LAKE HELENA WATERSHED RESTORATION PLAN

2016-2023

Lewis & Clark County Water Quality Protection District

Lake Helena Watershed Group

Published December 2015

TABLE OF CONTENTS

EXECUTIVE SUMMARY

About 55,000 people live in the Lake Helena watershed in a basin that ranges from the top of Elkhorn Peak to its outlet of Lake Helena. Over 150 years of human activity ranging from mining to agriculture and burgeoning residential development have impacted many streams in the watershed.

Currently, twenty-four streams or portions of streams in this watershed have been identified as having one or more pollutants that negatively impact beneficial uses of segments of rivers, streams or lakes (waterbodies), including aquatic life, agriculture, and drinking water. In order to restore these streams to ensure that they can fully support these beneficial uses, this watershed restoration plan has been developed.

Community-based watershed restoration planning summarizes existing water quality problems, sets priorities for the next seven years to address these problems, and identifies best management practices and projects that are useful and feasible. This plan has been developed through a community process involving landowners, land managers, technical experts, and water users in the watershed.

The Lake Helena Watershed Restoration Plan (WRP) is a plan to improve water quality on Prickly Pear and Tenmile Creeks and their tributaries through best management practices over the next seven years.

Intended Audiences

- Landowners interested in enhancing their own property and water resources.
- Residents and visitors interested in approaches that enhance fish and wildlife habitat and recreational opportunities
- Community leaders, government officials, and agency employees, as a guide to community-based, feasible projects and priorities for water quality improvement
- All water users interested in the streams, rivers, and lakes in the Lake Helena watershed and the community they support and enhance

Watershed Restoration Priorities for 2016-2023

In the next seven years, the priorities for watershed restoration projects are:

- Sediment reduction activities throughout the watershed
- Lower Prickly Pear Creek, downstream from Lump Gulch
- Lower Tenmile Creek, below the water treatment plant

Expected Results

By 2023, it is expected that reductions in sediment will be measurable. Several projects in the Prickly Pear and Tenmile Creek will be implemented and pollutants will drop in those areas. More landowners will be using best management practices that enhance land and water resources on their property, with positive benefit for the entire watershed.

LIST OF ABBREVIATIONS AND ACRONYMS

BLM	Bureau of Land Management
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CFS	Cubic Feet per Second
DEQ	Montana Department of Environmental Quality
DNRC	Montana Department of Natural Resources and Conservation
EPA	U.S. Environmental Protection Agency
FWP	Montana Fish, Wildlife and Parks
GPS	Global Positioning System
WQPD	Lewis & Clark County Water Quality Protection District
LHWG	Lake Helena Watershed Group
MCPS	Montana Conservation Practice Standard
MDT	Montana Department of Transportation
METG	Montana Environmental Trust Group, LLC
MFOTG	Montana Field Office Technical Guide
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
NRD	State of Montana Natural Resource Damage Program
PPLT	Prickly Pear Land Trust
TMDL	Total Maximum Daily Load
WRP	Watershed Restoration Plan

1.0 INTRODUCTION TO WATERSHED RESTORATION PLANNING

1.1 WHAT IS A WATERSHED RESTORATION PLAN (WRP)?

A watershed restoration plan (WRP) is a work plan that identifies priority water quality problems and management solutions that will help restore and protect water quality for a geographically defined watershed. Watershed plans are a means to resolve and prevent water quality problems that result mainly from nonpoint source pollution that comes from diffused sources from an area. It includes the analysis, actions, participants, and resources related to development and implementation of the plan. The goal is to identify and quantify sources contributing water quality problems; identify and quantify potential solutions; and implement these solutions.

1.2 PURPOSE OF THE WATERSHED RESTORATION PLAN

The Watershed Restoration Plan provides a framework for our community to address the highest priority and most cost-effective actions to protect our water, now and in the years to come. The planning process offers an opportunity to leverage additional resources to address watershed goals through formation of collaborative partnerships and an action plan to access outside funding sources.

This document is intended to:

- Inform citizens, landowners, water users, local governments and business interests about current water quality, areas where significant progress can be made in the next seven years and high priority restoration projects.
- Guide the landowner in best management practices (BMPs) that can improve the water quality of surface and groundwater on or near his or her property.
- Identify priority areas and a pollutant that will be the focus of restoration work in the next seven years.
- With a DEQ-accepted WRP, it also allows the WQPD to pursue funding through the Montana Department of Environmental Quality 319 NPS Program for implementation of watershed restoration projects.

By focusing on activities that are the most developed and areas where improvements to water quality can be most easily accomplished, it is expected that reductions in excess pollutants and better support of beneficial uses will be accomplished.

1.3 DEVELOPMENT OF THE WATERSHED RESTORATION PLAN

The Lake Helena Watershed Restoration Plan (WRP) was developed by the Lewis & Clark County Water Quality Protection District (WQPD), the Lake Helena Watershed Group (LHWG), and an advisory committee along with the consulting firm Headwaters Policy/Planning Partnership, LLP, and private consultant Karen Filipovich. Input was also solicited from the public, partner agencies and groups.

An advisory committee was formed to review input and guide the process of developing this plan. The advisory committee members were:

- Bob Alexander: Lake Helena Watershed Group (LHWG) representative

- David Callery: Helena National Forest (HNF)
- Steve Carpenendo: Department of Environmental Quality (DEQ) Wetlands
- Jeff Erickson: Headwaters Partnership Group
- Mark Fitzwater: City of Helena Wastewater Treatment Supervisor
- Mark Gornick: Jefferson Valley Conservation District
- John Kandelin: Lake Helena Watershed Group (LHWG) representative
- Jennifer McBroom: Water Quality Protection District (WQPD)
- Robert Ray: Department of Environmental Quality (DEQ)
- Frank Rives: Senior Planner, Lewis and Clark Community Development Program
- Mary Vandenbosch: Headwaters Partnership Group
- Jim Wilbur: Water Quality Protection District (WQPD)

1.4 BENEFITS OF THE LAKE HELENA WATERSHED RESTORATION PLAN

1.4.1 ECONOMIC VITALITY AND QUALITY OF LIFE

Water is essential for everyone who lives, does business, or recreates in the Lake Helena watershed. We depend on water for crops and livestock, business and industry, fish and wildlife, boating, swimming, hunting, and fishing. We need a reliable supply of clean, safe, drinking water. The WRP is a locally-developed plan to restore and protect these beneficial uses, which are crucial in preserving economic vitality and quality of life.

Without a good plan in place to protect and restore water quality, this vital resource is likely to suffer additional pollution from daily activities on the landscape. For example, silt from roads and fields are carried into Tenmile and Prickly Pear Creeks, harming fish and filling in pools. Continued additions of nitrogen and phosphorus from wastewater treatment, septic systems, fertilizers and livestock waste will add to algal blooms and low dissolved oxygen levels in Prickly Pear Creek and Lake Helena. Cattle and pet wastes contribute pathogens to water that children swim in. High nitrate concentrations in groundwater from septic systems can increase drinking water treatment costs and human health concerns.

1.4.2 RESTORATION OF BENEFICIAL USES OF WATER RESOURCES

The Montana Water Quality Act (MCA 75-5-101 – Water Quality (2003)) provides the framework for implementing state and federal policies to protect the beneficial uses of water. Beneficial uses include agriculture, aquatic life support, drinking water and recreation. Water quality standards to protect these uses are developed by the Department of Environmental Quality (DEQ) and adopted by the Board of Environmental Review. Under the federal Clean Water Act, Montana is required to publish a list of waterbodies (rivers, lakes and streams) in the state that do not meet water quality standards. This is known as the “303(d) impaired waters list,” named after the section that defines it in the Clean Water Act.

DEQ is required to develop pollution control plans (also known as TMDLs, or total maximum daily loads), that if implemented, will result in meeting water quality standards. In 2006, DEQ published TMDLs for the Lake Helena watershed for 18 waterbodies (sections of rivers, streams, and lakes) and 109 waterbody-pollutant combinations.

The pollutants identified were excess sediment, excess nutrients, high temperatures and heavy metals. In 2006, when the Lake Helena Planning Area TMDL was completed, many of the metals identifications were not completed due to lack of data. In July of 2013 the metals were completed for the Lake Helena, including Corbin Creek, Granite Creek, Jackson Creek and Silver Creek in an addendum to the Lake Helena TMDL. Currently, twenty-four streams or portions of streams and Lake Helena have one or more pollutants that exceed state water quality standards and negatively affect beneficial uses.

The 2006 Lake Helena Planning Area TMDL and 2013 addendum included an assessment of pollution sources, refinement of the water quality improvement goals (or targets), development of the actual TMDLs (a maximum level of each identified pollutant that would still allow the stream or lake to meet designated beneficial uses), pollutant load allocations, and a conceptual restoration strategy and implementation effectiveness monitoring plan. This planning document provided a general conceptual plan to attain and maintain the necessary water quality improvements. It did not, however, provide in-depth details about how the plan will be implemented on a site-specific basis.

This WRP focuses on prioritizing areas and pollutants that can be successfully addressed in the next seven years, coupled with projects that are expected to address identified problems. It is expected that the LHWG and the WQPD will lead the implementation of this plan for water quality improvements that will improve designated beneficial uses. Many partners are represented in the LHWG. Landowners and land managers may also complete additional projects in the watershed.

1.5 HISTORIC AND ONGOING PARTNER EFFORTS IN THE WATERSHED

Restoration activities within the Lake Helena watershed have been going on long before this watershed plan for the Lake Helena area was being developed and before the TMDLs for the watershed were established in 2006 and 2013. Water quality problems listed in this plan have been known for many years and efforts to alleviate these issues have been ongoing.

Prickly Pear Creek has been classified as an "I" stream rather than the normal "B-1" classification of a cold water fishery (trout) stream, one of the few in Montana because of water quality concerns. Over the last couple of decades the cities of Helena and East Helena have invested significantly in their respective wastewater treatment facilities to address pollutant impacts from the permitted discharge of effluent into the creek. As point sources (out of a pipe) they are being held to mandatory higher and more restrictive discharge levels for various pollutants for their required permits to discharge. Non-point source pollutants are not out of a pipe, are not required to clean up their impacts, and are given voluntary targets to reduce their discharges.

Various groups and agencies have been working to implement many of the BMPs listed in this plan over the years. Since 2001 the WQPD has worked with grant funding from DEQ and EPA in various 319 non-point grants to help organized watershed groups like the Lake Helena Watershed Group and its predecessor the Lower Tenmile Watershed Group in implementing stream restoration projects on Tenmile Creek, Prickly Pear Creek, and other streams in the watershed.

DEQ 319 grants to the WQPD that have include funding for restoration activities:

- Lower Tenmile Creek Watershed Protection Project (2001-2004)
- Lake Helena Watershed Project (2003-2006)
- Prickly Pear - Lake Helena Project (2007-2009)

- Lake Helena Watershed Restoration Project (2011- 2015)

EPA grants to the WQPD and Lewis & Clark County for watershed restoration work:

- Targeted Watershed Grant: Lake Helena Watershed Implementation Project (2008-2013)
- Regional Geographic Initiative Grant: The Lake Helena Watershed Riparian Ag Project (2007-2010)

Riparian planting projects have been conducted for many years by these groups and the Upper Tenmile Watershed Steering Committee.

The City of Helena operates a regulated small Municipal Separate Storm Sewer system (MS4) which is required to implement Best Management Practices to protect and improve water quality by controlling and reducing impacts from pollutants resulting from urban storm water runoff. The City of Helena partners with the LHWG and the WQPD in monitoring and conducting outreach activities in accordance with the MS4 requirements. The WQPD and the City of Helena have a Memorandum of Understanding (MOU) for the WQPD to assist the City in conducting outreach & educational activities and aid in monitoring to fulfill MS4 requirements.

PP&L, when they owned Hauser Dam, and their successor Northwestern Energy have funded numerous conservation projects including riparian fencing, water gaps, stream restoration, fish ladders and other projects through their Federal Energy Regulatory Commission (FERC) license mandate. The Montana Department of Fish, Wildlife and Parks has initiated and funded various projects through the Future Fisheries Program. Other groups such as local Trout Unlimited chapter, MT Ducks Unlimited, the Lewis & Clark Conservation District and others have worked over the years to help restore the streams and creeks of the watershed.

Abandoned mines in the watershed are an ongoing problem since metal pollutants are released into the environment and the streams. DEQ’s Abandoned Mine Program, the U.S. Forest Service and U.S. Bureau of Land Management have worked for decades to cleanup historic mines and mine wastes that contribute to the water quality problems. In the 1990’s the extent of pollution impacts of mining in the Upper Tenmile watershed and health risks of that pollution led to listing the mining district as an EPA Superfund site, resulting in the EPA directing significant efforts and funding to addressing the impacts and the mining pollutant sources for over twenty years.

The historic ASARCO lead smelter on Prickly Pear Creek was known to have impacts to air, soils, groundwater, and Prickly Pear Creek from its operation for over 100 years near East Helena. It was listed as an EPA Superfund site in 1984. With the bankruptcy of the company in 2001, the cleanup of this site was entrusted to EPA and the state of Montana. The Montana Environmental Trust Group (METG) was created to oversee this cleanup. METG has embarked on an ambitious effort to alter the hydrologic setting of the plant site to minimize contact between onsite pollutants with groundwater and Prickly Pear Creek. In a multiple year phased project Prickly Pear Creek will be moved, an adjacent wetland complex will be moved and reconstructed, a historic dam on the creek is being removed, and an evapotranspiration (ET) cap is being constructed to cover the former smelter site.

Prickly Pear Creek, the largest perennial stream located in the Helena Valley, has historically faced fishery and numerous water quality impairments due to chronic de-watering, and thermal modification from surface water irrigation diversions. This practice and conditions existed in the creek until 2008 when the Montana Water Trust developed and coordinated an agreement between the Prickly Pear Water Users (PPWU) and the Helena Valley Irrigation District (HVID), which allowed for full flow restoration of the stream system through what is termed “source switching.”

Over the last eight years the Prickly Pear Creek Re-watering project has proven to be highly successful. The flow deal worked by purchasing approximately 2000 acre-feet of water annually from Helena Valley Irrigation District (HVID) and U. S. Bureau of Reclamation. The HVID would then deliver the 2000 acre-feet of water to the Prickly Pear Water Users (PPWU) ditch system (irrigated lands), thus allowing the PPWU to cease diversion on the creek system, allowing their surface water rights to remain in-stream to fully restore flows to Prickly Pear Creek. The WQPD has assumed administration of this ongoing project with a goal to continue to replicate this flow agreement to ensure flow restoration continues on Prickly Pear Creek. Numerous agency and corporate funding (*e.g.* DEQ 319 and Coca Cola) have allowed this project to continue and set a standard of how the over-allocation of water rights in this watershed leading to chronically dewatered streams can be addressed and overcome.

There are many individuals and entities actively working in restoration of the streams of the Lake Helena watershed alone and in cooperation with each other. Landowners are a critical component in addressing non-point pollution and their cooperation in the voluntary efforts to address the changes to ensure clean water in the watershed is crucial.

1.6 OVERVIEW OF THE CONTENTS OF THE LAKE HELENA WATERSHED RESTORATION PLAN (LHWRP)

The following watershed plan for the Lake Helena area will cover the nine elements required for a DEQ accepted WRP.

1.6.1 NINE ELEMENTS OF A WATERSHED-BASED RESTORATION PLAN

Watershed restoration planning and implementation is a dynamic process. Although many different components may be included in a watershed plan, EPA has identified nine key elements that are critical for achieving improvements in water quality. In brief, these elements are:

1. Identify and quantify causes and sources of the impairment(s). (Section 3 and Appendix B)

2. Estimate expected load reductions (Section 6. Section 3 and Appendix B contain further information on existing loads and allocations.)

3. Identify best management practices (BMPs) needed to achieve load reductions and critical areas where BMPs will be implemented. (Section 7 and Appendix C)

4. Estimate needed technical & financial resources. (Section 9)

5. Provide an information, education, and public participation component. (Section 8 and Appendix D)

6. A schedule for implementing nonpoint source management measures. (Sections 4 and 5)

7. Identify and describe interim measurable milestones for implementation. (Section 5)

8. Establish criteria to determine if load reductions/ targets are being achieved. (Section 10 – monitoring criteria)

9. Provide a monitoring component to evaluate effectiveness of the implementation over time for criteria in number 8. (Section 10)

In this WRP, local partners have addressed these elements and developed a strategy for project implementation in the next seven years.

1.6.2: GUIDE FOR LANDOWNERS AND WATER USERS

For those interested in projects related to sediment reduction or the Lower Prickly Pear Creek or Lower Tenmile Creek, Sections 4, 5, and 6 provide details on the importance of those priorities, identified projects and expected benefits.

Landowners and water users interested in a more detailed understanding of a particular stream or stream reach can refer to Appendix B for detailed information about a particular stream and recommended restoration strategies and best management practices.

Section 7 provides an overview of BMPs that have been identified as useful in addressing the priority areas. Appendix C provides more detail and further resources for each of the listed BMPs.

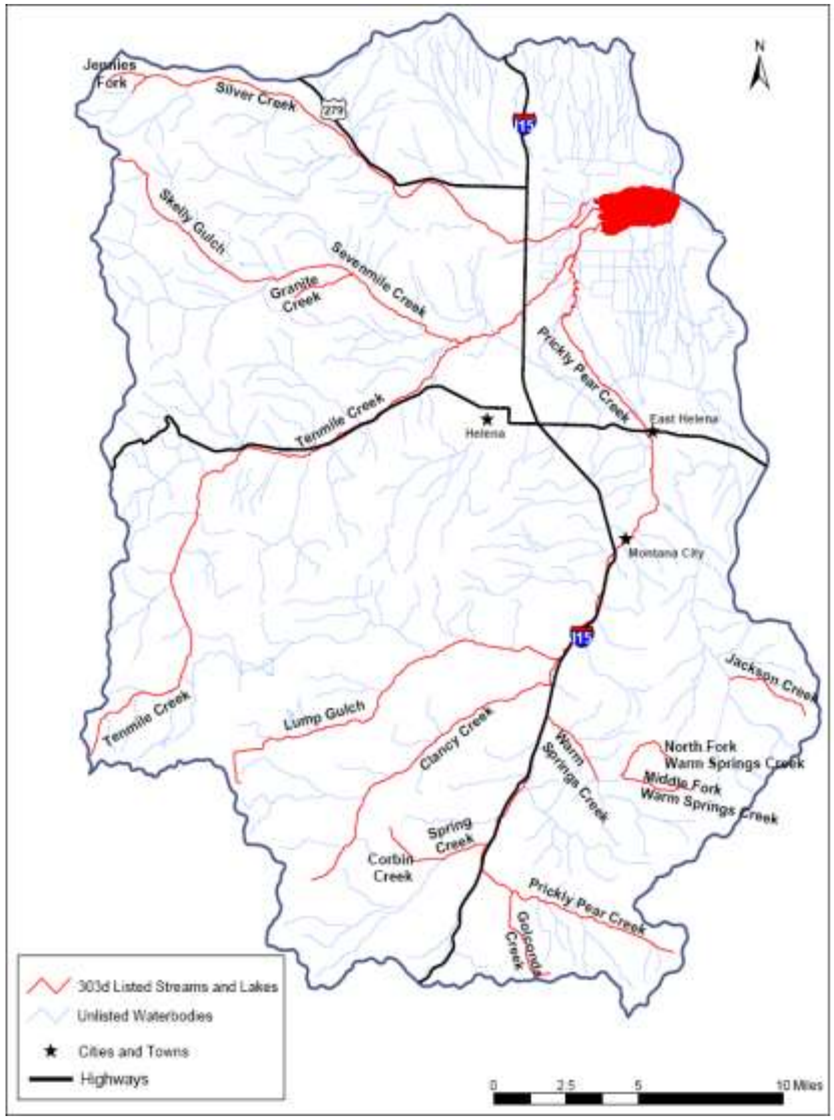
2.0 CHARACTERIZATION OF THE LAKE HELENA WATERSHED

2.1 LEWIS & CLARK AND JEFFERSON COUNTIES

2.1.1 PHYSICAL ATTRIBUTES

The Lake Helena watershed is located in Lewis and Clark and Jefferson counties, within the Upper Missouri River Water Basin. Thirty-two percent of the watershed lies in Jefferson County and sixty-eight percent is within the boundaries of Lewis and Clark County. The watershed encompasses 402,000 acres (~620 square miles) and includes the Silver, Tenmile, and Prickly Pear Creek subwatersheds (all perennial streams and USGS 5th field hydrologic units) and Lake Helena (Figure 2-1). The headwaters of these streams lie within the mountainous, forested lands of the Helena National Forest, along the Continental Divide to the west and the Elkhorn Mountains to the south. The streams flow east and north into and through the Helena Valley to Lake Helena and the Missouri River. Lake Helena was formed when the extensive wetland area formed by the convergence of Silver, Tenmile and Prickly Pear Creeks was flooded as a result of the Upper Missouri River dam construction, in particular Hauser Dam. This permanent flooding created the approximately 1600-acre Lake Helena.

Figure 2-1. Lake Helena Watershed

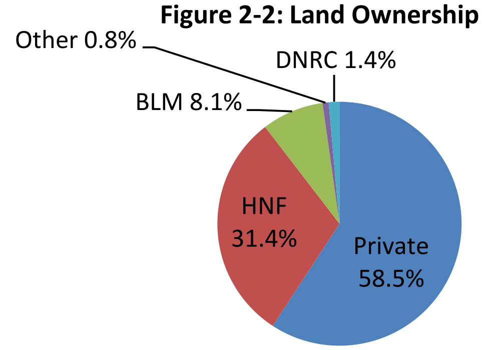


Watershed elevations range from 9,381 feet on Elkhorn Peak to 3,550 feet at Lake Helena. Average annual precipitation ranges from 30 inches along the Continental Divide to 10 inches in the lower parts of the valley. Soils range from sand and gravels to loam to silty clay loam and are subject to erosion when vegetation is removed. The stream channels and stream banks are generally composed of sand, gravel and cobbles. As these streams leave the steeper mountain valleys and enter into the alluvium-filled Helena Valley, finer grain sediments are deposited as stream gradients are reduced, and alluvial fans are formed in some locations.

2.1.2 POPULATION CHARACTERISTICS

The population of the watershed is estimated to be 55,000 people. The area termed the Helena Valley and the area along the I-15 corridor have population densities ranging from 100 to over 5,000 persons per square mile.

Figure 2-2: Land Ownership



The Helena Valley is the primary population center and economic hub for Lewis and Clark County and northern Jefferson County. The Helena Valley continues to encompass the largest percentage of the Lewis and Clark County's population and growth (Lewis and Clark County Growth Policy Plan, 2004). According to the forecast, the population of the greater Helena Valley will increase to approximately 70,000 by 2020 (Lewis & Clark Growth Policy, 2004). Northern Jefferson County has grown at rates similar to the Helena Valley and this trend is predicted to continue due to the close proximity (6 miles) to the City of Helena and Helena Valley businesses.

2.1.3 LAND AND WATER USE

Montana's capital city, Helena, is the center of the watershed. Helena was founded in 1864 upon the discovery of significant placer gold deposits in Last Chance Gulch. This alluvial deposit emanated from a canyon later found to contain hardrock gold and silver veins. Helena became a railroad town in 1883. Its founders established significant banking, financing and supply institutions that supported vast areas of the region. Early on in its development, the area supported industrial operations – smelters, lime production facilities, foundries, lumber yards and many light manufacturing businesses that were linked to mining and agricultural production. Mining occurred in all of the tributaries of the Lake Helena watershed. Roads to access the mine sites were constructed along streams and many of these roads are still in existence today.

Land use historically changed and continues to change, both geographically and over time, from mining and logging to areas of irrigated agriculture (hay, alfalfa, and other grasses), livestock grazing, industrial use, and residential and commercial development in the cities of Helena and East Helena, the Helena Valley and northern Jefferson County. Extensive and continuing mining of metals has occurred in the planning area since the 1860's, with many inactive or abandoned mine sites remaining. Dredge and placer mining in the watershed resulted in disruption of natural stream systems. Storm water runoff from Helena and East Helena streets and lawns flows into Tenmile and Prickly Pear Creeks. Wastewater effluent from the Helena and East Helena treatment plants is released under permit into Prickly Pear Creek. Segments of all the main stem creeks have been channelized in the upper and lower reaches, with channelization in the lower reaches causing adverse impacts to riparian vegetation within the Helena Valley.

2.2 WATER RESOURCES

2.2.1 WATER SUPPLY AND USE

Water rights in the Upper Missouri River basin are closed to new appropriation due to over-allocation. Municipal and agricultural water diversions have led to dewatered conditions in Tenmile and Prickly Pear creeks. Seventy percent of the City of Helena's water supply is taken from the Upper Tenmile Creek watershed. The remaining thirty percent of Helena's water supply is diverted from Canyon Ferry Reservoir on the Missouri River during irrigation season. The City of East Helena withdraws a portion of its municipal water from an infiltration gallery on McClellan Creek in the Prickly Pear watershed. This source is supplemented by groundwater wells located within the Helena Valley aquifer. Tenmile, Silver, and Prickly Pear Creeks, and the HVID canal system all provide recharge to the Helena Valley aquifer, the only source of drinking water for approximately 25,000 residents in the Valley.

2.2.2 WETLANDS, RIPARIAN AREAS, AND FLOODPLAINS

The Lake Helena portion of the Helena Valley originally consisted of a wetland complex that ranged in size from 3,600 to 7,800 acres (The Wetlands Community Partnership, 2001). With the flooding of the lower Prickly Pear Creek in 1912 by Hauser Dam those wetlands were inundated. Fringe wetlands can now be found around the west and south of Lake Helena, but not of the size of the original complex.

A large wetland complex was mapped in the late 1800s along Tenmile Creek, in what is now part of the City of Helena. Filling of these wetlands created the Lewis & Clark Fairgrounds, Custer Avenue, and part of the Green Meadow Country Club Golf Course. Remnants of this complex can be found in the Custer Avenue wetlands, the Van Hook Wetlands, and fringes to the fairgrounds, Crystal Springs Creek, and the golf course.

Many wetlands were filled in, drained, or significantly altered by agricultural development, development of the City of Helena, and construction of the HVID. Interstate 15 was constructed in the 1950s, altering the normal surface water flow paths across the valley from west to east to Prickly Pear Creek.

A large wetland complex south of East Helena on the former ASARCO smelter site whether constructed or natural is undergoing a dramatic transformation with the site cleanup that is ongoing. Another constructed wetlands adjacent to Prickly Pear Creek called Stansfield Lake is believed to have been constructed in the late 1800s for ice ponds for railroad refrigeration, and has been restored by the current landowner. This area was part of the recent WQPD-led restoration project on that stream reach of Prickly Pear Creek to in part to protect the wetlands from adverse impacts by stream erosion.

Both Lewis & Clark County and the City of Helena have adopted administrative rules for subdivisions that protect wetlands and the area around them to help prevent more losses within the watershed (Lewis & Clark Subdivision Regulation, 2013).

Wetlands and healthy riparian areas can be found adjacent to many watershed streams, particularly in the headwater areas. However, the historic abundance of wetlands has been lost due to mining of the stream areas, hunting and removal of the beaver populations, and the development of grazing and agricultural cropping alongside the streams of the area.

Removal of stream bank woody vegetation has removed much of the natural protections from stream bank erosion in all parts of the watershed. Roads constructed adjacent to streams, channelization of stream reaches, unrestricted grazing of stream banks, and growing crops up to the stream channels have all contributed to the large increase of sediment found in the sediment impaired streams identified by DEQ.

Floodplains with the watershed have been impacted by not allowing the stream channels to migrate and evolve over time as a natural dynamic of the watershed. Tenmile Creek has been kept in the same location since settlement and now has a perched channel above its floodplain. When flooding occurs the floodwaters leave the channel and inundate the central Helena Valley between Tenmile and Silver Creeks. An area primarily developed as residential homes, causing significant property damage and issues with residents. Lewis & Clark County has spent considerable time and money developing a flood mitigation plan for this area of floodplain where development did not plan for the natural floods of Tenmile Creek. Detailed floodplain mapping of both Tenmile and Prickly Pear Creek in the valley was completed in the 1980s, and the Tenmile maps have been updated at least once since 2000. The lowering of the water table in the central Helena Valley for the HVID project has resulted in Prickly Pear Creek incising its channel to a lower water table elevation disconnecting it from its historic floodplain. This change is causing the creek to erode its stream banks to recreate a new floodplain, increasing the stream's current sediment load to Lake Helena.

2.2.3 GROUNDWATER

Groundwater issues in the Helena Valley reflect the mining history of the area for metals, natural conditions for arsenic, selenium and uranium, nutrients from agriculture and wastewater treatment, and chemicals from human sources. Nutrient enrichment of ground water is considered a primary issue. The WQPD has been actively supporting implementation of a septic maintenance program by Lewis & Clark Public Health as a method to help control nutrient releases to ground water from non-point sources.

The Helena Valley aquifer comprises surficial alluvial deposits overlying older Tertiary basin fill materials. The contact between recent deposits and older Tertiary deposits is poorly defined, and both units are considered as part of the Helena Valley Alluvial Aquifer. Ground water in the central part of the valley reflects a vertical, upward gradient with surface flowing wells present in the area. The area near Lake Helena was historically wetlands prior to development of the lake, reflecting a shallow water table in the area. After Lake Helena was established, a series of subsurface drains were installed in the central valley to lower the water table for agricultural use. As a result, the shallow aquifer in the central part of the valley reflects both seasonal recharge from irrigation and water table lowering from drains which generally flow year round. The Helena Valley Aquifer is the source aquifer for numerous Public Water Supplies (PWS) in the valley, as well as individual households using private wells.

Primary recharge to the aquifer system occurs from stream loss along the valley margins, direct infiltration of precipitation, and from flow from the adjacent bedrock aquifer systems. Additional recharge occurs seasonally from the irrigation canal system in the valley, including the main Helena Valley Irrigation Canal which brings water into the valley from outside of the Lake Helena watershed planning area. Streams in the Helena Valley generally lose water to ground water as they enter the valley, and become gaining streams in down-gradient areas near the discharge points into Lake Helena (Swierc, 2013 & Swierc, 2015).

DEQ has provided several 319 groundwater grants to WQPD to look at nutrient loading to groundwater from non-point sources and their contribution to surface water impairments. DEQ 319 groundwater grants to the WQPD:

- Helena Groundwater Project (2009-2010)
- Helena Groundwater Project – Phase II(2010-2012)
- Helena Valley Non-Point Source Assessment Project (2013- 2015)

These studies generated baseline groundwater data on metals and nutrients in the area and looked at how to address non-point pollutant impacts to groundwater and the resulting effect on surface waters. The latest project focused on down-gradient area waters with high frequency sampling to collect data to differentiate between septic system and agriculture impacts to groundwater.

The Montana Bureau of Mines and Geology Water Investigation Program, in cooperation with the WQPD, have conducted groundwater studies of the North Hills and Scratch Gravel Hills area around Helena to characterize the groundwater hydrology. These studies have collected extensive data that has been usefully in analyzing non-point pollution impacts to groundwater and the resulting receiving surface waters of the watershed.

Additional studies characterizing groundwater were conducted by DEQ in 2004-2005 in the Helena Valley. DEQ has sampled for PPCP's (pharmaceutical, personal care products) and microbial indicators of fecal contamination with the onset of increased septic systems in the valley (Miller and Meek, 2005).

3.0 POLLUTANTS, SOURCES, EXISTING POLLUTANT LOADS AND ALLOCATIONS

3.1 POLLUTANTS

The Lake Helena watershed is a geographically large and complex geographic area with three large streams, dozens of lesser streams and tributaries, as well as the large central area of the Helena Valley. Natural and man-made environmental impacts vary across the watershed, depending on natural factors such as climate, vegetation, and geology and the intensity and complexity of both historic and current land use practices.

