2020 319 Application Form

PART A—GENERAL INFORMATION

Project Name: Middle Fork West Fork Gallatin River Restoration

Sponsor Name: Gallatin River Task Force

Registered with the Secretary of State? Y

Registered with SAM? Y

Duns # 010769366

Does your organization have liability insurance? Y

Primary Contact: Kristin Gardner	Signatory: Rick Donaldson
Title: Executive Director	Title: Board Chair
Address: PO Box 160513	Address: PO Box 160513
City: Big Sky State: MT Zip Code: 59716	City: Big Sky State: MT Zip Code: 59716
Phone Number: 406-993-2519	Phone Number: 406-993-2519
Email Address: kristin@gallatinrivertaskforce.org	Email Address: rdonaldson@3rivers.net
Signature:	Signature:

Technical and Administrative Qualifications

Technical and administrative support for this project will be provided by the Gallatin River Task Force (Task Force), Trout Unlimited, and RESPEC Company LLC (RESPEC). Task Force staff supporting this project includes Executive Director Kristin Gardner, PhD, Director of Development, Ryan Newcomb, Finance and Operations Associate, Stefanee Lucksley, Conservation Project Manager, Emily O'Conner. Trout Unlimited staff supporting this project includes Upper Missouri and Yellowstone Project Manager Jeff Dunn, who provided support during the Upper Gallatin TMDL assessments conducted between 2005 and 2010 and managed the recently completed Upper West Fork Nitrogen & Sediment Reduction Project. RESPEC staff supporting this project includes Mike Rotar and Matt Johnson, both of whom are professional water resources engineers and certified floodplain managers.

Past and Current Projects

Project Name	Grant or Contract Amount	Funding Entity *(entity name/program, contact person, phone, email)*	Completion Date
Upper West Fork Nitrogen & Sediment Reduction Project	$ 130,000.00	Montana Department of Environmental Quality 319 Nonpoint Source Funding Mark Ockey, 406-444-5351, mockey@mt.gov	December 2017
Moose Creek Flat River Access Improvement Project	$ 220,000.00	Custer Gallatin National Forest Recreation Program Wendi Urie, 406-587-6757, wendi.urie@usda.gov	May 2018
Big Sky Sustainable Water Solutions Forum	$ 278,000.00	Big Sky Resort Area Resort Tax Funding Daniel Bierschwale, 406-995-3234, info@resorttax.org	January 2018

FUNDING REQUEST

319 Funds Requested *(**including** administrative fee)*	$ 154,400.00
State Cash Match	
Local Cash Match	$ 108,050.00
In-Kind Match	
Federal Funds	
Other Funds *(not 319, not match, not federal)*	$ 0.00
Total Project Cost	$ 262,450.00

Administrative Fee *(not to exceed 10% of total 319 funding request)*	$ 15,000.00
Total Non-Federal Match	$ 108,050.00

PART B—PROJECT INFORMATION

Part B must be filled out separately ***(including providing separate attachments)*** for each project included in your application. Use the following examples to help determine when to lump and when to split projects. If additional clarification is needed, contact Mark Ockey, at 406-444-5351 or mockey@mt.gov.

Splitting Examples (fill out multiple Part B's)

- Stream restoration work occurring on two separate streams, on parcels owned by two separate individuals
- Two projects with significantly different sets of project partners
- Two projects that address substantially different pollution sources (e.g., one project that moves a corral off of a stream, and another to remove mine tailings, with both projects being on the same 800-acre recreational property)

Lumping Examples

- Contiguous stream restoration work spanning multiple land parcels
- 3 projects that address similar sources of pollution on a single land parcel (e.g., moving a coral off a stream, implementing a grazing management plan, and relocating a manure storage facility out of the floodplain, all on the same ranch)
- A mini-grant program designed to address numerous failing septic systems scattered throughout a watershed

Project *(sub-project)* Name B1- Upper Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction

Total Project Cost *Include costs already incurred, as well as anticipated costs, from all sources, for all aspects of the project.* $ 262,450.00

Latitude 45.29192 Longitude -111.40438

Latitude 45.28904 Longitude -111.39657

Map Y

Latitude Longitude

12 Digit HUC #(s) 100200080202

Waterbody Name from 2018 List of Impaired Waters Middle Fork West Fork Gallatin River

Probable Causes of Impairment to be Addressed sedimentation/siltation, nitrate+nitrite, E. coli

Waterbody Name from 2018 List of Impaired Waters

Probable Causes of Impairment to be Addressed

Project Summary - Briefly describe the ***nature and extent*** of the problem, the ***root causes*** of the problem, and your ***proposed solution***.

Nature and Extent of the Problem:
The Middle Fork West Fork Gallatin River is a tributary to the West Fork Gallatin River flowing approximately 6 miles from its headwaters on Lone Mountain to its confluence with the North Fork West Fork Gallatin River. In 2010, The West Fork Gallatin River Watershed Total Maximum Daily Loads (TMDLs) and Framework Watershed Water Quality Improvement Plan (DEQ 2010) provided TMDLs for sediment, nitrate+nitrite (NO^3+NO^2) and E. coli in the Middle Fork West Fork Gallatin River.

Root Causes of the Problem:
Excess sediment is contributed from roads, resort development, recreation, and historic riparian vegetation removal. Sediment impairments, including the non-pollutant "alteration in stream-side or littoral vegetation covers" impairment, are described in the TMDL document as excess fine sediment in riffles and pool tails and low residual pool depths upstream of Lake Levinsky. Excess nutrients (nitrate+nitrite) are identified in the TMDL document as derived from residential and resort land and vegetation clearing, residential and commercial landscape and maintenance and management, and sewer or service line failures or leaks. The TMDL document indicates that controlling and limiting nitrate+nitrite from lands in the developed and residential areas upstream of Lake Levinsky are the focus of nutrient load reductions. Excess pathogens (E. coli) are identified in the TMDL document as derived from domestic pets, geese and waterfowl, wildlife, and refuse and runoff from streets, parking lots and other impervious surfaces in the developed area.

Proposed Solution:
The Middle Fork West Fork Gallatin River watershed is effectively divided into "upper" and "lower" segments by Lake Levinsky, which is a man-made impoundment in the Mountain Village that provides water storage for snowmaking at Big Sky Resort. Project B1 addresses impairments upstream of Lake Levinsky. For B1, Project 1 Upper Middle Fork West Fork Road Sediment BMP's addresses sediment inputs from the road network within the headwaters of the Middle Fork West Fork Gallatin River watershed, with additional potential to reduce nutrient and pathogen inputs. Sediment contributions addressed in Project 1 include runoff from unpaved roads, along with traction sand inputs from both paved and unpaved roads. For B1, Project 2 Upper Middle Fork West Fork Riparian Buffer addresses nutrient (nitrate+nitrite) inputs along the margin of Lake Levinsky, with additional potential to reduce sediment and pathogen inputs. Project 2 entails planting riparian shrubs and conifers to enhance the riparian buffer along Lake Levinsky to filter surface and subsurface nutrient contributions from adjacent areas.

Continuation of previous or ongoing activity? If "Yes", please explain the relationship.

Yes, the area upstream of Lake Levinsky was identified as a priority area for wetland and riparian restoration and conservation in the Big Sky Area Wetland and Riparian Mapping: Restoration and Conservation Opportunities report completed in 2018 and also implements recommendations provided in the Big Sky Area Sustainable Watershed Stewardship Plan completed in 2018, specifically implementing the action items for watershed conservation and restoration and stormwater management.

Watershed Restoration Plan (WRP) and authoring entity

Upper Gallatin River - Gallatin River Task Force

Letter of support from WRP authoring entity? If "No", please explain.

N

The Gallatin River Task Force authored the Upper Gallatin Watershed Plan (2012) under it's previous name as the Blue Water Task Force.

How will this project implement recommendations in the WRP?

For B1, Project 1 identified in the Middle Fork West Fork Gallatin River Restoration Project Plan primarily addresses sediment inputs to surface waters at road crossings as cited in Table 7 of the Upper Gallatin Watershed Restoration Plan, while also positively impacting nitrate+nitrite and E. coli inputs as cited in Tables 5 and 6 of the Upper Gallatin Watershed Restoration Plan. Project 2 identified in the Middle Fork West Fork Gallatin River Restoration Project Plan primarily addresses nitrate+nitrite inputs to surface waters in the Big Sky Resort base area and associated residential developments as cited in Table 5 of the Upper Gallatin Watershed Restoration Plan, while also positively impacting sediment and E. coli inputs.

Nonpoint Source Goals

For B1, nonpoint source goals include reducing sediment, nitrogen and pathogen inputs into the headwaters of the Middle Fork West Fork Gallatin River. For Project 1, the goal is to reduce sediment loading to streams at road crossings in the headwaters of the Middle Fork West Fork Gallatin River watershed upstream of Lake Levinsky. To attain this goal, the following objectives will be accomplished: 1) install and maintain BMPs at 16 road crossings on the Middle Fork West Fork Gallatin River (4 sites) and its tributaries (12 sites) upstream of Lake Levinsky (Table 3 and Figure 2). For Project 2, the goal is to reduce nutrient loading to Lake Levinsky, which is an impoundment on the Middle Fork West Fork Gallatin River. To attain this goal, the following objectives will be accomplished: 1) install riparian shrubs at five sites. Projects 1 and 2 implement DEQ's 2017 Nonpoint Source Management Plan by achieving the measurable milestone (outcome 36) to protect, restore and create riparian and wetland buffers to reduce nonpoint source pollution.

Partners and Roles

Landowner(s)

Name	Letter of Support Attached?
Project 1: Big Sky Resort, Moonlight Basin	Y
Project 2: Big Sky Resort, Lake Condos Homeowners Association	Y
	N

Other Partners

Name	Role	Letter of Support Attached?
Jeff Dunn, Trout Unlimited	Project management	Y
Mike Rotar and Matt Johnson, RESPEC	Engineering design	Y
		N
		N
		N
		N

Planning and Coordination

Planning and coordination includes permitting, design development, landowner agreements, volunteer labor recruitment, partnering and collaboration, alignment with watershed planning efforts, procurement and oversight of contractors, etc.

