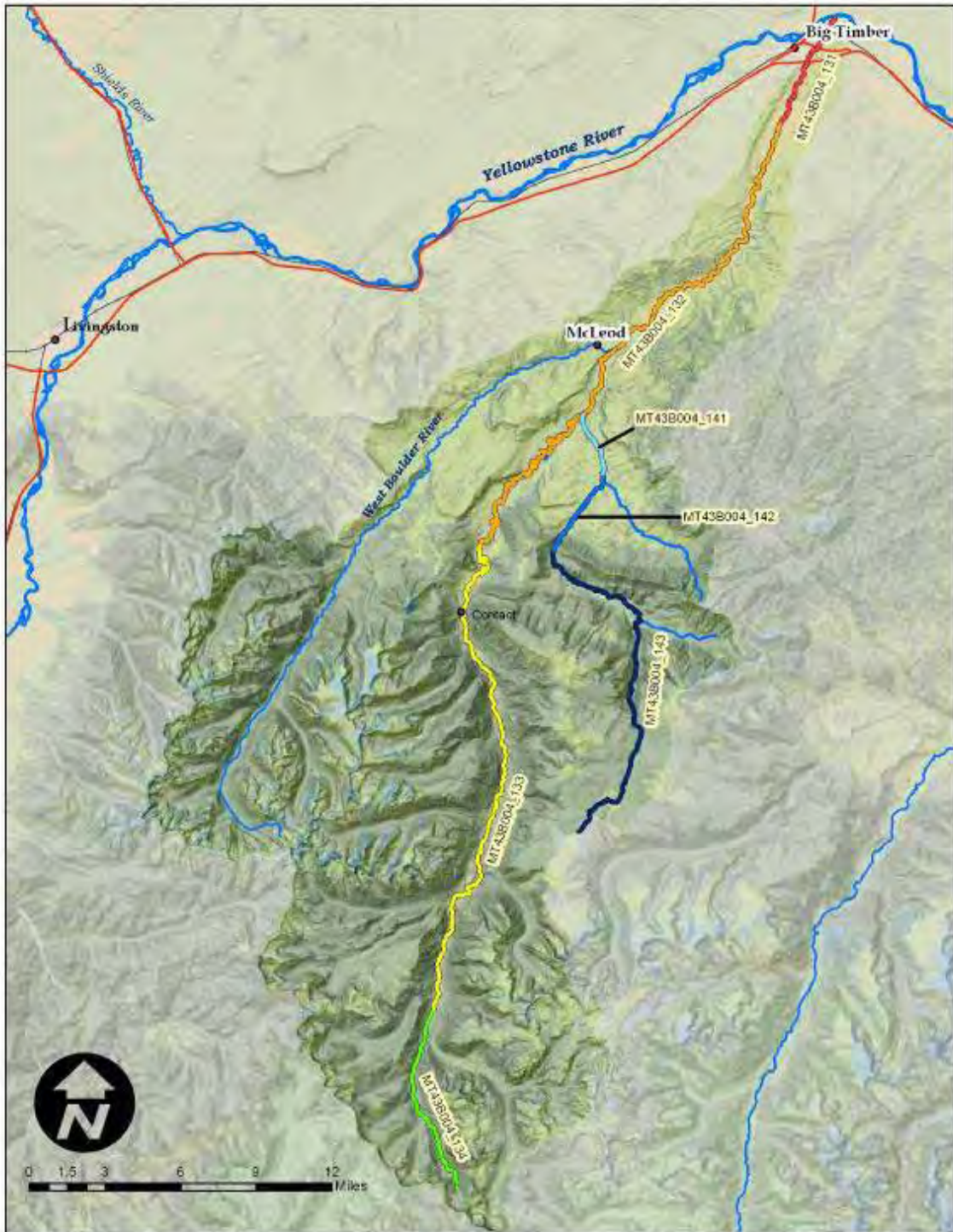


Figure 3-1. Water body Segments in the Boulder TMDL Planning Area

Table 3-1. Impaired Uses from both 1996 and 2006 303(d) Lists

Stream Reach (MT Water body ID)	1996 Use-Support						2006 Use Support							
	Use Classification	Aquatic Life	Cold Water Fishery	Drinking Water	Agriculture	Industry	Contact Recreation	Use Classification	Aquatic Life	Cold Water Fishery	Drinking Water	Agriculture	Industry	Contact Recreation
East Boulder River (from Elk Cr to the mouth) MT43B004_141	B-1	T						B-1	P	P	F	F	F	P
East Boulder River (from National Forest boundary to Elk Cr) MT43B004_142	B-1	T						B-1	P	P	X	F	F	P
East Boulder River (from National Forest Boundary to headwaters) MT43B004_143	B-1	T						B-1	F	F	F	F	F	F
Boulder River (from the mouth to five miles upstream) MT43B004_131	B-1	X	X	X	X	X	X	B-1	P	P	F	F	F	P
Boulder River (from 5 miles upstream of the mouth to the National Forest boundary) MT43B004_132	B-1	X	X	X	X	X	X	B-1	P	P	F	F	F	F
Boulder River (from the National Forest boundary to the East Fork Boulder River confluence) MT43B004_133	B-1	X	X	X	X	X	X	B-1	P	P	F	F	F	P
Boulder River (from the East Fork Boulder River to the headwaters) MT43B004_134	B-1	X	X	X	X	X	X	B-1	P	P	N	F	F	F

Source: DEQ, 1996, 2006

One water body in the Boulder River TMDL Planning area occurs on Montana's 1996 303(d) List: East Boulder River (entire reach). The cause and source of impairment for the 1996 303(d) List is shown in **Table 3-2**. The 2006 303(d) List is summarized in **Table 3-3**.

Table 3-2. 1996 303(d) List Information for the Boulder River TMDL Planning Area

Segment Name (MT Water body ID)	Length (miles)	Probable Cause	Probable Source
East Boulder River MT43B004_141 MT43B004_142 MT43B004_143	23	Nutrients	Resource Extraction

Source: DEQ, 1996

Table 3-3. 2006 303(d) List Information for the Boulder River TMDL Planning Area.

Segment Name (MT Water body ID)	Length (miles)	Probable Cause	Probable Source
East Boulder River MT43B004_141	3.1	Sedimentation/Siltation Low flow alteration Other anthropogenic substrate alterations Chlorophyll-a	Flow Alterations from water diversions Streambank modifications/destabilization Source unknown
East Boulder River MT43B004_142	3	Chlorophyll-a Low flow alteration	Source unknown Agriculture
East Boulder River MT43B004_143	16.6	NA	NA
Boulder River MT43B004_131	5	Copper Iron Lead Silver Low flow alterations	Impacts from abandoned mine lands Irrigated crop production
Boulder River MT43B004_132	27.8	Chromium Nickel Nitrate/Nitrite Total Kjeldahl Nitrogen Alteration of vegetative covers	Agriculture Grazing in riparian zones Source unknown
Boulder River MT43B004_133	23.5	Phosphorous (Total) Nitrate/Nitrite Total Kjeldahl Nitrogen Excess Algal Growth	Source Unknown
Boulder River MT43B004_134	8.2	Copper Lead	Impacts from abandoned mine lands

Source: DEQ 2006.

Pollutants of concern (in bold, **Table 3-3**), i.e. those requiring TMDL evaluation include:

- **Nutrients**
Nutrients describe a suite of pollutants that contribute to excessive chlorophyll-a (algae) growth. These typically include organic and inorganic forms of phosphorous and nitrogen. Presently listed nutrient impairment causes in the Boulder TPA include chlorophyll-a, excess algal growth, total phosphorous, nitrate/nitrite, and total Kjeldahl nitrogen.
- **Metals**
Metals include a variety of forms (dissolved and total recoverable) and can be evaluated as forms present in both water and sediment samples. Presently listed metals impairment causes in the Boulder TPA include copper, iron, lead, silver, chromium, and nickel.
- **Sediment**
Sediment-related impairments relate to excessive sediment deposited on stream bottoms and in the water column. Presently listed sediment impairment causes in the Boulder TPA include sedimentation and siltation.

Specific information regarding the status of these pollutants as causes of impairment is given in **Section 4**.

3.3 Applicable Water Quality Standards

Water quality standards include the uses designated for a water body, the legally enforceable standards that ensure that the uses are supported, and a non-degradation policy that protects the existing high quality of a water body. The ultimate goal of this TMDL plan, once implemented, is to ensure that water quality standards are met for all pollutants of concern identified on the Montana's list of impaired waters, the 303(d) List. Water quality standards form the basis for the targets described in **Section 4.0**. Pollutants addressed in this TMDL plan include: metals, nutrients and sediment. **Section 3.3.2** provides a summary of the applicable water quality standards for each of these pollutants.

3.3.1 Classification and Beneficial Uses

Classification is the assignment (designation) of a single or group of uses to a water body based on the potential of the water body to support those uses. Designated Uses or Beneficial Uses are simple narrative descriptions of water quality expectations or water quality goals. There are a variety of "uses" of state waters including: growth and propagation of fish and associated aquatic life; drinking water; agriculture; industrial supply; and recreation and wildlife. The Montana Water Quality Act (WQA) directs the Board of Environmental Review (BER, i.e., the State) to establish a classification system for all waters of the state that includes their present (when the Act was originally written) and future most beneficial uses (Administrative Rules of Montana (ARM) 17.30.607-616) and to adopt standards to protect those uses (ARM 17.30.620-670).

Montana, unlike many other states, uses a watershed based classification system with some specific exceptions. As a result, *all* waters of the state are classified and have designated uses and supporting standards. All classifications have multiple uses and in only one case (A-Closed) is a specific use (drinking water) given preference over the other designated uses. Some waters may

not actually be used for a specific designated use, for example as a public drinking water supply. However, the quality of that water body must be maintained suitable for that designated use. When natural conditions limit or preclude a designated use, permitted point source discharges or non-point source discharges may not make the natural conditions worse.

Modification of classifications or standards that would lower a water’s classification or a standard (i.e., B-1 to a B-3), or removal of a designated use because of natural conditions can only occur if the water was originally miss-classified. All such modifications must be approved by the BER, and are undertaken via a Use Attainability Analysis (UAA) that must meet EPA requirements (40 CFR 131.10(g), (h) and (j)). The UAA and findings presented to the BER during rulemaking must prove that the modification is correct and all existing uses are supported. An existing use cannot be removed.

Descriptions of Montana’s surface water classifications and designated beneficial uses are presented in **Table 3-4**. All water bodies within the Boulder River TPA are classified as B-1.

Table 3-4. Montana Surface Water Classifications and Designated Beneficial Uses

Classification	Designated uses
B-1 CLASSIFICATION:	Waters classified B-1 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

3.3.2 Standards

In addition to the Use Classifications described above, Montana’s water quality standards include numeric and narrative criteria as well as a nondegradation policy.

Numeric surface water quality standards have been developed for many parameters to protect human health and aquatic life. These standards are in the Department Circular DEQ-7 (DEQ, February 2006). The numeric human health standards have been developed for parameters determined to be toxic, carcinogenic, or harmful and have been established at levels to be protective of long-term (i.e., life long) exposures as well as through direct contact such as swimming.

The numeric aquatic life standards include chronic and acute values that are based on extensive laboratory studies including a wide variety of potentially affected species, a variety of life stages and durations of exposure. Chronic aquatic life standards are protective of long-term exposure to a parameter. The protection afforded by the chronic standards includes detrimental effects to reproduction, early life stage survival and growth rates. In most cases the chronic standard is more stringent than the corresponding acute standard. Acute aquatic life standards are protective of short-term exposures to a parameter and are not to be exceeded.

High quality waters are afforded an additional level of protection by the nondegradation rules (ARM 17.30.701 et. seq.) and in statute (75-5-303 MCA). Changes in water quality must be “non-significant” or an authorization to degrade must be granted by the Department. However, under no circumstance may standards be exceeded. It is important to note that, waters that meet or are of better quality than a standard are high quality for that parameter, and nondegradation policies apply to new or increased discharges to that the water body. Nondegradation rules do not apply to impaired streams and apply only where there are existing numeric water quality standards.

Narrative standards have been developed for substances or conditions for which sufficient information does not exist to develop specific numeric standards. The term “Narrative Standards” commonly refers to the General Prohibitions in ARM 17.30.637 and other descriptive portions of the surface water quality standards. The General Prohibitions are also called the “free from” standards; that is, the surface waters of the state must be free from substances attributable to discharges, including thermal pollution, that impair the beneficial uses of a water body. Uses may be impaired by toxic or harmful conditions (from one or a combination of parameters) or conditions that produce undesirable aquatic life. Undesirable aquatic life includes bacteria, fungi and algae.

The standards applicable to the list of pollutants addressed in the Boulder River TPA are summarized below.

3.3.2.1 Nutrients

The narrative standards applicable to nutrients elsewhere in Montana are contained in the General Prohibitions of the surface water quality standards (ARM 17.30.637 et. Seq.). The prohibition against the creation of “conditions which produce undesirable aquatic life” is generally the most relevant to nutrients.

Most waters of Montana are protected from excessive nutrient concentrations by narrative standards. The exception is the Clark Fork River above the confluence with the Flathead River, where numeric water quality standards for total nitrogen (300 ug/l) and total phosphorus (20 ug/l upstream of the confluence with the Blackfoot River and 39 ug/l downstream of the confluence) as well as algal biomass measured as chlorophyll a (summer mean and maximum of 100 and 150 mg/m², respectively) have been established.

3.3.2.2 Sediment

Sediment (i.e., coarse and fine bed sediment) and suspended sediment are addressed via the narrative standard identified in **Table 3-5**. The standard does not allow for harmful or other undesirable conditions related to increases above naturally occurring levels or from discharges to state surface waters. This is interpreted to mean that water quality goals should strive toward a condition in which any increases in sediment above naturally occurring levels are not harmful, detrimental, or injurious to beneficial uses (see definitions in **Table 3-2**).

Table 3-5. Applicable Rules for Sediment-Related Pollutants

Rule(s)	Standard
17.30.623(2)	No person may violate the following specific water quality standards for waters classified B-1.
17.30.623(2)(f)	No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except as permitted in 75-5-318, MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.
17.30.637(1)	State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will.
17.30.637(1)(a)	Settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines.
17.30.637(1)(d)	Create concentrations or combinations of materials that are toxic or harmful to human, animal, plant, or aquatic life.
	The maximum allowable increase above naturally occurring turbidity is: 0 NTU for A-closed; 5 NTU for A-1, B-1, and C-1; 10 NTU for B-2, C-2, and C-3)
17.30.602(17)	“Naturally occurring” means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied.
17.30.602(21)	“Reasonable land, soil, and water conservation practices” means methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after pollution-producing activities.