As summarized in the TMDL documents, the important categories of pollutants that impact the water environment in the watershed are:

- **Sediment**
- **Nutrients**
- **Metals**
- **Temperature**

Each of these four pollutants is caused by factors that have different effects in different parts of the watershed. This overview of the four pollutant types, their sources, and information about loads is derived from the TMDL reports (Final Report, Volume II (EPA 2006) and Metals Addendum (EPA 2013)), and provides a basis for understanding why the stakeholders involved in the development of this WRP set priorities and chose projects. Specific and more detailed discussions of these factors can be found in the TMDL reports and in the scientific literature. Details about specific impaired streams and water bodies can be found in Appendix B.

3.1.1 SEDIMENT

Sediment is the solid material carried in the streams in the watershed. The amount of sediment in a stream depends on two factors: how particles are eroded from the watershed and how particles are carried downstream. It is a very complex process, but the amount of natural deposition and contributions from human activities can be modeled. The 2006 TMDL report completed this determination.

Twelve streams in the Lake Helena watershed do not meet their full potential to support fish and aquatic life. Excessive levels of sediment cover fish spawning and aquatic insect habitat, fill pools, and alter stream channel morphology. (See Figure 3-1) In some streams, human-caused sediment loading also results in unnaturally high levels of turbidity (Final Report, Volume II (EPA 2006)).

Stream segments identified as impaired because of excess sediment sources are:

- **Clancy Creek** – headwaters to the mouth
- **Corbin Creek** – headwaters to the mouth
- **Jennies Fork** – headwaters to the mouth
- **Lump Gulch** – headwaters to the mouth
- **Middle Fork Warm Springs Creek** – headwaters to the mouth
- **North Fork Warm Springs Creek** – headwaters to the mouth
- **Warm Springs Creek** – Middle Fork to the mouth

- **Prickly Pear Creek** – headwaters to Lake Helena
- **Sevenmile Creek** – headwaters to the mouth
- **Skelly Gulch** – headwaters to the mouth
- **Spring Creek** – Corbin Creek to the mouth
- **Tenmile Creek** – headwaters to mouth

Figure 3-1-Streams Impaired by Sediment in the Lake Helena Watershed

(Final Report, Volume II, EPA 2006)

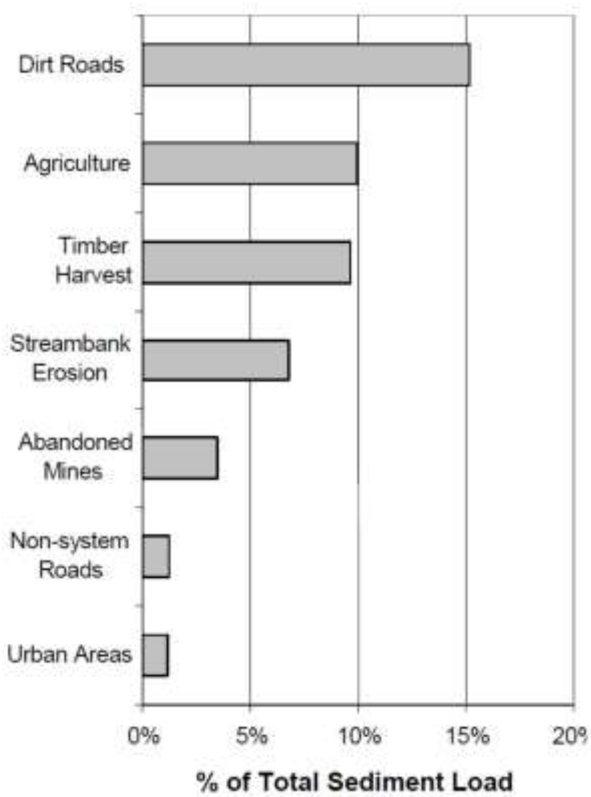
Sediment Sources

On average, sediment loading in the Lake Helena watershed is estimated to be approximately 47% above the naturally occurring level.

Figure 3-2 shows the sources of sediment in the Lake Helena watershed.

Figure 3-2:-Sources of Sediment in the Lake Helena Watershed

(Final Report, Volume II (EPA 2006))



The relative importance of these individual source categories varies dramatically from stream to stream. Unpaved roads, timber harvest, and abandoned mining are important sources of sediment in the headwaters of the watershed. Agricultural sediment loading increases in importance in the downstream areas of the watershed. Human-caused stream bank erosion is an important source of sediment throughout the watershed.

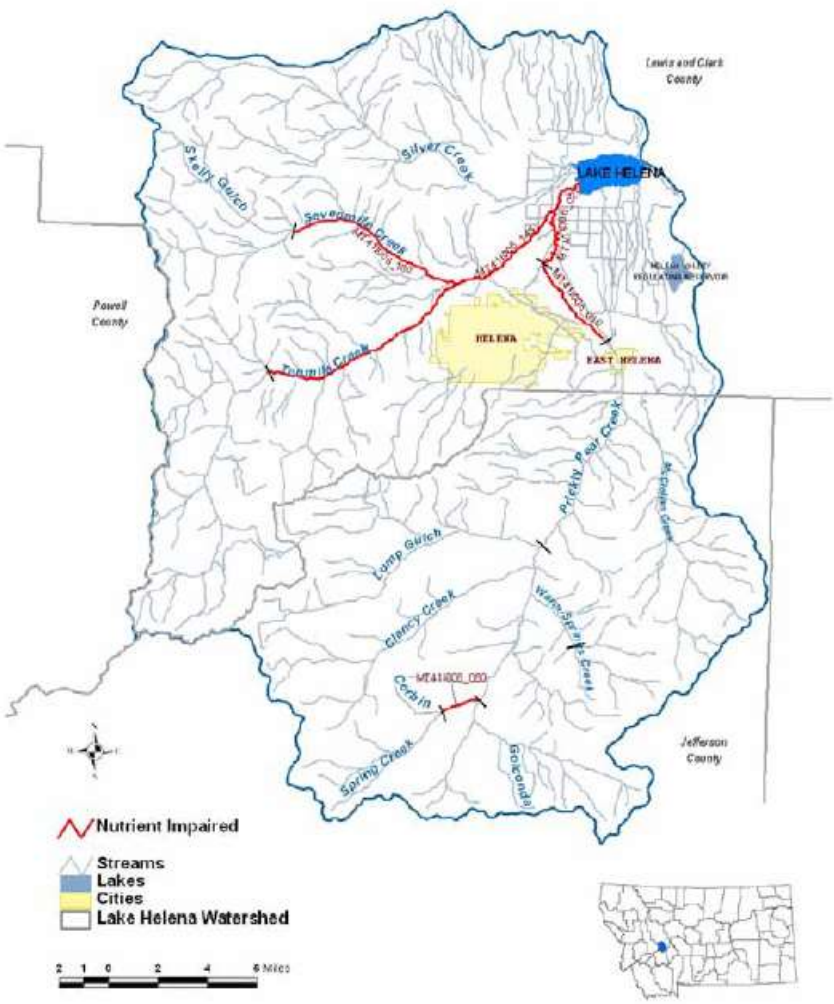
3.1.2 NUTRIENTS

The nutrients that are tracked and considered in excess are nitrogen and phosphorus, chemical elements and compounds that promote the growth of plants and algae in streams and lakes. Large amounts of nutrients in streams promote the growth of algae that uses the available dissolved oxygen in the stream during the night, depleting the oxygen available for other organisms such as fish. The amount of nutrients in streams and lakes is based on chemical interactions between atmosphere, water, sediments, and aquatic biology. The amount of stream nutrients also depends on the amount of nutrients entering the stream from adjacent land uses, which may vary seasonally.

In the Lake Helena watershed, five waterbodies have been identified as having enough excess nitrogen or phosphorus to the extent that beneficial uses have become impaired. These are:

- **Prickly Pear Creek** – Lump Gulch to mouth
- **Sevenmile Creek**
- **Spring Creek** – below Corbin Creek
- **Tenmile Creek**
- **Lake Helena**

Figure 3-3: Waterbodies with Nutrient Impairments



Nutrient Sources

Nutrient concentrations depend on the watershed land uses, soils, and wastewater discharges. In the Lake Helena watershed, which is fairly developed, the amount of nutrients generated from human activities (fertilizer runoff, septic systems, wastewater discharge, agriculture, storm water runoff, etc.) is much greater than from natural sources. In the Lake Helena watershed, anthropogenic sources of nutrients include both point sources such as sewage treatment plants and community wastewater systems as well as non-point sources such as fertilized lawns, septic systems, and crops and grazing. Groundwater with high nitrogen concentrations from septic systems and fertilizers has been shown to contribute to in-stream water quality impairments in the watershed.

3.1.3 METALS

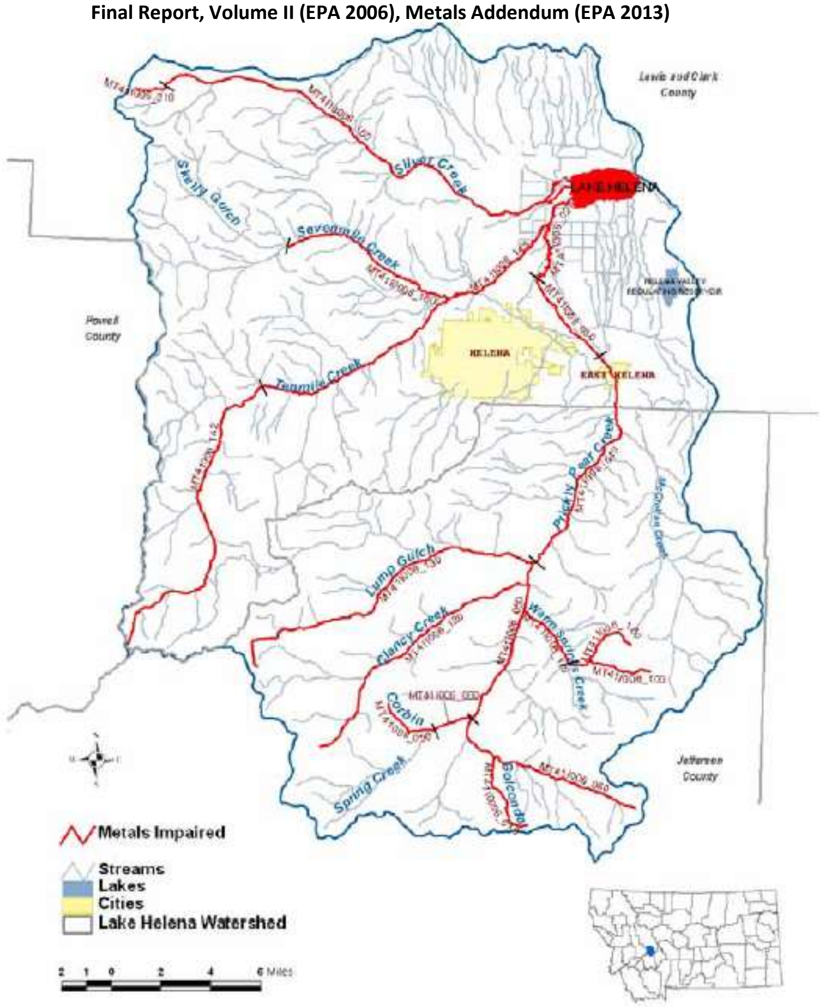
In excessive concentrations, metals such as arsenic, cadmium, copper, lead, and zinc are dangerous to public health if the stream is used as a source of drinking water or as recreational area. Metals are often toxic to fish and other aquatic biota at much lower concentrations than those that are to humans. Once in the stream, metal ions can be dissolved into stream water or be attached (adsorbed) to sediment particles.

Sixteen waterbodies have been identified as impaired because of elevated levels of arsenic, cadmium, copper, lead, and/or zinc.

- **Corbin Creek**
- **Clancy Creek**
- **Golconda Creek**
- **Jennies Fork**
- **Granite Creek**
- **Jackson Creek**
- **Middle Fork Warm Springs Creek**
- **North Fork Warm Springs Creek**
- **Warm Springs Creek**
- **Lump Gulch**
- **Prickly Pear Creek**
- **Tenmile Creek**
- **Sevenmile Creek**
- **Silver Creek**
- **Spring Creek**
- **Lake Helena**

Figure 3-4: Waterbodies with Metals Impairments

Final Report, Volume II (EPA 2006), Metals Addendum (EPA 2013)



Several waterbodies that are listed as impaired due to excess metals are located downstream of the mining activities that are the source of the metals impairment. Direct management of distant upstream sources may lead to significant downstream water quality improvement.

Metals Sources

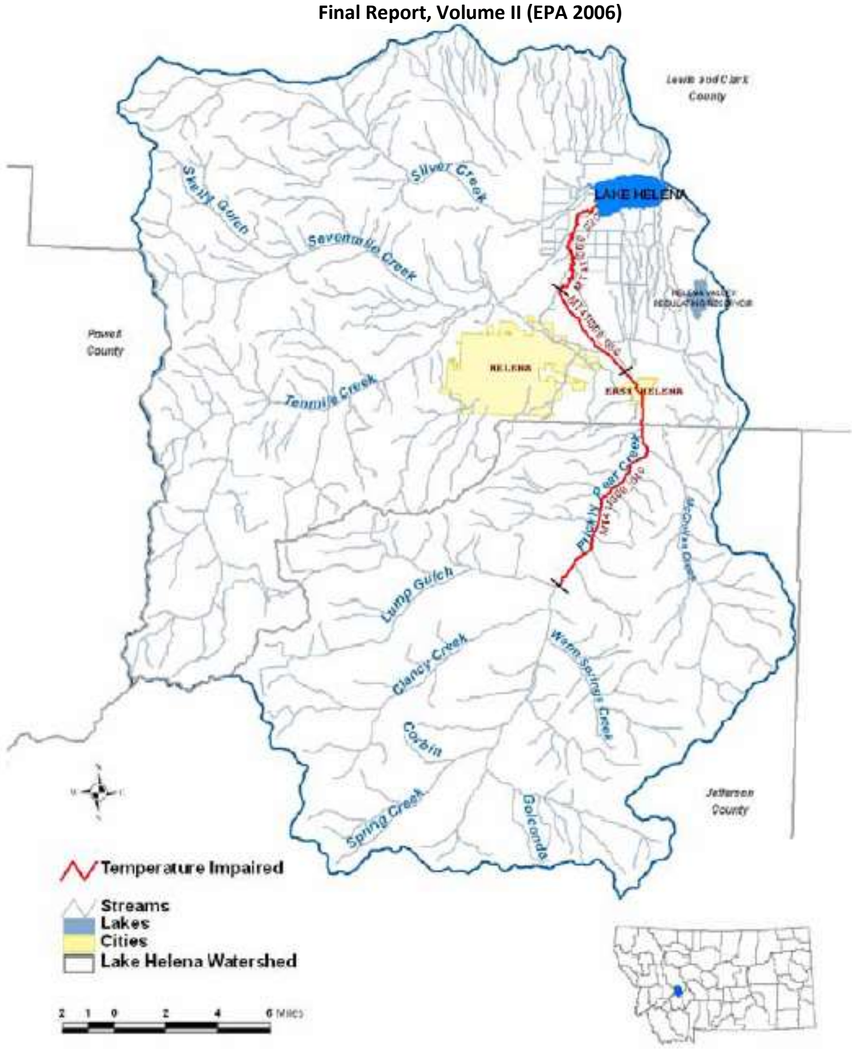
Metal concentrations can occur naturally as sediment is eroded from metal-containing rocks and transported into streams. The high concentration of metals in some streams in the Lake Helena watershed is most likely caused by the large number of historic mining sites in the watershed. Exposed ore, waste rock, and mine tailings with high metals content all weather, releasing metals into streams. Metal contamination in streams is largely determined by the historic mining in the watershed which was in turn controlled by geology. In the watershed, historic mining has been "hard rock" mining for metallic ores in igneous rocks located mostly south and west of Helena.

3.1.4 WATER TEMPERATURE

Water temperature controls the type and amount of biological organisms in a stream from microorganisms to larger organisms such as fish. All organisms have an optimum temperature range for survival. Temperature also indirectly affects organism survival because rates of both inorganic and organic processes are usually temperature dependent. With increasing temperature, the number of microorganisms such as bacteria and algae increase, causing greater consumption of dissolved oxygen, leading to decline of many of the native coldwater fish species (e.g. trout).

Figure 3-5: Waterbodies with Temperature Impairments

Final Report, Volume II (EPA 2006)



Stream temperatures can be affected by the amount of heat the stream absorbs from the atmosphere. Water must absorb a significant amount of heat energy in order to cause small increases in temperature. Near a stream, the air, land, and vegetation all have lower heat capacities than the water. Changes in stream temperatures tend to lag behind air temperatures as seasons change; even in late summer, stream water is much cooler than the air temperature. Stream temperature can reach critically high levels in summer (generally July through September). The lower seasonal water flow and lower water velocities in summer cause less water to pass through a stream reach, increasing the temperature in the remaining water.

In the Lake Helena watershed, Prickly Pear Creek downstream from Lump Gulch has been identified as having temperature impairment. Corbin Creek also are suspected of having temperature impairments, but no TMDL was recommended.

Water Temperature Sources

In addition to natural changes in water temperature, several human caused changes can affect water temperature. Upstream diversions for agriculture (livestock or crops), upstream direct intake of water from the stream for industrial or drinking water, or upstream pumping from high yield wells, causes water to be drawn out of the stream. This can affect temperature, especially during low flows in the hottest months of the year. The amount of shading along and over a stream reach also affects the temperature; lower temperatures are associated with fewer hours of direct exposure to sunlight. Land use that results in the removal of trees and tall shrubs from the stream banks increases stream temperatures. Stream temperature impairments are generally found lower in the watershed where the cumulative impact of water diversion and use is most pronounced.

3.2 POLLUTANT LOADS AND ALLOCATION TARGETS

A stream, lake or section of stream is considered impaired when input of a pollutant creates an environment where beneficial uses such as aquatic life are not fully supported. Watershed restoration is aimed at returning to conditions that support all designated beneficial uses by implementing projects that reduce excess pollutants. This is known as “load reduction.” The WRP will focus on anthropogenic sources such as streambank erosion, agriculture, and unpaved roads.

The two Framework TMDL documents (DEQ 2006 and 2013) characterized existing loads of pollutants in impaired streams and developed pollutant load reduction targets. The same studies established that some streams and stream reaches and other bodies of water would not be likely to return to reference conditions. In those cases, a feasible reduction of a given pollutant was established. In the next seven years, there are three priorities for the WRP:

- Address sediment impairments throughout the watershed.
- Plan and complete projects in the Lower Prickly Pear Creek watershed.
- Plan and complete projects in the Lower Tenmile Creek watershed.

Sediment loads and the load allocations for all streams in the watershed are listed in Table 3-1. Sediment, metals, nutrients, and temperature loads and load allocations for Prickly Pear Creek and Tenmile Creek are shown in Tables 3-2 and 3-3. Appendix B has a detailed description of the streams, pollutants, and management practices and strategies to address each area. These are of use to landowners interested in addressing concerns in areas through-out the watershed and also serve as a basis for future restoration work.

In all cases, more than one source contributes to the pollutant load. Pollutant loads can be reduced by focusing on areas and sources that offer significant opportunities with willing landowners and managers and by focusing on effective best management practices.

However, the Lake Helena watershed has over 150 years of significant impacts to its water resources through changing patterns of land use, starting with the first gold strikes in 1864 and the resulting settlement. (See Section 2 for more detail on watershed characteristics and land use.)

Section 5 has more information on priorities. Section 6 outlines pollutant load reductions thought possible with the first set of priority projects. Appendix B has more information about streams and pollutants throughout the Lake Helena watershed.

Table 3-1: Sediment Loads and Load Allocations in the Lake Helena Watershed

Pollutant	Current Anthropogenic Load (tons/year)	Percent reduction (%)	Load Allocation Goal (tons/year)	Reduction needed (tons/year)
Sediment -Watershed				
Clancy Creek – headwaters to the mouth	2,077	81	404	1,673
Corbin Creek – headwaters to the mouth	144	77	37	107
Jennies Fork – headwaters to the mouth	169	67	57	112
Lump Gulch – headwaters to the mouth	1,855	81	380	1,475
Warm Springs Creek – North Fork, Middle Fork, Middle Fork to the mouth	635	76	176	459
Sevenmile Creek – headwaters to the mouth	1,825	83	348	1,477
Prickly Pear Creek – headwaters to Lake Helena	20,708	73	5,652	15,056
Skelly Gulch – headwaters to the mouth	416	76	106	310
Spring Creek – Corbin Creek to the mouth	1,053	78	235	818
Tenmile Creek – headwaters to mouth	6,377	74	1,649	4,728

Final Report, Volume II (EPA 2006)

Table 3-2: Loads and Load Allocations for Prickly Pear Creek

Pollutant	Load (tons/yr.)	Percent Reduction (%)	Allocation (Tons/yr.)	Reduction needed (tons/yr)
Sediment	20,708	73	5,652	15,056
Metals	**(lbs./yr)**		**(lbs. /yr.)**	**(lbs. /yr.)**
Arsenic	7,771	70	2,338	5,433
Cadmium	558	86	77	481
Lead	5,545	82	999	4546
Zinc	211,211	83	35,909	175,297
Copper	10,644	77	2412	8232
Nutrients	**(Tons/yr.)**		**(Tons/yr.)**	**(Tons/yr.)**
Nitrogen	95.5	40	57.0	38.5
Phosphorus	11.0	78	2.4	8.6
Temperature	**Thermal Load (+ degrees F)**	**Percent Reduction (%)**	**Allocation (+ degrees F)**	
Lump Gulch to Wylie Drive	2.7	81	0.5	
Wylie Drive to mouth	Thermal allocation found; no formal thermal load determined or allocation set.			
Final Report, Volume II (EPA 2006)				

Table 3-3: Loads and Load Allocations for Tenmile Creek				
Pollutant	**Load (tons/year)**	**Percent reduction (%)**	**Allocation (Tons/yr.)**	**Reduction needed (tons/yr.)**
Sediment –HW to mouth	6,377	74	1,649	4,728
Metals	**(lbs. /yr.)**		**(lbs. /yr.)**	**(lbs. /yr.)**
Arsenic	5,040.5	72	1,386.3	3,654.2
Cadmium	313.8	88	38	275.8
Copper	6,015.5	83	1,000.2	5015.3
Lead	3,070.9	88	366.6	2,704.3
Zinc	67,655.6	78	14,515.7	53,139.9
Nutrients	**(lbs. /yr.)**		**(lbs. /yr.)**	**(lbs. /yr.)**
Nitrogen (tons/yr.)	39.66	33	27.18	12.48
Phosphorus (tons/yr.)	3.71	73	.99	2.72
Final Report, Volume II (EPA 2006)				

4.0 LAKE HELENA WATERSHED RESTORATION PRIORITIES

Community based watershed restoration engages stakeholders throughout the watershed to determine the highest priorities for action to reduce pollutants and return rivers, lakes and streams to more fully support the designated beneficial uses. (For more about the community engagement process, please see Section 8.)

Working together, criteria for prioritization were developed. For this first seven-year WRP, the criteria established are:

- Areas with significant landowner interest
- Places or type of projects likely to result in pollutant load reductions
- Approaches that relied on best management practices that built on existing technical skills
- Project types that were low enough in cost to be feasibly funded in the next seven years

Using these criteria, stakeholders identified three key priorities:

- Projects aimed at reducing sediment loads throughout the Lake Helena watershed
- Lower Tenmile Creek, below the water treatment plant
- Prickly Pear Creek, from Lump Gulch to the mouth

Choosing these priority areas does not preclude interest or other projects that address water quality in the Lake Helena watershed. Partners in this watershed have and continue to work on projects that address metals and nutrients as well as these priorities in the watershed.

This watershed restoration employs a holistic approach. Many stakeholders contributed input in the development of these priorities. Major stakeholders include private landowners, the Helena Forest Service, Bureau of Land Management, Department of Environmental Quality, Montana Fish, Wildlife and Parks, DNRC State Lands, city government officials, city and county experts on stormwater, drinking water and wastewater, and private business interests including agricultural, timber, energy, and development interests.

The selected priorities are those that the WQPD and LHWG will work to accomplish. Individual landowners, land managers and private business may decide to work on additional opportunities for restoration. Appendix B has more detail on streams, Lake Helena and water quality problems and restoration opportunities throughout the watershed.

4.1 SEDIMENT REDUCTION

Twelve streams or segments of streams have been identified as impaired due to excess sediment. It is the most widespread pollutant and affects turbidity, aquatic life and fish spawning. (See Section 3 for further information on sources and impacts of the sediment.)

The WQPD and the LHWG have identified projects that reduce sediment as priorities for this WRP. Sediment was chosen as a priority for this WRP because:

- Excess sediment is a significant cause of impairment in the Lake Helena watershed. Most of the impaired streams in the Lake Helena watershed are polluted by sediment resulting from erosion associated with a variety of land uses.

- Management practices that result in reduced sediment loads have the potential to also reduce nutrient and metal pollutant levels.
- Establishment of healthy riparian buffers to reduce sediment loads can also lower water temperature to provide better habitat for fish.
- The WQPD and the LHWG have experience with implementing projects that control erosion and sedimentation.

4.1.1 SEDIMENT RESTORATION GOALS

The WQPD and the LHWG have established the following goals for improving watershed health and water quality in streams impaired by sediment in the Lake Helena watershed:

- Improve fish, aquatic, and wildlife habitat
- Reduce nutrients and metals in association with sediment reduction projects

Sediment reduction projects that will also address these two goals are high priority for this watershed.

4.1.2 WATERSHED RESTORATION STRATEGIES

The LHWG and the WQPD have identified the following priority management measures to reduce loads of sediment and associated pollutant:

- Bioengineered Streambank Stabilization
- Filter Strip
- Forestry BMPs
- Rewatering and Maintaining In-Stream Water Flow
- Off-Stream Watering Facility
- Riparian Buffer
- Riparian Fencing
- Road BMPs
- Storm Water BMPs
- Water Gap

These management measures are described in more detail in Section 7 and in Appendix C.

More detailed information about the amount of sediment load by source and location of sites that contribute sediment loads on specific stream reaches can be found in the characterization document Watershed Characterization, Volume I (EPA 2004), Final Report, Volume II (EPA 2006), Section 3 and Appendix B. More on BMPs is in Appendix C.

4.2 LOWER TENMILE CREEK

Lower Tenmile Creek was chosen as one of two high priority geographic areas for concentrated watershed restoration efforts. This priority area covers the stream from the water treatment plant to its mouth. The upstream pollution sources are being addressed by other partners such as US Forest Service and Environmental Protection Agency (EPA) primarily treating abandoned mines and other pollutant sources.

Aquatic life and drinking water are important uses of water that are not fully supported in the segment of Tenmile Creek that begins at the Helena Drinking Water Treatment Plant and goes to the mouth of the creek. (DEQ CWAIC 2014)

The DEQ and the EPA have identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These include:

- **Sedimentation/Siltation**
- **Metals:** arsenic, cadmium, copper, lead, and zinc
- **Nutrients:** total nitrogen, total phosphorus, and nutrient/eutrophication biological indicators

In addition, significant habitat and environmental alterations have been identified that affect the use of Lower Tenmile Creek:

- Low flow alterations
- Alteration in streamside vegetative covers

The primary human-caused sources of impairment identified in Final Report, Volume II (EPA 2006) are:

- Sediment, primarily from agricultural activities, with smaller contributions from unpaved roads, riparian grazing practices, road encroachment, stream channelization, riparian vegetation removal, and historic mining activity. Development activities are associated with several sources
- Metals, primarily from abandoned mines that are upstream of this stream segment
- Nutrients, from septic systems, urban areas, agriculture, unpaved roads, streambank erosion, timber harvest, and paved roads

In addition to these pollutant sources, dewatering between McHugh Lane and a downstream point between I-15 and the Sierra Road crossing has affected the quality of the aquatic habitat. (Watershed Characterization, Volume I, EPA 2004). Dewatering is a result of withdrawal for municipal use upstream, diversions for irrigation in this reach, and natural losses to aquifer recharge.

4.2.1 LOWER TENMILE WATERSHED RESTORATION GOALS AND STRATEGY

The WQPD and the LHWG have the following goals for improving water quality and watershed health in the Lower Tenmile Creek watershed:

- Seek opportunities to ensure that water continues to flow throughout this reach of Tenmile Creek
- Improve fish and wildlife habitat
- Reduce sediment, nutrients, and associated metals
- Improve water quality to achieve state water quality standards

Watershed Restoration Strategies

The reach between the Helena Drinking Water Treatment Plant and Montana Avenue provides the greatest opportunity to engage landowners in implementing management measures that will reduce sediment, nutrients, and associated metals. Priority management measures for Lower Tenmile Creek for the LHWG and the WQPD for 2016-2023 include:

- Identify and pursue additional opportunities to improve instream flows and fish spawning by eliminating or moving diversions when necessary to maintain stream flows or provide for fish passage.
- Seek willing landowners to put in place and maintain riparian buffers and filter strips.
- Encourage use of water gaps, off-stream watering, and riparian fencing to control livestock access to the stream.
- Implement bioengineered stream bank stabilization treatments and stream channel restoration projects.

More information about best management practices can be found in Section 7 and Appendix C. Landowners in this area can use this information as a resource for implementation of management measures on their property.

Several priority projects for this area have been identified for implementation in the next seven years and can be found in Section 5. A discussion of expected pollutant load reductions can be found in Section 6.

In seven years, it is expected that the Lower Tenmile Creek will be moving toward the goal of supporting all designated beneficial uses. These implemented changes should begin to result in improved fish, aquatic, and wildlife habitat.

Lower Tenmile Creek Priority Area

Figure 4-1

4.3 LOWER PRICKLY PEAR CREEK

The Lower Prickly Pear Creek was chosen as one of two priority areas for targeted watershed restoration. This priority area covers Prickly Pear Creek from Lump Gulch to the mouth of the creek. The upstream pollution sources are being addressed by other partners such as the Helena National Forest and the Lewis and Clark and Jefferson Counties and others treating abandoned mines and other pollutant sources.

Agriculture, aquatic life, drinking water, and recreation are all important uses of water that are not fully supported in some segments of Prickly Pear Creek from Lump Gulch to Lake Helena. (DEQ CWAIC 2014)

The DEQ and the EPA have identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These are:

- **Sedimentation/Siltation**
- **Temperature**
- **Metals:** arsenic, cadmium, copper, lead, and zinc
- **Nutrients:** total nitrogen, total phosphorus, nitrate/nitrite

Lower Prickly Pear Creek Priority Area

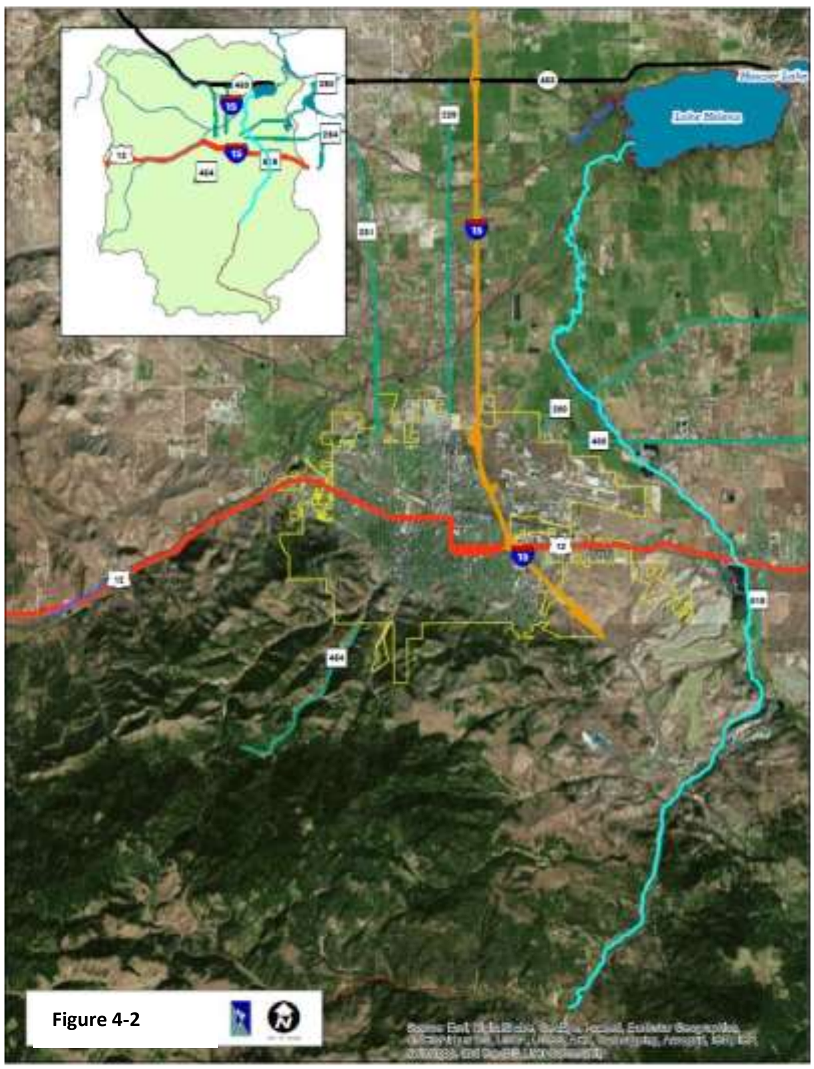


Figure 4-2

Sediment, elevated water temperature, and metals are too high in the entire reach. Excess nutrients were found from Wylie Drive to Lake Helena.

