Otter Creek Iron Total Maximum Daily Load – Draft

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Steve Bullock, Governor
Tom Livers, Director DEQ

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Prepared by:
Water Quality Planning Bureau
Watershed Management Section

Contributors:
Water Quality Planning Bureau
Watershed Management Section
Paul Kusnierz, Senior TMDL Planner and Iron TMDL Project Manager
Kristy Fortman, Senior TMDL Planner
Christina Staten, TMDL Planner and Project Coordinator
Dean Yashan, Watershed Management Section Supervisor

Information Management and Technical Services Section
Erik Makus, Hydrologist

Montana Department of Environmental Quality
Water Quality Planning Bureau
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

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Appendix A – Otter Creek Watershed Description Tables and Figures
Appendix B – Iron Water Quality Data

ACRONYM LIST

An acronym list will be included in the final Otter Creek Iron Total Maximum Daily Load document.

DOCUMENT SUMMARY

This document presents a total maximum daily load (TMDL) for iron in Otter Creek, located near Ashland, MT (**Figure DS-1**). The Montana Department of Environmental Quality (DEQ) develops TMDLs and submits them to the U.S. Environmental Protection Agency (EPA) for approval. Both the Montana Water Quality Act and the Federal Clean Water Act require DEQ to develop TMDLs for streams and lakes that do not meet, or are not expected to meet, Montana water quality standards. A TMDL is the maximum amount of a pollutant a waterbody can receive and still meet water quality standards. TMDLs provide an approach to improve water quality so that streams and lakes can support and maintain their designated beneficial uses.

Otter Creek is located in southeast Montana within the Lower Tongue River Basin: U.S. Geological Survey (USGS) 4th level hydrologic unit code (HUC) 10090102. The Otter Creek watershed encompasses 711 square miles, draining from its headwaters to the Tongue River near Ashland, MT, is made up of three USGS 5th level HUCs (1009010201, 1009010202, and 1009010203), and is located in the Northwestern Great Plains Level III Ecoregion. Otter Creek has a C-3 beneficial use classification, and flows through both publicly-owned (United States Forest Service, state of Montana, and Bureau of Land Management) and privately-owned land.

DEQ determined that Otter Creek (water quality assessment unit MT42C002_020) does not meet numeric water quality standards for iron, and it is included on the 2014 303(d) List as impaired by iron. Otter Creek enters into the Tongue River (water quality assessment unit MT42C001_013), which is also impaired for iron both upstream and downstream of the Otter Creek confluence. DEQ recognizes that Otter Creek is also identified as impaired for salinity on the 2014 303(d) List; however this document addresses only iron.

Metals concentrations exceeding the aquatic life and/or human health standards can impair support of numerous designated uses including aquatic life, drinking water, and agriculture. Within aquatic ecosystems, metals can have a toxic, carcinogenic, or bioconcentrating effect on biota. Water quality restoration objectives for metals are established based on numeric water quality criteria defined in Montana's numeric water quality standards. The iron TMDL is based on the chronic aquatic life water quality target and streamflow, which is the most stringent applicable water quality standard. Using the most stringent target ensures the TMDL is protective of all designated beneficial uses.

The data indicate that the high iron concentrations in Otter Creek are largely the result of natural sources within the watershed. The upper portions of Otter Creek have had few instances where the surface water quality did not meet the iron target (i.e., exceeded the iron target), whereas the lower part of the watershed frequently met the iron target. The frequency of iron target exceedances has been greater than 10% and remained relatively constant since the mid-1970s. The timing of high iron values in Otter Creek indicates two different processes are driving iron concentrations. The first is the result of iron entering the streams with sediment in spring runoff when hillslope and streambank erosion occur. The second is when groundwater high in iron is contributing a large proportion of the flow under low flow conditions during the summer.

The Otter Creek iron TMDL applies to any point along the waterbody and therefore protects beneficial uses along the entire stream. The TMDL is comprised of a point source wasteload allocation for the proposed Otter Creek Mine, and a composite load allocation for all nonpoint sources in the watershed,

including natural background. Although most nonpoint source water quality improvement actions associated with load allocations are based on voluntary measures, point source wasteload allocations must be incorporated into the appropriate Montana Pollutant Discharge Elimination System permit. This would apply to the iron wasteload allocation developed for Otter Creek Coal, LLC.

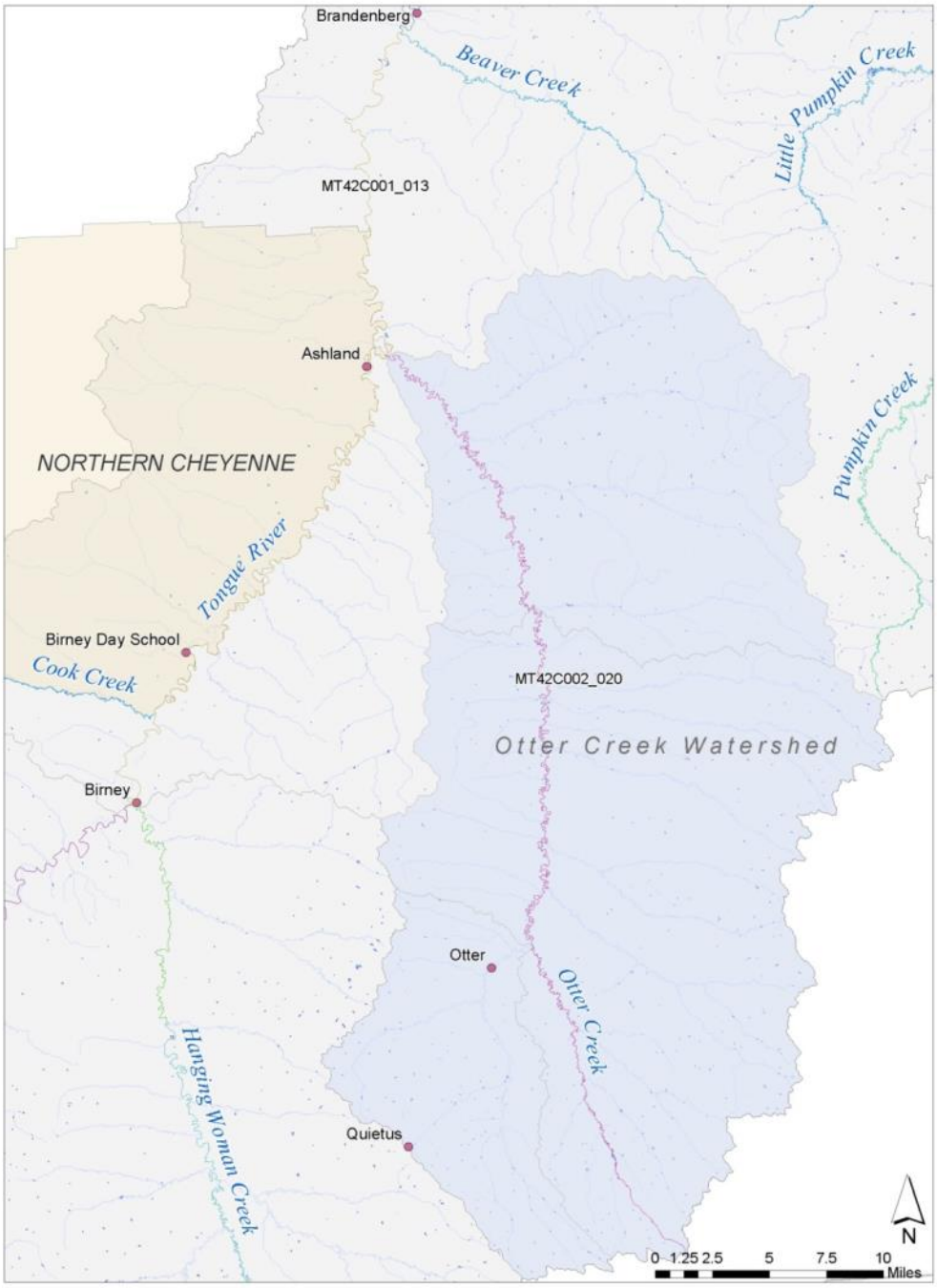

Figure DS-1. Location of the Otter Creek watershed

1.0 PROJECT OVERVIEW

This document presents an analysis of water quality information and establishes total maximum daily loads (TMDLs) for total recoverable iron in Otter Creek.

1.1 WHY WE WRITE TMDLS

In 1972, the U.S. Congress passed the Water Pollution Control Act, more commonly known as the Clean Water Act (CWA). The CWA's goal is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The CWA requires each state to designate uses of their waters and to develop water quality standards to protect those uses.

Montana's water quality designated use classification system includes the following:

- fish and aquatic life
- wildlife
- recreation
- agriculture
- industry
- drinking water

Each waterbody in Montana has a set of designated uses from the list above. Montana has established water quality standards to protect these uses, and a waterbody that does not meet one or more standards is called an impaired water. Each state must monitor their waters to track if they are supporting their designated uses, and every two years the Montana Department of Environmental Quality (DEQ) prepares a Water Quality Integrated Report (IR) which lists all impaired waterbodies and their identified impairment causes. Impairment causes fall within two main categories: pollutant and non-pollutant.

Montana's biennial IR identifies all the state's impaired waterbody segments. The 303(d) list portion of the IR includes all of those waterbody segments impaired by a pollutant, which require a TMDL, whereas TMDLs are not required for non-pollutant causes of impairments. Otter Creek is identified in Montana's "2014 Water Quality Integrated Report" as impaired for the pollutants iron and salinity, and for the non-pollutant "alteration in stream-side or littoral vegetative covers" (Montana Department of Environmental Quality, 2014).

Both Montana state law (75-5-701, Montana Code Annotated (MCA) of the Montana Water Quality Act) and section 303(d) of the federal CWA require the development of total maximum daily loads for all impaired waterbodies when water quality is impaired by a pollutant. A TMDL is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards.

Developing TMDLs and water quality improvement strategies includes the following components, which are further defined in **Section 4.0**:

- Determining measurable target values to help evaluate the waterbody's condition in relation to the applicable water quality standards
- Quantifying the magnitude of pollutant contribution from their sources
- Determining the TMDL for each pollutant based on the allowable loading limits for each waterbody-pollutant combination

- Allocating the total allowable load (the TMDL) into individual loads for each source

Basically, developing a TMDL for an impaired waterbody is a problem-solving exercise: The problem is excess pollutant loading that impairs a designated use. The solution is developed by identifying the total acceptable pollutant load (the TMDL), identifying all the significant pollutant-contributing sources, and identifying where pollutant loading reductions should be applied to achieve the acceptable load.

1.2 WHAT THIS DOCUMENT CONTAINS

This document addresses all of the required components of an iron TMDL. The salinity and "alteration in stream-side or littoral vegetative covers" impairments identified for Otter Creek on the 2014 303(d) List are not addressed in this document. DEQ is pursuing site-specific salinity standards for Otter Creek.

The iron TMDL components are summarized within the main body of the document. **Appendix A** contains maps and tables associated with the watershed description and **Appendix B** contains the iron water quality data used for this TMDL. In addition to this introductory section, this document includes:

Section 2.0 Otter Creek Watershed Description:
Describes the physical characteristics and social profile of the Otter Creek watershed.

Section 3.0 Montana Water Quality Standards
Discusses the water quality standards that apply to the Otter Creek watershed.

Section 4.0 Defining TMDLs and Their Components
Defines the components of TMDLs and how each is developed.

Sections 5.0 Otter Creek Iron TMDL and Components:
Includes (a) a discussion of Otter Creek and iron's effect on designated beneficial uses, (b) the information sources and assessment methods used to evaluate stream health and iron source contributions, (c) water quality targets and existing water quality conditions, (d) the quantified pollutant loading from the identified sources, (e) the determined iron TMDL for Otter Creek, (f) the allocations of the allowable pollutant load to the identified sources.

Section 6.0 Public Participation & Public Comments:
Describes other agencies and stakeholder groups who were involved with the development of this plan and the public participation process used to review the draft document. Addresses comments received during the public review period.

2.0 OTTER CREEK WATERSHED DESCRIPTION

This section provides a general overview of the physical and social characteristics of the Otter Creek watershed, and establishes a context to support total maximum daily load (TMDL) planning. The area described is called the Otter Creek TMDL Project Area and consists of the Otter Creek watershed in its entirety. The project area is a part of the larger Tongue TMDL Planning Area. Otter Creek is the only identified impaired waterbody in the project area (**Figure A-1**).

2.1 PHYSICAL CHARACTERISTICS

The following information describes the physical characteristics of the Otter Creek watershed.

2.1.1 Location

The Otter Creek watershed encompasses approximately 711 square miles (455,228 acres), with the majority of the watershed being located in Powder River County and small portions in Big Horn and Rosebud Counties (**Figure A-2**). The project area is located within the Lower Tongue River Subbasin *10090102* and is composed of three 5th order HUC (Hydrologic Unit Code) watersheds: Bear Creek *1009010202*, Upper Otter Creek *1009010203*, and Lower Otter Creek *1009010205* (**Figure A-3**). Otter Creek is 108.1 miles in length and runs from its headwaters near the Montana/Wyoming border, northward to its mouth at the confluence with the Tongue River near the town of Ashland, MT. The Otter Creek watershed falls within the Northwestern Great Plains (43) Level III Ecoregion and is further divided into three Level IV Ecoregions: the Central Grassland (43n), Ponderosa Pine Forest – Savanna Hills (43p), and Mesic Dissected Plains (43q) (**Figure A-4**).

2.1.2 Climate

Average annual precipitation in the watershed ranges from 13 inches/year in the central portion of the valley to 20 inches/year at higher elevations in the headwaters area (**Figure A-5**). Data from the Western Regional Climate Center (WRCC, 2013) indicates that the average total snowfall at the Otter, MT climate station (the only climate station within the watershed with a 30 year dataset) is 13.6 inches/year, with the average total precipitation being 19.0 inches/year. The months of May and June typically receive the greatest amount of precipitation, with most precipitation in the winter months coming in the form of snow. Temperatures at the Otter climate station range from an average low of 11˚F in January to an average high of 88˚F in July (**Table 2-1**).

Table 2-1. Western Regional Climate Center climate data for the Otter, MT climate station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	31	38	47	59	68.6	78	88	87	74	61	45	34	59.2
Average Min. Temperature (F)	11	16	23	33	41.4	50	57	55	45	35	24	14	33.6
Average Total Precipitation (in.)	0.9	0.8	1.3	2.2	2.73	3.3	1.5	1.1	1.7	1.3	1.1	1	18.97
Average Total SnowFall (in.)	4	0	0	1.2	0	0.3	0	0	0	1.6	1.9	4.5	13.6
Average Snow Depth (in.)	5	5	2	0	0	0	0	0	0	0	1	3	1

**Period of record 10/01/1961 to 01/31/1990*

2.1.3 Hydrology

The average annual streamflow for Otter Creek at Ashland, MT (1973-2012) is 4.7 cubic feet per second (cfs). The peak streamflow event of 425 cfs at the Ashland gage occurred on March 21, 1978, and a

graph of historic peak flows can be seen in **Figure 2-1** (USGS, 2013). Streamflows in the Otter Creek watershed vary greatly from year to year, but typically have a bimodal distribution - peaking in March from snowmelt runoff and again in May/June due to rainfall - then tapering off to baseflow conditions by late summer. A hydrograph from the Ashland gage displaying the average streamflow values for the years 1972 to 2012 shows the typical flow patterns for Otter Creek (**Figure 2-2**; USGS, 2013).

