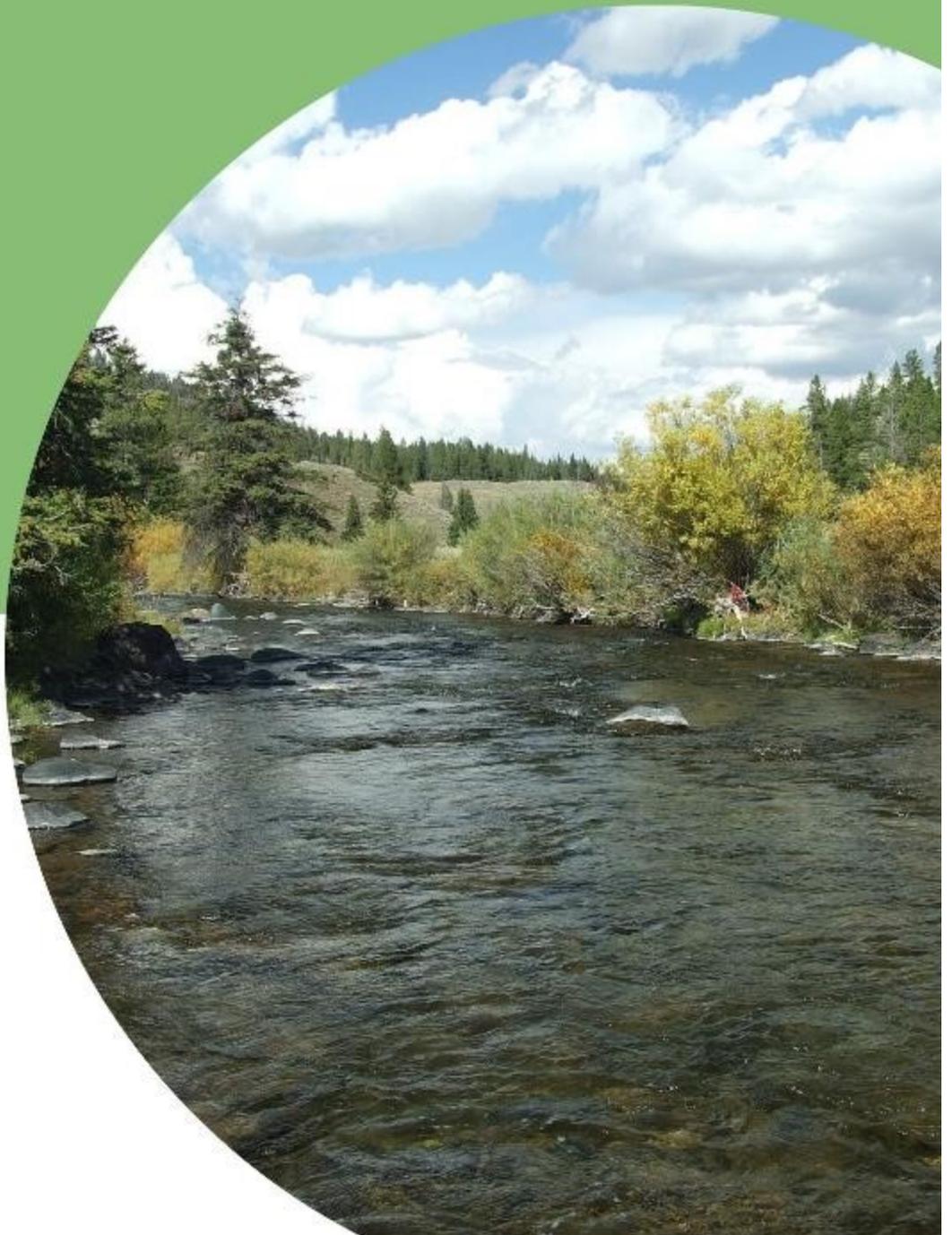


# MADISON WATERSHED

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**STREAM SUMMARIES  
2020**



# Credits

**Prepared by:**

Montana Department of Environmental Quality, Water Quality Planning Bureau, Watershed Protection Section

**Contributors:**

Water Quality Planning Bureau

Watershed Protection Section

Kristy Fortman

Hannah Riedl

Christina Staten

Monitoring and Assessment Section

Katie Makarowski

Madison Conservation District

Ethan Kunard, Former Water Programs Manager

**Cover Photo:** West Fork Madison River

Photo by: Montana Department of Environmental Quality

**Individual Stream Summaries Photos By:** Montana Department of Environmental Quality

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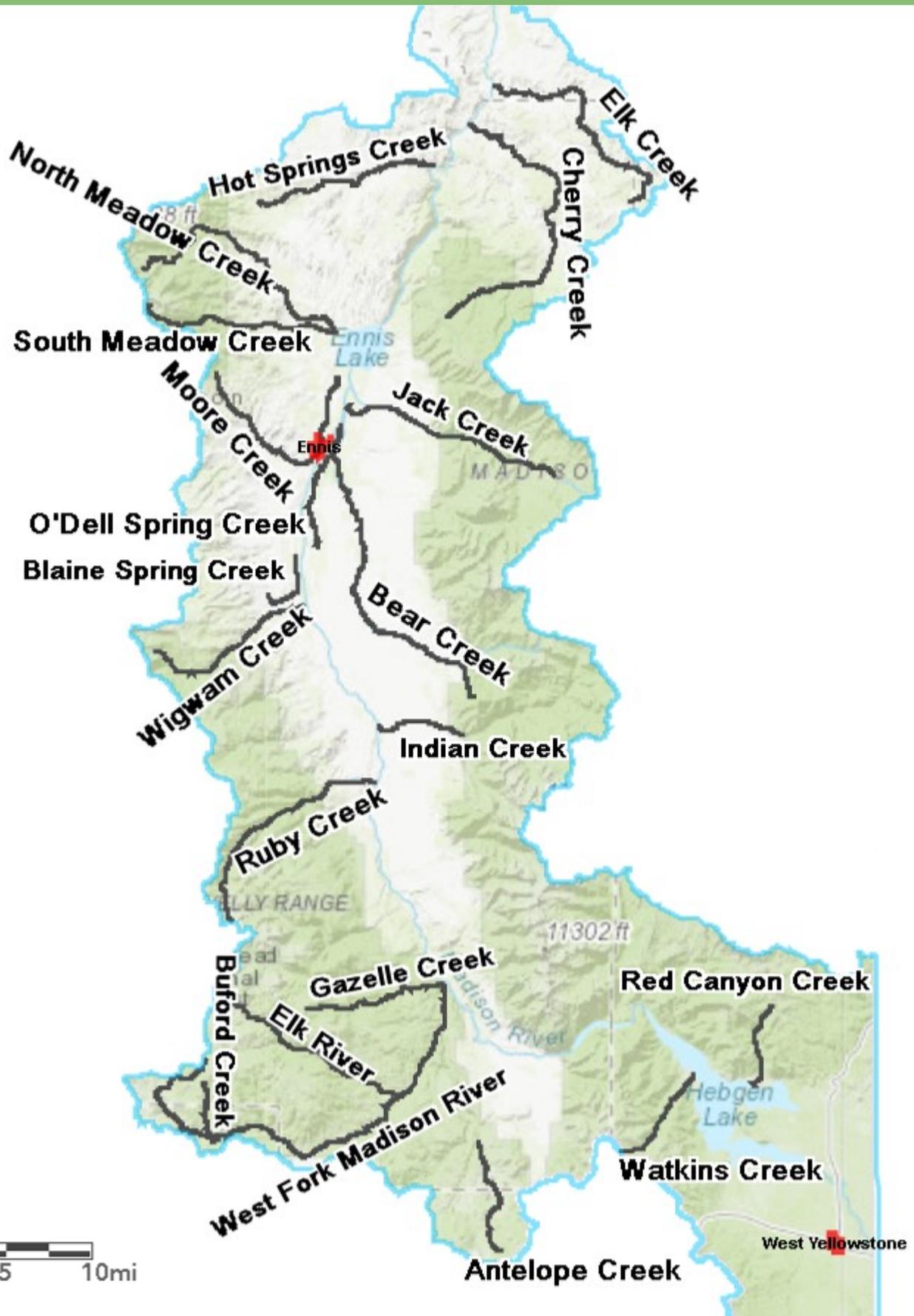
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# Purpose of These Stream Summaries

This document is intended to provide a summary of the condition of streams in the Madison River watershed that the Montana Department of Environmental Quality (DEQ) monitored for sediment, temperature, and related pollution problems between 2013 and 2015. The summaries provide a description of water quality problems, achievable solutions to those problems, and possible restoration project locations. This document is also intended to assist interested local entities with development of a watershed restoration plan (WRP) by providing tables of the total maximum daily load (TMDL) elements needed for inclusion in a DEQ-approvable WRP. Information provided in these summaries is based on DEQ's water quality assessment results, field observations, and review of aerial imagery. Some of the information provided is not ground-truthed.



# Madison River Watershed Streams



# Pollution Problems

## Sediment

Sediment is a naturally occurring component of a healthy and stable stream system. Excess amounts of sediment, however, has many negative effects. Accumulation of fine sediment reduces availability of suitable spawning habitat for fish and smothers fish eggs and fry. Accumulation of large particles, such as cobbles, leads to over-widened channels and reduced streamflow (sometimes leading to subsurface flow). Water can also appear murky when excess sediment is suspended in the water (turbidity).

### Human-Caused Sources

- Streambank Erosion
- Erosion from dirt/gravel roads
- Construction sites
- Mining
- Agricultural activities

### Solutions

Improve health of streamside vegetation to increase streambank stability and filter sediment from reaching the stream from upland sources.



## Temperature

Montana's western streams naturally run cold and support trout fisheries. Increased stream temperatures from solar radiation or human additions of heated water threaten the health of fish by reducing dissolved oxygen and increasing amounts of algae growing in the stream that further reduces available dissolved oxygen for fish. Higher stream temperatures also make fish more susceptible to disease and boost the opportunity for non-native fish more tolerant of higher stream temperatures to outcompete native trout.

### Human-Caused Sources

- Removal of native streamside vegetation
- Irrigation withdrawals
- Warm irrigation return flows

### Solutions

Improve health of streamside vegetation to create temperature-reducing shade and channel stability (keep streams from becoming wide and shallow).



# Pollution Problems

## Flow Modifications

Flow modification refers to a change in the flow characteristics of a waterbody relative to natural conditions. Modifications could be associated with changes in runoff and streamflow, commonly linked to elevated peak flows. Road crossings, particularly where culverts are undersized or inadequately maintained, can also alter flows by causing water to back-up upstream of the culvert. Irrigation withdrawal management can lead to base flows that are too low to support aquatic life and recreational activities, or result in dry channels. Low flow conditions absorb solar radiation more readily and increase stream temperatures, which in turn creates dissolved oxygen conditions too low to support some species of fish.

### Human-Caused Sources

- Urban development
- Timber harvest
- Undersized culverts
- Irrigation withdrawal management

### Solutions

- Install properly sized culverts at stream crossings
- Implement irrigation efficiency projects, where appropriate
- Maintain buffers between streams and timber harvest areas
- Avoid straightening stream channels



## Instream and Streamside Habitat Alterations

These alterations refer to circumstances where practices along stream channel have altered or removed vegetation and cases where the stream has been physically altered or manipulated. These changes subsequently alter channel shape and stream temperature, and may result in loss of instream habitat (riffles and pools).

### Human-Caused Sources

- Removal of streamside vegetation
- Overgrazing in stream corridors
- Channel straightening to accommodate roads, agricultural fields, or mining operations
- Channel alterations due to new infrastructure (roads, bridges, dam impoundments)

### Solutions

- Maintain streamside buffers
- Grazing management practices that maintain healthy streamside vegetation
- Maintain natural stream shape and pattern and allow streams to move/migrate (avoid straightening streams)

# Antelope Creek

## Location Description: Headwaters to junction with Cliff Lake

**Impairments: Sediment, Flow Modification, Alterations to Streamside Vegetation**

**Negatively Affects: Aquatic Life**

### Problem

The excess fine sediment loading at the upper DEQ - monitored site (ATLP 04-02) is linked to riparian grazing in the form of trampled streambanks and over-widened areas of the stream from cattle crossings.

### Solutions

Riparian area improvements in the form of grazing best management practices could eventually result in reducing sediment loading enough to meet the water quality standard. The DEQ-monitored site on lower Antelope Creek (ATLP 10-01) demonstrated stable streambanks and a recovering riparian area due to a more recent fencing project and hardened stream crossing that has reduced livestock access to the stream.

### Potential Restoration Project Locations

The project locations discussed in this section are directly linked to riparian grazing management or other riparian zone improvement BMPs that would subsequently result in reduced bank erosion and improvements in the stream's ability to transport sediment and provide aquatic habitat (channel form and function). Based on reviews of aerial photography, riparian areas generally appear healthy along the very upper reaches of Antelope Creek. Heavy grazing throughout the middle and lower portions of Antelope Creek is likely creating the same conditions seen at the DEQ-monitored site ATLP 04-02 (unstable streambanks and unhealthy riparian areas). Additionally, Antelope Creek runs dry during the summer months below ATLP 04-02 and projects to increase streamflow during hot summer months would prove beneficial to aquatic life as well as the riparian area for maintaining stable streambanks.