In addition to the TMDL listed impairments, several other factors that can negatively impact beneficial uses were identified. These include:

- Low water flows
- Channelization
- Alteration of streamside vegetative cover
- Alteration to the material at the substrate (bottom of the stream)

Sources for these pollutants and alterations have been identified (Appendix A to Final Report, Final Report (EPA 2006)) Primary sources of impairment in this area are summarized below.

- Metals, from upstream and adjacent historical slag piles and permitted discharges from the ASARCO East Helena Lead Smelter

- Nutrients, primarily from permitted wastewater treatment plant discharges, septic systems, increased concentrations due to dewatering, and some grazing and septic systems. Sediment, primarily from agricultural sources, followed by contributions from unpaved roads, run-off in high road density areas, stream bank erosion resulting from a range of current and historic activities, timber harvest and mining activity
- Elevated temperatures from flow alterations, riparian degradation, stream channelization, and possible inputs from point sources

4.3.1 LOWER PRICKLY PEAR WATERSHED RESTORATION GOALS AND STRATEGY

The WQPD and the LHWG have the following goals for improving water quality and watershed health in the Lower Prickly Pear Creek watershed:

- Ensure that water continues to flow throughout this reach of Prickly Pear Creek.
- Cool high water temperatures in Prickly Pear Creek.
- Improve fish and wildlife habitat.
- Reduce sediment, nutrients, and metals.
- Improve water quality to towards meeting state water quality standards.

More information about best management practices can be found in Section 6 and Appendix C. Landowners in this area can use this information as a resource for implementation of management measures on their property.

Several priority projects for this area have been identified for implementation in the next seven years and can be found in Section 5. A discussion of expected pollutant loads can be found in Section 6.

In seven years, it is expected that the Lower Prickly Pear Creek area will be moving toward the goal of supporting all designated beneficial uses. Pollutant loads, particularly for sediment and nutrients, will begin to be reduced, and more water will flow in the dewatered section. These implemented changes should result in improved fish, aquatic, and wildlife habitat.

5.0 PRIORITY PROJECTS AND MILESTONES

5.1 HOLISTIC APPROACH TO WATER QUALITY IMPROVEMENT

Water quality concerns predate the 2006 TMDL and this watershed restoration plan. Partners have been working in the watershed for many years. Section 1.5 has a summary of those activities. However, this does not preclude further work on other identified pollutants and areas within the watershed.

5.2 PRIORITY PROJECTS AND MILESTONES IN THE LAKE HELENA WATERSHED

The WQPD and LHWG have identified several projects that meet the priority criteria. Landowner and land manager interest in projects that have significant potential for reducing the pollutant loads were chosen as the highest priority projects. It is expected that additional projects will be developed as these are implemented.

Table 5-1: Priority Projects and Milestones

Activities in Priority area- Lower Tenmile (TMC) and Prickly Pear Creeks (PPC)	Targeted Reach	Interim Milestones	Cost
1. Identify willing landowners to put in place and maintain riparian buffers and filter strips	1. PPC reach from York to Sierra 2.TMC reach from WTP to North MT	1. Identify 1 landowner every two years. 2. Identify 1 landowner every two years.	Low ($5,000)
2. Develop projects. Encourage use of water gaps, off-stream watering, riparian fencing and other BMP's to reduce erosion on banks	1. PPC reach from York to Sierra 2.TMC reach from WTP to North MT	1. Obtain funding for 1 project every two years. 2. 1.Obtain funding for 1 project every two years.	Medium ($5,000 to $25,000)
3. Implement bank stabilization treatments	1. PPC reach from Lump to Sierra 2. TMC WTP to PPC	1.Implement one stream project/2-3 years 2. Implement one stream project/2-3 years	High ($25,000 to 100,000)
4. Eliminate, move or improve diversions to maintain stream flows provide for fish passage	1. PPC reach from York to Sierra– one diversion 2. TMC WTP to PPC – one diversion	1. One diversion in 5 years 2. One diversion in 5 years	High ($25,000 to 75,000)
5. Reduce nutrient loading by supporting efforts, including WWTP optimization studies, to reduce nutrient loading of wastewater discharged to PPC	PPC Wylie to Sierra	1. Implement recommendations from studies	High ($25,000 to 75,000)
6. Develop funding plan for the operation of the PPC Rewatering project to maintain stream flows	PPC Wylie to Sierra	1. Develop a funding plan for obtaining long-term funding and change water rights	Medium ($20,000/year).
7. Sediment BMP's – riparian fencing, riparian planting, off-stream stock watering and water gaps.	Lake Helena Watershed	1. Obtain funding for 2-3 projects every 2 years depending on funding	Low ($5,000/landowner)

It is expected that these seven activities will be implemented in the next seven years. Section 7 and Appendix C offer additional information on BMPs that will be useful during the implementation phase. Appendix B offers stream by stream information on watershed restoration strategies that can be employed to meet current WRP priorities, and will serve as a basis for developing future projects after the priority projects above are implemented. Partners may also identify and implement other projects in the priority areas of Lower Tenmile and Lower Prickly Pear Creek in the next seven years.

6.0 EXPECTED LOAD REDUCTIONS

Exact load reductions will ultimately be the result of the number of effective projects put in place. The load reduction estimates in Table 6-1 are based on calculations that were conducted on recently completed restoration project on Lower Prickly Pear Creek. Reductions will vary according to location in the watershed due to changes in sediment composition and land use.

Monitoring will be an important activity as projects are implemented, in order to verify load reductions in the watershed. Section 10 has more information on monitoring and criteria.

Table 6-1: Expected Load Reductions

Stream Segment in priority reach	Pollutant mostly from anthropogenic sources	Total pollutant load allocations (TMDL)	*Reduction in per restoration project (2400 feet)
Lake Helena watershed –Sediment impaired streams	Sediment	44,554 T./Year	10-14 T/year reduction in sediment per project
Lower Prickly (Lump to Lake Helena)	Nutrients (TN & TP) Temperature	111.7 tons/yr TN & 13.6 tons/yr TP ≤1° F when water temp is <67°F	10-14 lbs reduction in TN 0-1 lbs reduction in TP
Tenmile Creek (WTP to Lake Helena)	Nutrients (TN & TP) Temperature	44.47 Tons/year TN & 4.39 tons/yr TP ≤1° F when water temp is <67°F	10-14 lbs reduction in TN lbs reduction in TP

7.0 BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) are management techniques and strategies designed to address identified pollutant loads. In order to address the priorities in this WRP, many different BMPs will need to be employed.

Table 7-1: Summary of Best Management Practices for Lake Helena Watershed Restoration

Best Management Practice	Pollutants Addressed	Other Benefits	Uses
Bioengineered Stream Bank Stabilization	• Sediment • Temperature • Nitrogen • Phosphorus	• Prevent or minimize loss of land • Prevent or minimize damage to adjacent facilities • Maintain flow capacity in streams or channels • Improve fish and wildlife habitat • Improve recreation • Enhance aesthetics • Enhance riparian vegetation	• Anywhere banks are eroding excessively
Filter Strip	• Sediment • Temperature • Nitrogen • Phosphorus • Metals • Pathogens	• Slow runoff	• Agriculture: Down gradient from crop field, pasture, barnyard or animal confinement area • Can be used in conjunction with grazing management practices • Applications downgradient from some urban/transportation impervious surfaces
Forest Management Practices	• Sediment • Temperature • Phosphorus • Toxic Chemicals	• Slow run-off	• Any timber management area
Off-stream Watering Facility	• Sediment • Temperature • Nitrogen • Phosphorus • Pathogens	• Prevent or minimize flow reduction • Protect riparian vegetation and habitat • Protect in-stream aquatic habitat	• Livestock watering and management • Used in conjunction with riparian fencing
Riparian Buffer	• Sediment • Temperature • Nitrogen • Metals	• Enhancement of fisheries and aquatic life • Filter and reduce pollutants. • Enhance wildlife	• Anywhere adjacent to streams where natural vegetation has been altered or removed

Best Management Practice	Pollutants Addressed	Other Benefits	Uses
Rewatering and Maintaining In-stream Flow	• Sediment • Temperature • Nitrogen • Phosphorus • Metals	• Maintain stream wetted perimeter. • Maintain aquatic life and fish passage. • Promotes riparian vegetation. • Dilutes pollutant concentrations	• Any stream segment that is over allocated for water use; primarily dewatered sections
Riparian Fencing	• Sediment • Temperature • Nitrogen • Phosphorus • Pathogens	• Promote plant species growth and diversity. • Prevent or minimize bank erosion. • Prevent siltation of stream.	• Livestock. Usually used as part of a grazing management plan
Road Management Practices	• Sediment • Temperature • Phosphorus • Metals • Toxic Chemicals	• Reduce or eliminate dust into stream. • Improved access for travelers	• Anywhere roads are built and are adjacent to or cross streams
Septic System Inspection, Operations, and Maintenance	• Nitrogen • Phosphorus • Pathogens • Toxic Chemicals	• Maintain proper operation and maintain water quality. • Avoid costly repairs or replacement • Minimize unpleasant odors • Reduce algal and weed growth in nearby surface water • Maintain safe drinking water supply	• Residential septic systems
Stormwater Management Practices	• Sediment • Temperature • Nitrogen • Phosphorus • Pathogens • Toxic Chemicals	• Retain water and limit runoff • Enhance natural water filtration • Reduce flood severity	• Residential • Commercial • Installation and maintenance of roads and other infrastructure
Water Gap	• Sediment • Temperature • Nitrogen • Phosphorus • Pathogens	• Reduce bank erosion and riparian vegetation removal. • Lessen stream siltation	• Livestock. Usually used as part of a grazing management plan. • Used in conjunction with riparian fencing

More details about these best management practices can be found in Appendix C. The WQPD and the LHWG and their partners have experience implementing these BMPs, so landowners interested in implementing any of these practices can draw on their technical expertise.

8.0 COMMUNITY ENGAGEMENT, EDUCATION AND OUTREACH STRATEGY

8.1 WATERSHED STAKEHOLDERS

Anyone living in the Lake Helena watershed is a stakeholder. They are also the water users and recreationists that value clean water and will restore and protect it. Examples of stakeholders in the Lake Helena watershed include:

- Residents of the Lake Helena watershed, including in Helena, East Helena, Montana City and rural areas
- Upper Tenmile Steering Committee
- Lewis & Clark and Jefferson Counties
- Lewis & Clark and Jefferson Valley Conservation Districts
- Cities of Helena and East Helena

8.1.1 WATER USERS

Water users in the Lake Helena watershed have a stake in maintaining and improving the quality and quantity of the water supply in this area. Primary water uses in the Lake Helena watershed are listed below.

Table 8-1: Water Users

Water Use Types	Water Users and Uses
Agriculture	Livestock watering & irrigation of crops and pasture
Construction	Dust control, runoff
Drinking water (Residential)	Upper Tenmile (City of Helena), portion from McClellan Creek (City of East Helena) , groundwater (valley and upper watershed residents)
Wastewater	City of Helena , East Helena Groundwater septic system and other on-site wastewater system users
Recreation	Recreational use by streams & lakes
Fish and Wildlife	Rivers, streams, and lakes and associated riparian and wetland areas provide important habitat for a variety of mammals, fish, birds, and amphibians.
Forestry	Helena National Forest, Bureau of Land Management, private landowners
Mining	Montana Tunnels, rock and sand quarries

8.2 COMMUNITY ENGAGEMENT IN THE DEVELOPMENT OF THE WRP

The WQPD and the LHWG facilitated public participation in the development of the WRP. An advisory committee reviewed input, guided the identification of priorities and projects, and oversaw formulation of the WRP. Members were:

- Bob Alexander: Lake Helena Watershed Group (LHWG) representative
- David Callery: Helena National Forest (HNF)
- Steve Carpenendo: Department of Environmental Quality (DEQ) Wetlands
- Jeff Erickson: Headwaters Partnership Group
- Mark Fitzwater: City of Helena Wastewater Treatment Supervisor
- Mark Gornick: Jefferson Valley Conservation District
- John Kandelin: Lake Helena Watershed Group (LHWG) representative
- Jennifer McBroom: Water Quality Protection District (WQPD)

- Robert Ray: Department of Environmental Quality (DEQ)
- Frank Rives: Senior Planner, Lewis and Clark Community Development Program
- Mary Vandenbosch: Headwaters Partnership Group
- Jim Wilbur: Water Quality Protection District (WQPD)

Interested parties were engaged through the following information, education, and outreach activities and resources. Public engagement and input occurred from 2012-2014.

- Lewis & Clark County WQPD Watershed Restoration Plan website page created to house documents for plan development
- Fact Sheet located on the WQPD website and also handed out during stakeholder meetings.
- Letter to stakeholders sent out to the LHWG mailing list of over 750 members in November of 2012
- Nineteen stakeholder interviews were conducted
- Four presentations to community organizations
- LHWG public meeting focused on setting watershed priorities on April 18, 2013
- Survey located on the website and handed out at public meeting
- News media coverage

Input from the public meeting and stakeholder interviews, along with comments sent to the watershed group or WQPD was used to identify concerns and come up with ideas for restoration and priority areas.

Further detail about the community engagement can be found in Appendix D.

8.3 EDUCATION AND OUTREACH STRATEGY FOR RESTORATION IMPLEMENTATION

Information and education has always been an important component for the community and the LHWG. Informing and educating watershed members and the public of past and proposed activities is paramount for successful projects. Additionally, public and landowner knowledge of watershed concerns and the best management practices that might resolve the concerns is essential to carrying out a successful water quality improvement program.

Listed below are ways the WQPD and the LHWG will implement educational outreach to the public. Collectively, these activities will ensure that watershed group members, watershed stakeholders and the interested public are aware of water quality issues and restoration progress, provide ways for landowners to find out more about successful restoration efforts, and provide models and information that can help landowners and other stakeholders envision and develop further restoration projects

Table 8-2: Education and Outreach Strategy Components		
Activity	**Purpose**	**Timeline**
Social Media	Informs the public of watershed activities	On-going
Newsletter	Sent to roughly 750 members on the mailing list informing of current activities in the watershed	At least 2x year
Presentations	Informing the public on issues of concern in the watershed	3x year
Watershed tours	To highlight previous and proposed restoration work	As-needed
Watershed group meeting	Focuses on one or two current issues in the watershed	Quarterly
Workshops/festival	Informs landowners/public on issues in watershed	On-going
Youth Programs	Increases youth awareness of water quality and local concerns such as expand grades for the Water Watchers Program, Youth monitoring	On-going

9.0 TECHNICAL AND FINANCIAL RESOURCES NEEDED FOR IMPLEMENTATION

9.1 TECHNICAL RESOURCES

The WQPD and the LHWG do not maintain a formal technical advisory committee for project review. Instead, the LHWG steering committee and local partners' expertise is sought during project development and implement to provide technical advice and evaluation.

Listed below are technical experts that the WQPD and the LHWG currently collaborate with on potential projects in the watershed.

- McNeal Resources, Allen McNeal, Townsend, MT
- Montana Department of Environmental Quality (DEQ): Mark Ockey, Water Quality Specialist, Helena, MT
- Montana Fish, Wildlife and Parks (FW&P): Eric Roberts, Fisheries Biologist, Helena, MT
- Lewis and Clark Conservation District: Chris Evans, Administrator, Helena, MT
- Lewis and Clark Conservation District: Jeff Ryan, Supervisor, Stan Frasier, Supervisor
- MT Business Assistance Connection (MBAC): Brian Obert, Economic Development Specialist
- Prickly Pear Land Trust (PPLT): Andrea Silverman, Land Protection Coordinator
- NorthWestern Energy: Steven Leathe, Hydro Compliance Officer
- City of Helena: Don Clark, Water and Waste Water Superintendent

Additionally, the WQPD has staff with expertise in hydrology, water quality monitoring, project management and implementation and public and landowner engagement.

9.2 FINANCIAL RESOURCES

Funding for watershed restoration projects is essential. The community has identified and prioritized projects for the next seven years, but will not be able to complete those projects without financial as well as technical resources. Other work in the watershed that contribute to improved water quality such as road work, stormwater system improvements, and wastewater treatment plant upgrades are funded through other governmental agencies. (See sections 4 and 5 for priorities and projects.)

Table 9-1 lists sources of financial support that are focused on the types of restoration projects that have been identified.

Table 9-1: Funding Entities				
Financial Assistance	**Description**	**Funding**	**Grant Cycle**	**Contact/Website**
MT FW&P- Future Fisheries Improvement Program	Restore rivers, streams and lakes to improve and restore Montana's wild fish habitats.	Between $350,000 and $650,000 are available.	Applications are considered every year in June and December	http://fwp.mt.gov/fishAndWildlife/habitat/fish/futureFisheries/
Five Star Restoration Program	Brings together groups and organizations to provide environmental education and training through projects that restore wetlands and streams.	$5,000-$20,000	Annually	http://water.epa.gov/grants_funding/wetlands/restore/index.cfm
MT DEQ 319	The Montana DEQ provides 319 funding to protect water quality and restore water quality in water bodies whose beneficial uses are impaired by nonpoint source (NPS) pollution and whose water quality does not meet state standards	Recommended range is $20,000 to $300.000 per application	Grant cycle is annual Proposal application due in July Final applications due in October	http://www.deq.mt.gov/wqinfo/nonpoint/319grants.mcpx
DNRC HB 223 funds	Available to Conservation Districts for conservation, education, and natural resource related projects	"On the Ground Projects" $20,000 & Education Projects $10,000	Grant cycle is quarterly	Linda Brander Phone: 406-444- e-mail:lbrander@mt.gov http://dnrc.mt.gov/cardd/LoansGrants/ConservationDistrcitLoanGrants.asp
DEQ Mini-grants	Administered by the Soil and Water Conservation Districts of Montana, Incorporated (SWCDMI) with assistance from the DEQ NPS Program. To fund local education and outreach efforts that address nonpoint source pollution and water quality issues	Up to $2,000	Grant cycle is biannual	
Northwestern Energy FERC Conservation Funding	Administered by Northwestern Energy	Variable		Steven Leathe, Hydro Compliance Professional Northwestern Energy Phone: 406-750-0555
Donations – local and state nonprofit groups	Various, DU, TU	Variable	Variable	
Donations – private and business	Business in-kind and financial. (e.g. Coca-cola)	Variable	Variable	

10.0 MONITORING

The WQPD collects water quality and quantity data in order to describe long-term trends in watershed health. The WQPD prepares pollutant load reduction estimates and documents several environmental indicators for individual restoration projects. Sampling and Analysis Plans (SAPs) and other relevant technical documents guide monitoring efforts. The WQPD uses the trend data, the load reduction estimates, and several environmental indicators to assess progress towards achieving water quality standards such as implementing and achieving pollutant targets

10.1 LONG-TERM TREND MONITORING

The LHWG started a volunteer water monitoring group in 2010 to monitor flow and water quality indicators twice a year at twelve sites around the watershed. The sites were selected based on stakeholder interest and were selected to fill in water quality gaps associated with the TMDLs. The sites have varied from year to year depending on volunteer availability. Streams in the watershed that have been monitored include: Upper Prickly Pear Creek, Middle Fork Warm Springs, Clancy Creek, Lump Gulch, Spring Creek, Corbin Creek, Merritt Creek (Upper and Lower), and Skelly Gulch (Upper and Lower), Jennie's Fork and Crystal Springs. The SAP for the monitoring effort was approved by DEQ.

Historically, more sampling and analysis of streams was undertaken with funding assistance. Future monitoring is funding dependent. WQPD personnel have continued to monitor stream flow of selected locations within the previously established stream flow gaging network. A description of the current monitoring stations, parameter, and methods is provided in Table 10-1. The WQPD analyzes the collected data and identifies trends. Analysis results are then reported through Mt-eWQX and data is stored in EPA's STORET.

Table 10-1: Long-term Trend Sampling

Station Description	Parameter	Method	Measurement Frequency
Prickly Pear Creek at Kleffner Ranch	Flow and Temperature	TruTracks	At least three discharge measurements throughout the months of May to October in additional to Tru Tracks (Every 30 minutes water level and temperature) Placement following ice-out and before freeze-up)
Prickly Pear Creek at Wylie	Flow and temperature throughout all stations	TruTracks	Frequency same throughout
Prickly Pear Creek at Canyon Ferry	Flow	TruTracks	
Prickly Pear Creek at York	Flow	TruTracks	
Prickly Pear Creek at Sierra	Flow	TruTracks	
Prickly Pear Creek at Mouth	Flow	TruTracks	
Tenmile Creek at Williams Street Bridge		TruTracks	
Tenmile Creek at Country Club	Flow	TruTracks	
Tenmile Creek at Green Meadow	Flow	TruTracks	
Tenmile Creek at Sierra	Flow	TruTracks	

Station Description	Parameter	Method	Measurement Frequency
Sevenmile Creek at Head Lane	Flow and temperature throughout	TruTracks	Frequency same through out
Sevenmile Creek at Birdseye	Flow	TruTracks	
City of Helena Wastewater Effluent Discharge Canal at H1B	Flow	TruTracks	
Helena Valley Irrigation District Canal at D2 Drain at Arrowhead	Flow	TruTracks	

10.2 EFFECTIVENESS MONITORING

Volume II, Appendix A, Table 15-1 of the Lake Helena TMDL document identifies specific, measurable water quality targets that can be used as criteria to evaluate progress towards achieving water quality standards and restoring beneficial use support. A copy of Table 15-1 is included as Appendix E of this Watershed Restoration Plan. Table 15-1 includes specific targets for each pollutant/waterbody combination addressed in the Lake Helena TMDL, as well as targets for several temperature impairments for which TMDLs were not completed.

Current private, local, state, and federal financial resources are not adequate to support monitoring of the targets contained in Table 15-1. In lieu of monitoring the target criteria identified in Table 15-1, WQPD, LHWG and their partners use surrogate measures to track changes in the watershed that are likely to lead to improvements in water quality. The surrogates, the impairment causes they represent, the partners involved, and the tracking frequency are described in Table 10-2 below.

Table 10-2: Monitoring Criteria to Measure Progress			
Impairment Cause	**Surrogate Target/Measurement**	**Partners Involved**	**Monitoring Frequency**
Sediment	Length of eroding streambank revegetated (running total, by stream, in feet)	WQPD, LHWG	As projects are completed
	Length of additional channel added (running total, by stream, in feet)	WQPD, LHWG	As projects are completed
	Length of riparian buffer added (running total, by stream and lakeshore, in feet)	WQPD, LHWG	As projects are completed
	Project benefit sustainability (using photo-point documentation or visual observations)	WQPD, LHWG, FWP (for Future Fisheries projects)	Varies by project type and availability of funding for long-term monitoring
	Reductions in annual sediment load (running total, by stream, in tons/year)	WQPD, LHWG, DEQ	As projects are completed
	Forest road decommissioning (running total, miles of road decommissioned)	USFS	Annual
	Major forest road improvement projects completed (measurements will vary depending upon the nature and extent of the project, and the ability of USFS and other partners to collect data, but may include WEPP modeling)	USFS	As projects are completed
Temperature and Flow	Length of eroding streambank revegetated (running total, by stream, in feet)	WQPD, LHWG	As projects are completed
	Maintain 8-22 cfs in historically dewatered section of Prickly Pear Creek (proposed criteria)	WQPD, LHWG, HVID	Annual, depending on funding
	Maintain or increase instream flows (measured with Tru Tracks at specific locations)	WQPD, LHWG	Annual, depending on funding
	Where needed, reduce stream temperatures (measured with Tru Tracks at specific locations)	WQPD, LHWG	Annual, depending on funding

Table 10-2: Monitoring Criteria to Measure Progress			
Impairment Cause	**Surrogate Target/Measurement**	**Partners Involved**	**Monitoring Frequency**
Nutrients	Length of riparian buffer added (running total, by stream and lakeshore, in feet)	WQPD, LHWG	As projects are completed
	Reductions in annual nitrogen and phosphorus load (running total, by stream, in pounds/year)	WQPD, LHWG, DEQ	As projects are completed
Metals	Mine waste cleanup projects completed (running total, by stream)	USFS, DEQ AML Program	As projects are completed
Riparian/Aquatic Habitat Alterations	Length of eroding streambank revegetated (running total, by stream, in feet)	WQPD, LHWG	As projects are completed
	Length of additional channel added (running total, by stream, in feet)	WQPD, LHWG	As projects are completed
	Length of riparian buffer added (running total, by stream and lakeshore, in feet)	WQPD, LHWG	As projects are completed
	Project benefit sustainability (using photo-point documentation or visual observations)	WQPD, LHWG, FWP (for Future Fisheries projects)	Varies by project type and availability of funding for long-term monitoring

APPENDIX A: REFERENCES

Allen, H. H., and Leech, J. R. 1997. *Bioengineering for streambank erosion control; Report 1, Guidelines*. Technical Report EL-97-8, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. <http://www.engr.colostate.edu/~bbledsoe/CIVE413/Bioengineering_for_Streambank_Erosion_Control_report1.pdf>

Cleasby, T.E., and Nimick, D.A., 2002, *Streamflow, water quality, and quantification of metal loading in the upper Tenmile Creek watershed, Lewis and Clark County, west-central Montana*, September 1998: U.S. Geological Survey Water-Resources Investigations Report 02-4072, 64 p.

Montana Department of Environmental Quality (DEQ), 1995, *Abandoned Hard Rock Mine Priority Sites 1995 Summary.* Remediation Division. Helena, MT < http://www.deq.mt.gov/AbandonedMines/priority.mcpx>

Montana Department of Environmental Quality (DEQ) Clean Water Act Information Center (CWAIC) 2014 Water Quality Information < http://cwaic.mt.gov/>

DEQ. 2010. *A Montana Homeowner's Guide to Septic Systems*. Solid Waste Section, Septic Tank Pumper Program. Helena, MT

DEQ. 2012. *Montana Nonpoint Source Management Plan* (MT NPS Management Plan). Watershed Protection Section. Helena, MT

Montana Department of Natural Resources and Conservation (DNRC) Forestry Assistance Program http://dnrc.mt.gov/Forestry/Assistance/Practices/fpractices.asp

DNRC Forestry Division. 2012. *Montana Forestry Best Management Practices Monitoring: 2012 Forestry BMP Field Review Report*. Missoula, MT

DNRC. *Stream Permitting Guide*. <http://dnrc.mt.gov/permits/streampermitting/guide.asp>

Ellis, J.H. 2008. *The Need for Stream Vegetative Buffers: What Does the Science Say?* Report to Montana Department of Environmental Quality. Montana Audubon, Helena, MT. <http://mtaudubon.org/issues/wetlands/planning2.html#2>

Part I: Scientific Recommendations on the Size of Stream Vegetative Buffers Needed to Protect Water Quality.

Part II: Scientific Recommendations on the Stream Vegetative Buffer Size Needed to Protect Fish and Aquatic Habitat.

Part III: Scientific Recommendations on the Size of Stream Vegetative Buffers Needed to Protect Wildlife and Wildlife Habitat.

Fischenich, J. Craig and James V. Morrow, Jr. 2000. *Streambank Habitat Enhancement with Large Woody Debris*. US Army Corps of Engineers, Ecosystem Management and Restoration Research Program Technical Notes (ERDC TN-EMRRP-SR-13).< http://el.erdc.usace.army.mil/elpubs/pdf/sr13.pdf>

Helena Water Utilities Public Water System (PWS). 2003, Revised, 2012 *Source Water Delineation and Assessment Report*.

Helena National Forest, March, 27, 2013, David Callery, interview, Aerial Photography Project.

The *Helena Tenmile WTP LT2 Watershed Control Plan. http://www.helenamt.gov/uploads/media/LT2_Watershed_Control_Plan.pdf*

Jefferson County Public Health. http://www.jeffersoncounty-mt.gov/health/index.html Boulder, MT

Kendy, Eloise, Olsen, Bill, and Malloy, John C., 1997, *Field screening of water quality, bottom sediment, and biota associated with irrigation drainage in the Helena Valley, west-central Montana*, 1995: U.S. Geological Survey Water-Resources Investigations Report 97-4214, 62 p.

Knutson, K. Lea and Virginia L. Naef. 1997. *Management Recommendations for Washington's Priority Habitats: Riparian*. Washington Department of Fish and Wildlife. < http://wdfw.wa.gov/publications/00029/wdfw00029.pdf>

Lewis & Clark Public Health Department. *A Homeowners Guide to Groundwater Protection and Septic Systems.* (Undated brochure) Helena, MT

Lewis & Clark Public Health Department. < http://www.lccountymt.gov/health.html > Helena, MT

Lewis & Clark County. 2013. *Subdivision Regulations*. < http://www.lccountymt.gov/cdp/subdivision-regulation/current.html> Helena, MT

Lewis & Clark County Water Quality Protection District and City of Helena Public Works. 2014. *Storm Water Runoff Pollution* <http://www.lccountymt.gov/health/water/storm-water.html> Helena, MT

Montana Bureau Mines and Geology. Groundwater Investigative Reports. North Hills and Scratchgravel Hills. http://www.mbmg.mtech.edu/gwip/gwip_reports.asp

Montana Code Annotated (MCA). http://leg.mt.gov/bills/mca_toc/

Montana Environmental Trust Group, LLC *(*METG). 2012. *Former ASARCO East Helena Facility Interim Measures Work Plan—Conceptual Overview of Proposed Interim Measures and Details of 2012 Activities*. Helena, MT

Montana State University (MSU) Extension Service. 2001. *Water Quality BMPs for Montana Forests*. Missoula, MT

Natural Resources Conservation Service (NRCS). *Montana Field Office Technical Guide* (MTFOTG). <http://efotg.sc.egov.usda.gov/treemenuFS.aspx>

NRCS. 1996. *National Engineering Handbook Part 650, Engineering Field Handbook* (EFH), *Chapter 16, Streambank and Shoreline Protection*. < http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17553.wba>

Parrett, Charles, and Hettinger, P.S., 2000, *Streamflow and water-quality characteristics in the upper Tenmile Creek watershed, Lewis and Clark County, west-central Montana*: U.S. Geological Survey Water-Resources Investigations Report 00-4129, 71 p.
http://wy-mt.water.usgs.gov/pub/Bibliography.1.htm

Parrett, Charles, and Kendy, Eloise, 2001, *Streamflow and water quality of the lower Tenmile Creek watershed, Lewis and Clark County, west-central Montana*, 1997 and 1998: U.S. Geological Survey Water-Resources Investigations Report 01-4120, 35 p.

RIPARIAN AREA MANAGEMENT TR 1737-16 1999, Revised 2003 A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas U.S. Department of Agriculture Forest Service U.S. U.S. Department of the Interior Bureau of Land Management RIPARIAN AREA MANAGEMENT TR 1737-16 1999, Revised 2003 A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas U.S. Department of Agriculture Forest Service U.S. Department of Agriculture Natural Resources Conservation Service

Swierc, James. *Ground Water Monitoring Results of Surface Water - Groundwater Interaction, Helena Montana.* WQPD, 2013.

