Bitterroot Headwaters TMDL Implementation Evaluation

January 2021 FINAL

Steve Bullock, Governor
Chris Dorrington, Director DEQ
Prepared by:
Water Quality Planning Bureau

Document Number

Watershed Protection Section

Contributors:
Water Quality Planning Bureau
Watershed Protection Section
Robert Ray, Water Quality Specialist

Monitoring and Assessment Section
Chris Faubion, Water Quality Specialist

Acknowledgements:
United States Forest Service
Bitterroot National Forest
Marilyn Wildey, Hydrology Technician
Mike Jakober, Fisheries Biologist

Montana Department of Fish, Wildlife and Parks
Jason Lindstrom, Fisheries Biologist

Cover Photograph:
Overwhich Creek, from Forest Road 5703
Photo by: Montana Department of Environmental Quality

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

Suggested citation: Montana DEQ. 2021. Bitterroot Headwaters TMDL Implementation Evaluation. Helena, MT: Montana Dept. of Environmental Quality.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

AU / AU ID	Assessment Unit, Assessment Unit Identification
BRHW	Bitterroot Headwaters
BRWF	Bitter Root Water Forum
BMP	Best Management Practice
BNF	Bitterroot National Forest
D50	Diameter of the 50th percentile stream substrate size (in millimeters)
DEQ	Montana Department of Environmental Quality
EPA	United States Environmental Protection Agency
EQuIS	DEQ Environmental Quality Information Storage database
FWP	Montana Department of Fish, Wildlife and Parks
MCA	Montana Code Annotated
PIBO	PacFish/InFish Biological Opinion
RCP	Reasonable Land, Soil and Water Conservation Practices
TIE	TMDL Implementation Evaluation
TMDL	Total Maximum Daily Load
TPA	TMDL Planning Area
USFS	United States Forest Service
WRP	Watershed Restoration Plan

DOCUMENT SUMMARY

In 2005, the "Water Quality Restoration Plan and Total Maximum Daily Loads for the Bitterroot Headwaters Planning Area" document was published and provides total maximum daily loads (TMDLs) for sediment and/or temperature impairments for the East and West Forks of the Bitterroot River and a number of their tributaries (**Table DS-1,** below) (Montana Department of Environmental Quality, 2005). Sediment/siltation and/or suspended sediment TMDLs were developed for: Buck, Ditch, Gilbert, Hughes, Laird and Reimel Creeks, and the East and West Forks of the Bitterroot River. Thermal modification (temperature) TMDLs were developed for: Hughes and Overwhich Creeks, and Nez Perce Fork, and East Fork and West Fork Bitterroot River (Montana Department of Environmental Quality, 2005).

Table DS-1. Bitterroot River Headwaters 2004 Integrated Report Impaired Waterbodies

Waterbody	AU ID	Impairment(s)	TMDL(s) written
Buck Creek	MT76H003_070	Sediment/siltation Other habitat alterations	Yes No TMDL needed
Deer Creek	MT76H003_030	Other habitat alterations	Not impaired
Ditch Creek	MT76H003_060	Sediment/siltation Other habitat alternations	Yes No TMDL needed
East Fork Bitterroot River	MT76H002_010	Sediment/siltation Temperature Other habitat alternations	Yes Yes No TMDL needed
Gilbert Creek	MT76H002_080	Sediment/siltation Other habitat alternations	Yes No TMDL needed
Hughes Creek	MT76H003_040	Sediment/siltation Temperature Other habitat alterations	Yes Yes No TMDL needed
Laird Creek	MT76H002_070	Sediment/siltation Other habitat alterations	Yes No TMDL needed
Martin Creek	MT76H002_050	Flow alteration	Not impaired
Meadow Creek	MT76H002_030	Other habitat alterations	No TMDL needed
Moose Creek	MT76H002_040	Sediment/siltation Nutrients	Not impaired Not impaired
Nez Perce Fork Bitterroot	MT76H003_020	Temperature	Yes
Overwhich Creek	MT76H003_050	Sediment/siltation Temperature	Not impaired Yes
Reimel Creek	MT76H002_020	Sediment/siltation Other habitat alterations	Yes No TMDL needed
West Fork Bitterroot River	MT76H003_010	Sediment/siltation Temperature Other habitat alterations	Yes Yes No TMDL needed

Montana law requires that after TMDL plans and reasonable land, soil and water conservation practices have been implemented, the Montana Department of Environmental Quality (DEQ) conducts an evaluation of progress to examine if relevant water quality standards are being met. This TMDL Implementation Evaluation (TIE) documents an evaluation for the Bitterroot Headwaters watershed.

The Bitterroot National Forest and its partners have implemented reasonable land, soil and water conservation practices (RCPs) in the Bitterroot Headwaters TMDL Planning Area (TPA), called for in the Bitterroot Headwaters TMDL document, as well as monitoring and planning activities **(Section 3.0** of this document).

Nevertheless, this Bitterroot Headwaters TIE finds that, with the potential exception of Reimel Creek, the above listed impaired waterbodies will require an improved phase of voluntary reasonable land, soil and water conservation practices in order to meet state water quality standards for siltation, thermal, and/or other habitat alteration sources of aquatic life impairment.

1.0 BACKGROUND

The Bitterroot Headwaters (BRHW) TMDL Planning Area (TPA) encompasses the East and West Fork of the Bitterroot Rivers to their confluence near Conner, an area of approximately 618,000 acres (967 square miles) in southwest Montana, fully within Ravalli County (**Figure 1-1**). Approximately 92% of the land is managed by the Bitterroot National Forest, 5.4% is privately owned, and less than 3% is managed by the state of Montana. Land cover is largely evergreen forest, with some mixed forest; brush, grass, and mixed rangeland; crop and pasture (Montana Department of Environmental Quality, 2005). The East and West Forks join to form the Bitterroot River and are located within hydrologic unit code 17010205. **Figure 1-1** below shows the currently-identified impaired waterbodies in the Bitterroot Headwaters TMDL Planning Area.

As required by Montana state law, the Montana Department of Environmental Quality (DEQ) develops total maximum daily loads (TMDLs) for waterbodies impaired by a pollutant, and TMDLs are contained in documents that provide a framework for water quality restoration efforts. DEQ also works with local, state, federal, and private partners to assist those entities conducting voluntary nonpoint source water quality improvement activities.

In 2005, the "Water Quality Restoration Plan and Total Maximum Daily Loads for the Bitterroot Headwaters Planning Area" document was published and provides TMDLs for sediment and/or temperature impairments for the East and West Forks of the Bitterroot River and a number of their tributaries (**Table 1-1** below) (Montana Department of Environmental Quality, 2005).

Montana law (Montana Code Annotated 75-5-703(9)) requires that after TMDL plans and reasonable land, soil and water conservation practices have been implemented, DEQ conduct an evaluation of progress in restoring water quality. This TMDL Implementation Evaluation (TIE) documents an evaluation of progress for the Bitterroot Headwaters watershed.

This TIE is an evaluation of the progress toward meeting the water quality goals of the 2005 TMDLs for ten sediment and/or temperature-impaired waterbodies, as well as an evaluation of the success of on-the-ground efforts to address the water quality impairments and DEQ's recommendations for potential next steps for addressing those impairments.

Contributors to TMDL development and implementation include staff from Bitterroot National Forest, Montana Fish Wildlife and Parks, and the Bitter Root Water Forum. The Bitter Root Water Forum (BRWF) developed the "Bitterroot Watershed Restoration Plan" (Bitter Root Water Forum, 2014), which was accepted by DEQ in March 2014 and updated in January 2020 (Bitter Root Water Forum, 2020). The East Fork Bitterroot is identified within the watershed restoration plan as a "Level 1" stream "currently having restoration momentum and for which we envision good progress being made over the next five years to achieve goals outlined in the WRP." (Bitter Root Water Forum 2014). The West Fork Bitterroot River was added to the "Bitterroot River Watershed Restoration Plan in 2020 (Bitter Root Water Forum, 2020).