Planning Activities Already Completed	Documentation Attached?
Middle Fork West Fork Gallatin River Restoration Project Plan	Y
Upper Gallatin River Watershed Restoration Plan	Y
Big Sky Area Wetland and Riparian Mapping: Restoration and Conservation Opportunities	Y
	N
	N
	N

Task Description

Task 1-B1 - Planning and Coordination

Planning and coordination for Projects 1 and 2 identified in the Middle Fork West Fork Gallatin River Restoration Project Plan includes project design and engineering, landowner agreements, subcontracting, and volunteer coordination. Specifically, an engineering design detail will be prepared for installation of BMPs at road crossings for Project 1 and, for a riparian planting plan will be developed for riparian buffer enhancement along Lake Levinsky for Project 2. For both projects, landowner agreements will be executed to ensure long-term maintenance. A contractor will be selected for installation of BMPs for Project 1 and to auger holes for planting containerized riparian vegetation for Project 2. Riparian planting activities for Project 2 will be performed by volunteers and the Task Force will ensure that riparian plantings receive irrigation for the first two growing seasons. A monitoring plan will be developed that identifies success criteria and provides tools for estimating pollutant load reductions.

Deliverables

1) Draft and final design detail for road crossing BMP's
2) Draft and final riparian planting plan
3) Draft and final monitoring plan
4) Signed landowner agreements
5) Summary of volunteer engagement activities

Funding

319 Funds	$ 2,200.00
Non-Federal Match	$ 1,790.00
Federal Funds	$ 0.00
Other Funds	$ 0.00
Total Cost	$ 3,990.00
Is Match Secured	N

Timeline 7/2020-12/2021

Match Source Resort Tax, other sources

Project Implementation

Task Description

Task 2-B1 - Project Implementation

Project implementation for Projects 1 and 2 include: 1) installation of BMPs at 16 road crossings on the Middle Fork West Fork Gallatin River (4 sites) and its tributaries (12 sites) upstream of Lake Levinsky and 2) riparian buffer enhancement along Lake Levinksy through the installation of riparian shrubs at five sites totaling approximately 0.43 acres. BMPs installed at road crossings in Project 1 will include coir wattles along both sides of the road crossing. Riparian buffer enhancements along Lake Levinsky in Project 2 will typically be 15 feet wide, with a range of 5 feet to 20 feet wide, and will be comprised of native riparian shrub plantings.

Deliverables

1) Invoices for installation of road BMPs
2) Invoices for riparian buffer enhancements along Lake Levinsky
3) Invoices for construction oversight provided by the Task Force and it's project partners

Funding

319 Funds	$ 12,000.00
Non-Federal Match	$ 9,660.00
Federal Funds	$ 0.00
Other Funds	$ 0.00
Total Cost	$ 21,660.00
Is Match Secured	N

Timeline 4/2021-12/2021

Match Source Resort Tax, other sources

Appropriate Next Step

Pollutants identified in the 2010 TMDL document leading to water quality impairments in the Middle Fork West Fork Gallatin River include sediment, nutrients, and pathogens.

Excess sediment is contributed from roads, resort development, recreation, and historic riparian vegetation removal. Sediment impairments are described in the TMDL document as excess fine sediment in riffles and pool tails and low residual pool depths upstream of Lake Levinsky. Thus, reducing sediment inputs from road crossings as specified in Project 1 is an appropriate next step for making progress towards removing a pollutant/waterbody combination from Montana's 2018 Impaired Waters List.

Excess nutrients (nitrate+nitrite) are identified in the TMDL document as derived from residential and resort land and vegetation clearing, residential and commercial landscape and maintenance and management, and sewer or service line failures or leaks. The TMDL document indicates that controlling and limiting nitrate+nitrite from lands in the developed and residential areas upstream of Lake Levinsky are the focus of nutrient load reductions. Thus, enhancing the riparian buffer along Lake Levinsky to reduce nitrate +nitrite inputs from surface runoff and shallow groundwater as specified in Project 2 is an appropriate next step.

Excess pathogens (E. coli) are identified in the TMDL document as derived from domestic pets, geese and waterfowl, wildlife, and refuse and runoff from streets, parking lots and other impervious surfaces in the developed area. The road BMPs specified in Project 1 and riparian buffer enhancements described in Project 2 reduce the transport pathways for E. coli to enter surface waters.

Sustainability

Project 1 will contribute to the long-term, sustainable reductions in nonpoint source pollution by developing BMPs for the road network in the headwaters of the Middle Fork West Fork Gallatin River. It is anticipated that installation of these BMPs will help engage local managers in the importance of these road-stream intersections and that additional opportunities for BMPs, culvert replacements, and fish passage barrier removal will be identified through this process.

Project 2 will contribute to the long-term, sustainable reductions in nonpoint source pollution by creating a riparian buffer along Lake Levinsky that will filter pollutant inputs from surface water runoff and shallow ground water.

Natural Processes

Project 1 is a first step in restoring self-maintaining natural processes by reducing sediment loading to these small headwater streams that were identified as impaired due to excess fine sediment in riffles and pool tails and low residual pool depths.

Project 2 will promote self-maintaining natural processes that protect water quality by creating a riparian buffer around Lake Levinsky using native riparian vegetation to filter nutrient inputs from surface water runoff and shallow groundwater.

Project Effectiveness Evaluation

Task Description

Task 3-B1 - Project Effectiveness Evaluation

Project effectiveness evaluation will include photo-point monitoring with before and after photos, nitrogen and sediment load reduction estimates, and vegetation mortality monitoring for riparian buffer enhancements.

Deliverables

1) Before and after photos
2) Nitrogen and sediment load reduction estimates
3) Vegetation mortality rates

Funding

319 Funds	$ 1,700.00
Non-Federal Match	$ 1,300.00
Federal Funds	$ 0.00
Other Funds	$ 0.00
Total Cost	$ 3,000.00
Is Match Secured	N

Timeline 7/2021-12/2022

Match Source Resort Tax, other sources

The Bigger Picture

Other Natural Resources

For B1, Project 2 enhances wetland/riparian resources.

Climate Resiliency

For B1, Projects 1 and 2 are located in the headwaters of the upper Missouri river system. Riparian buffer enhancements in Project 2 will increase the amount of shading along the shoreline of Lake Levinsky, which will positively benefit water temperatures.

Public Visibility

For B1, Projects 1 and 2 are located in the highly visible Big Sky Ski Resort base area, which showcases Montana's natural amenities to residents from throughout Montana, along with national and international travelers. In addition to recreationists, Big Sky Resort regularly hosts large conferences attracting national and international attendees, making this an ideal location for showcasing community-driven water quality enhancement efforts.

Point Source / Nonpoint Source Relationships

With the ongoing growth in the Big Sky area, the Big Sky Sustainable Water Solutions Forum (Water Forum) was conducted from 2016-2018 to develop a unified vision for water resources management in the Big Sky area that maintains and enhances ecologically healthy river systems in the community and downstream, while also identifying sustainable solutions for community water supply and wastewater treatment challenges. There is currently no direct discharge of effluent into the Gallatin River and recommendations from the Water Forum outlines several wastewater reuse alternatives intended to keep direct discharges of treated wastewater effluent out of the Gallatin River.

Source Water Protection

The primary drinking water source for the Big Sky County Water and Sewer District (BSCWSD) is the shallow alluvial Meadow Village Aquifer located under the West Fork Gallatin River, to which the Middle Fork West Fork Gallatin River is a major tributary. The Meadow Village Aquifer is recharged from surface water and groundwater interactions and is hydrologically connected to the West Fork Gallatin River. Thus, improving surface water quality in the Middle Fork West Fork Gallatin River provides improved water quality in surface water contributions recharging the Meadow Village aquifer. In addition, BSCWSD maintains water supply wells in the shallow alluvial aquifer in the Mountain Village area, where Projects 1 and 2 are located and to which the Middle Fork West Fork Gallatin River and Lake Levinsky are hydrologically connected.

Healthy Watersheds

The mainstem of the Gallatin River is currently not considered impaired by the Montana Department of Environmental Quality. However, the rapid rate of development in the Big Sky area has the potential to degrade water quality in the mainstem of the Gallatin River, including increasing nutrient loads, as expressed in the 2018 algae blooms. In addition, land development activities, stormwater runoff, and winter traction sanding along Highway 191 have the potential to increase sediment loads to the Gallatin River mainstem. The West Fork Gallatin River is a major tributary to the Gallatin River, contributing approximately 15% of the flow to the Gallatin River during spring runoff. Thus, water quality restoration activities in the headwaters of the West Fork Gallatin River watershed play a key role in maintaining healthy conditions in the Gallatin River mainstem.

PART C—EDUCATION AND OUTREACH

Task Description

Task 4 - Education and Outreach

Education and outreach activities will target Big Sky residents, second homeowners, and businesses and aim to build knowledge of local water quality issues, sources of nitrogen and sediment, the importance of streamside vegetation, and actions individuals and businesses can take to prevent nonpoint source pollution. Education and outreach will include: 1) Design and installation of interpretive signage at one frequently visited site, 2) articles in Task Force newsletter and local newspapers
In addition, volunteer planting opportunities will be provided as components of Projects 2, 4 and 5.

Deliverables

1) Electronic file of interpretive sign and photo of installed interpretive signage
2) Electronic and hard copies of all newsletters and news articles.
3) A brief record of emails and social media activities.
4) A summary of volunteer planting opportunities and number of volunteers

Funding

319 Funds	$ 5,000.00
Non-Federal Match	$ 0.00
Federal Funds	$ 0.00
Other Funds	$ 0.00
Total Cost	$ 5,000.00
Is Match Secured	N

Timeline 7/2020-6/2023 Match Source n/a

PART D—PROJECT ADMINISTRATION

Task Description

Task 5 - The Task Force will oversee and be accountable for the completion of all tasks with project management support from Trout Unlimited. The Task Force will prepare and submit billing statements, status reports, annual reports, and a final report. The Task Force shall maintain regular contact as defined by DEQ project manager.

Deliverables

1) Billing statements, status reports, annual reports, and a final report, adhering to document formatting guidance provided by DEQ project manager

Funding

319 Funds	$ 15,000.00
Non-Federal Match	$ 0.00
Federal Funds	$ 0.00
Other Funds	$ 0.00
Total Cost	$ 15,000.00
Is Match Secured	N

Timeline 7/2020-6/2023 Match Source n/a

Project *(sub-project)* Name B2 - Lower Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction

Total Project Cost *Include costs already incurred, as well as anticipated costs, from all sources, for all aspects of the project.* $ 233,800.00

Latitude 45.28729 Longitude -111.39264

Latitude 45.27927 Longitude -111.36258

Latitude 45.26795 Longitude -111.33333

Map Y

12 Digit HUC #(s) 100200080202

Waterbody Name from 2018 List of Impaired Waters Middle Fork West Fork Gallatin River

Probable Causes of Impairment to be Addressed sedimentation/siltation, nitrate+nitrite, E. coli

Waterbody Name from 2018 List of Impaired Waters

Probable Causes of Impairment to be Addressed

Project Summary - Briefly describe the ***nature and extent*** of the problem, the ***root causes*** of the problem, and your ***proposed solution***.