Swierc, James. *Helena Valley Non-Point Source Assessment, Groundwater Loading of Nutrients to Surface Water Non-Point Loading to Lake Helena*. WQPD, 2015.

Tenmile Ecosystem Watershed Analysis, Helena National Forest, 2008. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5352802.pdf

U.S. Environmental Protection Agency (EPA), Region 8. 2004. *Water Quality Restoration Plan and Total Maximum Daily Loads (TMDLs) for the Lake Helena Watershed Planning Area: Volume I - Final Report* (Volume I). Helena, MT.

U.S. Environmental Protection Agency (EPA), Montana Operations Office. 2006. *Framework Water Quality Restoration Plan and Total Maximum Daily Loads (TMDLs) for the Lake Helena Watershed Planning Area: Volume II – Final Report.* Prepared for the Montana Department of Environmental Quality, Helena, MT.

EPA. 2013. *2013 Draft Lake Helena Planning Area Metals TMDL Addendum.* Prepared for DEQ. Helena, MT

Wenger, S.J. 1999. A review of the scientific literature on riparian buffer width, extent and vegetation. Athens: Institute of Ecology Office for Public Service and Outreach, University of Georgia. 59 pp.<http://www.rivercenter.uga.edu/service/tools/buffers/buffer_lit_review.pdf>

Wetlands Resources Assessment Helena Valley, Montana, The Wetlands Community Partnership, February, 2001. 41 pages.

Wetlands Resources Assessment: A Wetlands Community Partnership Phase II, The Wetlands Community Partnership, June, 2002. 40 pages.

APPENDIX B: LAKE HELENA WATERSHED STREAM IMPAIRMENT AND RESTORATION STRATEGY

The Watershed Restoration Strategy for the Lake Helena watershed focuses on sediment and two key areas: Lower Tenmile Creek and Lower Prickly Pear Creek. This is the area of focus for the first seven years and is expected to reduce pollutant loads. However, watershed-wide alterations since the initial gold strike in 1864 have resulted in a complex mosaic of substantial impacts throughout the watershed, making it sometimes difficult to predict the overall outcome of restoration efforts.

This appendix summarizes existing information about sources of pollutants, best management practices, restoration strategies, and pollutant load reductions that have been calculated to restore designated beneficial uses.

OVERVIEW OF IMPAIRED STREAMS IN THE LAKE HELENA WATERSHED

The Lake Helena watershed has twenty-four waterbodies and 109 total stream reach-pollutant combinations that do not fully support beneficial uses such as full support of aquatic life, water for agricultural purposes and other uses.

Pollutants that were identified were:

- **Sediment**
- **Nutrients:** nitrogen, phosphorus
- **Metals:** arsenic, cadmium, copper, lead, and zinc
- **Temperature**
- In addition, several non-pollutant causes of beneficial use impairment have been identified, including stream channelization, vegetation removal, and substrate alteration.

These tables show the existing loads of pollutants, by stream, as determined in the 2006 TMDL report, followed by a determination of the allocation (amount) of a pollutant that would be low enough that all designated beneficial uses could be maintained.

Table B-1: Sediment Loads and Load Allocations in the Lake Helena Watershed			
Pollutant	**Load (tons/yr.)**	**Percent reduction (%)**	**Allocation (tons/yr.)**
Sediment -Watershed			
Clancy Creek – headwaters to the mouth	2,077	81	404
Corbin Creek – headwaters to the mouth	144	77	37
Jennies Fork – headwaters to the mouth	169	67	57
Lump Gulch – headwaters to the mouth	1,855	81	380
Warm Springs Creek – North Fork, Middle Fork, Middle Fork to the mouth	635	76	176
Sevenmile Creek – headwaters to the mouth	1,825	83	348
Prickly Pear Creek – headwaters to Lake Helena	20,708	73	5,652
Skelly Gulch – headwaters to the mouth	416	76	106
Spring Creek – Corbin Creek to the mouth	1,053	78	235
Tenmile Creek – headwaters to mouth	6,377	74	1,649

Final Report, Volume II (EPA 2006)

Sediment is the most prevalent pollutant throughout the watershed. The advisory team had identified this pollutant as a priority for this WRP.

Excess nutrients are a concern in four streams and Lake Helena. Stream by stream strategies are highlighted in the individual streams in this appendix.

Table B-2: Nutrient Loads and Load Allocations for the Lake Helena Watershed						
	Nitrogen			**Phosphorous**		
Nutrient Sources	**Load (tons/yr)**	**Percent reduction (%)**	**Allocation (tons/yr)**	**Load (tons/yr)**	**Percent reduction (%)**	**Allocation (tons/yr)**
Overall Nutrients						
Prickly Pear Creek	95.5	40	57.0	11.0	78	2.4
Sevenmile Creek	8.40	38	5.24	0.99	75	0.25
Spring Creek	3.07	55	1.38	0.48	79	0.11
Tenmile Creek	39.67	33	27.18	3.71	73	0.99
Lake Helena	252.1	36	160.9	24.9	70	7.6

Final Report, Volume II (EPA 2006)

Metal impairments are located in many streams throughout the watershed. More details on these streams are highlighted in individual stream descriptions in this Appendix.

Table B-3: Metals Loads and Load Allocations for Lake Helena Watershed (all sources)					
Segment	**Metal**		**Load (tons/ year)**	**Percent reduction (%)**	**Allocation (tons./yr)**
Clancy Creek	Arsenic		717.9	61.1	279.3
	Cadmium		34.0	61.2	13.2
	Copper		897.0	42.3	517.6
	Lead		339.0	54.1	155.6
	Zinc		20,038.9	47.0	10,620.6
Corbin Creek	Arsenic		48.4	24.7	36.2
	Cadmium		87.7	96.8	2.8
	Copper		1,058.5	89.2	114.6
	Lead		97.4	65.9	33.2
	Zinc		58,393.2	97.2	1,660.6
Granite Creek (lbs/day)	Arsenic	High flow	.21*	74	.00054*
		Low flow	.0006*	83	.0001*
	Cadmium	High flow	.00004*	0	.00003*
		Low flow	.0000009*	0	.000006*
Golconda Creek	Cadmium		1.1	40.9	.7
	Lead		27.2	76.9	6.3
Jennies Fork	Lead		15.5	45.7	8.4
Lake Helena	Arsenic		13,032.2	60.8	5,104.2
	Lead		8,134.6	65.6	2,798.0
Lump Gulch	Cadmium		43.9	76.1	10.4
	Copper		745.9	39.3	452.8
	Lead		241.3	43.9	135.3
	Zinc		26,599.2	68.1	8,485.1
Jackson Creek (lbs./day)	Zinc	High flow	0.331*	0	0.077*
		Low flow	0.272*	31	0.395*
Middle Fork, North Fork, Main Stem Warm Springs Creek	Arsenic		472.8	58.7	195.1
	Cadmium		14.3	61.9	5.4
	Lead		102.5	31.6	70.1
	Zinc		7,076.0	43.8	3,976.7
Prickly Pear Creek	Arsenic		9,497.9	58.5	3,942.6
	Cadmium		652.1	73.8	171.2
	Copper		14,200.1	58.0	5,968.3
	Lead		6,627,9	68.6	2,081.8
	Zinc		293,913.6	59.6	118,623.5
	Copper		1,203.8	51.9	578.7
Sevenmile Creek	Lead		1,565.8	47.1	828.0
	Zinc		766.7	63.0	283.8
Silver Creek	Arsenic		2,752.5	64.6	974.4
Spring Creek	Arsenic		671.2	56.1	294.6
	Cadmium		123.6	87.1	15.9
	Copper		1,860.7	64.1	668.0
	Lead		1,195.0	81.6	219.8
	Zinc		74,792.8	80.7	14,401.0
Tenmile Creek	Arsenic		5,566.8	65.6	1,912.6
	Cadmium		343.4	80.3	67.6
	Copper		7,247.7	69.2	2,232.4
	Lead		3,438.4	78.7	734.1
	Zinc		96,844.7	54.9	43,706.0

Final Report, Volume II (EPA 2006) and Metals Addendum (EPA 2013)

Thermal loads from high temperatures have been determined for part of Lower Prickly Pear Creek. Tenmile and Corbin Creeks also have potential temperature impairments, but no TMDL was determined. This Appendix and Section 4 has more information.

Table B-4: Temperature Impairments the Lake Helena Watershed			
Temperature	**Thermal Load (+ degrees F)**	**Percent reduction (%)**	**Allocation (+ degrees F)**
Lump Gulch to Wylie Drive	2.7	81	0.5
Wylie Drive to mouth	Thermal impairment found; no formal thermal load determined or allocation set.		
Final Report, Volume II (EPA 2006)			

SUBWATERSHED RESTORATION NEEDS AND STRATEGY

Understanding in full detail why the various streams and tributaries of the Lake Helena watershed each show specific impairments caused by the four pollutant groups (sediment, nutrients, metals, temperature) is beyond the scope of this discussion. However, by geographically organizing the watershed into sub watersheds, the general spatial trends of the impairments can be understood.

For the purposes of this plan, the Lake Helena watershed is subdivided into seven sub-watersheds. The boundaries between the sub watersheds are subtle; the characteristics of neighboring sub watersheds tend to be very similar near the boundary.

The seven sub-watersheds are:

1) **West Upper Prickly Pear Tributaries,** south of Montana City, west of Prickly Pear Creek
2) **East Upper Prickly Pear Tributaries**, south of Montana City, east of Prickly Pear Creek
3) **Main Stem of Prickly Pear Creek**, south of Montana City
4) **The Helena Valley**, including the lower downstream segments of Ten Mile Creek, Prickly Pear Creek, and Silver Creek
5) **Upper Ten Mile Creek Watershed**, upstream of Ten Mile Water Treatment Plant
6) **Western Hills Watershed**, north of Highway 12, west of Fort Harrison, west of Green meadow Drive
7) **Lake Helena**

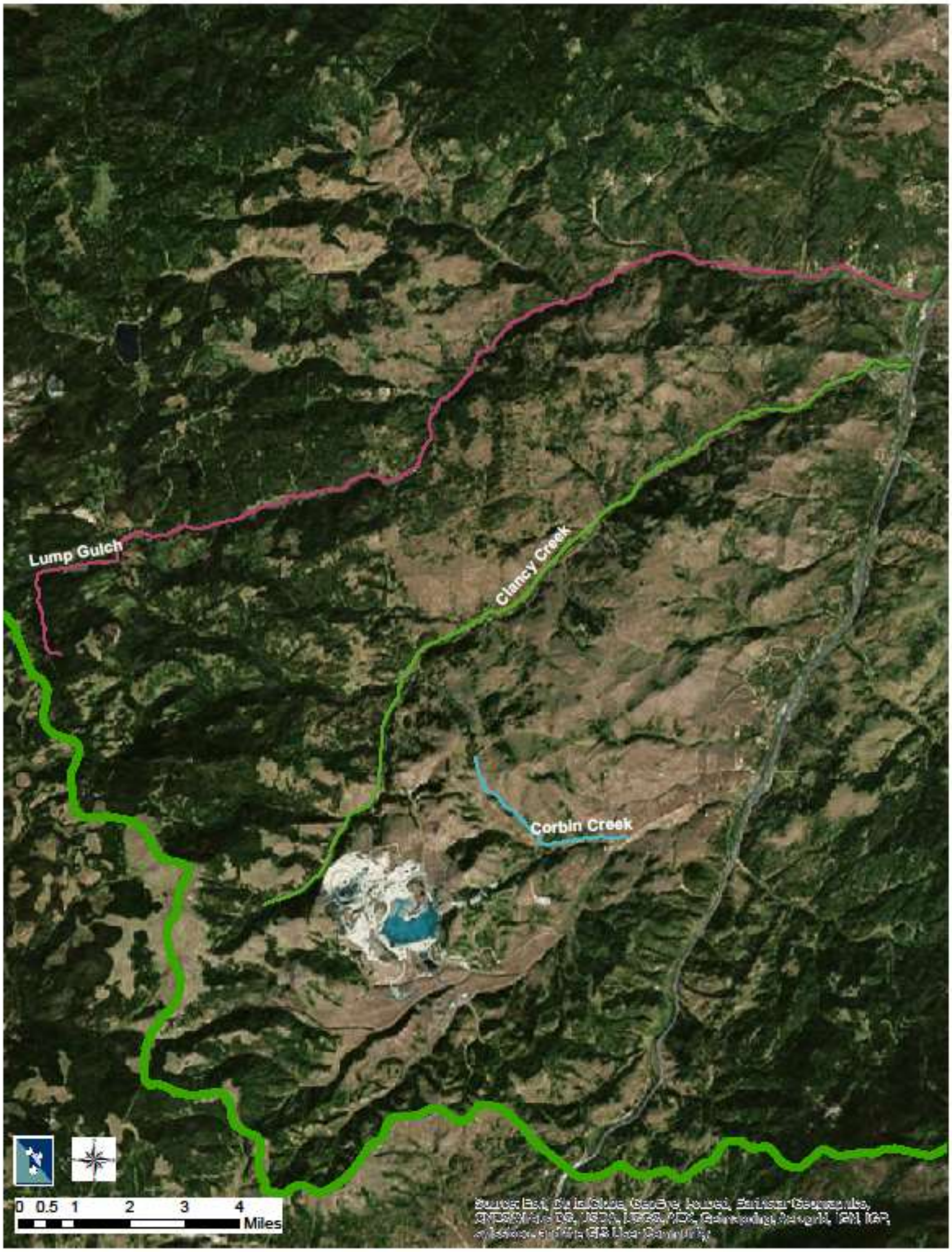
WEST UPPER PRICKLY PEAR CREEK TRIBUTARIES

(South of Montana City, West of Prickly Pear Creek)

The western slopes of the Upper Prickly Pear Watershed are formed from extensive igneous (granitic) rock that historically was extensively mined. These slopes are drier than the eastern slopes with mostly grasses and brush at lower elevations and limited forests in the Helena National Forest at higher elevations. The land use is mixed with limited development (small towns and housing subdivisions) at lower elevation near the center of the Prickly Pear valley, ranching dispersed along the tributaries, some extensive mined areas, and limited logging. The area has an extensive network of roads.

The steep slopes accelerate the erosion of the granitic rock, inherently susceptible to weathering, and the rapid transport of coarse sediment into the tributaries of Prickly Pear Creek. Metals accumulate in the tributaries from this erosion. Reaches of several tributaries have TMDLs for both sediment and metals: Clancy Creek; Corbin Creek; Lump Gulch. Grazing near Corbin Creek has raised nutrient concentrations in the stream; Corbin Creek has a TMDL for nutrients.

Figure B-1: West Upper Prickly Pear Creek Tributaries



CLANCY CREEK

Water Quality Problems

Aquatic life and drinking water are important uses of water that are not fully supported in Clancy Creek. The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These are:

- **Metals:** arsenic, cadmium, copper, lead, and zinc
- **Sedimentation/Siltation**

Beneficial uses of Clancy Creek are also affected by alteration of streamside vegetative covers and the substrate (material at the bottom of the stream that provides habitat for aquatic life). Brook trout are common in Clancy Creek below the confluence with Kady Gulch. Genetically pure westslope cutthroat trout have been found in the upper two miles of the stream.

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (EPA 2004) and Final Report, Volume II (EPA 2006) are summarized below.

Metals Sources

Abandoned mines, sediment-associated metals and human-caused streambank erosion are the primary sources of metals in Clancy Creek.

Calculations in Final Report, Volume II (EPA 2006) show that an overall, watershed scale metals load reduction of 61, 61,42, 54 and 47 percent for arsenic, cadmium, copper, lead, and zinc, respectively would result in achievement of the applicable water quality standards for metals.

Sediment Sources

The primary sources of sediment in the Clancy Creek watershed, in order of importance, are streambank erosion, timber harvest, unpaved roads, urban development, and non-system roads and trails.

Streambank erosion was primarily caused by riparian grazing, stream channelization from road encroachment, historic mine tailings piles, and channel incisement. The stream has been widened, straightened and incised as a result of placer mining, which may have altered the stream’s hydrology in addition to its morphology.

Clancy Creek Road is directly adjacent to the stream for much of its length. Road sediment is readily transported to Clancy Creek due to the lack of a riparian vegetative buffer, removal of road shoulder vegetation from road grading activities, and the inherent erodibility of the granitic geology.

Sediment is also generated from forestry activities and unpaved roads and trails in the upper watershed and residential development downstream.

An overall, watershed scale sediment load reduction of 40% will result in achievement of the applicable water quality standards.

A 2003 Proper Functioning Condition assessment rated the reach below the Gregory Mine as “Non-functional.”

Watershed Restoration Opportunities

Land managers can improve water quality and watershed health in Clancy Creek and downstream in Prickly Pear Creek and Lake Helena by cleaning up abandoned mines and closing and reclaiming unauthorized roads. Changes in current management practices could include greater use of riparian buffers along Clancy Creek Road, and greater use of best management practices aimed at slowing and preventing runoff, including stormwater controls in residential areas, increased application of forestry best management practices and changes in road maintenance practices designed to reduce sediment runoff and enhance vegetative buffers.

Watershed Restoration Strategies

Priority management measures for Clancy Creek that are described in Appendix C include:

- Filter strips
- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Off-stream watering facilities
- Forestry BMPs
- Water gaps
- Road Best Management Practices (BMPs)

Other important management practices include:

- Stormwater BMPs
- Mine reclamation

CORBIN CREEK

Water Quality Problems

Aquatic life and drinking water are important beneficial uses of water that are not fully supported in Corbin Creek. The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These include:

- **Metals:** arsenic, cadmium, copper, iron, lead, silver, and zinc
- **pH**
- **Solids (Suspended/Bedload)**
- **Temperature**

The uses of Corbin Creek are also affected by alteration of streamside vegetative covers.

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (EPA 2004) and Final Report, Volume II (EPA 2006) are summarized below.

Metal Sources

Historic mining activities and sediment-associated metals sources are the primary sources of metals in Corbin Creek. Two mines, Bertha and Alta, are listed in the State of Montana's inventory of high priority abandoned hard rock mine sites. (DEQ Mines, 1995)

Calculations in Final Report, Volume II (EPA 2006) show that an overall, watershed scale metals load reduction of 25, 97, 89, 66, and 97 percent for arsenic, cadmium, copper, lead, and zinc, respectively would result in achievement of the applicable water quality standards.

Sediment Sources

The primary human-caused sources of sediment, in order of importance, are unpaved roads, streambank erosion, abandoned mines, timber harvest, and non-system roads and trails.

An aerial photography inventory showed six road crossings and road encroachment along 17% of the stream. The unpaved Corbin Creek Road is directly adjacent to the stream throughout much of its length. A large quantity of road-based sediment is delivered directly to the stream due to the close proximity to the stream channel and the lack of any significant riparian vegetation in the lower watershed. A large portion of the total road length in the watershed is steep and generates significant sediment loads.

Streambank erosion is primarily caused by riparian grazing, stream channelization, and historic mining activity. Abandoned mines – including the Blackjack and Bertha mines -- contribute 16% of the total Corbin Creek human-caused sediment load. Although the Bertha mine has been partially reclaimed, model results indicate the Bertha mine site continues to produce notable sediment quantities. Severe channel alterations begin after the first road crossing and continue to the mouth. The stream is channelized through the town of Corbin, located in the lowest ¼ mile of Creek.

Unpaved non-system roads and trails in the central and upper watershed contribute sediment due to the lack of runoff mitigation structures.

A 2003 Proper Functioning Condition assessment rated the reach approximately ½ mile above the mouth as "Non-functional", citing excessive sediment deposition, lack of flow and lack of riparian vegetation.

An overall, watershed scale sediment load reduction of 23% is believed to be necessary in order to achieve applicable water quality standards.

Watershed Restoration Opportunities

Landowners can improve water quality and watershed health in Corbin Creek and downstream in Prickly Pear Creek and Lake Helena by cleaning up abandoned mines, closing and reclaiming unauthorized and unused roads, and using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals. Corbin Creek does not currently support fish; however, the Creek is expected to support fish once toxicant levels are reduced.

Watershed Restoration Strategies

Best management practices for Corbin Creek that are described in Appendix C include:

- Filter strips
- Riparian fencing
- Riparian buffers
- Off-stream watering facilities
- Water gaps
- Bioengineered stream bank stabilization treatments and stream channel restoration projects

- Road BMPs
- Forestry BMPs

Mine reclamation is also important.

LUMP GULCH

Water Quality Problems

Aquatic life and drinking water are beneficial uses of water that are not fully supported in Lump Gulch. The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These include:

- **Metals:** cadmium, copper, lead, and zinc
- **Total suspended solids**

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (EPA 2004) and Final Report, Volume II (EPA 2006) are summarized below.

Metals Sources

Historic mining activities in the upper watershed and sediment-associated metals sources are the primary sources of metals in Lump Gulch. Documented sources of metals include: road sediment delivery points, mine waste rock dumps, a mining dam, and channel incision. There are more than 10 historic hard rock mines in the headwaters area. Four sites are listed in the State of Montana's inventory of high priority abandoned hard rock mine sites: Nellie Grant, two Frohner mines, and General Grant. An aerial photography assessment showed the drainage has been disrupted by historic mining dams at the Frohner Meadows Mine. (DEQ Mines, 1995)

Calculations in the Final Report, Volume II (EPA 2006) show that an overall, watershed scale metals load reduction of 76, 39, 44, and 68 percent for cadmium, copper, lead, and zinc, respectively would result in achievement of the applicable water quality standards for metals.

Sediment Sources

The primary sources of sediment in the Lump Gulch watershed, in order of contribution, are timber harvest, unpaved roads, human-caused streambank erosion, urban development, abandoned mines, and non-system roads and trails.

Significant timber harvest activities have occurred in the Lump Gulch watershed on land owned by the state, BLM, and private landowners.

The Helena National Forest conducted a road sediment survey on the Forest portion of the creek and identified five sites that contribute an estimated 3 tons of sediment to the stream each year.

An aerial photography inventory showed seventeen road crossings and road encroachment along 22% of the stream. Lump Gulch Road is directly adjacent to the stream throughout much of the central area of the segment length. The erodible parent material, high road usage, close proximity to the stream channel, and a narrow riparian buffer throughout much of the upper watershed result in large quantities of road-based sediment being delivered to the stream.

Streambank erosion is primarily caused by riparian grazing, road encroachment, stream channelization, and historic mining activity.

Below the Helena National Forest's administrative boundary, housing development is prominent and riparian buffer widths decrease.

The Nellie Grant mine has been reclaimed; however, the Frohner and Yama mining sites continue to produce sediment.

Unpaved, non-system roads and trails in the central and upper watershed contribute sediment due to the lack of runoff mitigation structures and their location in steep topography near watercourses.

An overall, watershed scale sediment load reduction of 45% is estimated to result in achievement of the applicable water quality standards.

A 2003 Proper Functioning Condition assessment rated the reaches above Park Lake and below Little Buffalo Gulch as "Functional – at risk".

Watershed Restoration Opportunities

Landowners and land managers can improve water quality and watershed health in Lump Gulch and downstream in Prickly Pear Creek and Lake Helena by cleaning up abandoned mines, closing and reclaiming unauthorized roads and trails, and using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals. Brook trout reside in the lower 5 miles of Lump Gulch, while genetically pure westslope cutthroat trout and rainbow/cutthroat hybrids have been found in the upper six miles of the stream.

Watershed Restoration Strategies

Priority management measures for Lump Gulch that are described in Appendix B include:

- Filter strips
- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Off-stream watering facilities
- Forestry BMPs
- Water gaps
- Road BMPs

Other important management practices include:

- Stormwater BMPs
- Mine reclamation

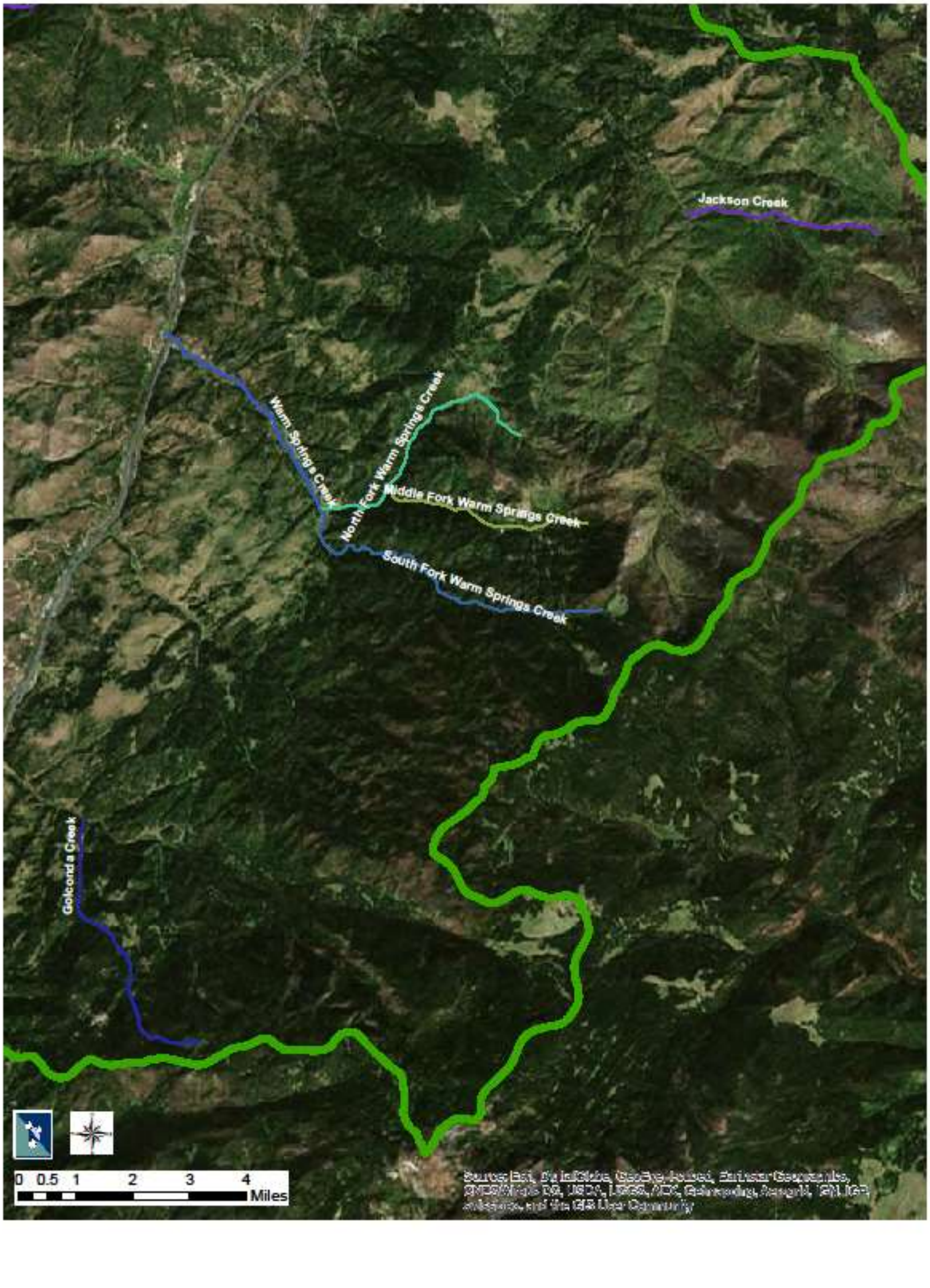
EAST UPPER PRICKLY PEAR CREEK TRIBUTARIES

(South of Montana City, East of Prickly Pear Creek)

The east side of the Upper Prickly Pear Watershed shares some characteristics with the west side. The geology is also composed of igneous rocks and is chemically similar (Elkhorn Volcanics). The steep east side was also extensively mined. Unlike the west side, the eastern slopes are extensively forested and are enclosed mostly in the Helena National Forest with an extensive network of logging roads. As a result, there is less development, with only scattered subdivisions and housing.

In a similar fashion to the western slopes, eroding logging roads and the eroding volcanic rock result in the transport of large amounts of sediment into tributaries of Prickly Pear Creek. Metals from the volcanic rock especially in the mining districts accumulate in the tributaries. Reaches of several tributaries have TMDLs for metals and sediment: the headwaters of Prickly Pear Creek; Warm Springs Creek. Reaches of Golconda Creek have a TMDL for sediment only.

Figure B-2: East Upper Prickly Pear Creek Tributaries



NORTH FORK, MIDDLE FORK AND WARM SPRINGS CREEK

Water Quality Problems

Aquatic life and drinking water are important uses of water that are not fully supported in North Fork, Middle Fork, and Warm Springs Creek. Primary contact recreation and agricultural uses are fully supported. The DEQ has identified pollutants that cause impairment of these beneficial uses of water (DEQ CWAIC 2014). These are:

- **Metals:** arsenic, cadmium, and zinc
- **Sedimentation/siltation.** There is also a listing for organic enrichment (sewage) biological indicators

The uses of Warm Springs Creek subwatershed are also affected by grazing in the riparian area that has resulted in manure inputs, as well as alteration of streamside vegetative covers and the material at the bottom of the stream that provides habitat for aquatic life. The North Fork Warm Springs Creek is managed as a brook trout fishery.

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (EPA 2004) and Final Report, Volume II (EPA 2006) are summarized below.

Metals Sources

Historic mining activities in this subwatershed are the primary sources of metals in the Warm Springs Creek. The State of Montana's inventory of mines shows two hard rock mines close to the headwaters and one mine close to the mouth of the stream. None of the mines in the basin are listed in the State of Montana's inventory of high priority abandoned hard rock mine sites. (DEQ Mines, 1995)

Calculations in the Final Report, Volume II (EPA 2006) show that an overall, watershed scale metals load reduction of 59, 62, 32, and 44 percent for arsenic, cadmium, lead, and zinc, respectively would result in achievement of the applicable water quality standards.

Sediment Sources

The primary sources of sediment in the Warm Springs Creek subwatershed, in order of importance, are unpaved roads, abandoned mines, timber harvest, streambank erosion, and non-system roads and trails.

Roads cross, and are adjacent to the channel throughout much of the watershed. The Helena National Forest conducted a road sediment survey on the forest portion of the creek and identified twenty-seven sites that are estimated to contribute approximately fifteen tons of sediment to the stream each year. The aerial photography inventory showed two road crossings and road encroachment along 26% of the stream.

The aerial photography inventory showed that extensive conifer and deciduous riparian buffers were present on the portion of the stream within the Helena National Forest, but were limited in width on a small section of private property below the headwaters.

An overall, watershed scale sediment load reduction of 76% is estimated to result in achievement of the applicable water quality standards.

A 2003 Proper Functioning Condition assessment rated the reach approximately 0.5 mile upstream of the mouth as "Functional – at risk" as a result of excess sediment deposition.

Watershed Restoration Opportunities

Landowners and land managers can improve water quality and watershed health in Warm Springs Creek subwatershed and downstream in Prickly Pear Creek and Lake Helena by cleaning up abandoned mines, closing and reclaiming unauthorized roads and trails, and using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals.

Watershed Restoration Strategies

Priority management measures for North Fork Warm Springs Creek that are described in Appendix C include:

- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Off-stream watering facilities
- Water gaps
- Road BMPs

Mine reclamation would also be a helpful best management practice.

GOLCONDA CREEK

Water Quality Problems

Aquatic life and drinking water are beneficial uses of water that are not fully supported in Golconda Creek. The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These are:

- **Metals:** cadmium and lead

The primary human-caused sources of impairment that were identified in Volume I (2004) and Final Report, Volume II (EPA 2006) are summarized below.

Metals Sources

Sediment-associated metals and historic mining activities in the watershed are the primary sources of metals in Golconda Creek.

A 2003 aerial photography inventory showed two road crossings and road encroachment along 20% of the creek. Extensive conifer and deciduous riparian buffers were present in the headwaters and along most of the stream managed by the BLM. Closer to the mouth, the widths of riparian buffers are reduced by development and landscaping in the floodplain. A 2003 Proper Functioning Condition assessment rated the segment about 1.5 miles above the mouth as “Proper Functioning Condition.”