3.3.2.3 Metals

Numeric criteria for metals in Montana include specific standards for the protection of both aquatic life and human health. As described above, acute and chronic criteria have been established for the protection of aquatic life. The criteria for some metals vary according to the hardness of the water. The standards for cadmium, copper, chromium (III), lead, nickel, and silver vary according to the hardness of the water. These standards have an inverse relationship to toxicity (decreasing hardness causes increased toxicity). The applicable numeric criteria for the metals of concern in the Boulder River TPA are defined in *Montana DEQ Circular, DEQ-7: Montana Numeric Water Quality Standards* and are presented in **Table 3-6**.

Table 3-6. Montana Numeric Surface Water Quality Standards for Metals

Parameter	Aquatic Life (acute) (µg/L)^a	Aquatic Life (chronic) (µg/L)^b	Human Health (µg/L)^a
Chromium (III) (TR)	579 @ 25 mg/L hardness ^c	28 @ 25 mg/L hardness ^c	—
Copper (TR)	3.8 @ 25 mg/L hardness ^c	2.85 @ 25 mg/L hardness ^c	1,300
Iron (TR)	—	1,000	—
Lead (TR)	14 @ 25 mg/L hardness ^c	0.545 @ 25 mg/L hardness ^c	15
Nickel (TR)	145 @ 25 mg/L hardness ^c	16 @ 25 mg/L hardness ^c	100
Silver (TR)	0.4 @ 25 mg/L hardness ^c	—	100

^aMaximum allowable concentration.

^bNo 4-day (96-hour) or longer period average concentration may exceed these values.

^cStandard is dependent on the hardness of the water, measured as the concentration of CaCO₃ (mg/L).

Note: TR = total recoverable.

SECTION 4.0 POLLUTANT ASSESSMENT AND STATUS

4.1 Introduction

Section 4.0 includes a review of existing data for which TMDLs have been prepared (**Section 5.0**). Existing data for each water body segment is evaluated in comparison to water quality criteria (targets). Segments not meeting water quality criteria are determined to be impaired for the pollutant of concern and require the establishment of Total Maximum Daily Loads. TMDLs and load allocations for these segments are given in **Section 5**.

Water body segments on the 2006 303(d) List and associated causes of impairment are included in **Table 4-1**. Segment locations are given in **Figure 3-1**. Note that several probable causes of impairment have not been addressed by DEQ at this time. They include 1) Nitrate/Nitrite and Total Kjeldahl Nitrogen (segment MT43B004_132), and 2) Phosphorus (Total), Nitrate/Nitrite, Total Kjeldahl Nitrogen, Excess Algal Growth (segment MT43B004_133). As these pollutants were newly listed in 2006, resources were not available to provide adequate assessment and verification of these pollutant listings at the time of document production. DEQ will address these pollutants at a later date.

Table 4-1. 2006 303(d) listings in the Boulder Watershed TMDL Planning Area

MT Water Body Segment Identifier	Water body Segment	Probable Causes of Impairment
MT43B004_131	Boulder River (from the mouth to 5 miles upstream)	Copper Iron Lead Silver Low flow alterations
MT43B004_132	Boulder River (from 5 miles upstream of the mouth to the National Forest boundary)	Chromium Nickel Nitrate/Nitrite Total Kjeldahl Nitrogen Alteration of vegetative covers
MT43B004_133	Boulder River (from the National Forest boundary to the East Fork Boulder River confluence)	Phosphorus (Total) Nitrate/Nitrite Total Kjeldahl Nitrogen Excess Algal Growth
MT43B004_134	Boulder River (from the East Fork Boulder River to the headwaters)	Copper Lead
MT43B004_141	East Boulder River (from the mouth to the Elk Creek confluence)	Chlorophyll- <i>a</i> Low flow alterations Anthropogenic substrate alterations Sedimentation/Siltation
MT43B004_142	East Boulder River (From Elk Creek to the National Forest boundary)	Chlorophyll- <i>a</i> Low flow alterations
MT43B004_143	East Boulder River (From the National Forest boundary to the headwaters)	None

4.2 Assessment Framework

Assessing attainment of numeric water quality criteria (targets), and subsequent determination of whether a TMDL is necessary for each water body segment involves three steps:

1. Evaluation of pollutant sources

Pollutant sources in a watershed are both natural and anthropogenic. Both natural and anthropogenic sources must be considered when developing appropriate water quality targets. TMDLs are not developed for streams that are not meeting water standards due solely to ‘naturally occurring’ pollutants.

2. Development of numeric water quality criteria (targets) that represent water quality conditions that are unimpaired for the pollutant of concern

A required component of TMDL plans is the establishment of numeric water quality criteria or *targets* that represent a condition that meets Montana’s ambient water quality standards. Numeric targets are measurable water quality indicators that, either by themselves or in combination with others, reflect attainment of water quality standards (narrative and numeric) or represent a water quality condition that is unimpaired for the pollutant of concern. For pollutants with numeric standards (metals, toxins), the established state numeric standard as defined in *DEQ Circular DEQ-7* is typically adopted as the water quality target. For pollutants with narrative standards (sediment, nutrients), a translation of the narrative standard into a measurable, numeric surrogate parameter(s) is necessary. Depending on the nature of the pollutant, processes affecting impairment conditions and other factors, either a single parameter or a suite of parameters or indicators may be employed to evaluate whether water quality standards are met for the pollutant in question.

Targets represent translations of water quality standards at the time of document preparation. As water quality standards or assessment and evaluation tools are refined or further developed, DEQ may modify targets to better reflect the state’s process for evaluating attainment of water quality standards. Because numeric nutrient water quality standards are currently under development by the State of Montana, nutrient targets may be subject to change based on the results of the rule-making process.

Targets are used to facilitate evaluation of state waters specifically for TMDL purposes and may or may not be appropriate for other planning objectives on a case by case basis as defined within each TMDL document. Appropriate use of the targets will vary based on the level of certainty regarding the target(s) value and how well that value effectively defines attainment of the narrative standard, the impacts that attainment of target value(s) may have on activities in a watershed, and whether or not the water body is impaired. If the water body is not impaired, then the targets provide the necessary numeric translations/measures to justify a decision of no impairment in addition to providing the numeric interpretation of narrative standards that existing activities can use to assist with planning and water quality protection efforts.

3. Comparison of existing data with water quality targets to evaluate water quality target attainment and, consequently, determine whether a TMDL is necessary.

Attainment of water quality targets (and subsequent beneficial use determination) is evaluated by comparing existing water quality data and information to the established targets. Determination typically involves evaluation of many data types distributed both spatially and temporally, some of which may meet water quality targets, and some of which may not. Where such condition exists, a discussion of data and its utility in characterizing existing conditions is presented, followed by a determination of whether the stream is impaired and therefore whether a TMDL is required. Criterion for evaluating attainment of targets is defined in the Basis for Target Values within each specific target description.

4.3 East Boulder River Segment MT43B004_141 (Sediment)

The 2006 303(d) list status of water bodies in the Boulder River TPA is summarized in **Section 4.0**. East Boulder River segment MT43B004_141 (from the mouth to the Elk Creek confluence) is the only segment on the 2006 303(d) listed as impaired for sedimentation/siltation, and identifies aquatic life and cold-water fisheries as the beneficial uses that are impaired.

Since its original listing for sediment on the 2000 303(d) list, new data and information relevant to sediment impairment determinations has been gathered. Recent data shows that East Boulder River segment MT43B004_141 may be meeting the applicable narrative water quality standards for sediment; therefore, DEQ is not proceeding with a TMDL for sediment at this time. *East Boulder River Sediment Assessment* (DEQ, 2007) provides an assessment of sediment sources and an evaluation of existing conditions and data for segment MT43B004_141. Until such time as this segment is reevaluated following Montana's Water Quality Assessment Methodology (SOP WQP BWQM-001), it will remain on the 303(d) list as impaired for sediment. The *East Boulder River Sediment Assessment* will be considered along with all other readily available data when it is reevaluated for purposes of the 303(d) list.

4.4 East Boulder River Segments MT43B004_141 and MT43B004_142 (Chlorophyll-*a*/Nutrients)

In 1996 the entire East Boulder River, from headwaters to mouth, was listed as 'threatened' due to nutrients with the probable source being resource extraction. The basis for this original listing was founded on an interpretation of the term, 'threatened'. In 1997, the term 'threatened' was defined in the Montana Water Quality Act [MCA 75-5-103 (31)]. Consequently, the East Boulder River did not fit the definition of a 'threatened water body' as proposed sources are subject to pollution control measures through a state of Montana MPDES permit, and subsequent DEQ review determined that insufficient data existed to support 'adverse water quality trends'. DEQ later split the East Boulder River into three discrete segments (**Figure 3-1**), based on ecoregional influences and changes in stream type and character.

- MT43B004_141 (from the mouth to the Elk Creek confluence)
- MT43B004_142 (from Elk Creek to the National Forest boundary)
- MT43B004_143 (from the National Forest Boundary to the headwaters)

On the 2006 303(d) list, East Boulder River segments, MT43B004_141 and MT43B004_142 were listed as impaired for chlorophyll-*a* (algal growth), and identified aquatic life, cold-water fisheries, and recreation as the impaired beneficial uses. Segment MT43B004_143 was found to be fully supporting its beneficial uses.

Recent data collection and evaluation shows that segments MT43B004_141 and MT43B004_142 may be meeting the applicable narrative water quality standards for nutrients; therefore, DEQ is not proceeding with a TMDL at this time. *East Boulder River Nutrient Assessment* (DEQ, 2007) provides an assessment of nutrient sources affecting chlorophyll-*a* growth, and an evaluation of existing conditions and data for segments MT43B004_141 and MT43B004_142. Until such time as these segments are reevaluated following Montana's Assessment Methodology (SOP WQPBWQM-001), they will remain on the 303(d) list as impaired for nutrients. The *East Boulder River Nutrient Assessment* will be considered along with all other readily available data when it is reevaluated for purposes of the 303(d) list.

4.5 Boulder River Segments MT43B004_131, MT43B004_132, MT43B004_133, MT43B004_134, & MT43B005_010 (Metals)

The 2006 303(d) list status of water bodies in the Boulder River TPA is summarized in **Section 4.0**. Boulder River segments MT43B004_131, MT43B004_132, and MT43B004_134 are listed as impaired for metals (copper, lead, chromium, nickel, silver, iron): aquatic life, cold-water fisheries and drinking water are the beneficial uses that have been identified as not fully supported due to these impairment conditions.

Section 4.5 provides an assessment of metals sources, metals water quality targets, and an evaluation of existing conditions and data with respect to water quality targets for segments MT43B004_131, MT43B004_132, MT43B004_133, and MT43B004_134. In addition to these segments, Basin Creek segment MT43B005-010 is evaluated. Basin Creek lies at the headwaters of the Boulder River and is a known source of abandoned mine lands that contribute metals loads to the Boulder River.

4.5.1 Metals Sources

Sources of metals in the Boulder River include nonpoint sources (natural geologic sources & historic mining sites), and point sources (permitted discharges from the East Boulder Mine, and the city of Big Timber wastewater lagoon). Additional nonpoint sources may include downstream channel and streambank/floodplain deposits where historical mining has elevated metals concentrations.

Natural sources of metals are those that contribute metals independently of human disturbance or influence. Natural sources are geologically derived from metals found within the Earth's crust. The geology throughout the watershed is mineral rich and has the potential to contribute metals to receiving waters through natural weathering processes. Abandoned mines have a large potential to affect receiving water quality through non-point source loading. Lands surrounding abandoned mines often contain exposed mineral deposits, mine dumps, adit discharges and

tailings that can contaminate the surrounding watershed and ecosystem. There are a number of known abandoned mines within the Boulder River watershed. Although the total number of mines is fairly large, State priority abandoned mine sites in the basin are limited to the Independence Mining District, and the Basin Creek sub-basin. Channel and streambank/floodplain deposits can harbor higher levels of metals, as loads from upstream abandoned mine source areas move their way downstream through the river system. High flows may remobilize these sediment-metals through bank erosion and channel scouring and contribute to water quality impairment. Permitted discharges through the state’s MPDES Permitting Program may contribute metals to surface water. Load limits defined in the MPDES permit are designed to maintain water quality standards.

4.5.2 Metals Water Quality Targets

Water Quality Criteria

For pollutants with numeric standards (metals), the established state numeric water quality criteria as defined in *MDEQ Circular DEQ-7* is typically adopted as the water quality target. Numeric standards apply to both human health and aquatic life protection. The numeric aquatic life criteria for most metals are dependent upon water hardness values as the hardness increases, the water quality criteria for a specific metal increase also. Water quality criteria (acute¹ and chronic aquatic² life, human health) for each parameter of concern at a water hardness of 25 mg/L are shown in **Table 4-2**. Consequently, where the aquatic life numeric criteria is used as the target, the water quality target values for specific metals will vary with water hardness.

Table 4-2. Water quality criteria for metals at 25 mg/L hardness

Metal	Aquatic Life Criteria (ug/L)		Human Health Criteria (ug/L)	
	Acute	Chronic	Surface Water	Ground Water
Cadmium	0.52	0.01	5	5
Chromium	579	27.7	100	100
Copper	3.79	2.85	1,300	1,300
Lead	13.98	0.545	15	15
Nickel	145	16.1	100	100
Silver	0.374	NA	100	100
Zinc	37	37	2,000	2,000
Iron	1000	1000	* ³	* ³

Water quality targets for metals are the State of Montana acute and chronic aquatic life criteria as defined in DEQ Circular DEQ-7. In the case of silver, which does not have a chronic criteria, the acute criteria is the target value. Compliance with *chronic* water quality criteria are based on an average water quality metals concentration over a 96 hour period. *Acute* water quality criteria are applied as a ‘not-to-exceed’ value. Metals water quality targets are

¹ No surface or ground water sample concentration shall exceed these values

² No surface or ground water average concentration shall exceed these values based upon a 4-day (96 hr) or longer period.

³ The concentration of iron must not reach values that interfere with the uses specified in the surface and groundwater standards (17.30.601 et seq. and 17.30.1001 et seq) (DEQ, 2006))

given in **Table 4-3** for two hardness conditions that represent water quality conditions within the Boulder River.

Table 4-3. Metals water quality targets for the Boulder River TMDL Planning Area (values in ug/L)

Parameter	Water Quality Target at 25 mg/L hardness		Water Quality Target at 100 mg/L hardness	
	Acute	Chronic	Acute	Chronic
Cadmium	0.52	0.01	2.13	0.27
Chromium	579	27.7	1803	86
Copper	3.79	2.85	14.0	9.3
Lead	13.98	0.545	81.6	3.2
Nickel	145	16.1	469	52
Silver	0.37	NA	4.06	NA
Zinc	37	37	119	120
Iron	1000	1000	1000	1000

Sediment Quality Criteria

Stream sediment data may also be indicative of impairment caused by elevated metals and are used as supplementary indicators of impairment. In addition to directly impairing aquatic life that interacts with the elevated metals in the sediment, the elevated sediment values can also be an indicator of elevated concentrations of metals during runoff conditions. This can be a particularly important supplemental indicator when high flow data is lacking.