Nature and Extent of the Problem:
The Middle Fork West Fork Gallatin River is a tributary to the West Fork Gallatin River flowing approximately 6 miles from its headwaters on Lone Mountain to its confluence with the North Fork West Fork Gallatin River. In 2010, The West Fork Gallatin River Watershed Total Maximum Daily Loads (TMDLs) and Framework Watershed Water Quality Improvement Plan (DEQ 2010) provided TMDLs for sediment, nitrate+nitrite (NO^3+NO^2) and E. coli in the Middle Fork West Fork Gallatin River.

Root Causes of the Problem:
Excess sediment is contributed from roads, resort development, recreation, and historic riparian vegetation removal. Sediment impairments, including the non-pollutant "alteration in stream-side or littoral vegetation covers" impairment, are described in the TMDL document as decreased pool and large woody debris frequency downstream of Lake Levinsky. Excess nutrients (nitrate +nitrite) are identified in the TMDL document as derived from residential and resort land and vegetation clearing, residential and commercial landscape and maintenance and management, and sewer or service line failures or leaks. Excess pathogens (E. coli) are identified in the TMDL document as derived from domestic pets, geese and waterfowl, wildlife, and refuse and runoff from streets, parking lots and other impervious surfaces in the developed area, along with sewer line failures or leaks, particularly downstream of Lake Levinsky.

Proposed Solution:
The Middle Fork West Fork Gallatin River watershed is effectively divided into "upper" and "lower" segments by Lake Levinsky. Project B2 addresses impairments downstream of Lake Levinsky. For B2, Project 3 Middle Fork West Fork Restoration downstream of Lake Levinsky addresses sediment impairments, including "alteration in stream-side or littoral vegetation covers" by enhancing the riparian buffer and improving in-stream habitat in a channelized reach downstream of Lake Levinsky. For B2, Project 4 Middle Fork West Fork Restoration in Lone Moose Meadows addresses sediment impairments, including "alteration in stream-side or littoral vegetation cover" by reducing streambank erosion, enhancing the riparian buffer, and improving in-stream habitat through the addition of large woody debris within a historically logged reach. For Project B2, Project 5 Middle Fork West Fork Restoration in Aspen Groves/Antler Ridge addresses sediment impairments, including "alteration in stream-side or littoral vegetation covers", by reducing streambank erosion, enhancing the riparian buffer, and improving in-stream habitat. In addition, riparian buffer enhancements included in Projects 3, 4, and 5 will help reduced nitrate+nitrate and E. coli contributions from surface runoff and shallow groundwater.

Continuation of previous or ongoing activity? If "Yes", please explain the relationship.

Yes, Projects 3, 4 and 5 were identified in the Big Sky Area Wetland and Riparian Mapping: Restoration and Conservation Opportunities report completed in 2018 and also implements recommendations provided in the Big Sky Area Sustainable Watershed Stewardship Plan completed in 2018, specifically implementing the action items for watershed conservation and restoration and for providing shallow groundwater recharge by slowing the flow of water within the watershed.

Watershed Restoration Plan (WRP) and authoring entity

Upper Gallatin River - Gallatin River Task Force

Letter of support from WRP authoring entity? If "No", please explain.

N

The Gallatin River Task Force authored the Upper Gallatin Watershed Plan (2012) under it's previous name as the Blue Water Task Force.

How will this project implement recommendations in the WRP?

For B2, Projects 3, 4, 5 identified in the Middle Fork West Fork Gallatin River Restoration Project Plan primarily addresses sediment inputs to surface waters due to streambank erosion as cited in Table 7 of the Upper Gallatin Watershed Restoration Plan, while also positively impacting nitrate+nitrite and E. coli inputs to surface waters as cited in Tables 5 and 6 of the Upper Gallatin Watershed Restoration Plan and addressing impairments due to alteration in stream-side or littoral vegetation covers.

Nonpoint Source Goals

For B2, nonpoint source goals include reducing sediment, nitrogen and pathogen inputs into the headwaters of the Middle Fork West Fork Gallatin River. For Project 3, the goal is to address sediment impairments by improving in-stream habitat within a channelized reach downstream of Lake Levinsky. To attain this goal, the following objectives will be accomplished: 1) approximately 420 feet of stream will be restored to a natural meandering riffle-pool sequence with increased floodplain connectivity and 2) develop wetland features and natural water storage within the existing channel. For Project 4, the goal is to address sediment impairments by enhancing the riparian buffer and improving in-stream habitat within a historically logged reach of the Middle Fork West Fork Gallatin River. To attain this goal, the following objectives will be accomplished: 1) riparian shrub and conifer plantings in historically logged areas within 50 feet of the channel margin and 2) large woody debris additions, including approximately six large woody debris clusters, along with the addition of individual trees. For Project 5, the goal is to address sediment impairments by reducing sediment loading from streambank erosion and improving in-stream habitat. To attain this goal, the following objectives will be accomplished: 1) relocate the channel away from a large eroding streambank and restore the channel into a historic channel in the center of the meadow, totaling approximately 540 feet of restored channel, 2) enhance the riparian buffer, and 3) develop wetland features and natural water storage within existing channel. Projects 3, 4 and 5 implement DEQ's 2017 Nonpoint Source Management Plan by achieving the measurable milestone (outcome 36) to protect, restore and create riparian and wetland buffers to reduce nonpoint source pollution.

Partners and Roles

Landowner(s)

Name	Letter of Support Attached?
Project 3: Big Sky Resort	Y
Project 4: Lone Moose Meadows Homeowners Association, Michael Schreiner	Y
Project 5: Antler Ridge Homeowners Association, Aspen Groves Homeowners Association,	Y

Other Partners

Name	Role	Letter of Support Attached?
Jeff Dunn, Trout Unlimited	Project management	Y
Mike Rotar and Matt Johnson, RESPEC	Engineering design	Y
		N
		N
		N
		N

Planning and Coordination

Planning and coordination includes permitting, design development, landowner agreements, volunteer labor recruitment, partnering and collaboration, alignment with watershed planning efforts, procurement and oversight of contractors, etc.

Planning Activities Already Completed	Documentation Attached?
Middle Fork West Fork Gallatin River Restoration Project Plan	Y
Upper Gallatin River Watershed Restoration Plan	Y
Big Sky Area Wetland and Riparian Mapping: Restoration and Conservation Opportunities	Y
	N
	N
	N

Task Description

Task 1-B2 - Planning and Coordination

Planning and coordination for Projects 3, 4 and 5 identified in the Middle Fork West Fork Gallatin River Restoration Project Plan includes project design and engineering, permitting, landowner agreements, subcontracting, and volunteer coordination. Specifically, an engineering design set will be prepared for stream restoration, wetland enhancement, and large woody debris placement for Projects 3, 4 and 5 and will include a riparian planting plan for riparian buffer enhancements. Based on the engineering design, a Joint Application for Proposed Work in Montana's Stream, Wetlands, Floodplains, and other Water Bodies will be prepared. For all three project areas, landowner agreements will be executed to ensure long-term maintenance. A contractor will be selected for project implementation of construction activities. Riparian planting activities for Projects 4 and 5 will be performed by volunteers and the Task Force will ensure that riparian plantings receive irrigation for the first two growing seasons. A monitoring plan will be developed that identifies success criteria and provides tools for estimating pollutant load reductions.

Deliverables

1) Draft and final designs for stream channel restoration, wetland enhancement, large woody debris placement, and riparian buffer enhancement
2) Draft and final monitoring plan
3) Copies of all permits and authorizations
4) Signed landowner agreements
5) Summary of volunteer engagement activities
6) As-built drawings

Funding

319 Funds	$ 20,000.00
Non-Federal Match	$ 15,880.00
Federal Funds	$ 0.00
Other Funds	$ 0.00
Total Cost	$ 35,880.00
Is Match Secured	N

Timeline 7/2020-12/2021 Match Source Resort tax, other sources

Project Implementation

Task Description

Task 2-B2 - Project Implementation

For Project 3, approximately 420 feet of stream will be restored to a natural meandering riffle-pool sequence with increased floodplain connectivity and wetland features and natural water storage will be developed within the existing channel. For Project 4, the riparian buffer will be enhanced within 50 feet of the channel and large woody debris will be placed at approximately 6 sites. For Project 5, approximately 540 feet of stream will be restored to a natural meandering riffle-pool sequence with increased floodplain connectivity, the riparian buffer will be enhanced within 50 feet of the channel, and wetland features and natural water storage will be developed within the existing channel. All projects will be completed using natural materials appropriate to the landscape setting.

Deliverables

1) Invoices for installation of channel restoration, wetland features, large woody debris placement, and riparian buffer enhancement activities
2) Invoices for construction oversight provided by the Task Force and it's project partners

Funding

319 Funds	$ 96,000.00
Non-Federal Match	$ 77,420.00
Federal Funds	$ 0.00
Other Funds	$ 0.00
Total Cost	$ 173,420.00
Is Match Secured	N

Timeline 7/2021-12/2022

Match Source Resort tax, other sources

Appropriate Next Step

Pollutants identified in the 2010 TMDL document leading to water quality impairments in the Middle Fork West Fork Gallatin River include sediment, nutrients, and pathogens. Sediment impairments, including the non-pollutant "alteration in stream-side or littoral vegetation covers" impairment, are described in the TMDL document as decreased pool and large woody debris frequency downstream of Lake Levinsky. Excess nutrients (nitrate+nitrite) are identified in the TMDL document as derived from residential and resort land and vegetation clearing, residential and commercial landscape and maintenance and management, and sewer or service line failures or leaks. Excess pathogens (E. coli) are identified in the TMDL document as derived from domestic pets, geese and waterfowl, wildlife, and refuse and runoff from streets, parking lots and other impervious surfaces in the developed area, along with sewer line failures or leaks, particularly downstream of Lake Levinsky.

Projects 3, 4, and 5 primarily address sediment impairments, including the non-pollutant "alteration in stream-side or littoral vegetation covers" impairment. Project implementation will enhance pool and large woody debris frequency in all three project areas, while also eliminating sediment loading from a large eroding streambank in Project 5. In addition, riparian buffer enhancements will benefit nitrate+nitrite and E. coli impairments by filtering surface water runoff and shallow groundwater. Collectively, Projects 3, 4, 5 are an appropriate next step for making progress towards removing a pollutant/waterbody combination from Montana's 2018 Impaired Waters List.