Old mining areas were observed in tributary drainages to the west of the main stem. The State of Montana’s inventory of mine sites shows three mines in the drainage: Buckeye, Golconda, and Big Chief. None of the mines in the basin are listed in the state’s inventory of high priority abandoned hardrock mine sites. (DEQ Mines, 1995)

Calculations in Final Report, Volume II (EPA 2006) show that an overall, watershed scale metals load reduction of 41 and 77 percent for cadmium and lead, respectively would result in achievement of the applicable water quality standards.

Watershed Restoration Opportunities

Landowners and land managers can improve water quality and watershed health in Golconda Creek and downstream in Prickly Pear Creek and Lake Helena by cleaning up abandoned mines, maintaining existing road crossings, and closing and reclaiming unauthorized roads and trails, and using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals.

JACKSON CREEK (TRIBUTARY TO MCCLELLAN CREEK)

Water Quality Problems

The use of water for aquatic life is not fully supported in Jackson Creek. (DEQ CWAIC 2014) A TMDL was established for zinc in 2013. Data suggest that the zinc TMDL is met during high flow conditions; however, a reduction in zinc loads is required during some low flow time periods.

Metal Sources

Historic mining activities in the watershed are significant contributors of zinc to Jackson Creek. (EPA 2013) No mines are listed by the State of Montana as high priority and no reclamation work has occurred. According to the Montana Bureau of Mines and Geology's abandoned and inactive mines database, there are two abandoned mines in the basin: the Pilot Mine and the Thomas Cruse Mine.

A 2003 Proper Functioning Condition assessment rated the segment above the mouth as "Proper Functioning Condition."

At low flow, it is recommended that zinc is reduced by 31 percent. There is no recommended reduction at high flow.

Watershed Restoration Opportunities

Landowners and land managers can improve water quality and watershed health in Jackson Creek and downstream in McClellan Creek, Prickly Pear Creek and Lake Helena by cleaning up abandoned mines. The Helena National Forest estimates that brook trout occupy Jackson Creek to about 1.5 miles upstream from the mouth.

Watershed Restoration Strategies

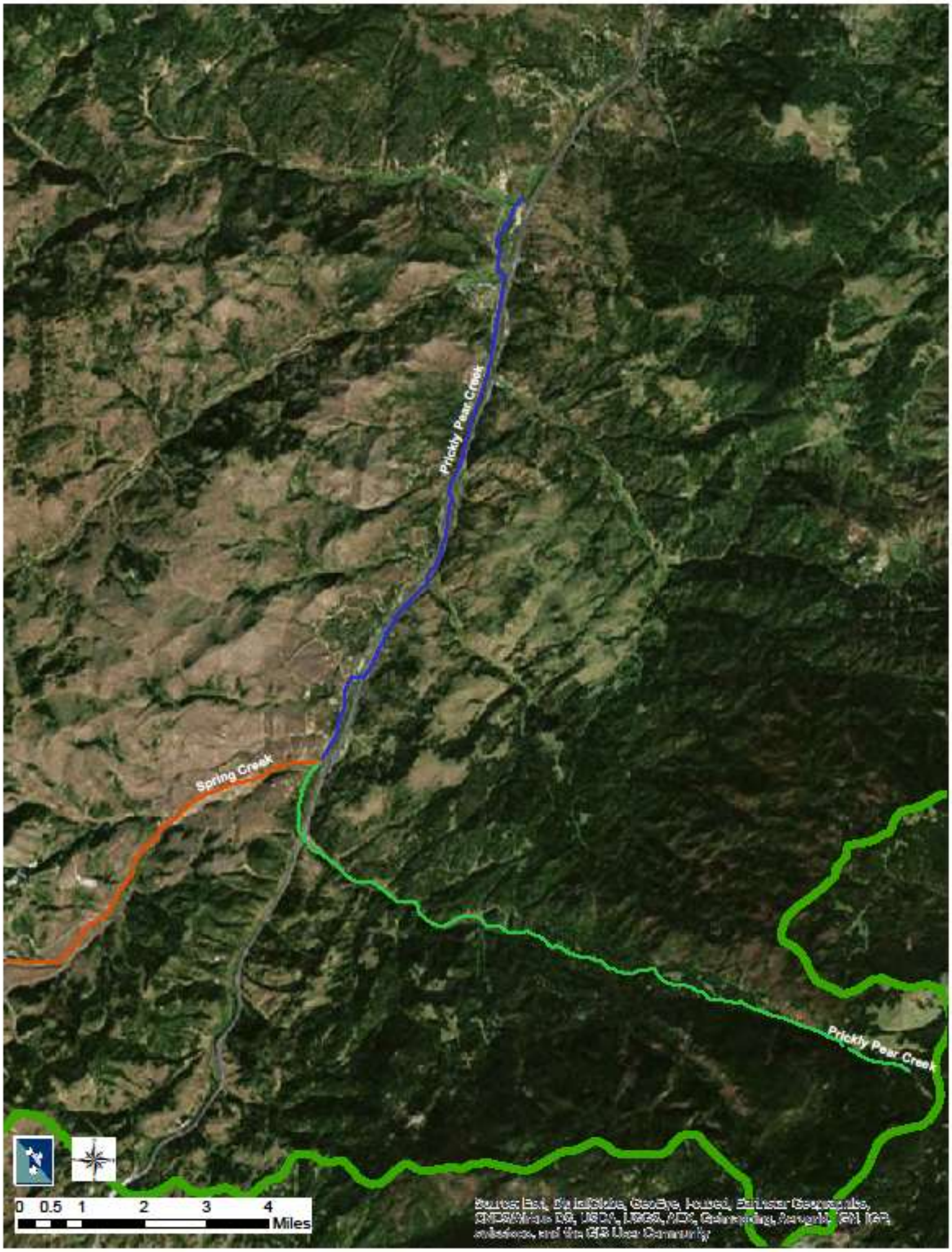
The TMDL for zinc in Jackson Creek is variable and depends on streamflow and the hardness of water. The suggested BMP is mine reclamation.

MAIN STEM OF PRICKLY PEAR CREEK

(South of Montana City)

The main segment of Prickly Pear Creek receives water from the east and west upper Prickly Pear subwatersheds previously described. The main segment receives sediment and metals loads from tributaries, and has TMDLs for both metals and sediment. The stream has undergone extensive alteration, mostly from extensive placer mining. The stream's native riparian vegetation has largely been removed, causing elevated stream temperatures. This segment of Prickly Pear Creek has TMDLs for temperature, metals, and sediment.

Figure B-3: Main Stem Prickly Pear Creek



PRICKLY PEAR CREEK: HEADWATERS TO SPRING CREEK

Water Quality Problems

Aquatic life and drinking water are important uses of water that are not fully supported in Prickly Pear Creek from the headwaters to Spring Creek.

The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These include:

- **Metal:** cadmium, lead
- **Total suspended solids**

The uses of this segment of Prickly Pear Creek are also affected by alteration of streamside vegetative covers and the material at the bottom of the stream that provides habitat for aquatic life.

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (2004) and Final Report, Volume II (EPA 2006) are summarized below.

Metals Sources

Golconda Creek and historic mining activities in the immediate drainage area are the primary sources of metals. None of the mines in the drainage area of this segment are listed in the State of Montana's inventory of high priority abandoned hard rock mine sites. (DEQ Mines, 1995)

Calculations in the Final Report, Volume II (EPA 2006) show that a 40 percent reduction in the cadmium load and a 77 percent reduction in the lead load would result in achievement of the applicable water quality standards in the Prickly Pear watershed.

Sediment Sources

Roads are the primary source of sediment in this segment of Prickly Pear Creek. The Helena National Forest conducted a road sediment survey on the forest portion of the creek and identified 11 sites that are estimated to contribute approximately 5.2 tons of sediment to the stream each year. The aerial photography inventory showed eight road crossings and road encroachment along 30 percent of the stream. Road-related sources of sediment were also identified outside of the Helena National Forest. The last one-third mile of the stream segment was channelized during construction of Interstate 15.

The aerial photography inventory showed that extensive conifer and deciduous riparian buffers were present on the portion of the stream within the Helena National Forest. The widths of deciduous riparian buffers tended to decrease as the Valley bottom widths increased downstream. Widths were variable depending on land ownership and proximity to the Tizer Lake Road.

Severe channel alterations begin below the confluence with Golconda Creek. These likely generate sediment. A historical placer gold dredge operation just above I-15 marks where the stream becomes incised, overly widened, and straightened as a result of the operation.

A 2003 Proper Functioning Condition assessment rated the reach approximately one mile upstream of Helena National Forest administrative boundary as "Proper Functioning Condition." (PFC), but noted some sediment deposition.

An overall, watershed scale sediment load reduction of 32% is estimated to result in achievement of the applicable water quality standards.

Watershed Restoration Opportunities

Landowners can improve water quality and watershed health in this segment of Prickly Pear Creek and in downstream segments of Prickly Pear Creek and in Lake Helena by cleaning up abandoned mines, closing and reclaiming unauthorized roads and trails, and using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals. Prickly Pear Creek is managed as a trout fishery. Genetically pure westslope cutthroat trout are common year-round residents in this segment of Prickly Pear Creek.

Watershed Restoration Strategies

Priority management measures for Prickly Pear Creek that are described in Appendix C include:

- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Road BMPs

PRICKLY PEAR CREEK: SPRING CREEK TO LUMP GULCH

Water Quality Problems

Aquatic life and drinking water are important uses of water that are not fully supported in Prickly Pear Creek from Spring Creek to Lump Gulch.

The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These include:

- **Metals:** cadmium, lead, zinc
- **Sedimentation/siltation**

The uses of this segment of Prickly Pear Creek are also affected by alteration of streamside vegetative covers and the material at the bottom of the stream that provides habitat for aquatic life.

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (2004) and Final Report, Volume II (EPA 2006) are summarized below.

Metals Sources

Upstream sources, tributary streams, and historic mining activities in the immediate drainage area are the primary sources of metals. Spring seeps were noted entering Prickly Pear Creek from placer tailings piles along the stream.

None of the mines in the drainage area of this segment are listed in the State of Montana's inventory of high priority abandoned hard rock mine sites. (DEQ Mines, 1995)

Calculations in Final Report, Volume II (EPA 2006) show that an overall, watershed scale metals load reduction of 74, 69, and 60 percent for cadmium, lead, and zinc, respectively would result in achievement of the applicable water quality standards.

Sediment Sources

Road runoff and road placement are the primary sources of sediment in this segment of Prickly Pear Creek. Tributaries and localized grazing activities also contribute sediment.

The aerial photography inventory showed 16 road crossings. Approximately 91% of the stream segment has been channelized to accommodate the construction of I-15 and the railroad.

The aerial photography inventory showed that the width of deciduous riparian buffers ranged from 30 to 100 feet and were correlated to their distance from roads.

Severe channel alterations from placer mining and the transportation corridor have probably affected the flow regime along this segment.

An overall, watershed scale sediment load reduction of 32% is estimated to result in achievement of the applicable water quality standards.

A 2003 Proper Functioning Condition assessment rated the reach just below the Alhambra RV Park as "Non-functional."

Watershed Restoration Opportunities

Landowners and land managers can improve water quality and watershed health in this segment of Prickly Pear Creek and in downstream segments of Prickly Pear Creek and in Lake Helena by using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals. Prickly Pear Creek is managed as a trout fishery.

Watershed Restoration Strategies

Best management practices for Prickly Pear Creek that are described in Appendix C include:

- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Off-stream watering facilities
- Water gaps
- Road BMPs

Abandoned mine reclamation would also be a helpful strategy to address a significant sediment source however the work entailed to address this is best done by state and federal agencies with their expertise and jurisdiction. The LHWG and the WQPD are solely addressing private sediment sources in this plan.

SPRING CREEK

Water Quality Problems

Aquatic life and drinking water are important uses of water that are not fully supported in Spring Creek in the listed segment which runs from the confluence with Corbin Creek to the mouth of Spring Creek. The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These include:

- **Metals:** arsenic, cadmium, copper, lead, and zinc
- **Nutrients:** nitrogen, phosphorus
- **Total suspended solids**

The uses of Spring Creek are also affected by low flows and alteration of streamside vegetative covers and the material at the bottom of the stream that provides habitat for aquatic life.

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (EPA 2004) and Final Report, Volume II (EPA 2006) for the Spring Creek watershed are summarized below.

Metals Sources

Corbin Creek, historic mining activities and sediment-associated metals sources are the primary sources of metals in Spring Creek. The Montana Tunnels Mine in the headwaters of the watershed may also be a source of metals. The Corbin Flats Mine is listed in the State of Montana's inventory of high priority abandoned hard rock mines sites. (DEQ Mines, 1995)

Calculations in the Final Report, Volume II (EPA 2006) show that an overall, watershed scale metals load reduction of 56, 87, 64, 82, and 81 percent for arsenic, cadmium, copper, lead, and zinc, respectively, would result in achievement of the applicable water quality standards.

Nutrient Sources

The primary sources of nitrogen, in order of importance, are dirt roads, septic systems, timber harvest, abandoned mines, and human-caused streambank erosion.

A nitrogen load reduction of 75% would be required to support all beneficial uses. However, the maximum attainable nitrogen load reduction for the Spring Creek watershed is estimated to be only 22%.

The primary sources of phosphorus, in order of importance, are dirt roads, timber harvest, abandoned mines, and human-caused streambank erosion.

A phosphorus load reduction of 83% would be required to support all beneficial uses. However, the estimated maximum attainable phosphorus load reduction for the Spring Creek watershed is only 29%.

Sediment Sources

The primary sources of sediment, in order of importance, are unpaved roads, timber harvest, abandoned mines, human-caused streambank erosion, and non-system roads and trails. Unpaved roads contribute an estimated 43% of the sediment load. Road crossings throughout the watershed and direct road tread drainage in the central watershed are contributing to road related sediment impacts. Timber harvest has occurred in the upper watershed.

Four abandoned mines (Bluebird, Corbin Flats, Washington, and Salvai) were identified as being capable of delivering sediment to the channel. Human-caused streambank erosion is isolated throughout Spring Creek and largely the result of stream channelization and historic mining activity. Non-system roads and trails were observed in the uplands of the Spring Creek watershed.

Nearly the entire segment of the creek above the town of Jefferson City has been channelized by mine reclamation. The 2003 preliminary source assessment showed that riparian buffers were virtually absent.

Most of the creek is surrounded by private lands that are used for grazing and rural housing. The last one-quarter mile of the creek flows through Jefferson City. Tailings piles line the banks throughout the town of Jefferson City.

The 2003 preliminary source assessment noted channel incisement and dewatering resulting from a holding pond and water transfer station used by the Montana Tunnels mine for pumping water to its operation.

Extensive channel alterations from mine reclamation begin near the confluence with Corbin Creek. Watershed Characterization, Volume I (EPA 2004) described the channel as “basically a ditch” -- the stream is incised and straightened. There is little bank-stabilizing riparian vegetation.

Unpaved non-system roads and trails in the upper watershed contribute sediment due to the lack of drainage structures.

An overall, watershed scale sediment load reduction of 30% is estimated to result in achievement of the applicable water quality standards.

A 2003 Proper Functioning Condition assessment rated the reach approximately 3/4 mile above the mouth as “Non-functional”, citing excessive fines, lack of riparian vegetation, and channel alterations.

Watershed Restoration Opportunities

Landowners can improve water quality and watershed health in Spring Creek and downstream in Prickly Pear Creek and Lake Helena by cleaning up abandoned mines, reclaiming and closing unauthorized roads and trails and using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals.

Watershed Restoration Strategies

Priority management measures for Spring Creek that are described in Appendix C include:

- Filter strips
- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Off-stream watering facilities
- Forestry BMPs
- Water gaps
- Road BMPs

- Stormwater BMPs

Other important management practices include:

- Proper installation and maintenance of septic systems
- Mine reclamation

While it may not be possible to reduce nutrient loads to the levels where all beneficial uses are supported, water quality in Spring Creek and downstream water bodies will continue to degrade if no action is taken to reduce nutrient pollution.

THE HELENA VALLEY

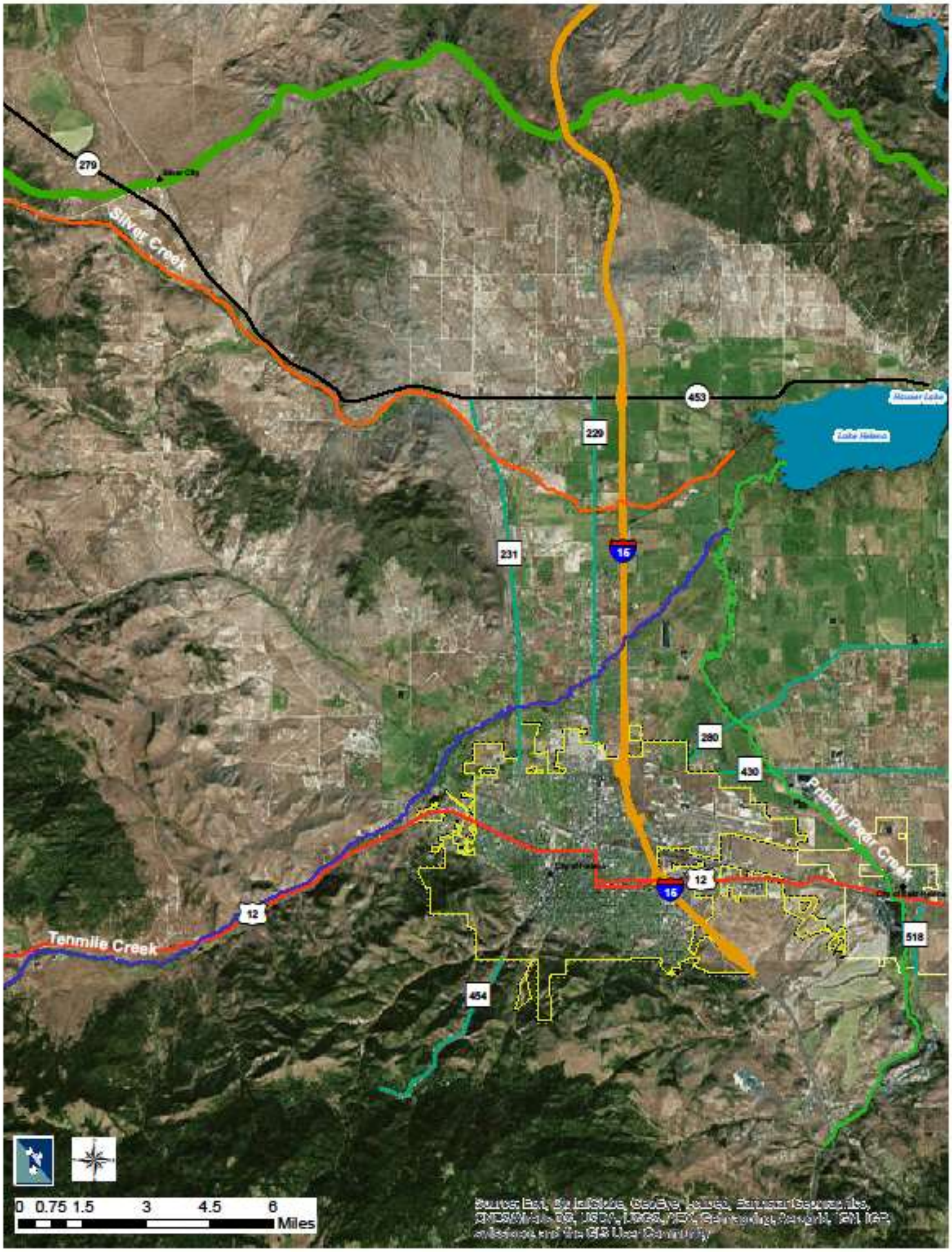
(Tenmile Creek below water treatment plant, Prickly Pear Creek below Montana City, Silver Creek below Silver City)

This sub-watershed can be defined as the Valley floor, the edges of which are determined where stream slopes (gradients) significantly start to flatten out such as Tenmile Creek downstream of the water treatment plant and Silver Creek as it enters the northwestern corner of the Helena Valley. The watershed is largely dominated by the large, densely populated urban area of Helena with adjoining, less densely populated suburban areas to the west, north, and east. This area is characterized by extensive dense land use by agriculture (grazing, hay), and housing developments with lawns. Because of the extensive development, a significant proportion of the surface area is impermeable, covered with asphalt or concrete.

The surface water and groundwater systems have been extensively changed by human activity. The Helena Irrigation Canal supplies surface water to agriculture in the Valley while the unlined canals leak water, recharging the groundwater. In the central part of the Valley, surface drains lower the water table in order to make more land suitable for agricultural use. The drain water is channeled to Lake Helena. Extensive surface water diversions for agriculture reduce stream flow. There are extensive return flows of wastewater to the streams from both point sources (City of Helena Water Treatment Plan) and nonpoint sources (home septic systems, grazing and agriculture on land adjacent to streams). The banks of both Prickly Pear Creek and Ten Mile Creek have been extensively grazed, resulting in increased erosion.

Impacts in the major streams result from a complex set of factors, including land use in the Valley, as well as the accumulation of material from the tributary sub-watersheds. Both Prickly Pear Creek and Ten Mile Creek have TMDLs for nutrients because of the wastewater flows into the streams. The TMDLs for metals for both streams are the result of runoff from rock containing metals in the upper watersheds. The extensive erosion of banks on both streams in the Valley has resulted in TMDLs for sediment for both streams. Prickly Pear Creek has been extensively dewatered in the Valley, resulting in a TMDL for temperature.

Figure B-4: The Helena Valley



LOWER PRICKLY PEAR CREEK

Water Quality Problems

Agriculture, aquatic life, drinking water, and recreation are all important uses of water that are not fully supported in some segments of Prickly Pear Creek from Lump Gulch to Lake Helena.

Table B-5-Beneficial Use Support: Prickly Pear Creek from Lump Gulch to Lake Helena		
Use of Water	**Fully Supported in These Segments**	**Not Fully Supported in These Segments**
Agriculture	Helena Wastewater Treatment Plant (WWTP) Discharge to Lake Helena	Wylie Drive to Helena WWTP Discharge
Aquatic Life		Lump Gulch to Lake Helena
Drinking Water		Lump Gulch to Lake Helena
Primary Contact Recreation		Wylie Drive to Lake Helena

Source: DEQ CWAIC 2014

The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These are shown in Table B-6.

Table B-6: Causes of Impairment with Completed TMDLs Prickly Pear Creek from Lump Gulch to Lake Helena	
Pollutants Causing Impairment	**Impaired Segments**
Metals: arsenic, cadmium, copper, lead, and zinc.	Lump Gulch to Lake Helena
Nutrients: total nitrogen, total phosphorus, nitrate/nitrite.	Wylie Drive to Lake Helena
Sedimentation/Siltation	Lump Gulch to Lake Helena
Water Temperature	Lump Gulch to Wylie Drive

Source: DEQ CWAIC 2014

A TMDL has been established for each of the causes of impairment listed above. The uses of Prickly Pear Creek are also affected by low flows, ammonia, and alteration of streamside vegetative covers and the material at the bottom of the stream that provides habitat for aquatic life. Table B-7 shows which reaches are affected by these additional causes of impairment.

Table B-7: Additional Causes of Impairment with No TMDLs: Prickly Pear Creek from Lump Gulch to Lake Helena	
Pollution	**Segment**
Alteration in streamside vegetative covers	Lump Gulch to Lake Helena
Ammonia	Wylie Drive to Lake Helena
Low flow alterations	Wylie Drive to Lake Helena
Physical substrate habitat alterations	Lump Gulch to Lake Helena

Source: DEQ CWAIC 2014

Appendix A to the Final Report, Volume II (EPA 2006) identifies the sources of impairment of beneficial uses. Primary sources of impairment in this area are summarized below.

Metals Sources

Metals sources include upstream sources and the Lump Gulch tributary. Historical mining activities in the immediate drainage area of the Lump Gulch to Wylie Drive segment have contributed to metals in this section. None of the mines in the immediate drainage area of this segment are listed in the State of Montana's inventory of High Priority Abandoned Hardrock Mine Sites. (DEQ Mines, 1995)

The ASARCO East Helena Lead Smelter was permitted to discharge arsenic, cadmium, copper, lead and zinc.

Calculations in the Final Report, Volume II (EPA 2006) show that watershed scale metals load reductions of 58, 74, 58, 69, and 60 percent, for arsenic, cadmium, copper, lead and zinc, respectively, would result in achievement of the applicable water quality standards.

Nutrients Sources

Wastewater treatment plant discharges are the primary human-caused source of nutrients in the Prickly Pear Creek watershed. Septic systems are a significant source of nitrogen.

Dewatering results in increased nutrient concentrations and increased stream temperature and may exacerbate the impacts of nutrient loading.

In localized areas, nutrient loading from grazing and single-family residential sources may be far more significant than at the watershed scale.

Sediment Sources

Agriculture was the single largest source of sediment within the greater Prickly Pear Creek watershed. The reach from Lump Gulch to the WWTP produces the greatest quantities of sediment from agricultural activities. Unpaved roads were the second largest source of sediment. The segments between Lump Gulch and Wylie Drive produced the most road-related sediment due to high road densities associated with subdivision development. The third largest source of sediment is streambank erosion from activities including riparian grazing, road encroachment, stream channelization, riparian vegetation removal and historic mining activity.

Clancy Creek and Lump Gulch also contribute sediment to Prickly Pear Creek. Timber harvest is another significant source of sediment above Wylie Drive. Abandoned and active mines and quarries are other sources of sediment.

A sediment load reduction of 38% for the entire Prickly Pear Creek watershed is estimated to result in achievement of the applicable water quality standards.

A nitrogen load reduction of 80% would be required to support all beneficial uses. However, the maximum attainable nitrogen load reduction for the Prickly Pear Creek watershed is estimated to be only 39%.

A phosphorus load reduction of 87% would be required to support all beneficial uses. However, the maximum attainable phosphorus load reduction for the Prickly Pear Creek watershed is estimated to be only 62%.

While it may not be possible to reduce nutrient loads to the levels where all beneficial uses are supported, water quality in Prickly Pear Creek and Lake Helena will continue to degrade if no action is taken to reduce nutrient pollution. An adaptive management strategy is presented in Final Report, Volume II (EPA 2006).

Temperature Sources

Three key sources contributed to increased temperatures in Prickly Pear Creek: flow alterations, riparian degradation and point sources.

Irrigation withdrawals, industrial withdrawals, and dams reduce the amount of water in the lower 6 miles of Prickly Pear Creek. The Creek has been completely dewatered in the segment between Wylie Drive and the Helena WWTP.

Proper Functioning Condition assessments were conducted at three sites along lower Prickly Pear Creek in 2003. The upstream site ranked as functional, but at risk. Two downstream segments were ranked non-functional, indicating severe riparian degradation.

The City of East Helena and City of Helena WWTP outfalls may affect stream temperature. Effluent temperature was not monitored.

Watershed Restoration Goals

The WQPD and the LHWG have the following goals for improving water quality and watershed health in the Lower Prickly Pear Creek watershed:

- Ensure that water continues to flow throughout this reach of Prickly Pear Creek.
- Provide for cooler temperatures in Prickly Pear Creek.
- Improve fish and wildlife habitat.
- Reduce sediment, nutrients, and associated metals.

Watershed Restoration Strategies

Priority management measures for Prickly Pear Creek for the LHWG and the WQPD for 2014-2019 include:

- Maintain streamflows in Prickly Pear Creek through purchase of water from the Bureau of Reclamation (Prickly Pear Creek Re-Watering Project).
- Identify and pursue additional opportunities to improve instream flows and fish spawning by eliminating or moving diversions when necessary to maintain stream flows or provide for fish passage.
- Seek willing landowners to put in place and maintain riparian buffers and filter strips.
- Encourage use of water gaps, off-stream watering, and riparian fencing to control livestock access to the stream.
- Implement bioengineered stream bank stabilization treatments.
- Reduce nutrient loading by supporting efforts by the cities of Helena or East Helena to reduce nutrients in wastewater discharged to Prickly Pear Creek. These efforts may include plant optimization studies or nutrient trading.

The management measures identified are described in Appendix C. Landowners in this area can use these best management practices as a resource for implementation of management measures on their property.

The measures identified above will improve water quality and watershed health in this reach in the following ways:

- Maintaining cooler stream temperatures in Prickly Pear Creek.
- Reducing sediment and nutrient pollution.
- Maintaining continuous flow of water throughout Prickly Pear Creek and thereby improving habitat for fish and other aquatic life.
- Improving fish and wildlife habitat.

Riparian buffers will also trap metals in runoff; however, this management measure will not be sufficient to restore beneficial uses impaired by metals because most metals come from upstream sources.

Table B-8 presents a summary of initiatives to improve water quality, targeted areas and the party responsible for carrying out the initiative.

Table B-8: Initiatives, Targeted Areas, and Responsible Party

Initiative	Targeted Reach	DEQ Segment(s)	Responsible Party
Prickly Pear Creek Restoration Project	Prickly Pear Creek between York and Sierra Roads	Wylie Drive to Helena WWTP Helena WWTP to Lake Helena	WQPD LHWG
Prickly Pear Creek Re-Watering Project	Immediately downstream of East Helena almost to York Road	Wylie Drive to Helena WWTP	WQPD Prickly Pear Water Users Helena Valley Irrigation District
Aspen Trails Ranch Project	Prickly Pear Creek north of Olsen Road	Wylie Drive to Helena WWTP	PPLT FWP
ASARCO East Helena Facility Site Cleanup	Former ASARCO East Helena Facility site	Lump Gulch to Wylie Drive	METG
Natural Resource Damage Program	Former ASARCO East Helena Facility site	Lump Gulch to Wylie Drive	State of Montana NRDP
City of Helena WWTP	Helena WWTP to Lake Helena	Helena WWTP to Lake Helena	City of Helena

These initiatives are described in more detail below.

Prickly Pear Creek Restoration Project

The WQPD and the LHWG have completed a restoration project on the lower end of Prickly Pear Creek between York and Sierra roads.

The goals of this project include:

- Reduce landowner property loss, improve aquatic and riparian habitat
- Improve livestock management, stabilize the stream channel
- Increase fish populations
- Enhance flood storage
- Measurably reduce sediment and nutrient loads and temperature impairments

Phase I: Elliot Property

The WQPD and the LHWG have completed the first phase of this project: the restoration of the segment of Prickly Pear Creek that flows through the Elliot property. This reach has been impacted by significant stream modification. The channel is incised with limited access to its floodplain. Bioengineered streambank stabilization management measures were implemented. A project effectiveness monitoring plan has been put in place and the initial data has been gathered.

Phase II

The WQPD and the LHWG will seek funding as well as opportunities to partner with other landowners to restore the entire reach of Prickly Pear Creek between York and Sierra roads. Additional opportunities in this reach include the following:

- Restore fish passage and natural hydrology through removal of a diversion and stream channel enhancement. There may be an opportunity to replace the diversion and construct a pipeline or diversion to convey effluent from the City of Helena's wastewater treatment plant to irrigate this property if water rights can be secured. The diversion is currently a barrier to fish passage and also alters the hydrology of the creek, causing sediment deposits and wave erosion.
- Restore natural riparian vegetation in areas where grazing has recently been eliminated.

Prickly Pear Creek Re-Watering Project

The Prickly Pear Creek Re-Watering Project maintains flows in the segment of Prickly Pear Creek from Wylie Drive to the City of Helena WWTP. Prior to 2008, a reach extending approximately 2-3 miles downstream from the Prickly Pear Water Users diversion had been completely dewatered at times during the irrigation season. (This reach begins just downstream from the City of East Helena and extends almost to York Road.)

The Prickly Pear Creek Re-Watering Project was initiated in 2008. Water purchased from the Bureau of Reclamation Canyon Ferry Reservoir Project is substituted for water that has been historically diverted from Prickly Pear Creek to grow crops. Contractual agreements provide for the purchase of 2,000 acre-feet of water from the Canyon Ferry Reservoir Project. When flows in Prickly Pear Creek fall below 20 cfs, the Prickly Pear Water Users stop diverting water from Prickly Pear Creek. The Helena Valley Irrigation District then delivers water purchased from the Canyon Ferry Reservoir Project to the conveyance system used by the Prickly Pear Water Users.