**A lack of healthy streamside vegetation and a trampled streambank due to cattle access at monitoring site ATLP 04-02**



**Healthy riparian vegetation along Antelope Creek**



**Monitoring site ATLP 10-01 above Cliff Lake**

# Antelope Creek

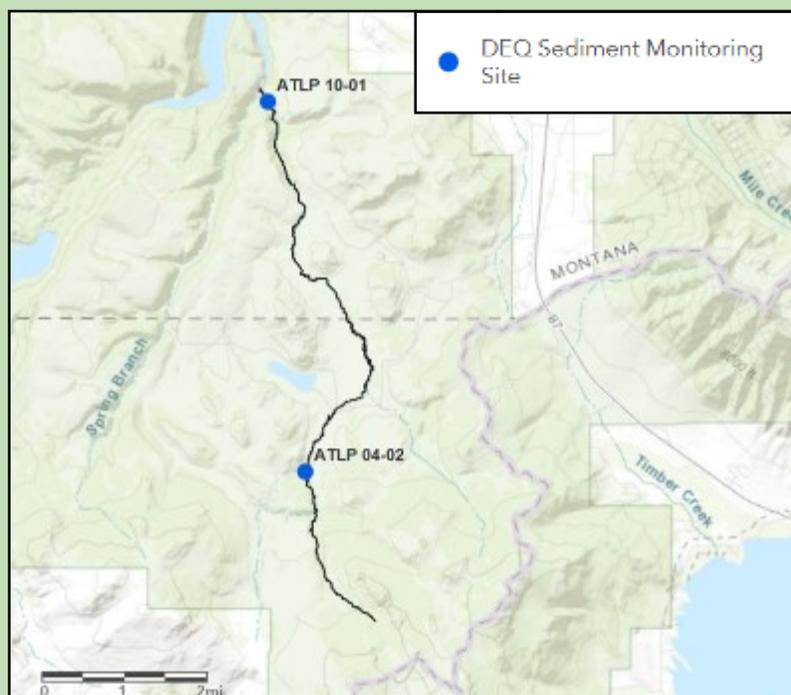
## WATERSHED RESTORATION PLAN INFORMATION

### Antelope Creek WRP Elements

Waterbody / Assessment Unit ID: MT41F004\_140

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.1, 5.5	5.6, 5.7.1	5.4.1	9.0, 10.0
Alteration in stream-side or littoral vegetative covers	NA	NA	NA	8.0, 9.0, 10.0
Flow Regime Modification	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable



## MONITORING LOCATIONS AND COLLECTED DATA

### Antelope Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude <sup>1</sup>	Longitude <sup>1</sup>	Monitoring Parameters
ATLP 04-02 (M06ANTLC02)	DEQ	44.68141	-111.52829	Instream fine sediment <sup>2</sup> Instream habitat BEHI Greenline
ATLP 10-01 (M06ANTLC02)	DEQ	44.74677	-111.53753	Instream fine sediment <sup>2</sup> Instream habitat BEHI Greenline

<sup>1</sup> Latitude/longitudes are the downstream end of the sampling site

<sup>2</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# Bear Creek

**Location Description: Headwaters to junction with O'Dell Spring Creek**

**Impairments: Sediment**

**Negatively Affects: Aquatic Life**

## Problem

Excess fine sediment in Bear Creek is primarily linked to livestock grazing within the riparian area. Extensive pugging and hummocking, bank trampling, over-widened sections of stream where cattle crossings are located, and loss of riparian vegetation have been observed throughout the watershed.

## Solutions

Riparian area improvements in the form of grazing best management practices could substantially reduce the amount of fine sediment reaching Bear Creek and eventually result in reducing sediment loading enough to meet the water quality standard. Obvious sediment loading from other sources such as road crossings and confined animal feeding areas should also be addressed to further ensure improved stream health.

## Potential Restoration Project Locations

Almost the entirety of Bear Creek, once the stream emerges into the valley, is grazed and contains an extensive network of irrigation ditches reducing instream flows; therefore, there are few areas of the stream that are not candidates for a restoration project. However, downstream of Longhorn Road, there are multiple beaver dams that are creating healthy riparian habitat, and this area should be protected. Upstream of Longhorn Road, there are many small homeowner ponds intersecting the flow of Bear Creek, which are likely increasing water temperatures; discouraging this type of future development may prove beneficial to stream health. There is also a series of two ponds downstream of Highway 287, below which Bear Creek runs dry. Efforts should be considered to increase flow in Bear Creek below these two ponds. Additionally, downstream of Highway 287, heavy grazing occurs on both sides of the stream; many areas are denuded of vegetation and the stream is over-widened at cattle crossings. Hay fields also appear to lack riparian buffers. This entire stretch of the stream is in need of improved riparian zone management. Undersized culverts at road crossings on Valley Cutoff Road were also noted during DEQ assessments of sediment contributions from unpaved roads.



**Hummocked streamside vegetation due to livestock grazing along Bear Creek**



**Aerial of extensive livestock access causing poor riparian conditions and over-widened sections of Bear Creek**



**An undersized culvert at a road crossing along Bear Creek**

# Bear Creek

## WATERSHED RESTORATION PLAN INFORMATION

### Bear Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F004\_021

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.2, 5.5	5.6, 5.7.2	5.4.1	9.0, 10.0



## MONITORING LOCATIONS AND COLLECTED DATA

### Bear Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude <sup>1</sup>	Longitude <sup>1</sup>	Monitoring Parameters
BEAR 09-03 (M06BEARC02)	DEQ	45.29629	-111.69257	Instream fine sediment <sup>2</sup> Instream habitat BEHI Greenline
BEAR 10-01 (M06BEARC03)	DEQ	45.31418	-111.70622	Instream fine sediment <sup>2</sup> Instream habitat BEHI Greenline
X-16A	DEQ	45.16827	-111.59631	Road crossing
X-26A	DEQ	45.16763	-111.59217	Road crossing
P-16	DEQ	45.16285	-111.56912	Parallel road segment
P-17	DEQ	45.15644	-111.55544	Parallel road segment

<sup>1</sup> Latitude/longitudes are the downstream end of the sampling site

<sup>2</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# Blaine Spring Creek

**Location Description: Headwaters to junction with the Madison River**

**Impairments: Sediment, Flow Modification**

**Negatively Affects: Aquatic Life**

## Problem

Excess sediment in Blaine Spring Creek is primarily related to streambank erosion as a result of current and historical grazing in the riparian area.

## Solutions

Improved grazing management practices in the riparian area will reduce fine sediment entering Blaine Spring Creek. An example includes a fencing project that reduced livestock access to the stream at DEQ-monitored site, BLNS 06-01. This site demonstrates recovering streambanks and recovering riparian vegetation previously impacted from livestock grazing.

## Potential Restoration Project Locations

The riparian zone along Blaine Spring Creek may be limited in some sections due to confined conditions and road encroachment, but other areas could improve where livestock grazing is occurring. Downstream of Gravelly Range Road, there are areas in need of improved grazing management practices and larger riparian buffers.



**An eroding streambank with lack of stabilizing streamside vegetation at monitoring site BLNS 06-01**



**Streamside vegetation conditions of Blaine Spring Creek**



**Streamside vegetation conditions at monitoring site BLNS 06-01**

# Blaine Spring Creek

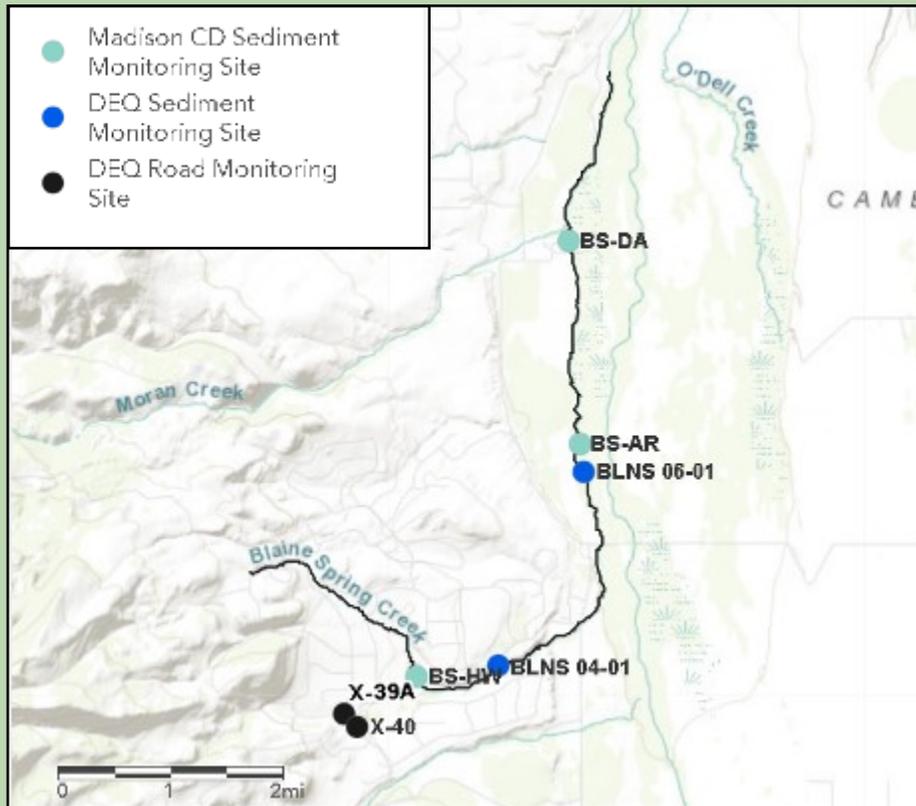
## WATERSHED RESTORATION PLAN INFORMATION

### Blaine Spring Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F004\_010

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.3, 5.5	5.6, 5.7.3	5.4.1	9.0, 10.0
Flow Regime Modification	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable



## MONITORING LOCATIONS AND COLLECTED DATA

### Blaine Spring Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
BLNS 04-01 (M06BLNSC09)	DEQ	45.21657	-111.77651	Instream fine sediment <sup>1</sup> Instream habitat
BLNS 06-01 (M06BLNSC08)	DEQ	45.24178	-111.76086	BEHI Greenline
BS-DA	Madison CD	45.27176	-111.76354	Pebble counts
BS-AR	Madison CD	45.24539	-111.76152	Pebble counts
BS-HW	Madison CD	45.21515	-111.79153	Pebble counts
X-39A <sup>2</sup>	DEQ	45.21048	-111.80486	Road crossing
X-40 <sup>2</sup>	DEQ	45.20863	-111.80251	Road crossing

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

<sup>2</sup> Road crossing is on an unnamed tributary to Blaine Spring Creek

# Buford Creek

**Location Description: Headwaters to junction with West Fork Madison River**

**Impairments: None related to sediment or temperature**

## Stream Condition

DEQ monitored two sediment sites on Buford Creek, but only the lower site (BFRD 07-01), just above the junction with the West Fork Madison River, had all sediment parameters monitored. The lower site was dominated by wetland vegetation along streambanks, surrounded by high-elevation sagebrush steppe uplands. The site showed evidence of past grazing within the riparian area; however, streambanks were low and mostly stable due to the recovering vegetation. Minimal sediment inputs from uplands were observed, except for a stream ford/crossing at the downstream end of the site. Further upstream at BFRD 06-01, the stream was confined and had a willow-dominated riparian area, demonstrating the potential mature riparian zone that Buford Creek is capable of supporting throughout its entire stream length.

From a review of aerial imagery, the upper reaches of Buford Creek travel through a conifer-dominated riparian area. The middle reaches appear to have a shrub-dominated riparian area (e.g., willows), while the lower reaches of the stream appear to be lacking this type of mature riparian vegetation, most likely due to historical riparian grazing, as evidenced by the DEQ monitoring site. Protection of the riparian area around Buford Creek will allow the stream time to fully recover from past grazing practices. Unless grazing is reinstated, Buford Creek does not appear to be in need of restoration projects.



**Downstream end of Buford Creek (monitoring site BFRD 07-01). Picture shows a stream ford.**



**Lower sediment monitoring site, BFRD 07-01**



**Upper monitoring site (BFRD 06-01), showing riparian vegetation potential for entirety of Buford Creek**

# Buford Creek

## WATERSHED RESTORATION PLAN INFORMATION

Buford Creek (Waterbody/Assessment Unit ID: MT 41F004\_150) is identified as impaired for arsenic, but does not have water quality impairments associated with sediment or temperature. Probable sources of arsenic are likely predominately naturally occurring. However, Buford Creek could be included in a watershed restoration plan (WRP) if determined to be a priority by those developing the WRP. See Section 9.0 of the Madison sediment and temperature TMDL document for additional information on WRP development.

## MONITORING LOCATIONS AND COLLECTED DATA



**Buford Creek Sediment Monitoring Locations**

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
BFRD 06-01 (M06BUFDC02)	DEQ	44.76420	-111.86948	Instream fine sediment <sup>1</sup> Instream habitat
BFRD 07-01 (M06BUFDC01)	DEQ	44.75557	-111.85623	Instream fine sediment <sup>1</sup> Instream habitat BEHI Greenline

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# Cherry Creek

**Location Description: Headwaters to junction with the Madison River**

**Impairments: Sediment, Temperature**

**Negatively Affects: Aquatic Life**

## Problem

Excess fine sediment is related to streambank erosion from livestock grazing and is notably causing pools to fill with sediment, reducing fish habitat. Mid-channel bars were observed during DEQ field work, indicating channel aggradation (inability to transport/move its natural sediment load). Irrigated cropping and livestock grazing are the primary contributions to elevated stream temperatures. Encroaching cropland reduces riparian buffer zones, thereby reducing shade to the stream, and irrigation diversions may be creating low flow stream conditions that exacerbate high stream temperatures and create difficult growing conditions for healthy riparian vegetation.

## Solutions

Improvements in grazing management practices in the riparian zone and increased buffer widths between crop fields and the stream will lead to reductions in sediment loading reaching the stream and reduced water temperatures. Efforts to conserve instream flows will also reduce water temperatures and help support healthy riparian vegetation that in turn stabilizes streambanks and filters sediment from reaching the stream. Attention should also be paid to protecting adjacent wetland areas that provide crucial temperature-lowering benefits. Multiple restoration projects in the lower portion of Cherry Creek, including riparian planting and fencing have already been implemented and need time to take effect.

## Potential Restoration Project Locations

The upper headwaters of Cherry Creek contain the most shade deficits, mainly due to an irrigation diversion. Moving downstream in the headwaters, Cherry Creek is heavily forested and contains sufficient shade. About halfway down, Cherry Creek begins to develop mid-channel bars, indicative of an aggrading system unable to transport its sediment load. The channel also begins to over-widen due to livestock access to the stream and bank destabilization is apparent from aerial photographs. However, Cherry Creek appears to have a high water table in its downstream reaches, which will allow for easy regeneration of a healthy riparian area once appropriate best management practices are applied in the riparian zone.