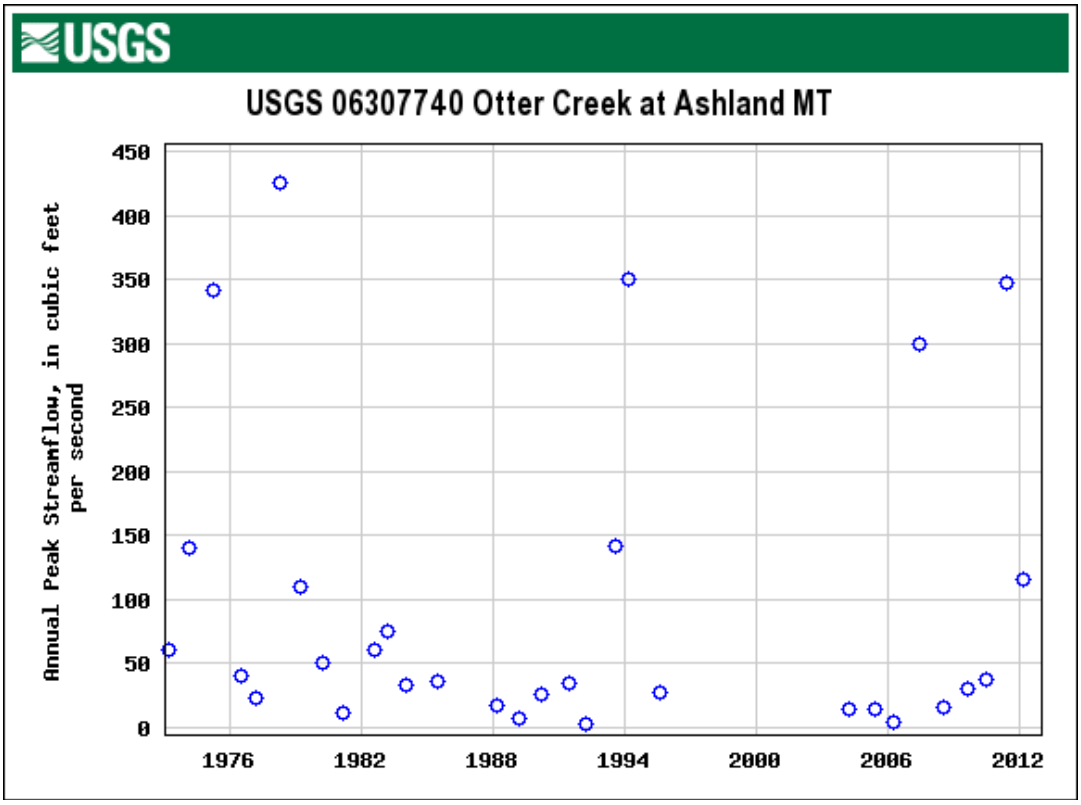

Figure 2-1. Annual peak streamflow (1973-2012) for Otter Creek at Ashland, MT

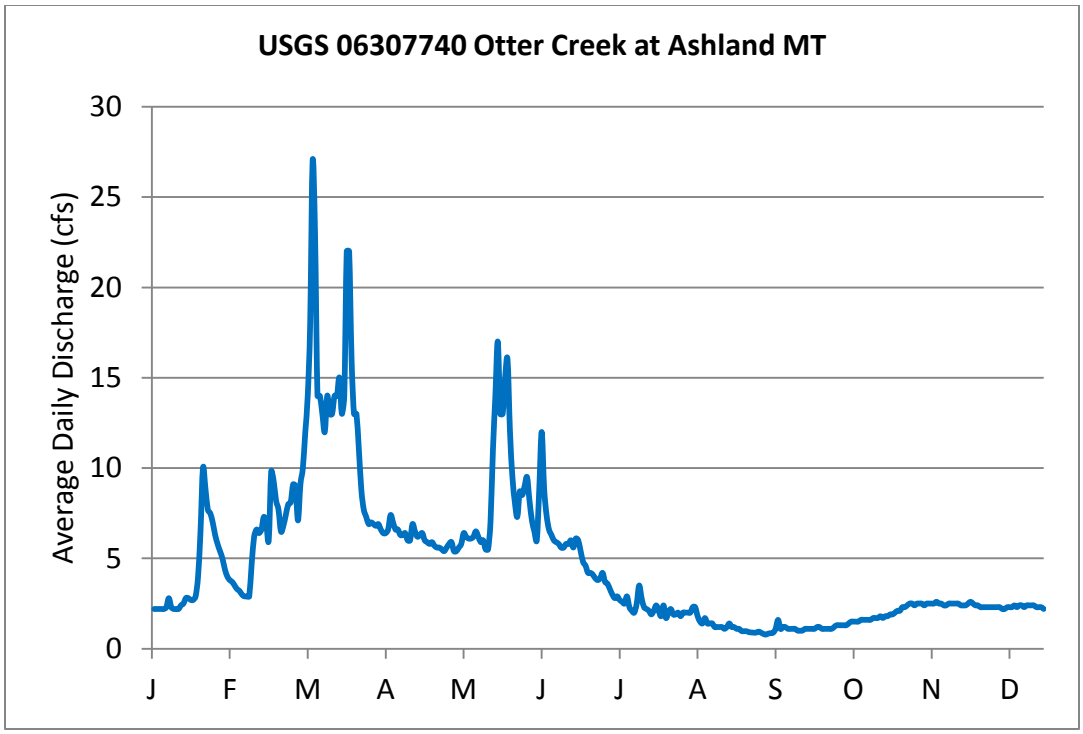

Figure 2-2. Average flow regime for Otter Creek using flow data from 1972 to 2012 from Otter Creek at Ashland, MT

2.1.4 Topography

The highest elevation in the watershed is Home Creek Butte (4,410 ft) on the eastern edge of the watershed and the lowest elevation is at the mouth of Otter Creek (2,860 ft) near the town of Ashland **(Figure A-6)**. Slopes can be highly variable, ranging from 0% in the river bottoms to greater than 100% in the steep rock outcroppings and badland-type areas (**Figure A-7**).

2.1.5 Geology

Geologic mapping of the area was conducted by the Montana Bureau of Mines and Geology at the 1:100,000 scale, and includes the Birney, Broadus, Lame Deer, and Powderville quadrangles (Vuke et al. 2001a; 2001b; 2001c; 2001d). The majority of the watershed is underlain by Tertiary deposits of the Tongue River member of the Fort Union Formation, with the upper (South) end of the watershed being underlain by Tertiary deposits of the Wasatch Formation. The Tongue River Member of the Fort Union Formation is composed of yellow, orange, or tan, fine-grained sandstone with thinner interbeds of yellowish brown, orange, or tan siltstone; light-colored mudstone, and clay; and coal beds. The Wasatch Formation is composed of yellowish gray to light gray siltstone and medium- to coarse-grained, massive, or cross-bedded sandstone interbedded with medium gray and brown carbonaceous shale and coal. Quaternary alluvial deposits occur in the floodplains, with some small Quaternary alluvial terrace deposits on the lower (North) end of the watershed. Alluvial terrace deposits are light-brown and light-gray gravel and sand, while the alluvium is light-gray and light-brown gravel, sand, silt, and clay deposited in stream and river channels and on their flood plains. See **Figure A-8** for more detail.

2.1.6 Soils

Soils are mapped by the U.S. Department of Agriculture – Natural Resources Conservation Service and a general soils map can be found in **Figure A-9,** which displays generalized soil map units and soil

associations (NRCS, 2013). More detailed soil maps are available from the U.S. Department of Agriculture – Natural Resources Conservation Service.

The most dominant soils in the watershed are the Yawdim-Ringling-Farland-Cabba, the Yawdim-Ringling-Cabbart-Cabba, and the Yawdim-Thurlow-Cabbart associations. They altogether comprise approximately 75% of the soils found within the Otter Creek watershed. These soils are characterized as hydrologic groups B and C, well drained loams, silt loams, and clay loams with permeability ranging from 0.51 to 2.76 inches/hour. Erodibility rates (or the K factors) of these major soils range from 0.23-0.29 which classifies them as low to moderate in terms of erodibility potential, and have slopes typically ranging from 19% to 29% and electrical conductivity ranges from 0 to 8 mmhos/cm. The value for K factors is primarily determined by soil texture. Clay soils have the lowest K factor because they are tightly bound together and not easily dissociated by the impact of raindrops. Silty soils on the other hand typically have the highest K factor because they are most easily dissociated by the impact of raindrops and therefore highly susceptible to erosion. K factors for some of the minor soils in the watershed range from 0.17 (low) to 0.35 (moderate-high) with slopes ranging from 0% to greater than 100%. The soils with the highest erodibility potential are located in the bottom of the Otter Creek valley (**Figure A-10**).

2.2 Social Profile

The following information describes the social profile of the Otter Creek watershed.

2.2.1 Land Ownership

Land ownership within the Otter Creek watershed consists mainly of U.S. Forest Service managed lands (54%) as part of the Custer National Forest in the central part of the watershed, and private lands (41%) in the upper and lower parts of the watershed. Small amounts of state managed land (2%) and land managed by the U.S. Bureau of Land Management (2%) are also distributed throughout the watershed, with the remaining < 1% owned by local government and established rights of way (**Table 2-2**). **Figure A-11** shows in greater detail the distribution of land ownership in the Otter Creek watershed.

Table 2-2. Land ownership in the Otter Creek watershed

Entity	Acres	Square Miles	Percent of Total
US Forest Service (USFS)	245,697.90	383.90	53.97%
Private	188,280.60	294.19	41.36%
US Bureau of Land Management (BLM)	10,990.80	17.17	2.41%
State	10,184.80	15.91	2.24%
Right of Way	41.40	0.06	0.01%
Local Government	32.60	0.05	0.01%
Total	**455,228.10**	**711.29**	

2.2.2 Land Use

The National Land Cover Dataset developed by the U.S. Geological Survey (USGS) shows that the watershed is composed of a mix of grassland/herbaceous cover, shrub/scrub cover, and evergreen forest (**Figure A-12**) (Homer et al, 2004). These three types of land cover make up 97% of the Otter Creek watershed as shown in **Table 2-3**.

Agriculture is the number one land use in the watershed, with ranching being the dominant form of agriculture. According to data from the National Agricultural Statistics Service some alfalfa and grass hay is grown in the valleys, but the majority of the watershed is composed of grazing land, as shown in **Figure A-13** (USDA, 2013). The Tongue River and adjacent Powder River basins also have a long history as production areas for coal mining.

Table 2-3. Land cover distribution in the Otter Creek watershed

Land Cover	Acres	Square Miles	Percent of Total
Grassland/Herbaceous	187,373.18	292.77	41.16%
Shrub/Scrub	148,362.33	231.82	32.59%
Evergreen Forest	107,513.95	167.99	23.62%
Woody Wetlands	4,977.69	7.78	1.09%
Emergent Herbaceous Wetlands	2,934.36	4.58	0.64%
Developed, Open Space	1,963.86	3.07	0.43%
Cultivated Crops	993.33	1.55	0.22%
Pasture/Hay	500.36	0.78	0.11%
Barren Land (Rock/Sand/Clay)	379.89	0.59	0.08%
Developed, Low Intensity	162.55	0.25	0.04%
Deciduous Forest	51.66	0.08	0.01%
Developed, Medium Intensity	10.18	0.02	0.00%
Open Water	4.77	0.01	0.00%
Total	**455,228.10**	**711.29**	

2.2.3 Population

According to the 2010 census, the total population within the watershed is 464 with population densities throughout most of the watershed being characterized as less than 1 person per square mile (**Figure A-14**) (US Census Bureau, 2013). Most of the population in the watershed is located in the area including and immediately surrounding the town of Ashland, MT near the mouth of Otter Creek. One unincorporated community, Otter, and the ghost town of Quietus also exist in the upper portion of the watershed. Septic tank densities are also considered low throughout the entire watershed with the exception of the areas including and immediately surrounding Ashland (**Figure A-15**). The Ashland Census Designated Place (which includes a portion of the Northern Cheyenne Reservation that lies outside of the watershed) contains a total population of 824 people.

2.2.4 Transportation

Transportation networks in a watershed have the potential to influence stream morphology, hydrology, sediment transport, aquatic life, and riparian areas. US Highway 212 is the only major highway found in the watershed and it dissects the northern portion of the watershed near the town of Ashland. Otter Creek Road (State Highway 484) parallels Otter Creek for the majority of the length of the stream. A map showing the transportation network in the watershed can be found in **Figure A-16.**

2.2.5 Species of Concern

Several animal and plant species of concern are found within the Otter Creek watershed. Species of concern are either classified as sensitive, threatened, or endangered. Any changes to the environment can have significant impacts on the behavior and survival of these species. A list showing all species of

concern can be seen in **Table A-1** (MTNHP, 2012a; 2012b). Fish species of concern on Otter Creek (Flathead Chub, Sauger, Stonecat, and Western Silvery Minnow) can be found from the confluence of Threemile Creek downstream to the mouth (**Figure A-17**). The Montana Fisheries Information System is a database maintained by Montana Fish Wildlife and Parks. This database includes fisheries related information (if available) for all surveyed waterbodies in Montana. A general list of fish species and their distribution in Otter Creek can be found in **Table A-2**.

2.2.6 Point Source Discharges

Point sources or potential point sources of surface water pollution are typically permitted through either the Montana Pollutant Discharge Elimination System (MPDES) or through the National Pollutant Discharge Elimination System (NPDES). As of May 2015, there were two active MPDES construction stormwater permits in the Otter Creek watershed. The first, MTR105803 (facility name: Summit Gas Resources – East Bear Creek Phase 1 Federal), had a size of 65 acres and Bales and Billup creeks as the receiving water bodies. The second, MTR104649 (facility name: MDOT – Ashland East), had a size of 180 acres and Otter Creek as the receiving waterbody; however GIS mapping indicated that the site was located on a tributary to Otter Creek. A third MPDES permit for industrial activities, MTR0031852 (facility name: Otter Creek Coal, LLC – Otter Creek Mine), had a receiving waterbody of Otter Creek and was pending.

Stormwater construction permits are required if the area disturbed during construction activities exceeds one acre in size. Under the stipulations of the permits, the facilities maintain an approved storm water pollution prevention plan (SWPPP). The SWPPP sets forth the procedures, methods, and equipment used to prevent the pollution of stormwater discharges. In addition, the SWPPP describes general practices used to reduce pollutants in stormwater discharges. The SWPPPs contain best management practices (BMPs) such as using conveyances that minimize contact between runoff and sediment and other pollutants and retention basins that allow sediment to settle and water to infiltrate into the ground. Because these permits are related to stormwater runoff, a discharge to surface waterbodies may or may not occur while the permit is in place.

Industrial storm water permits regulate the direct discharge of stormwater draining the facility and its grounds. Under the stipulations of the permits, the facilities maintain an approved SWPPP, which sets forth the procedures, methods, and equipment used to prevent the pollution of stormwater discharges. In addition, the SWPPP describes general practices used to reduce pollutants in stormwater discharges. The SWPPPs contain BMPs such as using conveyances that minimize contact between runoff and sediment and other pollutants and retention basins that allow sediment to settle and water to infiltrate into the ground.

2.2.7 Surface Water Monitoring

The U.S. Geological Survey (USGS) has one active stream gage on Otter Creek and six historical inactive gages established throughout the watershed. These gaging stations typically measure discharge (flow), but some stations also measure other parameters such as specific conductance and sodium adsorption ratio. The gaging stations can be seen on the map in **Figure A-18**. USGS site 06307740 - Otter Creek at Ashland, MT is the only currently operating stream gage, while historical gages are: USGS site 06307735 - Home Creek near Ashland, MT, USGS site 06307730 - Threemile Creek near Ashland, MT, USGS site 06307725 - Otter Creek above Tenmile Creek near Ashland, MT, USGS site 06307717 - Otter Creek below Fifteenmile Creek near Otter, MT, USGS 06307670 - Bear Creek at Otter, MT, USGS 06307665 - Otter Creek near Otter, MT.