The National Oceanic and Atmospheric Administration (NOAA) has developed Screening Quick Reference Tables for stream sediment quality, and gives metals concentration guidelines for freshwater sediments. Screening criteria concentrations come from a variety of studies and investigations, and are expressed in Threshold Effects Levels (TEL) and Probable Effects Levels (PEL). TELs represent the sediment concentration below which toxic effects to aquatic life occur rarely, and are calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set. PELs represent the sediment concentration above which toxic effects frequently occur, and are calculated as the geometric mean of the 50th percentile concentration of the toxic effects data set and the 85th percentile of the no-effect data set.

The state of Montana does not currently have criteria that define impairment condition based on sediment quality data, however general water quality prohibitions given in **Table 3-5** state that “*state surface waters must be free from substances...that will...create concentrations or combinations of materials that are toxic or harmful to aquatic life.*” TELs and PELs provide a screening tool that may assist in identification of *the presence of* toxic substances, and can be used to assist in impairment determinations where water chemistry data is limited.

Table 4-4 contains the TEL and PEL values (in parts per million) for parameters of concern in the Boulder TPA.

Table 4-4. Screening level criteria for sediment metals concentrations

Metal of Concern	TEL (ppm)	PEL (ppm)
Cadmium	0.596	3.53
Chromium	37.3	90
Copper	35.7	197
Lead	35	91
Nickel	18	36
Silver	NA	NA
Zinc	123	315

Reference: NOAA, 1999

4.5.3 Water Quality Targets Evaluation

Metals indicator data (water quality and sediment samples) are available at several locations in Boulder River Segments MT43B004_131, MT43B004_132, MT43B004_133, and MT43B004_134 (**Figure 4-1**). In this section, data collected at these sites is compared to the Boulder River metals targets established in **Section 4.5.2**, followed by a determination of whether TMDLs are developed; TMDLs are developed for those pollutants not meeting water quality targets.

TMDL determination is based on the following assumptions:

- Natural levels of metals are below the chronic water quality criteria for aquatic life under all flow conditions.
- Single water quality samples represent a 96-hour average water quality condition.

Data utilized in evaluating attainment of water quality targets consisted of water quality data collected since 1993, including additional data that was collected in 2004 and 2005 that was not readily available when making impairment determinations for the 2006 303(d) List. Historical data collected primarily in the 1970s and early 1980s was not considered due to data quality and reliability concerns (reporting limits, collection, analysis and recording methods) and because older data may not adequately characterize existing conditions.

Where there is any exceedance of the water quality target, a TMDL is developed. If there are no recent target exceedances, but there is insufficient data to fully evaluate all seasonal flow conditions, then TMDL development may not be pursued within this document, and a framework sampling plan is presented to obtain additional data to better define water quality conditions for making updated impairment determinations.

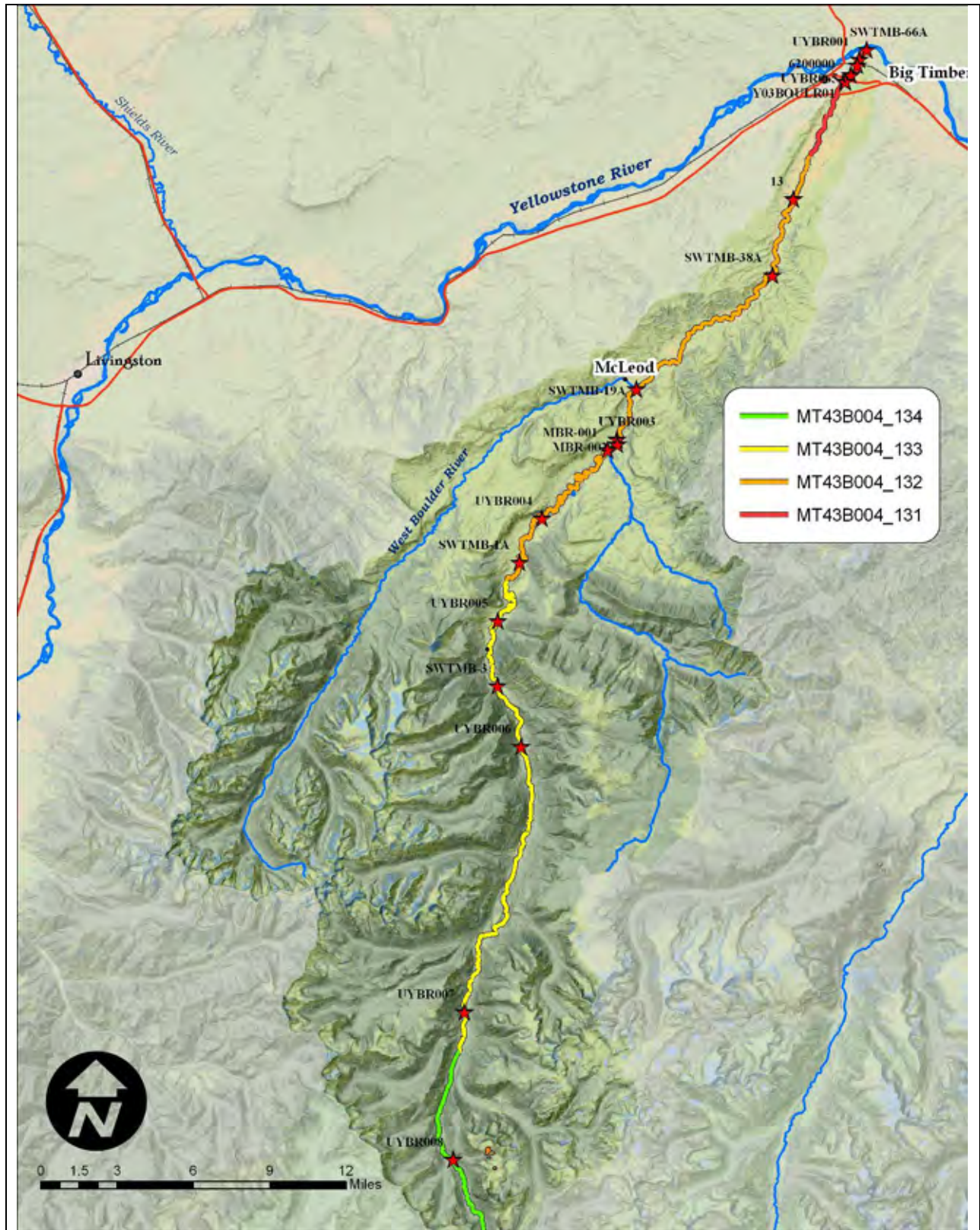


Figure 4-1. Boulder River metals sampling locations (1992-2006)

4.5.3.1 Boulder River Segment MT43B004_131

The 2006 303(d) list identifies Boulder River Segment MT43B004_131 as impaired due to metals: lead, copper, silver and iron.

Water Quality Data Results

Water quality metals samples from segment MT43B004_131 have been collected primarily by the USGS and DEQ, and are given in **Table 4-6**. For each listed pollutant, the water quality sampling result is in the ‘*Value*’ column and the chronic and acute water quality target for the sampling event is given in columns, ‘*Chronic*’ and ‘*Acute*’. Values in **bold** were unable to be evaluated because reporting limits were higher than the water quality target. Values in **grey-box bold** are exceedances of the water quality target.

Lead and copper exceed the water quality target on four separate sampling events. Each target exceedance occurred during high seasonal flows (May and June) at flows at or above 1500 cfs. There were no exceedances at flows lower than 1000 cfs.

Impairment determinations for silver and iron are based on older data that shows some exceedances of the water quality targets. There were no exceedances of silver or iron in the more recent data set presented in **Table 4-6**. June 2004 data indicates increased iron levels at higher seasonal flows (<1000 cfs), however silver and iron data was not available for high-flow sampling events (>1500 cfs) when lead and copper exceedances were observed.

Sediment Quality Data Results

Sediment quality data is limited (**Table 4-5**), and showed no exceedances of copper, lead, or silver above Threshold Effects Levels (TELs). Both chromium and nickel sediment levels were slightly elevated above TELs, however no water quality exceedances of chromium or nickel were observed.

Table 4-5. Sediment water quality metals data, Boulder River segment MT43B004_131

Station ID	Date	Copper (ppm)			Lead (ppm)			Silver (ppm)		
		Value	TEL	PEL	Value	TEL	PEL	Value	TEL	PEL
UYBR001	8/13/99	13	35.7	197	7	35	91	ND	0.733	1.77
Y03BOULR01	7/24/01	22	35.7	197	15	35	91	ND	0.733	1.77

Data Discussion

At high flows, lead and copper concentrations exceeded water quality targets. Iron and silver data did not exceed water quality targets using more recent data, and copper, lead and silver do not appear to be at elevated levels in stream sediments. Iron and silver concentrations were not available for the same sampling events when lead and copper exceedances were observed. High seasonal flows (late may through june) correlate with increased levels of most metals, suggesting runoff and stream channel sources as potential contributors. It is possible that at flows higher than 1500 cfs, some additional metals concentrations may exceed water quality targets, but only copper and lead exceedances have been verified.

Conclusion

Recent data show several water quality target exceedances for lead and copper; TMDLs will be developed for these metals.

The impairment determination listing iron and silver as causes of impairment for Boulder River segment MT43B004_131 was based on data over 20 years old. Newer data do not demonstrate impairment from silver or iron in this segment, although representative high flow data is lacking in the more recent data sets. Additional sampling should be conducted, particularly at flows > 1500 cfs to better define impairment conditions and facilitate future TMDL development for these metals.

Table 4-6. Water quality metals data, Boulder River segment MT43B004_131

Station ID	Date	Flow (cfs)	Copper (µg/L)			Lead (µg/L)			Silver (µg/L)			Iron (µg/L)		
			Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute
SWTMB-66A	10/02/03	72	<1	11.9	18.4	<1	4.6	118				20	1000	
UYBR001	05/25/04	~398	1.0	6.8	9.8	2	2.0	51	<1		2.1	50	1000	
UYBR001	06/04/04	~855	2.0	5.1	7.2	<1	1.3	34	<1		1.2	590	1000	
14	08/13/99		1.0	7.7	11.3	<2	2.4	61	<3		2.7	110	1000	
UYBR065A	09/03/04		1.0	12.1	18.6	<2	4.7	120	<1		6.8	20	1000	
6200000	06/17/99	3,780	5.3	3.1	4.2	1.7	0.6	16						
6200000	08/17/99	312	<1	8.8	13.1	<1	2.9	74						
6200000	11/04/99	141	0.7	11.7	17.9	<1	4.4	114						
6200000	05/31/00	2,130	2.2	3.4	4.6	<1	0.7	18						
6200000	05/16/01	2,050	7.2	3.0	4.1	1.44	0.6	15						
6200000	08/23/01	17	0.7	12.5	19.4	<1	4.9	126						
6200000	10/25/01	110	1.0	11.7	17.9	<1	4.4	114						
6200000	05/22/02	1,510	5.5	3.3	4.5	1.14	0.7	18						
6200000	05/21/03	591	1.0	7.0	10.1	0.13	2.1	53						
6200000	07/29/03	233	0.6	9.7	14.7	<0.06	3.4	87						
6200000	10/02/03	75	<1	12.0	18.4	<2	4.6	118	<3		6.7			
Y03BOULR01	06/24/04	1,500	1.0	4.0	5.5	1.00	0.9	23	<1		0.7	540	1000	
Y03BOULR01	07/16/05	700	<1	6.1	8.8	ND	1.7	43	<1		1.7	80	1000	
SWTMB-66A	10/02/03	72	<0.1	0.34	2.86	<1	109	2,286	<10	67	599	<10	153	153
UYBR001	05/25/04	~398	<0.1	0.21	1.46	<1	63	1,327	<10	38	342	<1	87	87
UYBR001	06/04/04	~855	<0.1	0.16	1.05	2	49	1,017	<10	29	260	<1	66	66
14	08/13/99		<0.1	0.23	1.69	2	71	1,496	<10	43	387	<10	99	99
UYBR065A	09/03/04		<0.1	0.34	2.89	<1	110	2,305	<10	67	605	<10	155	155
6200000	06/17/99	3,780	<1	0.11	0.58	6	30	636	6.50	18	160	<40	41	41
6200000	08/17/99	312	<1	0.26	1.98	<1	81	1,699	<1	49	441	<40	113	113
6200000	11/04/99	141	<0.1	0.33	2.79	<1	107	2,235	<1.8	65	586	<31	150	150
6200000	05/31/00	2,130	<0.1	0.11	0.65	2	33	691	1.14	19	174	4	44	44
6200000	05/16/01	2,050	<0.1	0.10	0.56	2	29	617	2.06	17	155	4	40	40
6200000	08/23/01	17	<0.1	0.35	3.02	<1	114	2,389	<1	70	627	<1	160	160
6200000	10/25/01	110	<0.1	0.33	2.79	<1	107	2,235	<1	65	586	1	150	150
6200000	05/22/02	1,510	<0.1	0.11	0.63	2	32	673	2.44	19	169	4	43	43

Table 4-6. Water quality metals data, Boulder River segment MT43B004_131

Station ID	Date	Flow (cfs)	Copper (µg/L)			Lead (µg/L)			Silver (µg/L)			Iron (µg/L)		
			Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute
6200000	05/21/03	591	<0.2	0.21	1.51	1	65	1,362	0.71	39	351	3	90	90
6200000	07/29/03	233	<0.04	0.28	2.24	<1	90	1,877	0.78	54	489	<2	125	125
6200000	10/02/03	75	<0.1	0.34	2.87				<10	67	600	<10	153	153
Y03BOULR01	06/24/04	1,500	<0.1	0.13	0.78	2	38	804	ND	23	204	2	52	52
Y03BOULR01	07/16/05	700	<0.1	0.19	1.29	<1	57	1,201	ND	34	308	1	79	79

4.5.3.2 Boulder River Segment MT43B004_132

The 2006 303(d) list identifies Boulder River Segment MT43B004_132 as impaired due to two metals: nickel, chromium.

Water Quality Data Results

Water quality metals samples from segment MT43B004_132 have been collected primarily by the USGS and DEQ, and are given in **Table 4-8**. For each listed pollutant, the water quality sampling result is in the ‘*Value*’ column and the chronic and acute water quality target for the sampling event is given in columns, ‘*Chronic*’ and ‘*Acute*’. Values in **bold** were unable to be evaluated because reporting limits were higher than the water quality target. Values in **grey-box bold** are exceedances of the water quality target.

The only exceedances of water quality targets occurred for iron during spring runoff flows. On 6/03/03 iron concentrations at sampling sites MBR-001 and MBR-002 exceeded the water quality target of 1000 ug/L. Flows were not recorded on this data, but it is assumed that samples were collected during high flows associated with runoff conditions.

Sediment Quality Data Results

Sediment quality data is limited, however data did reveal some sediment metals concentrations elevated above TELs (**Table 4-7**). One of three sediment samples contained elevated levels of chromium, and two of three contained levels of nickel above TELs.