Sustainability

Projects 3, 4 and 5 will contribute to the long-term, sustainable reductions in nonpoint source pollution by addressing historic environmental impacts incurred during logging activities and resort development. Stream channel restoration, wetland development, large woody debris placement, and riparian buffer enhancements are intended to recreate a naturally functioning stream system with a sufficient riparian buffer that will be resilient to future development activities and climate variability.

Natural Processes

Stream channel restoration, wetland development, large woody debris placement, and riparian buffer enhancements in Projects 3, 4, and 5 are intended to recreate a naturally functioning stream system with a sufficient riparian buffer in which natural ecological processes lead to woody debris inputs and pool formation, which create diverse habitat conditions for fish and aquatic life. Specifically, Project 3 will promote self-maintaining natural processes that protect water quality by creating a riparian buffer using native vegetation and restoring a natural riffle-pool sequence to the stream which is currently in a channelized condition. Project 4 will promote self-maintaining natural processes that protect water quality by creating a riparian buffer using native vegetation and increasing the amount of large woody debris in the stream channel, which will encourage pool formation. Project 5 will promote self-maintaining natural processes that protect water quality by creating a riparian buffer using native vegetation and removing a large sediment source from the stream channel.

Project Effectiveness Evaluation

Task Description

Task 3-B2 - Project Effectiveness Evaluation

Project effectiveness evaluation will include photo-point monitoring with before and after photos, pollutant load reduction estimates, and vegetation mortality monitoring for riparian buffer enhancements.

Deliverables

1) Before and after photos
2) Pollutant load estimates
3) Vegetation mortality rates

Funding

319 Funds	$ 2,500.00
Non-Federal Match	$ 2,000.00
Federal Funds	$ 0.00
Other Funds	$ 0.00
Total Cost	$ 4,500.00
Is Match Secured	N

Timeline 7/2021-12/2023 Match Source Resort tax, other sources

The Bigger Picture

Other Natural Resources

For B2, Projects 3, 4 and 5 enhance wetland/riparian resources and promote climate resiliency by reconnecting the Middle Fork West Fork Gallatin River with it's floodplain and expanding the potential for natural water storage in a high-elevation meadows at the headwaters of the Missouri River system.

Climate Resiliency

For B2, Projects 3, 4 and 5 address climate change resiliency and adaptation by reconnecting the Middle Fork West Fork Gallatin River with it's floodplain, expanding the potential for natural water storage in high-elevation meadows in the headwaters of the Missouri River system, and slowing the flow of water through the system. Riparian buffer enhancements will increase the amount of shade along the channel margin, which will positively benefit water temperatures.

Public Visibility

For B2, Projects 3 and 4 are located in the highly visible Big Sky Ski Resort base area, which showcases Montana's natural amenities to residents from throughout Montana, along with national and international travelers. In addition to recreationists, Big Sky Resort regularly hosts large conferences attracting national and international attendees, making this an ideal location for showcasing community-driven water quality enhancement efforts. Project 5 is located in an area of "designated parklands" in the Big Sky area which is publicly accessible and visible to hikers, bikers and cross-country skiers

Point Source / Nonpoint Source Relationships

With the ongoing growth in the Big Sky area, the Big Sky Sustainable Water Solutions Forum (Water Forum) was conducted from 2016-2018 to develop a unified vision for water resources management in the Big Sky area that maintains and enhances ecologically healthy river systems in the community and downstream, while also identifying sustainable solutions for community water supply and wastewater treatment challenges. There is currently no direct discharge of effluent into the Gallatin River and recommendations from the Water Forum outlines several wastewater reuse alternatives intended to keep direct discharges of treated wastewater effluent out of the Gallatin River.

Source Water Protection

The primary drinking water source for the Big Sky County Water and Sewer District (BSCWSD) is the shallow alluvial Meadow Village Aquifer located under the West Fork Gallatin River, to which the Middle Fork West Fork Gallatin River is a major tributary. The Meadow Village Aquifer is recharged from surface water and groundwater interactions and is hydrologically connected to the West Fork Gallatin River. Thus, improving surface water quality in the Middle Fork West Fork Gallatin River provides improved water quality in surface water contributions recharging the Meadow Village aquifer. In addition, BSCWSD maintains water supply wells in the shallow alluvial aquifer in the Mountain Village area, where Project 3 is located, and to which the Middle Fork West Fork Gallatin River is hydrologically connected.

Healthy Watersheds

The mainstem of the Gallatin River is currently not considered impaired by the Montana Department of Environmental Quality. However, the rapid rate of development in the Big Sky area has the potential to degrade water quality in the mainstem of the Gallatin River, including increasing nutrient loads, as expressed in the 2018 algae blooms. In addition, land development activities, stormwater runoff, and winter traction sanding along Highway 191 have the potential to increase sediment loads to the Gallatin River mainstem. The West Fork Gallatin River is a major tributary to the Gallatin River, contributing approximately 15% of the flow to the Gallatin River during spring runoff. Thus, water quality restoration activities in the headwaters of the West Fork Gallatin River watershed play a key role in maintaining healthy conditions in the Gallatin River mainstem.

Letters of Support

BIG SKY RESORT
P.O. Box 160001
Big Sky, Montana
59716

(406) 995-5000
Fax (406) 995-5001

National Reservations
(800) 548-4486

Group/Convention Sales
(800) 548-4487
Fax (406) 995-5003

www.bigskyresort.com

October 29, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

RE: Gallatin River Task Force 319 Grant Application Support Letter

Dear 319 Review Panel:

I am writing on behalf of Big Sky Resort to express support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction.*" These projects will improve and protect water quality in the Middle and protect degradation of downstream waters in the West Fork and Gallatin mainstem. The Middle Fork and downstream waters are highly treasured in our community for their ecological, recreational, and economical values.

I strongly urge you to fund the Gallatin River Task Force 319 application. Thank you for your consideration.

Sincerely,

Taylor Middleton
COO Big Sky Resort

October 22, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

RE: Gallatin River Task Force 319 Grant Application Support Letter

Dear 319 Review Panel:

I am writing on behalf of Middle Fork Meadows, LLC to express support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction*". These projects will improve and protect water quality in the Middle and protect degradation of downstream waters in the West Fork and Gallatin mainstem. The Middle Fork and downstream waters are highly treasured in our community for their ecological, recreational, and economical values.

I strongly urge you to fund the Gallatin River Task Force 319 application. Thank you for your consideration.

Sincerely,

Chris Leonard
Middle Fork Meadows, LLC
406-539-9862

October 15, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

RE: Blue Water Task Force 319 Grant Application Support Letter

Dear 319 Review Panel:

I live on the Middle Fork of the West Fork of the Gallatin River and want to express my support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction*". These projects will improve and protect water quality in the Middle and protect degradation of downstream waters in the West Fork and Gallatin mainstem. The Middle Fork and downstream waters are highly treasured in our community for their ecological, recreational, and economical values.

I strongly urge you to fund the Gallatin River Task Force 319 application. Thank you for your consideration.

Sincerely,

W. Jerry Capps, DDS

BIG SKY RESORT
P.O. Box 160001
Big Sky, Montana
59716

(406) 995-5000
Fax (406) 995-5001

National Reservations
(800) 548-4486

Group/Convention Sales
(800) 548-4487
Fax (406) 995-5003

www.bigskyresort.com

October 23, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

RE: Blue Water Task Force 319 Grant Application Support Letter

Dear 319 Review Panel:

I am writing on behalf of Big Sky Resort to express support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction.*" These projects will improve and protect water quality in the Middle and protect degradation of downstream waters in the West Fork and Gallatin mainstem. The Middle Fork and downstream waters are highly treasured in our community for their ecological, recreational, and economical values.

I strongly urge you to fund the Gallatin River Task Force 319 application. Thank you for your consideration.

Sincerely,

Taylor Middleton
COO Big Sky Resort

October 5, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

RE: Gallatin River Task Force 319 Grant Application Support Letter

To the 319 Application Panel:

We are home/landowners on the Middle Fork of the West Fork of the Gallatin. We are writing to express support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction*".

The Middle Fork has seen significant degradation, especially silting and erosion, in the 20 years we've lived here. These projects will improve and protect water quality in the Middle and protect degradation of downstream waters in the West Fork and main Gallatin. The Middle Fork and downstream waters are highly valued in our community for their ecological, recreational, and economical values.

We strongly urge you to fund the Gallatin River Task Force 319 application.

Thank you.

Sincerely,

Dick & Sherrie Fast
215 West Pine Cone Terrace
PO Box 160203
Big Sky, MT 59716

October 4, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E. SIxth Avenue
P.O. Box 200901
Helena, MT 59620-0901

RE: Gallatin River Task Force 319 Grant Application Support Letter

Dear 319 Review Panel:

I am writing on behalf of the Antler Ridge Homeowners' Association in Big Sky, MT to express support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction*". These projects will improve and protect water quality in the Middle and protect degradation of downstream waters in the West Fork and Gallatin mainstem. The Middle Fork and downstream waters are highly treasured in our community for their ecological, recreational, and economical values.

I strongly urge you to fund the Gallatin River Task Force 319 application. Thank you for your consideration.

Sincerely,

John Bauchman
10/28/2019 11:26:39 AM MDT

John Bauchman
President, Antler Ridge HOA

October 14, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

RE: Blue Water Task Force 319 Grant Application Support Letter

Dear 319 Review Panel:

This letter is sent by the Board of Directors of the Lone Moose Meadows Unit Owners Association, which is a complex of 28 units on the Middlefork River. Our community would like to express our support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction*". We believe these projects will improve and protect water quality in the Middlefork and protect degradation of downstream waters in the West Fork and Gallatin mainstem. We further believe that this initiative will have long-term, favorable impacts on the recreational, ecological and economic value of our property and for our friends and neighbors in the local community and the state.

We respectfully request funding for the Gallatin River Task Force 319 application. Thank you for your consideration.

Sincerely,

Lone Moose Meadows Unit Owners Association Board of Directors

October 14, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

RE: Blue Water Task Force 319 Grant Application Support Letter

Dear 319 Review Panel:

My name is Deborah Kozisek, and I live on the Middlefork of the West Fork of the Gallatin River. I am writing to express my support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction*". These projects will improve and protect water quality in the Middlefork and protect degradation of downstream waters in the West Fork and Gallatin mainstem. Both my husband and I enjoy the beauty of these waterways, and wish to have this initiative approved for ecological, recreational and economic benefits to us and our fellow community and state neighbors.

I strongly urge you to fund the Gallatin River Task Force 319 application. Thank you for your consideration.