Several surface water monitoring sites used for water quality data collection are found on Otter Creek and some of its tributaries. Data has been collected by DEQ and other sources and is stored in DEQ's EQuIS database. A map of the location of these sites can be found in **Figure A-18.**

2.2.8 Fire History

Wildland fires can be an important and significant source of disturbance in a watershed. These fires are part of the natural processes within an ecosystem, but human activities have vastly altered the occurrence and management of such fires. Historically, wildland fires have played a significant role in the Otter Creek watershed. Due to the open terrain and the present vegetation types, fires in the Otter Creek watershed have the potential to spread quickly and grow to substantial size, as evidenced by the 248,594 acre Ash Creek fire of 2012 (GeoMAC, 2013). Wildfires can provide a gateway for invasive weed species to establish and alter the vegetative community. A lack of native vegetation then leads to a greater risk of future wildfire events. A table showing the extent of historical fires within the Otter Creek watershed can be found in **Table A-3**, and is displayed spatially in the map, **Figure A-19** (USFS Region 1, 2013).

3.0 MONTANA WATER QUALITY STANDARDS

The federal Clean Water Act provides for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's surface waters so that they support all designated uses. Water quality standards are used to determine impairment, establish water quality targets, and to formulate the total maximum daily loads (TMDLs) and allocations.

Montana's water quality standards, and water quality standards in general, include three main parts:

1. Stream classifications and designated uses
2. Numeric and narrative water quality criteria designed to protect designated uses
3. Nondegradation provisions

Montana's water quality standards also incorporate general prohibitions against harming designated beneficial uses, as well as point source permitting and other water quality protection requirements.

Those water quality standards that apply to this document are reviewed briefly below. More detailed descriptions of Montana's water quality standards may be found in the Montana Water Quality Act (75-5-301, 302, MCA); Montana's Surface Water Quality Standards and Procedures (ARM 17.30.601-670); and Circular DEQ-7, Montana Numeric Water Quality Standards (Montana Department of Environmental Quality, 2012).

3.1 STREAM CLASSIFICATIONS AND DESIGNATED BENEFICIAL USES

Waterbodies are classified based on their designated uses. All Montana waters are classified for multiple uses; Otter Creek is classified as C-3 (ARM 17.30.611). The 'C' denotes the specific level of protection applied to uses, and the '3' denotes the suitability for growth and propagation of non-salmonid fishes and associated aquatic life. A C-3 designation specifies that the water must be maintained suitable for bathing, swimming, and recreation, and growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl, and furbearers. The quality of C-3 waters is naturally marginal for drinking, culinary, and food-processing purposes, and agricultural and industrial water supply (ARM 17.30.629). Otter Creek's water quality must be maintained suitable for all of its designated uses, whether or not it is currently being used for each of those uses.

Montana Department of Environmental Quality's (DEQ) water quality assessment methods are designed to evaluate the most sensitive uses for each pollutant group, thus ensuring protection of all designated uses (Department of Environmental Quality, Water Quality Planning Bureau, 2011). For Otter Creek, the most sensitive use assessed for iron is aquatic life.

3.2 NUMERIC AND NARRATIVE WATER QUALITY STANDARDS

In addition to the use classifications described above, Montana's water quality standards include numeric and narrative criteria that protect the designated uses. Numeric criteria define the allowable concentrations, frequency, and duration of specific pollutants so as not to impair designated uses.

Numeric standards apply to pollutants that are known to have adverse effects on human health or aquatic life (e.g., metals, organic chemicals, and other toxic constituents). Human health standards are set at levels that protect against long-term (lifelong) exposure via drinking water and other pathways

such as fish consumption, as well as short-term exposure through direct contact such as swimming. Numeric standards for aquatic life include chronic and acute values. Chronic aquatic life standards prevent long-term, low level exposure to pollutants. Acute aquatic life standards protect from short-term exposure to pollutants. Numeric standards also apply to other designated uses such as protecting irrigation and stock water quality for agriculture.

Narrative standards are developed when there is insufficient information to develop numeric standards and/or the natural variability makes it impractical to develop numeric standards. Narrative standards describe the allowable or desired condition. For Otter Creek, numeric standards for iron are applied as the primary targets for impairment determinations and subsequent TMDL development. These targets address allowable water column chemistry concentrations. **Section 5.4** defines the water quality criteria for Otter Creek.

3.3 NONDEGRADATION PROVISIONS

Nondegradation is addressed via the nondegradation policy within Montana state statute (75-5-303, MCA) and via Montana's nondegradation rules (ARM 17.30.7). The nondegradation policy states that existing uses of state waters and the level of water quality necessary to protect those uses must be maintained and protected (75-5-303(1), MCA). The nondegradation policy also addresses high-quality waters (75-5-303(2), MCA), which are further covered under Montana's nondegradation rules.

Montana nondegradation rules apply to any new or increased point or nonpoint source resulting in a change of existing water quality in a high quality water occurring on or after April 29, 1993 (ARM 17.30.702). High quality waters are determined on a parameter-by-parameter basis. A water is high quality for a parameter if its ambient condition meets the standard or is better than the standard. Otter Creek is not a high quality water for iron because the ambient condition of the water does not meet the iron water quality standard; therefore, the nondegradation rules do not apply to iron in Otter Creek. The relevant requirement for iron in Otter Creek is to maintain the existing uses consistent with the nondegradation policy defined under 75-5-303(1), MCA. This application of nondegradation rules in Otter Creek is specific to iron and is not intended to influence the application of nondegradation for other parameters, particularly as they may apply to the protection of high quality water under the nondegradation rules.

4.0 DEFINING TMDLS AND THEIR COMPONENTS

A total maximum daily load (TMDL) is a tool for implementing water quality standards and is based on the relationship between pollutant sources and water quality conditions. More specifically, a TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive from all sources and still meet water quality standards. The ultimate goal of the TMDL is to identify an approach to achieve and maintain water quality standards.

Pollutant sources are generally defined as two categories: point sources and nonpoint sources. Point sources are often linked to community wastewater treatment or industrial facilities with discernible, confined and discrete conveyances, such as pipes or ditches, from which pollutants are being, or may be, discharged to a waterbody. Some sources such as return flows from irrigated agriculture are not included in this definition. Pollutant loading sources that do not meet the definition of a point source are considered nonpoint sources. Nonpoint sources are associated with diffuse pollutant loading to a waterbody and are often linked to runoff from agricultural, urban, or forestry activities, as well as streambank erosion and groundwater seepage that can occur from these activities. Natural background loading and atmospheric deposition are both considered types of nonpoint sources.

As part of TMDL development, the allowable load is divided among all significant contributing point and nonpoint sources. For point sources, the allocated loads are called “wasteload allocations” (WLAs). For nonpoint sources, the allocated loads are called “load allocations” (LAs).

A TMDL is expressed by the equation: $TMDL = \Sigma WLA + \Sigma LA + MOS$, where:

ΣWLA is the sum of the wasteload allocation(s) (point sources)
ΣLA is the sum of the load allocation(s) (nonpoint sources)
MOS = Margin of Safety

TMDL development must include a margin of safety (MOS), which can be explicitly incorporated into the above equation as shown. Alternatively, the MOS can be implicit in the TMDL, meaning that the explicit MOS in the above equation is equal to zero and can therefore be removed from the equation. A TMDL must also ensure that the waterbody will be able to meet and maintain water quality standards for all applicable seasonal variations (e.g., pollutant loading or use protection).

Development of each TMDL has four major components:

- Determining water quality targets
- Quantifying pollutant sources
- Establishing the total allowable pollutant load
- Allocating the total allowable pollutant load to their sources

Although the way a TMDL is expressed can vary by pollutant, these four components are common to all TMDLs, regardless of pollutant. Each component is described in further detail in the following subsections.

Figure 4-1 illustrates how numerous sources contribute to the existing load and how the TMDL is defined. The existing load can be compared to the allowable load to determine the amount of pollutant reduction needed.

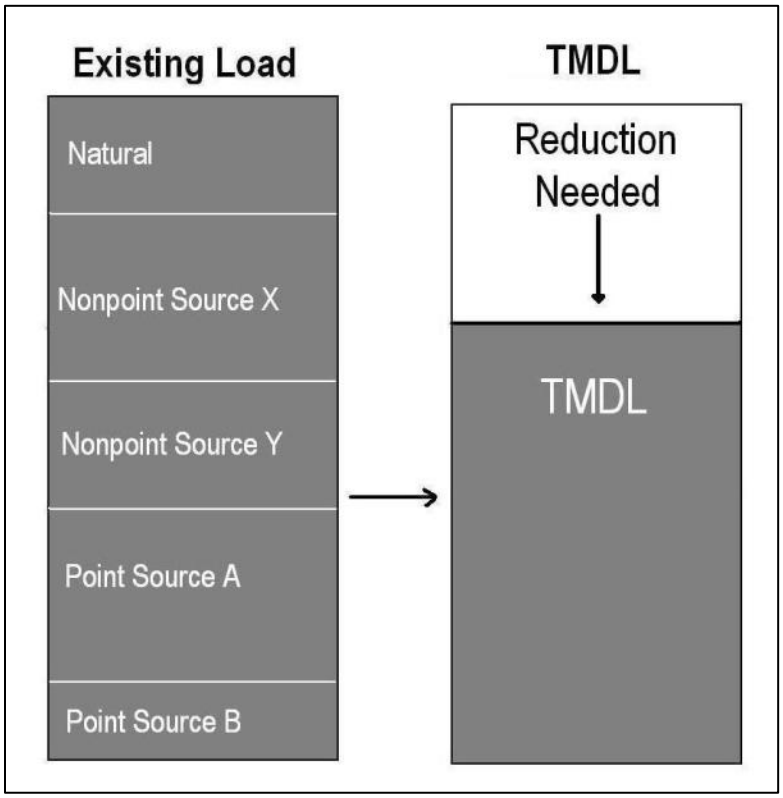

Figure 4-1. Schematic Example of TMDL Development

4.1 Developing Water Quality Targets

For each pollutant, TMDL water quality targets are based on the applicable numeric water quality standard and/or a translation of a narrative water quality standard(s). Total recoverable iron has established numeric water quality standards, thus the numeric values are used as the TMDL targets for Otter Creek (**Section 5.4**). The targets provide a benchmark by which to evaluate attainment of water quality standards. Furthermore, comparing existing stream conditions to target values allows for a better understanding of the extent and severity of the problem.

4.2 Quantifying Pollutant Sources

The goal of TMDL source assessment is to identify all significant pollutant loading sources, including natural background loading, and quantify them so that the relative pollutant contributions can be determined. Because the effects of pollutants on water quality can vary throughout the year, assessing pollutant sources includes an evaluation of the seasonal variability of the pollutant loading. The source assessment helps to define the extent of the problem by linking the pollutant load to specific sources in the watershed.

Source assessments are conducted on a watershed scale and can vary in level of detail resulting in reasonably accurate estimates or gross allotments, depending on the data availability and the techniques used for predicting the loading (40 CFR 130.2(I)). Nonpoint sources are typically quantified by source categories (e.g., septic systems or unpaved roads) and/or by land uses (e.g., crop production or

forestry). Alternatively, most, or all, nonpoint pollutant sources in a watershed or source area can be combined for quantification and TMDL load allocation purposes.

Additional detail is required for assessing pollutant loading from surface water point sources permitted under the Montana Pollutant Discharge Elimination System (MPDES) program. This is because the allowable loading within each MPDES surface water permit conditions must be consistent with the assumptions and requirements of the available WLA developed with the TMDL (40 CFR 122.44)

4.3 Establishing the Total Allowable Load

Identifying the TMDL requires a determination of the total allowable load over the appropriate time period necessary to comply with the applicable water quality standard(s). Per EPA requirements (40 CFR 130.2), "TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure." Where a stream is impaired by a pollutant for which numeric water quality criteria exist (e.g., iron), the TMDL, or allowable load, is typically calculated as a function of streamflow and the numeric criteria. This results in a mass per unit time TMDL expression such as pounds per day.

4.4 Determining Pollutant Allocations

Once the allowable load (the TMDL) is determined, that total must be divided among the contributing sources so that the sum of the allocations is equal to the TMDL, consistent with the above TMDL equation. Where a TMDL is variable based on streamflow, nonpoint source load allocations are often variable based on this same receiving streamflow. On the other hand, point source wasteload allocations are often based on conservative streamflow and discharge conditions and/or can be variable based on the point source discharge flow and a discharge concentration limit. Where the TMDL is a function of streamflow, the TMDL and allocations are calculated for example high and low flow stream conditions.

Figure 4-2 illustrates how, for a given streamflow condition, the TMDL is allocated to different sources using WLAs for point sources and LAs for natural and nonpoint sources. Although some flexibility in allocations is possible, the sum of all allocations must meet the water quality standards in all segments of the waterbody. **Figure 4-2** shows multiple point and nonpoint source allocations. In Montana, nonpoint source allocations are sometimes grouped into one composite load allocation. This composite load allocation approach is applied in cases where data is limited, there is a significant source assessment uncertainty, and/or the Montana DEQ has determined that the best approach is to provide stakeholders with flexibility in addressing sources, allowing them to choose where to focus on improved land management practices and other remediation or restoration efforts.

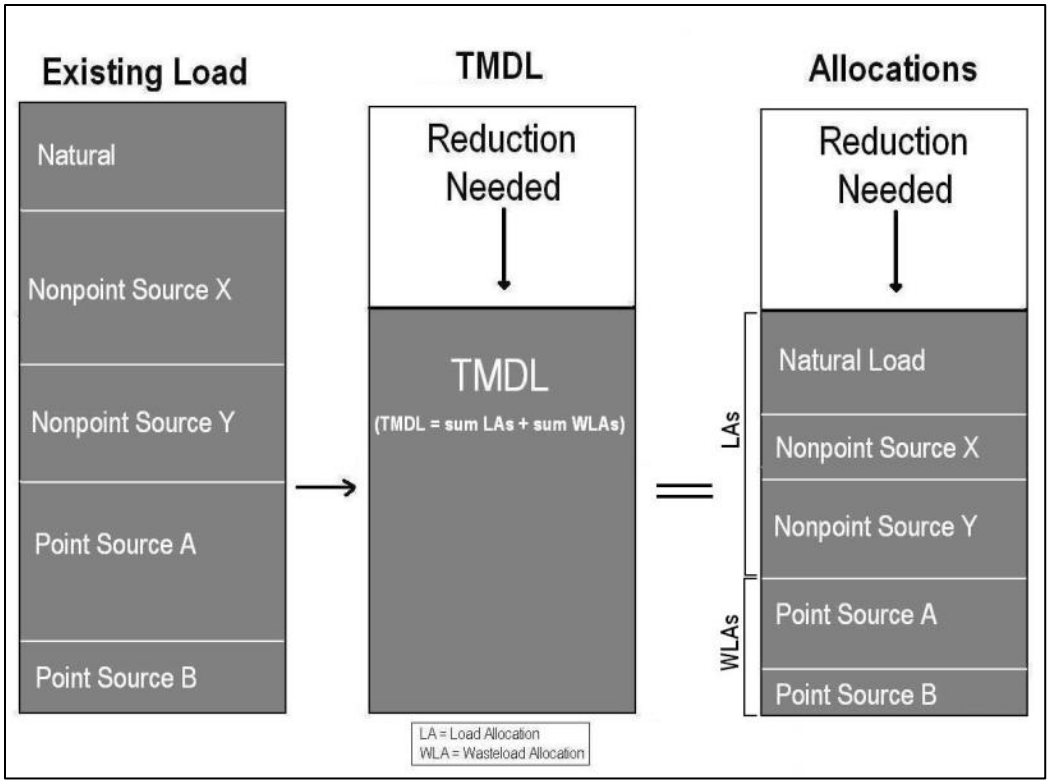

Figure 4.2. Schematic Diagram of a TMDL and its Allocations

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions. For the iron TMDL in this document where there is a combination of nonpoint sources and a permitted point source discharging into an impaired stream reach, the permitted point source WLA is not dependent on implementation of the LA. Instead, DEQ sets WLAs and LAs at levels necessary to achieve water quality standards throughout the watershed. Under these conditions, the iron LA is developed independently of the permitted point source WLA such that it would satisfy the TMDL target concentration within the stream reach immediately above the point source. In order to ensure that the water quality standard or target concentration is achieved below the point source discharge, the WLA is based on the point source's discharge concentration set equal to the standard or target concentration for each pollutant unless the loading from an individual point source is negligible based on no measureable impacts to water quality.