Table 4-7. Sediment water quality metals data, Boulder River segment MT43B004_132

Station ID	Date	Cadmium (ppm)			Chromium (ppm)			Copper (ppm)		
		Value	TEL	PEL	Value	TEL	PEL	Value	TEL	PEL
UYBR003	8/13/99	ND	0.60	3.53	49	37	90	11	35.7	197
UYBR004	8/13/99	ND	0.60	3.53	30	37	90	9	35.7	197
13	8/13/99	ND	0.60	3.53	26	37	90	11	35.7	197
Station ID	Date	Lead (ppm)			Nickel (ppm)			Silver (ppm)		
		Value	TEL	PEL	Value	TEL	PEL	Value	TEL	PEL
UYBR003	8/13/99	6	35	91	27	18	36	ND	0.733	1.77
UYBR004	8/13/99	ND	35	91	19	18	36	ND	0.733	1.77
13	8/13/99	ND	35	91	16	18	36	ND	0.733	1.77

Data Discussion

At low flows, metals concentrations in water quality samples were either at very low concentrations or were undetectable. At seasonal runoff flows (May, June), metals levels increased but were predominantly below target values. The exception occurred at sampling sites MBR-001 and MBR-002 where iron exceeded the target of 1,000 ug/L on 06/03/03.

While sediment metals concentrations for chromium and nickel were elevated above the TEL, no water quality target exceedances of these metals was observed. During seasonal runoff flows, elevated chromium levels were observed but remained below the water quality target; no detects for nickel were observed in any of the water quality samples collected.

Conclusion

Recent water quality data show water quality target exceedances of iron: a TMDL will be developed for iron. There were no exceedances of water quality targets for chromium or nickel. Additional sediment and water quality assessments should be conducted, particularly at flows > 1500 cfs, to further characterize impairment conditions and facilitate future TMDL development for these metals.

Table 4-8. Water quality metals data, Boulder River segment MT43B004_132

Station ID	Date	Flow (cfs)	Copper (µg/L)			Lead (µg/L)			Silver (µg/L)			Iron (µg/L)		
			Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute
13	08/13/99		1.0	6.7	9.7	<2	1.9	50	<3	N/A	2.1	160	1000	
SWTMB-38A	10/01/03	70	<1	10.9	16.6	<1	4.0	102	<1	N/A	5.5	<10	1000	
UYBR002	05/25/04		1.0	6.2	8.9	<1	1.7	45	<1	N/A	1.8	50	1000	
UYBR002	06/04/04		2.0	4.4	6.2	<1	1.1	27	<1	N/A	0.9	490	1000	
SWTMB-19A	08/15/03	130	<1	9.0	13.4	<1	3.0	77	<1	N/A	3.7	20	1000	
SWTMB-19A	10/01/03	73	<1	11.0	16.8	<1	4.1	104	<1	N/A	5.6	20	1000	
SWTMB-19A	09/03/04		<1	9.5	14.3	<2	3.3	84	<1	N/A	4.2			
12	08/13/99		1.0	5.1	7.1	<2	1.3	33	<3	N/A	1.2	280	1000	
UYBR003	05/25/04		1.0	5.0	7.0	<1	1.2	32	<1	N/A	1.1	70	1000	
UYBR003	06/04/04		2.0	4.1	5.7	<1	0.9	24	<1	N/A	0.8	170	1000	
MBR-002	08/28/00		<1	9.3	14.0	<3	3.2	82				20	1000	
MBR-002	10/30/00	30	<1	11.1	17.0	<3	4.1	106				20	1000	
MBR-002	03/07/01		<1	11.8	18.2	<3	4.5	116				20	1000	
MBR-002	05/22/01		<1	5.3	7.6	<3	1.4	36				50	1000	
MBR-002	08/29/01		<1	9.7	14.7	<3	3.4	87				30	1000	
MBR-002	11/14/01	89	<1	12.1	18.6	<3	4.7	120				30	1000	
MBR-002	03/26/02		<1	10.6	16.1	<3	3.8	99				30	1000	
MBR-002	06/04/02		2	3.0	3.9	<3	0.6	15				830	1000	
MBR-002	08/27/02	123	<1	9.6	14.5	<3	3.3	86				30	1000	
MBR-002	11/05/02	75	<1	10.7	16.4	<3	3.9	101				20	1000	
MBR-002	03/19/03	67	1	11.8	18.1	<3	4.5	115				40	1000	
MBR-002	06/03/03		2	2.9	3.8	<3	0.5	14				1160	1000	
MBR-002	09/10/03	89	<1	7.9	11.6	<3	2.5	63				20	1000	
MBR-001	08/25/00		1	9.0	13.5	<3	3.0	78				30	1000	
MBR-001	10/30/00	31	<1	8.3	12.3	<3	2.7	68				20	1000	
MBR-001	03/07/01		<1	9.2	13.9	<3	3.1	81				20	1000	
MBR-001	05/22/01		<1	3.7	5.1	<3	0.8	21				80	1000	
MBR-001	08/29/01		<1	9.2	13.9	<3	3.1	81				30	1000	
MBR-001	11/14/01	78	<1	8.8	13.1	<3	2.9	74				30	1000	
MBR-001	03/26/02		<1	8.9	13.3	<3	3.0	76				30	1000	
MBR-001	06/04/02		2	2.9	3.8	<3	0.5	14				880	1000	
MBR-001	08/27/02	132	<1	9.6	14.5	<3	3.3	86				30	1000	

Table 4-8. Water quality metals data, Boulder River segment MT43B004_132

Station ID	Date	Flow (cfs)	Copper (µg/L)			Lead (µg/L)			Silver (µg/L)			Iron (µg/L)		
			Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute
MBR-001	11/05/02	72	<1	8.6	12.8	<3	2.8	72				30	1000	
MBR-001	03/19/03	58	1	9.0	13.5	<3	3.0	78				50	1000	
MBR-001	06/03/03		1	2.9	3.8	<3	0.5	14				1090	1000	
MBR-001	09/10/03	86	<1	7.8	11.5	<3	2.4	62				20	1000	
11	08/13/99		<1	4.0	5.5	<2	0.9	23	<3	N/A	0.7	60	1000	
UYBR004	05/25/04		1.0	3.5	4.8	<1	0.8	19	<1	N/A	0.6	70	1000	
UYBR004	06/04/04		1.0	3.2	4.4	<1	0.7	17	<1	N/A	0.5	170	1000	
SWTMB-1A	08/15/03	133	<1	4.2	5.9	<1	1.0	25	<1	N/A	0.8	40	1000	
SWTMB-1A	10/01/03	73	<1	5.1	7.1	<1	1.3	33	<1	N/A	1.2	100	1000	
13	08/13/99		<0.1	0.27	2.11	3	63	1,315	<10	38	339	<10	86	86
SWTMB-38A	10/01/03	70	<0.1	0.31	2.56	<1	100	2,086	<10	61	545	<10	139	139
UYBR002	05/25/04		<0.1	0.19	1.31	<1	58	1,221	<10	35	314	<1	80	80
UYBR002	06/04/04		<0.1	0.14	0.88	1	42	884	<10	25	225	<1	57	57
SWTMB-19A	08/15/03	130	<0.1	0.26	2.03	<1	83	1,735	<10	50	451	<10	115	115
SWTMB-19A	10/01/03	73	<0.1	0.31	2.59	<1	101	2,109	<10	61	552	<10	141	141
SWTMB-19A	09/03/04		<0.1	0.27	2.18	<1	88	1,833	<10	53	477	<1	122	122
12	08/13/99		<0.1	0.16	1.03	3	48	1,004	<10	28	256	<10	65	65
UYBR003	05/25/04		<0.1	0.16	1.01	<1	47	985	<10	28	251	<1	64	64
UYBR003	06/04/04		<0.1	0.13	0.81	2	39	823	<10	23	209	<1	53	53
MBR-002	08/28/00		<0.1	0.27	2.13	<1	86	1,803	<20	52	469	<10	120	120
MBR-002	10/30/00	30	<0.1	0.32	2.63	<1	102	2,136	<20	62	559	<10	143	143
MBR-002	03/07/01		<0.1	0.33	2.83	<1	108	2,263	<20	66	593	<10	152	152
MBR-002	05/22/01		<0.1	0.17	1.10	<1	50	1,055	<20	30	270	<10	69	69
MBR-002	08/29/01		<0.1	0.28	2.24	<1	90	1,877	<20	54	489	<10	125	125
MBR-002	11/14/01	89	<0.1	0.34	2.89	<1	110	2,305	<20	67	605	<10	155	155
MBR-002	03/26/02		<0.1	0.30	2.48	<1	97	2,036	<20	59	532	<10	136	136
MBR-002	06/04/02		<0.1	0.10	0.54	4	29	598	<20	17	150	<10	38	38
MBR-002	08/27/02	123	<0.1	0.28	2.22	<1	89	1,862	<20	54	485	<10	124	124
MBR-002	11/05/02	75	<0.1	0.31	2.52	<1	99	2,065	<20	60	540	<10	138	138
MBR-002	03/19/03	67	<0.1	0.33	2.81	<1	108	2,249	<20	66	590	<10	151	151
MBR-002	06/03/03		<0.1	0.10	0.52	4	28	579	<20	16	145	<10	37	37
MBR-002	09/10/03	89	<0.1	0.23	1.74	<1	73	1,533	<20	44	397	<10	101	101

Table 4-8. Water quality metals data, Boulder River segment MT43B004_132

Station ID	Date	Flow (cfs)	Copper (µg/L)			Lead (µg/L)			Silver (µg/L)			Iron (µg/L)		
			Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute
MBR-001	08/25/00		<0.1	0.26	2.05	<1	83	1,744	<20	50	453	<10	116	116
MBR-001	10/30/00	31	<0.1	0.24	1.85	<1	77	1,609	<20	46	417	<10	106	106
MBR-001	03/07/01		<0.1	0.27	2.11	<1	85	1,788	<20	52	465	<10	119	119
MBR-001	05/22/01		<0.1	0.12	0.71	<1	36	745	<20	21	188	<10	48	48
MBR-001	08/29/01		<0.1	0.27	2.11	<1	85	1,788	<20	52	465	<10	119	119
MBR-001	11/14/01	78	<0.1	0.26	1.98	<1	81	1,699	<20	49	441	<10	113	113
MBR-001	03/26/02		<0.1	0.26	2.02	<1	83	1,729	<20	50	449	<10	115	115
MBR-001	06/04/02		<0.1	0.10	0.52	4	28	579	<20	16	145	<10	37	37
MBR-001	08/27/02	132	<0.1	0.28	2.22	3	89	1,862	<20	54	485	<10	124	124
MBR-001	11/05/02	72	<0.1	0.25	1.94	<1	80	1,669	<20	48	433	<10	111	111
MBR-001	03/19/03	58	<0.1	0.26	2.05	<1	83	1,744	<20	50	453	<10	116	116
MBR-001	06/03/03		<0.1	0.10	0.52	4	28	579	<20	16	145	<10	37	37
MBR-001	09/10/03	86	<0.1	0.23	1.72	<1	73	1,517	<20	44	393	<10	100	100
11	08/13/99		<0.1	0.13	0.78	2	38	804	<10	23	204	20	52	52
UYBR004	05/25/04		<0.1	0.12	0.67	<1	34	713	<10	20	180	<1	46	46
UYBR004	06/04/04		<0.1	0.11	0.61	<1	31	656	<10	18	165	<1	42	42
SWTMB-1A	08/15/03	133	<0.1	0.14	0.84	<1	41	848	<10	24	215	<10	55	55
SWTMB-1A	10/01/03	73	<0.1	0.16	1.03	<1	48	1,004	<10	28	256	<10	65	65

4.5.3.3 Boulder River Segment MT43B004_133

The 2006 303(d) list does not identify Boulder River Segment MT43B004_133 as impaired due to metals. This segment is included here because additional data, unavailable during the most recent assessment, show water quality target exceedances.

Water Quality Data Results

Water quality metals samples from segment MT43B004_133 have been collected primarily by the USGS and DEQ, and are given in **Table 4-10**. For each listed pollutant, the water quality sampling result is in the ‘*Value*’ column and the chronic and acute water quality target for the sampling event is given in columns, ‘*Chronic*’ and ‘*Acute*’. Values in **bold** were unable to be evaluated because reporting limits were higher than the water quality target. Values in **grey-box bold** are exceedances of the water quality target.

The only exceedance of water quality targets occurred for lead on 5/24/04 at site UYBR007, when lead concentration was elevated (1.0 ug/L) above the chronic level of 0.6 ug/L. The remainder of the lead data set (n=8) could not be evaluated, as reporting limits were higher than the chronic water quality target.

Sediment Quality Data Results

Sediment quality data is limited to two sampling sites in 1999; data did reveal that some sediment metals concentrations were elevated above TELs (**Table 4-9**). Sediment concentrations of both chromium and nickel were slightly elevated above TELs at sampling site UYBR005, but were below TELs at site UYBR006.

Table 4-9. Sediment water quality metals data, Boulder River segment MT43B004_133

		Cadmium (ppm)			Chromium (ppm)			Copper (ppm)		
		Value	TEL	PEL	Value	TEL	PEL	Value	TEL	PEL
UYBR005	8/13/1999	ND	0.596	3.53	40	37.3	90	10	35.7	197
UYBR006	8/13/1999	ND	0.596	3.53	28	37.3	90	7	35.7	197
		Lead (ppm)			Nickel (ppm)			Silver (ppm)		
		Value	TEL	PEL	Value	TEL	PEL	Value	TEL	PEL
UYBR005	8/13/1999	5	35	91	22	18	35.9	ND	0.733	1.77
UYBR006	8/13/1999	ND	35	91	17	18	35.9	ND	0.733	1.77

Data Discussion

Only one lead sample demonstrated a target exceedance, and reporting limits were too high to adequately evaluate attainment of the water quality target during all other sample events. It is possible that additional exceedances of the water quality target for lead occurred, yet analytical procedures preclude their evaluation. Since lead exceedances also occur lower in the Boulder River (segment MT43B004_131), and abandoned mine sources exist in the upper watershed, it is reasonable to assume that any lead exceedances observed on contiguous segments of the Boulder River are related to similar sources, and can be reduced through similar control efforts.

Chromium and nickel sediment concentrations are elevated above the TEL at UYBR005, however no water quality target exceedances of these metals were observed.

Conclusion

Recent water quality data show water quality target exceedances of lead: a TMDL will be developed for lead. There were no exceedances of water quality targets for other metals. Additional sediment and water quality assessments should be conducted, particularly at flows > 1500 cfs, to further characterize impairment conditions and facilitate possible future TMDL development.

