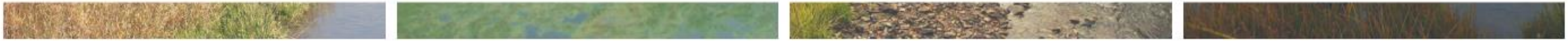
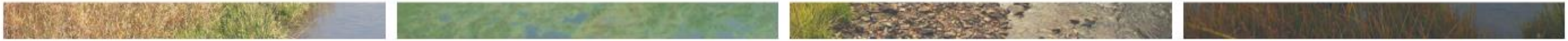
IMPLEMENTABLE TMDLS



Kristy Fortman | Montana DEQ

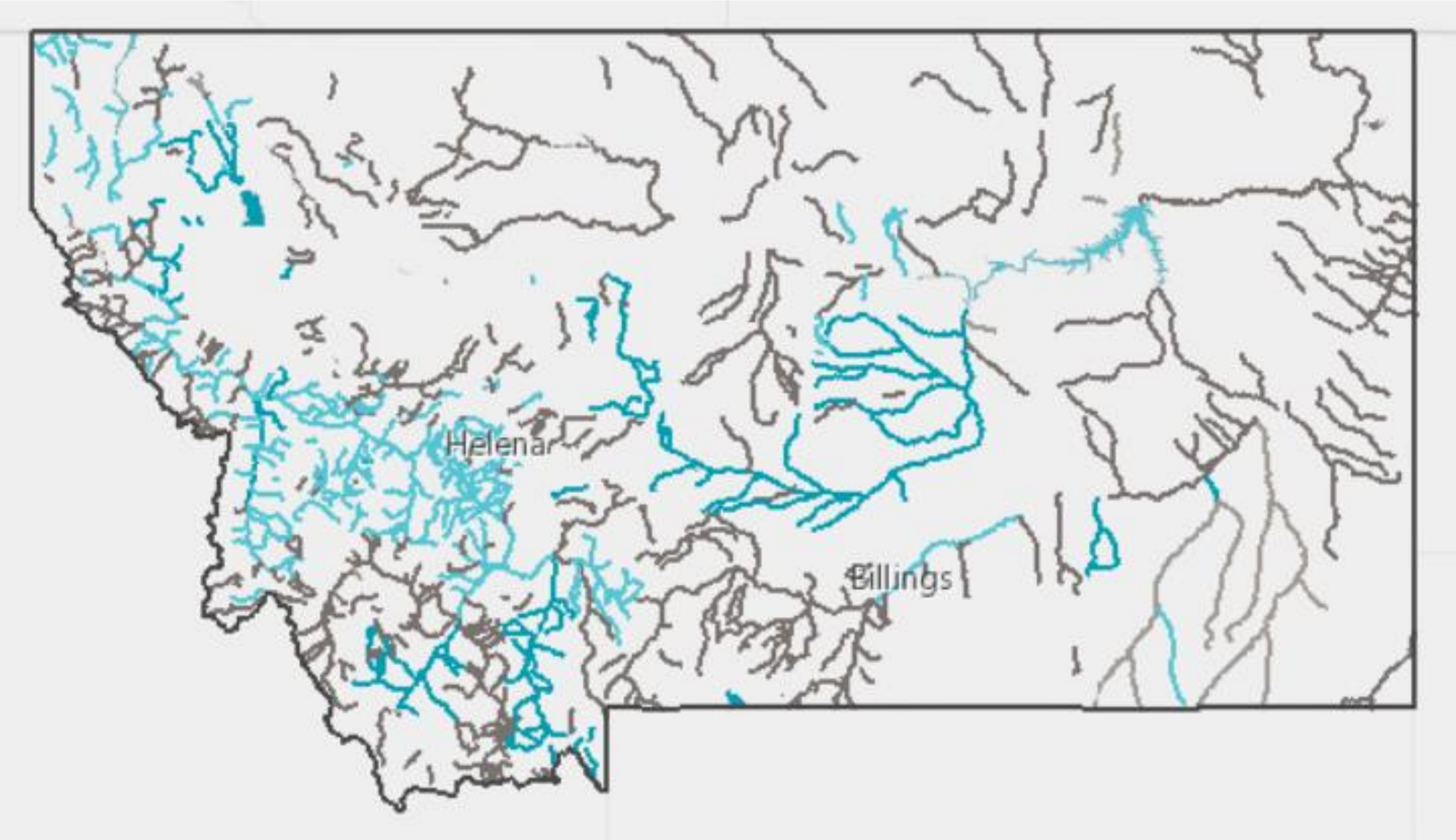
2020 NATIONAL CWA 303(d) TRAINING WORKSHOP

IMPLEMENTABLE TMDLS



- TMDL Development | context and stakeholder involvement
- Creating Better Products | for stakeholders and public
- Project Implementation | focusing resources
- Project Follow-Up | what’s working?

Completed Assessments



Legend

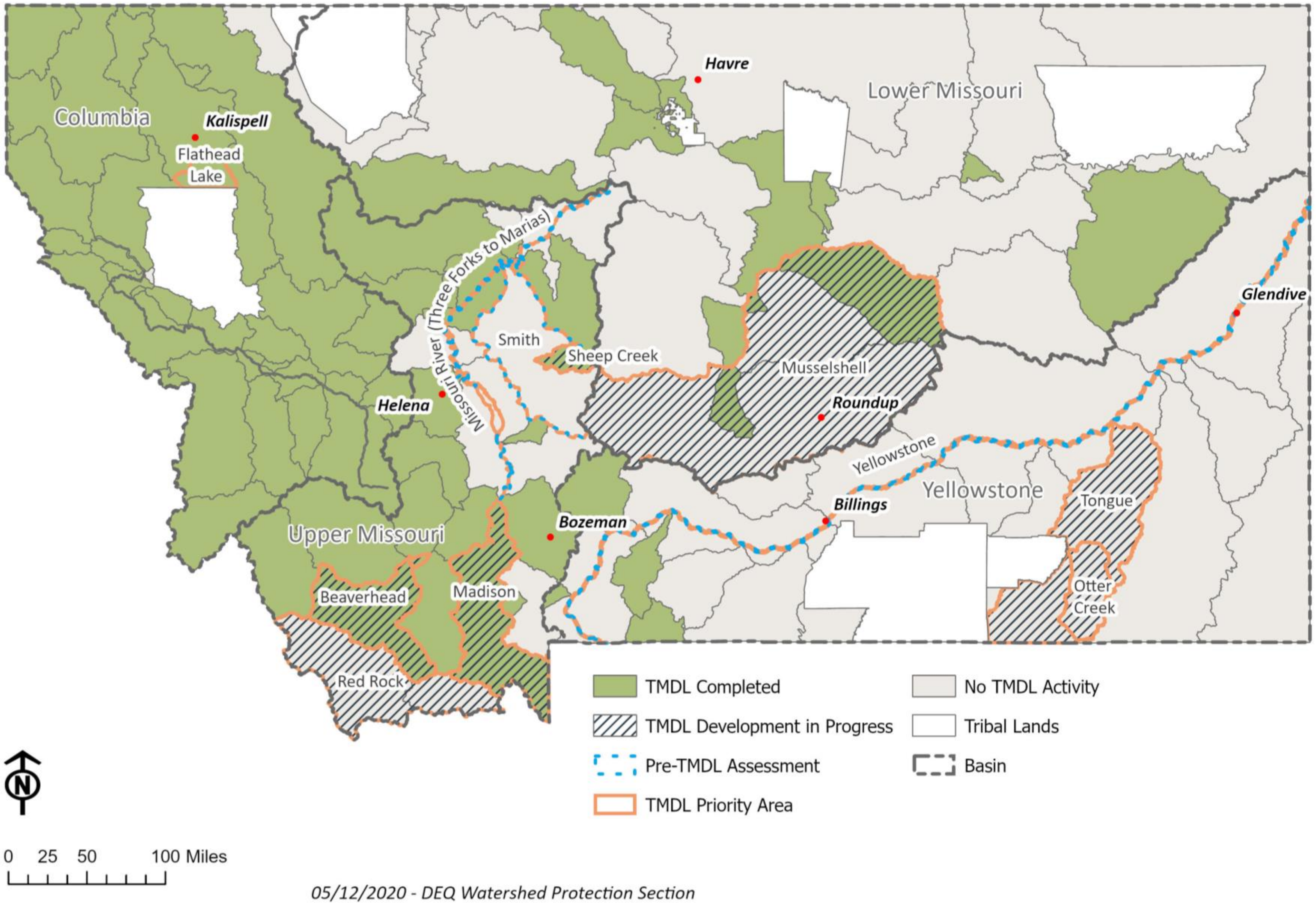
Completed Assessments

DEQ's Water Quality Monitoring and Assessment Section assesses whether state waters meet water quality standards and support beneficial uses.

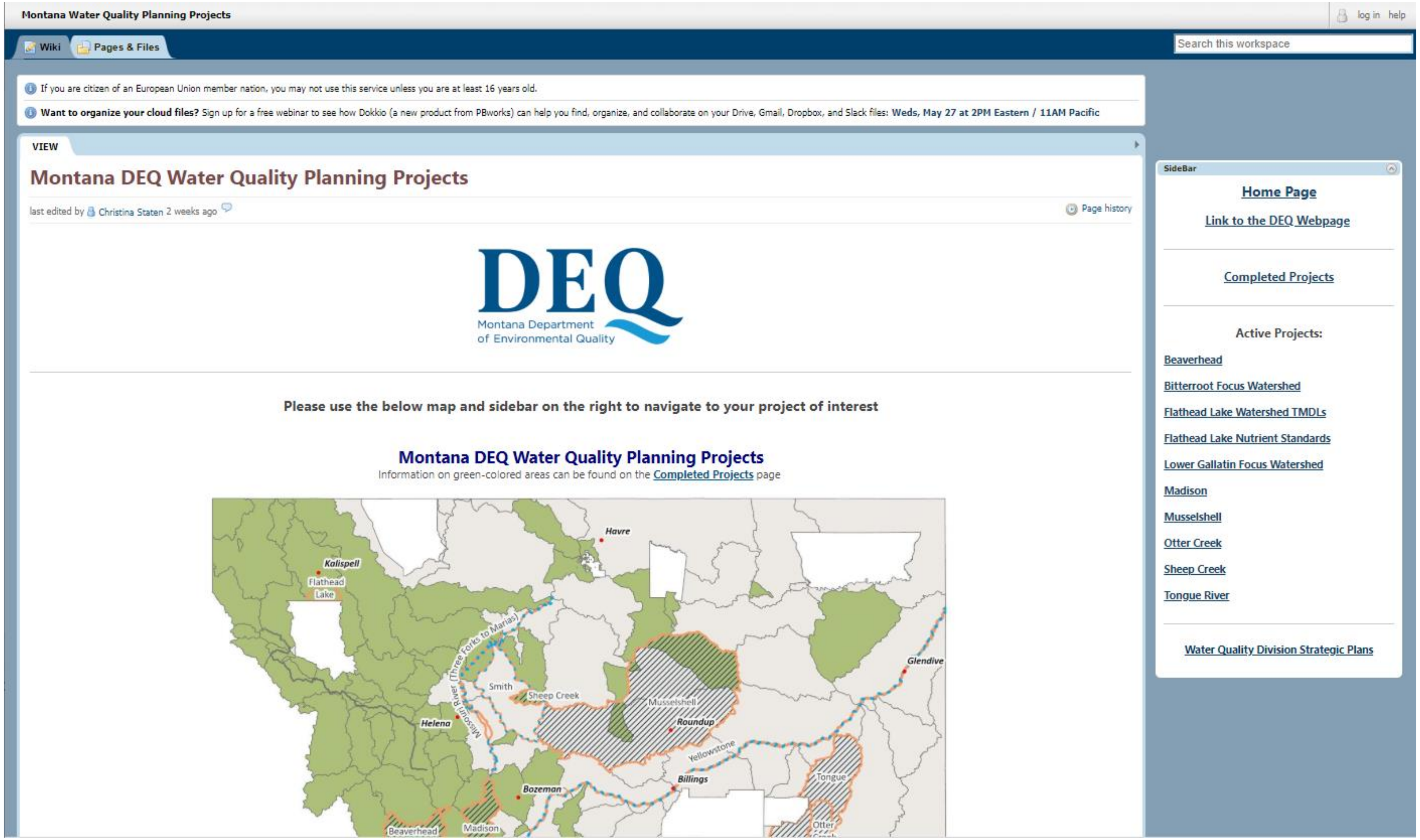
Streams and Lakes Assessed

- > 2014 - 2018
- > 2010 - 2014
- > 2006 - 2010
- 2002 - 2006

TMDL Development Status



TMDL Stakeholder Involvement



TMDL Wiki for Projects in Development

Madison River Watershed

last edited by Christina Staten 4 months ago   Page history

Madison TMDL Development Homepage   **Madison Project Outreach**

Page Contents:

Madison Project Area Location

The Madison River originates in Yellowstone National Park in Wyoming at the confluence of the Gibbon and Firehole rivers, and flows to its confluence with the Gallatin and Jefferson rivers in Three Forks, Montana to form the Missouri River. The Madison Total Maximum Daily Load (TMDL) Project Area, however, does not include the portion of the watershed within Yellowstone National Park and Wyoming. The project area includes the watersheds of the tributary streams draining directly to the Madison River and encompasses approximately 2,583 square miles (1,653,311 acres). The project area is in western Montana, and includes portions of Madison and Gallatin counties (Figure 1).