4.5 Implementing TMDL Allocations

The Clean Water Act (CWA) and Montana state law (75-5-703, MCA of the Montana Water Quality Act) require wasteload allocations to be incorporated into appropriate discharge permits, thereby providing a regulatory mechanism to achieve load reductions from point sources. Because of the limited regulatory requirements at the state and federal level, nonpoint source reductions linked to LAs are implemented primarily through voluntary measures, although there are some important nonpoint source regulatory requirements, such as Montana streamside management zone law and applicable septic system requirements. DEQ's Watershed Protection Section (Nonpoint Source Program) helps to coordinate water quality improvement projects for nonpoint sources of pollution throughout the state

and provides resources to stakeholders to assist in nonpoint source best management practices (BMPs). Montana's Nonpoint Source Management Plan (available at http://deq.mt.gov/wqinfo/nonpoint/NonpointSourceProgram.mcpx) further discusses nonpoint source implementation strategies at the state level.

DEQ uses an adaptive management approach to implementing TMDLs to ensure that water quality standards are met over time (**Section 5.9**). This includes a monitoring strategy and an implementation review that is required by Montana statute (75-5-703, MCA of the Montana Water Quality Act). TMDLs may be refined as new data become available, land uses change, or as new sources are identified.

5.0 Otter Creek Iron Total Maximum Daily Load and Components

This portion of the document focuses on iron as a cause of water quality impairment to Otter Creek. It describes: (1) how excess metals can impair beneficial uses, (2) the affected stream segment, (3) the currently available data pertaining to the iron impairment in the watershed, (4) an analysis of the data and linkages to sources of iron, (5) the iron total maximum daily load (TMDL) and associated allocations, (6) examples of how to apply the TMDL under high and low flow conditions in Otter Creek, (7) how the TMDL can be implemented, and (8) uncertainties and how adaptive management can address uncertainties.

5.1 Effects of Excess Metals on Beneficial Uses

Waterbodies with metals concentrations exceeding the aquatic life and/or human health standards can impair support of numerous beneficial uses including aquatic life, drinking water, and agriculture. Within aquatic ecosystems, elevated concentrations of heavy metals can have a toxic, carcinogenic, or bioconcentrating effect on biota. Likewise, humans and wildlife can suffer acute and chronic effects from consuming water or fish with elevated metals concentrations. Because elevated metals concentrations can be toxic to plants and animals, high metals concentrations in irrigation or stock water may affect agricultural uses. The metal TMDL provided in this document is based upon protecting the most sensitive use to iron, aquatic life, and thus protects all other uses.

5.2 Stream Segment of Concern

Otter Creek consists of a single waterbody segment (MT42C002_020; **Figure A-1**). DEQ has determined that Otter Creek does not meet the water quality standard for iron (Montana Department of Environmental Quality, 2014).

5.3 Information Sources and Assessment Methods

To assess iron conditions for TMDL development, DEQ compiled iron data. Since the assessment update in 2008 additional iron monitoring has occurred. The following data sources represent the primary information used to characterize water quality.

1. **Otter Creek Coal, LLC Sampling:** Otter Creek Coal conducted water quality sampling from 2010 through 2014. These data were collected from Otter Creek, tributaries to Otter Creek, and groundwater within the Otter Creek watershed. Much of the sampling occurred adjacent to and downstream of the proposed Otter Creek Mine.
2. **United States Geological Survey (USGS) Sampling:** This dataset consists of water quality sampling conducted by the USGS on Otter Creek, Otter Creek Tributaries, and the Tongue River from 1974 through 2014.
3. **Groundwater Information Center Data (GWIC):** This dataset consists of groundwater data collected from wells, springs and streams. Data for portions of counties within the Otter Creek watershed were reviewed.

Sample locations were generally such that they provided a comprehensive upstream to downstream view of metals levels. Data used in TMDL development was collected year-round and consisted of both high- and low-flow events.

Data collected included total recoverable iron, dissolved iron, flow, total suspended solids (TSS), and suspended sediment concentration (SSC). Total recoverable and dissolved iron samples are described as such within figures. Most suspended sediment data was SSC with the exception of the data from the Home Creek near Ashland, MT site. At this site 12 of 21 samples (57%) were TSS. Although TSS and SSC are not typically comparable (Gray et al., 2000), iron is expected to have a similar relationship to both measures of suspended sediment (e.g., if iron increases with increasing TSS, it would also increase with greater SSC values). As such, TSS samples are portrayed as SSC for this site in figures to show the general relationship between suspended sediment and iron.

4. **DEQ Assessment Files:** These files contain information used to make the existing iron impairment determination.

Data used for impairment assessment purposes and TMDL development are included in **Tables B-1** through **B-4** of **Appendix B**. These data and other data from the watershed are publicly available through the Environmental Protection Agency's (EPA) STOrage and RETrieval database (STORET at http://www.epa.gov/storet/) and DEQ's EQuIS water quality databases, the U.S. Geological Survey's National Water Information System (NWIS at http://nwis.waterdata.usgs.gov/mt/nwis/qwdata?introduction), and the Montana Bureau of Mines and Geology's Groundwater Information Center (http://mbmggwic.mtech.edu/).

Additional sources of information used to develop TMDL components include the following:

- Geographic Information System (GIS) data layers
- Outside agency and university websites and documentation
- Land-use information

The above information and water quality data are used to compare existing conditions to waterbody restoration objectives (targets), to assess iron pollutant sources, and to help determine TMDL allocations. Laboratory methods and QA/QC criteria were also reviewed to ensure these values were accurate. No QA/QC problems were identified.

5.4 Water Quality Targets

TMDL water quality targets are numeric indicator values used to evaluate whether water quality standards have been met. This is discussed further in **Section 4.1**. This section presents the iron water quality target and compares it with iron data collected from Otter Creek and other nearby watersheds.

5.4.1 Iron Water quality Standards and Target Values

The aquatic life criterion for total recoverable iron is 1,000 µg/L based on chronic exposure, and is intended to prevent long-term, low level exposure to the pollutant (**Table 5-1**). This value was derived from studies that specifically examined the iron concentrations at which harm to aquatic organisms has been observed (U.S. Environmental Protection Agency, 1976). It is defined in DEQ Circular DEQ-7 (Montana Department of Environmental Quality, 2012). The target for iron in Otter Creek is the same as

the aquatic life criteria with the intent that aquatic life is protected by keeping concentrations below levels where harm occurs.

Table 5-1. Numeric water quality target for iron

Metal of Concern	Aquatic Life Criteria (µg/L)
	Chronic
Iron, total recoverable	1,000

5.4.2 Existing Condition, Comparison to Target, and Evaluation of Iron Sources

To evaluate whether attainment of the iron target is being met, the existing water quality conditions in Otter Creek are compared to the water quality target in **Table 5-1**. When assessing for the aquatic life beneficial use, the DEQ guidance document "The Montana Department of Environmental Quality Metals Assessment Method" (Drygas, 2012), states that the maximum allowable percentage of samples that do not meet the standard is 10% (i.e., a maximum exceedance rate of 10%), based on a sample data set that incorporates both high and low streamflow conditions. In addition to comparing water quality samples to the iron target, the target exceedance **r**ate will also be evaluated. This evaluation is intended to provide an overview of the existing and historical conditions within the Otter Creek watershed, point out where and when iron concentrations are highest, and describe how iron concentrations in Otter Creek compare to some of its tributaries and the Tongue River. This evaluation is not intended to provide an updated impairment determination. Any future assessments for iron in Otter Creek would apply the recently updated metals assessment method (Drygas, 2012), or a revision thereof.

5.4.2.1 Iron Concentrations 1974 – 2014

During the 1974 – 2014 time period, the USGS and Otter Creek Coal collected total recoverable iron samples from many locations in Otter Creek and adjacent watersheds. Specific locations were used to examine iron conditions because they had the longest period of record and/or the greatest number of samples (**Figure 5-1**).

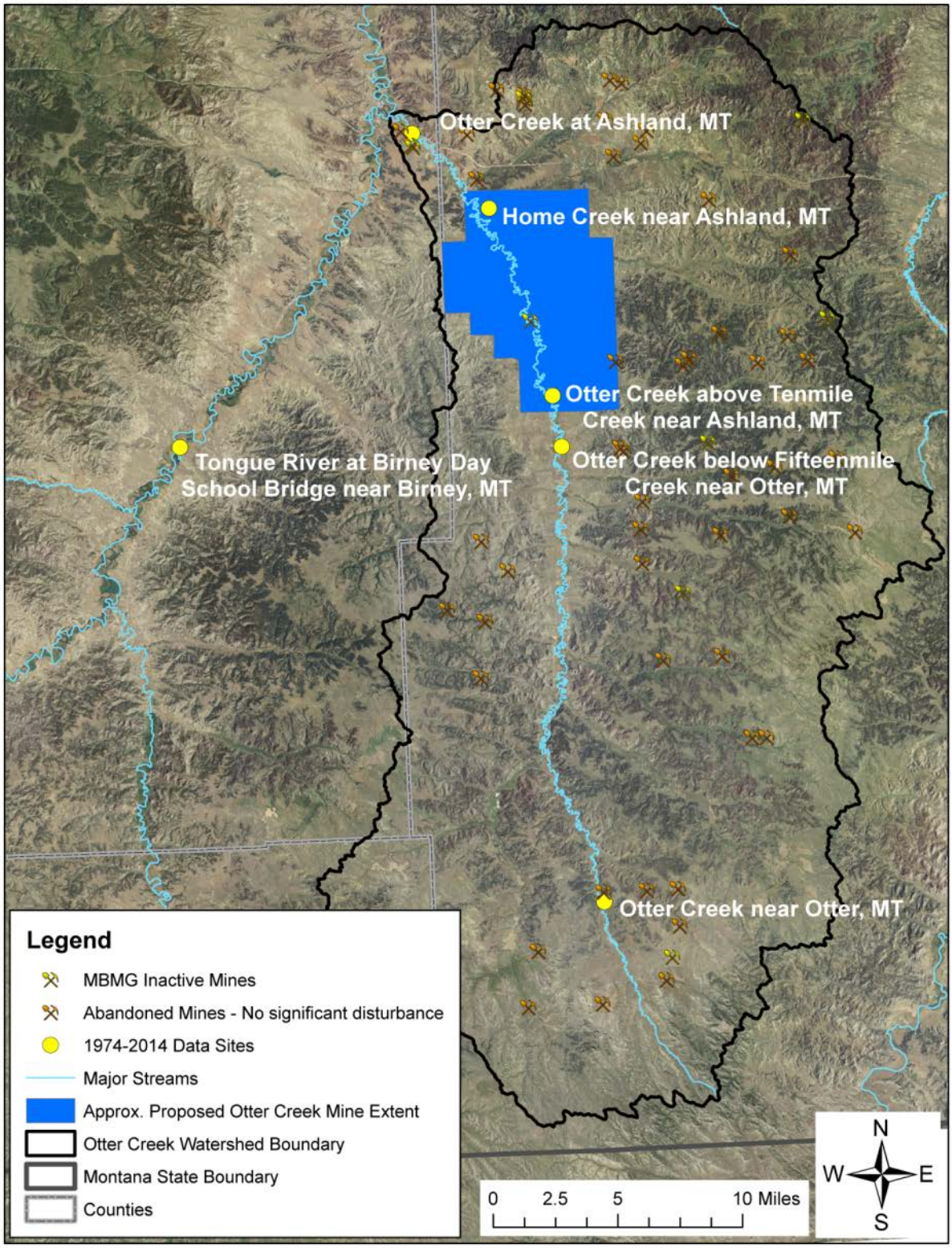

Figure 5-1 Location of long-term sampling sites in the Otter Creek watershed and on the Tongue River
Note: MBMG = Montana Bureau of Mines and Geology

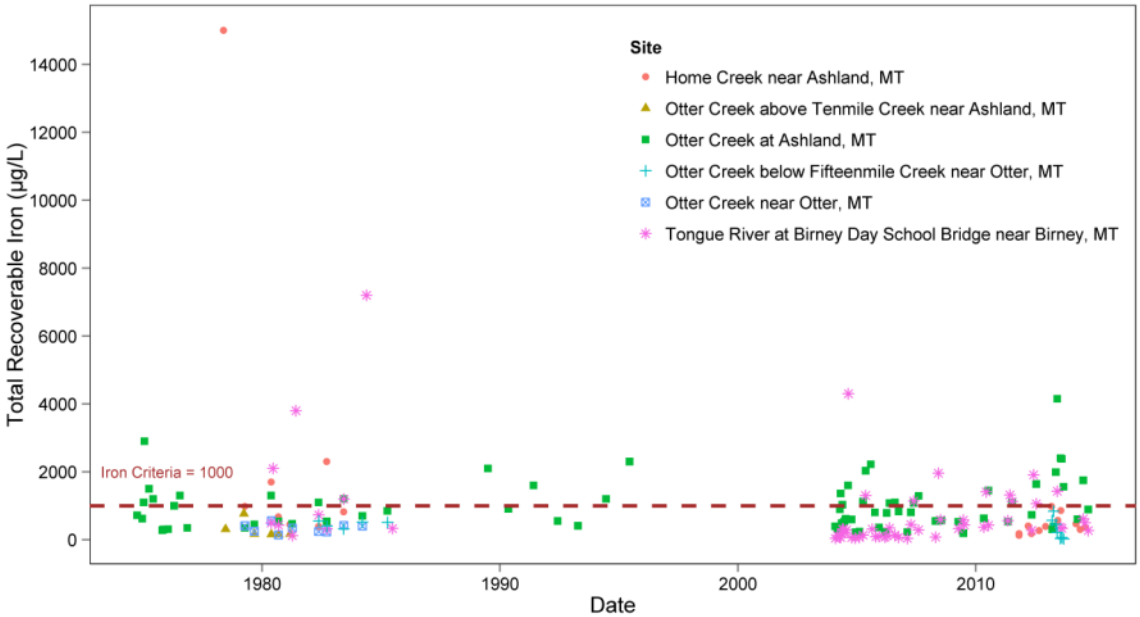

Figure 5-2. Total recoverable iron concentrations from 1974–2014 at sites on Otter Creek, Home Creek, and the Tongue River

Total recoverable iron concentrations have been variable since 1974 (**Figure 5-2**). Although the two highest observed concentrations were measured prior to 1985, concentrations well over the target of 1,000 µg/L have been regularly observed since 2004. Iron concentrations by month were plotted for the two locations where the most data has been collected (**Figure 5-3**). Both sites exhibit a similar distribution with iron concentrations peaking in late spring and summer. The months of May through August have most of the target exceedances for the Otter Creek site and all of the exceedances for the Tongue River site (**Figure 5-3**).