Sincerely,

Deborah Kozisek and Cameron MacKenzie

BIG SKY RESORT
P.O. Box 160001
Big Sky, Montana
59716

(406) 995-5000
Fax (406) 995-5001

National Reservations
(800) 548-4486

Group/Convention Sales
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Fax (406) 995-5003

www.bigskyresort.com

October 23, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

RE: Blue Water Task Force 319 Grant Application Support Letter

Dear 319 Review Panel:

I am writing on behalf of Big Sky Resort to express support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction.*" These projects will improve and protect water quality in the Middle and protect degradation of downstream waters in the West Fork and Gallatin mainstem. The Middle Fork and downstream waters are highly treasured in our community for their ecological, recreational, and economical values.

I strongly urge you to fund the Gallatin River Task Force 319 application. Thank you for your consideration.

Sincerely,

Taylor Middleton
COO Big Sky Resort

October 29, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E Sixth Avenue
P.O Box 200901
Helena, MT 59620-0901

RE: Gallatin River Task Force 319 Grant Application Support Letter

Dear 319 Review Panel:

I am writing on behalf of Middle Fork Properties, LLC to express support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction*". These projects will improve and protect water quality in the Middle and protect degradation of downstream waters in the West Fork and Gallatin mainstem. The Middle Fork and downstream waters are highly treasured in our community for their ecological, recreational, and economic values.

I strongly urge you to fund the Gallatin River Task Force 319 application. Thank you for your consideration.

Sincerely,

Michael J. Schreiner
Principal
Middle Fork Properties, LLC

MOONLIGHT BASIN

October 28, 2019

319 Application Agency Review Panel
Montana Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

RE: Gallatin River Task Force 319 Grant Application Support Letter

Dear 319 Review Panel:

I am writing on behalf of Moonlight Basin to express support for the Gallatin River Task Force 319 application, "*Middle Fork West Fork Gallatin River Sediment, Nutrient and Pathogen Reduction*". These projects will improve and protect water quality in the Middle and protect degradation of downstream waters in the West Fork and Gallatin mainstem. The Middle Fork and downstream waters are highly treasured in our community for their ecological, recreational, and economical values.

I strongly urge you to fund the Gallatin River Task Force 319 application. Thank you for your consideration.

Sincerely,

Kevin P. Germain
V.P. Moonlight Basin

October 29, 2019

Montana Department of Environmental Quality
319 Nonpoint Source Project Program
PO Box 200901
Helena, MT 59620-0901

Dear 319 Nonpoint Source Project Program:

RE: Middle Fork West Fork Gallatin River Restoration Projects

The intent of this letter is to convey support from RESPEC Company LLC to the Gallatin River Task Force in their request for funding from the Department of Environmental Quality 319 Nonpoint Source Project Program in the 2020 Fiscal Year cycle.

We have been honored to collaborate with the Gallatin River Task Force for several years in the successful planning, designing, permitting, and implementation of several restoration projects along the Gallatin River and its tributaries, including the Middle Fork West Fork Gallatin River.

As you know, the Big Sky area is rapidly growing and the demands on its water resources are increasing. Looking ahead, development pressures will continue to increase, and the resource needs every single opportunity for support to offset nonpoint source impacts to this treasured resource.

The five projects described in the Gallatin River Task Force's Middle Fork West Fork Gallatin River Restoration Project Plan are designed to improve water quality in the headwaters of the Gallatin River. The plan aims to reduce sediment and nutrient loading through stream restoration, floodplain and riparian enhancements, and implementation of best management practices along roadways which will have direct positive impacts on the resource.

We request Department of Environmental Quality support the Gallatin River Task Force in their effort to enhance water quality with an award of a 319 grant for implementation of these five projects.

Sincerely,

Matt Johnson, PE
Senior Water Resources Engineer
RESPEC Company LLC

3810 VALLEY COMMONS DRIVE
SUITE 4
BOZEMAN, MT 59718
406.284.2525

respec.com

Jeff Dunn
Upper Missouri and Yellowstone Project Manager

Montana Department of Environmental Quality
319 Nonpoint Source Project Program
PO Box 200901
Helena, MT 59620-0901

October 20, 2019

Dear 319 Nonpoint Source Project Program,

Trout Unlimited supports the implementation of the Gallatin River Task Force's Middle Fork West Fork Gallatin River Restoration Project Plan. These five projects will help address sediment, nitrogen, and pathogen impairments in the Middle Fork West Fork Gallatin River, which is a major tributary of the West Fork Gallatin River, draining the eastern face of Lone Peak, the Big Sky Resort base area, and the surrounding rapidly developing areas. These projects are one of several water quality improvement efforts being undertaken by the Big Sky Community as an outcome of the Big Sky Sustainable Water Solutions Forum conducted from 2016-2018 and build upon the successfully completed Upper West Fork Gallatin River Nitrogen and Sediment Reduction Project, which was funded through the 319 program. Trout Unlimited is proud to partner with the Task Force to assist them in implementing the projects.

While the mainstem of the Gallatin River is currently not considered impaired by the Montana Department of Environmental Quality, the rapid rate of development in the Big Sky area has the potential to degrade water quality in the Gallatin River mainstem, including increasing nutrient loads, as expressed in the 2018 algae bloom. In addition, land development activities, stormwater runoff, and winter traction sanding along Highway 191 have the potential to increase sediment loads to the Gallatin River mainstem. Thus, water quality restoration activities in the headwaters of the West Fork Gallatin River watershed play an important role in maintaining water quality throughout the Gallatin River mainstem.

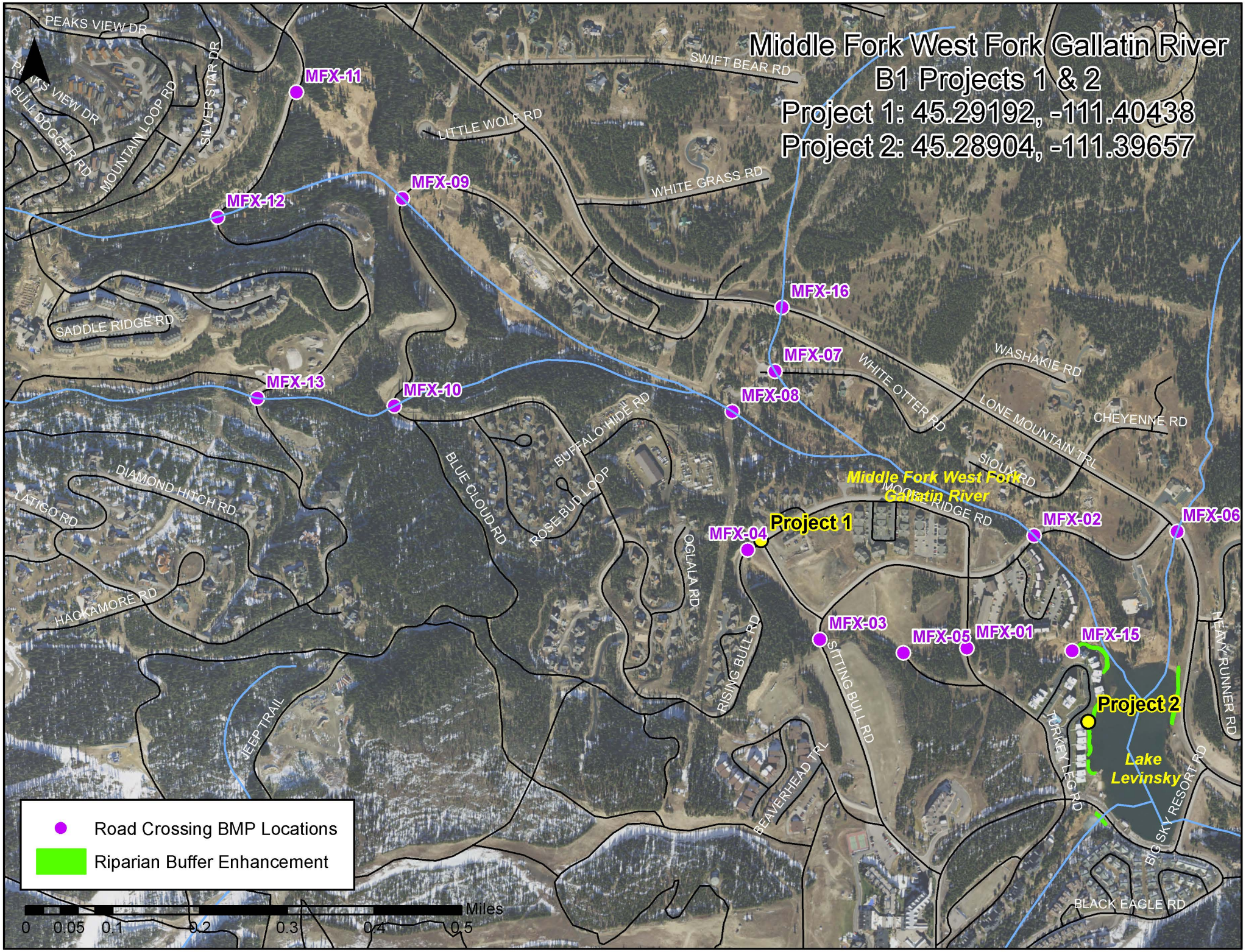
Completion of the five projects described in the Middle Fork West Fork Gallatin River Restoration Project Plan will improve water quality in this important headwater tributary and Trout Unlimited respectfully requests that the Department of Environmental Quality continue to support the Gallatin River Task Force's efforts to enhance water quality.