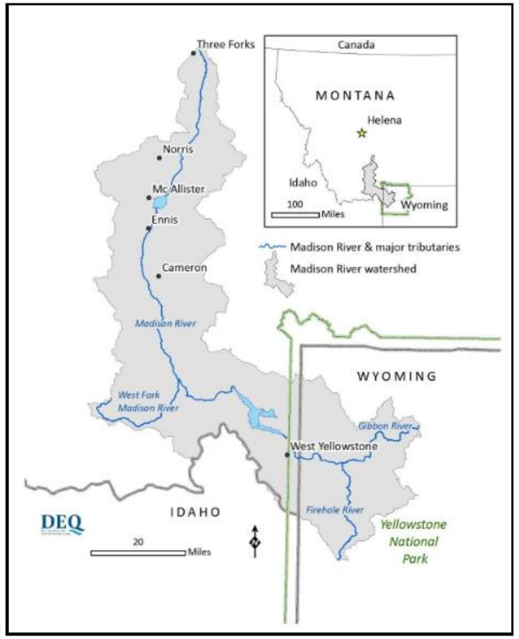


Figure 1: Location of the Madison River Watershed

(click on map to enlarge)

TMDL Documents Under Development

Montana DEQ is currently drafting a document containing sediment and temperature TMDLs for tributaries of the Madison River. The below tabl

Impairments to be Addressed in a Madison Sediment & Temperature TMDL Document

Montana's Clean Water Act Information Center details the pollutant and non-pollutant impairments for each stream, accessed at: cwaic.mt.gov

Waterbody & Location Description	Assessment Unit ID	Sediment Impairment	Temperature Impairment	Non-Pollutant Impairment[1]
Antelope Creek, Headwaters to mouth (Cliff Lake)	MT41F004_140	X		X
Bear Creek, Headwaters to mouth (O'Dell Spring Creek)	MT41F004_021	X		
Blaine Spring Creek, Headwaters to mouth (Madison River, T7S R1W S6)	MT41F004_010	X		X
Cherry Creek, Headwaters to mouth (Madison River)	MT41F002_010	X	X	
Elk Creek, Headwaters to mouth (Madison River)	MT41F002_020	X	X	X
Hot Springs Creek, Headwaters to mouth (Madison River)	MT41F002_030	X		X
Indian Creek, Lee Metcalf Wilderness boundary to mouth (Madison River)	MT41F004_040			X
Jack Creek, Headwaters to mouth (Madison River, T5S R1W S23)	MT41F004_050			X
Moore Creek, Springs to mouth (Fletcher Channel), T5S R1W S15	MT41F004_130	X	X	X
North Meadow Creek, Headwaters to mouth (Ennis Lake)	MT41F004_060	X		X
Red Canyon Creek, Headwaters to mouth (Hebgen Lake)	MT41F006_020	X		X
Ruby Creek, Headwaters to mouth (Madison River)	MT41F004_080	X		X
South Meadow Creek, Headwaters to mouth (Ennis Lake)	MT41F004_070	X		
Watkins Creek, Headwaters to mouth (Hebgen Lake)	MT41F006_030	X		X
Wigwam Creek, Headwaters to mouth (Madison River)	MT41F004_160	X		

"X" = pollutant impairment will have a TMDL included in the document (sediment and/or temperature) or non-pollutant impairment will be discussed in the document

1. Non-Pollutant Impairments include altered habitat or flow impairments related to sediment and temperature pollutant impairments

TMDL Documents

DEQ
Montana Department of Environmental Quality

Madison Nutrient, *E. coli*, and Metal TMDLs and Water Quality Improvement Plan

February 2019

Steve Bullock, Governor
Shaun McGrath, Director DEQ

Document Number M06-TMDL-01aF

Document Summary

This document presents total maximum daily loads (TMDLs) and a water quality improvement plan for five impaired tributaries of the Madison River including: Elk Creek, Hot Springs Creek, Moore Creek, O'Dell Spring Creek, and South Meadow Creek.

The Montana Department of Environmental Quality (DEQ) develops TMDLs and submits them to the U.S. Environmental Protection Agency (EPA) for approval. The Montana Water Quality Act requires 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 state-designated beneficial uses.

The Madison TMDL Planning Area (TPA) follows the mainstem of the Madison River from the Wyoming border near West Yellowstone to the river's mouth near Three Forks, encompassing approximately 2,583 square miles (1,653,311 acres) and includes the watersheds of tributary streams draining directly to the Madison River. The planning area includes portions of Madison and Gallatin counties (**Figure 1-1**).

DEQ determined that five tributaries of the Madison River do not meet the applicable water quality standards for nutrients, *E. coli* and metals, and 15 TMDLs are included in this document (**Table DS-1**) that address 16 pollutant impairments. Although DEQ recognizes that there are other pollutant listings for this planning area, this document addresses only nutrient, *E. coli* and metals pollutant impairments.

Nutrients

Nine nutrient TMDLs are provided for five streams in the Madison TPA (**Table DS-1**), addressing the following pollutant and non-pollutant impairments: nitrate/nitrite, total nitrogen and total phosphorus in Elk Creek; total nitrogen and total phosphorus in Hot Springs Creek; total nitrogen and total phosphorus in Moore Creek; total nitrogen in O'Dell Spring Creek; and total nitrogen, total phosphorus, and chlorophyll-*a* in South Meadow Creek.

Nutrient and/or biological data in these streams indicate nutrients are present in concentrations that can cause algal growth that harms recreation and aquatic life beneficial uses. Water quality restoration goals for nutrients are based on Montana's numeric nutrient criteria, measures of algal growth/density, and biological metrics for macroinvertebrates and periphyton. DEQ's water quality assessment methods for nutrient impairment are designed to evaluate the most sensitive use, thus ensuring protection of all designated uses. For streams in western Montana, the most sensitive uses assessed for nutrients are aquatic life and primary contact recreation.

Nutrient loading in the Madison TPA is attributable to two source categories: natural sources such as local geology and the effects of natural events such as flooding and wildland fires; and human-caused nonpoint sources dispersed across the landscape from agriculture, residential development and subsurface wastewater disposal and treatment, historical mining, and timber harvest. Total nitrogen reductions needed to meet the TMDLs range from 0 to 57%; total phosphorus reductions needed range from 0 to 72%. Implementing the recommended best management practices for nonpoint sources identified in this plan are anticipated to achieve the reduction goals and meet the TMDLs.

1.0 Project Overview

This document presents an analysis of water quality information and establishes total maximum daily loads (TMDLs) for nutrient, *Escherichia coli* (*E. coli*), and metals problems in the Madison TMDL Planning Area (TPA). This document also presents a general framework for resolving these problems. **Figure 1-1** shows a map of the Madison River watershed; the TMDL planning area, however, only encompasses the portion of the watershed within the state of Montana.

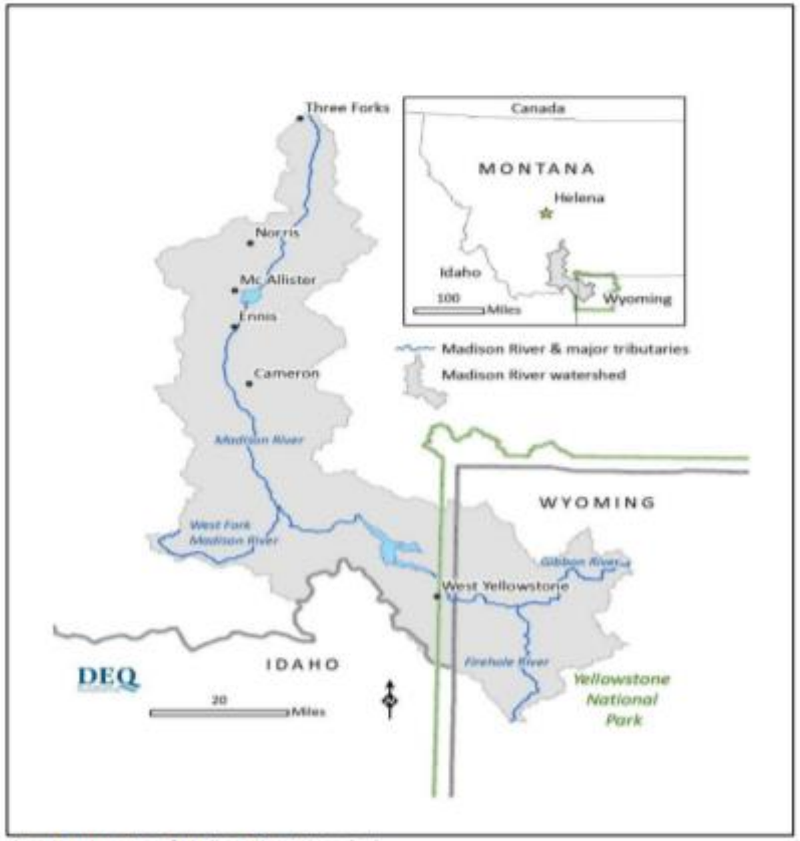


Figure 1-1. Location of Madison River Watershed

2.0 Madison TMDL Planning Area Description

This section describes the physical, ecological, and social characteristics of the Madison TMDL Planning Area, which encompasses the portion of the Madison River watershed within the state of Montana. These descriptions provide a context for the more detailed pollutant source assessments presented in **Sections 5.0 – 7.0**.

2.1 Physical Characteristics

The following information describes the physical geography of the planning area. This includes location, climate, hydrology, and geology.

2.1.5 Geology and Soils

The TMDL planning area is large and the geology is varied (**Figure 2-5**). Bedrock is dominated by Precambrian metamorphic rocks, with significant areas of Paleozoic and Mesozoic sedimentary rocks. Upstream of the planning area, in Wyoming, the watershed headwaters are underlain by mainly rhyolitic volcanic rocks of the Yellowstone caldera.