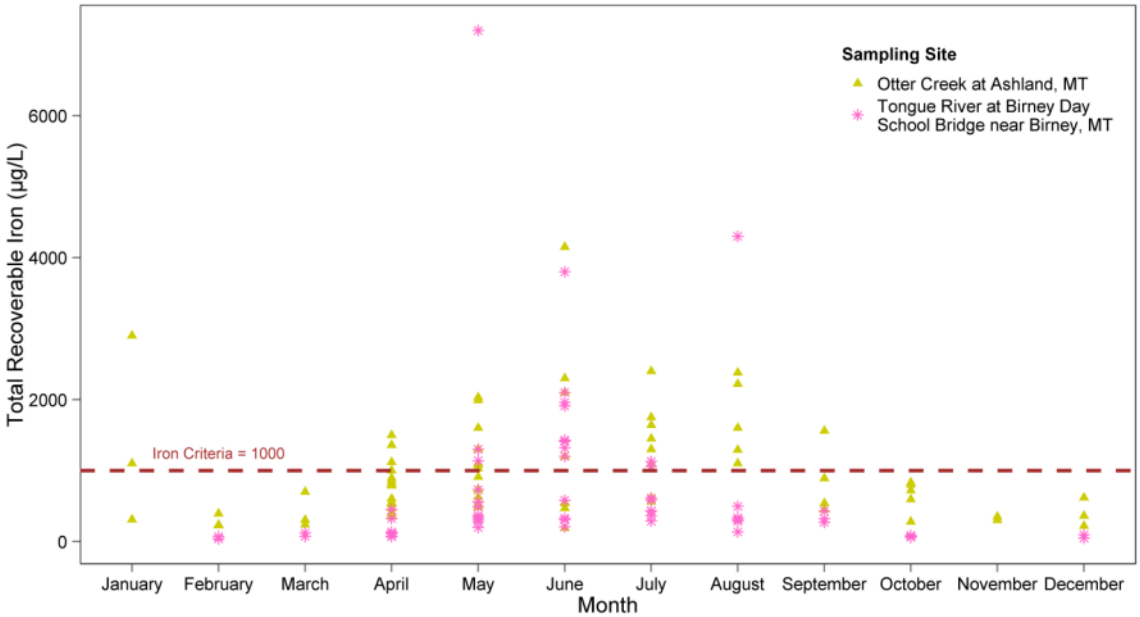

Figure 5-3. Total recoverable iron concentrations from 1974–2014 by month at sites on Otter Creek and the Tongue River

5.4.2.2 The Relationship between Iron and Other Variables

Total recoverable iron concentrations tend to increase with increasing flow (as measured at the time of water sample collection; **Figure 5-4**). However, the relationship between iron concentration and flow is variable among the sites. For example, Otter Creek near Otter, MT has an R^2=0.09 meaning that less than 10% of the observed variability in the iron concentrations is explained by flow, whereas at Home Creek near Ashland, MT, R^2=0.98 meaning that 98% of the variability observed in the iron concentrations is explained by the flow, although this relationship is based on few data points and is substantially influenced by one (high flow and high concentration) data point. In cases where the R2 is low, it suggests a lack of correlation between the two variables. When sites have iron concentrations that exceed the target, the exceedances tend to occur under variable flow conditions (**Figure 5-4**), including low flow conditions where Otter Creek is predominately comprised of groundwater inflow.

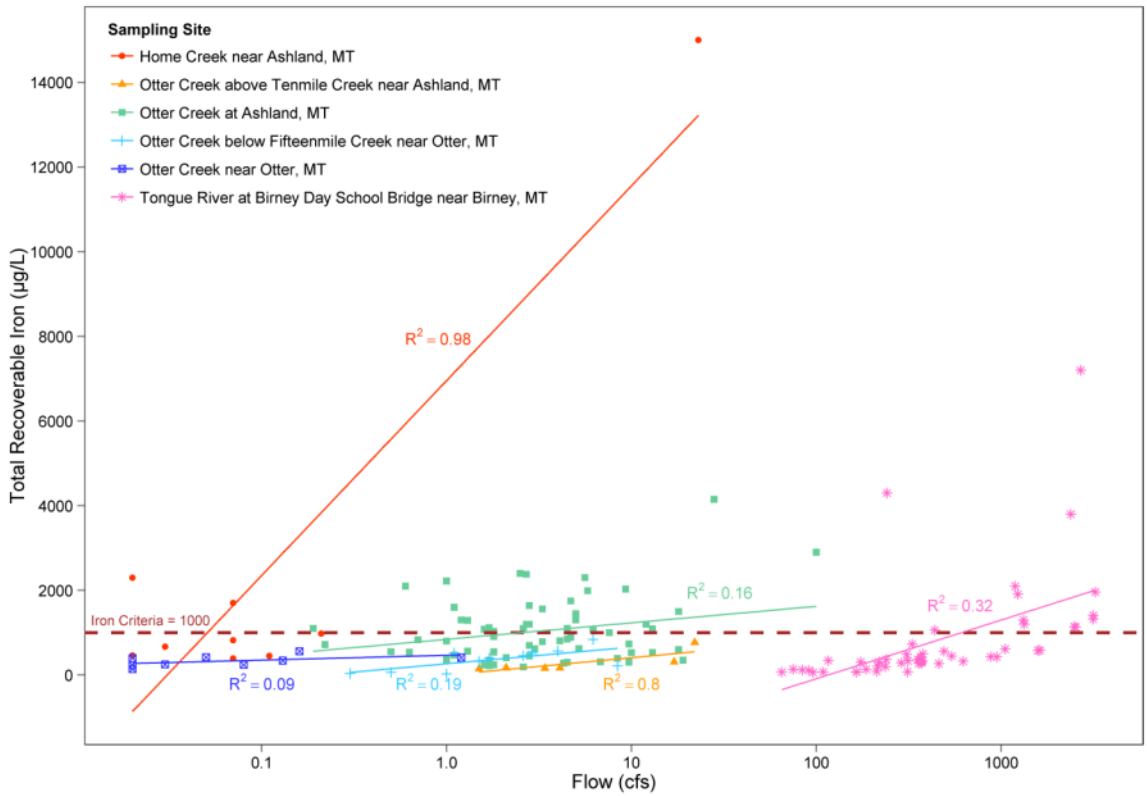

Figure 5-4. Total recoverable iron versus flow from 1974–2014 at sites on Otter Creek, Home Creek, and the Tongue River

Similar to the relationship between iron and flow, iron concentrations tend to increase with increasing SSC (**Figure 5-5**). These relationships are also highly variable with R^2 values ranging from 0.02 to 0.98, with the same caveats with regards to correlation strength discussed above. Iron target exceedances occur across a wide range of SSC concentrations but have not been observed below an SSC concentration of 30,000 µg/L (**Figure 5-5**). Although iron tends to increase with both flow and SSC, the two measurements of flow and SSC are not always positively related (**Figure 5-6**). This lack of a positive relationship between flow and SSC at several sample locations is somewhat unusual and could be linked to the network of check dams that moderate flow along Otter Creek. Another potential explanation is that many of the extreme flows in Otter Creek occur when the ground is frozen and rain on snow events occur, often during late winter. This would likely result in less erosion which equates to lower SSC concentrations in a receiving stream.

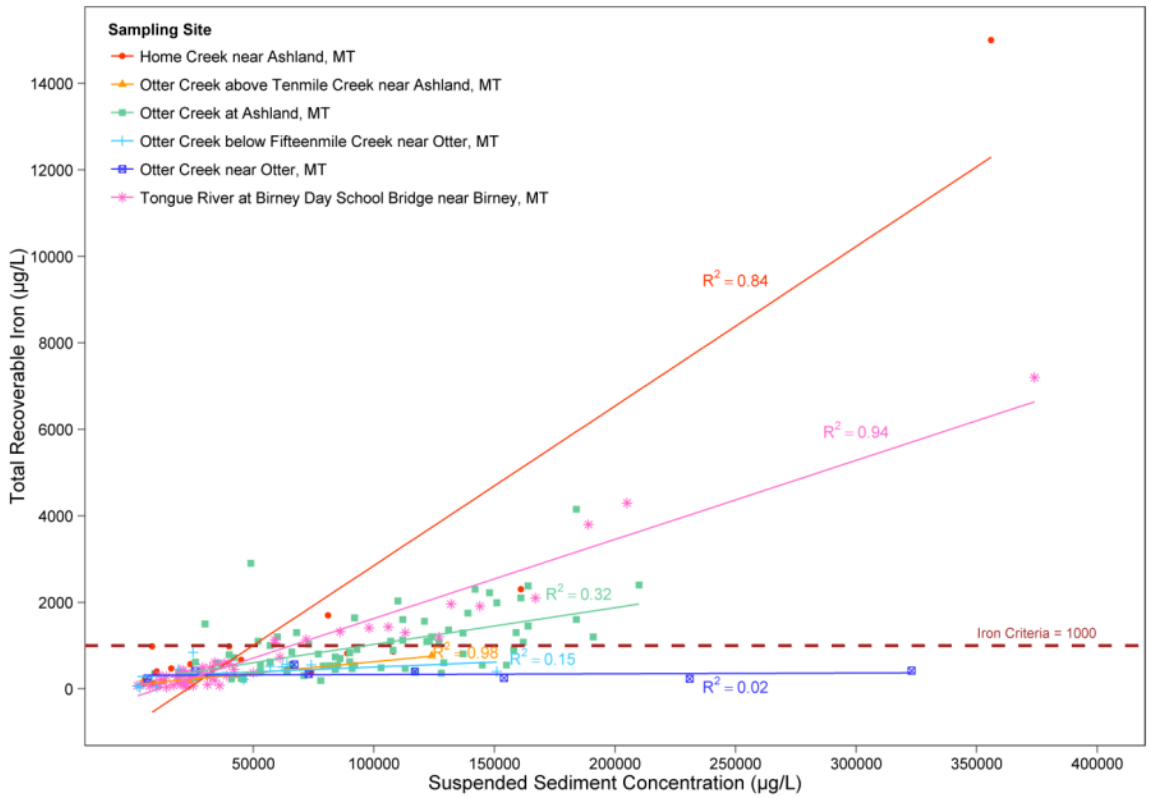

Figure 5-5. Total recoverable iron versus suspended sediment concentration from 1974–2014 at sites on Otter Creek, Home Creek, and the Tongue River

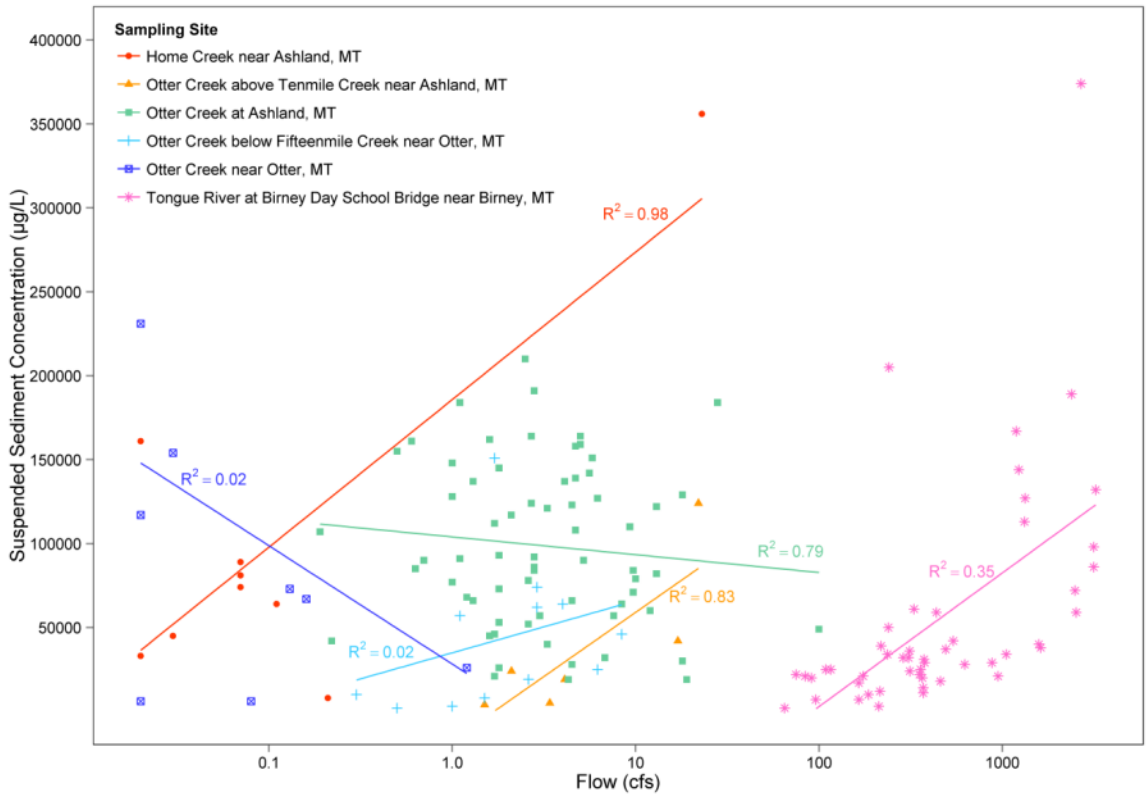

Figure 5-6. Suspended sediment concentration versus flow from 1974–2014 at sites on Otter Creek, Home Creek, and the Tongue River

The relationship between total recoverable iron and dissolved iron is variable with only two of the four sites having positive relationships (**Figure 5-7**). In addition, the amount of variability in total recoverable iron concentrations explained by the dissolved iron concentrations is low at all sites with R^2 ranging from <0.01 to 0.35 (i.e., <1% to 35% of variability explained). Note that the dissolved iron is a component of total recoverable iron and that the dissolved iron concentrations within **Figure 5-7** are all below 300 µg/L.

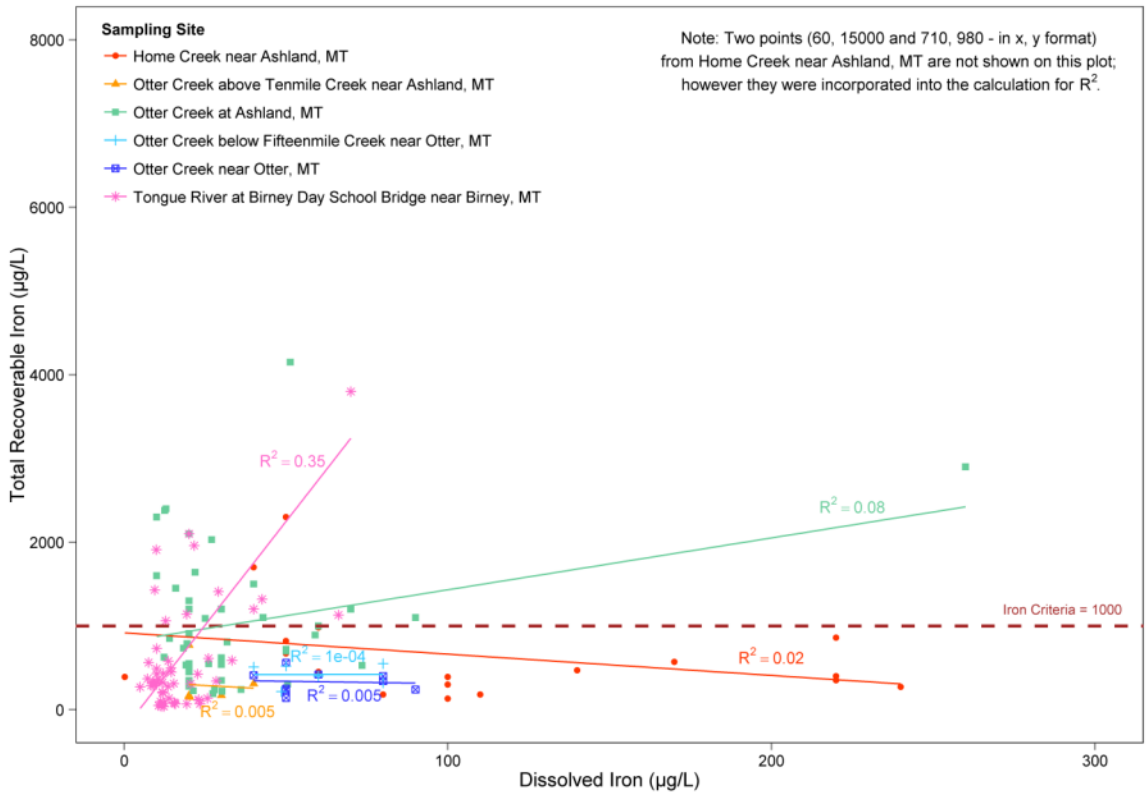

Figure 5-7. Total recoverable iron versus dissolved iron from 1974–2014 at sites on Otter Creek, Home Creek, and the Tongue River

5.4.2.3 Iron Target Exceedance Rates

Total iron target exceedances were observed at three of the six long-term dataset sites (**Figure 5-8**). All three sites with exceedances had rates in excess of the 10% allowed by the DEQ metals assessment method (Drygas, 2012); with the Otter Creek at Ashland, MT site having the greatest exceedance rate (41%).