Sincerely,

Jeff Dunn

321 E. Main Street, Suite 411, Bozeman, MT 59715
406-579-0516 • jeff.dunn@tu.org • www.tu.org

Maps, Designs, Other Attachments


Middle Fork West Fork Gallatin River
B1 Projects 1 & 2
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Project 2: 45.28904, -111.39657
MFX-11
MFX-12
MFX-09
MFX-16
MFX-07
MFX-08
MFX-13
MFX-10
MFX-04
MFX-02
MFX-06
MFX-03
MFX-05
MFX-01
MFX-15
Project 1
Project 2
Middle Fork West Fork Gallatin River
Lake Levinsky
PEAKS VIEW DR
BULL DOGGER RD
MOUNTAIN LOOP RD
SILVER STAR DR
SWIFT BEAR RD
LITTLE WOLF RD
WHITE GRASS RD
SADDLE RIDGE RD
WASHAKIE RD
WHITE OTTER RD
LONE MOUNTAIN TRL
CHEYENNE RD
SIOUX RD
MOONRIDGE RD
BUFFALO HIDE RD
ROSE BUD LOOP
BLUE CLOUD RD
DIAMOND HITCH RD
LATIGO RD
HACKAMORE RD
OGLALA RD
RISING BULL RD
SITTING BULL RD
BEAVERHEAD TRL
JEEP TRAIL
TURKEY LEG RD
BIG SKY RESORT RD
HEAVY RUNNER RD
BLACK EAGLE RD
Road Crossing BMP Locations
Riparian Buffer Enhancement
Miles
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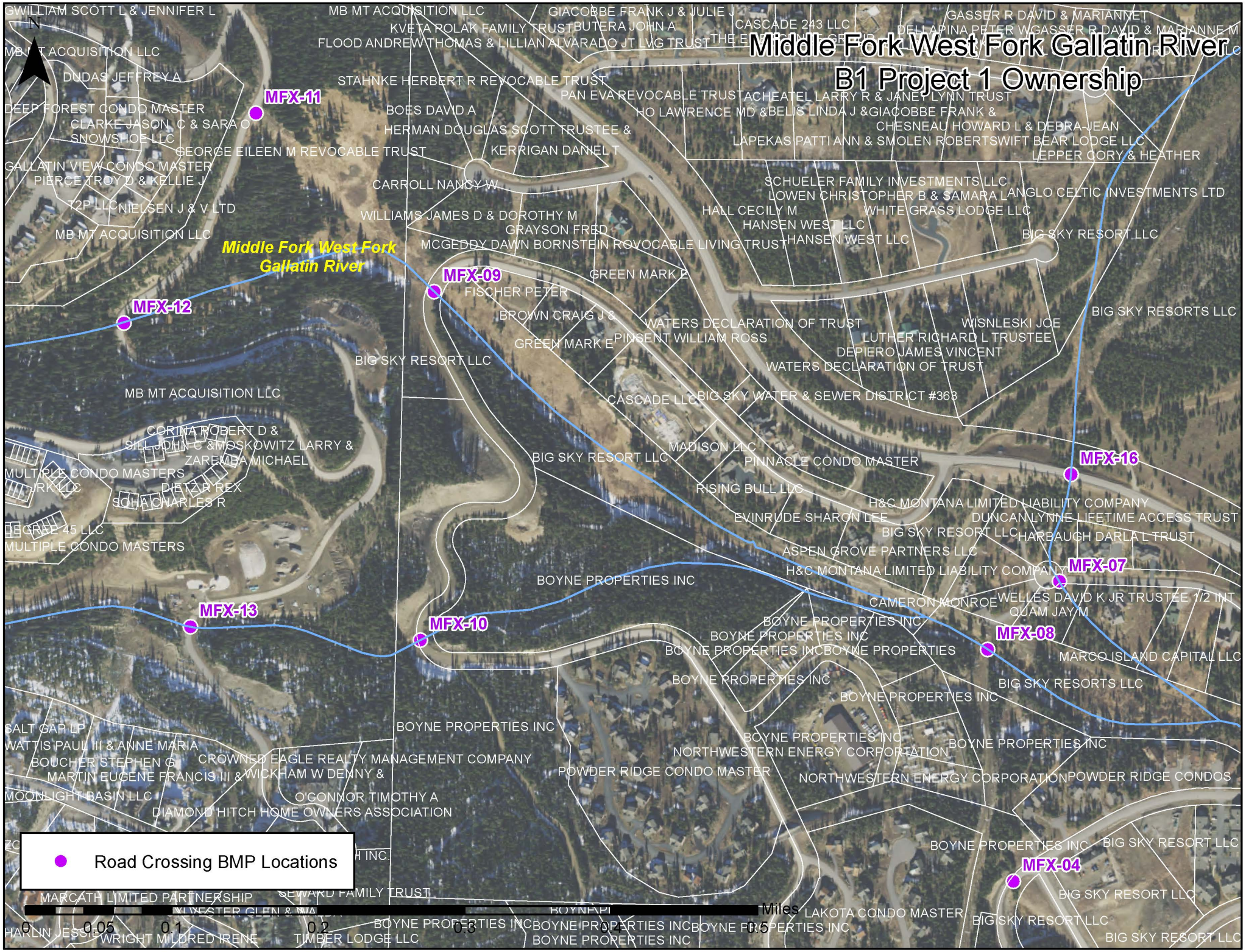
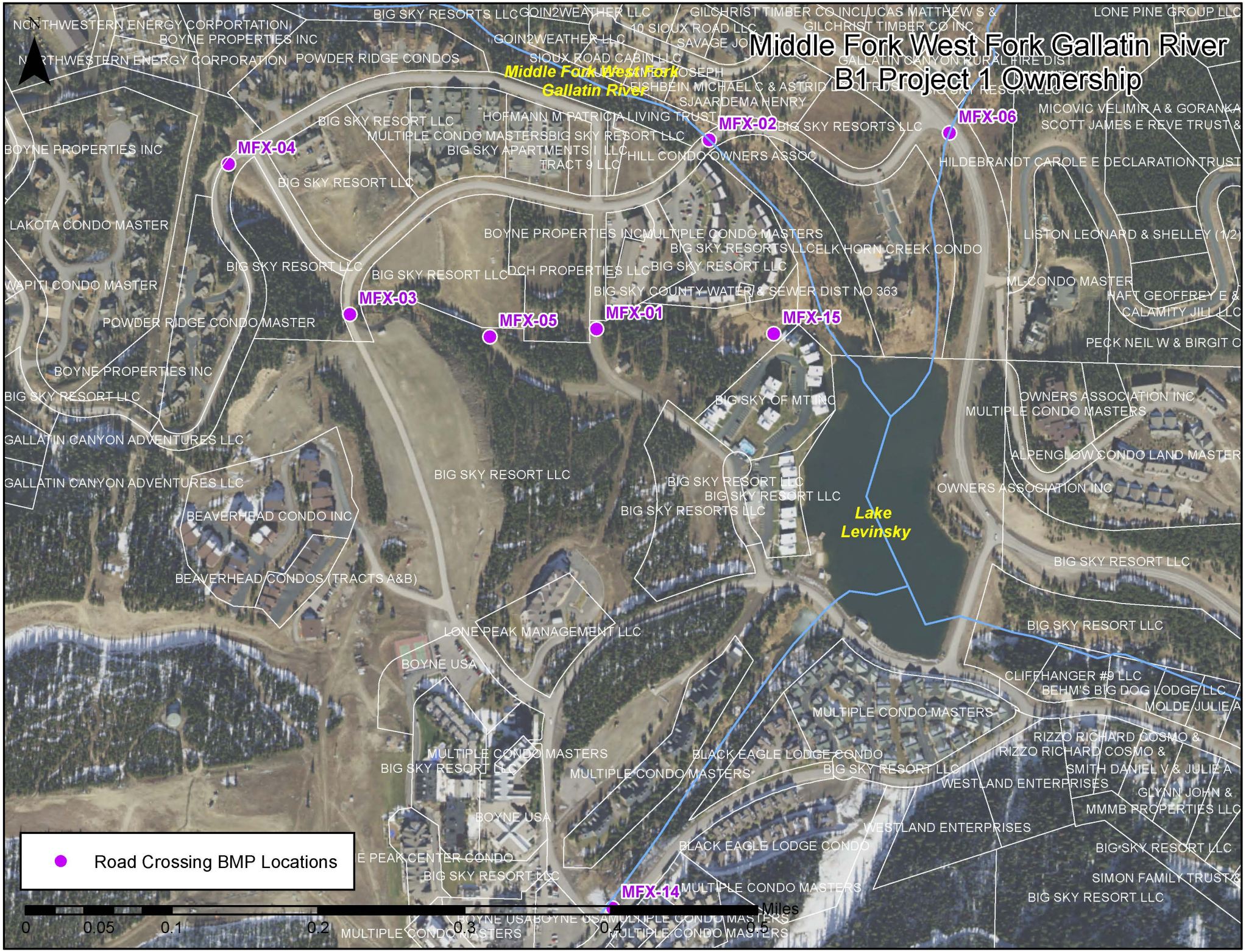
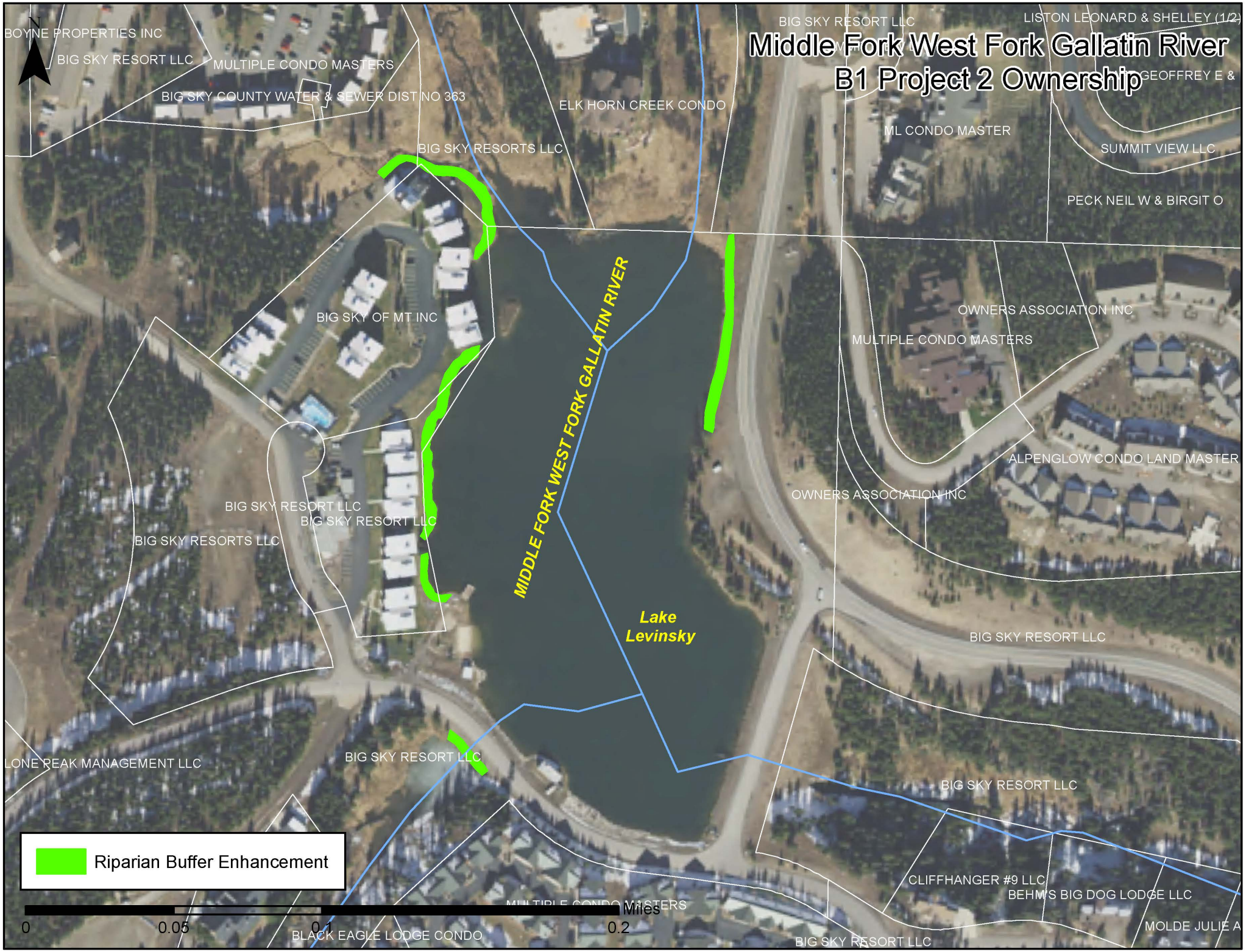
0.1
0.2
0.3
0.4
0.5