Table 4-10. Water quality metals data, Boulder River segment MT43B004_133

Station ID	Date	Flow (cfs)	Cadmium (µg/L)			Chromium (µg/L)			Copper (µg/L)			Lead (µg/L)		
			Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute
10	08/13/99		<0.1	0.12	0.68	1	34	715	<1	3.6	4.8	<2	0.8	19
UYBR005	06/04/04		<0.1	0.11	0.64	<1	33	687	1.0	3.4	4.6	<1	0.7	18
UYBR005	05/25/04		<0.1	0.10	0.52	<1	28	579	1.0	2.9	3.8	<1	0.5	14
SWTMB-3	10/01/03	70	<0.1	0.13	0.78	<1	38	804	<1	4.0	5.5	<1	0.9	23
UYBR006	06/04/04		<0.1	0.10	0.58	<1	30	630	2.0	3.1	4.2	<1	0.6	16
UYBR006	05/25/04		<0.1	0.10	0.52	<1	28	579	1.0	2.9	3.8	<1	0.5	14
6	08/13/99		<0.1	0.10	0.54	2	28	593	<1	2.9	3.9	<2	0.6	14
UYBR007	06/04/04		<0.1	0.10	0.57	<1	30	624	1.0	3.1	4.1	1	0.6	16
UYBR007	05/25/04		<0.1	0.10	0.52	<1	28	579	1.0	2.9	3.8	<1	0.5	14
10	08/13/99		<10	20	180	<10	46	46	<3	N/A	0.6	80	1000	
UYBR005	06/04/04		<10	19	173	<1	44	44	<1	N/A	0.5	40	1000	
UYBR005	05/25/04		<10	16	145	<1	37	37	<1	N/A	0.4	130	1000	
SWTMB-3	10/01/03	70	<10	23	204	<10	52	52	<1	N/A	0.7	<10	1000	
UYBR006	06/04/04		<10	18	158	<1	40	40	<1	N/A	0.4	40	1000	
UYBR006	05/25/04		<10	16	145	<1	37	37	<1	N/A	0.4	120	1000	
6	08/13/99		<10	17	149	<10	38	38	<3	N/A	0.4	40	1000	
UYBR007	06/04/04		<10	17	157	<1	40	40	<1	N/A	0.4	40	1000	
UYBR007	05/25/04		<10	16	145	<1	37	37	<1	N/A	0.4	610	1000	

4.5.3.4 Boulder River Segment MT43B004_134, and Basin Creek Segment MT43B005_010

The 2006 303(d) list identifies Boulder River Segment MT43B004_134 as impaired due to metals: copper, lead. Basin Creek was not assessed and was not incorporated into the 2006 303(d) list, but is included here since one or more metals targets were exceeded.

Water Quality Data Results

Water quality metals samples from segment MT43B004_134 have been collected primarily by the USGS and DEQ, and are given in **Table 4-12**. For each listed pollutant, the water quality sampling result is in the ‘*Value*’ column and the chronic and acute water quality target for the sampling event is given in columns, ‘*Chronic*’ and ‘*Acute*’. Values in **bold** were unable to be evaluated because reporting limits were higher than the water quality target. Values in **grey-box bold** are exceedances of the water quality target.

There were no water quality exceedances of metals in the data set which included three water quality samples taken downstream of Basin Creek. Samples taken from Basin Creek by the DEQ’s Abandoned Mine Program showed water quality target exceedances of both copper and lead on two separate occasions in 1993.

Sediment Quality Data Results

Sediment quality data is limited, however data did reveal some sediment metals concentrations elevated above TELs (**Table 4-11**). Sediment concentrations of both copper and nickel were slightly elevated above TELs at sampling site UYBR008.

Table 4-11. Sediment water quality metals data, Boulder River segment MT43B004_134

		Cadmium (ppm)			Chromium (ppm)			Copper (ppm)		
		Value	TEL	PEL	Value	TEL	PEL	Value	TEL	PEL
UYBR008	8/13/1999	ND	0.596	3.53	20	37.3	90	65	35.7	197
		Lead (ppm)			Nickel (ppm)			Silver (ppm)		
		Value	TEL	PEL	Value	TEL	PEL	Value	TEL	PEL
UYBR008	8/13/1999	9	35	91	26	18	35.9	ND	0.733	1.77

Data Discussion

Water quality data, while limited, show no water quality target exceedances for segment MT43B004_134. Sediment quality data show copper and nickel concentrations above the TEL.

The Independence Mining District lies at the headwaters of Basin Creek, a tributary to the Boulder River, and is on the State’s Priority Abandoned Mines List. Abandoned mines are scattered throughout this area and are likely contributors to metals contamination in Basin Creek and downstream in the Boulder River. Water quality and sediment quality data collected in Basin Creek by the DEQ’s Abandoned Mines Program in August 1993 showed exceedances of copper and lead water quality targets, and sediment levels of copper and lead in Basin Creek were among the highest in the watershed. Onsite adit discharges were also sampled: maximum copper concentration was 186 ug/L.

The dearth of data for Boulder River segment MT43B004_134 limits interpretation. Known sources of metals contamination exist in Basin Creek, and Basin Creek itself shows elevated levels of metals in both the sediment and water quality samples. Additional water quality data under a variety of flow conditions is recommended in order to better characterize water quality conditions.

Conclusion

While water quality data in Boulder River Segment MT43B004_134 do not show exceedances of water quality targets, the paucity of available data precludes determination of water quality condition with a high level of certainty.

Because significant metals sources exist in Basin Creek, and there are exceedances of water quality targets, copper and lead, TMDLs will be developed for Basin Creek segment MT43B005_010.

Table 4-12. Water quality metals data, Boulder River segment MT43B004_134

Station ID	Date	Flow (cfs)	Cadmium (µg/L)			Chromium (µg/L)			Copper (µg/L)			Lead (µg/L)		
			Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute	Value	Chronic	Acute
UYBR008	05/25/04		<0.1	0.15	0.96	<1	45	946	1.0	4.8	6.7	<1	1.2	30
UYBR008	06/04/04		<0.1	0.14	0.83	1	40	839	2.0	4.2	5.8	<1	1.0	25
1.0	08/13/99		<0.1	0.10	0.52	3	28	579	1.0	2.9	3.8	<2	0.5	14
UYBR008	05/25/04		<10	27	241	<1	61	61	<1	N/A	1.0	50	1000	
UYBR008	06/04/04		<10	24	213	<1	54	54	<1	N/A	0.8	600	1000	
1.0	08/13/99		<10	16	145	20	37	37	<3	N/A	0.4	70	1000	

4.5.4 Boulder River Metals Summary

Present understanding of the conditions under which Boulder River water quality exceeds water quality targets for metals is limited by the spatial and temporal constraints of the existing data. Most elevated metals concentrations occur during spring runoff flows, when low hardness values make the Boulder River susceptible to chronic metals exceedances. Along its length, the Boulder River has exhibited exceedances of water quality criteria for copper, lead and iron, particularly during seasonal high flow periods. While each segment does not necessarily exhibit water quality criteria exceedances for each metal of concern, sources of metals are thought to be common to all segments and are predominantly from natural and historical mining sources (abandoned mines) throughout the watershed. Controlling and remediating loading from these sources will not only act to reduce loading of copper, lead and iron on all segments of the Boulder River, but also reduce elevated levels of other metals that may be impacting beneficial uses but where limited data limits evaluation.

TMDLs for copper, lead and iron will be prepared for Boulder River segments MT43B004_131, MT43B004_132, MT43B004_133, MT43B004_134 and Basin Creek segment MT43B005_010, and are given in **Section 5.0. Table 4-13** provides a summary of verified target exceedances in the Boulder River, and subsequent TMDL preparation. Additional data collection and source assessments is recommended and will allow a more accurate characterization of water quality conditions under higher flow conditions, and assist in further evaluating attainment of water quality targets.

Table 4-13. Boulder River metals impairment summary

Water Body Segment	2006 303(d) Listing (metals)	Verified Target Exceedances (metals)	TMDLs Prepared (Section 5)
MT43B004_131	Copper Lead Silver Iron	Copper Lead	Copper Lead Iron
MT43B004_132	Nickel Chromium	Iron	
MT43B004_133	None	Lead	
MT43B004_134	Copper Lead	None	
MT43B005_010	None	Copper Lead	

4.6 Monitoring Recommendations

The recommendations provided herein do not assign responsibility to specific entities, agencies or organizations for monitoring and assessment activity, but act to promote collaborative and coordinated resource management so that all beneficial uses may be maintained and protected, and that trends in water quality are identified and documented. Monitoring recommendations are meant to highlight data and information needs aimed at monitoring potential pollutant sources as well as monitoring the condition of the East Boulder River, and provide a framework for present and future monitoring activity. Implementation of monitoring recommendations may require adoption of existing monitoring frameworks, or may require the development of additional resources and technical considerations.

4.6.1 Sediment, Flow and Habitat Monitoring & Assessment

Probable anthropogenic sources of sediment in the East Boulder River identified on the 2006 303(d) list include:

- Flow alterations from water diversions
- Streambank modifications/destabilization

Flow alteration is commonly considered water *quantity* rather than water quality issues; however changes to stream flow can have a profound effect on the proper functioning of stream systems and can be a major factor influencing water quality impairments. Stream channel form evolves and stabilizes over long time periods based on the amount of stream flow (energy) and sediment supply (Leopold et al., 1964; Rosgen, 1996). When the balance between sediment supply and stream energy is disrupted, changes in channel form result. Decreases in stream energy may result in an inability of the stream to effectively transport sediments, thereby causing aggradation, or deposition of sediments in the stream channel, which further contributes to a decrease in stream energy by creating a wider and shallower channel. Consequently, appropriate duration and magnitude of peak flows (i.e. bankfull or flood flows) and base flows are critical to a stream's ability to transport sediments. Sustained low flows, whether from flow regulation, channel alteration, drought, or other natural conditions can lead to sediment-related impairments, and while TMDLs are not required for water quantity-related issues, flow alteration has been identified as a cause of sediment-related impairments on the 2006 303(d) list and is acknowledged as a factor that influences impairment condition.

Streambank modifications refer to a variety of impacts to the stream channel and associated riparian zone. These may include: removal or alteration of streamside vegetation, riparian encroachment from construction or streamside development, removal of large woody debris, alteration of channel form or substrate, bank erosion, or other alterations to terrestrial and aquatic habitat elements. Streambank modification can be a contributor or strong influence on sediment loading. For instance, removal of riparian vegetation, especially trees and woody shrubs, may lead to bank instability and increased bank erosion and consequently increases in sediment loading to a stream. Likewise, vegetation removal may also reduce the ability of vegetated buffer zones to intercept sediment-laden runoff from uplands during storm or runoff events.

Quantitative sediment and habitat data (width-to-depth ratios, percent surface fines <2mm) used to evaluate attainment with water quality targets was collected in the summer of 2005. In order to evaluate spatial and temporal water quality trends over a variety of conditions, the DEQ recommends an evaluation of methods and sampling locations used in this effort, and development of a long-term *Sediment and Habitat Monitoring Plan* that incorporates, but is not limited to the following monitoring parameters.

Percent fines <2mm in riffle habitats

East Boulder River Sediment Assessment (DEQ, 2007) provides rationale behind utilization of riffle fines as an indicator of aquatic life support. Long-term monitoring should identify representative riffles within segments MT43B004_141 and MT43B004_142 and establish a sampling frequency.

Percent fines <6mm in pool tail habitats

Percent fines <6mm in pool tail habitats is an indicator of the potential spawning success of salmonids. Trout typically establish redds in pool tail habitat. Excessive fine sediment in pool tails can inhibit spawning success of salmonids. Long-term monitoring should identify areas of potential salmonid spawning and establish a sampling frequency that allows evaluation of beneficial use support for cold-water fishery.

Fish habitat indicators

In addition to percent fines data, habitat assessments should be conducted that provide information on suitability of the East Boulder River to support and propagate cold-water fish species. Habitat assessments may provide information that can assist in identifying limitations and prioritizing fisheries enhancement efforts in the East Boulder watershed.

Bioassessments

Macroinvertebrate and periphyton sampling and assessment can provide information regarding biological response to pollutant loads and impacts from other pollution-related sources. Bioassessments provide a direct indicator of beneficial use support for aquatic life and, in conjunction with existing bioassessment data, can inform as to long-term biological trends in the East Boulder River.

Streamflow

DEQ recommends that local landowners, watershed organizations, and resource managers continue to work collaboratively with local and state agencies to ensure protection of beneficial uses through flow monitoring and the development of flow enhancement and management plans designed to enhance streamflows for the maintenance of both irrigation and aquatic life uses. Ongoing planning efforts in the Boulder Watershed have identified and prioritized a variety of potential implementation projects in the watershed (**Appendix B**), many of which may result in direct water quality and quantity improvements. Continued implementation of priority projects resulting in water quality improvements and *long-term* in-stream flow enhancement through local collaborative efforts is encouraged.

The framework and objectives of a long-term *Sediment and Habitat Monitoring Plan* should be developed in a way as to adequately and accurately characterize sediment and habitat conditions in the East Boulder watershed and should allow for data collection that meets a variety of objectives, including the continued evaluation of beneficial use attainment and maintenance. Key participants in the development and maintenance of stream sampling activities may include: local landowners, Sweet Grass Conservation District, Boulder River Watershed Group, Montana Department of Fish, Wildlife & Parks, Montana Department of Natural Resources & Conservation, Natural Resources Conservation Service and the Montana Department of Environmental Quality. Other organizations and non-profits that may provide assistance through technical expertise, funding, educational outreach, or other means include: Montana Water Trust, Natural Resources Conservation Service, Northern Plains Resource Council, Cottonwood Resource Council, and the Montana Water Center

4.6.2 Nutrient Monitoring & Assessment

Probable anthropogenic sources of nutrients in the East Boulder River identified on the 2006 303(d) list include:

- Agriculture sources
- Other unknown sources

Agricultural sources include nutrients such as phosphorus and nitrogen in the form of fertilizers that are applied to crops to enhance production. Agricultural associated nutrients are also found in manure, sludge, irrigation water, legumes, and crop residues. When nutrients are applied in excess of plant needs, they can wash into aquatic ecosystems where they can cause excessive plant growth which can impair recreation and aquatic life in the water bodies. In addition to cropland areas, overgrazing and poorly managed agricultural lands can expose soils, increase erosion, encourage invasion by undesirable plants, impact fish habitat, and reduce riparian vegetation necessary to maintain streambanks and provide habitat.

Stream de-watering through irrigation can result in higher water temperatures, decreased solar radiation attenuation, and increased sensitivity to external nutrient loads. These factors can contribute to and exacerbate nuisance algal growth (excessive chlorophyll-*a*).

In addition to agricultural non-point sources, there exists a nutrient point-source that has the potential to impact downstream surface water quality: the East Boulder Mine permitted wastewater discharge. The East Boulder Mine holds a Montana Pollutant Discharge Elimination System (MPDES) permit that regulates discharge of nutrients, predominantly from ammonium nitrate blast residue, through ground water. To date, there has been no direct surface water discharge from the mine. The mine's ground water discharges are regulated through the mine's MPDES discharge permit.