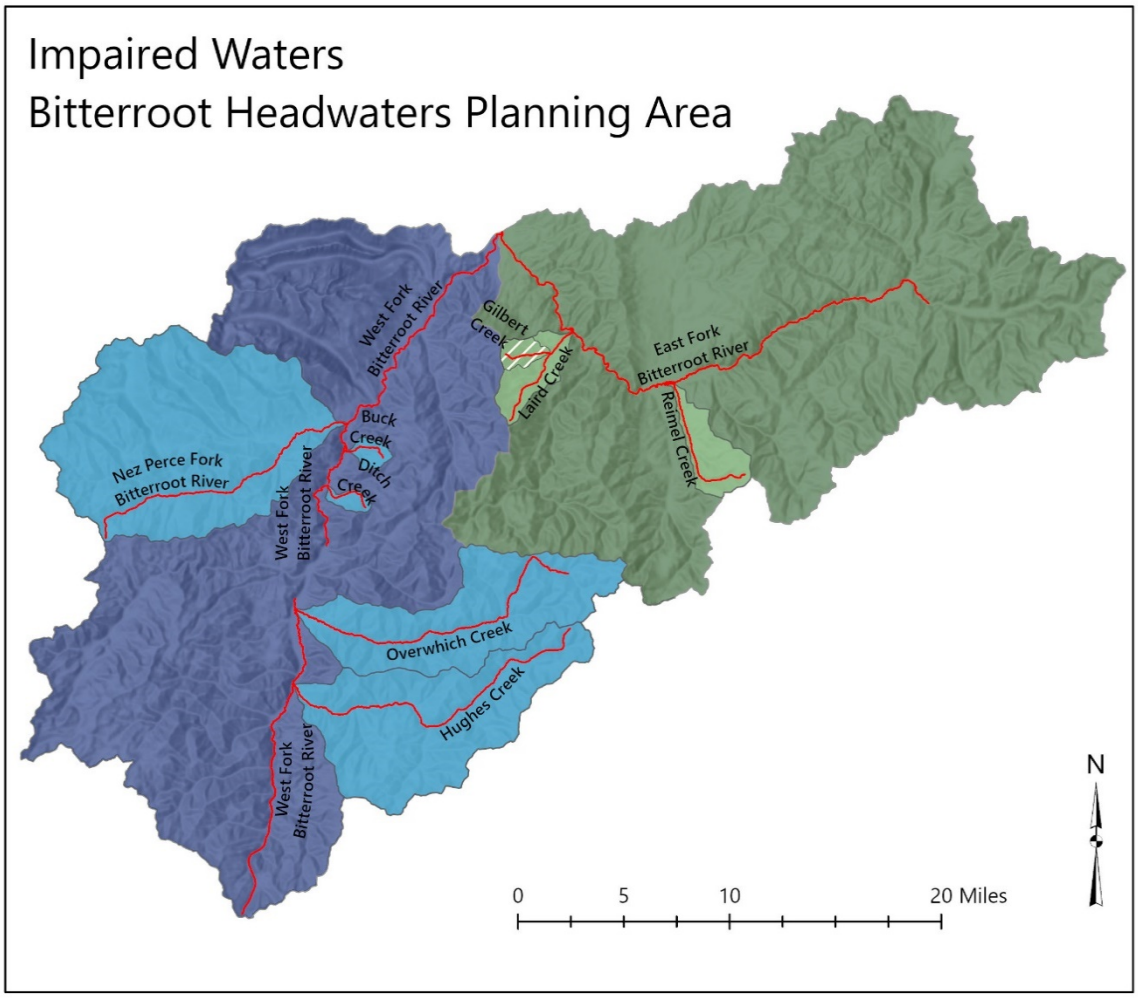

Figure 1.1 Currently DEQ-identified impaired waterbodies in the Bitterroot River Headwaters TMDL Planning Area

1.1 PURPOSE OF THE BITTERROOT HEADWATERS TMDL IMPLEMENTATION EVALUATION

The purpose of this Bitterroot Headwaters Total Maximum Daily Load (TMDL) Implementation Evaluation is to document the following:

- A TMDL implementation evaluation process that is consistent with and satisfies requirements under 75-5-703(9) Montana Code Annotated (MCA).
- Suggestions for voluntary monitoring or other types of monitoring to help evaluate progress and/or establish existing conditions.
- Provide constructive feedback to those pursuing water quality improvements.
    a. Acknowledge water quality restoration activities.
    b. Identify water quality success stories for Montana.
    c. Provide WRP document improvement recommendations.
    d. Provide additional guidance or suggestions for best management practice (BMP) implementation and extent of activities necessary to meet one or more TMDLs.
- Identify TMDL document update requirements and/or other TMDL document improvement recommendations, if needed.
- Document conditions where water quality standards work may be necessary for future beneficial support resolution, if applicable.

1.2 IMPAIRED WATERBODIES, CAUSES, SOURCES AND TMDL TARGETS

The following impaired waterbodies (**Table 1-1**) (Montana Department of Environmental Quality 2004 Integrated Report) were identified in the Montana Department of Environmental Quality "Water Quality Restoration Plan and Total Maximum Daily Loads for the Bitterroot Headwaters Planning Area" (Montana Department of Environmental Quality, 2005):

Table 1-1. Bitterroot River Headwaters 2004 Integrated Report Impaired Waterbodies

Waterbody	Assessment Unit ID	Impairment(s)	TMDL(s) written
Buck Creek	MT76H003_070	Sediment/siltation Other habitat alterations	Yes No TMDL needed
Deer Creek	MT76H003_030	Other habitat alterations	Not impaired
Ditch Creek	MT76H003_060	Sediment/siltation Other habitat alterations	Yes No TMDL needed
East Fork Bitterroot River	MT76H002_010	Sediment/siltation Temperature Other habitat alterations	Yes Yes No TMDL needed
Gilbert Creek	MT76H002_080	Sediment/siltation Other habitat alterations	Yes No TMDL needed
Hughes Creek	MT76H003_040	Sediment/siltation Temperature Other habitat alterations	Yes Yes No TMDL needed

Laird Creek	MT76H002_070	Sediment/siltation Other habitat alterations	Yes No TMDL needed
Martin Creek	MT76H002_050	Flow alteration	Not impaired
Meadow Creek	MT76H002_030	Other habitat alterations	No TMDL needed
Moose Creek	MT76H002_040	Sediment/siltation Nutrients	Not impaired Not impaired
Nez Perce Fork Bitterroot	MT76H003_020	Temperature	Yes
Overwhich Creek	MT76H003_050	Sediment/siltation Temperature	Not impaired Yes
Reimel Creek	MT76H002_020	Sediment/siltation Other habitat alterations	Yes No TMDL needed
West Fork Bitterroot River	MT76H003_010	Sediment/siltation Temperature Other habitat alterations	Yes Yes No TMDL needed

Table Note: "No TMDL needed" indicates an impairment cause is a "non-pollutant" – there is an impairment but no TMDL is required for flow (de-watering), in-stream or near-stream habitat alterations, channelization, etc.