**Lack of native, shading streamside vegetation at monitoring site CHRR 20-01**



**An eroding streambank and poor streamside vegetation conditions on Cherry Creek**



**An eroding streambank and poor streamside vegetation at monitoring location CHRR 18-02**

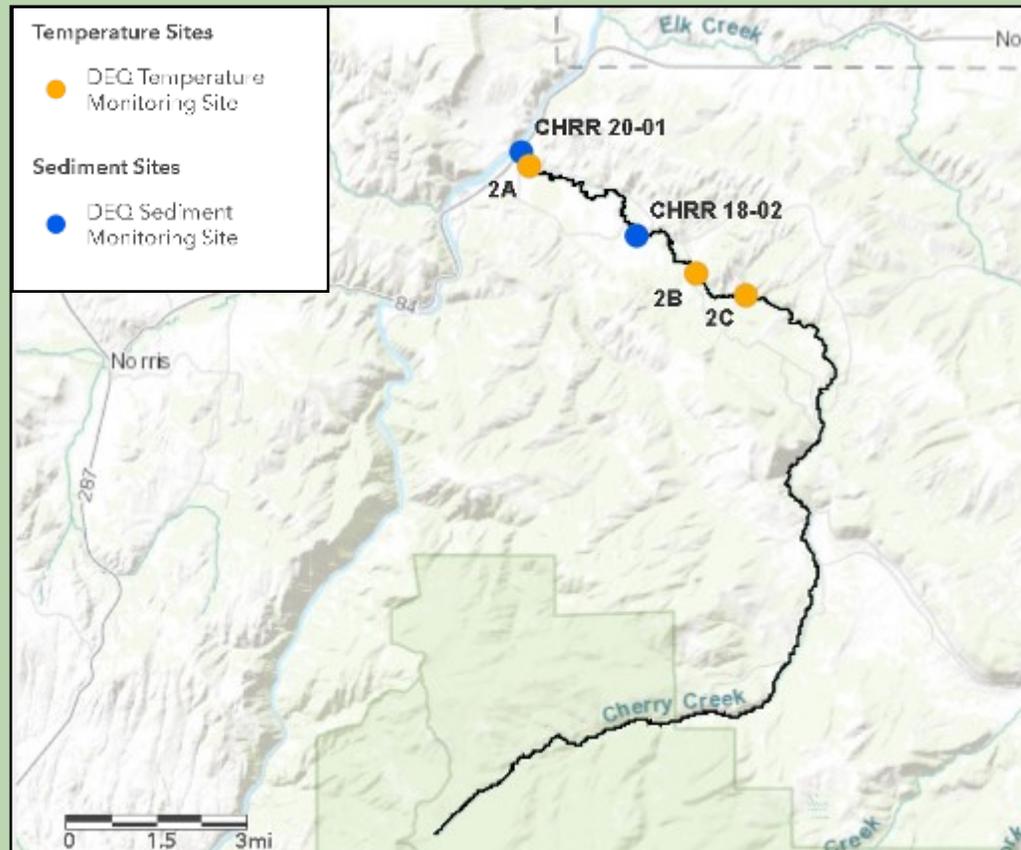
# Cherry Creek

## WATERSHED RESTORATION PLAN INFORMATION

### Cherry Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F002\_010

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.4 5.5	5.6, 5.7.4	5.4.1	9.0, 10.0
Temperature	6.6.1, 6.6.2	6.7, 6.8.1	6.4.1.5, 6.4.2.1	9.0, 10.0



## MONITORING LOCATIONS AND COLLECTED DATA

### Cherry Creek Sediment and Temperature Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
CHRR 18-02 (M06CHRYC05)	DEQ	45.60161	-111.50781	Instream fine sediment <sup>1</sup> Instream habitat
CHRR 20-01 (M06CHRYC04)	DEQ	45.62159	-111.54733	BEHI Greenline
2A (M06CHRYC01)	DEQ	45.6184	-111.5448	Temperature data logger Shade
2B (M06CHRYC03)	DEQ	45.5921	-111.4875	Flow Cross section
2C (M06CHRYC02)	DEQ	45.5870	-111.4702	

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# Elk Creek

## Location Description: Headwaters to junction with the Madison River

**Impairments: Sediment, Temperature, Turbidity, Alterations to Streamside Vegetation**

**Negatively Affects: Aquatic Life**

### Problem

Poor riparian conditions related to livestock grazing and crop production are the primary cause of excess fine sediment in Elk Creek. Streambank erosion and failure (sloughing and collapsing) was observed throughout middle and lower portions of Elk Creek. Elevated stream temperatures are a result of poor riparian conditions (lack of shade) and irrigation dewatering.

### Solutions

Improvements in riparian habitat management will greatly reduce the amount of fine sediment entering Elk Creek and will allow for recovery of critical shade-providing vegetation to help reduce stream temperatures. However, Elk Creek will not fully support its beneficial uses without the return of stream flow to dry reaches.

### Potential Restoration Project Locations

The riparian zone needs improvement along almost all of Elk Creek. Opportunities should be pursued to increase riparian buffer widths between crop fields and Elk Creek, as well as around confined livestock feeding areas. Reductions in livestock grazing pressure to riparian areas will substantially improve the water quality of Elk Creek. Where possible, improvements in irrigation efficiency may help return flow to lower portions of Elk Creek. Elk Creek may also be a candidate for instream channel modifications to alleviate the impacts of historical channelization in sections of lower Elk Creek.

Uncertainty exists about the causes of the dry reaches of lower Elk Creek, near the mouth. Further investigation into the impacts of irrigation withdrawals and locations of losing and gaining reaches will help determine the types of restoration projects needed in these areas. Additionally, the protection of existing beaver complexes and habitat will help maintain late-season flows for Elk Creek.



**A failing streambank and poor riparian conditions due to livestock grazing. Lack of shading vegetation has resulted in excessive algal growth.**



**Elk Creek without flow, resulting from irrigation diversions**



**Turbid water in Elk Creek and lack of native, shading streamside vegetation**

# Elk Creek

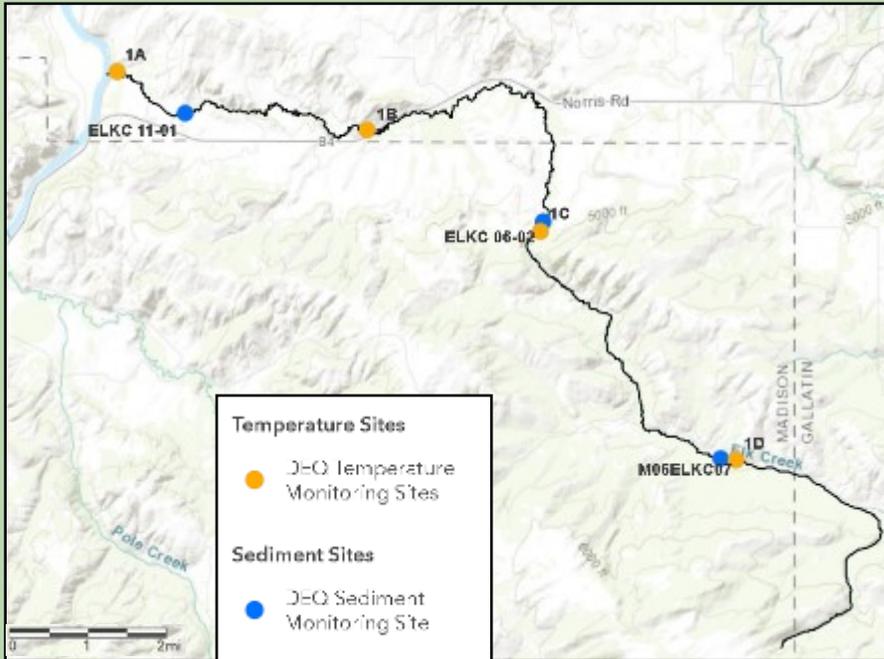
## WATERSHED RESTORATION PLAN INFORMATION

### Elk Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F002\_020

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.5, 5.5	5.6, 5.7.5	5.4.1	9.0, 10.0
Temperature	6.6.1, 6.6.3	6.7, 6.8.2	6.4.1.5, 6.4.2.2	9.0, 10.0
Turbidity	Addressed by sediment TMDL; no targets or load reductions provided			9.0, 10.0
Alteration in stream-side or littoral vegetative covers	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable



## MONITORING LOCATIONS AND COLLECTED DATA

### Elk Creek Sediment and Temperature Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
M06ELKC07	DEQ	45.58689	-111.36656	Instream fine sediment <sup>1</sup> Instream habitat
ELK 06-02 (M06ELKC02)	DEQ	45.62838	-111.413	
ELKC 05-01 (M06ELKC05)	DEQ	45.58781	-111.37117	Instream fine sediment <sup>1</sup> Instream habitat
ELKC 11-01 (M06ELKC06)	DEQ	45.64703	-111.501941	
1A (M06ELKC04)	DEQ	45.6544	-111.5188	Temperature data logger Shade Flow Cross section
1B (M06ELKC03)	DEQ	45.6442	-111.4568	
1C (M06ELKC02)	DEQ	45.6267	-111.4139	
1D (M06ELKC05)	DEQ	45.5871	-111.3657	

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# Elk River

**Location Description: Headwaters to junction with West Fork Madison River**

**Impairments: None**

## Stream Condition

The lower reaches of the Elk River appear to be experiencing the most influence from human activity, particularly livestock grazing and recreational use by off-road vehicles. The lower sites visited by DEQ (ELKR 17-01 and ELKR 18-01) were recovering from historical riparian grazing, and streambank erosion was not contributing much fine sediment to the river. Stream and riparian condition improves moving upstream, with the upper reaches having no apparent human influence. Overall, the Elk River appears to be “at potential,” in terms of stream form and function, and continued protection of its riparian areas will keep the river in good health.



**An eroding streambank and ATV crossing/stream ford on the Elk River**



**An eroding streambank along the lower reaches of the Elk River**



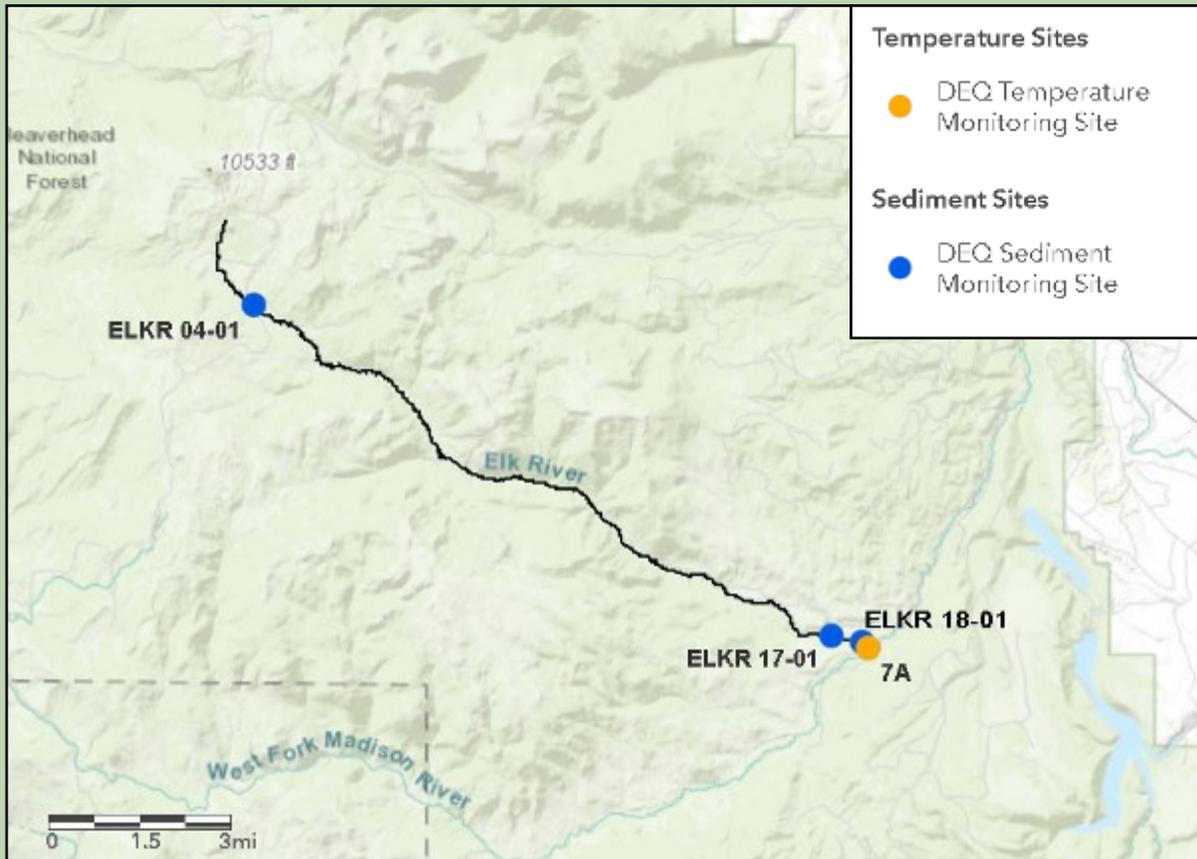
**Healthy streamside vegetation in the headwaters of the Elk River**

# Elk River

## WATERSHED RESTORATION PLAN INFORMATION

Even though the Elk River (Waterbody/Assessment Unit ID: MT 41F004\_110) is not currently listed for any water quality impairments, it could be included in a watershed restoration plan (WRP) if determined to be a priority by those developing the WRP. See Section 9.0 of the 2020 Madison sediment and temperature TMDL document for additional information on WRP development.