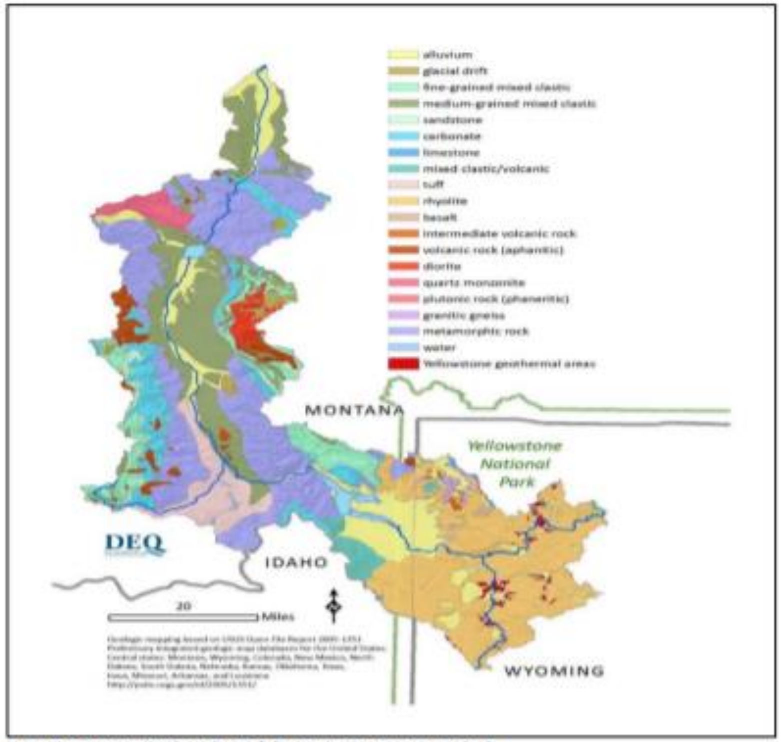


Figure 2-5. Generalized Geology of the Madison River Watershed

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 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 prohibitions against water quality degradation as well as point source permitting and other water quality protection requirements. That being said, Montana's nondegradation provisions are not applicable to the TMDLs developed within this document because of the impaired nature of the streams addressed.

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 Montana Code Annotated (MCA)), Montana's Surface Water Quality Standards and Procedures (Administrative Rules of Montana (ARM) 17.30.601-670), Circular DEQ-7, Montana Numeric Water Quality Standards (Montana Department of Environmental Quality 2017), and Circular DEQ-12A, Montana Base Numeric Nutrient Standards (Montana Department of Environmental Quality 2014).

3.1 Stream Classifications and Designated Beneficial Uses

Stream classification is the assignment (designation) of a single group of uses to a waterbody based on the potential of the waterbody to support those uses. Designated uses, or beneficial uses, are simple narrative descriptions of water quality expectations or water quality goals. All Montana waters are classified for multiple uses. All streams and lakes within the Madison TMDL Planning Area are classified as B-1 (ARM 17.30.623). In accordance with ARM 17.30.623, waters classified as B-1 are to be maintained suitable for:

- Culinary and food processing purposes after conventional treatment (Drinking Water)
- Bathing, swimming, and recreation (Primary Contact Recreation)
- Growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers (Aquatic Life)
- Agricultural and industrial water supply

While some of the waterbodies might not actually be used for a designated use (e.g., drinking water supply), their water quality still must be maintained suitable for that designated use. DEQ's water quality assessment methods are designed to evaluate the most sensitive uses for each pollutant group addressed within this document, thus ensuring protection of all designated uses (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau, 2011). For streams in western Montana, the most sensitive use assessed for nutrients is aquatic life and primary contact recreation, and for metals is drinking water and/or aquatic life. For the Madison TPA, primary contact recreation is the most sensitive use assessed for *E. coli*. DEQ determined that five

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 above 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., changes in pollutant loading during the year, or seasonal water quality standards).

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.

5.0 Nutrient TMDL Components

This portion of the document focuses on nutrients as a cause of water quality impairment in the Madison TMDL Planning Area. It describes: (1) how excess nutrients impair beneficial uses, (2) the affected stream segments (waterbodies), (3) the currently available data pertaining to nutrient impairments in the watershed, (4) the identification of nutrient targets and the comparison of those targets to the affected stream segments, (5) the nutrient TMDLs, (6) the sources of nutrients based on recent studies, (7) source allocations for each TMDL, and (8) the seasonality and margin of safety for the TMDLs.

5.1 Effects of Excess Nutrients on Beneficial Uses

Nitrogen and phosphorus are naturally occurring elements required for healthy functioning of aquatic ecosystems. Streams are dynamic systems that depend on a balance of nutrients, which can enter streams from various sources. Healthy streams strike a balance between organic and inorganic nutrients from sources such as natural erosion, groundwater discharge, and instream biological decomposition. This balance relies on autotrophic organisms (e.g., algae) to consume excess nutrients and on the cycling of biologically fixed nitrogen and phosphorus into higher levels on the food chain, as well as on nutrient decomposition (e.g., changing organic nutrients into inorganic forms). Human influences may alter nutrient cycling, damaging biological stream function and degrading water quality. The effects on streams of total nitrogen (TN), nitrate and nitrite (NO_3+NO_2; a component of TN), and total phosphorus (TP) are all considered in assessing the effects on beneficial uses.

Excess nitrogen in the form of dissolved ammonia (which is typically associated with wastewater) can be toxic to fish and other aquatic life. Excess nitrogen in the form of nitrate in drinking water can inhibit normal hemoglobin function in infants. In addition, excess nitrogen and phosphorus from human sources can cause excess algal growth, which in turn depletes the supply of dissolved oxygen, killing fish and other aquatic life. Excess nutrient concentrations in surface water can create nuisance algae blooms including blue-green algae blooms (Priscu 1987), which can produce toxins lethal to aquatic life, wildlife, livestock, and humans. Aside from the toxicity effects of blue-green algae, nuisance algae can reduce water clarity and shift the structure of macroinvertebrate communities, which may also negatively affect the fish that feed on macroinvertebrates (U.S. Environmental Protection Agency 2010). Additionally, changes in water clarity, fish communities, and aesthetics can harm recreational uses, such as fishing, swimming, and boating (Suplee et al. 2009). Nuisance algae can also increase the cost of treating drinking water or pose health risks if ingested in drinking water (World Health Organization 2003). Where instream nutrient concentrations are grossly elevated over naturally occurring concentrations, net primary production may lead to anoxic conditions in the water column. Under redox conditions, some sediment-bound metals may be released into the water column further impairing water quality.

5.2 Stream Segments of Concern

The nutrient impaired stream segments of concern for the Madison TMDL Planning Area are based on the 2016 Integrated Report, and are shown in **Figure 5-1**. These include six different streams with 13 differing types of nutrient impairment as identified within **Table 5-1** (Montana Department of Environmental Quality, Water Quality Division, Water Quality Planning Bureau 2016).

8.0 Water Quality Improvement Plan

8.1 Purpose of Improvement Strategy

This section describes an overall strategy and specific on-the-ground measures designed to restore water quality beneficial uses and attain water quality standards in Madison TPA streams. The strategy includes general measures for reducing loading from each identified significant pollutant source.

This section should assist stakeholders in developing a watershed restoration plan (WRP) that will provide more detailed information about restoration goals within the watershed. The WRP may also encompass broader goals than the water quality improvement strategy outlined in this document. The intent of the WRP is to serve as a locally organized "road map" for watershed activities, prioritizing types of projects, sequences of projects, and funding sources towards achieving local watershed goals. Within the WRP, local stakeholders identify and prioritize streams, tasks, resources, and schedules for applying best management practices (BMPs). As restoration experiences and results are assessed through watershed monitoring, this strategy could be adapted and revised by stakeholders based on new information and ongoing improvements.

8.2 Role of DEQ, Other Agencies, and Stakeholders

The Montana Department of Environmental Quality (DEQ) does not implement TMDL pollutant-reduction projects for nonpoint source activities, but may provide technical and financial assistance for stakeholders interested in improving their water quality. Successful implementation of TMDL pollutant-reduction projects requires collaboration among private landowners, land management agencies, and other stakeholders. DEQ will work with participants to use the TMDLs as a basis for developing locally-driven WRPs, administer funding specifically to help support water quality improvement and pollution prevention projects, and help identify other sources of funding.

Because most nonpoint source reductions rely on voluntary measures, it is important that local landowners, watershed organizations, and resource managers work collaboratively with local and state agencies to achieve water quality restoration goals and to meet TMDL targets and load reductions. Specific stakeholders and agencies that will likely be vital to restoration efforts for streams discussed in this document include:

- Madison Conservation District
- Gallatin County Conservation District
- U.S. Forest Service (USFS)
- Natural Resources and Conservation Service (NRCS)
- U.S. Fish & Wildlife Service (USFWS)
- U.S. Environmental Protection Agency (EPA)
- Montana Department of Natural Resources and Conservation (DNRC)
- Montana Fish, Wildlife & Parks (FWP)
- Montana Department of Environmental Quality (DEQ)

Other organizations and non-profits that may provide assistance through technical expertise, funding, educational outreach, or other means include:

- Montana Trout Unlimited
- U.S. Army Corp of Engineers

9.0 Monitoring for Effectiveness

9.1 Monitoring Purpose

The monitoring strategies discussed in this section are an important component of watershed restoration, and a requirement of TMDL implementation under the Montana Water Quality Act (75-5-703(7), MCA), and the foundation of the adaptive management approach. Water quality targets and allocations presented in this document are based on available data at the time of analysis. The scale of the watershed analysis, coupled with constraints on time and resources, often result in necessary compromises that include estimations, extrapolation, and a level of uncertainty in TMDLs. The margin of safety (MOS) (**Section 4.0**) is put in place to reflect some of this uncertainty, but other issues only become apparent when restoration strategies are underway. Having a monitoring strategy in place allows for feedback on the effectiveness of restoration activities, the amount of reduction of instream pollutants (whether TMDL targets are being met), if all significant sources have been identified, and whether attainment of TMDL targets is feasible. Data from long-term monitoring programs also provide technical justifications to modify restoration strategies, targets, or allocations where appropriate.

The monitoring strategy presented in this section provides a starting point for the development of more detailed planning efforts regarding monitoring needs; it does not assign monitoring responsibility. Monitoring recommendations provided are intended to assist local land managers, stakeholder groups, and federal and state agencies in developing appropriate monitoring plans to meet the water quality improvement goals outlined in this document. Funding for future monitoring is uncertain and can vary with economic and political changes. Prioritizing monitoring activities depends on funding opportunities and stakeholder priorities for restoration. Once restoration measures have been implemented for a waterbody with an approved TMDL and given time to take effect, DEQ will conduct a formal evaluation of the waterbody's impairment status and whether TMDL targets and water quality standards are being met.

9.2 Adaptive Management and Uncertainty

In accordance with the Montana Water Quality Act (75-5-703 (7) and (9), MCA), DEQ is required to assess the waters for which TMDLs have been completed and restoration measures, or best management practices (BMPs), have been applied to determine whether compliance with water quality standards has been attained. This aligns with an adaptive management approach that is incorporated into DEQ's assessment and water quality impairment determination process.

Adaptive management as discussed throughout this document is a systematic approach for improving resource management by learning from management outcomes, and allows for flexible decision making. There is an inherent amount of uncertainty involved in the TMDL process, including: establishing water quality targets, calculating existing pollutant loads and necessary load allocations, and determining effects of BMP implementation. Use of an adaptive management approach based on continued monitoring of project implementation helps manage resource commitments as well as achieve success in meeting the water quality standards and supporting all water quality beneficial uses. This approach further allows for adjustments to restoration goals, TMDLs, and/or allocations, as necessary.

For an in-depth look at the adaptive management approach, view the U.S. Department of the Interior's Technical Guide and description of the process at:

255 Pages!!

10.0 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 (Montana Code Annotated (MCA) 75-5-703 and 75-5-704) which directs the Department of Environmental Quality (DEQ) to consult with a watershed advisory group and local conservation districts during the TMDL development process. Technical advisors, 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 Madison TMDL Planning Area.

10.1 Participants and Roles

During completion of the nutrient, *E. coli*, and metals TMDLs in this document, 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 TMDLs 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 (see **Section 1.1**), and EPA has developed guidance and programs to assist states in that regard. EPA has provided funding and technical assistance to Montana's overall TMDL program and is responsible for reviewing and e[...]g TMDLs to see that they meet all federal requirements.

Conservation Districts
DEQ consulted with the Madison and Gallatin County conservation di[...]cts during [...]ment of the TMDLs in this document, which included opportunities to prov[...]nt during th[...]us stage[...] TMDL development and an opportunity for participation [...] advisory gr[...] below.