Within the Bitterroot Headwaters TMDL Planning Area (TPA), the main pollutant sources include:

- Sediment/siltation from
    - Natural background loading
    - Timber harvest
    - Fire
    - Roads
    - Unstable/eroding streambanks
    - Highway traction sand
- High stream temperatures from
    - Historical timber harvest
    - Mining
    - Road building
    - Flow alteration

The 2005 TMDL targets for sediment/siltation included: percent surface fines less than 2mm and less than 6mm in riffles; various ranges of D_{50} (in-stream median particle size) for different Rosgen classification stream type; and macroinvertebrate "clinger richness" of greater than 14. Sources identified in the 2005 document included sediment/siltation from road surface erosion and runoff were identified as the greatest contributor to anthropogenic sediment load. Primary contributors were roads and unstable stream banks.

In-stream temperature targets for Bitterroot Headwaters (BRHW) higher elevation streams (generally above 5,200 ' elevation) were established at 12° C, and 15° C for lower elevation streams. Main roads, mining, other roads and impervious surfaces and loss of riparian vegetation and shade due to near-stream timber harvest were identified as anthropogenic sources of thermal impairments in five streams.

This TMDL Implementation Evaluation (TIE) focuses specifically on pollutant listings (e.g. sediment, siltation, and temperature) and does not go into detail regarding non-TMDL impairment listings (e.g. other habitat alterations, flow alteration). Nevertheless, TMDL implementation activities can often address multiple impairments. For example, addressing temperature concerns through in-stream flow improvements or increased shade, can reduce flow or other habitat alteration impairments.

1.3 APPLICATION OF TMDL TARGETS

Consistent with state law and the federal Clean Water Act, DEQ reviews and revises water quality standards on a three-year basis (75-5-301(3) Montana Code Annotated). Additionally, assessment methodologies for interpreting and applying numeric and narrative standards are often developed or updated between completion of the TMDL targets and the subsequent TMDL Implementation Evaluation. In some cases, TMDL targets or target values may be superseded by an updated standard and/or assessment method since the goal of a TMDL is to achieve ***applicable*** water quality standard(s). Therefore, the TIE will often focus on a combination of existing and modified 'targets' in recognition of assessment method improvements and/or water quality standards updates (e.g., Montana Department of Environmental Quality, 2015 Sediment and Habitat Field Method for Wadeable Streams).

For some pollutants, such as sediment, the TMDLs and allocations are presented as percent reductions in loading over a specified timeframe, typically a yearly timeframe for sediment. The TMDL goal is to meet the applicable pollutant targets using current assessment methods. In some situations, a higher percent reduction than was established by the TMDL may be necessary to achieve targets/standards, while in other situations it may be concluded that a waterbody is no longer impaired for the pollutant of concern even if the TMDL percent reductions are not fully met. This is due to the inherent uncertainty in the TMDL development process in determining the correct pollutant percent reduction that results in target achievement.

2.0 TMDL DOCUMENT-RECOMMENDED ACTIVITIES

Section 8 – Restoration Strategy, of the Bitterroot Headwaters TMDL document recommends specific restoration activities for addressing pollutants within the Bitterroot Headwaters TPA. These recommendations are summarized by waterbody, below:

- East Fork Bitterroot River
    - Forest Service road BMPs to reduce sediment (including surfacing and removal/reclamation)
    - Numerous tributary culvert replacements to improve or allow fish passage
    - Detailed assessment of bank instabilities (in reaches 1, 2, 6 and 7, TMDL Appendix H, Fig. H-5)
    - Reduce road and home construction encroachment on riparian areas
    - Implement grazing BMPs (e.g. riparian fencing, off-stream watering, grazing management) to reduce streambank instability/ sediment and improve stream shading
    - Prioritization and restoration of thermal sources (roads, mines and impervious surfaces)
- Reimel Creek
    - 1 culvert replacement on private land to improve or allow fish passage
    - Restore Reimel Creek/East Fork Bitterroot hydrologic connection on private land
- Gilbert and Laird Creeks
    - Forest Service road BMPs to reduce sediment
    - 1 culvert replacement on private land to improve or allow fish passage
    - Assess streambank instability (reaches 1 and 3, TMDL Appendix H, Fig. H-6) and address human-caused instabilities (including cattle)
- West Fork Bitterroot River
    - Road BMPs to reduce sediment
    - Improve riparian woody vegetation overstory below Deer Creek
    - Numerous tributary culvert replacements to improve or allow fish passage
    - Assess streambank instability and address human-caused streambank instabilities
    - Prioritization and restoration of thermal sources (roads, mines and impervious surfaces)
- Nez Perce Fork
    - 6 culvert replacements to improve or allow fish passage
    - Prioritization and restoration of thermal sources (roads, mines and impervious surfaces)
- Hughes Creek
    - Forest Service road BMPs to reduce sediment
    - Assess streambank instability (reach 13, TMDL Appendix H, Fig. H-7) and address human-caused streambank instabilities
    - Address mining-related impacts on private lands
    - Prioritization and restoration of thermal sources (roads, mines and impervious surfaces)
- Overwhich Creek
    - 1 culvert replacement to improve or allow fish passage (low priority)
    - Prioritization and restoration of thermal sources (roads, mines and impervious surfaces)
- Ditch Creek
    - Forest Service road BMPs to reduce sediment
    - 2 culvert replacements to improve or allow fish passage
    - Culverts caused streambank instabilities

- Buck Creek
    - Forest Service road BMPs to reduce sediment

The TMDL document provided detailed recommendations for monitoring activities, summarized below:
For all listed/impaired streams

- Implementation and restoration monitoring
- Trend monitoring of target variables
- Trend monitoring of supplemental indicators
- Stream geomorphic condition monitoring (e.g. entrenchment ratio, sinuosity, width/depth ratio)
- Reference monitoring
- Filling data gaps

For specific streams

- Phased study approach for flow alterations
- Temperature monitoring (instream and effective shade)
- Unstable stream bank assessments

3.0 INDICATORS OF PROGRESS

Indicators of progress towards achieving water quality standards for the Bitterroot Headwaters TPA generally fall into one of three major categories: 1) TMDL Implementation/ Restoration, 2) Monitoring, and 3) Planning.

3.1 RESTORATION

Bitterroot National Forest staff (Wildey and Jakober, February 2019) documented improvement projects from 2001-2018 in a "Summary of Watershed Improvement Projects [WIP] – Montana Portion of Bitterroot National Forest 2001 -2018". In the Bitterroot Headwaters TPA, 74 projects were documented in this period. Activities included forest road BMPs, road storage and decommissioning, riparian plantings, livestock ford hardenings and riparian exclosures, culvert replacements, etc. (see **Appendix A** for details)

Clean Water Act Section 319 contracts with the Bitterroot National Forest, Trout Unlimited (TU) and Bitter Root Water Forum (BRWF) provided funds for work in the TPA (BRWF 208026: $30,000 project; BRWF 212054 $21,000 planning; TU 213020 $40,000 East Fork Bitterroot River roads project; BRWF 213024 $19,000 -Rye Creek/Doran Creek project).

Meadow Creek was reported meeting targets in the 2005 TMDL and delisted in 2014 (U.S. Environmental Protection Agency, 2015 Meadow Creek Success Story). Documented restoration efforts began in 1996 and included grazing management, riparian fencing, hardened stream crossings for livestock, and significant road upgrades (culvert replacements and bridge installations, road out-sloping and crowning, reseeding and graveling). No riparian grazing has occurred along Meadow Creek since prior to 2010 and the Bitterroot National Forest retired the livestock grazing lease in the Meadow Creek drainage in 2016. The riparian fences along Meadow Creek were removed in 2019 and 2020.

Appendix C of the 2016 Reimel Creek TIE (Montana Department of Environmental Quality, 2016) contains a summary of USFS activities in Reimel Creek – 1999 – 2016. Activities included moving the road away from the creek, riparian fencing and cattle guard installations, stream crossing hardening, road gravel application, and riparian willow and burned area tree planting. No livestock grazing has occurred on Bitterroot National Forest land in the Reimel Creek drainage over the past decade.