## MONITORING LOCATIONS AND COLLECTED DATA



Elk River Sediment and Temperature Monitoring Locations

Site ID	Collection Entity	Latitude <sup>1</sup>	Longitude <sup>1</sup>	Monitoring Parameters
ELKR 04-01 (M06ELKR04)	DEQ	44.8716	-111.84016	Instream fine sediment <sup>2</sup> Instream habitat BEHI Greenline
ELKR 17-01	DEQ	44.79316	-111.64545	BEHI Greenline
ELKR 18-01 (M06ELKR02)	DEQ	44.7914	-111.635	Instream fine sediment <sup>2</sup> Instream habitat
7A <sup>3</sup> (M06ELKR03)	DEQ	44.7898	-111.6333	Temperature data logger Shade Flow Cross section

<sup>1</sup> Latitudes/longitudes are the downstream end of the sampling site

<sup>2</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

<sup>3</sup> Temperature monitoring was in support of temperature monitoring on West Fork Madison River, as opposed to a temperature assessment for the Elk River

# Gazelle Creek

**Location Description: Headwaters to junction with West Fork Madison River**

**Impairments: None**

## Stream Condition

Human impacts at the upper DEQ sediment monitoring site on Gazelle Creek (GAZL 09-01) were minimal. The stream had a steep slope and the channel was comprised of bedrock and large boulders. Streambanks were protected by boulders, large woody debris, and vegetation, but were undercut. The lower sediment monitoring site (GAZL 16-01) also had well-armored streambanks and large woody debris, but a few cattle crossings and cattle trails along the bank. Riparian vegetation was well established, however.

Except for the headwaters and the lower reach near the mouth, the majority of Gazelle Creek appears to move through a heavily forested landscape. Nevertheless, best management practices related to livestock grazing should be implemented to protect the riparian area and streambanks. Wetland areas in the headwaters should also be protected.



**Gazelle Creek monitoring site GAZL 09-01 containing healthy amounts of large woody debris**



**Streambank erosion resulting from livestock access at Gazelle Creek monitoring site GAZL 16-01**



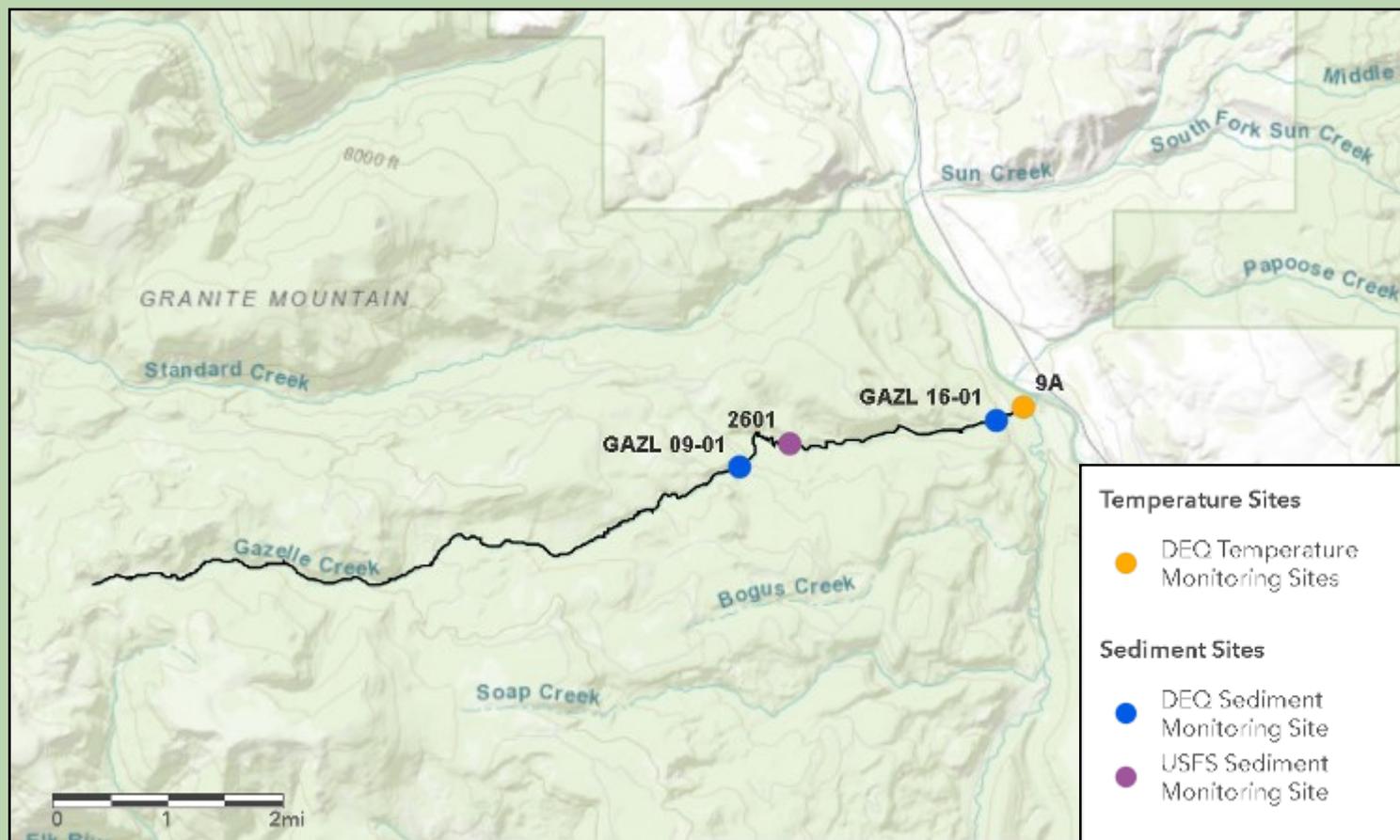
**Healthy streamside vegetation along Gazelle Creek**

# Gazelle Creek

## WATERSHED RESTORATION PLAN INFORMATION

Even though Gazelle Creek (Waterbody/Assessment Unit ID: MT 41F004\_120) is currently not determined to have any water quality impairments, it could be included in a watershed restoration plan (WRP) if determined to be a priority by those developing the WRP. See Section 9.0 of the 2020 Madison sediment and temperature TMDL document for additional information on WRP development.

## MONITORING LOCATIONS AND COLLECTED DATA



**Gazelle Creek Sediment and Temperature Monitoring Locations**

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
GAZL 09-01 (M06GAZLC05)	DEQ	44.87938	-111.6340	Instream fine sediment <sup>1</sup> Instream habitat BEHI Greenline
GAZL 16-01 (M06GAZLC02)	DEQ	44.8852	-111.58853	
2601	USFS	44.88244	-111.624984	Instream fine sediment <sup>1</sup> Instream habitat
9A <sup>2</sup> (M06GAZLC04)	DEQ	44.8871	-111.5835	Temperature data logger Shade Flow Cross section

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

<sup>2</sup> Temperature monitoring was in support of temperature monitoring on West Fork Madison River, as opposed to a temperature assessment for Gazelle Creek

# Hot Springs Creek

**Location Description: Headwaters to junction with the Madison River**

**Impairments: Sediment, Flow Modification**

**Negatively Affects: Aquatic Life**

## Problem

Unpaved roads and riparian grazing are the biggest contributors of excess fine sediment reaching Hot Springs Creek. Overgrazed riparian areas have led to unhealthy riparian vegetation and compromised streambanks. A wildfire burned the lower reach of the stream in 2012 (at DEQ monitoring site HOTS 16-01), which has undoubtedly contributed to excess fine sediment in this portion of the stream. However, riparian vegetation is quickly rebounding to create a buffer against unstable soils in the burned uplands.

## Solutions

Best management practices to control sediment from adjacent segments of unpaved roads and road crossings, and improved riparian grazing management practices, are needed to curb excess fine sediment inputs.

## Potential Restoration Project Locations

The majority of Hot Springs Creek has opportunities for grazing management improvements within the riparian area; however, downstream of Sterling is in the most need, particularly between Sterling and Norris. It was noted during DEQ field work that better best management practices could be implemented around the Red Bluff Research Ranch, as a lot of fine sediment was observed in the stream at this location and hummocking was prominent along streambanks. Additionally, riparian areas adjacent to irrigated fields in the Hot Springs Creek drainage could be improved with expanded buffers. Culverts along Sterling Road were observed to be large contributors of sediment, and there is opportunity for improved road best management practices (BMPs) along a tributary that follows Bradley Creek Road.



**Hummocking, loss of streamside vegetation, and streambank erosion resulting from livestock access to Hot Springs Creek**



**An undersized road culvert and eroding streambanks along Hot Springs Creek**



**Unhealthy streamside vegetation and hummocking as a result of livestock grazing along Hot Springs Creek**

# Hot Springs Creek

## WATERSHED RESTORATION PLAN INFORMATION

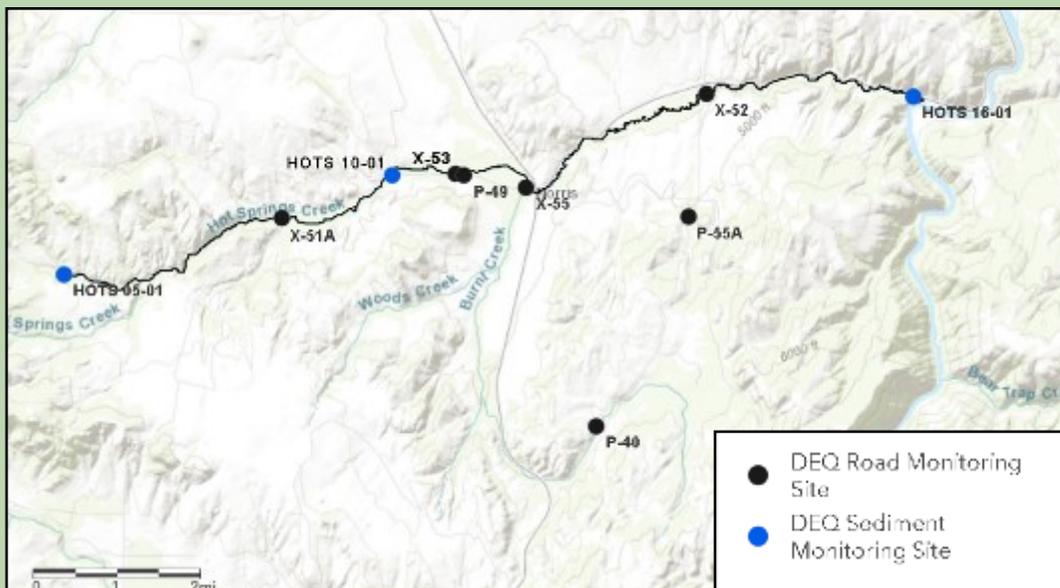
### Hot Springs Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F002\_030

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.6, 5.5	5.6, 5.7.6	5.4.1	9.0, 10.0
Flow Regime Modification	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable

## MONITORING LOCATIONS AND COLLECTED DATA



### Hot Springs Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude <sup>1</sup>	Longitude <sup>1</sup>	Monitoring Parameters
HOTS 05-01 (M06HTSPC05)	DEQ	45.55532	-111.808	Instream fine sediment <sup>1</sup> Instream habitat BEHI Greenline
HOTS 10-01 (M06HTSPC06)	DEQ	45.57259	-111.72612	
HOTS 16-01 (M06HTSPC01)	DEQ	45.58635	-111.59624	
X-51A	DEQ	45.56500	-111.75372	Road crossing
X-52	DEQ	45.58676	-111.64798	Road crossing
X-53	DEQ	45.57280	-111.71042	Road crossing
X-55	DEQ	45.57044	-111.69280	Road crossing
P-40 (Bradley Creek)	DEQ	45.52880	-111.67526	Parallel road segment
P-49 <sup>2</sup>	DEQ	45.57264	-111.70816	Parallel road segment
P-55A <sup>2</sup>	DEQ	45.56533	-111.65250	Parallel road segment

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

<sup>2</sup> P-40 was monitored along Bradley Creek, a tributary to Hot Springs Creek. P-55A was measured along an unnamed tributary to Hot Springs Creek.

# Indian Creek

**Location Description: Lee Metcalf Wilderness boundary to junction of Madison River**

**Impairments: Alterations to Streamside Vegetation, Flow Modification**

**Negatively Affects: Aquatic Life**

## Problem

Irrigation diversions are creating low flow or dewatered conditions in Indian Creek. Additionally, in some locations, the riparian area is lacking healthy vegetation.

## Solutions

Improved grazing management practices will lead to a healthier riparian area and address the “alteration in stream-side or littoral vegetative covers” impairment. Where possible, efforts should be made to increase instream flow when Indian Creek faces severe low flow conditions or runs dry during summer months.

## Potential Restoration Project Locations

The headwaters of Indian Creek form within the Lee-Metcalf Wilderness and see minimal human disturbances. Where the creek leaves the wilderness area, an irrigation diversion exists that sometimes results in all flow being diverted from the creek. Opportunities for conserving instream flow should be pursued for this location.

Indian Creek appears to have mature Cottonwoods providing overstory shade along its entire reach; however, many are dying without young trees to take their place. Periodic flooding is required to generate Cottonwood seedlings, and protection from cattle browse is equally important to allow trees to establish. If flooding is prevented by irrigation withdrawals, this presents another opportunity for discussions of modifying irrigation practices to periodically allow for small floods above the banks of the stream. The DEQ-visited sediment monitoring sites were noted to have good riparian vegetation and minimal/limited human-caused disturbances. However, many locations along the middle reaches of Indian Creek are candidates for improved grazing management practices and revegetation efforts to establish healthier riparian vegetation.