Madison TMDL Planning Area TMDL Watershed Advis[...]up
The Madison TMDL Planning [...]rshed Adv[...]roup [...]elected resource professionals who posses[...]er quality[...] Madison River watershed, and represe[...]erest grou[...]ed to partici[...] and work with DEQ in a[...]sory capac[...]ontana sta[...]w (75-5-703 a[...]DEQ req[...] participation from the in[...]rest groups de[...]75-5-704 MCA and included lo[...]and county representatives; livestock-oriented and f[...]oriented agriculture represen[...]conservation groups; watershed groups; the hydroele[...]ustry; state and federal la[...]ment agencies; and representatives of fishing, recreation, a[...]sm interests. The[...]so included additional

Appendix A – Surface Water Nutrient, *E. coli*, and Metal Data for the Madison TMDL Planning Area

List of Tables

Appendix B – Method for Estimating A[...]ation of Nutrients from Septic Systems Mod[...]sults (ME[...]s) for the Madison TMDL Planning Area

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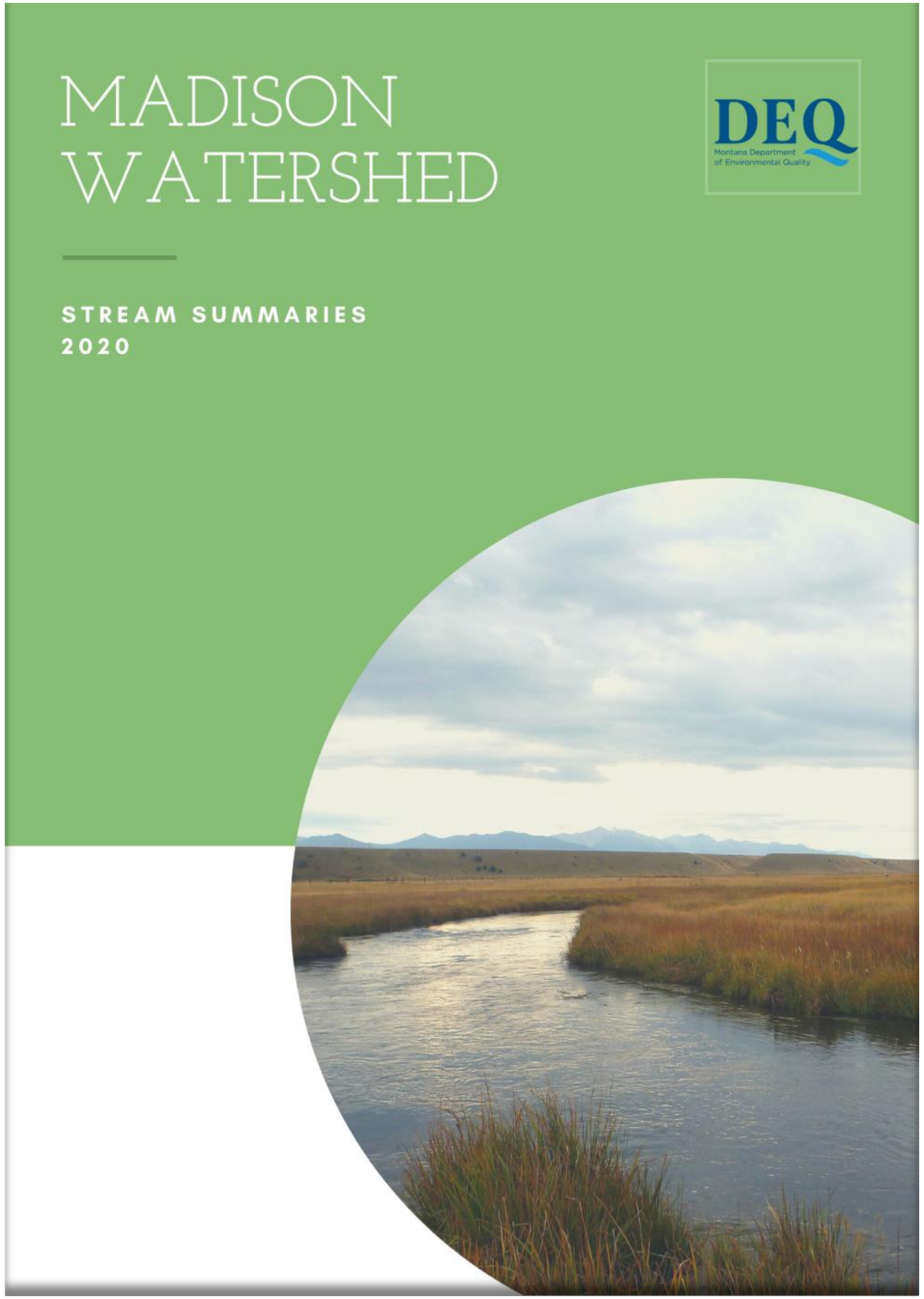
Stream Summaries



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

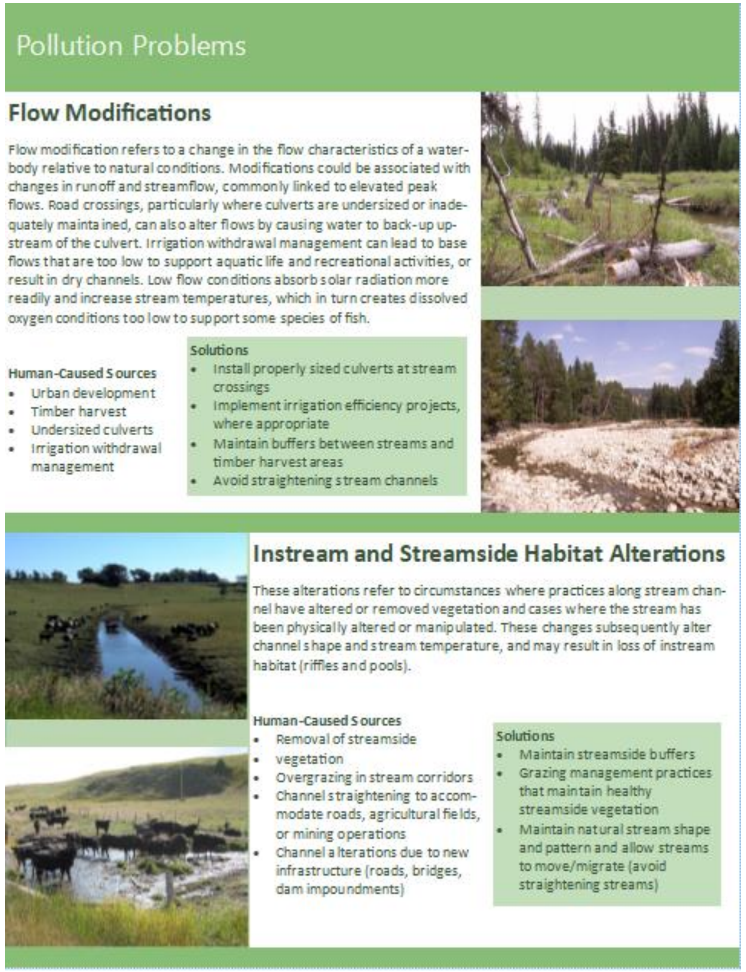
Montana's western streams naturally run cold and support trout fisheries. Increased stream temperatures from solar radiation or human additions of heated water threaten the health of fish by reducing dissolved oxygen, and increases amounts of algae growing in the stream that further reduces available 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 Alteration, 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.

A trampled stream bank from cattle access at monitoring site ATLP 04-02

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.

Healthy riparian vegetation along Antelope Creek

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.

Monitoring location 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

Legend

Sediment, Bank Erosion, and Greenline Sites

Study Stream

Antelope Creek Sediment Monitoring Locations

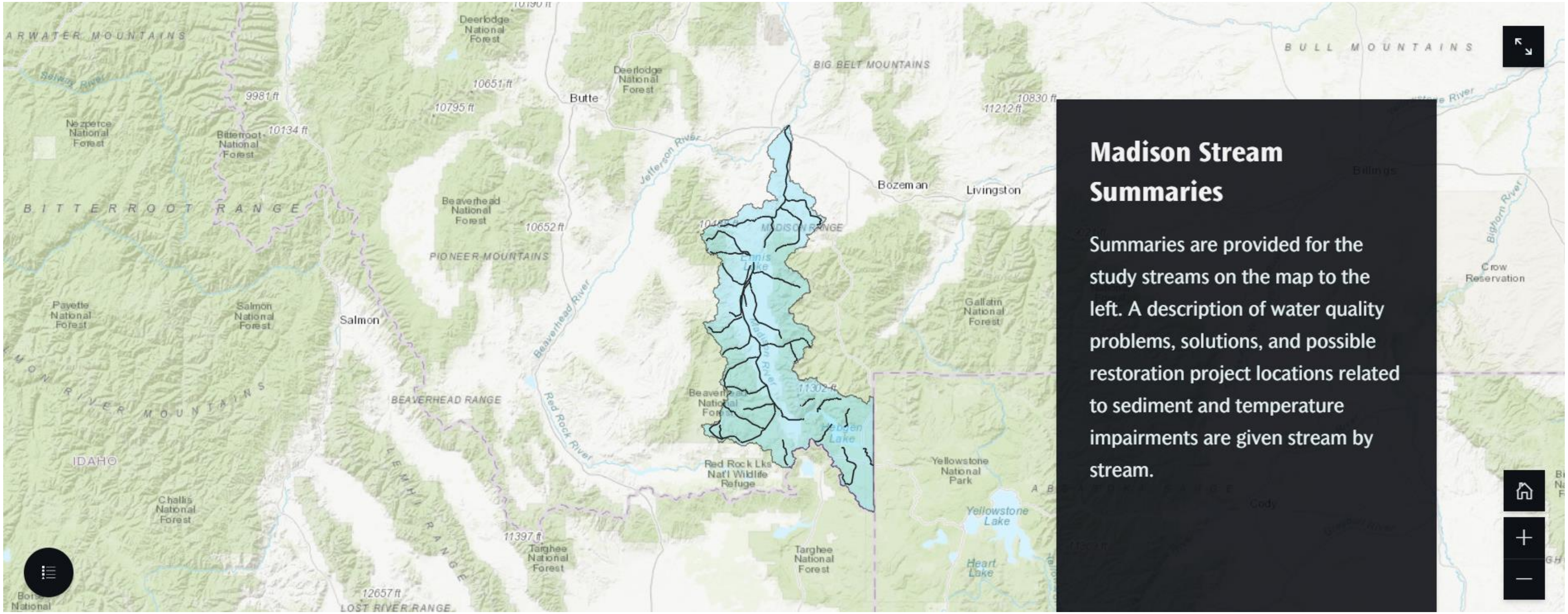
Site ID	Collection Entity	Latitude[1]	Longitude[1]	Monitoring Parameters
ATLP 04-02 (M06ANTLC02)	DEQ	44.68141	-111.52829	Instream fine sediment[2] Instream habitat BEHI Greenline
ATLP 10-01 (M06ANTLC02)	DEQ	44.74677	-111.53753	Instream fine sediment[2] Instream habitat BEHI Greenline