Overwhich Creek was reported as meeting targets in the 2005 TMDL and was formally delisted for sediment in 2014 but is still listed for thermal impairment.

Buck Creek road BMPs have been documented by the Bitterroot National Forest (BNF) (King, 2017a).

Ditch Creek road BMPs have also been documented by the BNF (King, 2017b)

3.2 MONITORING

3.2.1 Sediment Impairments-Related Monitoring

Since the Bitterroot Headwaters 2005 sediment TMDLs, DEQ has built upon its sediment assessment methodology for wadeable streams and has updated its various sediment targets (based on ecoregion

stream type and geology) for western Montana. DEQ reviewed and analyzed target values used in the 2011 Bitterroot Temperature and Tributary Sediment TMDL document (Montana Department of Environmental Quality, 2011, Montana Department of Environmental Quality, 2020), as well as sediment data collected by the Bitterroot National Forest, Forest Service PacFish/InFish Biological Opinion (PIBO) and DEQ (total of 62 sites in the Idaho Batholith and Middle Rockies ecoregions). DEQ determined the Forest Service and DEQ reference site data ("PIBO reference site data") and 2011 Bitterroot tributary sediment targets produce similar values.

Threshold values reported in 2020 were based on Bitterroot National Forest (n = 23), PIBO (n = 35), and DEQ (n = 4) reference data. DEQ defines reference condition as the condition of a waterbody capable of supporting its present and future beneficial uses when all reasonable land, soil, and water conservation practices have been applied (Kusnierz et al., 2013). Reference sites were selected based on similar ecoregion, geology, stream slope (<= 2%), and channel morphology to 2019 sample sites. Bitterroot National Forest and PIBO data were selected from the Level III Idaho Batholith ecoregion, whereas DEQ data was selected from Middle Rockies because Idaho Batholith data did not exist. Reference site geology consisted of intrusive igneous or sedimentary rock types which reflected the lithologies captured from 2019 sample sites. Thresholds were calculated by comparing mean values from 2019 site data (**Table 3-2**) to selected reference data (**Table 3-1**) in non-parametric Wilcoxon sign-rank tests ($\alpha < 0.25$).

Therefore, DEQ used both the PIBO reference data and 2011 targets to evaluate three waterbodies (Buck, Ditch and Reimel creeks). These target values include riffle percent fines less than 6mm and less than 2mm; and grid toss pool tail percent fines less than 6mm (**Table 3-1)**. Data were collected from three sites on Buck, Ditch, and Reimel creeks by DEQ in September 2019 and included width/depth and entrenchment ratio data (**Appendix C**) to compare to target values. None of the three waterbodies evaluated met the target values for fines, except for Reimel Creek, which met the target for mean pool percent fines less than 6mm (**Table 3-2**). A very simple evaluation comparing the 2005 TMDL data to data collected in September 2019 suggests that sediment/siltation in Ditch and Buck Creeks has increased, while Reimel has decreased (improved).

Table 3-1. 2011 Bitterroot Tributary Sediment TMDL target values and PIBO reference data values

Dataset	Mean Riffle % <6mm	Mean Riffle % <2mm	Mean Pool % <6mm
2011 Bitterroot Tributaries TMDL targets	14%	8%	10%
PIBO reference site data from Idaho Batholith and Middle Rockies ecoregions (1991-2019) (n=62)	14%	11%	16%

Table 3-2. 2019 DEQ monitoring site data from the Bitterroot Headwaters TPA compared to 2011 TMDL targets and PIBO reference data

Stream	Date Visit	Mean Riffle % <6mm	Mean Riffle % <2mm	Mean Pool % <6mm
Buck Creek	9/16/2019	**51%***	**28%***	**44%***
Ditch Creek	9/16/2019	**59%***	**35%***	**41%***
Reimel Creek	9/17/2019	**27%***	**21%***	8%
***** *indicates target exceedance*				

A TIE was completed for Reimel Creek in 2016 (Montana Department of Environmental Quality, 2016). That document concluded that all reasonable land, soil, and water conservation practices had been implemented in Reimel Creek and recommended that an assessment of beneficial use support be completed, based on field observation. In 2020 DEQ initiated a sediment/siltation assessment of Reimel Creek aimed at determining whether Reimel Creek should be removed from the Impaired Water Bodies List. This effort is ongoing.

The U.S. Forest Service conducts PIBO monitoring at 17 sites within the Bitterroot Headwaters TPA. Of those sites, two are located on streams that are currently listed as impaired (East and West Fork Bitterroot River). **Table 3-3** provides data comparing East and West Fork Bitterroot PIBO sediment data with Idaho Batholith and Middle Rockies PIBO reference sites and 2011 Bitterroot tributaries TMDL targets (**Table 3-1**). The PIBO data from the East Fork Bitterroot site suggests some sediment targets are being met, while the West Fork Bitterroot River PIBO site data suggests continued sediment impairment.

Table 3-3. Sediment evaluation reference targets and Forest Service PIBO data for Site IDs 268 (East Fork Bitterroot River) and 264 (West Fork Bitterroot River)

STREAM	Date Visit	Mean Riffle % <6mm	Mean Riffle % <2mm	Mean Pool % <6mm
EF Bitterroot	7/19/2003	11%	7%	ND
EF Bitterroot	7/26/2008	9%	6%	ND
EF Bitterroot	8/4/2013	4%	2%	ND
EF Bitterroot	8/8/2018	1%	0.3%	ND
WF Bitterroot	8/27/2004	**93%***	**91%***	ND
WF Bitterroot	8/21/2009	**23%***	**13%***	ND
WF Bitterroot	09/1/2014	**35%***	**28%***	ND
: * indicates target exceedance; ND: No data				

Other monitoring done by the Bitterroot National Forest includes 2014-2015 Bitterroot National Forest road BMP monitoring, and large woody debris (LWD) and pool frequency in Buck and Ditch Creek (King, 2017a,b).

Bitterroot National Forest fisheries biologists conduct monitoring of supplemental indicators (pools, large wood, and residual pool depth) in the following reaches of the Bitterroot Headwaters: East Fork (two reaches); Reimel; Gilbert; Laird; West Fork Bitterroot (2 reaches); Hughes (two reaches); Ditch, and Buck. Each reach is monitored every five years. This monitoring commenced in 2005 and continues to this day.

The Bitterroot National Forest (BNF) provided DEQ with a document titled "Bitterroot National Forest Monitoring – Headwaters TMDL Area (Jakober and Wildey, 2019). This document provides a summary of Forest Service staff BMP monitoring between 2009 and 2018. Activities monitored included: grazing, prescribed fire, ditch management, timber management, road decommissioning and storage, dispersed recreation sites, and road management.

3.2.2 Temperature Impairments-Related Monitoring

The Montana Department of Fish Wildlife and Parks (FWP) has collected water temperature data in the Bitterroot Drainage starting as early as 1993. Of five temperature listed streams in this TPA (East and West Fork Bitterroot River, Nez Perce, Overwhich, and Hughes Creek), all except Hughes Creek show an annually increasing trend in the annual sum of average daily temperatures (degree days) for the period July 19 – September 30 (Jason Lindstrom, FWP personal communication, June 2020).

The Bitterroot National Forest maps, reports, and tracks forest fires larger than 1,000 acres that have occurred on forest lands since 1984 through a database "Monitoring Trends In Burn Severity (MTBS)." The data is accessible via the website: https://www.mtbs.gov . **Table 3-3** below, lists the fires, size and year of fires that are tracked in the database since the completion of TMDLs in the Bitterroot Headwaters TPA. A review of the National Interactive Burn Severity Fire map indicates that between 2005 and 20017 there were 7 wildfire fires, larger than 1,000 acres, that burned a total of approximately 88,000 acres in the Bitterroot Headwaters TPA. The data indicates that over 14% of the watershed burned in last 12 years. **Figure 3-1** shows the location of those fires.