Substitution of Canyon Ferry Reservoir Project water for Prickly Pear Creek water has increased streamflows during the driest time of the year by 2-3 cfs. Since its inception in 2008, the Project has been successful in maintaining a continuous flow of water throughout Prickly Pear Creek.

Various partners have provided financial support for this project. However, there is no ongoing, stable source of funding. Annual costs for purchase of water are approximately $25,000. Additional funds are needed to submit an application and obtain approval from the Department of Natural Resources and Conservation to temporarily change the permitted use of these water rights to allow for temporary instream use to benefit the fishery.

Aspen Trails Ranch Project

The Prickly Pear Land Trust (PPLT) acquired a 36-acre parcel on Prickly Pear Creek north of Olsen Road. The parcel includes a small portion of the historic Stansfield Lake lakebed and a spring creek. This parcel has been donated to FWP for the purpose of establishing a day use fishing access site. The PPLT also acquired a 230-acre conservation easement on an adjacent parcel. FWP plans to manage grazing and weeds and restore riparian plant communities and streambanks to more natural conditions. FWP may restore the spring creek. This initiative was funded by the Lewis & Clark County Open Space Bond and the Land and Water Conservation Fund.

ASARCO East Helena Facility Site Cleanup

The Montana Environmental Trust Group (METG) is a private non-profit entity that is responsible for carrying out the cleanup and restoration of the former ASARCO East Helena Facility. Their efforts are focused on soil and groundwater contamination. Improving the quality of Prickly Pear Creek waters is not a specific goal of their effort; however, the activities identified below will affect water quality and quantity. Many impacts have not been analyzed. It is anticipated that environmental impacts of activities will be analyzed in the application and review process for various required permits.

- Measures to stabilize the slag pile and realign Prickly Pear Creek will reduce erosion of slag into Prickly Pear Creek.
- The combined South Plant Hydraulic Control Interim Measures will change hydraulics on the south end of the site.
- Realignment of Prickly Pear Creek with the realigned channel designed for additional meandering, length, and other attributes to lower stream velocities.
- Removal of the smelter dam in 2014. This removed a barrier to fish passage. Impacts to pollutant loads have not been analyzed.
- The Upper Lake diversion structure will be removed and Upper and Lower Lakes will be drained. Upper Lake, Upper Lake Marsh, and Lower Lake are human-made features that will be returned to pre-smelter conditions.
- Wilson Ditch, which supplies irrigation water to Burnham Ranch, will be abandoned and the point of diversion moved. Sixteen water rights for four different owners are legally tied to the Wilson Ditch headgate. The current point of diversion at Upper Lake must be relocated for these water rights because Upper Lake will no longer store water.
- Two MPDES permitted discharges were eliminated: one for discharging treated stormwater from the wastewater treatment plant to Lower Lake expired July 31, 2015 and an authorization to discharge under a general permit for stormwater discharges associated with industrial activity. The METG ultimately plans to eliminate these discharges. An Evapotranspiration Cover System has been proposed to cover the majority of the site that will eliminate contact between clean stormwater and contaminated soils so that active stormwater management and treatment is no longer required.
- Restore wetland functions. Removal of Tito Park, Lower Lake, and the open water of Upper Lake will increase the wetlands area by approximately 25 acres.
- A variety of water rights held by METG will be sold. Depending on the outcome, instream flows may be affected.

Natural Resource Damage (NRD) Program

The State of Montana's NRD Program has nearly $6 million to restore natural resources in the immediate area of the Former ASARCO East Helena Facility. The NRD has acquired approximately 240 acres of wetlands on the site. Projects may be funded through grants or direct contracts. A restoration plan will likely be developed by 2015.

Prior to that, the NRD is accepting applications for grants of up to $75,000 to restore or substantially improve or replace natural resources damaged by ASARCO.

City of Helena Wastewater Treatment Plant

The City of Helena has significantly reduced its total nitrogen (TN) and total phosphorus (TP) discharges to Prickly Pear Creek from its wastewater treatment plant. Alternative options to reduce nutrient pollution from the plant have been evaluated and some options have been implemented. Total nitrogen discharges have been reduced 24% by weight and total phosphorus discharges have been reduced 27% since 2008. Voluntary measures were implemented and the permit for the City's wastewater treatment facility the City to conducted an optimization study to improve treatment efficiency for these pollutants in 2013. The City has established the following goals: monthly average discharge of 8 mg/L or less for TN and 3 mg/L or less for TP.

Biosolids from the plant are land applied to agricultural lands (seasonally) and composted. The plant treats 1.5 million gallons per year of septic waste, reducing pollution from nonpoint sources. The City of Helena's Public Works Department recognizes the potential benefits of nutrient trading. For example, the City could pay for projects that reduce nutrient pollution instead of paying to upgrade the plant. Such projects must be cost-effective, which requires regulatory certainty and the elimination of regulatory barriers.

City of East Helena Wastewater Treatment Plant

The City of East Helena upgraded its wastewater treatment plant in 2014 to reduce copper, zinc and phosphorus discharges.

Montana Department of Transportation (MDT)

The Montana Department of Transportation (MDT) is responsible for maintaining the following routes that are adjacent to Prickly Pear Creek: Interstate 15 and its frontage road and Secondary 518. MDT utilizes traction sand mixed with salt (sand/salt) and salt brine during road winter maintenance activities. Over the past ten years, MDT has decreased the amount of sand applied to roadways within the watershed by: 1) increasing the salt content in the sand/salt mixture, 2) calibrating the sanders on MDT trucks, and 3) training snowplow drivers. The salt content in MDT stockpiles has gradually increased from approximately 5 to 7% ten years ago to the current salt content of 10%. As the salt content of the mix increases, the amount of sand discharged to surface water bodies decreases. MDT has also constructed new stormwater ponds adjacent to Canyon Ferry Road.

LOWER TENMILE CREEK

Water Quality Problems

Aquatic life and drinking water are important uses of water that are not fully supported in the segment of Tenmile Creek that begins at the Helena Drinking Water Treatment Plant and goes to the mouth of the creek. (DEQ CWAIC 2014)

The DEQ and the EPA have identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These include:

- **Metals:** arsenic, cadmium, copper, lead, and zinc
- **Nutrients:** nitrogen, phosphorus, and nutrient/eutrophication biological indicators
- **Sedimentation/Siltation**

Other types of pollution that do not require a TMDL, but do affect the use of Lower Tenmile Creek include:

- Low flow alterations
- Alteration in streamside vegetative covers

The primary human-caused sources of impairment that were identified in Final Report, Volume II (EPA 2006) are summarized below.

Metals Sources

Upstream sources and abandoned mines in the immediate drainage area are the primary sources of metals in this segment of Tenmile Creek.

Calculations in Volume II show that a watershed scale load reduction of 66, 80, 69, 79 and 55 percent for arsenic, cadmium, copper, lead, and zinc, respectively, will result in achievement of the applicable water quality standards.

Nutrient Sources

The primary human-caused source of nutrients in Tenmile Creek include (in order of importance): septic systems, urban areas, agriculture, dirt roads, streambank erosion, timber harvest, and paved roads.

A nitrogen load reduction of 59% is assumed to be necessary to support all beneficial uses. However, the maximum attainable nitrogen load reduction for the Tenmile Creek watershed is estimated to be only 23%; therefore, it may not be possible to attain the water quality target established for nitrogen. A phosphorus load reduction of 61% is assumed to be necessary to support all beneficial uses. However, the maximum attainable phosphorus load reduction for the Tenmile Creek watershed is estimated to be only 38%. An adaptive management strategy is presented in Final Report, Volume II (EPA 2006).

Sediment Sources

Agriculture is the single largest source of sediment within the greater Tenmile Creek watershed. Unpaved roads are the second largest source of sediment. The third largest source of sediment is streambank erosion from activities including riparian grazing, road encroachment, stream channelization, riparian vegetation removal and historic mining activity. Sediment from urban areas is associated with the development of the Helena Valley.

A 2003 Proper Functioning Condition assessment rated the reach above Sevenmile Creek as “Functional – at risk.” The stream in this area has healthy and diverse riparian vegetation, but the field crew noted that the stream was riprapped and that pool infilling was occurring. The reach above Green Meadow Drive was classified as “Functional – at risk verging on Non-functional.” The field crew noted that the stream had eroding banks, excess sediment deposition, and a limited riparian area. Watershed Characterization, Volume I (EPA 2004)

A sediment load reduction of 36% is estimated to result in achievement of the applicable water quality standards.

Dewatering

A TMDL is not required for dewatering; however, the watershed characterization in Watershed Characterization, Volume 1 (EPA 2004) notes that dewatering has affected the natural hydrology of the stream and the quality of aquatic habitat. Dewatering occurs in the reach beginning at McHugh Lane and continuing to a point downstream of I-5 and upstream from where the creek crosses Sierra road. Dewatering is a result of withdrawal for municipal use upstream, diversions for irrigation in this reach, and natural losses to aquifer recharge.

Watershed Restoration Goals

The WQPD and the LHWG have the following goals for improving water quality and watershed health in the Lower Tenmile Creek watershed:

- Seek opportunities to ensure that water continues to flow throughout this reach of Tenmile Creek
- Improve fish and wildlife habitat
- Reduce sediment, nutrients, and associated metals

Watershed Restoration Strategies

The reach between the Helena Drinking Water Treatment Plant and Montana Avenue provides the greatest opportunity to engage landowners in implementing management measures that will reduce sediment, nutrients, and associated metals. Priority management measures for Lower Tenmile Creek for the LHWG and the WQPD for 2016-2023 include:

- Identify and pursue additional opportunities to improve instream flows and fish spawning by eliminating or moving diversions when necessary to maintain stream flows or provide for fish passage.
- Seek willing landowners to put in place and maintain riparian buffers and filter strips.
- Encourage use of water gaps, off-stream watering, and riparian fencing to control livestock access to the stream.
- Implement bioengineered stream bank stabilization treatments and stream channel restoration projects.

The management measures identified are described in Appendix C. Landowners in this area can use this as a resource for implementation of management measures on their property.

The measures identified above will improve water quality and watershed health in this reach in the following ways:

- Reducing sediment and nutrient pollution.
- Improving fish and wildlife habitat.

Riparian buffers will also trap metals in runoff; however, this management measure will not be sufficient to restore beneficial uses impaired by metals because most metals come from upstream sources.

SILVER CREEK

Water Quality Problems

Aquatic life and drinking water are important uses of water that are not fully supported in Silver Creek from the headwaters to Lake Helena. The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These include the metals arsenic and mercury. A TMDL has been established for each of these metals.

The uses of Silver Creek are also affected by the pesticide DDE, low streamflow, and alteration of the substrate; material at the bottom of the stream that provides habitat for aquatic life.

The primary human-caused sources of impairment that were identified in Volume I (2004), Final Report, Volume II (EPA 2006), and the Metals TMDL Addendum (EPA 2013) are summarized below.

Metals Sources

Sediment-associated metals and historic hard rock mining activities in the upper watershed are the primary sources of metals in Silver Creek. Jennies Fork is a tributary and contributes to the metals loads. Five mine sites in the watershed are listed in the state's inventory of high priority abandoned hard rock mine sites: Goldsil Mill Site, Drumlummon Mine/Mill Site, Argo Mill Site, Belmont, and Bald Mountain (DEQ Mines, 1995). The historic use of mercury during the amalgamation process at placer mining sites is considered a significant source of mercury impairment.

The Drumlummon Mine and Mill site has been active intermittently since 1876. In 2008, RX Gold and Silver, Inc. began conducting surface and underground exploration work, working under the Small Miner Exclusion Statement. The DEQ issued a MPDES permit to address the discharge of pumped mineshaft water to Silver Creek through a drain field. The permit limits the concentrations of numerous pollutants including mercury. The mine also has a MPDES permit for storm water discharge associated with minor construction activities. In 2013, RX Gold and Silver, Inc. announced plans to halt work and close the Drumlummon Mine indefinitely.

Lewis and Clark County holds a stormwater permit for periodic reconstruction of the Marysville Road. Due to the nature of this activity, no metal loading is expected from this source and no waste load is allocated to it in the TMDL.

Silver Creek has been extensively placer mined, resulting in major channel and floodplain disturbance, waste rock dumps, settling ponds and numerous tailings dams spanning the stream channel.

Although DEQ has studied and proposed reclamation activities in the Silver Creek drainage, no action has taken place.

Calculations in the Final Report, Volume II (EPA 2006) show that an overall, watershed scale metals load reduction of 65% for arsenic would result in achievement of the applicable water quality standards. Calculations in the Metals TMDL addendum show that a 33% reduction in total mercury loading is required during low flow time periods to meet water quality standards.

Watershed Restoration Opportunities

Landowners and land managers can improve water quality and watershed health in Silver Creek by cleaning up abandoned mines, closing and reclaiming unauthorized roads and trails, and using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals. High levels of mercury have been found in fish tissue following a 1976 fish kill; FWP has maintained fish consumption advisory for Silver Creek since that time. Lower Silver Creek (downstream from Interstate 15 and the D2 drain ditch) has the potential to be a very productive rainbow and brown trout fishery. The D2 drain ditch provides an important spawning area for brown trout.

Watershed Restoration Strategies

Priority management measures for Silver Creek that are described in Appendix C include:

- Filter strips
- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Off-stream watering facilities
- Water gaps
- Road BMPs

Other important management practices include:

- Stormwater BMPs
- Mine reclamation

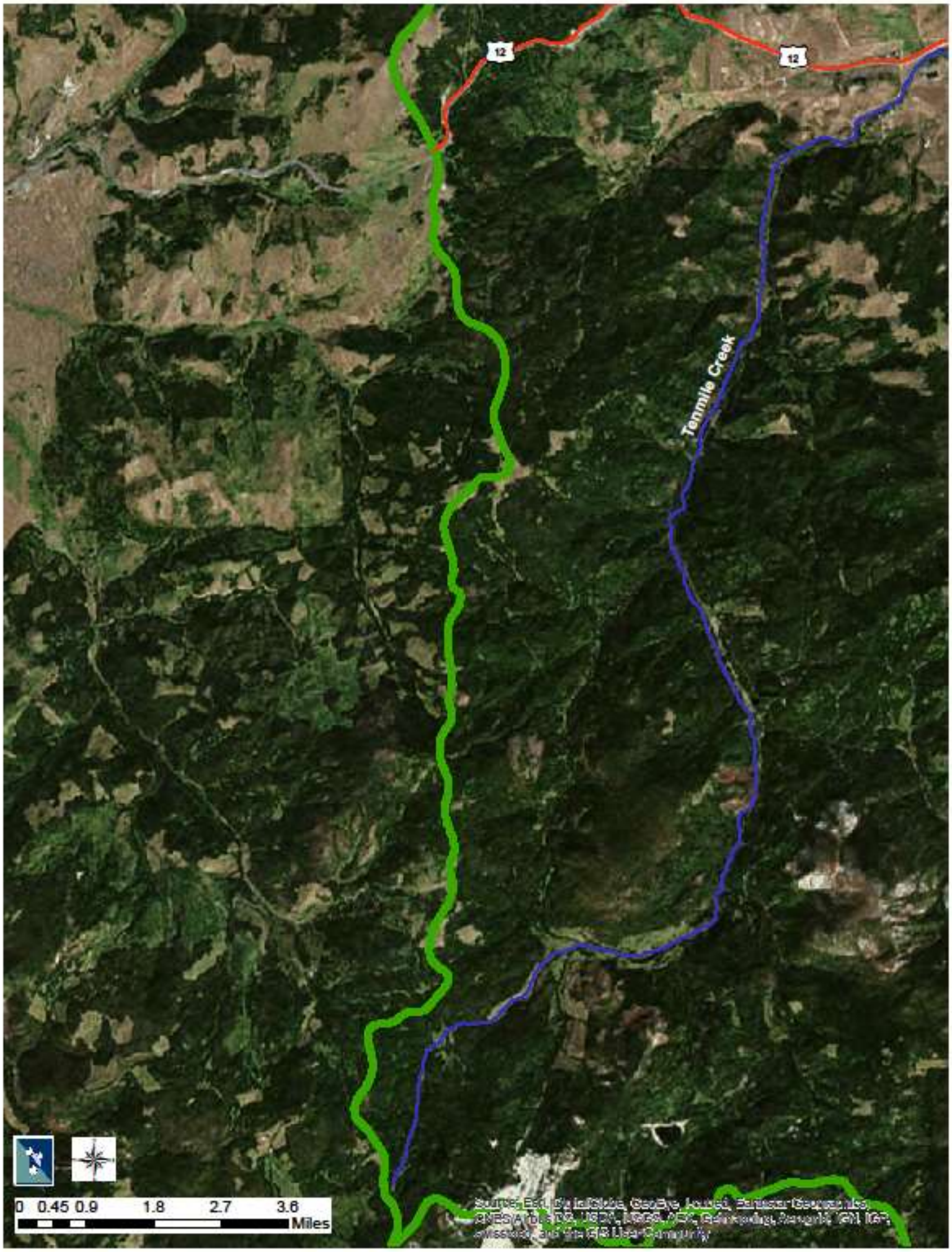
UPPER TENMILE CREEK WATERSHED

(Headwaters to Tenmile Creek water Treatment plant)

The Upper Ten Mile Creek Watershed is a narrow main Valley with steep side slopes draining substantial upland areas, particularly to the south. The geology of the area is mostly igneous and volcanic. Associated with the igneous rocks are ore bodies that have been intensively mined; the watershed has one of the highest densities of abandoned mines in Montana. The ridges and sideslopes are largely forestlands in the Helena National Forest, but historically the land near Ten Mile Creek has been greatly disturbed because of extensive mining, and the resultant construction of roads and a railroad. The watershed supplies a substantial portion of the drinking water for the City of Helena.

For this sub-watershed, the geology and steep topography are the natural causes of the pollution of Ten Mile Creek. Weathering and erosion of the volcanic rock yields large amounts of coarse grained sediment that are efficiently transported into Ten Mile Creek because of the steep stream slopes. The very extensive mining activity results in large volumes of sediment containing metals entering Ten Mile Creek. As a result, Ten Mile Creek in this watershed has TMDLs for sediment and metals.

Figure B-5: Upper Tenmile Creek Watershed



UPPER TENMILE CREEK

Water Quality Problems

Agriculture, aquatic life, drinking water, and recreation are all important uses of water that are not fully supported in Upper Tenmile Creek. (Beneficial uses for agriculture and recreation were not assessed for the segment of Tenmile Creek that goes from the headwaters to Spring Creek) (DEQ CWAIC 2014). The Upper Tenmile watershed is the primary source of drinking water for approximately 31,000 Helena residents.

The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These are:

- **Metals:** arsenic, cadmium, copper, lead, and zinc
- **Sedimentation/siltation** for the reach that extends from Spring Creek to the Helena Drinking Water Treatment Plant

The uses of water between Spring Creek and the Helena Drinking Water Treatment Plant are also affected by low streamflows.

Land uses that affect water quality in the watershed include streamside private residences, recreation, roads, remediation sites, grazing, and timber harvest. a localized area of moderate septic density is located downgradient of drinking water supply intake well #3 but upgradient of drinking water supply intake well #2. (PWS 2012) Should septic system failure occur in this localized area, effluent could leach to area groundwater or enter into Tenmile Creek via interaction of groundwater with surface water.

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (EPA 2004) and Final Report, Volume II (EPA 2006) are summarized below.

Metals Sources

Historic hard rock mining activities are the primary sources of metals in this segment of Tenmile Creek. Sixteen abandoned mines in the drainage area are listed in the state's inventory of high priority abandoned hardrock mine sites. (DEQ Mines, 1995)

Calculations in Volume II show that watershed scale metals load reductions of 66, 80, 79 and 55 percent for arsenic, cadmium, copper, lead, and zinc, respectively, would result in achievement of the applicable water quality standard.

Sediment Sources

Roads and localized channel alterations are the primary sediment sources.

A sediment load reduction of 36% for the entire Tenmile Creek watershed is estimated to result in achievement of the applicable water quality standards.

<u>Headwaters to Spring Creek.</u> The Helena National Forest conducted a road sediment survey on the forest portion of the segment of Tenmile Creek that extends 6.72 miles from its headwaters to the confluence with Spring Creek. Seven sites contribute approximately 0.76 tons of sediment to the stream each year. Another 14 sites on tributary streams were estimated to contribute 8.7 tons of sediment annually. The aerial photography inventory showed five road crossings and

road encroachment along 35 percent of the stream. Upslope logging, exposed stream banks, and stream incisement were notable on this portion of Tenmile Creek. Riparian buffer widths were variable due to moderate road encroachment.

Spring Creek to Water Treatment Plant. Road runoff and channel alterations due to road placement are likely the largest sediment sources in the reach that runs 7.32 miles from Spring Creek to the Helena Drinking Water Treatment Plant. The Helena National Forest conducted a road sediment survey on the forest portion of the creek and identified 11 sites that are estimated to contribute 1.3 tons of sediment each year. The aerial photography inventory showed 20 road crossings and road encroachment along 50 percent of this segment. The stream channel was straightened near the Rimini Road. The aerial photography inventory revealed stream incisement, eroding stream banks, and lack of flow. Intermittent logging has occurred on the slopes above tributary streams. Riparian buffer widths are limited as a result of encroachment from the Rimini Road.

Results of the 2003 Proper Functioning Condition assessment are presented in Table B-9.

Table B-9: Upper Tenmile Creek Proper Functioning Condition Assessment		
Reach	**Rating**	**Notes**
Headwaters	Proper Functioning Condition	
Above Banner Creek	Functional—at Risk	o Incised o Sediment deposition
Below Bear Gulch confluence	Functional—at Risk	o Under-sized for the available channel o Sediment deposition o Limited riparian zone

Dewatering

The stream is dewatered as a result of water withdrawals by the City of Helena. The streambeds generally are dry during the late summer below the city's intakes on Tenmile Creek and tributaries. During the 2003 source assessment, the stream was observed to be dry or occupying less than half its channel in the reach below the city's intake.

Watershed Restoration Opportunities

Landowners can improve water quality and watershed health in Upper Tenmile Creek and downstream in Lower Tenmile Creek and Lake Helena by cleaning up abandoned mines, closing and reclaiming unauthorized roads and trails, and using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals. Brook trout and rainbow trout are found in Upper Tenmile Creek; however, the impairments make the habitat unsuitable for a year-round fishery. The Upper Tenmile Creek watershed is a major wildlife movement corridor.

Best management practices for Upper Tenmile Creek that are described in Appendix C include:

- Filter strips
- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Forestry BMPs
- Off-stream watering facilities
- Water gaps

- Road BMPs

Further management practices that could also be helpful in addressing impairments include:

- Stormwater BMPs
- Proper installation and maintenance of septic systems.

Watershed Restoration Strategies

There are several completed, ongoing and planned initiatives that will yield higher quality water in upper Tenmile Creek. These are highlighted below.

Tenmile Creek Water Supply Fuel Reduction Project

A Mountain Pine Beetle infestation in the Upper Tenmile Creek watershed has caused wide-spread tree mortality. Elevated surface fuel loadings create conditions for an intense fire that would be difficult to suppress. Water quality would be adversely affected by an intense fire due to erosion, sedimentation, ash deposition, and debris torrents. Furthermore, falling dead trees and fire have the potential to physically damage the Red Mountain Flume that conveys water to Chessman Reservoir, where it is stored to supply Helena's drinking water.

The City of Helena and the Helena National Forest are working to implement fuels reduction projects to proactively protect the quality and supply of water for Helena residents. The City has already completed fuel reduction projects on city and private lands adjacent to the Red Mountain Flume. In 2014, the Forest issued a Record of Decision and Finding of No Significant Impact for the treatment and removal of fuels and hazard trees along a portion of the Red Mountain flume and Chessman Reservoir.

Watershed Control Program

The City of Helena developed a Watershed Control Program plan in 2011 to minimize contamination by *Cryptosporidium* in Helena's drinking water supply. Goals of the plan include:

- Identify and manage existing *Cryptosporidium* sources
- Address grazing within the watershed
- Increase watershed education and public outreach

Several partners are involved in implementing the plan. Action items include: outreach and education, vault pumping, research and monitoring, and promotion of grazing BMP's.

Superfund Cleanup

The EPA added the Upper Tenmile Creek Mining Area to the Superfund National Priorities List on October 22, 1999 and began cleanup. The U.S. Forest Service is responsible for cleanup within its boundaries.

Helena National Forest

The Helena National Forest rated the Upper Tenmile Creek as a number one priority in its Watershed Condition Framework Assessment. Over the long term, the Forest will implement a Watershed Restoration Action Plan. The Helena National Forest completed a *Tenmile Ecosystem Watershed Analysis* in 2008.

The Forest is in the process of revising the Divide Travel Plan. A Draft Environmental Impact Statement was released in 2014. The Divide Travel Plan Decision will determine which areas will be open or closed for motorized use.

The Helena National Forest is working to include grazing BMP's in management and operational plans.

The lower eight miles of Rimini road were realigned and paved by Lewis & Clark County in 2014 to reduce erosion and sedimentation.

Upper Ten Mile Watershed Steering Group

Projects have included stream bank stabilization and fish habitat improvement project that entailed planting over 35,000 trees and shrubs; and developing a cooperative plan to maintain instream flows in Upper Tenmile Creek during low flow periods.

Spring Creek (Crystal Springs Project)

Evaluation and monitoring (temperature and water quality) of Spring Creek for reconnection to Tenmile along with habitat improvement may warrant additional attention in the context of improving water quality and providing "colder" water refuge during summer low flow in Tenmile Creek. Water temperatures may be less in Crystal Springs Creek than in Tenmile due to groundwater flows entering Crystal Springs Creek.

WESTERN HILLS WATERSHED

(Sevenmile, Silver, Jennies Fork, Skelly Gulch, and Granite Creek)

The Western Hills Watershed comprises the mountainous area north of Highway 12, west to the Continental Divide, and north to the North Hills. This watershed also includes the Scratch Gravel Hills. Important streams in this area include Sevenmile Creek and Silver Creek. The area geology is mostly sedimentary with a few isolated areas of igneous (granitic) rock near Jennie's Creek, Silver Creek, and Skelly Gulch. Area mining is limited to concentrated locations of intensive mining of smaller ore bodies in igneous rocks, such as the Marysville Mining District. As a result of placer mining, streams near Marysville (Silver Creek, Jennies Fork) have been extensively reworked and disrupted. Typical vegetation at lower eastern elevations is grasses and shrubs because of lower rainfall. At higher elevations to the west, precipitation is higher, resulting in forests, mostly in the Helena National Forest. Aside from the Marysville area, the area is mostly sparsely developed with scattered houses and ranches at lower elevations with extensive logging and logging roads in the forests.

Both natural factors and land use determine the stream pollution. Sediments eroded at higher elevation are deposited in area streams. Sevenmile Creek, Skelly Gulch, and Jennies Fork all have TMDLs for sediment. Because of the concentrated mining activity, Sevenmile Creek and Silver Creek have TMDLs for metals. The TMDL for Sevenmile Creek for nutrients is necessary due to runoff from grazing lands.

Figure B-6: Western Hills Watershed

SEVENMILE CREEK

Water Quality Problems

Aquatic life and drinking water are important uses of water that are not fully supported in Sevenmile Creek. The listed segment runs 7.8 miles from its headwaters to the mouth, where it flows into Tenmile Creek. The DEQ has identified pollutants that cause impairment of these beneficial uses of water (DEQ CWAIC 2014). These include:

- **Metals:** arsenic, copper, and lead
- **Nutrients:** nitrogen, phosphorus
- **Sedimentation/siltation**

The uses of Sevenmile Creek are also affected by low flows and alteration of streamside vegetative covers.

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (EPA 2004) and Final Report, Volume II (EPA 2006) for the Sevenmile Creek watershed are summarized below.

Metals Sources

Skelly Gulch and historic mining are the primary sources of metals in Sevenmile Creek. None of the mines in the immediate drainage area are listed in the state's inventory of high priority abandoned hard rock mines sites. (DEQ Mines, 1995)

Calculations in the Final Report, Volume II (EPA 2006) show that an overall, watershed scale metals load reduction of 52, 47 and 63 percent for arsenic, copper, and lead, respectively, would result in achievement of the applicable water quality standards.

Nutrients Sources

The primary sources of nitrogen, in order of importance, are septic systems, urban areas, human-caused streambank erosion, dirt roads, and timber harvest activities.

The primary sources of phosphorus, in order of importance, are human-caused streambank erosion, dirt roads, urban areas, timber harvest, and agriculture.

An animal confinement area and suspected wastewater seepage from Fort Harrison's defunct sewage treatment facility were documented by GPS in 2003. Additional potential local sources include diffuse sediment, rural housing, and stream dewatering.

A nitrogen load reduction of 58% would be required to support all beneficial uses. However, the maximum attainable nitrogen load reduction for the Sevenmile Creek watershed is estimated to be only 20%.

A total phosphorus load reduction of 79% would be required to support all beneficial uses. However, the estimated maximum attainable phosphorus load reduction for the Sevenmile Creek watershed is only 32 percent.

While it may not be possible to reduce nutrient loads to the levels where all beneficial uses are supported, water quality in Sevenmile Creek and downstream water bodies will continue to degrade if no action is taken to reduce nutrient pollution. Sevenmile Creek has been identified as a source of eutrophication in Tenmile Creek.

Sediment Sources

The primary sources of sediment, in order of importance, are human-caused streambank erosion, unpaved roads, timber harvest, agriculture, non-system roads and trails, and urban areas.

Human-caused streambank erosion is largely a result of riparian grazing impacts, animal feedlot/confinement areas, road and railroad encroachments, stream channelization, beaver dam removal and historic mining activity. The railway and Birdseye Road have caused stream channelization along 13% of the stream. Stream incisement and eroding stream banks were observed approximately 1.25 miles downstream of the Austin Road crossing.

The aerial photography inventory showed five road crossings (HNF, interview, 2013). Road sediment delivery points were documented by GPS in 2003. Unpaved non-system roads and trails in the uplands of the watershed contribute sediment due to the lack of drainage structures.

Timber harvest has occurred in the uplands of the watershed on state and BLM lands.

Agricultural activities, including straightening for irrigation, irrigation diversions, return flows, and cultivation in the riparian zone, have visibly impacted Sevenmile Creek below Birdseye Road.

A 2003 Proper Functioning Condition assessment rated the reach above the mouth as "Functional-at risk." The field crew observed healthy and diverse riparian vegetation on the left bank, but also noted that the stream was choked with sediment and that cut banks were prevalent on the right bank.

An overall, watershed scale sediment load reduction of 33% is estimated to result in achievement of the applicable water quality standards.

Watershed Restoration Opportunities

Landowners and land managers can improve water quality and watershed health in Sevenmile Creek and downstream in Tenmile Creek and Lake Helena by cleaning up abandoned mines, reclaiming and closing unauthorized roads and trails and using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals. Sevenmile Creek is managed as a trout fishery; however, trout are considered rare.

Watershed Restoration Strategies

Priority management measures for Sevenmile Creek that are described in Appendix C include:

- Filter strips
- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Off-stream watering facilities
- Water gaps
- Road BMPs

Other management measures that can also have a positive impact on existing impairments include:

- Stormwater BMPs
- Proper installation and maintenance of septic systems.
- Mine reclamation

SKELLY GULCH

Water Quality Problems

Aquatic life is an important use of water that is not fully supported in Skelly Gulch. The impairment is:

- **Sedimentation** /siltation

The DEQ has established a TMDL for sedimentation and siltation (DEQ CWAIC 2014).

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (EPA 2004) and Final Report, Volume II (EPA 2006) are summarized below.

Sediment Sources

The primary sources of sediment in the Skelly Gulch watershed, in order of importance, are unpaved roads, timber harvest, human-caused streambank erosion, and non-system roads and trails.