**Lack of healthy streamside vegetation at Indian Creek monitoring site INDN 25-01**



**Indian Creek monitoring site INDN 23-01**



**Healthy streamside vegetation at monitoring site INDN 23-01**

# Indian Creek

## WATERSHED RESTORATION PLAN INFORMATION

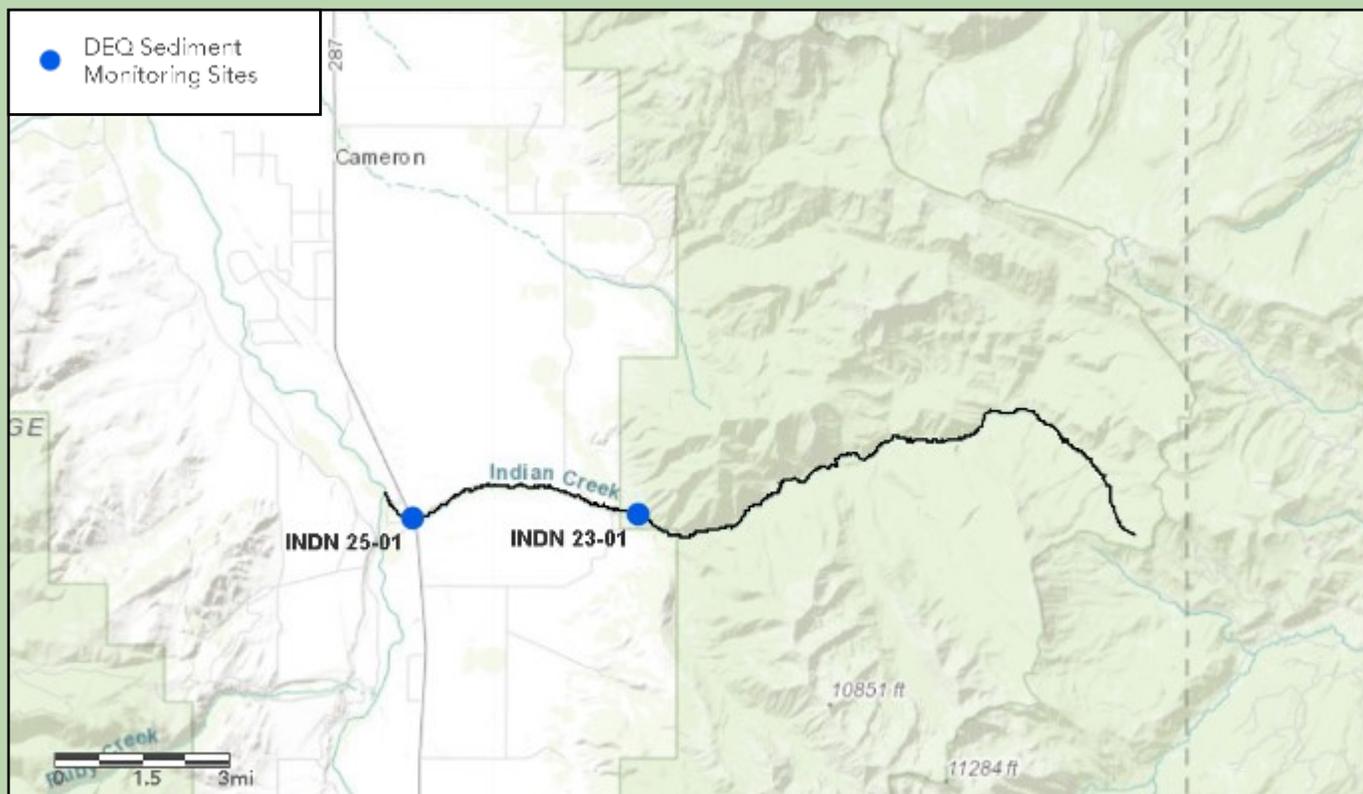
### Indian Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F004\_040

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Alteration in stream-side or littoral vegetative covers	NA	NA	NA	8.0, 9.0, 10.0
Flow Regime Modification	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable

## MONITORING LOCATIONS AND COLLECTED DATA



### Indian Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude <sup>1</sup>	Longitude <sup>1</sup>	Monitoring Parameters
INDN 23-01 (M06INDNC02)	DEQ	45.10407	-111.56902	Instream fine sediment <sup>2</sup> Instream habitat BEHI Greenline
INDN 25-01 (M06INDNC01)	DEQ	45.10349	-111.65027	Instream fine sediment <sup>2</sup> Instream habitat BEHI Greenline

<sup>1</sup> Latitude/longitudes are the downstream end of the sampling site

<sup>2</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# Jack Creek

**Location Description: Headwaters to junction with the Madison River**

**Impairments: Alterations to Streamside Vegetation, Flow Modification**

**Negatively Affects: Aquatic Life**

## Problem

Livestock grazing, eroding streambanks, historical channel manipulation, and new housing construction are all threatening the water quality of Jack Creek. Additionally, unpaved roads are having a moderate influence on Jack Creek, in the form of parallel road segments confining the stream and unpaved road crossings contributing sediment.

## Solutions

Improved grazing management practices within the riparian area, revegetation of native riparian vegetation, attention to implementation of construction stormwater best management practices, and maintaining riparian buffers between the stream and new housing will all lead to improved water quality.

## Potential Restoration Project Locations

Implementation of construction stormwater best management practices, that will limit impacts to Jack Creek in its headwaters, are required by Montana state law for projects greater than one acre in size. The same best management practices should be encouraged for construction projects smaller than one acre. Efforts should be made to maintain riparian buffers for all new home construction anywhere along Jack Creek, as well as for existing irrigated fields. Improved grazing management practices and possibly revegetation of native riparian species in the middle and lower sections of Jack Creek should be evaluated. Obvious sources of sediment from unpaved roads should also be addressed where possible.



**Healthy streamside vegetation at Jack Creek monitoring site JACK 14-06**



**Lack of stabilizing streamside vegetation resulting in an eroding streambank at site JACK 14-03**



**Unhealthy streamside vegetation and an eroding streambank at monitoring site JACK 14-03**

# Jack Creek

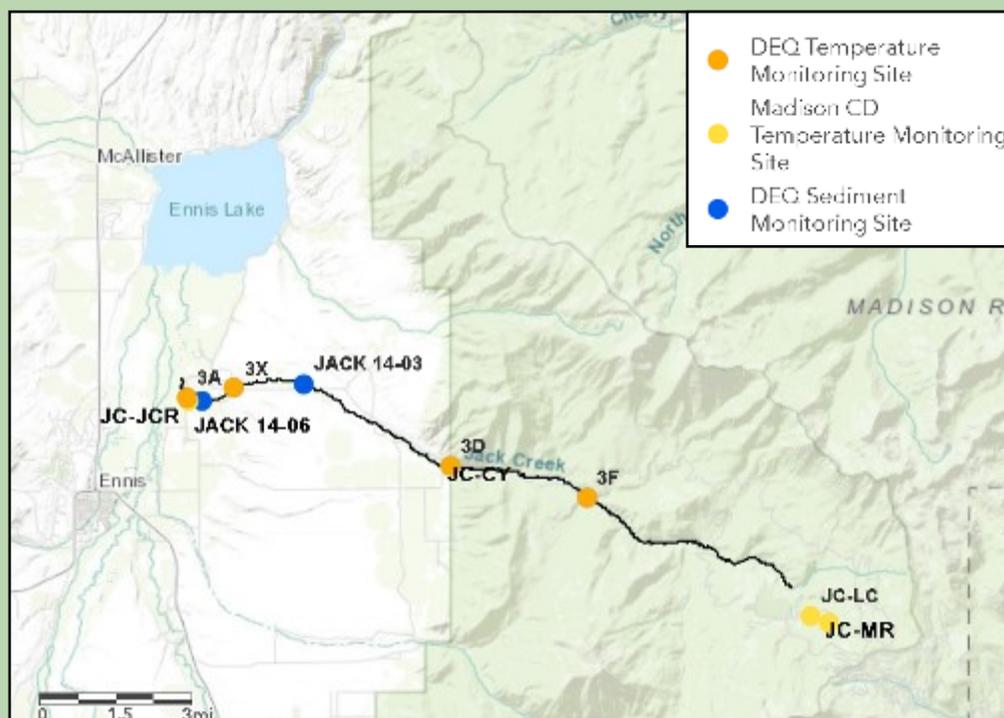
## WATERSHED RESTORATION PLAN INFORMATION

### Jack Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F004\_050

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Alteration in stream-side or littoral vegetative covers	NA	NA	NA	8.0, 9.0, 10.0
Flow Regime Modification	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable



## MONITORING LOCATIONS AND COLLECTED DATA

### Jack Creek Sediment and Temperature Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
JACK 14-03 (M06JACKC06)	DEQ	45.3799	-111.64666	Instream fine sediment <sup>1</sup> Instream habitat BEHI Greenline
JACK 14-06 (M06JACKC05)	DEQ	45.375	-111.6885	
JC-MR	Madison CD	45.31098	-111.43022	Hourly Temperature Flow
JC-LC	Madison CD	45.31318	-111.43758	
JC-CY	Madison CD	45.35646	-111.58602	
JC-JCR	Madison CD	45.37519	-111.69392	
3A (M06JACKC03)	DEQ	45.3762	-111.6948	Temperature data logger Shade Flow Cross section
3D (M06JACKC01)	DEQ	45.3565	-111.5859	
3F (BKK063)	DEQ	45.3472	-111.5299	
3X (M06JACKC04)	DEQ	45.3789	-111.6750	

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# Moore Creek

**Location Description: Springs to junction with Fletcher Channel**

**Impairments: Sediment, Temperature, Alterations to Streamside Vegetation**

**Negatively Affects: Aquatic Life**

## Problem

Riparian grazing is the main contributor of excess fine sediment reaching Moore Creek, with urban encroachment (reduced riparian buffer widths and lack of native riparian vegetation) also affecting the stream where it flows through the town of Ennis. Irrigation diversions and loss of riparian habitat from irrigated cropland are directly influencing elevated stream temperatures in Moore Creek. Residential development around the town of Ennis is also contributing to temperature problems through the replacement of native, woody riparian vegetation with grass lawns that do not provide shade to the stream. In the upper portions of Moore Creek, riparian grazing is diminishing shade-providing riparian vegetation.

## Solutions

Improvements to riparian grazing practices, along with increased buffer widths along irrigated cropland and residential property, will improve sediment and temperature-related water quality problems. Where possible, irrigation diversion efficiencies should be pursued to increase instream flow and reduce stream-canal exchanges/interactions. Additionally, perched culverts that create fish-passage barriers should be addressed, and undersized road culverts should also be replaced.

## Potential Restoration Project Locations

Livestock access to the stream should be limited where possible, in conjunction with improved riparian grazing management practices. Restoration opportunities exist for many small “ranchettes” near the town of Ennis, as well as for small confined feeding operations adjacent to the stream. Directly within the town of Ennis, lawn encroachment (reduced riparian buffer widths) should be discouraged and revegetation opportunities exist for these locations. Additionally, road crossings just upstream of Frieler Creek were noted during DEQ field work as needing improvements.



**An Inadequate streamside buffer between a lawn and Moore Creek**



**Unhealthy streamside vegetation and trampled streambanks resulting from livestock access to Moore Creek**



**Lack of shading streamside vegetation resulting from livestock grazing along Moore Creek**

# Moore Creek

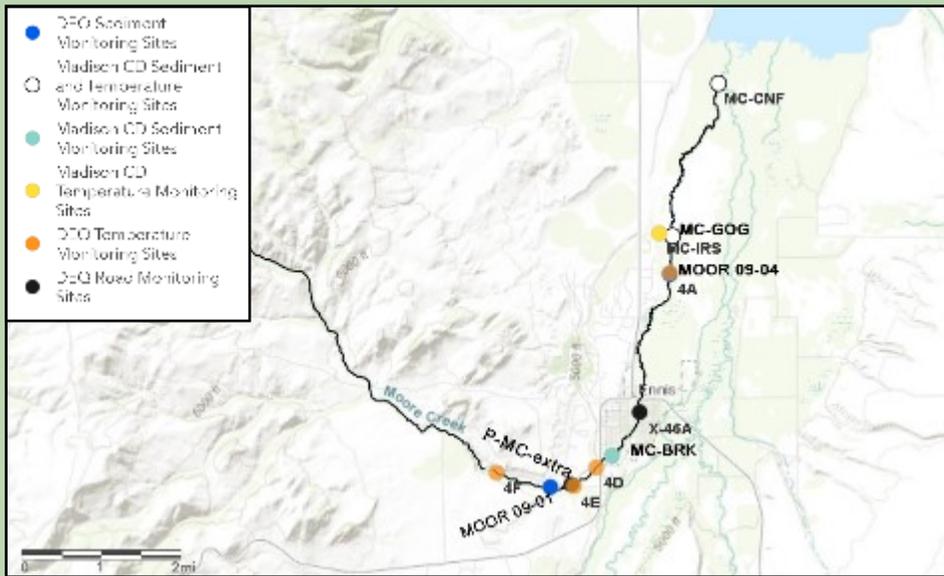
## WATERSHED RESTORATION PLAN INFORMATION

### Moore Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F004\_130

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.7, 5.5	5.6, 5.7.7	5.4.1	9.0, 10.0
Temperature	6.6.1, 6.6.4	6.7, 6.8.3	6.4.1.5, 6.4.2.3	9.0, 10.0
Alteration in stream-side or littoral vegetative covers	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable



## MONITORING LOCATIONS AND COLLECTED DATA

### Moore Creek Sediment and Temperature Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
MOOR 09-01 (M06MOREC09)	DEQ	45.33268	-111.75392	Instream fine sediment <sup>1</sup> Instream habitat
MOOR 09-04 (M06MOREC01)	DEQ	45.37174	-111.72272	BEHI Greenline
MC-BRK	Madison CD	45.338583	-111.737733	Pebble Count
MC-GOG	Madison CD	45.3787	-111.721883	Pebble Count Hourly Temperature Flow
MC-CNF	Madison CD	45.406833	-111.709983	Hourly Temperature Flow
MC-IRS	Madison CD	45.379317	-111.7254	Hourly Temperature Flow
X-46A	DEQ	45.34636	-111.73048	Road crossing
P-MC-extra	DEQ	45.33325	-111.74823	Parallel road segment
4A (M06MOREC01)	DEQ	45.3719	-111.7227	Temperature data logger
4D (M06MOREC02)	DEQ	45.3363	-111.7420	Shade Flow
4E (M06MOREC06)	DEQ	45.3329	-111.7478	Cross section
4F (M06MOREC03)	DEQ	45.3354	-111.7679	

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# North Meadow Creek

**Location Description: Headwaters to junction with Ennis Lake**

**Impairments: Sediment, Flow Modification**

**Negatively Affects: Aquatic Life**

## Problem

Excess fine sediment at the DEQ-monitored sites is linked to streambank erosion generally from riparian grazing, historical channel manipulation, and other human activities.

## Solutions

Reducing streambank erosion, from improvements in riparian zone management practices alone, could eventually result in reducing sediment loading enough to meet water quality standards. However, obvious sediment loading from other sources such as road crossings should also be addressed to further ensure improved stream health.