Table 3-4. Forest-fire burns greater than 1,000 acres (name, year and size) in part or whole in the Bitterroot Headwaters TMDL Planning Area between 2005 and 2017.

FIRE NAME	FIRE YEAR	Fire Acres in Bitterroot River Headwaters
Rombo	2007	29,075
Woods Pass	2011	15,864
Mustang Complex	2012	12,253
GoldPan	2013	3,479
Chrandal Creek	2012	2,447
Bare Peak	2006	2,237
Cougar	2012	1,304

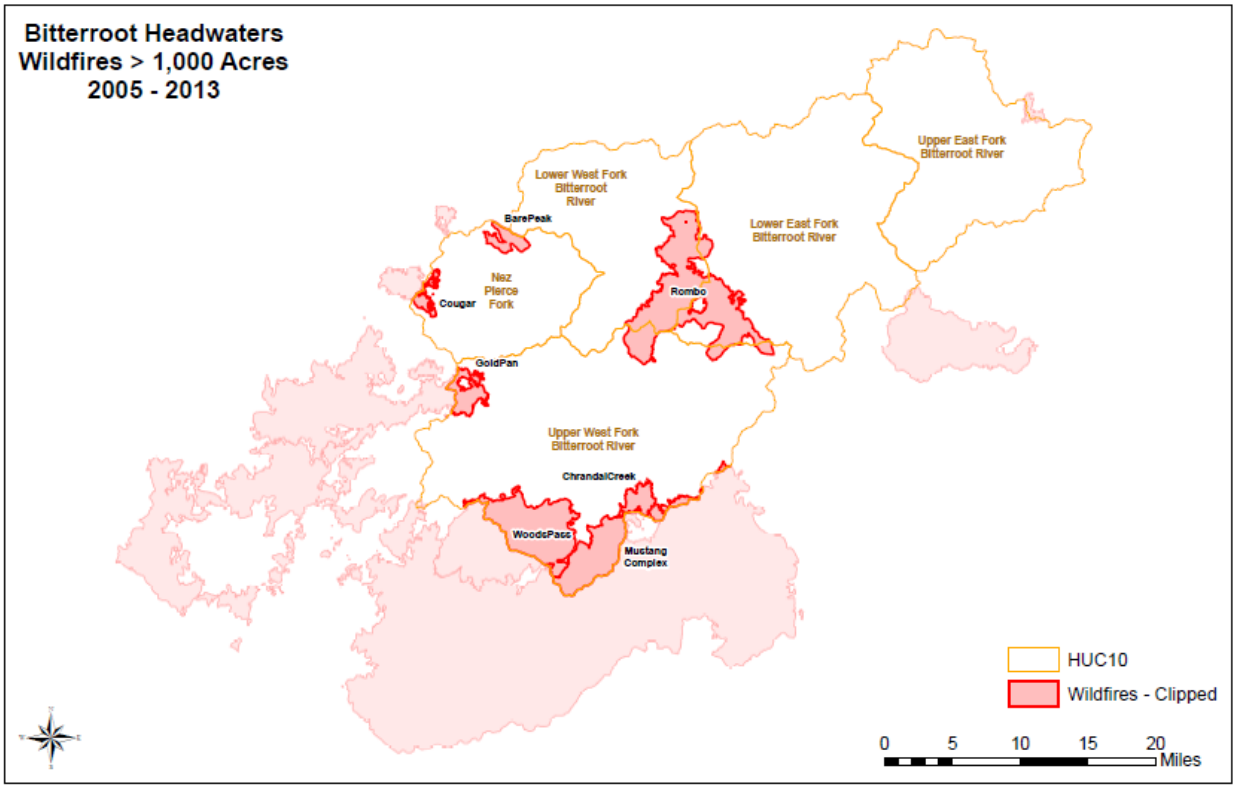

Figure 3-1. Bitterroot Headwaters watershed fire locations between 2005 and 2017.

Research suggests (DEQ, 2019b) that wildfire and climate change can have a significant role in increasing stream temperature.

Based on the individual stream reach temperature data for the five thermally-impaired listed streams in this TPA, and historical and research/model-based information (Isaak, 2010), these streams do not likely meet the targets set in the TMDL (12°C for higher elevation streams and 15°C for lower elevation streams). Higher elevation streams are those in the BRHW generally above 5,200' in elevation.

3.3 PLANNING

The Bitter Root Water Forum completed a Bitterroot Watershed Restoration Plan (WRP) in March 2014 that was accepted by DEQ. This plan includes the Bitterroot Headwaters and Bitterroot Mainstem TPAs. The East Fork Bitterroot River is identified in the WRP as a "Level 1" stream, that has "… restoration momentum and for which we envision good progress being made over the next 5 years to achieve goals outlined in the WRP." The Forum updated the existing plan in 2019 and the updated WRP was accepted by DEQ in January 2020.

Trout Unlimited surveyed a subset of water diversions in the Bitterroot, which included two survey locations in the East Fork Bitterroot and six in the West Fork Bitterroot watershed ("Upper Bitterroot Irrigation Diversion Inventory and Prioritization", Trout Unlimited, 2017). The primary project objectives were to:

1. Complete an inventory of diversion structures and fish entrainment on priority streams in the Upper Bitterroot basin
2. Consolidate existing fisheries data from FWP, Bitterroot National Forest (BNF) and other regional studies of fish passage and entrainment
3. Prioritize and develop recommendations for viable projects to reduce entrainment or improve fish passage

In August 2020, Trout Unlimited installed a new fish screen on a diversion from the upper West Fork Bitterroot River. A similar screen is scheduled to be installed on a diversion from the upper East Fork Bitterroot River in October 2020.

4.0 RECOMMENDATIONS FOR ADDITIONAL WORK

Recommendations for additional restoration work are outlined below. It may be possible to meet TMDL targets and water quality standards by implementing all or some of the described activities, or by implementing a different set of actions.

- Continue implementation of road BMPs, culvert replacements (upsizing to meet current Forest Service road standards), and road closing, storage and decommissioning where appropriate.
- Reduce road and home construction encroachment on riparian areas.
- Implement grazing BMPs (e.g., riparian fencing, off-stream watering, grazing management) to reduce streambank instability/ sediment.
- Prioritization and restoration of thermal sources (roads, riparian cover, over-widened channels, mines and impervious surfaces).
- Implement recommendations for viable projects to reduce fish entrainment (fish screens), improve fish passage and instream flows.
- Continue PIBO monitoring. Consider additional sites in sediment-listed impaired waterbodies.
- Continue collaboration with partnering agencies and landowners to promote vegetation management that will allow for restoration of a natural fire regime. Address hazardous fuels build-up, especially within the wildland-urban interface, through use of vegetative thinning, prescribed fire, and natural wildfire, where feasible.
- In watersheds where waterbodies continue to be listed for sediment/siltation and where timber harvest or fire mitigation activities are planned, a new or improved phase of RCPs is necessary.