The Helena National Forest conducted a road sediment survey on the forest portion of the creek and identified a single site that contributes an estimated 0.8 ton of sediment to the stream each year. An aerial photography inventory showed 11 road crossings and road encroachment along 17% of the stream. The unpaved Skelly Gulch Road is directly adjacent to the water body throughout much of the lower reach of the stream. There is minimal, if any, riparian buffer in this reach. The road crosses Skelly Gulch in the central reach via a bridge and a stream ford. Five road crossings related to timber harvest units were identified as sediment sources within Helena National Forest ownership.

Timber harvest activities have occurred in the upper watershed within the Helena National Forest as well as in the central area of the watershed.

Streambank erosion is primarily caused by riparian grazing, road encroachment, stream channelization, and historic mining activity. Except for the reach affected by the encroachment of Skelly Gulch Road, riparian buffers were extensive.

Unpaved non-system roads and trails in the central watershed contribute sediment due to the lack of runoff mitigation structures.

An overall, watershed scale sediment load reduction of 22% is estimated to result in achievement of the applicable water quality standards.

A 2003 Proper Functioning Condition assessment rated the reach about two miles above the mouth as "Proper Functioning Condition." Some sediment deposition was noted.

Watershed Restoration Opportunities

Landowners can improve water quality and watershed health in Skelly Gulch and downstream in Sevenmile Creek, Tenmile Creek, and Lake Helena by closing and reclaiming unauthorized roads and trails, and using appropriate management practices. Management practices can improve fish and wildlife habitat and reduce sediment and associated metals. Genetically pure westslope cutthroat have been documented in the upper 3.5 miles of Skelly Gulch. Eastern brook trout have been found in the lower 2.5 miles of the creek.

Watershed Restoration Strategies

Priority management measures for Skelly Gulch that are described in Appendix C include:

- Filter strips
- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Off-stream watering facilities
- Water gaps
- Road BMPs
- Forestry BMPs

GRANITE CREEK

Water Quality Problems

Drinking water is an important use of water that is not fully supported in Granite Creek. The listed segment runs 2.5 miles from its headwaters to the mouth, where it flows into Sevenmile Creek. The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014)

These are:

- **Metals:** arsenic and cadmium

Current land uses include grazing and rangeland and limited recreation. The upper half of the watershed is managed by the BLM and the lower half is private ranchland.

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (EPA 2004) and Volume III (EPA 2013) for the Granite Creek watershed are summarized below.

Metals Sources

Historic mining activities are the primary sources of metals in Granite Creek. None of the mines in the immediate drainage area are listed in the state's inventory of high priority abandoned hard rock mines sites (DEQ Mines, 1995). Upstream sources also contribute arsenic to Granite Creek.

The TMDLs for metals are flow and hardness dependent. A large reduction in arsenic loading is required during low and high flow conditions. No reduction of cadmium is required at the calculated low flow and high flow conditions. However, it is possible that a reduction in cadmium loading is required at times not represented in the sampling data used to calculate the TMDL (EPA 2013).

The recommended load reduction for Arsenic and Cadmium for both high flow and low flow are 75% and 83% respectively.

Flow and Riparian Alterations

During a 2004 field reconnaissance, Granite Creek was observed to be dry for its entire length. There was no indication of recent flow. Much of the Granite Creek channel lacked indications of more than brief seasonal flow. Riparian vegetation was absent in the headwaters and lower reaches. In the middle reaches the riparian zone was populated with aspen and a mixture of other vegetation.

Watershed Restoration Opportunities

Landowners and land managers can improve water quality and watershed health in Granite Creek and downstream in Sevenmile Creek, Tenmile Creek and Lake Helena by cleaning up abandoned mines and using appropriate management practices.

Watershed Restoration Strategies

Priority management measures for Granite Creek that are described in Appendix C include:

- Riparian fencing
- Off-stream watering facilities
- Water gaps

Other management practices that could be useful to address existing impairments are:

- Mine reclamation

JENNIES FORK

Water Quality Problems

Aquatic life and drinking water are important uses of water that are not fully supported in Jennies Fork from its headwaters to the mouth. Primary contact recreation and agricultural uses are fully supported. The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These are:

- **Metals:** lead
- **Sedimentation/siltation**

The uses of Jennies Fork are also affected by nutrients: Nitrate/Nitrite and total Phosphorus. (DEQ CWAIC 2014)

The primary human-caused sources of impairment that were identified in Watershed Characteristics, Volume I (EPA 2004) and the Final Report, Volume II (EPA 2006) are summarized below.

Metals Sources

Sediment-associated metals and historic hard rock mining activities in the upper watershed are the primary sources of metals in Jennies Fork. The point of origin of Jennies Fork is a mine shaft on Mount Belmont. Mining was active at this site until the late 1990s.

The Bald Mountain site is listed in the state's inventory of high priority abandoned hard rock mine sites. (DEQ Mines, 1995) The Bald Mountain Mill was located at the head of Jennies Fork. The BLM capped and revegetated mill tailings located on a slope above the chalet at the Great Divide in 1994. Precipitation and runoff from the Great Divide ski area caused erosion through the cap into the tailings and carried sediments contaminated with metals into Jennies Fork. Subsequent reclamation activities took place in 2011. Waste sources were removed from areas in or near the floodplain of Jennies Fork. Affected areas were reclaimed and stream channels were reconstructed to reestablish vegetation and habitat. In 2012 snowmelt runoff at the ski area eroded an abandoned road above the site and deposited sediment in runoff control ditches, causing overflow and moderate erosion to portions of the reclaimed slope. The eroded area was repaired and stabilized in June 2012.

Calculations in Final Report, Volume II (EPA 2006) show that a watershed scale metals load reduction of 46% for lead would result in achievement of the applicable water quality standards.

Sediment Sources

The primary sources of sediment in the Jennies Fork watershed, in order of importance, are unpaved roads, timber harvest, non-system roads, and human-caused streambank erosion.

During the sediment source assessment, significant quantities of sediment were observed entering Jennies Fork from the Great Divide ski area parking lot during spring snowmelt runoff. The aerial photography inventory showed four road crossings and road encroachment along 56% of the stream. There is an extremely high density of roads in the watershed, particularly in the vicinity of the ski area. Non-system roads are associated with the ski area and historic mining activities.

Timber harvest activities have occurred throughout the upper watershed on mining claims and Great Divide ski runs.

Streambank erosion is primarily caused by riparian grazing, road encroachment, stream channelization, and historic mining activity. The aerial photography assessment showed variable width riparian buffers. The stream flows underground in a series of culverts through most of the ski area. At least three channels were observed carrying spring runoff flow due to an under-sized culvert.

Cattle and horses were observed grazing below the ski area parking lot, impacting the stream banks and riparian vegetation.

A 2003 Proper Functioning Condition assessment rated the reach below the ski area parking lot “Functional—at Risk.” The field crew noted that sand deposition was excessive.

A watershed scale sediment load reduction of 27% will result in achievement of the applicable water quality standards.

Watershed Restoration Opportunities

Landowners can improve water quality and watershed health in Jennies Fork and downstream in Silver Creek by cleaning up abandoned mines, closing and reclaiming unauthorized roads and trails, and using appropriate management practices.

Watershed Restoration Strategies

Priority management measures for Jennies Fork that are described in Appendix C include:

- Filter strips
- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Off-stream watering facilities
- Water gaps
- Road BMPs
- Forestry BMPs

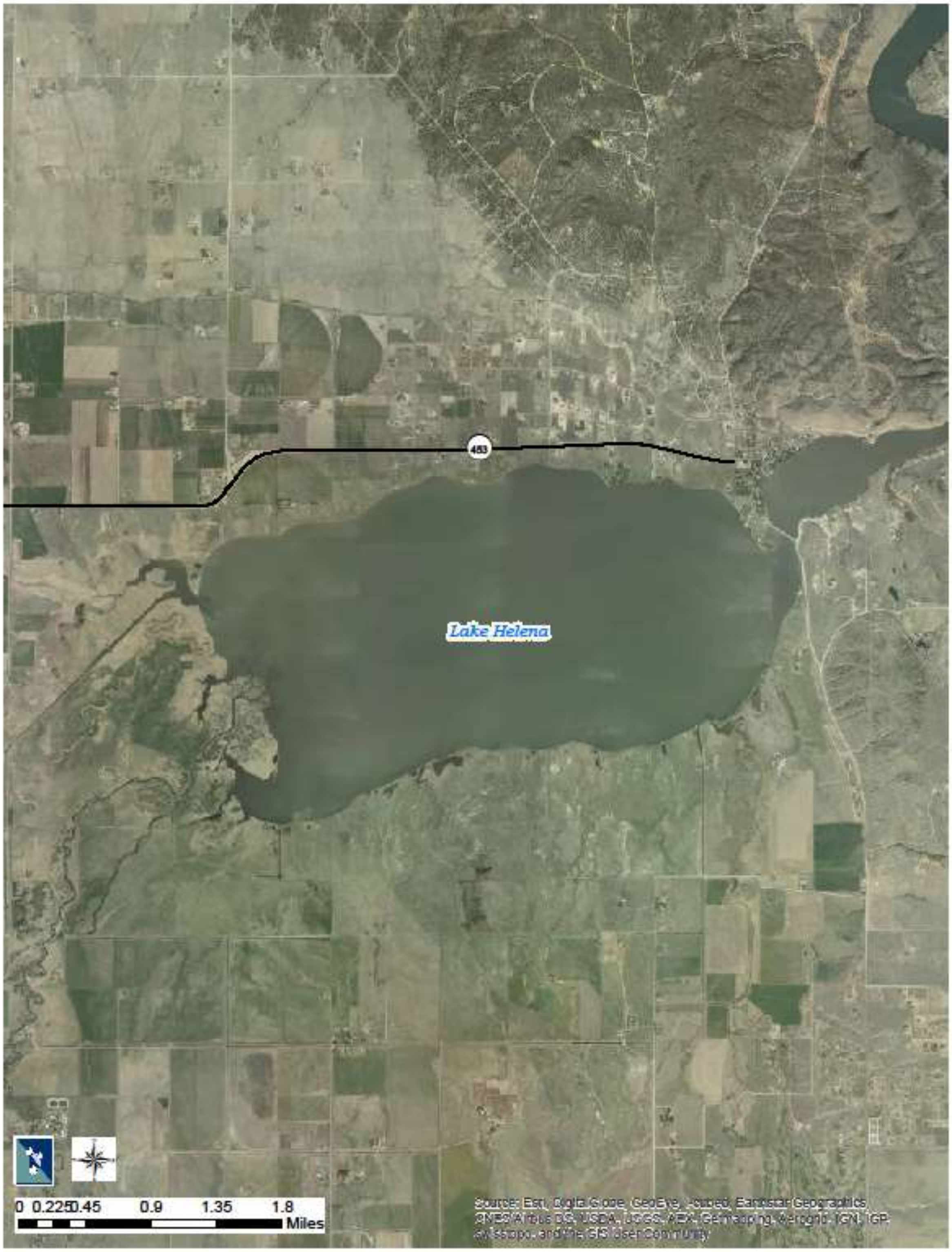
An additional management practice that would be helpful is:

- Mine reclamation

LAKE HELENA

Lake Helena is the most downstream portion of the watershed. Everything flows to this lowest point, so it acts as a catchment for many pollutants from upstream. It is also an artificial lake. Before the dams on the Missouri were put in place, the area was a wetlands complex.

Figure B-7: Lake Helena



LAKE HELENA

Water Quality Problems

Aquatic life and drinking water are important uses of water that are not fully supported in Lake Helena. Field measurements collected in 2003 showed algal blooms, low visibility, and widely variable dissolved oxygen levels. Agricultural use is fully supported. The DEQ has identified pollutants that cause impairment of these beneficial uses of water. (DEQ CWAIC 2014) These are:

- **Metals:** arsenic, and lead
- **Nutrients:** nitrogen and phosphorus

The primary human-caused sources of impairment that were identified in Watershed Characterization, Volume I (EPA 2004) and Final Report, Volume II (EPA 2006) for the Lake Helena watershed are summarized by pollutant below.

The quality of the water in Lake Helena is affected by water from various sources: Prickly Pear Creek, Tenmile Creek, and Silver Creek tributaries; ground water discharge; tile drainage associated with the Helena Valley Irrigation District, treated wastewater discharged to Prickly Pear Creek by the cities of Helena and East Helena; and the Missouri River, water from which is discharged directly or indirectly from the Helena Valley Irrigation Canal and from occasional backflows from Hauser Reservoir to Lake Helena. Most of Silver Creek's small volume of flow never reaches the Helena Valley because of channel losses to ground water and irrigation withdrawals. Although the Lake Helena area was once a substantial wetland, most of the riparian vegetation is now restricted to the portion of the shoreline where Prickly Pear Creek and the Silver Creek Ditch enter Lake Helena. This area is protected by an easement.

Metals Sources

Upstream tributaries are the primary sources of metals in Lake Helena. Local sediment sources also contribute to an increase in arsenic loading to Lake Helena. In addition, contaminated bottom sediment is a potential metals source.

Calculations in Volume II show that an overall, watershed scale metals load reduction of 61 and 66 percent for arsenic and lead, respectively, would result in achievement of the applicable water quality standards.

Nutrients Sources

The primary sources of nitrogen, in order of importance, are septic systems, return flows from the Helena Valley Irrigation System, municipal wastewater treatment facilities, and urban areas.

The primary sources of phosphorus, in order of importance, are municipal wastewater treatment facilities, return flows from the Helena Valley Irrigation System, agriculture, dirt roads, and urban areas. Agricultural and single family residential sources may be far more significant in localized areas than at the watershed scale.

An interim total nitrogen load reduction goal of 80% was established. It may not be possible to attain the 80% load reduction goal.

An interim total phosphorus load reduction goal of 87% was established. No concentration targets were proposed for Lake Helena. It may not be possible to attain the 87% load reduction goal.

While it may not be possible to reduce nutrient loads to the levels where all beneficial uses are supported, water quality in Lake Helena will continue to degrade if no action is taken to reduce nutrient pollution in the watershed.

Watershed Restoration Opportunities

Landowners can improve water quality and watershed health in Lake Helena by cleaning up tributaries using appropriate management practices. Management practices can improve fish and wildlife habitat. Lake Helena is managed as a trout fishery and hosts several species of fish.

Watershed Restoration Strategies

Priority management measures for Lake Helena that are described in Appendix C include:

- Filter strips
- Riparian fencing
- Riparian buffers
- Bioengineered stream bank stabilization treatments and stream channel restoration projects
- Off-stream watering facilities
- Water gaps

Other important management practices include:

- Stormwater BMPs.
- Proper installation and maintenance of septic systems.

APPENDIX C: BEST MANAGEMENT PRACTICES

INTRODUCTION

This appendix includes a description of the nonpoint source management measures that will need to be implemented to achieve load reductions. Resources are identified for additional information.

BIOENGINEERED STREAMBANK STABILIZATION

Description

Bioengineered treatments used to stabilize and protect banks of streams or constructed channels, and shorelines of lakes or reservoirs. Biological, mechanical, and ecological concepts are synthesized to control erosion and stabilize soil through the use of vegetation. Tree and root wad revetments are used in place of or in combination with rock. This practice may require deflection of water away from the target reach. Bioengineering treatments are developed systematically, taking into consideration the causes of erosion and the upstream and downstream effects of the treatment and changes that may occur in the watershed hydrology and sedimentation over the design life of the treatments. Vegetation used in bioengineered treatments must be native or compatible with native habitat.

Treatments that include woody debris, woody riparian vegetation, or other treatments that provide shade and cover can improve fish and wildlife habitat in addition to water quality benefits.

Load Reductions and Pollutants

This BMP has the potential to improve the quality of water impaired by the following pollutants:

- Nitrogen
- Phosphorus
- Sediment
- Temperature

Additional Benefits

- Prevent or minimize loss of adjacent land or other properties.
- Prevent or minimize interference with land use.
- Prevent or minimize damage to adjacent facilities.
- Maintain the flow capacity of streams or channels.
- Improve or enhance the stream corridor for fish and wildlife habitat, aesthetics, recreation.

Bioengineering treatments are usually, but not always, much less expensive than traditional methods of streambank erosion control. Allen and Leech (1997) note that costs can vary tremendously due to differences in the availability of materials, hauling distances, labor rates, project objectives, and other factors. Maintenance costs over the life-cycle of the treatment must be considered. Allen and Leech (1997) present comparisons of actual costs of bioengineering treatments with estimated costs of traditional riprapped revetments under similar conditions in the same area. They estimate man-hour costs of bioengineering treatments.

Further Resources/References

These organizations and sources can provide more details and technical assistance on this BMP.

- Allen and Leech (1997)
- NRCS, Montana Conservation Practice Standard (MCPS), Streambank and Shoreline Protection, Code 580; Critical Area Planting, Code 342; Open Channel, Code 582
- NRCS, EFH, Chapter 16, Streambank and Shoreline Protection
- DEQ, MT NPS Management Plan
- Conservation Districts
- WQPD

FILTER STRIP

Description

A strip of permanent perennial vegetation placed on the downgradient edge of a field, pasture, barnyard, animal confinement area or some types of impervious urban/transportation areas. The strip can slow surface runoff, filter particulate matter, or absorb and use nutrients. If the purpose of the strip is to take up nutrients, the vegetation must be periodically harvested in order to prevent nutrient buildup. Grazing would not constitute harvesting because nutrients are deposited as well as removed.

Load Reductions and Pollutants

This BMP has the potential to improve the quality of water impaired by the following pollutants:

- Nitrogen
- Phosphorus
- Sediment
- Metals
- Temperature
- Pathogens

Additional Benefits

Additional benefits include:

- Slows run-off

Further Resources/References

These organizations and sources can provide more details and technical assistance on this BMP.

- DEQ, MT NPS Management Plan
- NRCS, Montana Conservation Practice Standard (MCPS), Field Border, Code 386; Filter Strip, Code 393; Hedgerow Planting, Code 422; Vegetated Treatment Area, Code 635
- Conservation Districts
- WQPD

FORESTRY BMPS

Description

The use of BMPs has proven to be an effective tool in limiting nonpoint source pollution from forest harvesting activities. The DNRC Forestry Practices Program has identified BMPs for the following activities:

- Road planning, design and construction
- Road maintenance
- Road drainage
- Timber harvest site preparation and design
- Timber harvesting activities
- Design, installation, and maintenance of stream crossings

Biennial audits of the application and effectiveness of forestry BMPs on selected high risk sites show that properly applied BMPs can limit nonpoint source pollution, such as sediment from a road or timber harvest.

The most recent field review results showed that BMPs were effective in protecting soil and water resources 98% of the time.

Load Reductions and Pollutants

These BMPs have the potential to improve the quality of water impaired by the following pollutants:

- Phosphorus
- Metals
- Sediment
- Temperature
- Toxic Chemicals

Additional Benefits

Additional benefits of forest management practices include:

- Slows run-off

Further Resources/References

These organizations and sources can provide more details and technical assistance on this BMP.

- MSU Extension Service (2001)
- DNRC Forestry Assistance Program
- DNRC (2012)

REWATERING AND MAINTAINING IN-STREAM FLOW

Description

Rewatering and maintaining in-stream flow are a set of practices that increase water flow, typically during periods of highest temperatures.

Load Reductions and Pollutants

This BMP can help address:

- Temperature (primarily)
- Sediment
- Nitrogen
- Phosphorus
- Metals

Additional Benefits

Additional benefits include maintenance of the wetted perimeter, fish passage and aquatic life, and helps promote riparian vegetation.

This approach is used in areas that are over-allocated for water use

Further References/Resources

Further information is available from the WQPD.

OFF-STREAM WATERING FACILITY

Description

An off-stream watering facility is a permanent or portable device to provide an adequate amount and quality of drinking water for livestock and wildlife. The device and its location should encourage or enable livestock to obtain water from a source other than a surface water body.

Load Reductions and Pollutants

This BMP has the potential to improve the quality of water impaired by the following pollutants:

- Nitrogen
- Phosphorus
- Sediment
- Temperature
- Pathogens

Additional Benefits

Off-stream watering facilities can help livestock meet daily water requirements and improve animal distribution.

Further Resources/References

These organizations and sources can provide more details and technical assistance on this BMP.

- NRCS, Montana Conservation Practice Standard (MCPS), Watering Facility, Code 614
- DEQ, MT NPS Management Plan
- Conservation Districts
- WQPD

RIPARIAN BUFFER

Description

A strip of perennial vegetation located adjacent to and upgradient from a water body. The strip must be designed to reduce nonpoint source pollution. Buffer width, slope, species composition, and target pollutants must be considered in the design.

Riparian vegetative buffers perform the following important functions that help to maintain beneficial uses of water:

- Break down, filter, and reduce the amount of pollutants that enter water bodies.
- Shade streams to maintain cooler temperatures.
- Stabilize stream banks to control erosion.
- Provide cover for fish.
- Contribute leaves, twigs, and insects to streams, providing food for invertebrates that support fish and wildlife.
- Moderate the amount of water in streams by reducing peak flows during floods and storing and slowly releasing water into streams when flows are low.

Vegetated buffers with woody plants provide the most effective water quality protection. Large trees are particularly important for fisheries and maintaining natural stream function by creating pools, riffles, backwaters, small dams, and off-channel habitat. The more complex the vegetation in terms of species and plant height, the greater the variety of wildlife.

Load Reductions and Pollutants

This BMP has the potential to improve the quality of water impaired by the following pollutants:

- Metals
- Nitrogen
- Phosphorus
- Sediment
- Temperature
- Pathogens

Additional Benefits

The series of reports prepared by Ellis (2008) summarize the results of more than 80 scientific studies that document the effectiveness of riparian buffers in protecting water quality, and improving fish and wildlife habitat.

- Fish habitat. "Keeping an adequate vegetated buffer along a stream is the most important thing that individual landowners can do to improve or maintain fish habitat . . ." (Ellis, 2008 Part II*).*
- Wildlife habitat. More than half of Montana's wildlife use riparian areas for food, protected access to water, cover, resting areas during migration, travel routes; protection from weather, breeding, and nesting. (Ellis, 2008, Part III)

Knutson and Naef (1997) reviewed scientific studies and found the following:

- In well-forested watersheds, mid-day summer water temperatures rise only 1-2 C (1-1.8° F) above year-round averages. Conversely, unbuffered streams in clear-cut watersheds may experience temperature increases of 7-16C (10-27° F).
- The structural diversity created by instream woody debris is essential in providing adequate fish habitat, particularly for spawning and rearing, in all sizes of streams and rivers.

Wenger (1999) reviewed scientific studies and concluded:

- Numerous studies have documented the effectiveness of buffers in trapping sediment transported by surface runoff. (Wenger summarized the results of these studies which reported total suspended solid removal rates ranging from 53% to 94%.)
- There is a positive correlation between a buffer's width and its ability to trap sediments. Wider buffers provide greater sediment control, especially on steeper slopes.
- Other factors that affect the sediment trapping efficiency of buffers are slope, soil infiltration, and the extent of buffers.
- It is very important that buffers be continuous along streams.

Further Resources/References

These organizations and sources can provide more details and technical assistance on this BMP.

- DEQ, MT NPS Management Plan
- NRCS, Montana Conservation Practice Standard (MCPS), Access Control, Code 472; Critical Area Planting, Code 342; Fence, Code 382; Field Border, Code 386; Hedgerow Planting, Code 422; Riparian Forest Buffer, Code 391; Riparian Herbaceous Cover, Code 390
- Ellis (2008)
- Knutson and Naef (2007)
- Conservation Districts
- WQPD

RIPARIAN FENCING

Description

Fencing used to permanently or temporarily control livestock access to riparian areas. Fencing may be used to prevent streambank trampling, reduce nutrient and pathogen pollution, or promote vegetative growth and plant species diversity.

Load Reductions and Pollutants

This BMP has the potential to improve the quality of water impaired by the following pollutants:

- Nitrogen
- Phosphorus
- Sediment
- Temperature
- Pathogens

Additional Benefits

Riparian fencing can also promote plant species growth and diversity, prevent or minimize bank erosion, and prevent siltation of the stream.

Fencing is used as part of a livestock management plan.

Further Resources/References

These organizations and sources can provide more details and technical assistance on this BMP.

- NRCS, Montana Conservation Practice Standard (MCPS), Access Control, Code 472; Fence, Code 382
- DEQ, MT NPS Management Plan
- Conservation Districts
- WQPD

ROAD BMPS

Description

Dirt roads are the largest source of sediment in the Lake Helena watershed, contributing an estimated 15% of the sediment load (EPA 2006). The contribution of sediment from roads can be minimized with good planning, and proper design, construction, and maintenance of roads, road drainage, and stream crossings. The DNRC Forestry Practices Program has identified BMPs for these activities. BMPs for roads are based on the following concepts:

- Minimize the number of roads constructed in a watershed through comprehensive road planning. Use existing roads where practical, unless the use would increase erosion.
- Locate roads on stable geology, including well-drained soils and rock formations that slant into the slope. Avoid slumps, slide-prone areas, and wet areas.
- Fit roads to the topography, following natural benches and contours. Avoid long, steep road grades and narrow canyons. Minimize disruption of natural drainage patterns.
- Vary road grades to reduce concentrated flow in road drainage ditches, culverts, and on fill slopes and road surfaces.
- Keep slope stabilization, erosion and sediment control work current with road construction. Do not disturb roadside vegetation more than necessary. Complete construction or stabilize road sections within the same operating season. Minimize earth-moving activities when soils appear excessively wet.
- Use sediment fabric fences and/or slash filter windrows to reduce movement of sediment into water bodies.

- Consider road surfacing and use of geotextiles to minimize erosion.
- Stabilize erodible, exposed soils on slopes adjacent to roads.
- Provide adequate drainage from road surfaces using ditch grades, ditch relief culverts, drain dips, open top culverts, rubber water diverters, and water bars. Route road drainage through vegetative filters or sediment-settling structures before the drainage enters streams.
- Prevent downslope movement of sediment by using sediment catch basins, drop inlets, changes in road grade, headwalls, or recessed cut slopes.
- Grade road surfaces only as often as necessary to maintain a stable running surface and adequate surface drainage. Avoid grading sections of road that don't need grading. Avoid grading when roads are dusty or muddy.
- Avoid cutting the toe of cut slopes when grading roads, pulling ditches or plowing snow.
- Do not sidecast material over culvert inlets or outlets or into streams. Manage sidecast material to avoid erosion.
- Maintain erosion control features of open and closed roads through periodic inspection and maintenance.
- Control road dust.
- Provide breaks in snow berms to allow road drainage.
- Close roads or restrict road use permanently or temporarily to protect water quality.
- Leave abandoned roads in a condition that provides adequate drainage without further maintenance.
- Minimize the number of stream crossings and choose stable stream crossing sites. Design stream crossings for adequate passage of fish and minimum impact on water quality.

Load Reductions and Pollutants

These BMPs have the potential to improve the quality of water impaired by the following pollutants:

- Phosphorus
- Metals
- Sediment
- Temperature
- Toxic Chemicals

Additional Benefits

Road BMPs can also reduce or eliminate dust into the stream.

Further Resources/References

These organizations and sources can provide more details and technical assistance on this BMP.

- MSU Extension Service (2001)
- DNRC Forestry Assistance Program
- DNRC (2012)

SEPTIC SYSTEM INSPECTION, OPERATIONS AND MAINTENANCE

Description

Septic systems contribute nutrients, pathogens, and chemicals to ground water and surface water. At the watershed scale (the entire Lake Helena watershed), septic systems are the most significant source of total nitrogen. Septic systems contribute an estimated 29% of the total nitrogen. (EPA 2006)

Management practices to protect water quality include:

- Test septic tanks for water tightness before installation is complete.
- Maintain septic systems by having them inspected at least annually and pumped every three to five years.
- Control and manage water use to avoid hydraulic overload of the septic system.
- Redirect surface water flow away from the soil absorption field.
- Plant a greenbelt (grassy strip or small, short-rooted vegetation) between the soil absorption field and the shoreline of any nearby stream or lake. Avoid planting water-loving shrubs with deep root systems or trees near the drain field. Mow, but do not fertilize, burn or over water this area.
- Keep chemicals, medications, and hazardous wastes out of the septic system.
- Keep all vehicles, bikes, snowmobiles, etc. off the tank, pipes and soil treatment area. Follow practices to prevent freezing, including mulching the entire system if needed.

Load Reductions and Pollutants

These BMPs have the potential to improve the quality of water impaired by the following pollutants:

- Nitrogen
- Phosphorus
- Biochemical Oxygen Demand
- Pathogens
- Toxic Chemicals

While most conventional septic systems are effective in removing phosphorus from effluent, most are not considered effective in removing nitrogen without additional treatment in the soil. Additional nitrogen removal can be achieved with advanced “Level 2” systems, which are required in some areas. Chemicals and drugs disposed of in a septic system will likely migrate to ground water.

Additional Benefits

- Minimize unpleasant odors
- Reduce growth of algae and weeds in nearby water bodies
- Maintain a clean, palatable drinking water supply
- Avoid costly repairs or replacement

Further Resources/References

These organizations and sources can provide more details and technical assistance on this BMP.

- DEQ 2010.

- EPA 2006.
- Jefferson County Environmental Health Department.
- Lewis and Clark Public Health Department.

STORM WATER

Description

Storm water runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, parking lots, streets, and sidewalks prevent storm water from naturally soaking into the ground. Storm water carries debris, chemicals, dirt and other pollutants into the surface waters of the Lake Helena watershed. Storm water runoff can also pollute the Helena Valley aquifer. Residents and businesses can help to reduce pollution by not dumping pollutants into storm drains and using the following BMPs:

- Proper storage, disposal, and recycling of hazardous wastes
- Pet waste management
- Storm drain inlet protection
- Lawn and garden fertilizer management
- Litter control and parking lot cleanup
- Vehicle and equipment maintenance to prevent leaks
- Permeable landscaping
- Preservation of existing vegetation
- Reuse of storm water by routing runoff to lawns, vegetation, or rain barrels
- Settling basins or sediment traps
- Composting organic wastes
- Vegetated filter strips

Load Reductions and Pollutants

These BMPs have the potential to improve the quality of water impaired by the following pollutants:

- Nitrogen
- Phosphorus
- Sediment
- Temperature
- Pathogens
- Toxic Chemicals

Additional Benefits

Stormwater management practices can retain water and limit run-off and enhance natural water filtration.

Further Resources/References

These organizations and sources can provide more details and technical assistance on this BMP.

- Conservation Districts

- DEQ, MT NPS Management Plan
- WQPD

WATER GAP

Description

A water gap is a controlled access point from which livestock can obtain drinking water directly from a water body. Where possible, the gap should be designed to admit only one animal at a time.

Load Reductions and Pollutants

This BMP has the potential to improve the quality of water impaired by the following pollutants:

- Nitrogen
- Phosphorus
- Sediment
- Temperature
- Pathogens

Additional Benefits

Water gaps can reduce bank erosion and riparian vegetation removal and lessen stream siltation. These are used as part of a livestock grazing plan, usually in conjunction with riparian fencing.

Further Resources/References

These organizations and sources can provide more details and technical assistance on this BMP.

- NRCS, Montana Conservation Practice Standard (MCPS), Access Control, Code 472; Fence, Code 382
- DEQ, MT NPS Management Plan
- Conservation Districts
- WQPD

APPENDIX D: WATERSHED RESTORATION DEVELOPMENT OUTREACH

The development of this Lake Helena Watershed Restoration Plan (WRP) was a community-based effort. Several channels for input were developed. This appendix contains more information about the methods used to develop the priorities and identify projects for the Lake Helena watershed.

WATER USERS

Throughout the development process, several types of water users were given opportunities to offer input on priorities and projects. People with interests in these areas were targeted, though any member of the public was encouraged to offer input:

Agriculture: Farmers, ranchers, the Helena Valley Irrigation District and those who use some of their land for agricultural purposes have significant interest in clean water and many potential projects will take place in partnership with agricultural landowners.

Drinking Water: Helena and East Helena residents both have significant stake in the availability of clean drinking water that is from or tied to surface water sources. The remainder of the residents in the Lake Helena watershed is dependent on groundwater. Since the Helena Valley Irrigation District canal, and Tenmile, Silver, and Prickly Pear Creeks recharge the Helena Valley aquifer, the only source of drinking water for about 25,000 residents, clean surface water is also essential.