## Potential Restoration Project Locations

Riparian areas generally appear healthy along the upper reaches of North Meadow Creek (above the lower crossing of Washington Bar Loop Rd). There is a large placer mine disturbance area just above where Washington Creek enters. This does not appear to be a significant source of fine sediment due to the coarse nature of the disturbed material. However, reconnaissance during high flow and/or storm events should be pursued to further evaluate fine sediment loading potential from this area and determine whether any subsequent projects are worthwhile. Between Washington Bar Loop Rd and Ennis Lake, streamside vegetation becomes more sparse, representing potential project areas for riparian grazing management and/or increasing riparian buffers along pastures. There is at least one area of apparent livestock confinement near North Meadow Creek (below N. Meadow Creek Rd) and another near the lower portion of Slim Sam Creek. These could be evaluated as potential sediment reduction project locations. Note that below Highway 287 it is possible that current riparian management is contributing to overly wide stream conditions. There is also a small reach where a housing encroachment may be impacting riparian health below Highway 287.



**Healthy streamside vegetation along an upper reach of North Meadow Creek**



**Lack of stabilizing streamside vegetation resulting in an eroding streambank due to livestock grazing**



**Streamside vegetation conditions along North Meadow Creek**

# North Meadow Creek

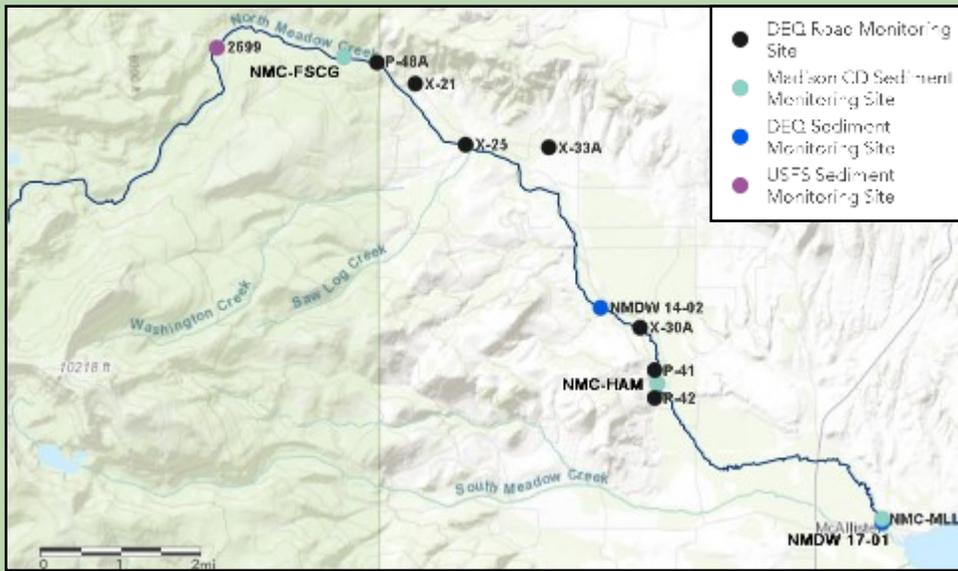
## WATERSHED RESTORATION PLAN INFORMATION

### North Meadow Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F004-060

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.8, 5.5	5.6, 5.7.8	5.4.1	9.0, 10.0
Flow Regime Modification	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable



## MONITORING LOCATIONS AND COLLECTED DATA

### North Meadow Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
NMDW 14-02 (M06NMDWC05)	DEQ	45.48444	-111.78708	Instream fine sediment <sup>1</sup> Instream habitat
NMDW 17-01 (M06NMDWC02)	DEQ	45.44537	-111.71374	BEHI Greenline
2699	USFS	45.531622	-111.886435	Instream fine sediment <sup>1</sup> Instream habitat
NMC-FSCG	Madison CD	45.52977	-111.85362	Pebble counts
NMC-HAM	Madison CD	45.470783	-111.7723	Pebble counts
NMC-MLL	Madison CD	45.4461	-111.713883	Pebble counts
X-21	DEQ	45.52455	-111.83451	Road crossing
X-25	DEQ	45.514	-111.822	Road crossing
X-30A	DEQ	45.48078	-111.77654	Road crossing
X-33A	DEQ	45.51361	111.80033	Road crossing
P-41	DEQ	45.47270	-111.77296	Parallel road segment
P-42	DEQ	45.46797	111.77299	Parallel road segment
P-48A	DEQ	45.52890	-111.84512	Parallel road segment

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# O'Dell Spring Creek

**Location Description: Headwaters to junction with the Madison River**

**Impairments: Alterations to Streamside Vegetation, Physical Substrate Habitat Alterations, Other Alterations**

**Negatively Affects: Aquatic Life**

## Problem

The stream appears over-widened in places and is lacking sufficient woody riparian vegetation in the upper and lower reaches. Riparian grazing is contributing to both issues. Additional data collection is needed to sufficiently assess O'Dell Spring Creek for a sediment impairment determination, as well as additional source assessments to evaluate nonpoint source pollution to the stream.

## Solutions

Improved riparian grazing management practices will lead to improved water quality in O'Dell Spring Creek. The upper reaches have undergone extensive restoration with installation of wetland vegetation and removal of riparian grazing. Although woody vegetation is lacking throughout these reaches, the wetland vegetation is stabilizing streambanks. This area serves as an example of improved stream health due to grazing best management practices and protection of the riparian area.

## Potential Restoration Project Locations

The lower reaches of O'Dell Spring Creek, downstream of the Bear Creek confluence, appear to have opportunity for improved grazing management practices and potentially revegetation of the riparian area.



**Stabilizing wetland vegetation at monitoring site ODEL 02-01**



**Healthy streamside vegetation conditions along O'Dell Spring Creek**



**Healthy streamside vegetation conditions along O'Dell Spring Creek**

# O'Dell Spring Creek

## WATERSHED RESTORATION PLAN INFORMATION

### O'Dell Spring Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F004\_020

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Alteration in stream-side or littoral vegetative covers	NA	NA	NA	8.0, 9.0, 10.0
Other anthropogenic substrate alterations	NA	NA	NA	8.0, 9.0, 10.0
Physical substrate habitat alterations	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable



## MONITORING LOCATIONS AND COLLECTED DATA

O'Dell Spring Creek Sediment Monitoring Locations				
Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
ODEL 02-01 (M06ODELSC04)	DEQ	45.26467	-111.73523	Instream fine sediment <sup>1</sup> Instream habitat BEHI Greenline
OD-RVL	Madison CD	45.34141	-111.71658	Pebble Count
OD-VGR	Madison CD	45.3639	-111.706967	Pebble Count
X-38	DEQ	45.23272	-111.73385	Road crossing

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# Red Canyon Creek

**Location Description: Headwaters to junction with Hebgen Lake**

**Impairments: Sediment, Flow Modification, Alterations to Streamside Vegetation**

**Negatively Affects: Aquatic Life**

## Problem

Existing and historical grazing in the riparian area is the largest contributor of human-caused excess fine sediment in Red Canyon Creek. Unpaved road crossings, segments of road parallel to the stream channel, and dispersed camping (campsites) are also contributing minor amounts of sediment to the stream.

## Solutions

Improved practices for riparian livestock grazing and implementation of sediment-reducing best management practices (BMPs) applicable to roads will both improve the water quality of Red Canyon Creek. Road BMPs should include appropriate sizing of culverts for road crossings and consideration of placement of gravel in the vicinity of road crossings to reduce sediment runoff.

## Potential Restoration Project Locations

The upper and middle reaches of Red Canyon Creek have minimal human influence, except for road crossings and parallel road segments. The lower reaches are experiencing impacts from livestock grazing. BMPs are particularly needed between the Red Canyon Creek Road and Hebgen Creek Road crossings. Riparian fencing has been installed at the lower DEQ monitoring site, RCYN 09-02, which is leading to successful recovery of riparian vegetation and can serve as an example for other projects.



**An undersized culvert at a road crossing along Red Canyon Creek**



**A heavily grazed parcel compared to protected streamside vegetation along Red Canyon Creek**



**An eroding streambank along Red Canyon Creek**

# Red Canyon Creek

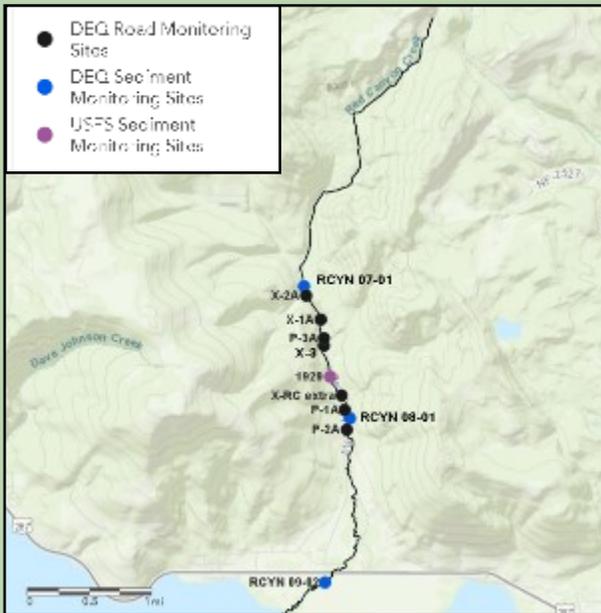
## WATERSHED RESTORATION PLAN INFORMATION

### Red Canyon Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F006\_020

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.9, 5.5	5.6, 5.7.9	5.4.1	9.0, 10.0
Alteration in stream-side or littoral vegetative covers	NA	NA	NA	8.0, 9.0, 10.0
Flow Regime Modification	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable



## MONITORING LOCATIONS AND COLLECTED DATA

### Red Canyon Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
RCYN 07-01 (M06REDCC01)	DEQ	44.83745	-111.20361	Instream fine sediment <sup>1</sup> Instream habitat
RCYN 08-01 (M06REDCC02)	DEQ	44.822	-111.196	BEHI Greenline
RCYN 09-02 (M06REDCC03)	DEQ	44.80277	-111.2002	
1929	USFS	44.826857	-111.199223	Instream fine sediment <sup>1</sup> Instream habitat
X-1A	DEQ	44.83360	-111.20085	Road crossing
X-2A	DEQ	44.83635	-111.20322	Road crossing
X-3	DEQ	44.83060	-111.20030	Road crossing
X-RC extra	DEQ	44.82469	-111.19737	Road crossing
P-1A	DEQ	44.82302	-111.19684	Parallel road segment
P-2A	DEQ	44.82064	-111.19654	Parallel road segment
P-3A	DEQ	44.83137	-111.20030	Parallel road segment

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# Ruby Creek

**Location Description: Headwaters to junction with the Madison River**

**Impairments: Sediment, Flow Modification**

**Negatively Affects: Aquatic Life**

## Problem

Current and historical riparian grazing is the primary human-caused source of excess fine sediment in Ruby Creek. Livestock access to the stream has resulted in trampled streambanks and over-widened sections at access points. An unpaved road was also noted during DEQ field work as having a significant contribution of sediment to the stream near the McAtee Homestead and DEQ monitoring site RUBY 17-01.

## Solutions

Improved riparian grazing management practices are the primary solution to improving water quality in Ruby Creek.

## Potential Restoration Project Locations

The upper portions of Ruby Creek do not appear to have human influences. Beginning with the middle reaches to the lower end of the stream, riparian grazing is contributing to fine sediment via trampled streambanks and livestock crossings.

Decommissioning of the old road near the McAtee Homestead should also be considered to discourage future use and reduce sediment inputs to the stream.



**Sediment erosion from an unpaved road along Ruby Creek**



**Unhealthy streamside vegetation resulting in an eroding streambank along Ruby Creek**



**Unhealthy streamside vegetation and an eroding streambank due to livestock grazing along Ruby Creek**

# Ruby Creek

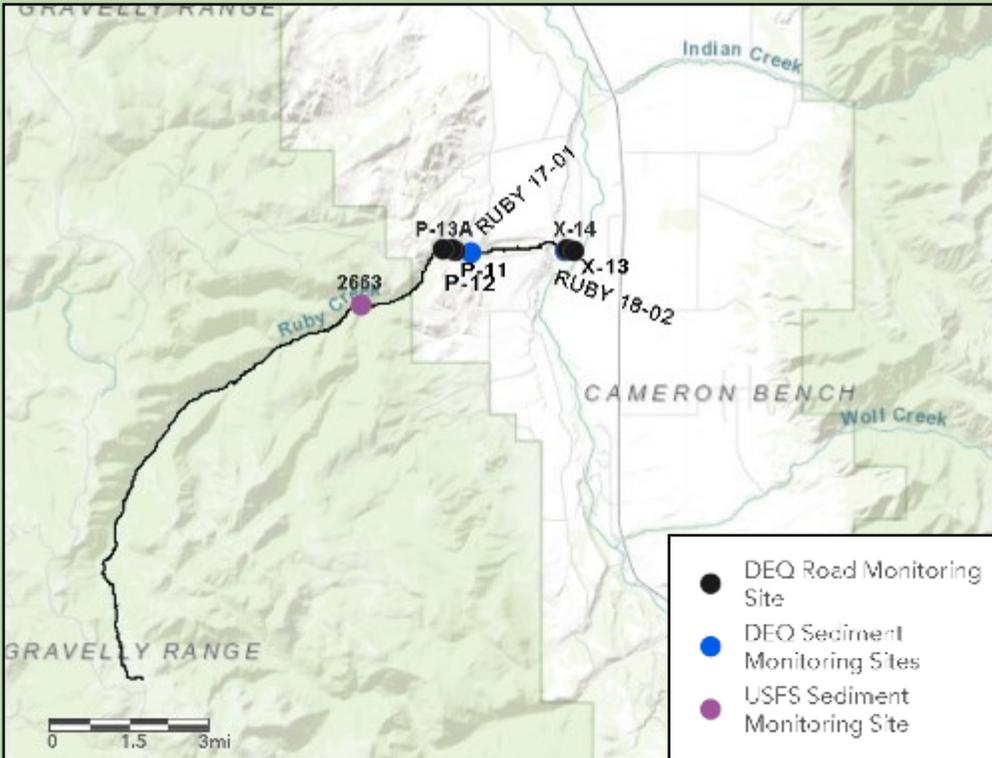
## WATERSHED RESTORATION PLAN INFORMATION

### Ruby Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F004\_080

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.10, 5.5	5.6, 5.7.10	5.4.1	9.0, 10.0
Flow Regime Modification	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable



## MONITORING LOCATIONS AND COLLECTED DATA

### Ruby Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
RUBY 17-01 (M06RUBYC01)	DEQ	45.05908	-111.70643	Instream fine sediment <sup>1</sup> Instream habitat
RUBY 18-02 (M06RUBYC01)	DEQ	45.05962	-111.66905	BEHI Greenline
2663	USFS	45.044516	-111.749673	Instream fine sediment <sup>1</sup> Instream habitat
X-13	DEQ	45.05975	-111.66843	Road crossing
X-14	DEQ	45.05961	-111.66537	Road crossing
P-11	DEQ	45.05943	-111.71209	Parallel road segment
P-12	DEQ	45.05988	-111.71380	Parallel road segment
P-13A	DEQ	45.05970	-111.71690	Parallel road segment

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# South Meadow Creek

**Location Description: Headwaters to junction with Ennis Lake**

**Impairments: Sediment**

**Negatively Affects: Aquatic Life**

## Problem

Riparian grazing, eroding streambanks, and stormwater runoff from unpaved roads is contributing excess fine sediment to South Meadow Creek.