5.0 CONCLUSIONS

Please see **Appendix A – Conclusions Table** for a detailed explanation of conclusions reached in the Bitterroot Headwaters TMDLs Implementation Evaluation. A summary is provided below in **Table 5-1.**

Table 5-1. Bitterroot River Headwaters Current Impaired Waterbody Conclusions

Waterbody	AU ID	Impairment(s)	Conclusion
Buck Creek	MT76H003_070	Sediment/siltation	1
Ditch Creek	MT76H003_060	Sediment/siltation	1
East Fork Bitterroot River	MT76H002_010	Sediment/siltation Temperature	1 1
Gilbert Creek	MT76H002_080	Sediment/siltation	1
Hughes Creek	MT76H003_040	Sediment/siltation Temperature	1 2
Laird Creek	MT76H002_070	Sediment/siltation	1
Nez Perce Fork	MT76H003_020	Temperature	1
Overwhich Creek	MT76H003_050	Temperature	1
Reimel Creek	MT76H002_020	Sediment/siltation	2
West Fork Bitterroot River	MT76H003_010	Sediment/siltation Temperature	1 1

1: Implementation of improved phase of RCPs is needed to achieve water quality standards
2: Additional monitoring is needed to determine if water quality standards have been met

APPENDIX A. CONCLUSIONS TABLE

Table A1 – Conclusions

Waterbody Pollutant	Conclusion*	Justification/Recommendations
MT76H002_010 E Fork Bitterroot – siltation	1	30.4 miles of road decommissioning (Meadow Vapor Project (2016-17) in 5 HUC-12 sub-basins 0.5 miles of road decommissioning (Martin Creek watershed restoration project, 2013) 5.3 miles of road decommissioning, 2.3 miles road stored (Martin Creek Watershed Restoration project 2014-15) 1.3 miles road maintenance on FR 5727 in riparian (2014-15) Grazing practices to improve riparian -Meadow Tolan allotment (2010-13) 16.5 miles road storage and decommission – Martin Creek Watershed Restoration (2010-13) Culvert replacement on FR 370 -Warm Springs (2010-13) 1.7 miles road graveled adjacent to stream channel – Robbin Gulch (2010-13) Improve grazing -Sula Peak East Fork Allotment Management Plan (2010-13) 3.7 miles road storage and decommission – Martin Creek Watershed Restoration Plan – Meadow Creek (2010-13) 1.3 miles road storage and decommission – Martin Creek Watershed Restoration Plan – Cameron Creek (2010-13 1.4 miles road storage and decomm. – Martin Creek Watershed Restoration Plan – Kerlee and Guide Creeks (2010-13) 1.9 miles road storage – stream crossings revegetated - Middle E Fork, Jennings Camp (2008) Undersized culvert replaced with bridge – FR 5759 Meadow Creek (2008) Fish passage culvert installed, dips and gravel crossing FR5753 Mink Creek (2008) Storage (seed, mulch, fertilize), remove 3 crossings, of FR 73259, 73260, 73261. Ditch seeding of FR 5778 (2007) 9.6 miles road decommission- FR 73258, 73262, 73213 (2007) 1.1 miles road storage – 73691, remove undersize culvert, restore crossing on FR 73702 – Warm Springs (2006) Improve 2 crossings to reduce erosion of FR 73253 – Jennings Camp (2006) 0.25 miles road storage, remove crossing FR 73313, 73315 (2005) 1.9 miles road gravel next to stream – FR 723 – Jennings Camp (2005) 2.8 miles road storage of FR 73424, 73693, 73692 - Warm Springs (2005) 3 acres of additional riparian fencing (to existing 4 acres) for exclusion of cattle – Meadow Creek (2005) 2 miles road BMP upgrades of FR 723 – Jennings Camp (2004) 11.6 miles road BMPs, inc. install of 46 culverts, 25 drain dips, 4.7 miles gravel, of FR 370 – Warm Springs. (2004) (Wildey and Jakober, Bitterroot NF 2019). PIBO site in upper East Fork Bitterroot watershed (ID #268). Monitored in July 2003, July 2008, August 2013 and August 2018. **D-50**: 6.7, 13.5, 8.5, 8.1; **% pool tail fines <2mm**: 7.2, 5.7, 2.1, 0.3; **% pool tail fines <6%**: 11.2, 8.6, 4.2, 1.2. The data shows this PIBO site consistently meeting limited (pool tail fines) sediment reference targets. Bitterroot NF fisheries biologists and hydrologists conduct annual BMP implementation and effectiveness monitoring for management activities associated with livestock grazing, prescribed fire, ditches, timber, road decommissioning, burned

		areas, and recreation. Reports are generated biennially. In general, the monitoring has found that effects have met activity expectations. (Jakober and Wildey, Bitterroot NF 2019). 5 riparian exclosures or drift fences associated with grazing allotments in tributary watersheds (Meadow, Waugh, Bugle, Reimel) are monitored annually by fisheries biologists and range specialists. All have been found to meet fisheries and watershed objectives (2016-18). (Jakober and Wildey, 2019). Monitoring period 2010 -13: Measurement of substrate composition (pebble counts) at 5 sites on the East Fork began in 2000 and continued in 2013. Particles sampled continued to be within the range of sizes established over the 13-year monitoring period (Jakober and Wildey, 2019) and are below the threshold for percent fines in the TMDL for similar stream types. Stable pool frequency and large woody debris monitored over 10 years (King, Bitterroot NF, 2017) Upstream and instream sources have not been adequately addressed.
MT76H002_010 E Fork Bitterroot – thermal		1993 – 2019 annually increasing trend in the sum of average daily temperatures for the period July 19 – September 30 (Lindstrom, FWP 2020). FWP historical record of temperature data suggests thermal impairment listing is appropriate.

MT76H002_020 Reimel - Siltation	2	2 miles of road maintenance on FR 727, located mostly in riparian (2014-15) Relocate FR 727 away from stream, obliterate sections of road adjacent to stream, 1.1 miles gravel of streamside sections and crossings, install cattle guards for better riparian graving management (2005) Grazing exclosure fence (Camp Reimel grazing allotment) (2001). (Wildey and Jakober, Bitterroot NF 2019). Grazing monitoring by Bitterroot NF in 2016-18. No or limited livestock use in 2001-02, 04, 06, 08-16. Planted shrubs growing well, channel narrowing, beaver have colonized stream. Fisheries and watershed objectives met. All reasonable land, soil and water conservation practices appear to be implemented (downstream private lands?) Increased pool frequency and large woody debris monitored in 2004, 2009, and 2014 (King, Bitterroot NF, 2017) Riparian is actively recovering. Wetland deciduous shrub community. Vigorous young and mature alder and willow, some aspen. Riparian buffer quality is medium-to-high and is at 50-75% of potential. Well shaded, but riparian area is narrow. Site is fenced, no current grazing (DEQ 2019 TIE monitoring). DEQ 2019 sediment monitoring suggests reassessment of siltation impairment listing is appropriate.

MT76H002_070 Laird – siltation	1	Repair of road instabilities and grading of FR 370 (2014-15). (King, Bitterroot NF 2017). Increased pool frequency and large woody debris monitored in 2004, 2009, and 2014 (King, Bitterroot NF, 2017) DEQ 2019 visual field review suggests that sediment impairment listing is appropriate.
MT76H002_080 Gilbert – siltation	1	Repair of road instabilities and grading of FR 5732 (2014-15) 11 miles road storage and decommission (2008) 9.4 miles road storage and decommission (2004). (Wildey and Jakober Bitterroot NF 2019) Increased pool frequency and large woody debris monitored in 2004, 2009, and 2014 (Julie King, Bitterroot NF, 2017) DEQ 2019 visual field review suggests that sediment impairment listing is appropriate.