When all four of the Otter Creek long-term sites are combined, the overall exceedance rate is 30% (31 of 103 samples exceed). The 90th percentile of values for the four Otter Creek sites combined is 1,706 µg/L. The 90th percentile would need to be equal to or less than 1,000 µg/L to achieve a 10% or less exceedance rate. Therefore, an iron reduction of up to 41% would be necessary to achieve a 10% exceedance rate. All of the data used to calculate exceedance rates met the independence requirements for assessment, as outlined in Drygas (2012).

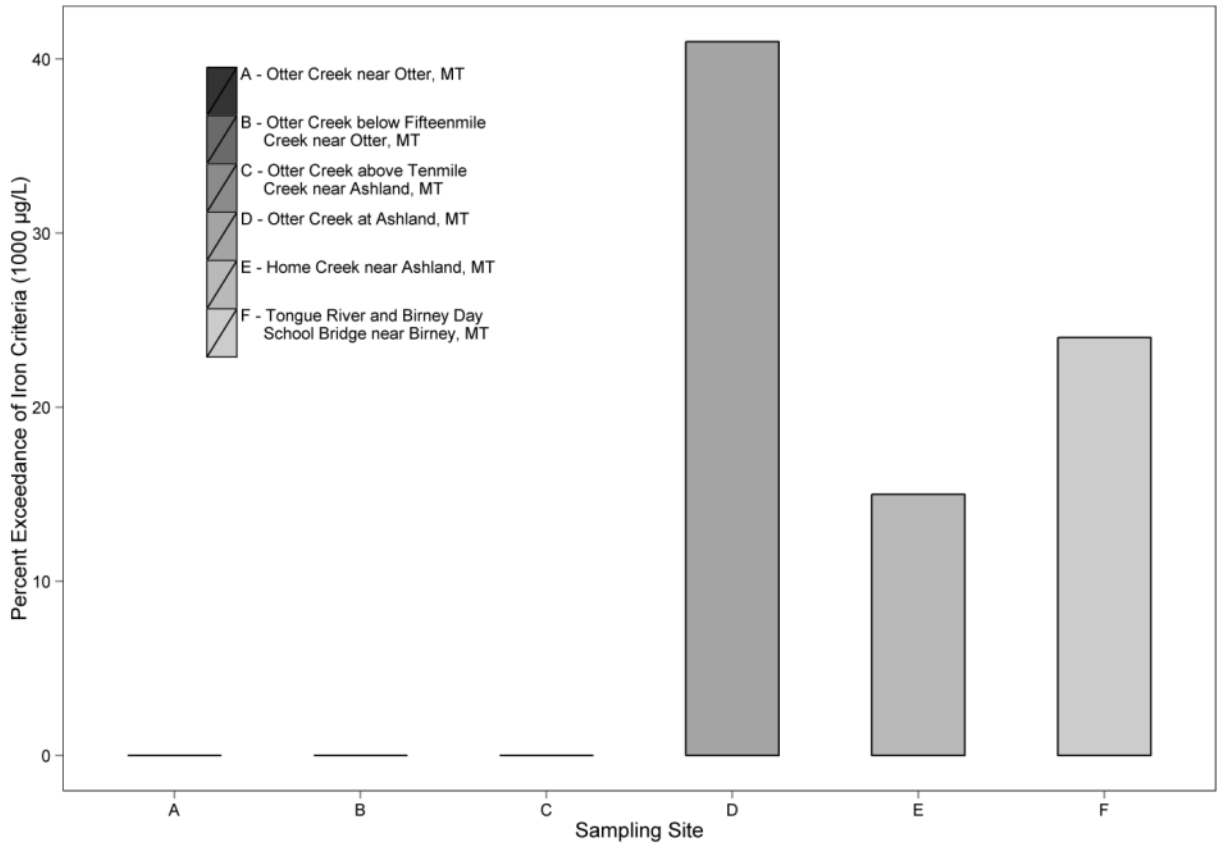

Figure 5-8. Exceedance rate for total recoverable iron from 1974–2014 at sites on Otter Creek, Home Creek, and the Tongue River

5.4.2.4 Otter Creek Synoptic Iron Sampling

Otter Creek Coal, LLC collected synoptic total recoverable iron samples from locations on Otter Creek from 2011–2014 (**Figure 5-9**). The results from these sampling events indicate that total recoverable iron concentrations increase in the downstream direction with the lowest values and fewest exceedances occurring at the five most upstream sites and the greatest values and most exceedances at the three most downstream sites (**Figure 5-10**). Exceedances were observed in 2012, 2013, and 2014 with most being in June; exceedances were also observed in March, May, August, and September (**Figure 5-10**).

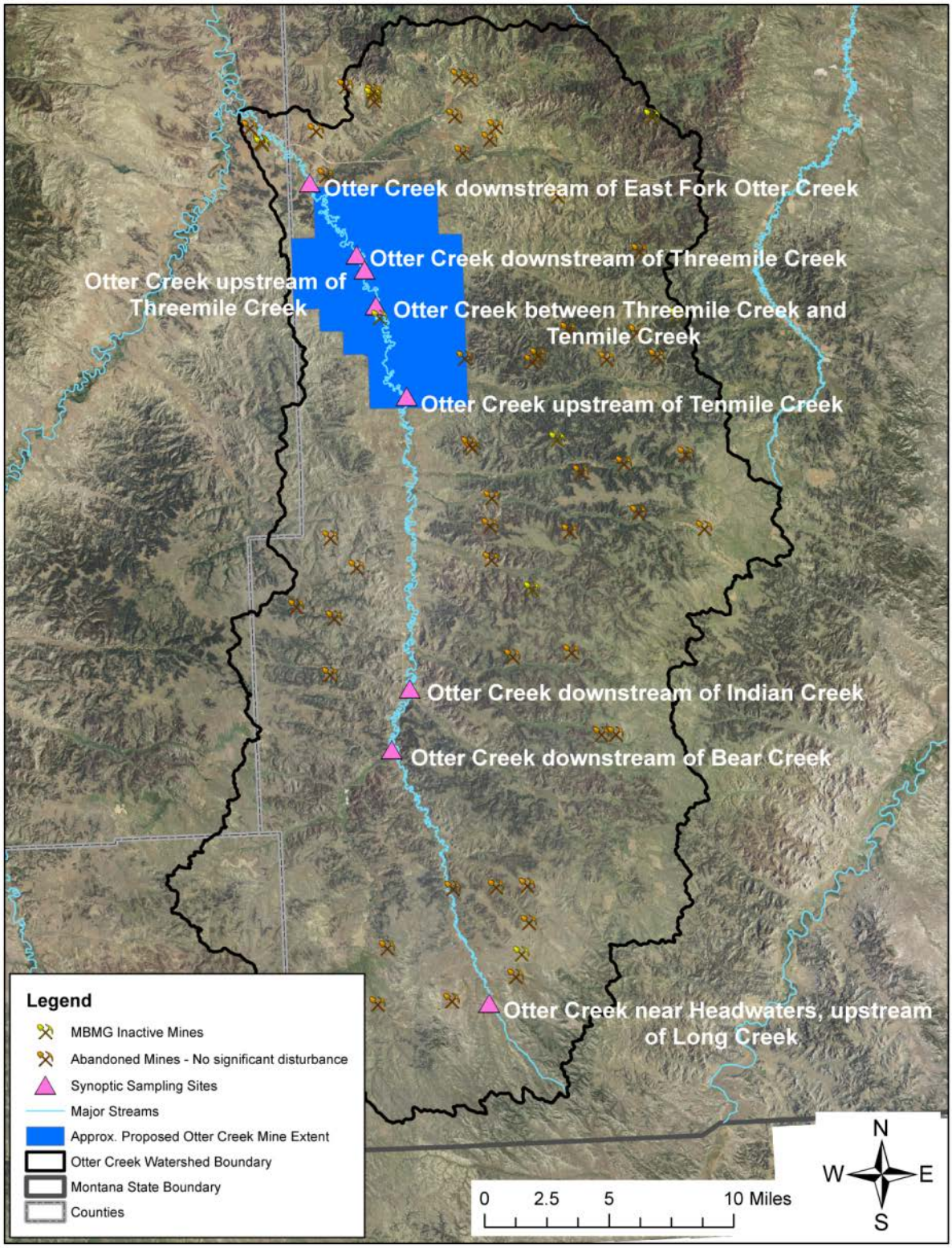

Figure 5-9. Location of synoptic sampling sites on Otter Creek
Note: MBMG = Montana Bureau of Mines and Geology

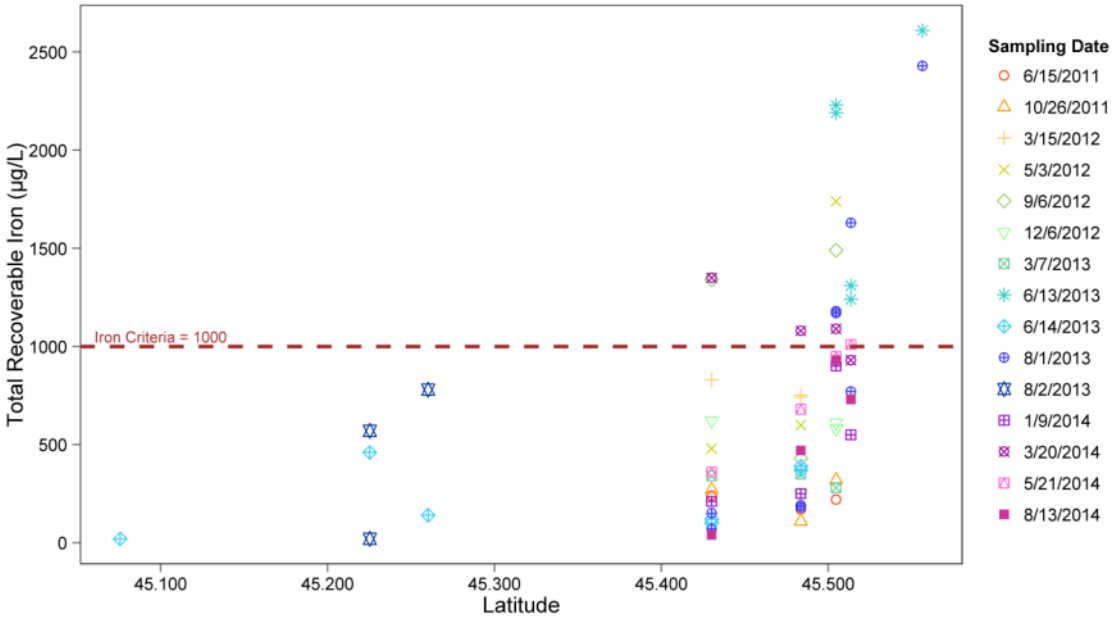

Figure 5-10. Synoptic sampling results for total recoverable iron concentrations from 2011–2014 at sites on Otter Creek

5.4.2.5 Wells, Springs, and Other Surface Water Sampling

Figure 5-11 shows the results for iron sampling at surface water sites (long-term and synoptic sampling data excluded), springs, and wells throughout the Otter Creek watershed. The surface water and well data exhibit iron values greater than the target of 1,000 µg /L as shown by the black symbols near the proposed mine site and near the headwaters. The large majority of Groundwater Information Center (GWIC) data is substantially below the target (i.e., ≤ 50 µg /L; white pentagons and squares); however, all of these samples were for dissolved iron, which is only a portion of what would be measured by total recoverable iron analysis. Note that some GWIC surface water sites within the headwaters represent spring samples with dissolved iron at levels greater than 1,000 µg/L.

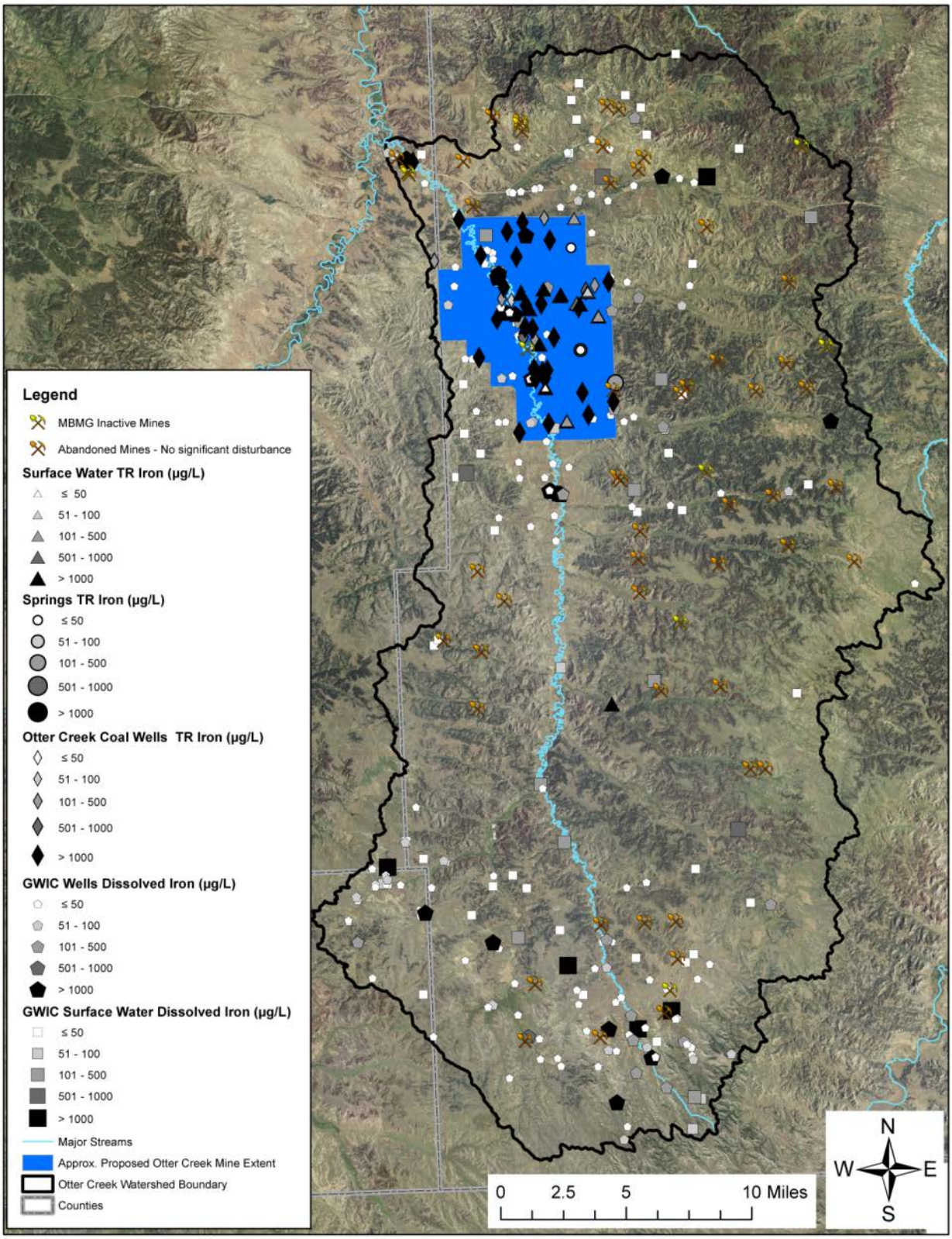

Figure 5-11. Surface water, spring, and well sampling results for iron concentrations at sites throughout the watershed Note: MBMG = Montana Bureau of Mines and Geology, TR = Total Recoverable, GWIC = Groundwater Information Center

5.4.2.6 Mining

Mining has occurred throughout the Otter Creek watershed (**Figure 5-11**). All of these mines are either abandoned or inactive. Most of the mines have been evaluated by DEQ and have been determined to be non-significant disturbances. Mines are located upgradient and downgradient of samples with both high and low iron concentrations (**Figure 5-2** in conjunction with **Figure 5-1**, **Figure 5-10** in conjunction with **Figure 5-9**, and **Figure 5-11**). Although each of the mines has the potential to contribute some iron to Otter Creek, the data indicate that their contribution of iron is minimal and that there are natural sources of iron independent of any mining that has occurred in the watershed.