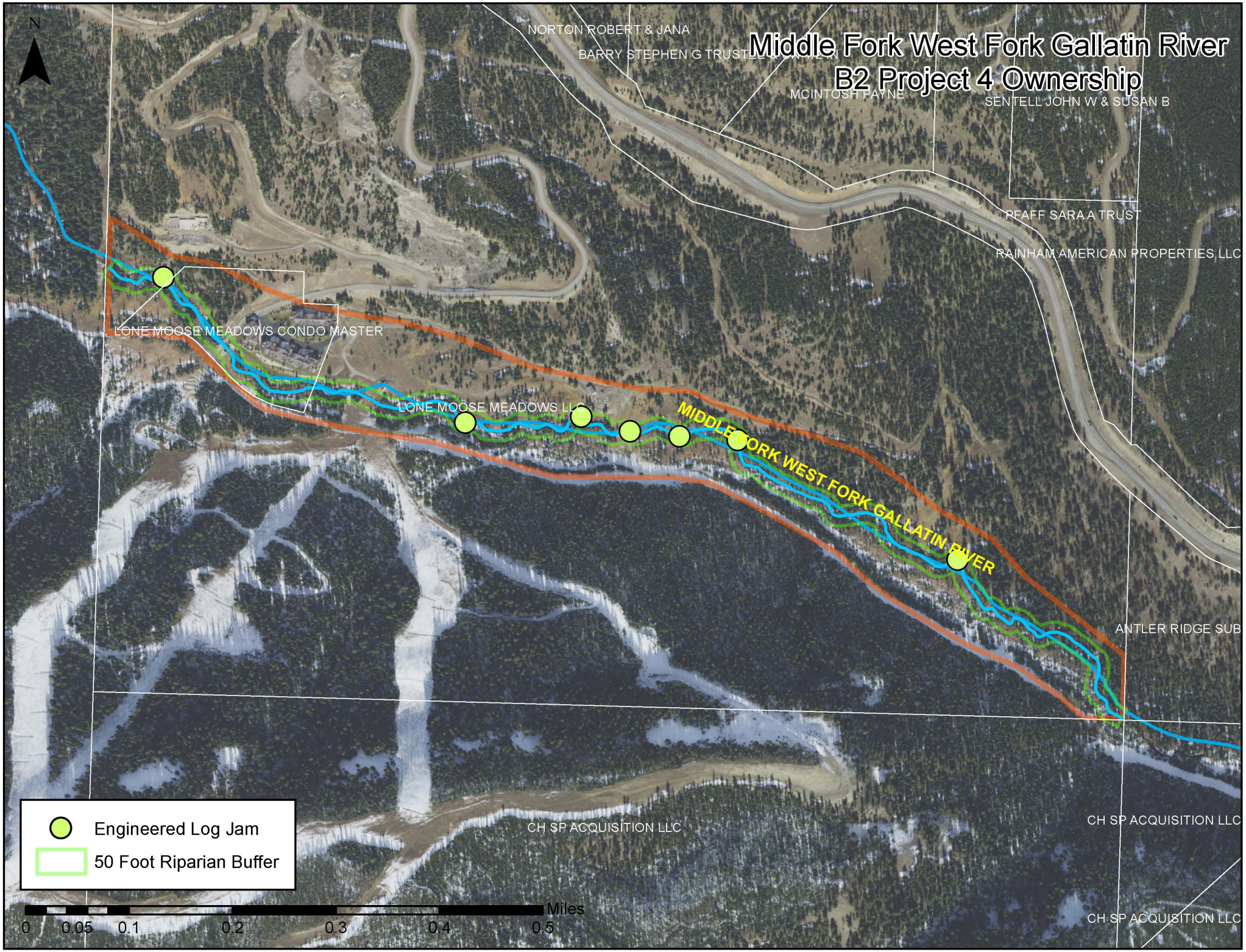

Middle Fork West Fork Gallatin River
B1 Project 1 Ownership
N
MFX-11
MFX-12
MFX-09
MFX-16
MFX-07
MFX-08
MFX-10
MFX-13
MFX-04
Middle Fork West Fork Gallatin River
Road Crossing BMP Locations
0
0.05
0.1
0.2
0.3
0.4
0.5
Miles
GWILLIAM SCOTT L & JENNIFER L
MB MT ACQUISITION LLC
DUDAS JEFFREY A
DEEP FOREST CONDO MASTER
CLARKE JASON C & SARA O
SNOWSHOE LLC
GEORGE EILEEN M REVOCABLE TRUST
GALLATIN VIEW CONDO MASTER
PIERCE TROY D & KELLIE J
T2P LLC
NIELSEN J & V LTD
MB MT ACQUISITION LLC
MB MT ACQUISITION LLC
KVETA POLAK FAMILY TRUST
FLOOD ANDREW THOMAS & LILLIAN
GIACOBBE FRANK J & JULIE J
BUTERA JOHN A
ALVARADO JT LVG TRUST
CASCADE 243 LLC
GASSER R DAVID & MARIANNE T
DELLAPINA PETER W
GASSER R DAVID & MARIANNE M
STAHNKE HERBERT R REVOCABLE TRUST
PAN EVA REVOCABLE TRUST
ACHEATEL LARRY R & JANET LYNN TRUST
BOES DAVID A
HO LAWRENCE MD &
BELIS LINDA J &
GIACOBBE FRANK &
HERMAN DOUGLAS SCOTT TRUSTEE &
CHESNEAU HOWARD L & DEBRA-JEAN
LAPEKAS PATTI ANN & SMOLEN ROBERT
SWIFT BEAR LODGE LLC
KERRIGAN DANIEL T
LEPPER CORY & HEATHER
CARROLL NANCY W
SCHUELER FAMILY INVESTMENTS LLC
LOWEN CHRISTOPHER B & SAMARA L
ANGLO CELTIC INVESTMENTS LTD
WILLIAMS JAMES D & DOROTHY M
HALL CECILY M
WHITE GRASS LODGE LLC
GRAYSON FRED
HANSEN WEST LLC
MCGEDDY DAWN BORNSTEIN REVOCABLE LIVING TRUST
HANSEN WEST LLC
BIG SKY RESORT LLC
GREEN MARK E
FISCHER PETER
BROWN CRAIG J &
WATERS DECLARATION OF TRUST
WISNLESKI JOE
LUTHER RICHARD L TRUSTEE
GREEN MARK E
PINSENT WILLIAM ROSS
DEPIERO JAMES VINCENT
BIG SKY RESORTS LLC
BIG SKY RESORT LLC
WATERS DECLARATION OF TRUST
MB MT ACQUISITION LLC
CASCADE LLC
BIG SKY WATER & SEWER DISTRICT #363
CORINA ROBERT D &
SILL JOHN C &
MOSKOWITZ LARRY &
ZAREMBA MICHAEL
MADISON LLC
BIG SKY RESORT LLC
PINNACLE CONDO MASTER
MULTIPLE CONDO MASTERS
JRK LLC
DIETZ R REX
SOHA CHARLES R
RISING BULL LLC
H&C MONTANA LIMITED LIABILITY COMPANY
EVINRUDE SHARON LEE
DUNCAN LYNNE LIFETIME ACCESS TRUST
DEGREE 45 LLC
MULTIPLE CONDO MASTERS
BIG SKY RESORT LLC
HARBAUGH DARLA L TRUST
ASPEN GROVE PARTNERS LLC
H&C MONTANA LIMITED LIABILITY COMPANY
BOYNE PROPERTIES INC
CAMERON MONROE
WELLES DAVID K JR TRUSTEE 1/2 INT
QUAM JAY M
BOYNE PROPERTIES INC
BOYNE PROPERTIES INC
BOYNE PROPERTIES INC
BOYNE PROPERTIES INC
MARCO ISLAND CAPITAL LLC
BOYNE PROPERTIES INC
BIG SKY RESORTS LLC
BOYNE PROPERTIES INC
SALT GAP LP
BOYNE PROPERTIES INC
WATTIS PAUL III & ANNE MARIA
BOYNE PROPERTIES INC
NORTHWESTERN ENERGY CORPORATION
BOUCHER STEPHEN G
CROWNED EAGLE REALTY MANAGEMENT COMPANY
MARTIN EUGENE FRANCIS III &
WICKHAM W DENNY &
POWDER RIDGE CONDO MASTER
NORTHWESTERN ENERGY CORPORATION
POWDER RIDGE CONDOS
MOONLIGHT BASIN LLC
O'CONNOR TIMOTHY A
DIAMOND HITCH HOME OWNERS ASSOCIATION
BOYNE PROPERTIES INC
BIG SKY RESORT LLC
BIG SKY RESORT LLC
MARCATH LIMITED PARTNERSHIP
SEWARD FAMILY TRUST
LAKOTA CONDO MASTER
BIG SKY RESORT LLC
HARLIN JESSE
WRIGHT MILDRED IRENE
TIMBER LODGE LLC
BOYNE PROPERTIES INC
BOYNE PROPERTIES INC
BOYNE PROPERTIES INC
BIG SKY RESORT LLC