MT76H003_010 W Fork Bitterroot – Siltation	1	0.4 miles riparian shrub planting (2016-17) 5.75 miles of road graveled near streams (2016-17) 2 culverts removed (2016-17) 3 culverts removed FR 13410, revegetation, inc. shrubs (2014-15) Improve dispersed recreation sites to protect streams, harden boat launch, gravel road access (2010-2013) 4.2 miles road storage and decommissioning Elk Creek (2010-13) 19.2 miles road storage and decommission Piquette Creek (Lower West Vegetation Management (2010-13) 8.4 miles road storage and decommission W Fork Lloyd Creek (Lower West Vegetation Management (2010-13) Remove crossing, revegetate, recontour FR 5672, Woods Creek (2008) Grazing drift fence installed to protect 6 acres of riparian from livestock – Coal Creek (2007) 0.8 miles road storage, remove 3 crossings of FR 74060, 74137, 74138 – Coal Creek [trib to Painted Rocks Lake. DROP?] 1.8 miles road storage of FR 13431 – Piquette Creek (2007) 3 miles of FR BMP upgrade – Pierce Creek, Lloyd Creek (2005). (Wildey and Jakober Bitterroot NF 2019) PIBO site in upper West Fork Bitterroot watershed (ID #264). Monitored in August 2004, August 2009, and September 2014. **D-50**: 2.5, 2.9, 2.6; **% pool tail fines <2mm**: 91.4,12.6, 28.2**; % pool tail fines <6%**: 93.4, 22.9, 35.3. The data shows this PIBO site consistently exceeding (not meeting) limited sediment reference threshold values. Stable pool frequency and increased large woody debris monitored over 10 years (King, Bitterroot NF, 2017) Bitterroot NF fisheries biologists and hydrologists conduct annual BMP implementation and effectiveness monitoring for management activities associated with livestock grazing, prescribed fire, ditches, timber, road decommissioning, burned areas, and recreation. Reports are generated biennially (Jakober and Wildey, 2019).

		1 riparian jackleg drift fence (1,100') associated with the Coal Creek grazing allotment (constructed in 2007) is monitored annually by fisheries biologists and range specialists. No livestock access, found to meet fisheries and watershed objectives (2016-18) (Jakober & Wildey, 2019).
MT76H003_010 W Fork Bitterroot - thermal	1	1994 – 2019 annually increasing trend in the sum of average daily temperatures for the period July 19 – September 30. (Lindstrom, FW&P 2020). FW&P historical record of temperature data suggests thermal impairment listing is appropriate.
MT76H003_020 Nez Perce – thermal	1	1.1 miles streambank improved (Nez Daly Railroad riparian restoration project – 2016-17). (Wildey and Jakober, Bitterroot NF 2019). 1996-2019 annually increasing trend in the sum of average daily temperatures for the period July 19 – September 30. (Lindstrom, FW&P 2020.) FW&P historical record of temperature data suggests thermal impairment listing is appropriate.
MT76H003_040 Hughes – Siltation	1	Relatively stable pool frequency and large woody debris monitored in 2004, 2009, and 2014 (King, Bitterroot NF, 2017)
MT76H003_040 Hughes – Thermal	2	Only thermally-listed Bitterroot Headwaters stream with 1998 – 2019 annually decreasing trend of average daily temperatures for the period July 19 – September 30. Currently no explanation for this trend. (Lindstrom, FWP 2020). USFS- managed riparian. Historical dredge mining throughout watershed, recreational suction dredge mining continues. Riparian consists of mixed vegetation – alder, willow, dogwood, fir, Ponderosa Pine. Healthy riparian. Over-wide channel leaves it only partially shaded where tall conifers are absent. Floodplain contains all age classes of conifers and young deciduous vegetation and shrub ground cover. Plentiful large woody debris. Slowly eroding 3' banks. (DEQ 2019 TIE monitoring). FWP historical record of temperature data suggests thermal impairment listing should be evaluated, given decreasing trend in average summer daily degree days.

MT76H003_050 Overwhich – Thermal	1	1995 – 2019 annually increasing trend in the sum of average daily temperatures (degree days) for the period July 19 – September 30 (Lindstrom, FWP, 2020). FWP historical record of temperature data suggests thermal impairment listing is appropriate.

MT76H003_060 Ditch – Siltation	1	Directional felling of dead conifers adjacent to FR 66E to prevent illegal firewood cutting in riparian area (2014) 5 stream crossings graveled and drain dips installed – FR 5715 (2008). (Wildey and Jakober Bitterroot NF, 2019) Increased pool frequency and decreased large woody debris monitored over 10 years (King, Bitterroot NF, 2017) 100% stable stream bank, very brushy. Riparian: Ponderosa pine (sparse), fir, few scattered aspen, mostly dogwood, alder shrub understory. No large woody debris. Pools common but shallow. 50-75% left bank encroachment by road w/in 25'. (Jakober, Bitterroot NF 2017 I-walk). Highly roaded, managed watershed. Historically logged, young conifers in uplands. Mixed conifer, deciduous riparian with shrub and wetland ground cover, with mosses and mushrooms. All age classes present, except pines are mature or decadent. Healthy diverse understory. Conifers are offset from stream channel. Shaded dense riparian understory with somewhat open canopy. Road encroachment on river right but highly vegetated 20' buffer Riparian buffer quality is high, 75-100% of potential. (DEQ 2019 TIE monitoring). Pool fines < 2%, and <6%, pool tail grid toss % fines exceeded sediment fine thresholds and indicate continued sediment impairment. (DEQ 2019 TIE monitoring).

MT76H003_070 Buck - Siltation	1	4 stream crossings graveled – FR 5715 (2008) 2 stream crossings graveled – FR 8186 (2008) Increased pool frequency and large woody debris monitored in 2004, 2009, and 2014 (King, Bitterroot NF, 2017) Mostly stable and vegetated streambank, meanders within well confined banks, undercut banks common. Single-thread channel. Riparian: Ponderosa pine, conifers in upper section, dogwood, alder, brushier lower section. Overstory canopy low, but understory canopy high. No road encroachment. (Jakober, Bitterroot NF 2019 I-walk) Roaded and managed watershed but no recent logging. Shrubs, mixed conifer/deciduous riparian, bank edges covered in moss & decaying woody debris, grasses further from bank. Decadent Doug fire, young and mature alder. Riparian buffer at 100% of potential. No grazing. Fully shaded site. (DEQ 2019 TIE monitoring). Pool fines < 2%, and <6%, pool tail grid toss % fines exceeded sediment fine thresholds and indicate continued sediment impairment. (DEQ 2019 TIE monitoring).

*****Conclusions are limited to one of the three specific conclusions identified in 75-5-703(9) MCA. In this column, the three possible conclusions will be denoted by individual numbers as described below:
1 – The implementation of a new or improved phase of voluntary reasonable land, soil, and water conservation practice is necessary.
2 – Water quality is improving but a specified time is needed for compliance with water quality standards.
3 – Revisions to the TMDL are necessary to achieve applicable water quality standards.

**In these instances, the typical three conclusions are superseded by complicating factors in statute, or a lack of sufficient information in order to draw defensible conclusions.