5.4.2.7 Sediment Loading and Linkage to Iron

In 2014, DEQ determined that Otter Creek was not impaired for sediment, and the sediment cause of impairment was removed from the 303(d) list (Montana Department of Environmental Quality, 2014). Evidence to support this included that a very small proportion of sediment loading to Otter Creek was from human sources. Using coarse modeling methods, the U.S. EPA estimated that upland sediment loading to Otter Creek was 19,558 tons per year (19,496 tons of which were natural) and human-caused bank erosion was 529 tons per year (U.S. Environmental Protection Agency and Tetra Tech, Inc., 2007). Using these values, about 3% of sediment loading to Otter Creek is human-caused and thus human-caused sediment-associated iron loading is analogously low. If it is assumed that iron concentrations could be reduced by 3%, the exceedance rate on Otter Creek would only be reduced from 30% to 29% because the magnitude of the collective exceedances is large enough that all but one would still be exceeding the 1,000 µg/L target after being reduced. As pointed out in **Section 5.4.2.3**, iron reductions of up to 41% would be required to achieve an exceedance rate of 10%.

The above discussion is based on the assumption that elevated iron concentrations are significantly linked to elevated SSC values or sediment erosion. However, as pointed out in **Section 5.4.2.2**, the relationship between iron and SSC is highly variable. Furthermore, iron exceedances occur at low flows where there may be high groundwater influence with little to no linkage to erosion. Consequently, sediment loading from existing land management activities is likely having little effect on iron exceedances in Otter Creek.

5.4.2.8 Existing Conditions Summary

The data indicate that Otter Creek is not meeting the target for total recoverable iron and that the high concentrations observed are largely the result of natural sources within the watershed. The upper portions of Otter Creek watershed have had few surface water exceedances of the iron target, with the exception of some groundwater wells and springs (GWIC data, **Figure 5-11**) and one high flow sample result from Taylor Creek on June 14, 2013 (**Appendix B**). The locations on Otter Creek where exceedances regularly occur are located within a portion of the watershed where high total recoverable iron has been measured in tributaries to Otter Creek and in the groundwater upgradient and adjacent to the Otter Creek channel. These tributaries include but are not limited to Tenmile, Threemile and Home creeks (**Figure 5-11**, **Appendix B**). Other streams within the Tongue River watershed, including the Tongue River (**Appendix B**) and Pumpkin Creek (USGS NWIS Database), also exhibit high iron concentrations. The frequency of iron target exceedances has remained relatively constant since the mid-1970s with target exceedance levels greater than 10%, thus leading to an iron impairment determination even when only evaluating more recent data (less than 10 years old).

The timing of high iron values in Otter Creek and the Tongue River are similar and indicates two different processes are driving iron concentrations. The first is the result of iron entering the streams

with sediment in spring runoff when hillslope and streambank erosion occur. The second is when groundwater high in iron is contributing a large proportion of the flow under low flow conditions during the summer. Although there may be some controllable sources of sediment and thus iron, overall, iron associated with human-caused sediment loading is not believed to be a large source within Otter Creek. The high iron levels in the groundwater are likely natural, based on the distribution of elevated low flow iron values and the lack of any apparent linkages to the existing agricultural activities, existing or historical mining activity, or other land uses.

5.5 CALCULATING THE TMDL

The TMDL must be established at a level that will achieve compliance with the applicable water quality standard (75-5-703, MCA of the Montana Water Quality Act). Therefore, the iron TMDL is based on the chronic aquatic life water quality target and streamflow. Using the most stringent target ensures the TMDLs are protective of all designated beneficial uses. This TMDL applies to any point along the waterbody and therefore protects beneficial uses along the entire stream. Because streamflow varies seasonally, the TMDL is not expressed as a static value, but as an equation of the target multiplied by flow using the following formula:

Equation 1:
TMDL = (X) (Y) (k)

TMDL = Total Maximum Daily Load in lbs/day
X = lowest applicable metals water quality target in µg/L
Y = streamflow in cubic feet per second (cfs)
k = conversion factor of 0.0054

For the Otter Creek iron TMDL, this equation simplifies to:
TMDL = (1,000) (Otter Creek Flow) (0.0054) = (5.4) (Otter Creek Flow)

Based on the target of 1,000 µg/L, the total recoverable iron TMDL for Otter Creek is shown in **Figure 5-12**. This figure shows the TMDL from a flow of 0 cfs (0 lbs/day) to 200 cfs (1,080 lbs/day). In cases where the flow is greater than that shown in **Figure 5-12**, **Equation 1** will need to be used to calculate the TMDL.

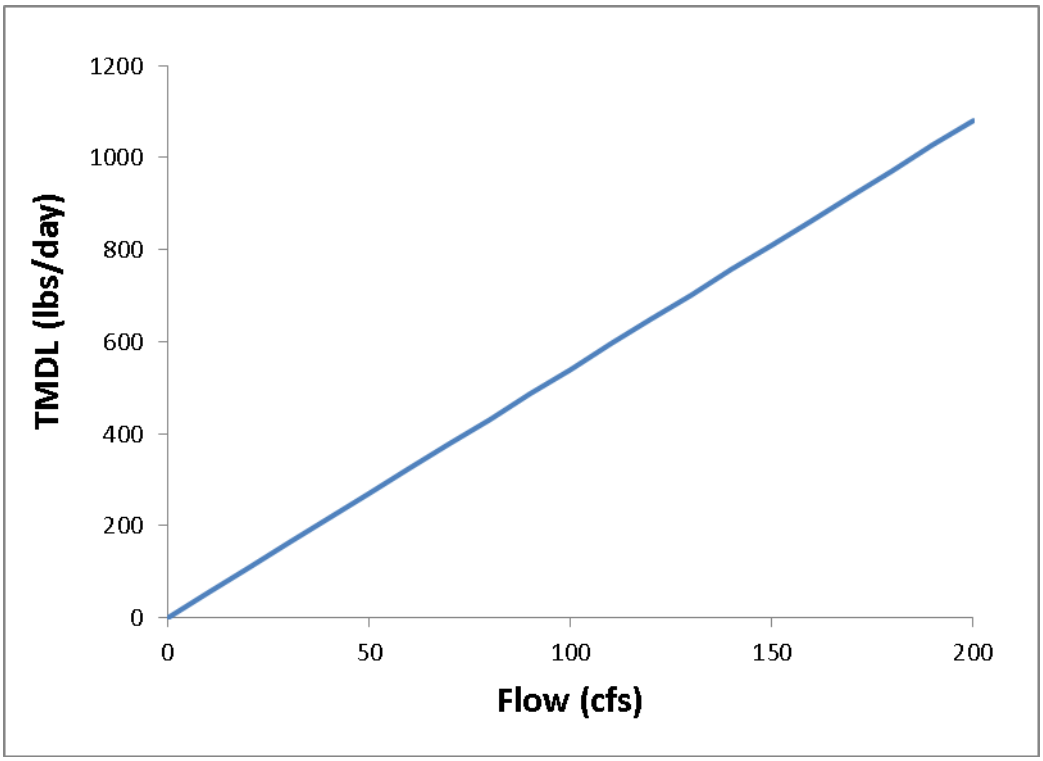

Figure 5-12. Total recoverable iron TMDL for Otter Creek

5.6 Iron Load and Wasteload Allocations

Once a TMDL is calculated, the total load must be allocated to all contributing sources. A TMDL is generally broken into one or more wasteload allocations (WLA), load allocations (LA), and a margin of safety (MOS). WLAs are allowable pollutant loads that are assigned to permitted and non-permitted point sources. LAs are pollutant loads assigned to nonpoint sources and may include the pollutant load from naturally occurring sources, as well as human-caused nonpoint loading. These elements are combined in the following equation:

Equation 2:
TMDL = ∑LA + ∑WLA

∑LA = the sum of all load allocations representing the portion of the TMDL allocated to nonpoint sources and naturally occurring background
∑WLA = the sum of all wasteload allocations representing the portion of the TMDL allocated to point sources

*Note: the Margin of Safety (MOS) for the iron TMDL in this document is implicit (i.e., MOS = 0) and is therefore not included in the above equation as discussed in **Section 4.0**. Additional detail regarding the implicit MOS is discussed in **Section 5.6.3**.*

For Otter Creek, the iron loading is predominately linked to natural sources throughout the watershed and will be addressed by one composite load allocation (LA_{comp}). This composite load allocation addresses both natural sources and any potential human caused iron loading even though it appears that the human caused component of the iron load is negligible based on the existing conditions summary (**Section 5.4.2.7**).

A wasteload allocation (WLA_{mine}) is also developed for the proposed Otter Creek Mine to address future iron loading that will be covered under a Montana Pollution Discharge Elimination System (MPDES) permit. This permit will authorize discharges to surface water, via surface water and groundwater pathways, from storage ponds built to capture stormwater and water from groundwater dewatering.

Therefore, **Equation 2** applied to the Otter Creek iron TMDL ($TMDL_{OtterFe}$) can be expressed as follows:

Equation 3:
$$\mathbf{TMDL_{OtterFe} = LA_{comp} + WLA_{mine}}$$

Section 5.6.1 provides additional detail on the WLA_{mine} including how it is calculated, and **Section 5.6.2** then defines how the LA_{comp} is calculated.

5.6.1 Developing the Otter Creek Mine Wasteload Allocation (WLA_{mine})

5.6.1.1 Basic Description of the Otter Creek Mine Discharge

The permit application for the Otter Creek Mine (dated December 2014) indicates that the mine will cover approximately 7,639 acres and that there are two pond systems (interior and exterior) that will be used to capture stormwater and water from groundwater dewatering (Hydrometrics, Inc. and Otter Creek Coal, LLC, 2014). During normal operation the pond system will be designed to discharge to groundwater via infiltration and surface discharge will only occur from the interior ponds during precipitation events greater than 100-year, 24-hr storms and from the exterior ponds during events greater than 10-year, 24-hr storms (Hydrometrics, Inc. and Otter Creek Coal, LLC, 2014). Though both the mine permit and discharge are still preliminary, the TMDL and associated (WLA_{mine}) are developed in a way that would still apply even if many of the above-referenced design details were to change.

5.6.1.2 Calculating the (WLA_{mine})

The Otter Creek Mine iron wasteload allocation (WLA_{mine}) for discharges from these ponds is calculated using a variation of **Equation 1**, defined in **Equation 4** below.

Equation 4:
$$\mathbf{WLA_{mine}} = (X)\ (Y)\ (k)$$

WLA_{mine} = Wasteload Allocation in lbs/day
X = iron water quality target for Otter Creek = 1,000 µg/L
Y = wasteload discharge flow in cubic feet per second (cfs)
k = conversion factor of 0.0054

This equation simplifies to:
WLA_{mine} = (1,000) (wasteload discharge flow) (0.0054) = (5.4) (wasteload discharge flow)

Based on the total recoverable iron target of 1,000 µg/L for Otter Creek, the iron WLA_{mine} for the Otter Creek Mine is shown in **Figure 5-13**. This figure shows the WLA_{mine} from an Otter Creek Mine pond discharge flow of 0 cfs (0 lbs/day) to 16 cfs (86.4 lbs/day). In cases where the flow is greater than that shown in **Figure 5-13**, **Equation 4** will need to be used to calculate the WLA_{mine}. Note that as long as the iron concentration in the mine discharge is less than or equal to 1,000 µg/L then the WLA requirement

will be satisfied. This WLA_{mine} can be readily incorporated into the applicable MPDES permit, particularly for direct surface discharges, using this 1,000 µg/L iron concentration.

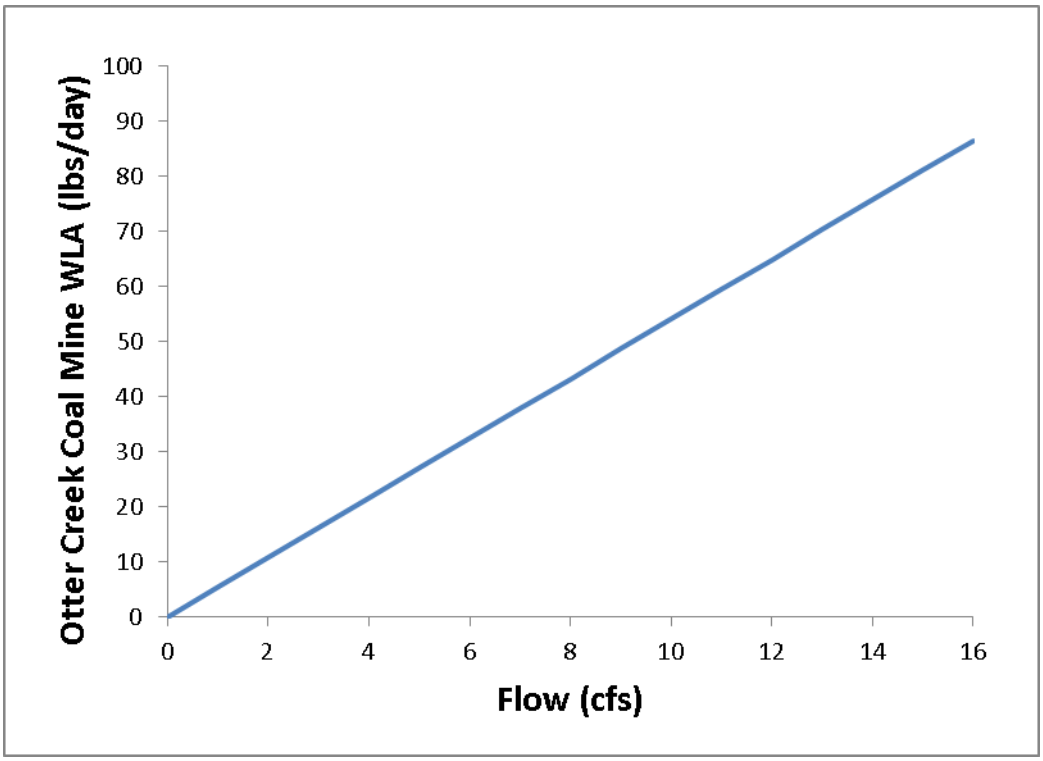

Figure 5-13. Iron (Total Recoverable) WLA for the Otter Creek Mine as a Function of Mine Discharge

Note that the iron wasteload allocation is not intended to influence the application of the nondegradation requirements for any other parameters such as flow, electrical conductivity, or sodium adsorption ratio. The application of a nondegradation requirement for another parameter, and/or the results of an authorization to degrade pursued under ARM 17.30.706-708, could result in discharge flow limitations that would effectively limit the maximum allowable iron load via **Equation 4**.

5.6.1.3 WLA_{mine} Applicability

The WLA for the Otter Creek Mine applies at all times and to both surface water and groundwater discharged from the Otter Creek Mine. Whether discharge from the Otter Creek Mine enters Otter Creek from surface water or groundwater, the water entering Otter Creek from the ponds will need to have a total recoverable iron concentration less than or equal to 1,000 µg/L in order to meet the WLA_{mine}. Regardless of the design of the Otter Creek Mine ponds that are constructed, the WLA in **Equation 4** and **Figure 5-13** will be applicable as it is predicated on the target of 1,000 µg/L being met at all times under all flow conditions. Montana DEQ will define compliance monitoring and other requirements necessary to satisfy this WLA_{mine} within an MPDES permit.

By basing the WLA on a discharge concentration of 1,000 µg/L, the permitted discharge cannot cause or contribute to an exceedance of the water quality standard within Otter Creek. Below the mine discharge, the flow within Otter Creek also includes the flow contributed by the mine and the TMDL equation downstream of the mine could be written as follows:

TMDL = (5.4) (mine discharge flow + flows from all other sources)

Therefore, the WLA_{mine} is specifically applicable within the Otter Creek TMDL equation only downstream of the Otter Creek Mine discharge where the flow within Otter Creek also includes the discharge flow from the mine. This is because the mine discharge flow is zero at Otter Creek locations above the mine. Additionally, the WLA_{mine} does not rely on upstream dilution in Otter Creek via the load allocation, thus ensuring consistency with the reasonable assurance approach defined in **Section 4.4**.