## Solutions

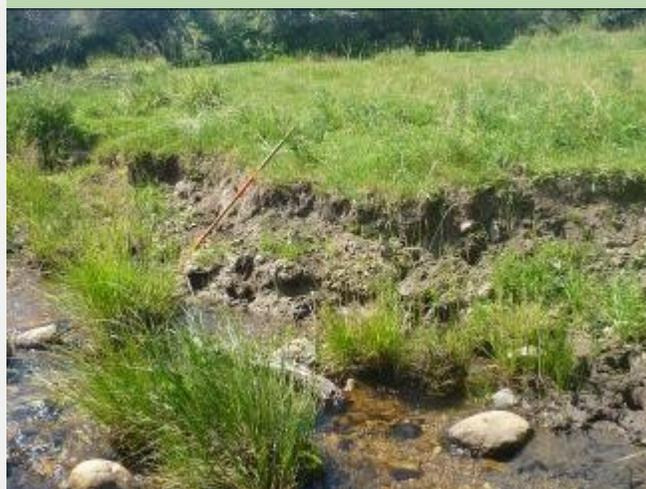
Improved riparian grazing management practices and best management practices to control sediment from adjacent segments of unpaved roads are needed to curb excess fine sediment inputs. Additionally, increasing riparian buffer widths between crop fields and South Meadow Creek will improve the sediment-filtering capacity of streamside vegetation.

## Potential Restoration Project Locations

In the upper headwaters of South Meadow Creek, road crossings and parallel segments of roads may be contributing fine sediment. Further downstream, riparian vegetation is not at desired conditions for protection of streambanks and capacity to filter sediment from reaching the stream, particularly above North Meadow Creek Road. In areas of beaver conflict, discussions should occur of how to support beaver habitat to improve riparian vegetation conditions, while also ensuring efficient agricultural production.



**Over-widened channel conditions due to livestock grazing along South Meadow Creek**



**An eroding streambank and unhealthy streamside vegetation resulting from livestock grazing on South Meadow Creek (site SMDW 18-01)**



**Sediment erosion/runoff from an unpaved road adjacent to South Meadow Creek**

# South Meadow Creek

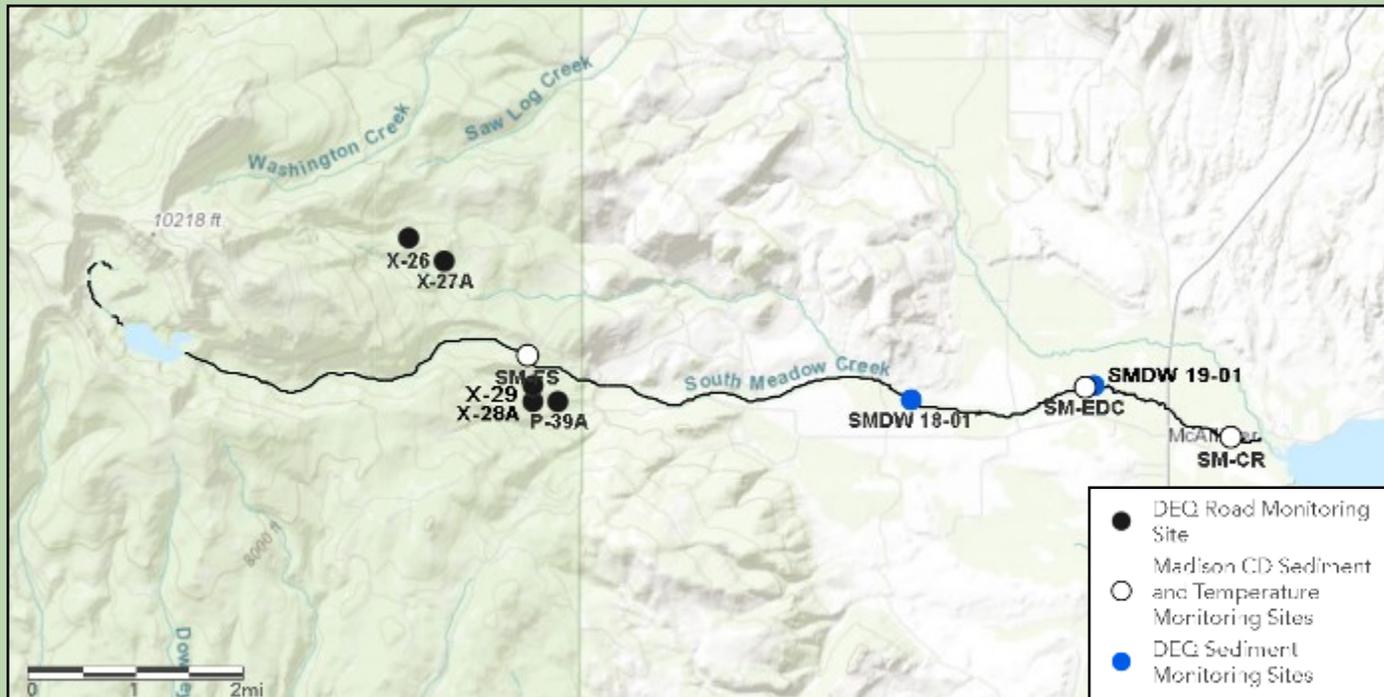
## WATERSHED RESTORATION PLAN INFORMATION

### South Meadow Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F004\_070

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.11, 5.5	5.6, 5.7.11	5.4.1	9.0, 10.0

## MONITORING LOCATIONS AND COLLECTED DATA



### South Meadow Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
SMDW 18-01 (M06SMDWC03)	DEQ	45.44926	-111.78096	Instream fine sediment <sup>1</sup> Instream habitat
SMDW 19-01 (M06SMDWC02)	DEQ	45.45102	-111.74529	BEHI Greenline
SM-FS	Madison CD	45.455117	-111.855	Pebble counts Hourly Temperature Flow
SM-EDC	Madison CD	45.450967	-111.747217	
SM-CR	Madison CD	45.444024	-111.719009	
X-26	DEQ	45.471	-111.878	Road crossing
X-27A	DEQ	45.468	-111.871	Road crossing
X-28A	DEQ	45.449	-111.854	Road crossing
X-29 <sup>2</sup>	DEQ	45.451	-111.854	Road crossing
P-39A	DEQ	45.449	-111.849	Parallel road segment

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

<sup>2</sup> Crossing was on an un-named tributary to South Meadow Creek

# Watkins Creek

**Location Description: Headwaters to junction with Hebgen Lake**

**Impairments: Sediment, Flow Modification, Alterations to Streamside Vegetation**

**Negatively Affects: Aquatic Life**

## Problem

Livestock grazing in the riparian zone is the primary human-caused source of excess fine sediment to Watkins Creek.

## Solutions

Improved riparian grazing management will substantially improve water quality in Watkins Creek. A restoration project at the lower DEQ monitoring site, WATK 14-02 near the mouth, is leading to recovery of the riparian vegetation and reduced streambank erosion; this project included either removal of, or limited, livestock access to the riparian area.

## Potential Restoration Project Locations

The upper reaches of Watkins appear to have minimal human influence. The lower portion of Watkins Creek may have opportunities for improvements to the riparian area, particularly below Forest Service Road 167.



**Streamside vegetation conditions along upper Watkins Creek**



**A trampled streambank due to livestock grazing along Watkins Creek**



**An eroding streambank at monitoring site WATK 12-01**

# Watkins Creek

## WATERSHED RESTORATION PLAN INFORMATION

### Watkins Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F006\_030

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.12, 5.5	5.6, 5.7.12	5.4.1	9.0, 10.0
Alteration in stream-side or littoral vegetative covers	NA	NA	NA	8.0, 9.0, 10.0
Flow Regime Modification	NA	NA	NA	8.0, 9.0, 10.0

NA = not applicable

## MONITORING LOCATIONS AND COLLECTED DATA



### Watkins Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
WATK 12-01 (M06WATKC01)	DEQ	44.78611	-111.30447	Instream fine sediment <sup>1</sup> Instream habitat
WATK 14-02 (M06WATKC02)	DEQ	44.80740	-111.27741	BEHI Greenline
X-4	DEQ	44.79900	-111.28616	Road crossing
X-5	DEQ	44.80581	-111.27857	Road crossing

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# West Fork Madison River

**Location Description: Headwaters to junction with the Madison River**

**Impairments: Temperature**

**Negatively Affects: Aquatic Life**

## Stream Description

Overall, DEQ monitoring sites on the West Fork Madison River and other field observations noted a stable system. Stream health appears to be trending toward recovery, and management of the riparian area is appropriate in most areas. There are some areas of cattle grazing, but are a low percentage of overall stream length. In particular, the reach below the Elk River confluence (and at DEQ monitoring site 25-01) has a few locations with limited riparian vegetation and heavy cattle grazing. Dispersed camping in the lower portions of the watershed have also diminished riparian conditions and the lower reaches of the river experience relatively heavy recreational use from off-road vehicles. Opportunities for riparian improvements exist; however, continuing current land management activities to protect existing beaver complexes in the upper reaches and limit livestock access to the stream will allow the river to fully recover.



**Healthy streamside vegetation in the headwaters of the West Fork Madison River**



**Healthy streamside vegetation along the West Fork Madison River**



**Healthy streamside vegetation along the lower West Fork Madison River**

# West Fork Madison River

## WATERSHED RESTORATION PLAN INFORMATION

The West Fork Madison River is identified as impaired for temperature on the 2020 list of impaired waters; however, a temperature TMDL was not written in the 2020 Madison sediment and temperature TMDL document. This does not preclude including the West Fork Madison River in a watershed restoration plan (WRP) if determined to be a priority by those developing the WRP, as there are opportunities for restoration work (discussed on the previous page).

### West Fork Madison River WRP Elements

Waterbody/Assessment Unit ID: MT41F004\_100

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Temperature <sup>1</sup>	Appendix H	NA <sup>1</sup>	NA <sup>1</sup>	9.0, 10.0

<sup>1</sup> A temperature TMDL was not prepared for West Fork Madison River  
NA = not applicable



An eroding streambank along the upper West Fork Madison River, above Buford Creek



An eroding streambank along the West Fork Madison River at monitoring site WFMA 26-01



Unhealthy streamside vegetation along the lower West Fork Madison River due to livestock grazing



Mix of healthy streamside vegetation and invasive weeds along the lower West Fork Madison River

# West Fork Madison River

Location Description: Headwaters to junction with the Madison River

## MONITORING LOCATIONS AND COLLECTED DATA



# West Fork Madison River

## MONITORING LOCATIONS AND COLLECTED DATA

### West Fork Madison River Sediment and Temperature Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
WFMA 14-02 5P (M06MDWFR09)	DEQ	44.77255	-111.91013	Instream fine sediment <sup>1</sup> Instream habitat BEHI
WFMA 25-01 5E (M06MDWFR03)	DEQ	44.80411	-111.61662	Greenline Temperature data logger Shade Flow
WFMA 26-01 (M06MDWFR05)	DEQ	44.8813	-11.582	Instream fine sediment <sup>1</sup> Instream habitat BEHI Greenline
2740	USFS	44.737981	-746894	Instream fine sediment <sup>1</sup> Instream habitat
WF-FSRD	Madison CD	44.803067	-111.616800	Pebble count
WF-CMP	Madison CD	44.848617	-111.58233	Pebble count
WF-CNF	Madison CD	44.8884	-111.581717	Pebble count
5A (M06MDWFR01)	DEQ	44.8872	-111.5833	Temperature data logger Shade Flow Cross section
5B (M06MDWFR06)	DEQ	44.8853	-111.5821	
5C (M06MDWFR07)	DEQ	44.8632	-111.5816	
5D (M06MDWFR02)	DEQ	44.8490	-111.5813	
5F (M06MDWFR08)	DEQ	44.7986	-111.6195	
5G (M06MDWFR09)	DEQ	44.7917	-111.6295	
5H (M06MDWFR10)	DEQ	44.7888	-111.6331	
5I (M06MDWFR12)	DEQ	44.7875	-111.6402	
5J (M06MDWFR11)	DEQ	44.7854	-111.6428	
5K (M06MDWFR13)	DEQ	44.7812	-111.6490	
5L (M06MDWFR14)	DEQ	44.7812	-111.6513	
5M (M06MDWFR15)	DEQ	44.7698	-111.6532	
5N (M06MDWFR16)	DEQ	44.7697	-111.65556	
5X (M06MDWFR18)	DEQ	44.7944	-111.9287	
5Y (M06MDWFR17)	DEQ	44.8002	-111.9148	
Freezeout Creek <sup>2</sup> 8A	DEQ	44.7983	-111.6198	
Teepee Creek <sup>2</sup> 10A	DEQ	44.7698	-111.6550	
Lake Creek <sup>2</sup> 12A	DEQ	44.8544	-111.5789	

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

<sup>2</sup> Freezeout, Teepee, and Lake creeks are tributaries to the West Fork Madison River and were included to evaluate tributary temperature effects on the River, as were Gazelle Creek and the Elk River.