APPENDIX B – CONSULTED SOURCES

Appendix B – Contacts, Publications and Databases

Author(s), Date	Title	Brief Content Description	Source Location
Bitter Root Water Forum, 2014	Bitterroot Watershed Restoration Plan		\\Deqwq001\wq\WQP\4_Watershed_Protection\Nonpoint_Source_Program\Watershed_Restoration_Plans\DEQ-AcceptedWRPs\Bitterroot_WRP_FINAL_07152014.pdf
Bitter Root Water Forum, 2020	Bitterroot Watershed Restoration Plan Update		\\Deqwq001\wq\WQP\4_Watershed_Protection\Nonpoint_Source_Program\Watershed_Restoration_Plans\DEQ-AcceptedWRPs\Bitterroot_WRP_FINAL_01132020.pdf
Department of Environmental Quality (Montana), 2004	Montana 2004 Final Water Quality Integrated Report	Clean Water Act Sections 305(b) and 303(d) Integrated Report	2004 Integrated Report
DEQ, 2005	Water Quality Restoration Plan and Total Maximum Daily Loads (TMDLs) for the Bitterroot Headwaters Planning Area		http://deq.mt.gov/Portals/112/Water/WQPB/TMDL/PDF/BitterrootHeadwaters/C05-TMDL-02a.pdf
DEQ, 2011	Bitterroot Temperature and Tributary Sediment TMDLs		http://deq.mt.gov/Portals/112/Water/WQPB/TMDL/PDF/BitterrootTribsTempSed/C05-TMDL-03a.pdf
DEQ, 2015	Sediment and Habitat Field Method for Wadeable Streams		\\Deqwq001\wq\WQP\3_Monitoring_Assessment\1_MAS_Guidance\2_Pollutants\Sediment\1_AssessmentMethod\Sediment_Method_Paul\FINAL_DRAFT_SedimentWhitePaper_V7.docx
DEQ, 2016	Reimel Creek TMDL Implementation Evaluation		http://deq.mt.gov/Portals/112/Water/WQPB/TMDL/PDF/BitterrootHeadwaters/C05-TMDL-02aReimel_TIE.pdf
DEQ, 2019a	Bitterroot Headwaters Monitoring Project Plan (Robert Ray)		\\Deqwq001\wq\WQP\4_Watershed_Protection\Nonpoint_Source_Program\TMDL_Implemention_Evaluations\TIEs_Working\BitterrootHeadwaters\BitterrootHeadwatersTIEProjectPlanOctober2019.docx
DEQ, 2019b	Lou Volpe email April 4, 2019, Subject “Wildland Fire Effects on Water Quality	Includes several links to USFS wildfire impact models and references on wildland fire effects on Water quality	Personal communication

DEQ, 2020	Chris Faubion email with Bitterroot sediment threshold values	Personal Communication on Bitterroot sediment threshold values, based on Montana and Idaho reference site data for same geology	Personal communication
Isaak et al., 2010	Effects of climate change and wildfire on stream temperatures and salmonid thermal habitat in a mountain river network.		Ecological Applications [Journal] 20(5). Journal of the Ecological Society of America, pp 1350 - 1371
Jakober and Wildey, 2019	National Forest Monitoring - Headwaters TMDL Area	Summary of biennial Forest Plan Monitoring Reports 2009 - 2018 by S Zone Fisheries Biologist; Hydrology Technician; Bitterroot National Forest Bitterroot	https://www.fs.usda.gov/detail/bitterroot/landmanagement/planning/?cid=fseprd490792
King, 2017a	Letter dated March 2, 2017	Bitterroot National Forest Supervisor request to DEQ for evaluation of Buck Creek sediment-impairment listing. Includes sediment reduction BMPs implemented, BMP and aquatic monitoring data, photographs of work completed in Buck Creek watershed.	Bitterroot National Forest, Supervisor's Office. 1801 North First Street, Hamilton MT 59840 (406) 363-7100. File code: 2500.
King, 2017b	Letter dated March 6, 2017	Bitterroot National Forest Supervisor request to DEQ for evaluation of Ditch Creek sediment-impairment listing. Includes sediment reduction BMPs implemented, BMP and aquatic monitoring data, photographs of work completed in Ditch Creek.	Bitterroot National Forest, Supervisor's Office. 1801 North First Street, Hamilton MT 59840 (406) 363-7100. File code: 2500.
Paul Kusnierz, Andy Welch, and Darrin Kron. 2013	The Montana Department of Environmental Quality Sediment Assessment Method: Considerations, Physical and Biological Parameters, and Decision Making.		Helena, MT: Montana Dept. of Environmental Quality
Lindstrom, 2020	Bitterroot River Temperature Data	Montana Department of Fish, Wildlife and Parks Bitterroot River and tributary water temperature monitoring data. Recorded hourly from July 19 – September 30, period of record, for some sites, extends back to 1993	Bitterroot Fisheries Biologist, 1801 North First Street, Hamilton MT 59840 (406) 363-7169. Jason.Lindstom@mt.gov
Trout Unlimited, 2017	Upper Bitterroot Irrigation Diversion Inventory and Prioritization	Report prepared for Bitterroot Conservation District on irrigation diversion structures in upper Bitterroot watershed and prioritization for bull trout conservation.	\\Deqwq001\wq\WQP\4_Watershed_Protection\Nonpoint_Source_Program\TMDL_Implemention_Evaluations\TIEs_Working\BitterrootHeadwaters\TU_Irrigation\Bull Trout Passage and Entrainment Inventory.pdf
U.S. Environmental Protection Agency, 2015	Section 319 Nonpoint Source Program Success Story Montana U.S. Forest Service Improves Water Quality In Meadow Creek		https://www.epa.gov/sites/production/files/2015-11/documents/mt_meadow.pdf

U.S. Forest Service	Monitoring Trends in Burn Severity" database	GIS-based database that provides forest fire burn-severity for fires greater than 1,000 acres in size, based on Landsat imagery going back to 1984.	Data is available on-line at: https://www.mtbs.gov
U.S. Forest Service, 2020	PacFish-Infish Biological Opinion Monitoring Program	Physical, biological water quality and habitat data collected by U.S. Forest Service associated with Endangered Species Act inland fisheries listed species in northwestern U.S. National Forests biological opinion [i.e. bull trout in western Montana waters]	U.S. Forest Service, Rocky Mountain Experimental Station, 860 North, 1200 East, Logan, Utah 84321
Wildey and Jakober, 2019	Summary of Watershed Improvement Projects - Montana Portion of Bitterroot National Forest 2001 – 2018	Table format with Bitterroot National Forest Watershed Improvement Projects, listed by biennium. Affected streams, HUC, project, decision date, and activity and unit of measure. Also GIS-generated maps with project locations indicated, by geographic area. Hydrology Technician, South Zone Fisheries Biologist; Bitterroot National Forest	Bitterroot National Forest, Southern portion 1801 North First Street, Hamilton MT 59840 (406) 363-7100

APPENDIX C – SEPTEMBER 2019 DEQ SEDIMENT MONITORING DATA

Bitterroot Headwaters Sediment Impairment Data													
Stream/site	Who/When	Lat/Long	TMDLChannelType	D-50 (mm)	GTPoolTailFines<6mm	GT%Fines<6mm	PebbleCount%<2mm	PebbleCount%<6mm	BankfullWidth(ft)	MeanDepth(ft)	Width/Depth	EntrenchRatio	
Reimel1-(	DEQ '19	45.8229/-1	C4	23.5	8.2% (12/147)	8	21	27	7.4	0.88	8.7	4.7	
Reimel1	DEQ '13	45.8227/-1	C4	15.8		12.6	14.6	24.94					
Reimel2	DEQ '13	45.7953/-1	B4	16.7		18	3.08	11.8					
ReimelD	BRNF '03	45.80905/-	C4	25			24	25					
ReimelU	BRNF '03	45.8079/-1	B4	24			30	31					
		45.7903/-113.9252?											
Buck-(site	DEQ '19	45.78485/-	B4	5.9	43.5% (64/147)	43	29	50	5.2	0.66	7.9	8.1	
Buck	BRNF '19	45.78411/-	B4	5.2			40	53			3.5-23.3		
Buck	BRNF '03	45.783/-11	B4	12			32	32					
Ditch-(site	DEQ '19	45.75649/-	B4	5.2	40.8% (60/147)	41	35	59	22	0.84	28.4	3.4	
Ditch	BRNF '19	45.75633/-	B4	2			50	68					
Ditch	BRNF '03	45.754/-11	B4	7			45	45			3.5-20		
												Target Not Met	
2011 Bitterroot Mainstem Tribs targets						< 10	<8	<14			<16	>2.5	
2005 Bitterroot Headwaters B4 Targets				7 - 64			<27	<38					
2005 Bitterroot Headwaters C4 Targets				3 - 47			<32	<49					