[1] Latitude/longitudes are the downstream end of the sampling site

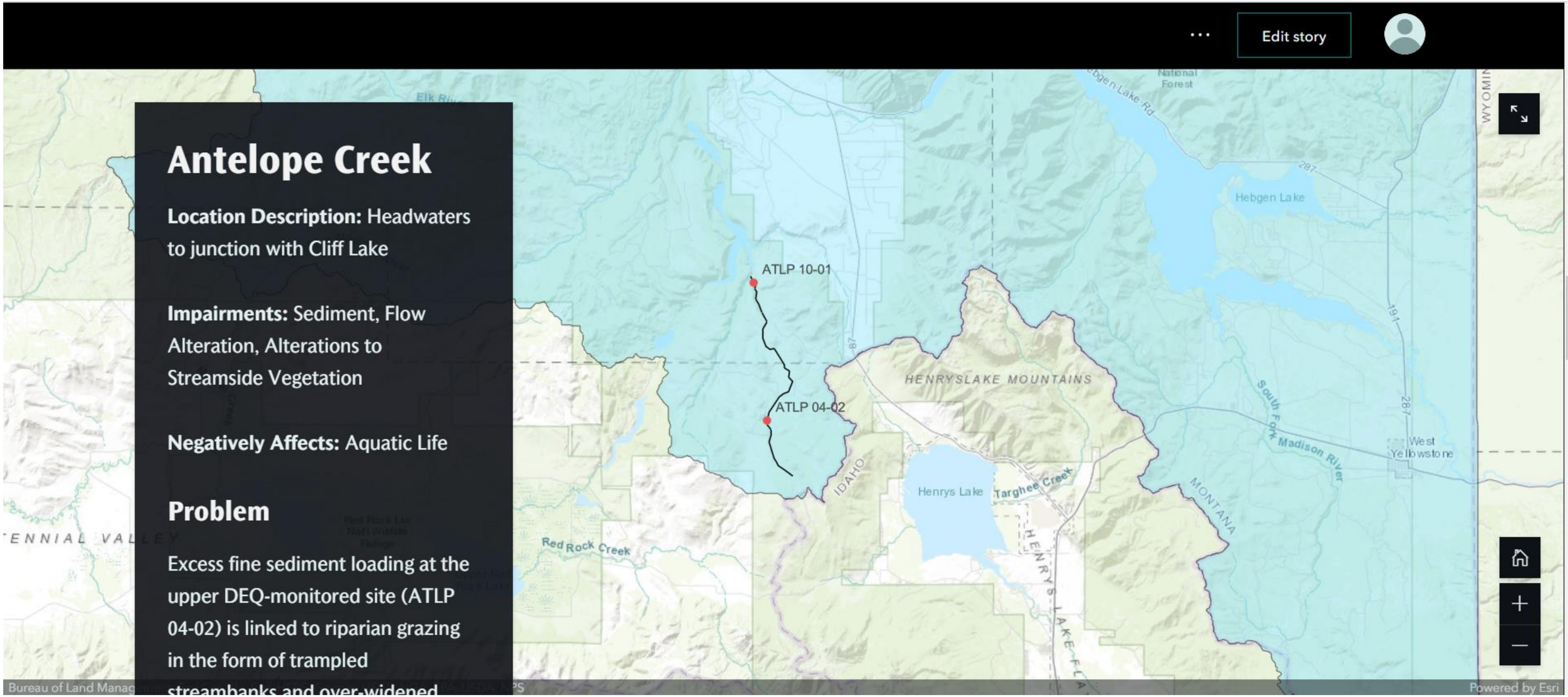
[2] Instream fine sediment includes cross sections, pebble counts and pool tail grid tosses