Wastewater: Everyone who drinks water or uses it for business or industrial applications also produces wastewater. Stormwater, point sources of wastewater, wastewater from septic systems, and other sources all can contribute to elevated pollutants that affect the beneficial uses of streams that ultimately receive that wastewater.

Recreation: Recreationists take advantage of the streams and lakes in the Lake Helena watershed to enjoy camping, boating, picnicking, fishing, hunting, wildlife watching, and outdoor learning.

Fish and Wildlife: The water bodies and associated riparian areas provide important habitat for a variety of mammals, amphibians, fish and birds. Game species include elk, deer, black bear, moose, burbot, mountain whitefish, walleye, yellow perch, and various types of trout and game.

PUBLIC ENGAGEMENT METHODS

Website

The Lewis & Clark County Water Quality Protection District (WQPD) hosts a web page specifically for restoration planning. Below is a link to the LHWRP website:

http://www.lccountymt.gov/health/water-quality/restoration-plan.html

The website includes links to the following information related to the WRP: the documents produced during Phase I and II of the watershed restoration planning and TMDL development process, a letter to stakeholders, the fact sheet, a map of the watershed, and links to EPA guidance about developing a watershed restoration plan.

Fact Sheet

A 2-page fact sheet was developed that includes an overview of the content and purpose of the WRP, a map and description of affected areas, the importance of the WRP to the Lake Helena watershed, the process for development of the WRP, and resources for additional information and participation. The fact sheet was posted online and distributed through the newsletter of the LHWG. This newsletter was mailed to more than 800 recipients. This was sent in 2013

Letter to Stakeholders

A letter was sent from the Lake Helena Watershed Group (LHWG) Chair to stakeholders. The letter invited participation from stakeholders in the development of the WRP. The letter was sent to about 750 individuals, organizations and businesses in the watershed.

Stakeholder Interviews

Representatives of the WQPD presented information about the WRP and the planning process and interviewed stakeholders. Interview questions addressed the following topics: values and goals, plans, projects and activities, data, and involvement in the planning process. Representatives of the following entities were interviewed:

- Bureau of Land Management, Butte Field Office
- City of East Helena
- Helena Valley Irrigation District
- Helena National Forest
- Jefferson County
- Jefferson Valley Conservation District
- Lewis & Clark Conservation District
- Lewis & Clark County
- Montana Business Assistance Connection
- Montana Department of Environmental Quality
- Montana Department of Justice Natural Resource Damage Program
- Montana Department of Transportation
- Montana Environmental Trust Group
- Montana Fish, Wildlife, and Parks
- Natural Resources Conservation Service
- PPL Montana
- Prickly Pear Land Trust
- U.S. Environmental Protection Agency

Notes from the interviews have been kept at the WQPD and with Headwaters Policy/Planning Partnership, LLC in hard copy. Information from these interviews was used throughout the WRP.

Presentations to Community Organizations

A presentation was developed to educate community residents about the importance of clean water and the benefits of watershed restoration, water quality impairments, watershed restoration planning, pollutants and sources of pollution found in the Lake Helena watershed, and solutions for improving water quality.

This presentation was delivered at meetings of the following groups:

- Kiwanis

- Agri Forum
- Lewis and Clark County Citizen's Advisory Committee on Open Lands
- City of Helena Commission and staff

Participants were provided with an opportunity to ask questions and provide ideas.

Public Meeting

The LHWG invited all interested persons to attend a meeting held in the Helena Valley on April 18, 2013 to help identify priority water quality improvement activities. After a short presentation on watershed restoration planning, participants were asked to identify the key issues related to water quality and watershed health in the Lake Helena watershed. Participants were then asked how these issues can best be addressed.

Survey

A survey was posted on the website, distributed through meetings and newsletters of stakeholder organizations and the LHWG. The survey asked respondents to answer questions about water quality and watershed health in the Lake Helena watershed, including questions on the following topics:

- Importance of watershed health to respondents
- Most urgent problems and best opportunities
- Highest priority impaired water bodies for water quality improvement activities
- Interest in collaboration on projects

Thirty-six surveys were returned.

News Media

A news release was distributed and two articles appeared in the major area newspaper, the Helena *Independent Record*.

APPENDIX E: TABLE 15-1. SUMMARY OF 303(D) LISTED STREAMS, POLLUTANTS, AND TMDLS IN THE LAKE HELENA WATERSHED

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
Clancy Creek, MT41I006_120	Siltation/ Suspended Solids	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	2,486 tons/yr	WLA: 0 LA: 2,486 tons/yr	Volume I; Volume II – Appendix A, C, and D
	Nutrients	No nutrient TMDL needed, not exceeding the narrative nutrient standards.			Volume I
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	279.4 lbs/yr	WLA: 0 LA: 279.4 lbs/yr	Volume I; Volume II – Appendix A and F
	Cadmium	• Aquatic Life (acute): 2.3 µg/L at 105.6 mg/L hardness • Aquatic Life (chronic): 0.3 µg/L at 105.6 mg/L hardness • Human Health: 5 µg/L	13.2 lbs/yr	WLA: 0 LA: 13.2 lbs/yr	Volume I; Volume II – Appendix A and F
	Copper	• Aquatic Life (acute): 14.6 µg/L at 105.6 mg/L hardness • Aquatic Life (chronic): 9.6 µg/L at 105.6 mg/L hardness • Human Health: 1,300 µg/L	517.6 lbs/yr	WLA: 0 LA: 517.6 lbs/yr	Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 86.3 µg/L at 105.6 mg/L hardness • Aquatic Life (chronic): 3.3 µg/L at 105.6 mg/L hardness • Human Health: 15 µg/L	155.8 lbs/yr	WLA: 0 LA: 155.8 lbs/yr	Volume I; Volume II – Appendix A and F
	Mercury	Insufficient data, not addressed in Volume II.			
	Zinc	• Aquatic Life (acute): 126.5 µg/L at 105.6 mg/L hardness • Aquatic Life (chronic): 126.5 µg/L at 105.6 mg/L hardness • Human Health: 2,000 µg/L	10613.3 lbs/yr	WLA: 0 LA: 10613.3 lbs/yr	Volume I; Volume II – Appendix A and F
Corbin Creek, MT41I006_090	pH	No TMDL needed, not exceeding the standards.			Volume I
	Suspended Solids	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	368 tons/yr	WLA: 0 LA: 368 tons/yr	Volume I; Volume II – Appendix A, C, and D

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	36.2 lbs/yr	WLA: 0 LA: 36.2 lbs/yr	Volume I; Volume II – Appendix A and F
	Cadmium	• Aquatic Life (acute): 8.95 µg/L at 400 mg/L hardness • Aquatic Life (chronic): 0.75 µg/L at 400 mg/L hardness • Human Health: 5 µg/L	2.8 lbs/yr	WLA: 0 LA: 2.8 lbs/yr	Volume I; Volume II – Appendix A and F
	Copper	• Aquatic Life (acute): 51.0 µg/L at 400 mg/L hardness • Aquatic Life (chronic): 29.8 µg/L at 400 mg/L hardness • Human Health: 1,300 µg/L	114.6 lbs/yr	WLA: 0 LA: 114.6 lbs/yr	Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 468.3 µg/L at 400 mg/L hardness • Aquatic Life (chronic): 18.2 µg/L at 400 mg/L hardness • Human Health: 15 µg/L	33.2 lbs/yr	WLA: 0 LA: 33.2 lbs/yr	Volume I; Volume II – Appendix A and F
	Zinc	• Aquatic Life (acute): 392.6 µg/L at 400 mg/L hardness • Aquatic Life (chronic): 392.6 µg/L at 400 mg/L hardness • Human Health: 2,000 µg/L	1,660.7 lbs/yr	WLA: 0 LA: 1,660.7 lbs/yr	Volume I; Volume II – Appendix A and F
	Thermal Modifications	• ≤ 1° F change when water temperature is < 67° F • No significant disturbance of riparian vegetation; Riparian vegetation approaching the maximum potential. • MFISH rating of "best" or "substantial" • Maintain recommended MFWP flows	Volume I stated that, "The available data suggest that impairments due to metals and siltation currently far outweigh any concerns posed by thermal modifications. Fisheries data suggest that the stream is not inhabited by fish. It is not recommended that a TMDL for temperature be prepared at this time. Once pollutant levels are reduced in the stream, Corbin Creek should be able to sustain a fish population and the application of the B-1 temperature targets would be appropriate."			
	Salinity/ TDS/Cl	Addressed as part of the metals goals and TMDLs. Volume I found that, "The impairment is likely associated with extremely high trace metals concentrations rather than high concentrations of sulfates, sodium, or chlorides. The project team finds that a specific TMDL to address salinity and total dissolved solids issues is not warranted pending implementation of a metals TMDL."			
Golconda Creek, MT41I006_070	Unknown Toxicity	The 1996 list did not have more specific details about the "unknown toxicity." Investigations performed during the Volume I report revealed that the unknown toxicity was most likely due to metals. The impairment is addressed as part of the cadmium and lead TMDLs.			Volume I
	Suspended Solids/ Turbidity	No suspended solids or turbidity TMDLs needed, not exceeding the narrative standards.			Volume I
	Cadmium	• Aquatic Life (acute): 0.8 µg/L at 38.5 mg/L hardness • Aquatic Life (chronic): 0.1 µg/L at 38.5 mg/L hardness • Human Health: 5 µg/L	0.7 lb/yr	WLA: 0 LA: 0.7lb/yr	Volume I; Volume II – Appendix A and F

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
	Lead	• Aquatic Life (acute): 23.9 µg/L at 38.5 mg/L hardness • Aquatic Life (chronic): 0.9 µg/L at 38.5 mg/L hardness • Human Health: 15 µg/L	6.3 lbs/yr	WLA: 0 LA: 6.3 lbs/yr	Volume I; Volume II – Appendix A and F
Granite Creek MT41I006_179 (Tributary to Austin Creek)	No pollutants	No TMDLs necessary.			Volume I
Granite Creek, MT41I006_230 (Tributary to Sevenmile Creek)	Arsenic	No flow was observed in Granite Creek. Therefore, insufficient information is available to determine impairment status.			Volume I
	Cadmium	No flow was observed in Granite Creek. Therefore, insufficient information is available to determine impairment status.			Volume I
	Lead	No flow was observed in Granite Creek. Therefore, insufficient information is available to determine impairment status.			Volume I
Jackson Creek, MT41I006_190	Siltation	No siltation TMDL needed, not exceeding the narrative standards.			Volume I
Jennie's Fork, MT41I006_210	Siltation	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	306 tons/yr	WLA: 0 LA: 306 tons/yr	Volume I; Volume II – Appendix A, C, and D
	Lead	• Aquatic Life (acute): 118.7 µg/L at 135.8 mg/L hardness • Aquatic Life (chronic): 4.6 µg/L at 135.8 mg/L hardness • Human Health: 15 µg/L	8.4 lbs/yr	WLA: 0 LA: 8.4 lbs/yr	Volume I; Volume II – Appendix A and F
Lake Helena, MT41I007_010	Suspended Solids	Impairment status unknown. Volume I states, "insufficient information is available to evaluate the degree of potential sediment impairment in Lake Helena, if any. A suitable reference lake would be needed to evaluate the sediment impairment of Lake Helena."			Volume I
	Nutrients	Insufficient data are currently available to establish nutrient targets for Lake Helena. A strategy to establish targets in the future is presented in Volume II, Section 3.2.3. TMDLs are presented based on % reductions for Prickly Pear Creek (the largest tributary to Lake Helena).	TN: 226.2 tons/yr TP: 20.7 tons/yr	**TN** WLA: 4.4 tons/yr LA: 221.8 tons/yr **TP** WLA: 1.8 tons/yr LA: 18.9 tons/yr	Volume I Appendix A, C, D, E, I, and K Volume II, Section 3.2.3 (Nutrient Strategy)
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	5,104.2 lbs/yr	WLA: 149.2 lbs/yr LA: 4,955.0 lbs/yr	Volume I; Volume II – Appendices A and F

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
	Lead	• Aquatic Life (acute): 157.6 µg/L at 169.7 mg/L hardness • Aquatic Life (chronic): 6.1 µg/L at 169.7 mg/L hardness • Human Health: 15 µg/L	2,798.0 lbs/yr	WLA: 66.8 lbs/yr LA: 2,731.2 lbs/yr	Volume I; Volume II – Appendices A and F
	Thermal Modifications	Unknown impairment status.			Volume I
Lump Gulch, MT41I006_130	Suspended Solids	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	1,780 tons/yr	WLA: 0 LA: 1,780 tons/yr	Volume I; Volume II – Appendix A, C, and D
	Cadmium	• Aquatic Life (acute): 1.1 µg/L at 51.4 mg/L hardness • Aquatic Life (chronic): 0.2 µg/L at 51.4 mg/L hardness • Human Health: 5 µg/L	10.4 lbs/yr	WLA: 0 LA: 10.4 lbs/yr	Volume I; Volume II – Appendix A and F
	Copper	• Aquatic Life (acute): 7.4 µg/L at 51.4 mg/L hardness • Aquatic Life (chronic): 5.2 µg/L at 51.4 mg/L hardness • Human Health: 1,300 µg/L	452.8 lbs/yr	WLA: 0 LA: 452.8 lbs/yr	Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 34.6 µg/L at 51.4 mg/L hardness • Aquatic Life (chronic): 1.3 µg/L at 51.4 mg/L hardness • Human Health: 15 µg/L	135.3 lbs/yr	WLA: 0 LA: 135.3 lbs/yr	Volume I; Volume II – Appendix A and F
	Zinc	• Aquatic Life (acute): 68.6 µg/L at 51.4 mg/L hardness • Aquatic Life (chronic): 68.6 µg/L at 501.4mg/L hardness • Human Health: 2,000 µg/L	8,485.9 lbs/yr	WLA: 0 LA: 8,485.9 lbs/yr	Volume I; Volume II – Appendix A and F
	Mercury	Insufficient data, not addressed in Volume II.			

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
Middle Fork Warm Springs Creek, MT41I006_100	Siltation	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	Load allocations are presented as part of the Warm Springs Creek watershed TMDL.		Volume I; Volume II – Appendix A, C, and D
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	Load allocations are presented as part of the Warm Springs Creek watershed TMDL.		Volume I; Volume II – Appendix A and F
	Cadmium	• Aquatic Life (acute): 1.3 µg/L at 61.2 mg/L hardness • Aquatic Life (chronic): 0.2 µg/L at 61.2 mg/L hardness • Human Health: 5 µg/L	Load allocations are presented as part of the Warm Springs Creek watershed TMDL.		Volume I; Volume II – Appendix A and F
	Copper	No copper TMDL needed, not exceeding the standards.			
	Lead	• Aquatic Life (acute): 43.2 µg/L at 61.2 mg/L hardness • Aquatic Life (chronic): 1.7 µg/L at 61.2 mg/L hardness • Human Health: 15 µg/L	Load allocations are presented as part of the Warm Springs Creek watershed TMDL.		Volume I; Volume II – Appendix A and F
	Zinc	• Aquatic Life (acute): 79.7 µg/L at 61.2 mg/L hardness • Aquatic Life (chronic): 79.7 µg/L at 61.2 mg/L hardness • Human Health: 2,000 µg/L	Load allocations are presented as part of the Warm Springs Creek watershed TMDL.		Volume I; Volume II – Appendix A and F
	Mercury	Insufficient data, not addressed in Volume II.			
North Fork Warm Springs Creek, MT41I006_180	Siltation	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	Load allocations are presented as part of the Warm Springs Creek watershed TMDL.		Volume I; Volume II – Appendix A, C, and D
	Low DO, organic enrichment	No nutrient TMDL needed, not exceeding the narrative standards.			Volume I
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	Load allocations are presented as part of the Warm Springs Creek watershed TMDL.		Volume I; Volume II – Appendix A and F

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
	Cadmium	• Aquatic Life (acute): 1.3 µg/L at 61.2 mg/L hardness • Aquatic Life (chronic): 0.2 µg/L at 61.2 mg/L hardness • Human Health: 5 µg/L	Load allocations are presented as part of the Warm Springs Creek watershed TMDL.		Volume I; Volume II – Appendix A and F
	Zinc	• Aquatic Life (acute): 79.7 µg/L at 61.2 mg/L hardness • Aquatic Life (chronic): 79.7 µg/L at 61.2 mg/L hardness • Human Health: 2,000 µg/L	Load allocations are presented as part of the Warm Springs Creek watershed TMDL.		Volume I; Volume II – Appendix A and F
Prickly Pear Creek, MT41I006_060	Suspended Solids	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A, C, and D
	Lead	• Aquatic Life (acute): 238.5 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 9.2 µg/L at 235.1 mg/L hardness • Human Health: 15 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
Prickly Pear Creek, MT41I006_050	Siltation/ Suspended Solids	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A, C, and D
	Cadmium	• Aquatic Life (acute): 5.2 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 0.5 µg/L at 235.1 mg/L hardness • Human Health: 5 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 238.5 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 9.2 µg/L at 235.1 mg/L hardness • Human Health: 15 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
	Zinc	• Aquatic Life (acute): 249.9 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 249.9 µg/L at 235.1 mg/L hardness • Human Health: 2,000 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
Prickly Pear Creek, MT41I006_040	Siltation/ Suspended Solids	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A, C, and D
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Cadmium	• Aquatic Life (acute): 5.2 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 0.5 µg/L at 235.1 mg/L hardness • Human Health: 5 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Copper	• Aquatic Life (acute): 31.0 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 18.9 µg/L at 235.1 mg/L hardness • Human Health: 1,300 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 238.5 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 9.2 µg/L at 235.1 mg/L hardness • Human Health: 15 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Zinc	• Aquatic Life (acute): 249.9 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 249.9 µg/L at 235.1 mg/L hardness • Human Health: 2,000 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Thermal Modifications	• ≤ 1° F when water temperature is < 67° F • 60 Percent Riparian Shade • MFISH rating of "best" or "substantial" • Maintain minimum MFWP recommended flows	67 °F	WLA: LA: 67 °F	Volume I; Volume II – Appendix A, Appendix G, Appendix E

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
Prickly Pear Creek, MT41I006_030	Siltation/ Suspended Solids	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A, C, and D
	Nutrients	TN: 0.33 mg/L TP: 0.04 mg/L (A strategy to revise these targets is presented in Volume II and Appendix I)	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Appendix A, C, D, E, I, and K Volume II, Section 3.2.3 (Nutrient Strategy)
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Cadmium	• Aquatic Life (acute): 5.2 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 0.5 µg/L at 235.1 mg/L hardness • Human Health: 5 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Copper	• Aquatic Life (acute): 31.0 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 18.9 µg/L at 235.1 mg/L hardness • Human Health: 1,300 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 238.5 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 9.2 µg/L at 235.1 mg/L hardness • Human Health: 15 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Zinc	• Aquatic Life (acute): 249.9 µg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 249.9 µg/L at 235.1 mg/L hardness • Human Health: 2,000 µg/L	Load allocations are presented as part of the Prickly Pear Creek watershed TMDL (Segment MT41I006_020).		Volume I; Volume II – Appendix A and F
	Thermal Modifications	• ≤ 1°F when water temperature is < 67°F • 60 Percent Riparian Shade • MFISH rating of "best" or "substantial" • Maintain minimum MFWP recommended flows	No TMDL is presented at this time. This segment is completely dewatered during critical summer low flow conditions. Reassessment should occur once the stream meets recommended minimum summer flows.		Volume I; Volume II – Appendix A, Appendix G, Appendix E

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
Prickly Pear Creek, MT41I006_020	Siltation/ Suspended Solids	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	24,186 tons/yr	WLA: 54 tons/yr LA: 24,132 tons/yr	Volume I; Volume II – Appendix A, C, and D
	Nutrients	TN: 0.33 mg/L TP: 0.04 mg/L (A strategy to revise these targets is presented in Volume II and Appendix I)	TN: 111.7 tons/yr TP: 13.6 tons/yr	**TN** WLA: 3.7 tons/yr LA: 108.0 tons/yr **TP** WLA: 1.6 ton/yr LA: 12.0 tons/yr	Volume I; Appendix A, C, D, E, and I; Volume II, Section 3.2.3 (Nutrient Strategy)
	Ammonia	No ammonia TMDL needed, not exceeding the standards.			Volume I
	Arsenic	• Aquatic Life (acute): 340 μg/L • Aquatic Life (chronic): 150 μg/L • Human Health: 10 μg/L	3,943 lbs/yr	WLA: 149 lbs/yr LA: 3,794 lbs/yr	Volume I; Volume II – Appendix A and F
	Cadmium	• Aquatic Life (acute): 5.2 μg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 0.5 μg/L at 235.1 mg/L hardness • Human Health: 5 μg/L	171 lbs/yr	WLA: 12 lbs/yr LA: 159 lbs/yr	Volume I; Volume II – Appendix A and F
	Copper	• Aquatic Life (acute): 31.0 μg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 18.9 μg/L at 235.1 mg/L hardness • Human Health: 1,300 μg/L	5,969 lbs/yr	WLA: 149 lbs/yr LA: 5,820 lbs/yr	Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 238.5 μg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 9.2 μg/L at 235.1 mg/L hardness • Human Health: 15 μg/L	2,082 lbs/yr	WLA: 67 lbs/yr LA: 2,015 lbs/yr	Volume I; Volume II – Appendix A and F
	Zinc	• Aquatic Life (acute): 249.9 μg/L at 235.1 mg/L hardness • Aquatic Life (chronic): 249.9 μg/L at 235.1 mg/L hardness • Human Health: 2,000 μg/L	118,617 lbs/yr	WLA: 1,977 lbs/yr LA: 116,640 lbs/yr	Volume I; Volume II – Appendix A and F
	Thermal Modifications	• ≤ 1°F when water temperature is < 67°F • 60 Percent Riparian Shade • MFISH rating of "best" or "substantial" • Maintain minimum MFWP recommended flows	No TMDL is presented at this time. This previous segment is completely dewatered during critical summer low flow conditions. Reassessment should occur once the stream meets recommended minimum summer flows.		Volume I; Volume II – Appendix A, Appendix G, Appendix E

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
Prickly Pear Creek, MT41I006_010	Metals	This segment of Prickly Pear Creek is located downstream of Lake Helena, and is therefore outside the scope of this assessment. Segment MT41I006_010 will be assessed at a future date as part of the Hauser Lake/Missouri River Planning Area.			
Sevenmile Creek, MT41I006_160	Siltation	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	3100 tons/yr	WLA: 0 LA: 3100 tons/yr	Volume I; Volume II – Appendix A, C, and D
	Nutrients	TN: 0.33 mg/L TP: 0.04 mg/L (A strategy to revise these targets is presented in Volume II and Appendix I)	TN: 12.26 tons/yr TP: 1.59 tons/yr	**TN** WLA: 0 tons/yr LA: 12.26 tons/yr **TP** WLA: 0 ton/yr LA: 1.59 tons/yr	Volume I; Appendix A, C, D, E, I, and K Volume II, Section 3.2.3 (Nutrient Strategy)
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	578.7 lbs/yr	WLA: 0 LA: 578.7 lbs/yr	Volume I; Volume II – Appendix A and F
	Copper	• Aquatic Life (acute): 33.6 µg/L at 256.4 mg/L hardness • Aquatic Life (chronic): 20.4 µg/L at 256.4 mg/L hardness • Human Health: 1,300 µg/L	828.0 lbs/yr	WLA: 0 LA: 828.0 lbs/yr	Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 266.2 µg/L at 256.4 mg/L hardness • Aquatic Life (chronic): 10.3 µg/L at 256.4 mg/L hardness • Human Health: 15 µg/L	283.7 lbs/yr	WLA: 0 LA: 283.7 lbs/yr	Volume I; Volume II – Appendix A and F
Silver Creek, MT41I006_150	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	968.3 lbs/yr	WLA: 0 LA: 968.3 lbs/yr	Volume I; Volume II – Appendix A and F
	Priority organics	No TMDL needed, not exceeding standards.			Volume I

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
Skelly Gulch, MT41I006_220	Siltation	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	1,097 tons/yr	WLA: 0 LA: 1,097 tons/yr	Volume I; Volume II – Appendix A, C, and D
	Metals	No TMDL needed, not exceeding standards.			Volume I
Spring Creek, MT41I006_080	Suspended Solids	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	1,954 tons/yr	WLA: 0 LA: 1,954 tons/yr	Volume I; Volume II – Appendix A, C, and D
	Nutrients	TN: 0.33 mg/L TP: 0.04 mg/L (A strategy to revise these targets is presented in Volume II and Appendix I)	TN: 5.84 tons/yr TP: 0.95 tons/yr	**TN** WLA: 0 LA: 5.84 tons/yr **TP** WLA: 0 LA: 0.95 tons/yr	Volume I; Appendix A, C, D, E, I, and K Volume II, Section 3.2.3 (Nutrient Strategy)
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	294.6 lbs/yr	WLA: 81.2 lbs/yr LA: 213.4 lbs/yr	Volume I; Volume II – Appendix A and F
	Cadmium	• Aquatic Life (acute): 8.95 µg/L at 400 mg/L hardness • Aquatic Life (chronic): 0.75 µg/L at 400 mg/L hardness • Human Health: 5 µg/L	15.9 lbs/yr	WLA: 4.1 lbs/yr LA: 11.8 lbs/yr	Volume I; Volume II – Appendix A and F
	Copper	• Aquatic Life (acute): 51.0 µg/L at 400 mg/L hardness • Aquatic Life (chronic): 29.8 µg/L at 400 mg/L hardness • Human Health: 1,300 µg/L	668.0 lbs/yr	WLA: 77.6 lbs/yr LA: 590.4 lbs/yr	Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 468.3 µg/L at 400 mg/L hardness • Aquatic Life (chronic): 18.2 µg/L at 400 mg/L hardness • Human Health: 15 µg/L	219.8 lbs/yr	WLA: 51.1 lbs/yr LA: 168.7 lbs/yr	Volume I; Volume II – Appendix A and F

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
	Zinc	• Aquatic Life (acute): 392.6 µg/L at 400 mg/L hardness • Aquatic Life (chronic): 392.6 µg/L at 400 mg/L hardness • Human Health: 2,000 µg/L	14,399 lbs/yr	WLA: 1,770 lbs/yr LA: 12629 lbs/yr	Volume I; Volume II – Appendix A and F
	pH	No TMDL needed, not exceeding standards.			Volume I
Tenmile Creek, MT41I006_141	Siltation	No TMDL needed, not exceeding standards.			Volume I
	pH	No TMDL needed, not exceeding standards.			Volume I
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A and F
	Cadmium	• Aquatic Life (acute): 2.3 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 0.3 µg/L at 106.5 mg/L hardness • Human Health: 5 µg/L	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A and F
	Copper	• Aquatic Life (acute): 14.7 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 9.7 µg/L at 106.5 mg/L hardness • Human Health: 1,300 µg/L	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 87.2 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 3.4 µg/L at 106.5 mg/L hardness • Human Health: 15 µg/L	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A and F
	Mercury	Insufficient data, not addressed in Volume II.			
	Zinc	• Aquatic Life (acute): 127.5 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 127.5 µg/L at 106.5 mg/L hardness • Human Health: 2,000 µg/L	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A and F
Tenmile Creek, MT41I006_142	pH	No TMDL needed, not exceeding standards.			Volume I
	Siltation	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A, C, and D
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A and F

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
	Cadmium	• Aquatic Life (acute): 2.3 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 0.3 µg/L at 106.5 mg/L hardness • Human Health: 5 µg/L	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A and F
	Copper	• Aquatic Life (acute): 14.7 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 9.7 µg/L at 106.5 mg/L hardness • Human Health: 1,300 µg/L	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 87.2 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 3.4 µg/L at 106.5 mg/L hardness • Human Health: 15 µg/L	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A and F
	Zinc	• Aquatic Life (acute): 127.5 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 127.5 µg/L at 106.5 mg/L hardness • Human Health: 2,000 µg/L	Load allocations are presented as part of the Tenmile Creek watershed TMDL (Segment MT41I006_143).		Volume I; Volume II – Appendix A and F
Tenmile Creek, MT41I006_143	Mercury	Insufficient data, not addressed in Volume II.			
	pH	No TMDL needed, not exceeding standards.			Volume I
	Siltation	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	8,247 tons/yr	WLA: 0 LA: 8,247 tons/yr	Volume I; Volume II – Appendix A, C, and D
	Nutrients	TN: 0.33 mg/L TP: 0.04 mg/L (A strategy to revise these targets is presented in Volume II and Appendix I)	TN: 44.47 tons/yr TP: 4.39 tons/yr	**TN** WLA: 0 tons/yr LA: 44.47 tons/yr **TP** WLA: 0 ton/yr LA: 4.39 tons/yr	Volume I; Appendix A, C, D, E, I, and K Volume II, Section 3.2.3 (Nutrient Strategy)
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	1,912.6 lbs/yr	WLA: 0 LA: 1,912.6 lbs/yr	Volume I; Volume II – Appendix A and F
	Cadmium	• Aquatic Life (acute): 2.3 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 0.3 µg/L at 106.5 mg/L hardness • Human Health: 5 µg/L	67.6 lbs/yr	WLA: 0 LA: 67.6 lbs/yr	Volume I; Volume II – Appendix A and F

Waterbody Name	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	WLA LA	Supporting Documentation
	Copper	• Aquatic Life (acute): 14.7 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 9.7 µg/L at 106.5 mg/L hardness • Human Health: 1,300 µg/L	2,232.4 lbs/yr	WLA: 0 LA: 2,232.4 lbs/yr	Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 87.2 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 3.4 µg/L at 106.5 mg/L hardness • Human Health: 15 µg/L	734.1 lbs/yr	WLA: 0 LA: 734.1 lbs/yr	Volume I; Volume II – Appendix A and F
	Zinc	• Aquatic Life (acute): 127.5 µg/L at 106.5 mg/L hardness • Aquatic Life (chronic): 127.5 µg/L at 106.5 mg/L hardness • Human Health: 2,000 µg/L	43,706.0 lbs/yr	WLA: 0 LA: 43,706.0 lbs/yr	Volume I; Volume II – Appendix A and F
Warm Springs Creek, MT41I006_110	Suspended Solids, Siltation	• % of subsurface fines < 6.4 mm: < or = to the average value for all Helena National Forest reference stream core samples • % of surface fines < 2.0 mm: 0.2 • Width/depth ratio: Comparable to reference values. • BEHI: Comparable to reference values. • D50: Comparable to reference values. • PFC: Proper Functioning Condition or "Functional - at Risk" with an upward trend. • Macro IBI: To be determined	1,030 tons/yr	WLA: 0 LA: 1,030 tons/yr	Volume I; Volume II – Appendix A, C, and D
	Arsenic	• Aquatic Life (acute): 340 µg/L • Aquatic Life (chronic): 150 µg/L • Human Health: 10 µg/L	195.0 lbs/yr	WLA: 0 LA: 195.0 lbs/yr	Volume I; Volume II – Appendix A and F
	Cadmium	• Aquatic Life (acute): 1.3 µg/L at 61.2 mg/L hardness • Aquatic Life (chronic): 0.2 µg/L at 61.2 mg/L hardness • Human Health: 5 µg/L	5.5 lbs/yr	WLA: 0 LA: 5.5 lbs/yr	Volume I; Volume II – Appendix A and F
	Lead	• Aquatic Life (acute): 43.2 µg/L at 61.2 mg/L hardness • Aquatic Life (chronic): 1.7 µg/L at 61.2 mg/L hardness • Human Health: 15 µg/L	70.0 lbs/yr	WLA: 0 LA: 70.0 lbs/yr	Volume I; Volume II – Appendix A and F
	Zinc	• Aquatic Life (acute): 79.7 µg/L at 61.2 mg/L hardness • Aquatic Life (chronic): 79.7 µg/L at 61.2 mg/L hardness • Human Health: 2,000 µg/L	3,970.5 lbs/yr	WLA: 0 LA: 3,970.5 lbs/yr	Volume I; Volume II – Appendix A and F