Other potential nutrient sources include roads and crossings, septic systems (particularly near-stream and/or failing systems), nutrient inputs from tributaries that flow into the East Boulder River, as well as nutrient inputs from natural springs and seeps. Anderson Spring, a natural spring on the East Boulder River, has documented water temperatures and nitrate concentrations

above that of the East Boulder River. This combination may affect algal growth, especially during late summer low flows.

DEQ recommends the following actions in order to assess potential impacts to surface waters from potential nutrient loading:

- Continue monitoring of ground water nitrate concentrations at established monitoring wells, EBMW-2, EBMW-3, EBMW-6, EBMW-7, EBMW-8 and EBMW-9 and at surface water monitoring locations EBR-003 and EBR-004 as stipulated in permit no. MT-0026808.
- Assess the potential for groundwater loading to surface waters upstream of ground water monitoring well EBMW-7, throughout the reach from EBR-001 to EBR-003.
- Continued biological monitoring in accordance with the Biological Monitoring Plan for Stillwater Mining Company – East Boulder Project (1998) as stipulated in permit no. MT-0026808.
- Quarterly nutrient sampling and annual macroinvertebrate and chlorophyll-a (late summer) at surface water monitoring stations EBR-005 – EBR-009
- Track coverage and spread of *Didymosphenia geminata* in the upper Boulder River through stream reach assessments and monitoring.
- Promote, support and maintain nutrient reduction BMPs throughout the watershed.

4.6.3 Metals Monitoring & Assessment

In order to adequately characterize conditions that contribute to water quality impairment in the Boulder River, additional water quality sampling for metals is recommended. While data shows that chronic water quality criteria for some metals are exceeded at times during seasonal runoff, further water quality sampling during the rising limb, falling limb and at base flow (**Figure 4-2**) of the typical Boulder River hydrograph will assist in meeting a variety of **monitoring goals**:

- Evaluate water quality target attainment
- Identify and evaluate metals loading from abandoned mining sites
- Estimate metals loading to the Boulder River from different source areas
- Refine metals source assessments
- Establish natural background conditions
- Prioritize remediation and restoration activities.

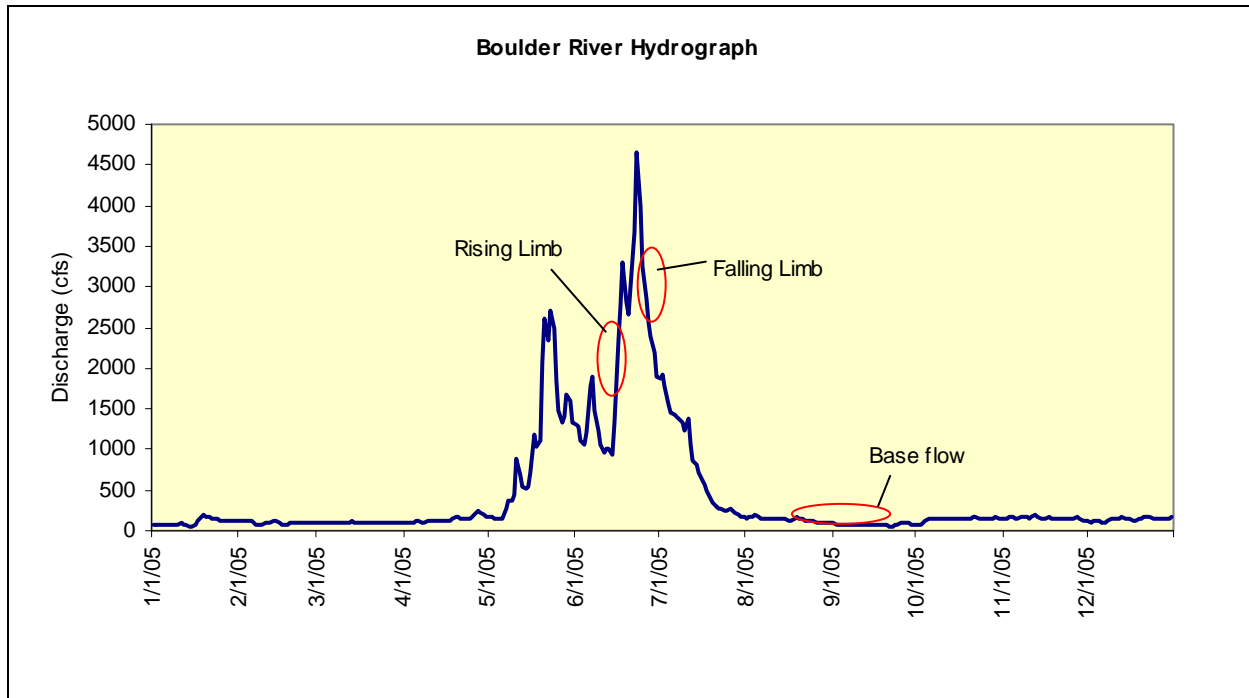


Figure 4-2. Boulder river hydrograph

Sampling sites for each synoptic sampling event should be chosen to include:

- Mouths of major tributaries (West Boulder River, East Boulder River)
- Mouths of selected tributaries known to have mining-related metals sources (including Basin Creek)
- Mouths of selected unmined tributaries.
- Permitted effluent discharges
- Multiple mainstem Boulder River sites within each segment

Water quality samples collected at each site should include, at a minimum, the following field parameters and lab analysis:

- Field Parameters (instantaneous discharge, pH, water temperature, electroconductivity)
- Water & Sediment Quality Analysis – (dissolved metals, total recoverable metals, hardness, suspended solids, sediment metals)

Provided above is a basic framework for continued monitoring and investigation of metals issues in the Boulder river watershed. Final sampling design, standard operating procedures, analytical methods, and quality assurance measures should be detailed in a formal Sampling and Analysis Plan (SAP) that has been approved by the DEQ.

SECTION 5.0

BOULDER RIVER METALS TMDLS AND ALLOCATIONS

A Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. TMDLs are a requirement of Section 303(d) of the Clean Water Act (CWA). To meet this requirement, MDEQ must identify water bodies not meeting water quality standards and then establish TMDLs for those pollutants responsible for water quality impairment. In general, a TMDL is a quantitative assessment of water quality problems, contributing sources, and pollution reductions needed to attain water quality standards. The TMDL specifies the amount of pollutant that must be reduced to meet water quality standards, allocates pollution control or management among sources in a watershed, and provides a framework for taking actions needed to restore a water body.

As concluded in **Section 4.0**, TMDLs for copper, lead and iron are calculated for Boulder River segments MT43B004_131, MT43B004_132, MT43B004_133 and MT43B004_134, and for Basin Creek, MT43B005_010.

Metals (copper, lead, iron) TMDLs in the Boulder River watershed will address the following elements:

- Loading Capacity (LC) or the maximum amount of pollutant loading a water body can receive without violating water quality standards
- Waste Load Allocation (WLA) or the portion of the TMDL allocated to existing and future point sources
- Load Allocation (LA) or the portion of the TMDL allocated to existing and future nonpoint sources and natural background
- Margin of Safety (MOS) or an accounting of uncertainty about the relationship between pollutant loads and receiving water quality

These elements are combined in equation 1:

$$TMDL = LC = \Sigma WLA + \Sigma LA + MOS$$

In addition, the TMDL must also take into account the seasonal variability of pollutant loads and adaptive management strategies in order to address uncertainties inherent in environmental analyses. The above described elements will be detailed throughout the remainder of this section.

5.1 Source Characterization and Assessment

This section identifies sources of copper, lead and iron in the Boulder River watershed. Potential source categories include those from natural sources (non-anthropogenic sources), point sources (MPDES permitted sources, and other unpermitted discrete point sources), and non-point sources. Sources identified within each category are presented below.

5.1.1 Natural Sources

Natural sources of metals are those that contribute metals independently of human disturbance or influence. Natural sources are geologically derived from metals found within the Earth's crust. The geology throughout the watershed is mineral rich and has the potential to contribute metals to receiving waters through natural weathering and transport processes.

Assessing the level of natural background metals using existing data from the Boulder River watershed is problematic due to a variety of reasons:

- Spatial and temporal extent of water quality data is limited
- Abandoned mines and their associated waste were established throughout the watershed prior to any historic water quality data collection
- Detection limits associated with many water quality data are not low enough to provide detection results at low (background) concentrations.

Because of the uncertainty inherent in establishing natural background levels, water quality standards exceedance evaluations and subsequent water quality impairment determinations are based on certain assumptions:

- natural background metals concentrations remain below the chronic water quality criteria for aquatic life under all flow conditions
- single water quality samples are assumed to represent a 96-hour average water quality concentration

5.1.2 Point Sources

Point sources in the Boulder River watershed include both permitted point sources and unpermitted point sources. Unpermitted point sources refer primarily to abandoned mine adits and other discrete historic mining sources that discharge to impaired streams and their tributaries.

5.1.2.1 Permitted Point Sources

Two permitted point sources exist in the Boulder River watershed (**Figure 5-1**).

- East Boulder Mine (MPDES permit MT-0026808) located in the Upper East Boulder River watershed, discharging to the East Boulder River
- City of Big Timber domestic wastewater treatment lagoon (MPDES permit MT-0020753) located on the Lower Boulder River near the confluence with the Yellowstone River, discharging to the Boulder River.

The East Boulder Mine MPDES permit allows water discharges through groundwater and surface water outfalls. To date, no direct discharges to the East Boulder River through surface water outfall have occurred: all discharges have been disposed of via infiltration to ground water through two percolation ponds. In-stream water quality monitoring data above and below the percolation ponds show no detectable increase in metals loading from the East Boulder Mine (Kuipers & Associates 2005-2007).

The City of Big Timber MPDES permit allows direct discharges from its domestic wastewater treatment lagoon to the Boulder River. Permit MT-0020753 does not specifically provide load limits for metals, or require ambient monitoring for these water quality parameters.

Consequently, existing metals loading from this point source is unknown. In order to properly evaluate metals effluent loading from the City of Big Timber's wastewater treatment lagoon, effluent monitoring should be conducted, and is included in the framework monitoring plan given in **Section 4.6.3**.

As permitted point sources and potential load contributors to metals-impaired water bodies, a metals (Cu, Pb, Fe) waste load allocation (WLA) will be provided for these point sources and is given in **Section 5.3.2**.

5.1.2.2 Unpermitted Point Sources: Adits and Abandoned Mining Sources

Section 4.0 discusses abandoned mining in the watershed and contamination sources associated with abandoned mining. These sources include adit discharges, waste rock piles and tailings. There are a number of known abandoned mines within the watershed. Mining districts within the Boulder River basin (**Figure 2-7**) include the following and are discussed in more detail below:

- Boulder River (gold, silver, copper, lead and chromium)
- Natural Bridge (gold, silver, and copper)
- Independence (gold, silver, copper and lead)

Boulder River District

The Boulder River Mining District was located in the Contact Mountain area and at the head of the East Boulder River about 30 miles south of Big Timber. Most of the mines in the district exploited the lower Stillwater Complex, which was relatively rich in copper and nickel sulfides, and chromite (chromium oxide). The most important mines in the area were the East Boulder, the Gish, Hubble Gulch, the Minnie, and Wright Gulch. None of the mines in the district are on the Priority Abandoned Mines List, and only one, the Gish, was reported to have an adit flow. No data were available from the Gish adit.

Natural Bridge District

The Natural Bridge District was located in the area of Placer Basin, which is a tributary of the East Boulder River. The district was to exploit the copper, gold and silver associated with the basal Stillwater Complex; however, mine production consisted only of test shipments.

Independence District

The Independence Mining District was located about 60 miles south of Big Timber near the head of the main stem of the Boulder River, including the area around Independence Peak and extending to Carbonate Mountain to the northwest. Gold, silver, copper, and lead were produced in the district from the free-milling oxidized zones of fissure veins within granite and diorite. The most important mines in the district were the Hidden Treasure, the Yager/Daisy, the Poorman, and the Independence, all of which had their own stamp mills and concentrators. Each of the principal mines had one or more shafts or adits, some of which discharge to Basin Creek, a tributary to Boulder River. In 1993, the Montana Department of State Lands conducted an evaluation of the Yager/Daisy, the Poorman, and the Independence properties and inventoried

the volume of unimpounded tailings/waste rock, and identified and sampled discharging adits at each site. The sampling results for the adit discharges from the Yager and Poorman sites are presented in **Table 5-1**.

Table 5-1. Adit Discharge Data from Yager and Poorman Sites

Property	Sample Number	Flow (cfs)	Copper (ug/L)	Copper (lbs/day)	Lead (ug/L)	Lead (lbs/day)
Poorman	49-003-GW-1		3.2		1.07	
Poorman	49-003-GW-2		1.9		0.72	
Yager	49-002-GW-1	0.033	5.37	0.0010	1.33	0.0002
Yager	49-002-GW-2	0.022	8.13	0.0010	0.72	0.0001
Yager	49-002-GW-3	0.011	186	0.0110	1.22	0.0001
Yager	49-002-GW-4	0.013	3.07	0.0002	9.37	0.0007

Reference: MDEQ 1993

In addition to the samples taken from adit sources, two surface water samples were taken at the Yager location from Basin Creek. **Table 5-2** contains these data as well as an estimated load being introduced to Basin Creek from this location.

Table 5-2. Surface Water Samples and Estimated Load from Yager Site

Sample Number	Flow (cfs)	Copper (ug/L)	Copper (lbs/day)	Lead (ug/L)	Lead (lbs/day)
49-002-SW-1	2.01	4.53	0.049	1.05	0.011
49-002-SW-2	0.825	2.27	0.010	0.75	0.003

Reference: MDEQ 1993

All samples (adit and surface water) were collected in August, 1993 and are considered to be low flow data. It is presumed, however, that loading of copper and lead to Basin Creek would be greater under higher flow conditions as lower quality waters are often flushed from mine workings and waste piles during runoff.

While data from the Yager and Poorman sites demonstrate that metals sources from abandoned mine operations exists, the absence of water quality and flow data preclude calculation of loading estimates under higher flow conditions when water quality exceedances have been observed.

During TMDL implementation, adit discharges identified here should be more thoroughly investigated in order to evaluate loading conditions and target attainment under a variety of flow conditions. Further investigation into additional potential adit sources throughout the watershed should also be conducted to better evaluate metals loading from adit sources and develop potential future allocations to these sources.



Figure 5-1. MPDES Permit Locations in the Boulder River Watershed

5.1.3 Non-point Sources

Non-point source pollutants originate from diffuse sources throughout the watershed. This type of pollution is caused primarily by rainfall, snowmelt and/or ground water moving over and through the landscape. As the runoff moves, it picks up and transports pollutants and deposits them into area receiving waters.