Stream Summaries StoryMap

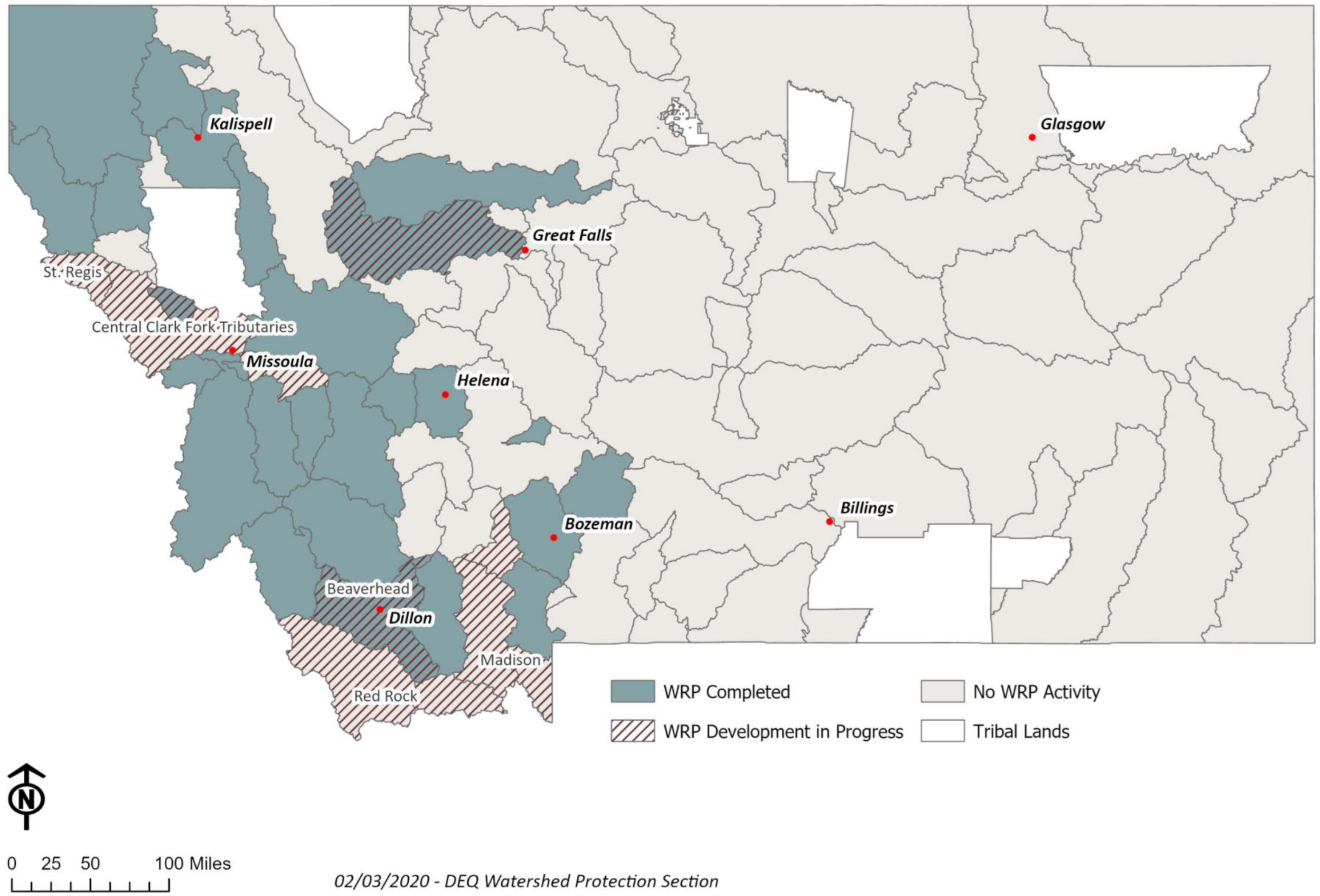
Stream Summaries StoryMap



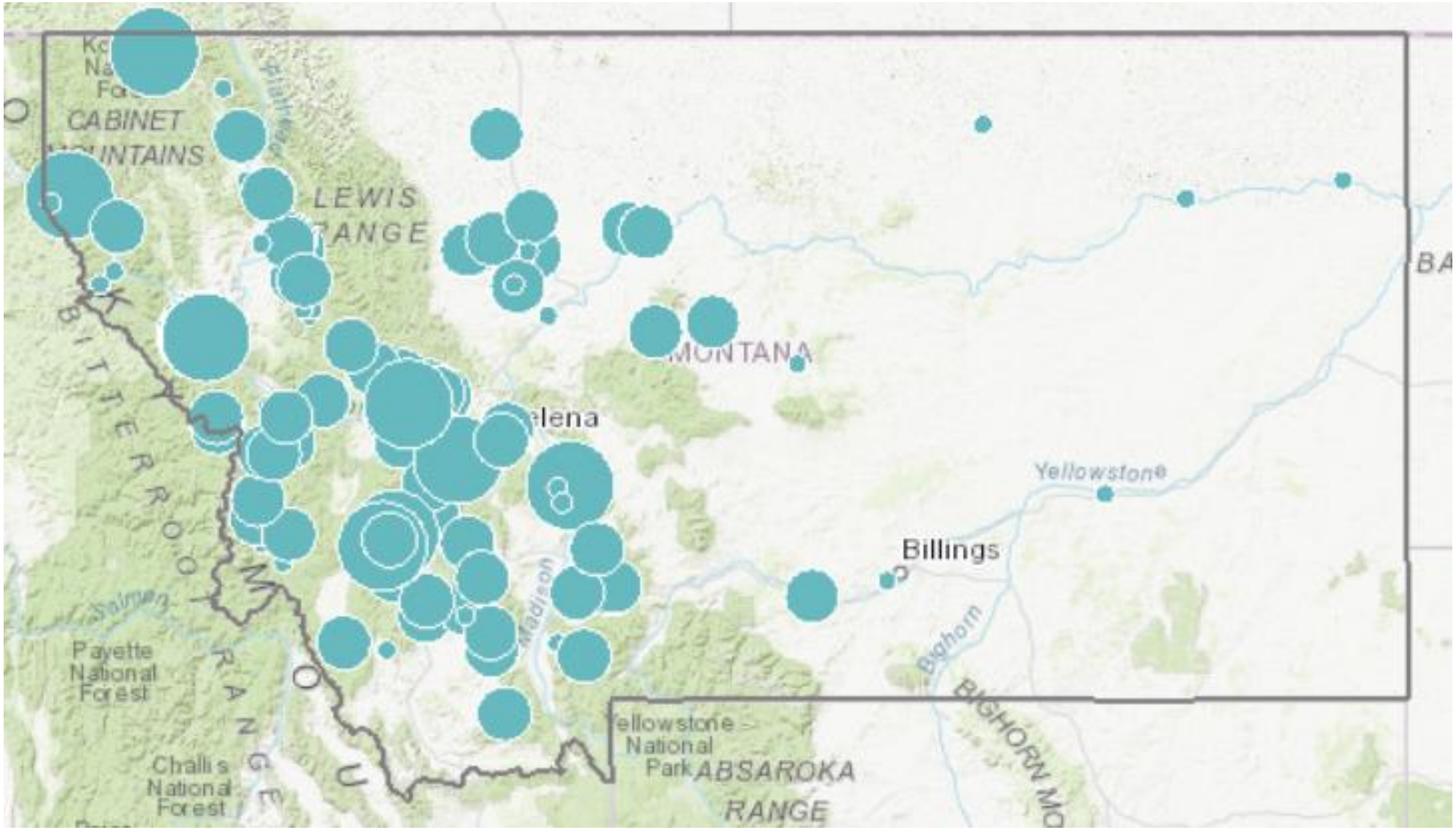
Stream Summaries StoryMap



Watershed Restoration Plan Status

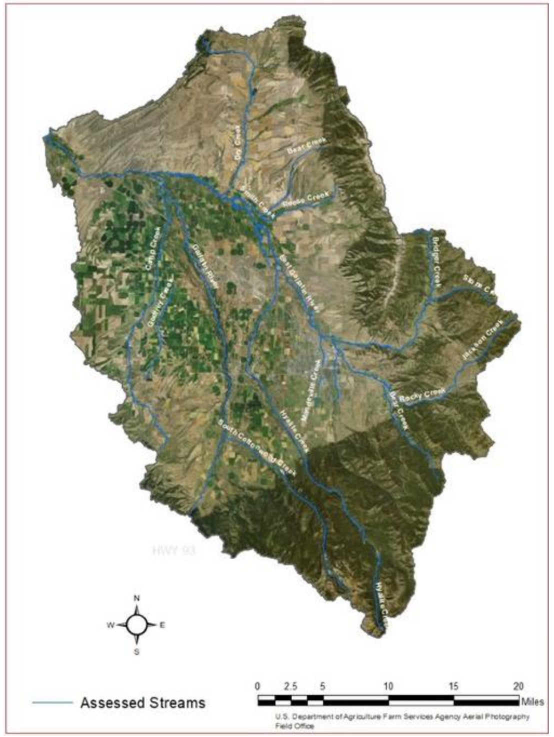


319 Project Implementation (click for webmap)



Bitterroot

Lower Gallatin



2020-2022

2023-2025

Increased Project Funding

Focus Watersheds

GOAL: Demonstrate Improvements to Water Quality

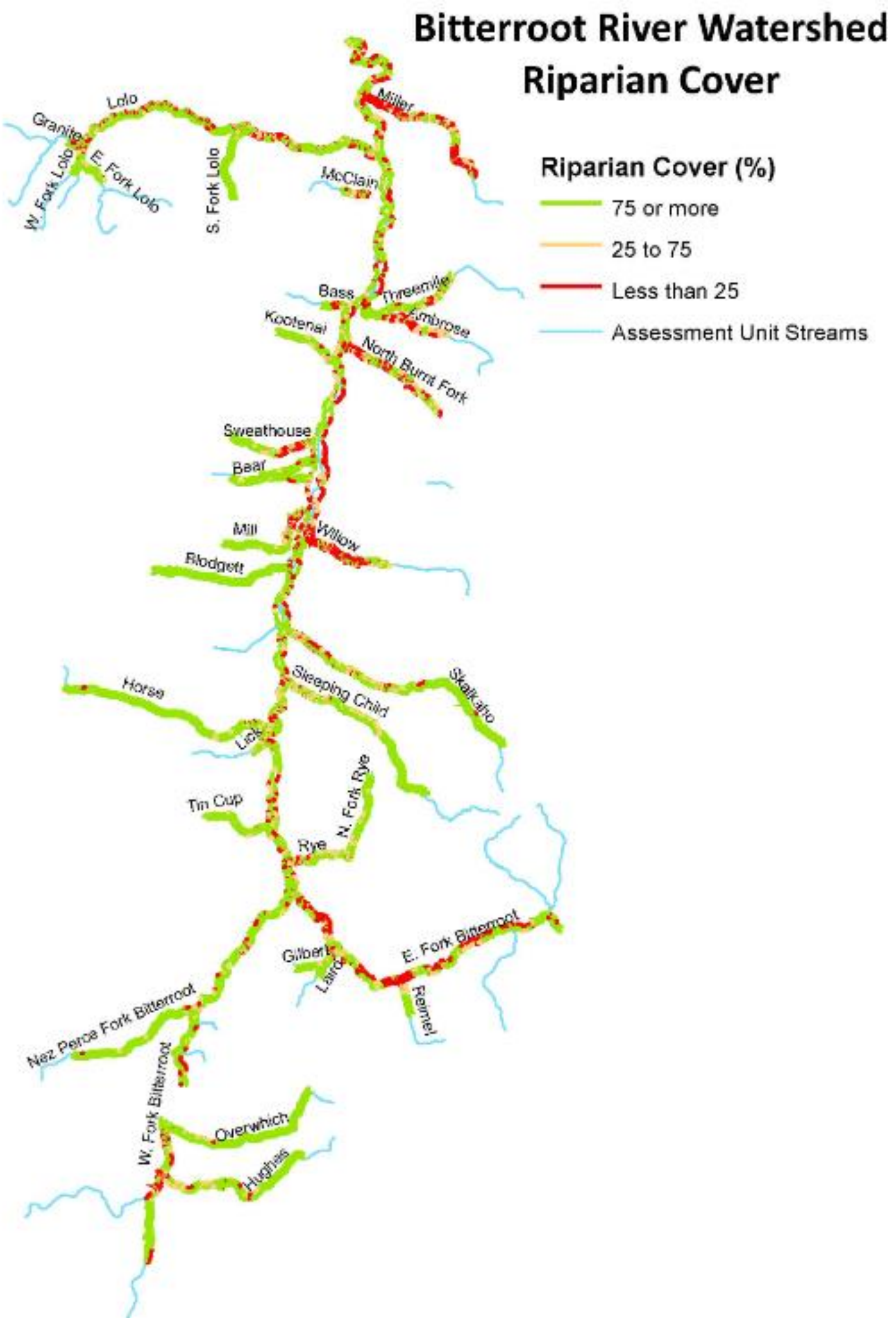
Strategies:

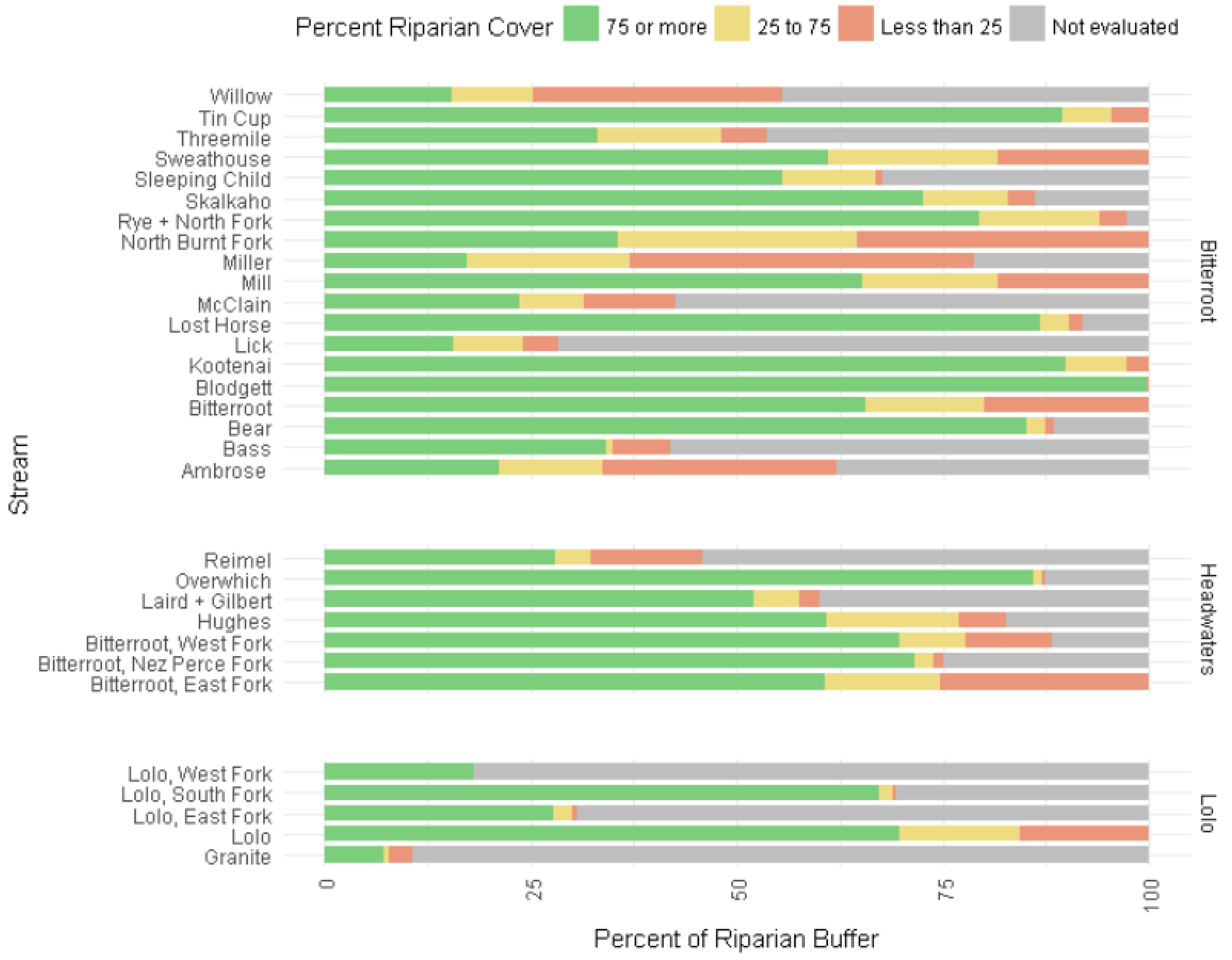
- More projects on the ground – 50% of 319 funds
- Increase technical assistance
- Track water quality trends
- Identify success stories and landowner stewardship
- Build capacity of local groups and leaders
- Foster interest in water quality

Focus Watershed Attributes

- WRP in place, momentum, stakeholder interest, ability to track change, easy to implement BMPs, potential to reduce a community's point source treatment costs

Riparian Evaluation





Streams with <%25 high riparian cover:

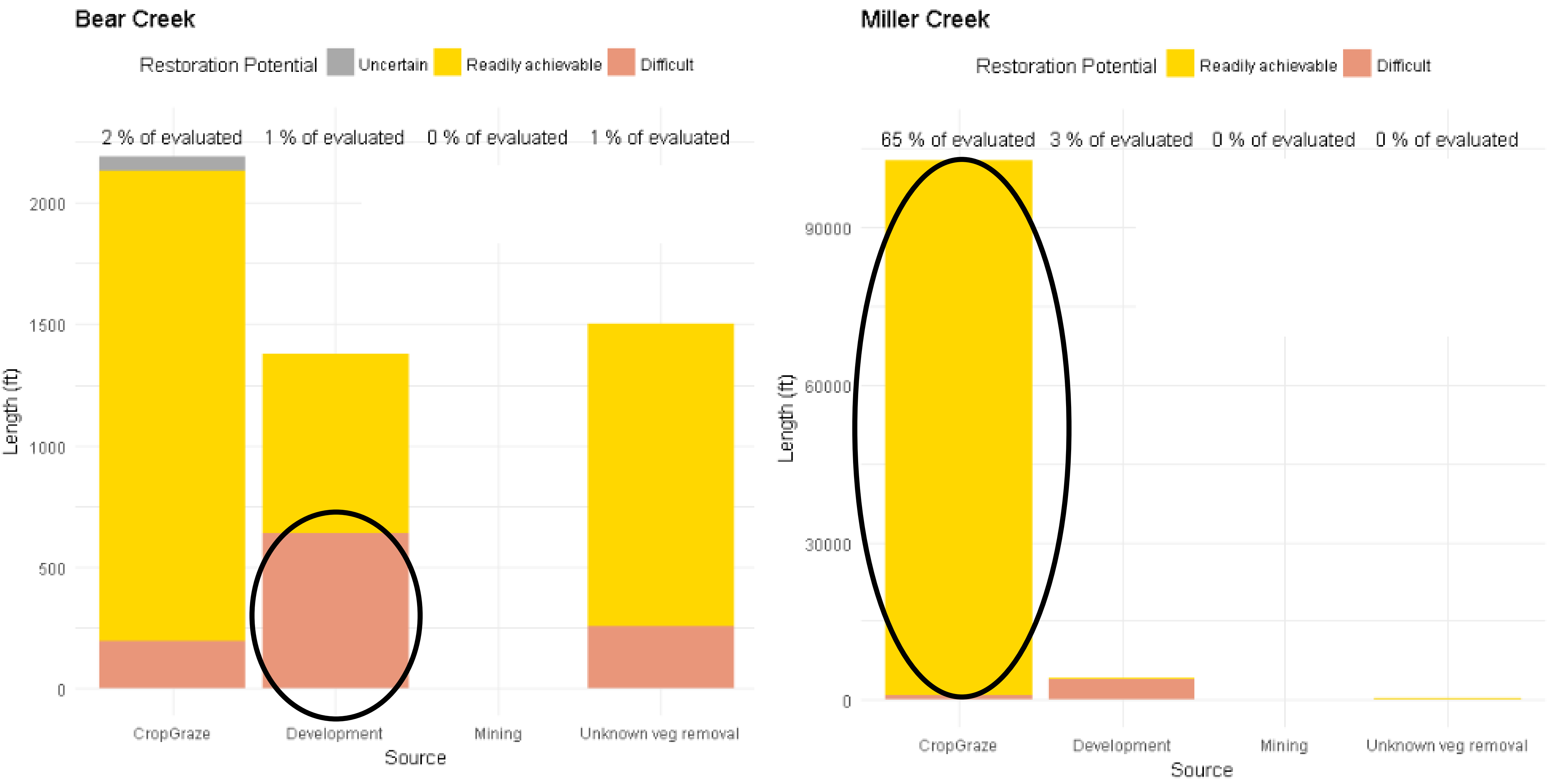
- Willow
- Miller
- McClain
- Lick
- Ambrose
- West Fork Lolo
- Granite

Streams with >75% high riparian cover:

- Tin Cup
- Rye Creek Watershed
- Lost Horse
- Kootenai
- Blodgett
- Bear
- Overwhich

Others important notes:

- North Burnt Fork (~40% low riparian cover)
- Most unevaluated reaches are in USFS property, where fine scale source assessment work is routinely done


Bear Creek
Restoration Potential
Uncertain
Readily achievable
Difficult
2 % of evaluated
1 % of evaluated
0 % of evaluated
1 % of evaluated
2000
1500
1000
500
0
Length (ft)
CropGraze
Development
Mining
Unknown veg removal
Source
Miller Creek
Restoration Potential
Readily achievable
Difficult
65 % of evaluated
3 % of evaluated
0 % of evaluated
0 % of evaluated
90000
60000
30000
0
Length (ft)
CropGraze
Development
Mining
Unknown veg removal
Source

Project Follow-up

- Project Effectiveness Reviews (PERs)
- TMDL Implementation Evaluations (TIEs)
- Re-assessment
- Success Stories

Project Effectiveness Reviews - PERs

- Primarily qualitative evaluation of success based on existing baseline data and current conditions
  - Projects achieving intended goals?
  - Landowners satisfied?
  - Influenced local attitudes?
- Photo points are critical component
- Eventually help guide the TMDL Implementation Evaluation process

PER Example
Upper Lolo Creek TMDL Culverts

Goal - Replace 5 priority culverts identified in the Upper Lolo TMDL to ensure fish passage and adequate passage of 100-yr flood events.