# Wigwam Creek

**Location Description: Headwaters to junction with the Madison River**

**Impairments: Sediment**

**Negatively Affects: Aquatic Life**

## Problem

Excess fine sediment in Wigwam Creek is primarily linked to livestock grazing within the riparian area. Impacts from livestock corrals and road crossings were also observed during DEQ field work.

## Solutions

Improved grazing management practices within the riparian area, such as limiting livestock access to the creek, may reduce sediment inputs enough to attain sediment water quality standards. Additionally, obvious sources of sediment from road crossings, such as undersized culverts, should be addressed.

## Potential Restoration Project Locations

Key recommendations for restoration and protection of Wigwam Creek include grazing management best management practices and riparian fencing in some of the most sensitive areas to promote healthy riparian vegetation. The most impacted areas appear to be the lower third of the stream below Bar 7 Lane and particularly in the Gravelly Range Road vicinity.



**Recovering vegetation along Wigwam Creek at monitoring site WGWM 08-01**



**Unhealthy streamside vegetation and over-widened channel conditions from livestock grazing along Wigwam Creek (site WGWM 18-01)**



**Unhealthy streamside vegetation and an eroding streambank due to livestock access to Wigwam Creek**

# Wigwam Creek

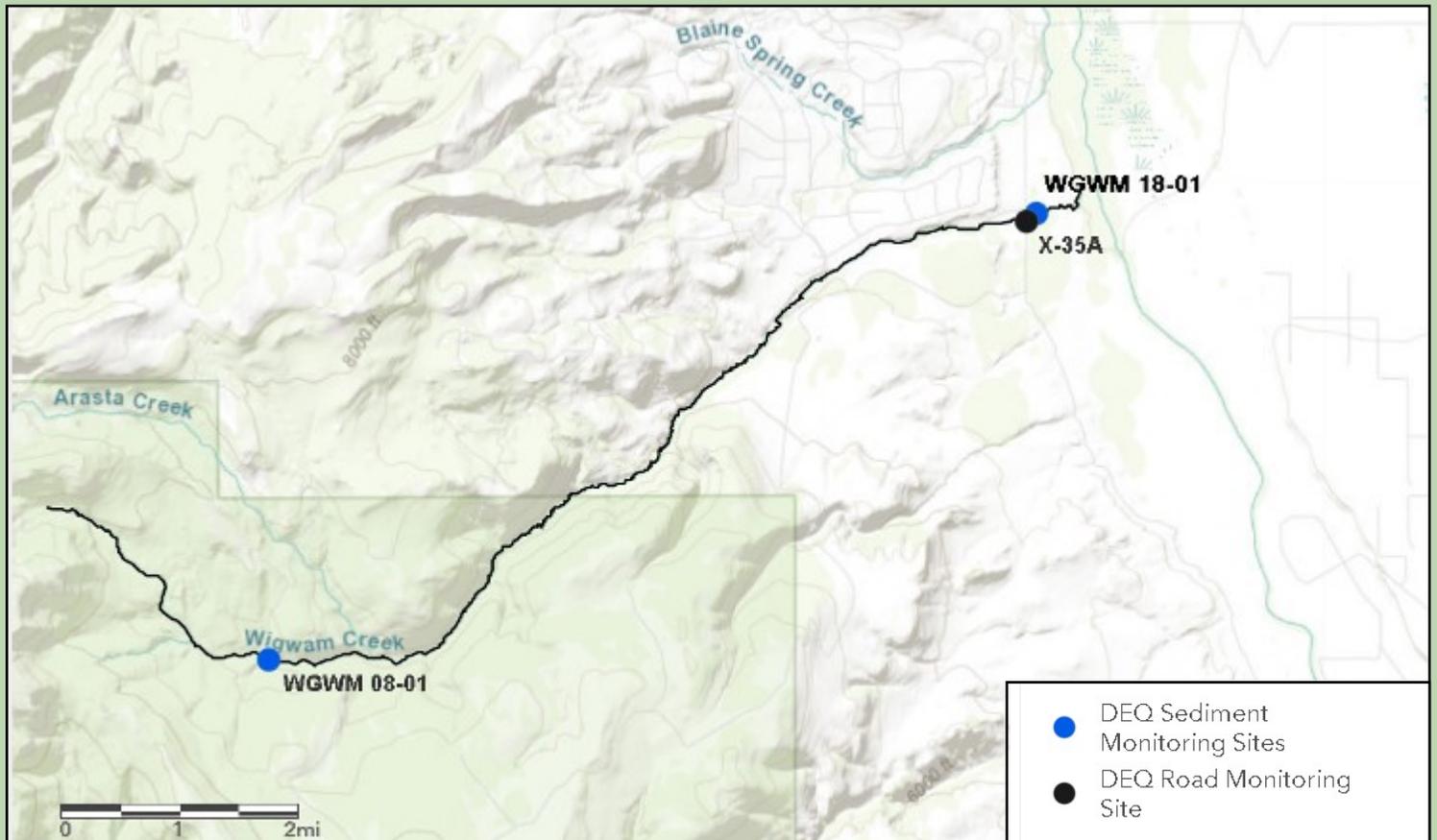
## WATERSHED RESTORATION PLAN INFORMATION

### Wigwam Creek WRP Elements

Waterbody/Assessment Unit ID: MT41F004\_160

Impairments Addressed in TMDL Document	Applicable Document Section(s)			
	Source Assessment	Load Reductions	Targets	Water Quality Improvement Practices & Monitoring Plan
Sedimentation – Siltation	5.4.3.13, 5.5	5.6, 5.7.13	5.4.1	9.0, 10.0

## MONITORING LOCATIONS AND COLLECTED DATA



### Watkins Creek Sediment Monitoring Locations

Site ID	Collection Entity	Latitude	Longitude	Monitoring Parameters
WGWM 08-01 (M06WIGWC01)	DEQ	45.15383	-111.89382	Instream fine sediment <sup>1</sup> Instream habitat
WGWM 18-01 (M06WIGWC02)	DEQ	45.2092	-111.759	BEHI Greenline
X-35A	DEQ	45.208	-111.761	Road crossing

<sup>1</sup> Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

# Important Notes for Watershed Restoration Plan Development

## **Deciding What Waterbodies to Include in a WRP**

It is up to the local watershed restoration plan (WRP) developer to determine what streams to include in their WRP. The summaries provided here for streams addressed in the 2020 Madison TMDL document with either a sediment and/or temperature TMDL, or with a discussion of a sediment- or temperature-related non-pollutant impairment, contain a table of the elements needed for inclusion in a WRP. Summaries are also provided for streams that were sampled by DEQ, but were determined not to be impaired for sediment or temperature. Since these latter streams are not addressed in the 2020 Madison sediment and temperature TMDL document, a table of WRP elements is not provided. Even though these streams are not determined to be impaired, they too can be included in a watershed restoration plan if determined to be a priority by those developing the WRP. Likewise, streams not monitored by DEQ can also be candidates for inclusion in a WRP.

It is also important to consider protection of streams that are fully functioning and supporting all their beneficial uses (i.e., meeting water quality standards) when evaluating areas for restoration projects. Protecting a stream from degradation can be just as important as restoring a stream that is already degraded. It is equally important to recognize existing land management practices that are improving water quality, as they serve as examples of proven methods to implement elsewhere in the watershed.

## **Determining Goals, Objectives, and Milestones**

The water quality targets and load reductions given in the Madison sediment and temperature TMDL document provide the basis for determining whether a waterbody is achieving water quality standards, which are part of the criteria for setting goals and objectives within the WRP. Keep in mind that milestones, however, should be small and achievable through individual restoration projects.

## **Understanding Sediment Loads Provided in the TMDL Document for Eroding Streambanks and Unpaved Roads**

The sediment loads presented in the Madison sediment and temperature TMDL document represent relative loading estimates for each source category (streambank erosion, unpaved roads, and upland erosion) based on separate modeling efforts, and should therefore not be compared against one another. For example, streambank erosion loads are calculated for the entire length of the stream, whereas fine sediment from unpaved roads (roads made of gravel or native material) is not calculated based on stream length, but instead the number of locations where a road crosses or runs parallel to the stream channel. Unpaved roads may seem like an insignificant source of sediment loading; however, they may have localized impacts that should be addressed. These relative loading estimates are intended to provide the basis for percent reduction in loads that can be accomplished via improved land management practices for each source category.

## **Addressing Temperature Impairments**

It is more important that restoration efforts for the Cherry Creek, Elk Creek, and Moore Creek temperature impairments focus on improvements to riparian vegetation and shade than actual water temperatures. The water quality targets provided in the 2020 Madison sediment and temperature TMDL document are based on riparian shade, channel geometry (width/depth), and instream flow conditions.

## **Addressing Flow Alteration Impairments**

Loss of flow is a water quality problem due to negative impacts on aquatic life, particularly fish. Networks of irrigation ditches exists throughout the Madison TMDL Planning Area, and irrigation withdrawal and return management should be considered during watershed restoration plan development. Possible approaches to irrigation efficiency improvements that would ultimately result in increased stream flow should be considered, when and where appropriate. Section 8.2 of Part 3 of the 2020 Madison sediment and temperature TMDL document further discusses flow regime modifications. The identification of flow regime modification as a probable cause of impairment, related to probable sources of agriculture and irrigated crop production, should not be construed to divest, impair, or diminish a water right. Instead, it should be considered an opportunity to characterize the impacts of flow alterations, and pursue solutions that can result in improved streamflows during critical periods, while at the same time ensuring no harm to water rights.

# Glossary of Water Quality Terminology

<b>Term</b>	<b>Definition or Description</b>
<b>Anthropogenic</b>	Human-caused, or human-influenced. Water quality pollution originating from human activity.
<b>Aquatic Life</b>	Fish and aquatic bugs (macroinvertebrates)
<b>Beneficial Use(s)</b>	Beneficial uses, or designated uses, are simply the ways that we use water, and are the uses of water that we protect with water quality standards. They may include support of drinking water, recreation, fish and aquatic life, agricultural uses, and industrial uses. All surface waters in Montana are classified with, or assigned, a group of beneficial uses they must support, based on the potential of the waterbody to support those uses.
<b>Best Management Practice (BMP)</b>	Appropriate management practices designed and implemented for a specific purpose and include management methods as well as actual physical structures. In the case of water quality, BMPs are practices designed to protect or improve the physical, chemical, or biological characteristics of surface water and groundwater resources.
<b>Buffer</b>	Also referred to as a “riparian buffer” or “buffer strip.” In the context of this document, a buffer is a strip of vegetation that filters pollutants from entering the water. It can also be defined as the distance between a waterbody and the adjacent uplands, which includes the riparian area/zone.
<b>Habitat, Instream or Aquatic</b>	Fish habitat within a waterbody (stream channel, lake, or reservoir).
<b>Habitat, Streamside or Riparian</b>	Wildlife habitat adjacent to a waterbody (stream channel, lake, or reservoir) and within the riparian zone.

# Glossary of Water Quality Terminology

<b>Term</b>	<b>Definition or Description</b>
<b>Hummocking</b>	Formation of grass mounds in a knob-like shape due to livestock access to soft ground in the riparian area or in a wetland. The mounds of grass or wetland vegetation are typically surrounded by bare soil.
<b>Impaired</b>	An unhealthy water or waterbody for which water quality data shows that the waterbody is failing to achieve compliance with applicable water quality standards and is not fully supporting one or more of its designated beneficial uses. DEQ maintains a list of impaired waters.
<b>Nonpoint Source Pollution</b>	Polluted runoff that comes from a variety of land-use activities. Common nonpoint source pollutants include sediment (dirt), nutrients (nitrogen and phosphorus), water temperature changes, metals, pesticides, pathogens, and salinity (salt). Nonpoint source pollution is the largest contributor of water quality problems in Montana, when compared to point sources of pollution in the state.
<b>Non-Pollutant</b>	Non-pollutants are human-induced alterations in the health of a water and have a harmful effect on any living thing that drinks or uses or lives in the water. For example, a human-induced alteration is the removal of streamside vegetation that results in the alteration of aquatic and wildlife habitat in and along the stream, which may subsequently increase stream temperatures and negatively affect the shape of the stream channel.

# Glossary of Water Quality Terminology

<b>Term</b>	<b>Definition or Description</b>
<b>Pollutant</b>	A pollutant is any substance that is introduced into a water, naturally or by human activities, that adversely affects the water quality for a specific use. Common water pollutants include nutrients (nitrogen and phosphorus), sediment (dirt), pathogens, temperature, and metals (e.g., aluminum, arsenic,
<b>Riparian</b>	Riparian areas are typically vegetated zones along a waterbody and are usually transitional areas between the waterbody and upland habitat. Riparian areas have one or both of the following characteristics: <ul style="list-style-type: none"><li>• Distinctly different vegetative species than adjacent areas</li><li>• Species similar to adjacent areas but exhibiting more vigorous or robust growth forms</li></ul>
<b>Stormwater</b>	Snowmelt and rainfall that does not infiltrate into the ground and runs off the land; also referred to as runoff or overland flow.
<b>Total Maximum Daily Load (TMDL)</b>	The maximum amount of a pollutant that a stream or waterbody can receive and still meet water quality standards. Think of it as a pollution diet or pollution budget. Section 4.0 the Madison sediment and temperature TMDL document
<b>Upland</b>	Land outside of the riparian zone, usually higher than, or elevated above, the riparian.

# Glossary of Water Quality Terminology

<b>Term</b>	<b>Definition or Description</b>
<b>Waterbody</b>	A water; a stream, creek, river, lake, or reservoir. Also referred to as an assessment unit for water quality impairment assessments/determinations, which can be the full length, or partial segment of the length or area, of a waterbody.
<b>Watershed</b>	A geographic area drained by a river or stream; also referred to as a drainage basin, which is any area of land where precipitation collects and drains into a common outlet, such as into a river, bay, or other body of water.
<b>Wetland</b>	Wetlands are transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. Wetlands are typically defined as those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils.
<b>Width / Depth Ratio</b>	A number calculated by dividing the width of a stream channel by the depth of the stream channel, which is measured along what is called a cross-section or transect.