5.1.3.2 Other Non-Point Sources

Another source of metals associated with abandoned mining is contaminated sediment. Historic practices have likely distributed metals throughout the stream channels downstream of mining sites. Over time, metals settled into the substrate and streambanks and are reintroduced to the system during high flow events when streambanks are eroded and sediments are disturbed. Sediment data are limited and were discussed in **Section 4.4.2**. The extent of loading from contaminated sediments is unknown; however, future monitoring (discussed in **Section 4.5.5.1**) may help evaluate the significance of this source.

5.1.4 Source Assessment Summary

Anthropogenic sources of metals in the Boulder Watershed are derived mainly from historic mining practices and abandoned mines scattered throughout the watershed. Metals are introduced to the stream primarily through land runoff and adit discharges. The Boulder River is particularly susceptible to water quality standards exceedences during high flows when 1) metals from land runoff are entering the stream and 2) low hardness values result in lower water quality criteria. Presently, permitted discharges do not appear to contribute significant metals loads to the Boulder River. Unpermitted point sources (mine adits and associated mining waste rock) are thought to contribute to water quality exceedences in the Boulder River watershed.

5.2 TMDLs and Load Allocations

TMDLs and load allocations are presented below for 4 discrete segments of the Boulder River, MT43B004_131, MT43B004_132, MT43B004_133 and MT43B004_134, and for Basin Creek segment MT43B005_010 (**Table 5-3**).

Table 5-3. Boulder River TMDLs

Water Body Segment	TMDLs
Boulder River MT43B004_131	copper, lead, iron
Boulder River MT43B004_132	copper, lead, iron
Boulder River MT43B004_133	copper, lead, iron
Boulder River MT43B004_134	copper, lead, iron
Basin Creek MT43B005_010	copper, lead, iron

5.2.1 Total Maximum Daily Loads

A water body's allowable daily loading capacity, or total maximum daily load, for most metals is dependent upon two factors: the water quality target and the streamflow. As described in **Section 4.0**, the adopted water quality target is the State of Montana's numeric aquatic life criteria. As the water quality target for copper and lead varies with water hardness, total maximum daily loads for copper and lead for any given flow will also vary with water hardness.

Total Maximum Daily Loads for copper, lead and iron are calculated using equation 2 (below). Note that chronic aquatic life criteria are adopted as the target and used to calculate the total maximum daily load. Using the chronic criteria to calculate an allowable daily load, rather than a 96-hour load limit⁴ affords a margin of safety in calculating TMDL and also establishes a daily load limit expression.

Equation 2

$$TMDL = (X) (Y) (0.0054)$$

TMDL = Total Maximum Daily Load in lbs/day

X = the chronic aquatic life use criteria (target) with hardness adjustments where applicable in ug/l

Y = streamflow in cubic feet per second

(0.0054) = conversion factor

To illustrate, TMDLs and estimated load reductions are calculated for typical seasonal flow conditions in the Boulder River (**Table 5-4, 5-5**). **Table 5-4** also shows the metals loading capacity when water hardness = 25mg/l and flow = 1500 cfs. Necessary load reductions to meet water quality targets are given in the far column. This condition represents water quality conditions experienced in the lower Boulder River periodically during seasonal runoff or other times of year when water hardness levels are their lowest.

Table 5-4. High Flow TMDL (1500 cfs, 25 mg/l hardness)

Metal	Target ug/l	TMDL lbs/day	Existing Load* lbs/day	Assimilative Capacity lbs/day	Necessary % reduction
Copper	2.85	23.09	34.3	-11.3	33%
Lead	0.545	4.41	10.7	-6.3	59%
Iron	1,000	8,090	9,100	-1010	11%

*assume average metals concentrations at flows >1500 cfs (DEQ data)

During typical low flow conditions (hardness = 100 mg/l, flow = 38 cfs) the TMDL is less, but due to higher water hardness, the water quality target is higher, resulting in in-stream loads under the allowable loading capacity.

⁴ Chronic aquatic life criteria are based on a 96-hour average in-stream concentration (DEQ-7)

Table 5-5. Low Flow TMDL (38 cfs, 100 mg/l hardness)

Metal	Target ug/l	TMDL lbs/day	Existing Load* lbs/day	Assimilative Capacity lbs/day	Necessary % reduction
Copper	9.33	1.91	0.102	1.81	0%
Lead	3.18	0.65	0.102	0.55	0%
Iron	1,000	205	6.1	199	0%

*assume average metals concentrations at flows <100cfs (DEQ data)

Data shows (**Section 4.0**) that copper and lead concentrations in the lower Boulder River are elevated above water quality targets under most high flow conditions (flows > 1500 cfs) during May and June. Iron concentrations have also exceeded the water quality target during high flow conditions. Necessary load reductions therefore apply particularly to high flow conditions, and strategies to reduce pollutant loading should address those processes and mechanisms that influence elevated metals concentrations during seasonal runoff.

5.2.2 Allocations

The TMDL is the sum of the waste load allocations (WLA) (point sources) plus the sum of the load allocations (LA) (nonpoint sources) for a water body, plus a margin of safety (MOS).

$$TMDL = \Sigma WLA + \Sigma LA + MOS$$

As discussed in **Section 5.1.2.2**, there are several abandoned mines in the Boulder River TPA, however, data is too limited to adequately distinguish point source loading from abandoned mines, adits, tailings, etc (WLA) from non-point source loading. *Therefore, a **composite wasteload allocation (WLA_C)** that includes the contribution from both **unpermitted abandoned mine sources** (e.g. adits, waste rock, and tailings) and **background (non-point) sources** is established. This WLA_C applies to contributing watershed of each stream segment.*

WLA_C = Composite waste load allocation from:

- Unpermitted abandoned mining sources
- Non-point sources

Boulder River segments MT43B004_134, MT43B004_133 and Basin Creek segment MT43B005_010 have no permitted point-source discharges. Consequently, the wasteload allocation for these segments will consist solely of the composite waste load allocation from unpermitted abandoned mining sources and non-point sources. Boulder River segments MT43B004_132 and MT43B004_131 have permitted point sources (**Figure 5-1**) within their contributing watershed area, requiring separate waste load allocations for these permitted sources in addition to a composite waste load allocation. Margin of safety (**Section 5.2.3.2**) is addressed implicitly in this TMDL through incorporation of various safety factors and contingencies incorporated into the TMDL development process. A separate explicit allocation as a margin of safety is therefore unnecessary.

5.2.2.1 Basin Creek Segment MT43B005_010 and Boulder River Segments MT43B004_134 and MT43B004_133: TMDLS and Allocations

For Basin Creek Segment MT43B005_010 and Boulder River Segments MT43B004_134 and MT43B004_133, metals TMDLs are equivalent to the composite waste load allocation for each metal.

$$\begin{aligned} \text{TMDL}_{(MT43B005_010)} &= \text{WLA}_C(MT43B005_010) \\ \text{TMDL}_{(MT43B004_134)} &= \text{WLA}_C(MT43B004_134) \\ \text{TMDL}_{(MT43B004_133)} &= \text{WLA}_C(MT43B004_133) \end{aligned}$$

The total composite waste load allocation (WLA_C) is equal to the total maximum daily load (Equation 2, Section 5.2.1) and includes the combined load from unpermitted abandoned mining sources and nonpoint sources.

5.2.2.2 Boulder River Segments MT43B004_132 and MT43B004_131: TMDLS and Allocations

For Boulder River segments MT43B004_132 and MT43B004_131, TMDLs will consist of the sum of the permitted and composite wasteload allocations for each stream segment:

$$\begin{aligned} \text{TMDL}_{(MT43B004_132)} &= \Sigma \text{WLA}_P(MT43B004_132) + \text{WLA}_C(MT43B004_132) \\ \text{TMDL}_{(MT43B004_131)} &= \Sigma \text{WLA}_P(MT43B004_131) + \text{WLA}_C(MT43B004_131) \end{aligned}$$

ΣWLA_P = Sum of the permitted waste load allocations that contribute to the stream segment of interest (see below)

WLA_C = Composite wasteload allocation within the stream segment of interest from:

- *Unpermitted abandoned mining sources*
- *Non-point sources*

5.2.2.2.1 Waste Load Allocations (permitted)

Waste load allocations for copper, lead and iron are provided for permit *MT-0020753 City of Big Timber*, and for permit *MT-0026808 Stillwater Mining Company* (**Figure 5-1**).

MPDES Permit MT-0020753 City of Big Timber

The City of Big Timber operates a wastewater treatment lagoon that discharges directly to impaired Boulder River segment MT43B004_131. Existing metals loading from the lagoon to the Boulder River is unknown, as effluent water quality data for metals does not exist for this facility. Limited data from similar lagoon systems in Montana, however, suggest that existing metals concentrations are not likely to be elevated above chronic aquatic life criteria. Additional effluent monitoring is recommended in order to verify this supposition.

In order to ensure that discharges do not contribute to in-stream target exceedances under all flow conditions, effluent metals concentrations should remain below the chronic

aquatic life criteria. Water quality data for the Boulder River show that hardness values periodically drop to or below 25 mg/L hardness during all seasons. The chronic water quality target at 25 mg/l is therefore used to calculate permitted waste load allocations.

The waste load allocations for the City of Big Timber permit *MT-0020753* (**Table 5-6**) are calculated using the existing design flow of the facility and an effluent concentration at the chronic water quality target (see **Section 4.5.2**). Waste load increases may be permitted with increases in design flow as long as effluent concentrations remain at or below the chronic criteria.

$$WLA_{(MT-0020753)} = (\text{design flow}) * (\text{chronic criteria at 25 mg/l hardness}) * (0.0054)$$

Table 5-6. City of Big Timber MPDES Permit MT-0020753: Metals waste load allocations

Copper $WLA_{(MT-0020753)}$	0.009 lbs/day	= (0.603 cfs) * (2.85 ug/L) * (0.0054)
Lead $WLA_{(MT-0020753)}$	0.002 lbs/day	= (0.603 cfs) * (0.545 ug/L) * (0.0054)
Iron $WLA_{(MT-0020753)}$	3.26 lbs/day	= (0.603 cfs) * (1000 ug/L) * (0.0054)

MPDES Permit MT-0026808 Stillwater Mining Company

The Stillwater Mining Company operates the East Boulder Mine and is permitted to discharge wastewater to the East Boulder River segment MT43B004_132 through ground water and surface water outfalls. Because flow from the East Boulder River contributes to Boulder River segments, MT43B004_131 and MT43B004_132, a wasteload allocation from this source is provided for both segments. To date, no direct discharges to the East Boulder River through surface water outfall have occurred: all discharges have been disposed of via infiltration to ground water through two percolation ponds. In-stream water quality monitoring data above and below the percolation ponds show no detectable increase in metals loading from the East Boulder Mine (Kuipers & Associates 2005-2007).

Waste load allocations (**Table 5-7**) were developed by calculating Average Monthly Limits (AMLs) using analyses established in *EPA Technical Support Document (TSD) for Water Quality-based Toxics Control* (EPA, 1991). AMLs were derived (**Appendix C**) in consultation with DEQ’s Water Quality Permitting Section and are consistent with processes used to define pollutant limits in MPDES permits. AML concentration values for copper, lead, and iron were multiplied by the design flow of the facility to calculate daily loads. Using AMLs to derive daily loading limits ensures protection from chronic exceedances in the East Boulder River and, as the Boulder River 7Q10 flow (38 cfs) is considerably greater than the East Boulder River 7Q10 flow (5 cfs), the WLAs provided are thereby protective of water quality conditions in the Boulder River.

$$WLA_{(MT-0026808)} = (\text{design flow}) * (\text{AML value}) * (0.0054)$$

Table 5-7. Stillwater Mining Company permit MT-0026808: Metals waste load allocations

Copper WLA _(MT-0026808)	0.061 lbs/day	= (1.65 cfs) * (6.9 ug/L) * (0.0054)
Lead WLA _(MT-0026808)	0.005 lbs/day	= (1.65 cfs) * (0.60 ug/L) * (0.0054)
Iron WLA _(MT-0026808)	28.5 lbs/day	= (1.65 cfs) * (3200 ug/L) * (0.0054)

5.2.2.2.2 Waste Load Allocations (composite)

The composite waste load allocation (WLA_C) includes the combined load from background (non-point) sources and unpermitted mining-related sources within the contributing watershed and is calculated by subtracting the permitted waste load allocations (ΣWLA_P) above from the Total Maximum Daily Load (TMDL) for each segment:

$$WLA_C = TMDL - \Sigma WLA_P$$

5.2.2.2.3 Boulder River Segment MT43B004_132: TMDLS and Allocations

The TMDL for Boulder River segment MT43B004_132 equals the sum of the permitted waste load allocations (ΣWLA_P) and the composite waste load allocation (WLA_C). As the East Boulder Mine is the only permitted point source that contributes to this segment, ΣWLA_P is equal to the waste load allocation established for the East Boulder Mine (Table 5-7).

$$TMDL_{(MT43B004_132)} = WLA_{(MT-0026808)} + WLA_C_{(MT43B004_132)}$$

As the TMDL is a function of flow and water hardness, TMDLs and WLA_C will vary with the season. To illustrate allocations under different conditions, Tables 5-8 and 5-9 show calculated TMDLs and waste load allocations for typical high and low flows for lower Boulder River segment MT43B004_132.

Table 5-8. High Flow TMDL and Allocations: Boulder River Segment MT43B004_132

High Flow TMDL*			
Pollutant	TMDL	WLA _C	ΣWLA _P lbs/day
	lbs/day	lbs/day	WLA (MT-0026808)
Cu	23.09	23.03	0.061
Pb	4.41	4.405	0.005
Fe	8,090	8061	28.5

*flow = 1500 cfs, hardness = 25 mg/l

Table 5-9. Low Flow TMDL and Allocations: Boulder River Segment MT43B004_132

Low Flow TMDL*			
Pollutant	TMDL	WLA _C	ΣWLA _P lbs/day
	lbs/day	lbs/day	WLA (MT-0026808)
Cu	1.91	1.85	0.061
Pb	0.65	0.645	0.005
Fe	205	177	28.5

*flow = 38 cfs, hardness = 100 mg/l

5.2.2.2.4 Boulder River Segment MT43B004_132: TMDLS and Allocations

The TMDL for Boulder River segment MT43B004_131 equals the sum of the permitted waste load allocations (ΣWLA_P) and the composite waste load allocation (WLA_C). As the East Boulder Mine and the City of Big Timber are permitted point sources that contribute to this segment, ΣWLA_P is equal to the sum of the waste load allocations established for these two point sources (Tables 5-6 and 5-7).

$$TMDL_{(MT43B004_131)} = \{WLA_{(MT-0026808)} + WLA_{(MT-00207053)}\} + WLA_{C(MT43B004_131)}$$

As the TMDL is a function of flow and water hardness, TMDLs and WLA_C will vary with the season. To illustrate allocations under different conditions, Tables 5-10 and 5-11 show calculated TMDLs and waste load allocations for typical high and low flows for lower Boulder River segment MT43B004_131.