Total cost $353,529; $55,000 in 319 funding

Existing data

- Photos
- Culvert surveys
- Substrate particle size distribution
- Gradient
- Fish movement and genetics

Data collected for PER

- Photos
- Qualitative assessment of instream and riparian conditions and existing BMPs

Re-assessment scheduled for 2020

Pre-construction (2002)

Post-construction (2008)

Post-construction (2018)

TMDL Implementation Evaluations - TIEs

Types of data and information needed

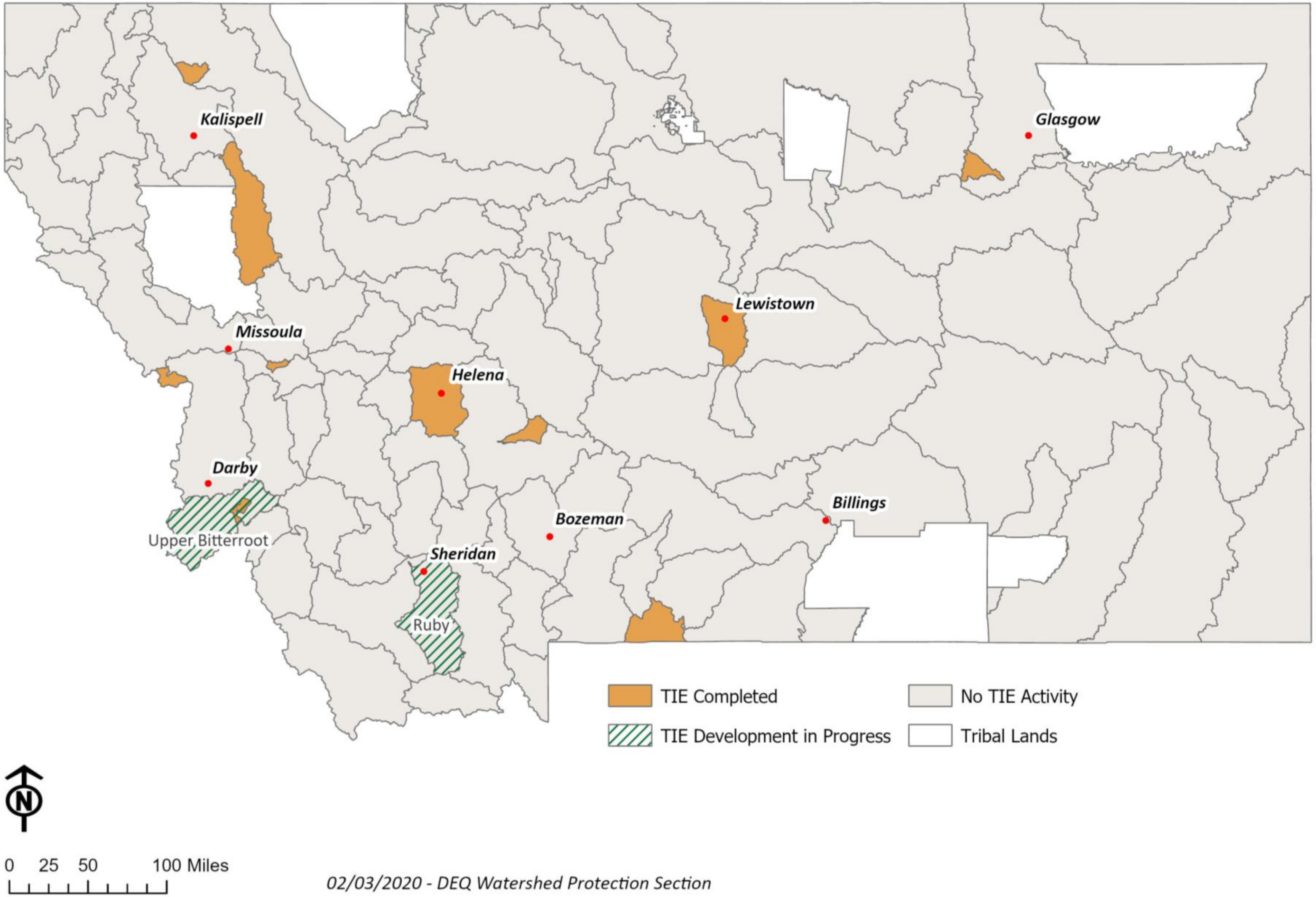
- Watershed projects implemented
- Photos
- Monitoring
  - pollutants
  - riparian condition and habitat

Outcomes

- Additional projects needed, time, or planning (TMDL revisions)
- Success Stories

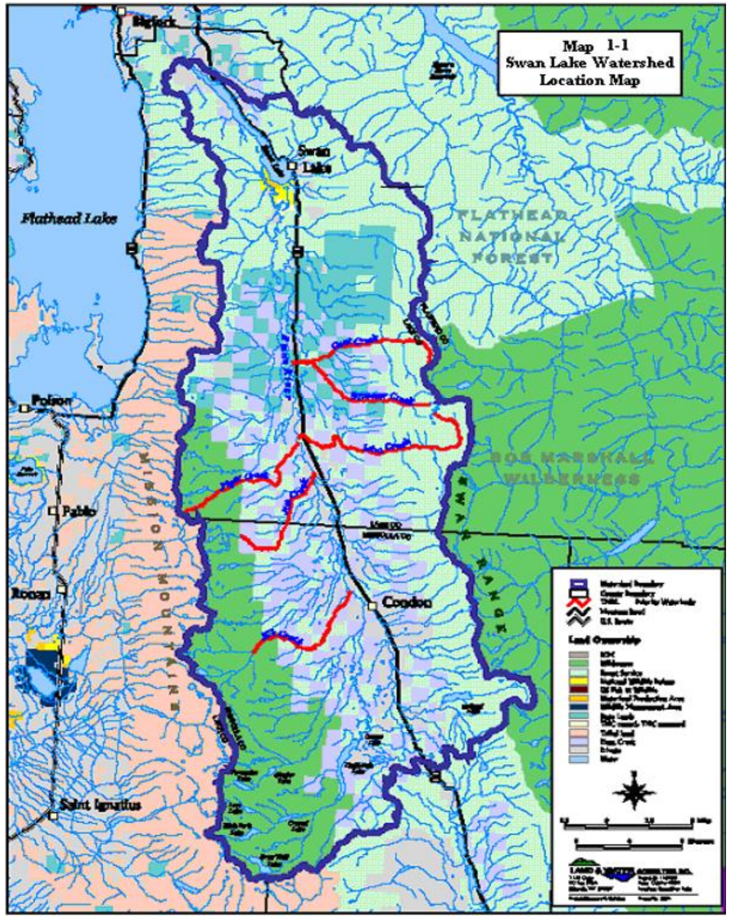
Watershed	Impairment listings	Year Completed
Big Creek	Sediment	2011
Upper Lolo	Sediment	2011
Cooke City	Metals, sediment	2011
Deep Creek	Sediment, temperature	2011
Reimel Creek	Sediment	2016
Lone Tree Creek	Sediment, nitrate	2017
Swan Lake	Sediment, POC	2018
Lake Helena	Nutrients only	2018
Cooke City Addendum	Metals, sediment	2018
Cramer Creek	Metals, sediment	2019
Big Spring Creek	Sediment, PCB, nutrients	2019
Ruby Watershed	Metal, sediment, temperature, nutrients	2020
Bitterroot Headwaters	Sediment, temperature	2020

TMDL Implementation Evaluation Status



02/03/2020 - DEQ Watershed Protection Section

Swan Lake Watershed TIE - Jim Creek



60,000 acres of Plum Creek Timber Company lands transferred to state and federal agencies in 2011

Watershed BMPs and restoration activities (2006 -2015)

- $320,260 (319)
- $693,585 (Local)
- $1,262,693 (Fed)

Findings

- Improvements in forestry BMPs resulted in broad scale habitat and water quality improvements
- Jim Creek: Proposed for delisting in 2018 DEQ Integrated Report.
- Goat Creek: reassessment in 2020
- Swan Lake: Development of lake numeric standards for chlorophyll, nitrogen, phosphorus and clarity would needed.

Soda Butte Creek (2018)
- Delisted for metals
- Custer Gallatin National Forest

Jim Creek (2017)
- Delisted for sediment
- Flathead National Forest

Deep Creek (2016)
- Delisted for sediment
- NRCS NWQI watershed

Meadow Creek (2014)
- Delisted for
- Bitterroot National Forest

Swift Creek Watershed (2013)
- Delisted for sediment and nutrients
- Flathead National Forest

Big Creek (2012)
- Delisted for sediment and habitat
- Flathead National Forest

Piper and Goat Creeks (2009)
- Delisted for nutrients and sediment
- Flathead National Forest

Upper Sun River (2008)
- Delisted for sediment

Success Stories

To document results as part of EPA National Water Program Guidance

NONPOINT SOURCE SUCCESS STORY

Montana

Projects Reduce Sediment from Forest Roads in Jim Creek in the Swan Lake Watershed

Waterbody Improved

Jim Creek was listed as impaired by sediment in 1996. Total maximum daily loads (TMDLs) were completed for the Swan Lake watershed by Montana Department of Environmental Quality (DEQ) in 2004 for Swan Lake, Goat Creek and Jim Creek. Swan Lake aquatic life use is threatened by particulate organic carbon and is linked to low summer dissolved oxygen levels in the deeper parts of the lake. Since the TMDLs were developed, the Swan Ecosystem Center (now Swan Valley Connections) has worked with Flathead National Forest, Department of Natural Resources and Conservation state trust lands, Plum Creek Timber, DEQ and other partners to develop and implement a watershed-based plan. Numerous Clean Water Act (CWA) section 319 projects have been implemented, focusing on forest road-generated sediment reductions. In 2015 and 2016 the Montana DEQ collected sediment-related data in Jim Creek and completed an assessment in March 2017, with an outcome of a proposed 2018 de-listing sediment/siltation as a cause of impairment in Jim Creek.

Problem

Jim Creek, a 12-mile-long stream in northwest Montana's Swan Lake watershed was listed as impaired by sediment in 1996 based on Montana's narrative standard (Figure 1). The standard does not allow increases above naturally occurring sediment concentrations that will or are likely to harm aquatic life or other beneficial uses.

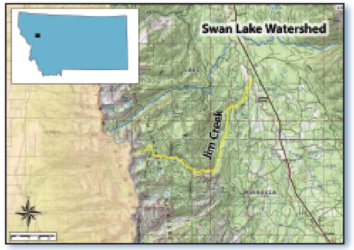


Figure 1. Jim Creek is in the Swan Lake watershed.

TMDLs were developed for three waterbodies (Swan Lake and Jim and Goat creeks) in 2004. Sediment sources were identified as road erosion, riparian and streambank erosion, and other timber harvest activities. Sediment targets (channel substrate fines, pools with cover, large woody debris, and macroinvertebrate community metrics) were established for Jim Creek as part of the TMDL process. TMDL restoration strategies included application of best management practices (BMPs) to existing forest roads, riparian and stream bank protection from existing and future private (non-timber) development, and application of forestry BMP practices, including the Streamside Management Zone.

Bull trout and grizzly bear, both listed under the Endangered Species Act, are found in the 408,630-acre Swan Lake watershed, which is classified as part of the Northern Rocky Mountain ecoregion.