The WLA_{mine} in this document applies during the construction and operation phases of the Otter Creek Mine and does not address potential loading from long-term spoil export subsequent to mine closure or any other future potential point sources of iron such as other coal mines or coal-bed methane development. This same or a similar approach could also be applied to any additional future mine or other point sources requiring WLAs for iron in Otter Creek.

5.6.2 Calculating the Load Allocation

The LA for Otter Creek will be calculated based on **Equation 3** when and where WLAs are applicable using the following rearrangement of the equation:

$$\mathbf{LA_{comp} = TMDL_{OtterFe} - WLA_{mine}}$$

In the absence of the $\mathbf{WLA_{mine}}$ (i.e., all of Otter Creek prior to the development of the Otter Creek Mine and Otter Creek upstream of the Otter Creek Mine discharge once developed), the LA_{comp} for Otter Creek is equal to the $\mathbf{TMDL_{OtterFe}}$ since the above Otter Creek TMDL equation simplifies to:

$$\mathbf{TMDL_{OtterFe} = LA_{comp}}$$

Once the mine is discharging, the LA_{comp} can be determined by subtracting out the WLA_{mine} as shown in the above rearrangement of **Equation 3** and using **Equation 4** to calculate the WLA_{mine}.

5.7 TMDL Calculations Using Example Flow and Discharge Values

Otter Creek iron TMDLs are calculated using example high and low flow conditions to provide the reader additional clarification on how to apply the TMDLs and allocations and to also describe how seasonality is considered in this document. Seasonality is important because metals loading pathways change as flow conditions change. During high flows, loading associated with overland flow and erosion of metals-containing sediment tends to be the major cause of elevated metal concentrations. Contributions switch during low flow, as groundwater transport often become the largest source of metals pollution.

The steps taken to establish a value for the iron TMDL and the allocations during both an example high and example low flow condition in Otter Creek are provided below. The field flow data used for these example calculations correspond to the highest (100 cfs) and lowest (0.16 cfs) flow measured that was paired with iron data for the Otter Creek at Ashland, MT site sampled by the USGS. This monitoring site on Otter Creek had the most iron target exceedances. To determine the WLA_{mine}, an example discharge flow from the Otter Creek Mine of 1.6 cfs is used. This discharge flow is based on the conservative assumption that all of the water that enters into the pond systems (1,153.4 ac-ft/yr; Figure 2-1 in Hydrometrics, Inc. and Otter Creek Coal, LLC, 2014) leaves the system and enters Otter Creek at a constant flow. Because both the high and low flow examples are for Otter Creek below the Otter Creek Mine discharge, the flow in Otter Creek is increased by the Otter Creek Mine discharge (1.6 cfs for these

example calculations), resulting in an example high flow of 101.6 cfs and an example low flow of 1.76 cfs.

Establish TMDLs using the example high and low Otter Creek flows (see Equation 1)

TMDL (high flow example) = (1,000 µg/L) x (101.6 cfs) x (0.0054) = 548.6 lbs/day
TMDL (low flow example) = (1,000 µg/L) x (1.76 cfs) x (0.0054) = 9.5 lbs/day

Calculate WLA_{mine} using the example discharge flow (see Equation 4)

WLA_{mine} = (1,000 µg/L) x (1.6 cfs) x (0.0054) = 8.6 lbs/day
(Note that this calculation is independent of the above TMDL equation and any Otter Creek flow condition)

Calculate LA_{comp} (see Equation 3 rearrangement identified in Section 5.6.2)

LA_{comp} (high flow example) = 548.6 lbs/day – 8.6 lbs/day = 540 lbs/day
LA_{comp} (low flow example) = 9.5 lbs/day – 8.6 lbs/day = 0.9 lbs/day

Table 5-2 provides a summary of the TMDLs and allocations for example high and low flow conditions in Otter Creek and an example Otter Creek Mine discharge. It is important to note that the TMDLs and allocations calculated below only apply under the example Otter Creek flow and Otter Creek Mine discharge conditions. The Otter Creek iron TMDL and allocations must always be based on **Equations 1** through **4** for any other Otter Creek flow or mine discharge conditions.

Table 5-2. Example Calculation Results for Iron TMDLs in Otter Creek

Example Otter Creek Flow (cfs)		Iron TMDL[3] (lbs/day)		WLA_{mine}[4] (lbs/day)		LA_{comp} (lbs/day)	
High Flow[1]	Low Flow[2]	High Flow Example	Low Flow Example	High Flow Example	Low Flow Example	High Flow Example	Low Flow Example
101.6	1.76	548.6	9.5	8.6	8.6	540	1.1

[1]The high flow example is based on an instream flow of 100 cfs and a mine discharge of 1.6 cfs
[2] The low flow example is based on an instream flow of 0.16 cfs and a mine discharge of 1.6 cfs
[3]The TMDL is applicable to any location on Otter Creek below the mine discharge. The same basic approach could be used to calculate the TMDL and load allocation for an example flow above the mine discharge by subtracting out all mine influences in the above equations.
[4] Based on the example mine discharge of 1.6 cfs

5.8 Margin of Safety and Seasonality

Natural systems are inherently complex. Any approach used to quantify or define the relationship between pollutant loading rates and the resulting water quality effects, no matter how rigorous, will include some level of uncertainty or error. To compensate for this uncertainty and ensure water quality standards are attained, a MOS is required as a component of each TMDL. The MOS may be applied implicitly by using conservative assumptions in the TMDL development process or explicitly by setting aside a portion of the allowable loading (U.S. Environmental Protection Agency, 1999b). An implicit margin of safety (i.e., MOS = 0) is applied to the TMDL in this document through use of conservative assumptions throughout the TMDL development process as summarized below:

- Although a 10% exceedance rate is allowed for chronic aquatic life targets, the TMDL is set so the lowest applicable target is satisfied 100% of the time. This focuses watershed management practices toward 100% compliance with all targets, thereby providing a margin of safety for the majority of conditions where the most protective (lowest) target value is linked to the numeric aquatic life criteria.
- The TMDL and allocations are based on daily loading (24-hour period) calculated from an instantaneous concentration of 1,000 µg/L whereas chronic aquatic life criteria are based on average conditions over a 96-hour period. This provides a margin of safety since a four-day loading limit could potentially allow higher daily loads in practice.
- The lowest, most stringent numeric water quality criterion is used as the TMDL target in impairment determinations for all waterbody-pollutant combinations. This ensures protection of all designated beneficial uses.
- The TMDLs are based on numeric water quality criteria developed at the national level via EPA and incorporate a margin of safety necessary for the protection of human health and aquatic life.
- Target attainment, allocations refinement, impairment determinations and TMDL-development decisions are all based on an adaptive management approach that relies on future monitoring and assessment for updating planning and implementation efforts.

All TMDL documents must consider the seasonal applicability of water quality standards as well as the seasonal variability of pollutant loads to a stream. Seasonality was addressed in this document by making the TMDL and WLA target for iron applicable year-round and under all flow conditions. The TMDL for a given flow can be determined by using **Figure 5-12** or **Equation 1**; the WLA for a given wasteload discharge can be determined by using **Figure 5-13** or **Equation 3**. Seasonality was also addressed by the inclusion and analysis of sampling results from seasonal high and low flow conditions in Otter Creek.

5.9 Monitoring Recommendations

Although the MPDES permit will define the specific monitoring requirements necessary to evaluate compliance with WLA_{mine}, two types of WLA_{mine} monitoring are identified for consideration. The first type of monitoring would characterize any surface discharge to Otter Creek from the pond systems. The second monitoring type would characterize the surface water quality influence from groundwater or subsurface flows that originate from the pond systems and are covered under the MPDES permit. This could involve an evaluation of upstream to downstream iron concentrations within Otter Creek prior to and during mine operations.

Section 5.4 identified significant available data to characterize other potential sources within the watershed, concluding that natural sources are the predominate cause of an iron standard exceedance rate greater than the allowable 10%. Future monitoring elsewhere in the watershed should focus on areas where there is potential for additional future sources of iron, particularly point source discharges, such as from coal bed methane wells.

5.10 Achieving the Iron TMDL Allocations and Protecting the Tongue River

Otter Creek iron concentrations are less than 1,000 µg/L along most of its length under most conditions, but the overall exceedance rate remains above 10%. Because of natural conditions within the Otter Creek watershed, it does not appear that the target exceedance rate of ≤ 10% can be achieved, and a future water quality standard modification might be desirable to address the naturally high exceedance rate. A potential approach for modifying the water quality standard would be to maintain the 1,000 µg/L criteria and only modify the exceedance rate. This would then be consistent with a primary objective of this TMDL, which is to prevent a new source from increasing either the magnitude or frequency of the iron target exceedances in Otter Creek. The approach used for the WLA_{mine} should ensure that this objective is met. Note that it is not the intent to require that the WLAmine provide the necessary dilution to reduce an upstream iron concentration greater than 1,000 µg/L to less than 1,000 µg/L below the WLAmine discharge to Otter Creek.

The data analysis of **Section 5.4** also included discussion of Tongue River iron data. The data show that the iron concentrations in the Tongue River are similar to those in Otter Creek and that there are similar exceedance rates of the iron water quality standard in both streams. Therefore, meeting the Otter Creek WLA_{mine} is expected to also ensure that the magnitude and frequency of iron target exceedances will not increase for the Tongue River.

DEQ believes that future nonpoint source land management activities similar to those currently existing within the Otter Creek watershed are unlikely to substantially influence iron levels in Otter Creek, particularly if appropriate and reasonable best management practices (BMPs) are implemented and maintained. Guidance on BMP implementation in Montana can be found in: *Montana Nonpoint Source Management Plan* (Montana Department of Environmental Quality, 2012b) and *Water Quality BMPs for Montana Forests* (Montana State University, Extension Service, 2001) or by directly contacting nonpoint source program representatives at the Montana Department of Environmental Quality.

5.11 Uncertainty and Adaptive Management

Uncertainties in the accuracy of field data, source assessments, water quality models, loading calculations and other considerations are inherent when evaluating environmental variables for TMDL development. While uncertainties are an undeniable fact of TMDL development, mitigation, and reduction of uncertainty through adaptive management approaches are key components of ongoing TMDL implementation activities. Uncertainties, assumptions, and considerations are applied throughout this document and point to the need for refining analyses when needed.

The process of adaptive management is predicated on the premise that TMDLs, allocations, and their supporting analyses are not static, but are processes that are subject to periodic modification and adjustment as new information and relationships are better understood. As further monitoring and assessment is conducted, uncertainties with present assumptions and consideration may be mitigated via periodic revision or review of the assessment that occurred for this document. As part of the adaptive management approach, changes in land and water management that affect iron loading should be monitored.

The TMDLs and allocations established in this document are meant to apply to recent conditions of natural background and natural disturbance (e.g., flood, wildfire, diseased vegetation). Under some

periodic but extreme natural conditions, iron concentrations in Otter Creek could exceed the target value more frequently. Under these circumstances, land management activities should apply BMPs that will prevent significant long-term excess loading during recovery from these natural events.

6.0 PUBLIC PARTICIPATION AND PUBLIC COMMENTS

Stakeholder and public involvement is a component of total maximum daily load (TMDL) planning supported by U.S. Environmental Protection Agency (EPA) guidelines and required by Montana state law (75-5-703 and 75-5-704, Montana Code Annotated (MCA)) which directs the Montana Department of Environmental Quality (DEQ) to consult with a watershed advisory group and local conservation districts during the TMDL development process. Technical advisors, stakeholders, state and federal agencies, interest groups, and the public were solicited to participate in differing capacities throughout the TMDL development process for this project in the Otter Creek watershed.

6.1 PARTICIPANTS AND ROLES

Throughout completion of the Otter Creek iron TMDL, DEQ worked to keep stakeholders apprised of project status and solicited input from a TMDL watershed advisory group. A description of the participants and their roles in the development of the TMDL in this document is contained below.

Montana Department of Environmental Quality
Montana state law (75-5-703, MCA) directs DEQ to develop all necessary TMDLs. DEQ provided resources toward completion of these TMDLs in terms of staff, funding, internal planning, data collection, technical assessments, document development, and stakeholder communication and coordination. DEQ has worked with other state and federal agencies to gather data and conduct technical assessments.

United States Environmental Protection Agency
EPA is the federal agency responsible for administering and coordinating requirements of the Clean Water Act (CWA). Section 303(d) of the CWA directs states to develop TMDLs (**Section 1.1**), and EPA has developed guidance and programs to assist states in that regard. EPA has provided technical assistance to Montana's overall TMDL program and is responsible for final TMDL approval.

Conservation Districts
The Otter Creek watershed falls within the boundaries of both the Powder River Conservation District and the Rosebud Conservation District. DEQ consulted with both conservation districts during development of the iron TMDL in this document, which included opportunities to provide comment and an opportunity for participation in the watershed advisory group described below.

Otter Creek TMDL Watershed Advisory Group
The Otter Creek TMDL Watershed Advisory Group consisted of selected resource professionals who possess a familiarity with water quality issues and processes in the Otter Creek watershed, and also representatives of applicable interest groups. All members were solicited to participate in an advisory capacity per Montana state law (75-5-703 and 704, MCA). DEQ requested participation from the interest groups defined in MCA 75-5-704 and included local city and county representatives; livestock-oriented and farming-oriented agriculture representatives; conservation groups; watershed groups; state and federal land management agencies, tribal representatives; and representatives of fishing, recreation, and tourism interests. The advisory group also included additional state and federal agency professionals and stakeholders with an interest in maintaining and improving water quality.

Advisory group involvement was voluntary and the level of involvement was at the discretion of the individual members. Members had the opportunity to provide comment and review of technical TMDL assessments and reports and to attend meetings organized by DEQ for the purpose of soliciting feedback on project planning. Typically, draft documents were released to the advisory group for review under a limited timeframe, and their comments were then compiled and evaluated. Final technical decisions regarding document modifications resided with DEQ.

Communication with advisory group members was conducted through a series of group meetings and e-mails. Draft documents, project status updates, and meeting agendas and presentations were made available both via e-mail and through DEQ's wiki for TMDL development projects (http://montanatmdlflathead.pbworks.com). Opportunities for review and comment were provided for participants at varying stages of TMDL development, including a two-week review and comment period for a draft version of this TMDL document prior to the public comment period. Members' comments were incorporated into this version of the draft document.

6.2 Response to Public Comments

Upon completion of a draft TMDL document, and prior to submittal to EPA, DEQ issues a press release and enters into a public comment period. During this timeframe, the draft TMDL document is made available for public comment, and DEQ addresses and responds to all formal public comments.

The formal public comment period for the "Otter Creek Iron Total Maximum Daily Load" was initiated on October 1, 2015 and will close on October 30, 2015. Electronic copies of the draft document are available at the Miles City, Billings, and Henry A. Malley Memorial (Broadus) public libraries; the Dr. John Woodenlegs Memorial Library in Lame Deer; and at the State Library in Helena. Electronic copies of the final document will also be available at these libraries.

A public informational meeting will be held at Miles Community College in Miles City at 5:30 p.m. on October 21, 2015. A second meeting will be held at the Bureau of Land Management's Billings Field Office in Billings at 10:00 a.m. on October 22, 2015. At each meeting, DEQ will provide an overview of the document, answer questions, and solicit public input and comment on the iron TMDL in this document. The announcement of the public comment period and public meetings was distributed to the Otter Creek TMDL Watershed Advisory Group, which included the Powder River and Rosebud conservation districts; the Statewide TMDL Advisory Group; and other identified contacts via e-mail. Notice of the public comment period and public meetings are posted on the DEQ webpage and DEQ wiki for TMDL Development Projects, and also advertised in the Billings Gazette, Miles City Star, Powder River Examiner, The Independent Press, and A Cheyenne Voice newspapers.

Responses to public comments will be included either in this section of, or an appendix to, the final document. Original comment letters and submissions will be held on file at DEQ and may be viewed upon request.

7.0 REFERENCES

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