Table 5-10. High Flow TMDL and Allocations: Boulder River Segment MT43B004_131

High Flow TMDL*				
Pollutant	TMDL	WLA_C	ΣWLA_P lbs/day	
	lbs/day	lbs/day	WLA (MT-0026808)	WLA (MT-0020753)
Cu	23.09	23.02	0.061	0.009
Pb	4.41	4.40	0.005	0.002
Fe	8,090	8058	28.5	3.26

*flow = 1500 cfs, hardness = 25 mg/l

Table 5-11. Low Flow TMDL and Allocations: Boulder River Segment MT43B004_131

Low Flow TMDL*				
Pollutant	TMDL	WLA_C	ΣWLA_P lbs/day	
	lbs/day	lbs/day	WLA (MT-0026808)	WLA (MT-0020753)
Cu	1.91	1.84	0.061	0.009
Pb	0.65	0.64	0.005	0.002
Fe	205	173	28.5	3.26

*flow = 38 cfs, hardness = 100 mg/l

Under most circumstances, the Boulder River does not exceed water quality targets and maintains assimilative capacity. It is under periodic high flow conditions (expressed in Table 5-4) that the TMDL is typically exceeded. It is expected that reductions in abandoned mining loads through mitigation and restoration of abandoned mining sites and associated impacts in the upper watershed will reduce the loading from controllable metals sources to levels that fall within the allowable allocation and satisfy the TMDLs for each stream segment under high flow conditions. Both permitted facilities are discharging consistent with the WLAs. Most of the suspected sources of elevated and controllable loading to meet the composite WLAs are in the upper portions of the Boulder River watershed. Therefore, addressing TMDLs in the upper watershed (Section 5.2.2.1) should result in meeting the above TMDL goals for the two lower Boulder River stream segments via abandoned mines loading reductions.

5.2.3 Seasonality and Margin of Safety

All TMDL documents must consider the influence of seasonal variability on water quality impairment conditions, maximum allowable pollutant loads (TMDLs), and allocations. TMDL development must also incorporate a margin safety into the load allocation process to account for uncertainties in pollutant sources and other watershed conditions, and ensure (to the degree practicable) that the TMDL components and requirements are sufficiently protective of water quality and beneficial uses. This section addresses considerations of seasonality and a margin of safety in the Boulder River watershed metals TMDL development process.

5.2.3.1 Seasonality

Seasonality addresses the need to ensure year round beneficial use support. Seasonality was considered for assessing loading conditions and for developing water quality targets, TMDLs, and allocation schemes. As with most metals TMDLs, seasonality is critical due to varying metals loading pathways and varying water hardness during high and low flow conditions. Loading pathways associated with overland flow and erosion of metals-contaminated soils and wastes tend to be the major cause of elevated metals concentrations during high flows, with the highest concentrations and metals loading typically occurring during the rising limb of the hydrograph. Loading pathways associated with ground water transport and/or adit discharges tend to be the major cause of elevated metals concentrations during low or baseflow conditions. Hardness tends to be lower during higher flow conditions, thus leading to lower water quality standards for some metals during the runoff season. Seasonality is addressed in this document as follows:

- Metals impairment and loading conditions are evaluated for both high flow and low flow conditions.
- Metals TMDLs incorporate streamflow as part of the TMDL equation.
- Metals targets apply year round, with monitoring criteria for target attainment developed to address seasonal water quality extremes associated with loading and hardness variations.
- Example targets, TMDLs and load reduction needs are developed for high and low flow conditions.

5.2.3.2 Margin of Safety

A margin of safety is applied implicitly by using conservative assumptions throughout the TMDL development process (U.S. EPA, 1999). This implicit margin of safety is addressed in several ways as part of this document:

- Target attainment, refinement of allocations, and, in some cases, impairment determinations are all based on an adaptive management approach that relies on future monitoring and assessment for updating planning and implementation efforts.
- Chronic criteria was used to calculate a daily load rather than a 96-hour load limit
- The most protective hardness condition (25 mg/l hardness) was used to calculate load limits for waste load allocations

- Sediment metals concentration criteria were used as secondary indicators.
- Metals allocations for MPDES permit MT-0020752 are based on meeting chronic aquatic life criteria in wastewater effluent.

5.3 Monitoring Strategy

Refer to **Section 4.6** for a framework monitoring strategy.

5.4 Restoration Strategy

This section outlines strategies for addressing metals loading sources in need of restoration activities within Boulder River watershed. The restoration strategies focus on regulatory mechanisms and/or programs applicable to the controllable source types present within the watershed, which for the most part are associated with historic mining and mining legacy issues.

Potential metals loading sources include abandoned mining disturbances: discharging mine adits and mine waste materials on-site and in-channel. Following is a discussion of general restoration programs and funding mechanisms that may be applicable to these sources. The need for further characterization of impairment conditions and loading sources in the Boulder River is addressed through the framework monitoring plan in **Section 4.6**.

5.4.1 General Restoration & Remediation Funding Options

A number of state and federal regulatory programs have been developed over the years to address water quality problems stemming from nonpoint sources of pollution. Nonpoint sources of pollution, particularly historic mines and associated disturbances, constitute a source of metals loading to the Boulder River and Basin Creek. Some regulatory programs and approaches considered most applicable to Prospect Creek watershed include:

- The State of Montana Mine Waste Cleanup Bureau's Abandoned Mine Lands (AML) Reclamation Program
- The Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA) which incorporates additional cleanup options under the Controlled Allocation of Liability Act (CALA) and the Voluntary Cleanup and Redevelopment Act (VCRA).

Montana Mine Waste Cleanup Bureau Abandoned Mine Reclamation Program

The Montana Department of Environmental Quality's Mine Waste Cleanup Bureau (MWCB), part of the MDEQ Remediation Division, is responsible for reclamation of historical mining disturbances associated with abandoned mines in Montana. The MWCB abandoned mine reclamation program may be a viable alternative for addressing metals loading sources in the Boulder River watershed.

The MWCB abandoned mine reclamation program is funded through the Surface Mining Control and Reclamation Act of 1977 (SMCRA) with SMCRA funds distributed to states by the federal government. In order to be eligible for SMCRA funding, a site must have been mined or affected by mining processes, and abandoned or inadequately reclaimed, prior to August 3, 1977 for

private lands, August 28, 1974 for Forest Service administered lands, and prior to 1980 for lands administered by the U.S. Bureau of Reclamation. Furthermore, there must be no party (owner, operator, other) who may be responsible for reclamation requirements, and the site must not be located within an area designated for remedial action under the federal Superfund program or certain other programs.

Within the Boulder River TPA, the Yager/Daisy Mine in the Independence Mining District is ranked 99th on the MDEQ priority list.

Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA)

Reclamation of historic mining-related disturbances administered by the State of Montana and not addressed under SMCRA typically are addressed through the MDEQ State Superfund or CECRA program. The CECRA program maintains a list of facilities potentially requiring response actions based on the confirmed release or substantial threat of a release of a hazardous or deleterious substance that may pose an imminent and substantial threat to public health, safety or welfare or the environment (ARM 17.55.108). Listed facilities are prioritized as maximum, high, medium or low priority or in operation and maintenance status based on the potential threat posed. Currently there are no CECRA-listed facilities in Boulder River watershed.

CECRA also encourages the implementation of voluntary cleanup activities under the Voluntary Cleanup and Redevelopment Act (VCRA), and the Controlled Allocation and Redevelopment Act (CALA). It is possible that any historic mining-related metals loading sources identified in the watershed in the future could be added to the CECRA list and addressed through CECRA, with or without the VCRA and/or CALA process. A site can be added to the CECRA list at MDEQ's initiative, or in response to a written request made by any person to the department containing the required information.

Other Programs

In addition to the programs discussed above, other funding may be available for water quality restoration activities. These sources may include the yearly RIT/RDG grant program or the EPA Section 319 Nonpoint Source yearly grant program. The RIT/RDG program can provide up to \$300,000 to address environmental related issues. This money can be applied to sites included on the MWCB's AML priority list but of low enough priority where cleanup under AML is uncertain (possibly the Yager/Daisy site). RIT/RDG program funds can also be used for conducting site assessment/characterization activities such as identifying specific sources of water quality impairment.

Section 319 grant funds are typically used to help identify, prioritize, and implement water quality protection projects with focus on TMDL development and implementation of nonpoint source projects. Individual contracts under the yearly grant typically range from \$20,000 to \$150,000, with a 25% or more match requirement. RIT/RDG and 319 projects typically need to be administered through a non-profit or local government such as a conservation district, a watershed planning group, or a county.

5.4.2 General Restoration & Remediation Priorities

The source characterization and assessment performed for this study identified abandoned mining sites associated with the Independence Mining District located in the headwaters of the Boulder River watershed. It is possible that these apparent sources constitute a significant portion of the metals loading sources in the drainage area. Efforts should focus on reclamation of these identified sources following more detailed site characterization as outlined in the Monitoring Strategy. Detailed surface water sampling should be initiated when feasible to better quantify metals loading rates and mechanisms from this area. Additional information in the form of stream sediment chemistry and mine waste physical and chemical characteristics should be obtained so that reclamation planning can be pursued as soon as feasible.

5.5 Adaptive Management Strategy

The water quality restoration targets and associated metals TMDLs developed for the Boulder River are based on future attainment of the B-1 classification water quality standards. In order to achieve attainment, all significant sources of metal loading must be addressed via all reasonable conservation practices. Because of the potential for metals contributions from natural sources as well as from controllable anthropogenic sources, an adaptive management approach is adopted for all metals targets described within this document.

In previous sections, a monitoring strategy was suggested that will provide further information on source characterization, target attainment and effectiveness of restoration activities. The adaptive management strategy presented in this section describes the process for modifying the Boulder River restoration strategy when deemed necessary. As is the case with all restoration activities, this adaptive management strategy will be best accomplished through cooperation with personnel with the authority and time to make a commitment of resources and technical personnel with the ability to evaluate monitoring data and identify scientific issues accordingly.

Possible scenarios for metals identified in this plan include:

- Implementation of restoration activities resulting in full attainment of restoration targets for all parameters;
- Implementation of restoration activities fails to result in target attainment due to underperformance or ineffectiveness of restoration actions. Under this scenario the water body remains impaired and will require further restoration efforts associated with the pollutants of concern. The target may or may not be modified based on additional information, but conditions still exist that require additional pollutant load reductions to support beneficial uses and meet applicable water quality standards. This scenario would require some form of additional, refocused restoration work.
- Implementation of restoration activities fails to result in target attainment, but target attainment is deemed unachievable even though all applicable monitoring and restoration activities have been completed. Under this scenario, site-specific water quality standards and/or the reclassification of the water body may be necessary. This would then lead to a new target (and TMDL) for the pollutant(s) of concern, and the new target could either reflect the existing conditions at the time or the anticipated future conditions associated with the restoration work that has been performed.

The MDEQ Remediation Division and/or MDEQ Standards Program personnel will lead this effort within MDEQ to make determinations concerning the appropriateness of specific mine cleanup activities relative to expectations for mining cleanup efforts for any impairment condition associated with mining impacts. This includes consideration of appropriate evaluation of cleanup options, actual cleanup planning and design, as well as the appropriate performance and maintenance of the cleanup activities. Where NPDES permitted point sources are involved, the MDEQ Permitting Program will also be involved. MDEQ TMDL program personnel will need to be involved in adaptive management to make sure there is consistency in water quality restoration goals as they apply to beneficial use support. Determinations on the performance of all aspects of restoration activities, or lack thereof, will then be used along with available in-stream data to reevaluate impairment determinations. The information will also help determine any further cleanup/load reduction needs for any applicable water body and will ultimately help determine the success of water quality restoration. Other stakeholders, including opportunities for public comment, will also be involved as required under applicable regulations. Public involvement is discussed further in **Section 6**.

SECTION 6.0

PUBLIC INVOLVEMENT

Public and stakeholder involvement is a component of TMDL planning efforts. Stakeholders, including the Sweet Grass County Conservation District, Boulder Watershed Committee, Montana Department of Natural Resources and Conservation, Montana Department of Fish, Wildlife & Parks, Stillwater Mining Company, Northern Plains Resource Council, Cottonwood Resource Council, and the Gallatin National Forest were kept abreast of the TMDL process through periodic meetings of the Boulder Watershed Committee, and were provided opportunities to review and comment on technical documents. Stakeholder review drafts were provided to several agency representatives, landowners, conservation district and government representatives, and representatives from conservation and watershed groups. Stakeholder comments, both verbal and written, were accepted and addressed.

An additional opportunity for public involvement is the 30-day public comment period. This public review period was initiated on May 14th, 2007 and extended to June 18th, 2007. At public meeting on May 16th in Big Timber, MT, DEQ provided an overview of the Boulder River Watershed Total Maximum Daily Loads, made copies of the document available to the public, and solicited public input and comment on the plan. Appendix A includes DEQ's response to all official public comments received during the 30-day comment period. The final document was updated, based on public input and comment.

SECTION 7.0

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ACRONYMS

ABWA	Absarokee-Beartooth Wilderness Area
AML	Abandoned Mine Lands
ARM	Administrative Rules of Montana
BER	Board of Environmental Review
BLM	Bureau of Land Management
BNF	Beaverhead National Forest
CALA	Controlled Allocation of Liability Act
CECRA	Montana Comprehensive Environmental Cleanup and Responsibility Act
cfs-	Cubic Feet Per Second
CWA	Clean Water Act
DEQ	Montana Department of Environmental Quality
DMR	Discharge Monitoring Report
EPT	Ephemeroptera, Plecoptera, Trichoptera
IR	Integrated Report
LA	Load Allocation
LC	Loading Capacity
LNF	Lolo National Forest
MCA	Montana Code Annotated
MDEQ	Montana Department of Environmental Quality
MFISH	Montana Fisheries Information System
MFWP	Montana Department of Fish, Wildlife and Parks
MMI	Multi-Metric Index
MNHP	Montana Natural Heritage Program
MOS	Margin of Safety
MPDES	Montana Pollutant Discharge Elimination System
MWCB	Mine Waste Cleanup Bureau
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
NWIS	National Water Information System
O/E	Observed/Expected
PEL	Probable Effects Levels
RIVPACS	River Invertebrate Prediction and Classification System
SABS	Suspended and Bedded Sediments
SAP	Sampling and Analysis Plan
SCD/BUD	Sufficient Credible Data/Beneficial Use Determination
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SMCRA	Surface Mining Coal and Reclamation Act
SNOTEL	Snowpack Telemetry
TEL	Threshold Effects Levels
TMDL	Total Maximum Daily Loads
TN	Total Nitrogen
TP	Total Phosphorus
TPA	TMDL Planning Area
UAA	Use Attainability Assessment

USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGS	United States Geological Survey
VCRA	Voluntary Cleanup and Redevelopment Act
WLA	Waste Load Allocation
WQA	Water Quality Act
WQRP	Water Quality Restoration Plans