Project Highlights

The 12,512-acre Jim Creek watershed was the focus of two CWA section 319 projects (2006 and 2012) that implemented forest road BMPs, including cross drains, rolling dips, flapper bars, blading and reshaping roadway surfaces, upsizing and replacing culverts, active and passive road decommissioning, and road realignment. Since the TMDLs were developed, Swan Valley Connections (SVC) has been awarded seven CWA section 319 contracts, addressing sediment sources throughout the Swan Lake watershed, with an emphasis on the forest roads network—the largest anthropogenic source of sediment in the watershed. SVC developed a Quality Assurance Project Plan in 2008, and a Watershed Restoration Plan in 2009 that was updated in 2012. Between 2010 and 2017, SVC has implemented 10 wetland, stream or riparian restoration projects on nine privately owned parcels (92 acres) and one on public land (12 acres) that were funded by sources other than the CWA section 319 program.

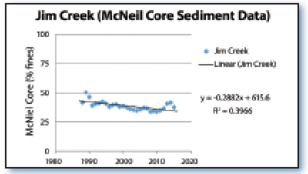


Figure 2. Regression trend line shows that percent fines have declined over time.


Figure 3. Lower Jim Creek, seen here in 2013, now meets Montana's narrative sediment standard.

Other factors contributing to sediment reduction include state regulatory requirements. In 1989 Montana passed the BMP Notification Law, which requires landowners to notify Montana Department of Natural Resources and Conservation (DNRC) prior to harvesting timber. DNRC foresters provide technical assistance on proper harvesting techniques and BMP implementation. In 1991 Montana enacted the Streamside Management Zone Law, which requires, among other things, that a riparian buffer of at least 50 feet from each bank be maintained during commercial timber harvesting. These two laws have significantly improved implementation of forestry practices designed to protect water quality.

Results

With support by CWA section 319 and state and local match funding, SVC has reported a sediment reduction of 159 tons per year in the Swan Lake watershed. Additionally, the Montana Department of Transportation has decreased their application of traction sand along 47 miles of state highway 83 through the Swan Valley, from about 500 pounds to 250 pounds per road mile per year. Projects in the Jim Creek watershed have resulted in an estimated sediment reduction of 33 tons per year, a 24 percent decrease from the estimated 135 tons per year total sediment load. Sediment sampling has shown that the percent of sediment fines in the Jim Creek channel substrate have declined (Figure 2).

Macroinvertebrate and periphyton algae sampling yielded results that indicate a high level of biological integrity on Jim Creek. The three macroinvertebrate samples had an average Hilsenhoff biotic index value of 1.96 (range: 1.84-1.97). The single periphyton sample yielded a sediment taxa probability of impairment of 16 percent, well within the target of less than 51 percent. Because Jim Creek is now meeting the state's narrative standard for "...naturally occurring concentrations of sediment or suspended sediment," MDEQ is proposing to remove the sediment/siltation impairment from Jim Creek in 2018 (Figure 3).

Partners and Funding

SVC has provided the leadership, coordination, management and administration for TMDL implementation in the watershed. Major partners include the Flathead National Forest; the DEQ; DNRC; the Swan Lakers and Flathead Biological Station; the Montana Department of Fish, Wildlife and Parks; and the Montana Department of Transportation. A total of $390,260 in CWA section 319 funds has supported on-the-ground BMPs, planning, monitoring, coordination, and education and outreach activities in the watershed. State and local match has totaled $716,029, and the Flathead National Forest has reported $1,262,639 in project contributions.

U.S. Environmental Protection Agency
Office of Water
Washington, DC

EPA 841-F-17-001AA
December 2017

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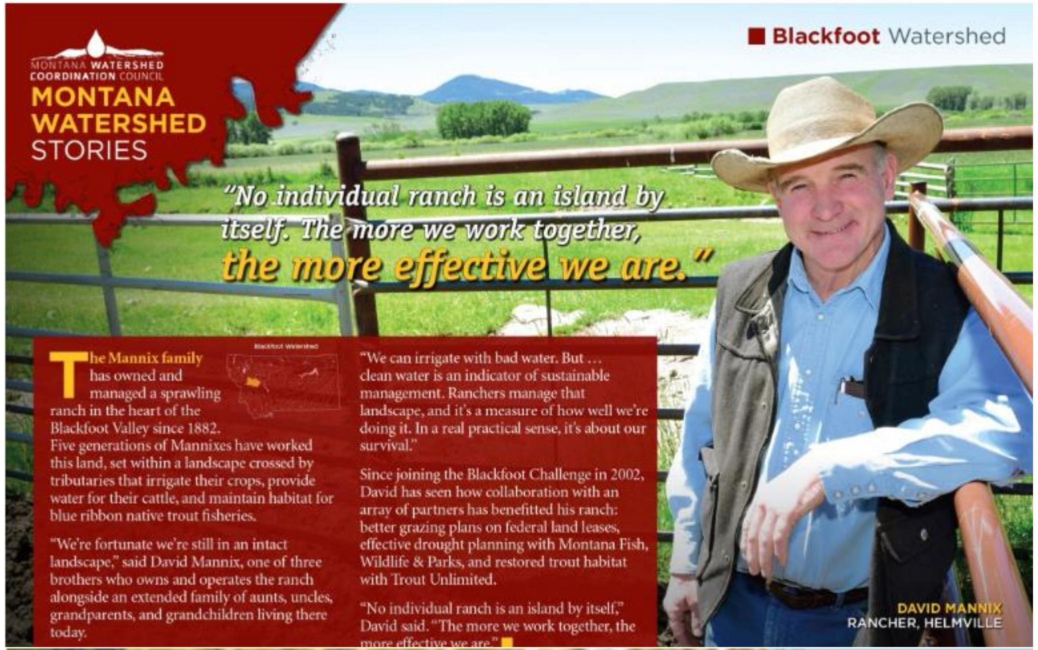
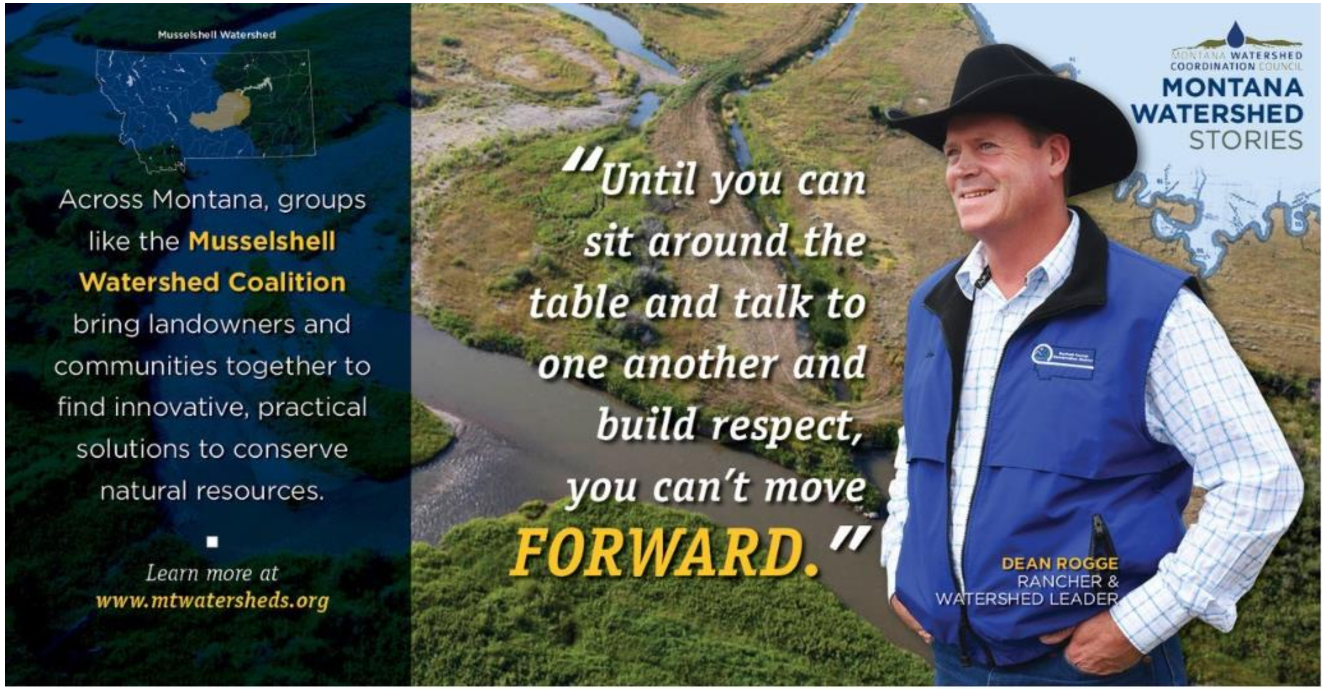
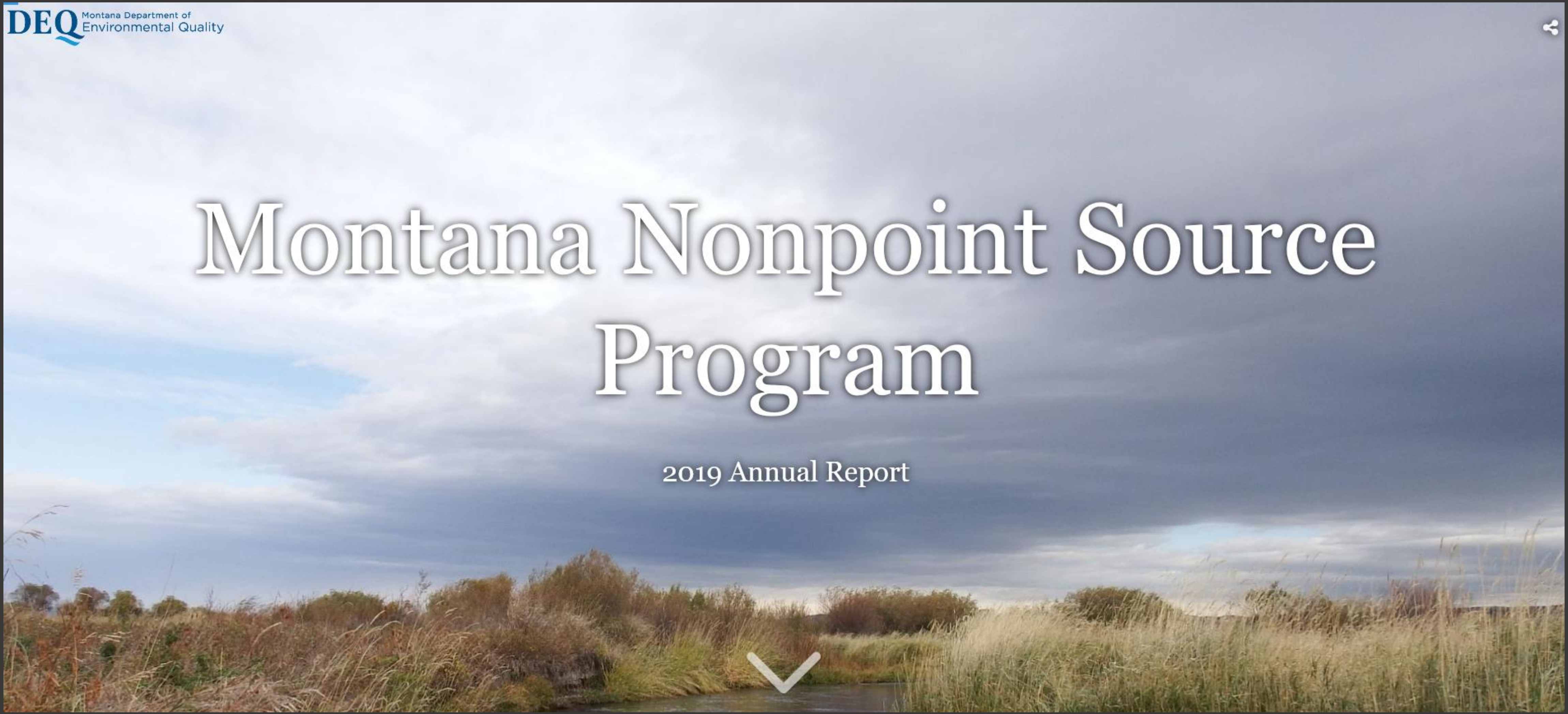


Partners



https://mtwatersheds.org/app/audio-watershed-stories/



https://mtdeq.maps.arcgis.com/apps/Cascade/index.html?appid=0acefeef0e824d878f3d77edfaf40901

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