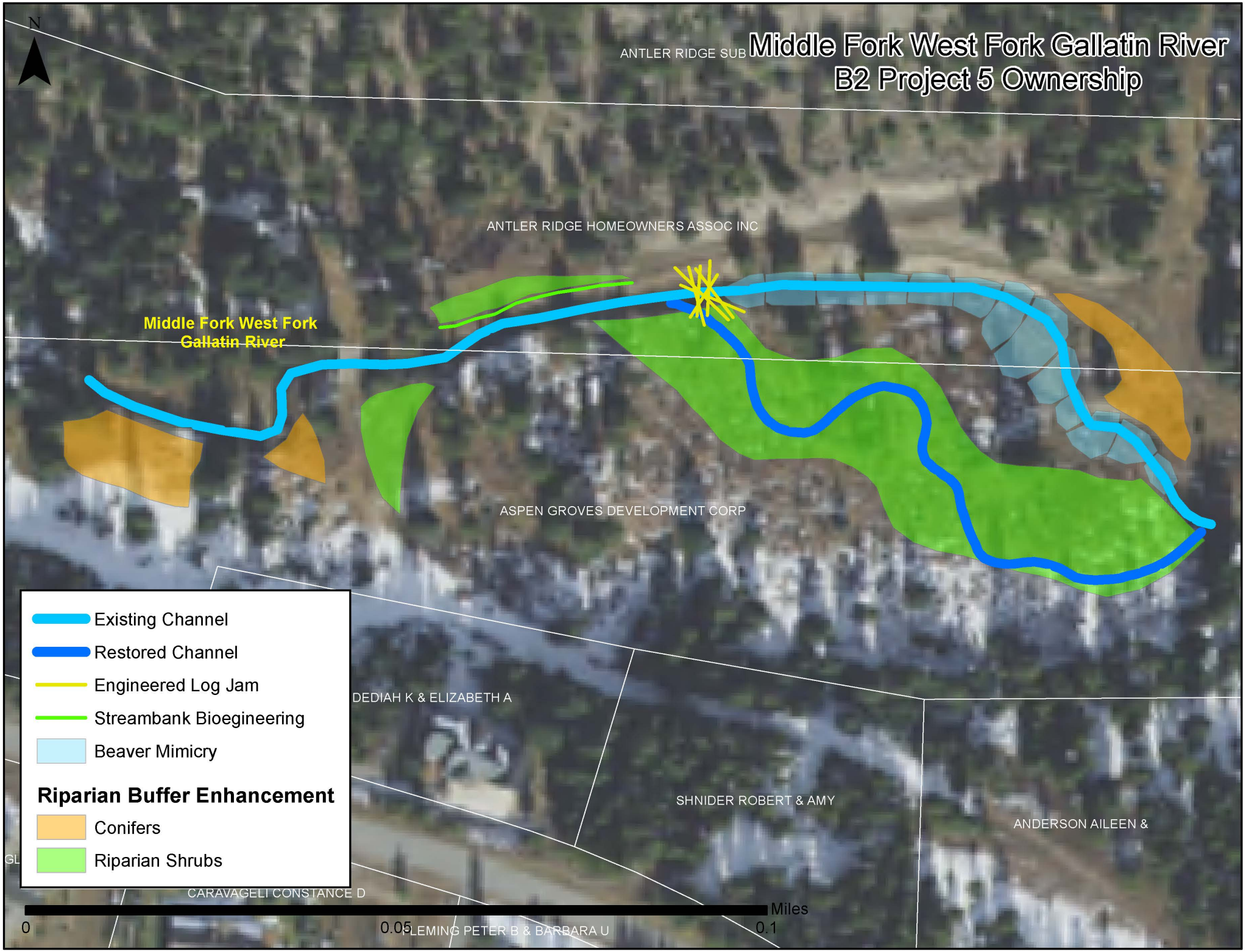

Middle Fork West Fork Gallatin River
B1 Project 1 Ownership
MFX-04
MFX-03
MFX-05
MFX-01
MFX-02
MFX-15
MFX-06
MFX-14
Lake Levinsky
Middle Fork West Fork Gallatin River
Road Crossing BMP Locations
0
0.05
0.1
0.2
0.3
0.4
0.5
Miles
NORTHWESTERN ENERGY CORPORATION
BOYNE PROPERTIES INC
POWDER RIDGE CONDOS
BIG SKY RESORTS LLC
GOIN2WEATHER LLC
10 SIOUX ROAD LLC
SIOUX ROAD CABIN LLC
GILCHRIST TIMBER CO INC
LUCAS MATTHEW S &
LONE PINE GROUP LLC
GALLATIN CANYON RURAL FIRE DIST
MICOVIC VELIMIR A & GORANKA
SCOTT JAMES E REVE TRUST &
HOFMANN M PATRICIA LIVING TRUST
BIG SKY RESORT LLC
MULTIPLE CONDO MASTERS
BIG SKY APARTMENTS I LLC
TRACT 9 LLC
HILL CONDO OWNERS ASSOC
HILDEBRANDT CAROLE E DECLARATION TRUST
LAKOTA CONDO MASTER
BOYNE PROPERTIES INC
MULTIPLE CONDO MASTERS
BIG SKY RESORTS LLC
ELK HORN CREEK CONDO
LISTON LEONARD & SHELLEY (1/2)
DCH PROPERTIES LLC
WAPITI CONDO MASTER
BIG SKY COUNTY WATER & SEWER DIST NO 363
ML CONDO MASTER
HAFT GEOFFREY E &
CALAMITY JILL LLC
POWDER RIDGE CONDO MASTER
PECK NEIL W & BIRGIT C
BIG SKY OF MT INC
OWNERS ASSOCIATION INC
GALLATIN CANYON ADVENTURES LLC
ALPENGLOW CONDO LAND MASTER
BEAVERHEAD CONDO INC
BEAVERHEAD CONDOS (TRACTS A&B)
LONE PEAK MANAGEMENT LLC
BOYNE USA
CLIFFHANGER #9 LLC
BEHM'S BIG DOG LODGE LLC
MOLDE JULIE A
RIZZO RICHARD COSMO &
SMITH DANIEL V & JULIE A
BLACK EAGLE LODGE CONDO
WESTLAND ENTERPRISES
GLYNN JOHN &
MMMB PROPERTIES LLC
SIMON FAMILY TRUST &


Middle Fork West Fork Gallatin River
B1 Project 2 Ownership
N
BOYNE PROPERTIES INC
BIG SKY RESORT LLC
MULTIPLE CONDO MASTERS
BIG SKY COUNTY WATER & SEWER DIST NO 363
ELK HORN CREEK CONDO
BIG SKY RESORTS LLC
BIG SKY RESORT LLC
LISTON LEONARD & SHELLEY (1/2)
GEOFFREY E &
ML CONDO MASTER
SUMMIT VIEW LLC
PECK NEIL W & BIRGIT O
BIG SKY OF MT INC
MIDDLE FORK WEST FORK GALLATIN RIVER
OWNERS ASSOCIATION INC
MULTIPLE CONDO MASTERS
ALPENGLOW CONDO LAND MASTER
OWNERS ASSOCIATION INC
BIG SKY RESORT LLC
BIG SKY RESORT LLC
BIG SKY RESORTS LLC
Lake
Levinsky
BIG SKY RESORT LLC
LONE PEAK MANAGEMENT LLC
BIG SKY RESORT LLC
BIG SKY RESORT LLC
CLIFFHANGER #9 LLC
BEHM'S BIG DOG LODGE LLC
MULTIPLE CONDO MASTERS
BLACK EAGLE LODGE CONDO
BIG SKY RESORT LLC
MOLDE JULIE A
Riparian Buffer Enhancement
0
0.05
0.1
0.2
Miles


N
Middle Fork West Fork Gallatin River
B2 Projects 3, 4 & 5 Overview
Project 3: 45.28729, -111.39264
Project 4: 45.27927, -111.36258
Project 5: 45.26795, -111.33333
Project 3
Middle Fork West Fork
Gallatin River
Project 4
Project 5
Miles
0 0.05 0.1 0.2 0.3 0.4 0.5


N
Middle Fork West Fork Gallatin River
B2 Project 3 Ownership
BIG SKY RESORT LLC
MIDDLE FORK WEST FORK GALLATIN RIVER
BIG SKY RESORT LLC
BIG SKY RESORT LLC
MIDDLE FORK WEST FORK GALLATIN RIVER
Lake
Levinsky
CLIFFHANGER #9 LLC
BEHM'S BIG DOG LODGE LLC
FETZER ANN D LIVING TRUST
Engineered Log Jam
Restored Channel
Wetland Creation / Natural Water Storage
Existing Channel
BIG SKY RESORT LLC
WESTLAND ENTERPRISES
RIZZO RICHARD COSMO &
SMITH DANIEL V & JULIE A
0
0.05
0.1
Miles


N
Middle Fork West Fork Gallatin River
B2 Project 4 Ownership
NORTON ROBERT & JANA
BARRY STEPHEN G TRUSTEE
MCINTOSH PAYNE
SENTELL JOHN W & SUSAN B
PFAFF SARA A TRUST
RAINHAM AMERICAN PROPERTIES LLC
LONE MOOSE MEADOWS CONDO MASTER
LONE MOOSE MEADOWS LLC
MIDDLE FORK WEST FORK GALLATIN RIVER
ANTLER RIDGE SUB
CH SP ACQUISITION LLC
CH SP ACQUISITION LLC
CH SP ACQUISITION LLC
Engineered Log Jam
50 Foot Riparian Buffer
Miles
0
0.05
0.1
0.2
0.3
0.4
0.5


N
Middle Fork West Fork Gallatin River
B2 Project 5 Ownership
ANTLER RIDGE SUB
ANTLER RIDGE HOMEOWNERS ASSOC INC
Middle Fork West Fork Gallatin River
ASPEN GROVES DEVELOPMENT CORP
DEDIAH K & ELIZABETH A
SHNIDER ROBERT & AMY
ANDERSON AILEEN &
CARAVAGELI CONSTANCE D
FLEMING PETER B & BARBARA U
Existing Channel
Restored Channel
Engineered Log Jam
Streambank Bioegineering
Beaver Mimicry
Riparian Buffer Enhancement
Conifers
Riparian Shrubs
Miles
0
0.05
0.1

Big Sky Area
Wetland and Riparian Mapping

Restoration and Conservation Opportunities

June 2018

BIG SKY AREA
WETLAND AND RIPARIAN MAPPING

Prepared by

RESPEC

Jeff Dunn, Watershed Hydrologist
Michelle Pettit, GIS Analyst

Prepared for

GALLATIN RIVER TASK FORCE

Big Sky, MT

June 2018

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ATTACHMENTS

1.0 INTRODUCTION

Wetland and riparian mapping was performed within the Big Sky Resort Area District boundary (Big Sky area) using GIS data layers, aerial photography and on-the-ground observations. This project was conducted as a first step toward implementing the recommendations of the *Big Sky Area Sustainable Watershed Stewardship Plan* (Dunn et al. 2018) to identify existing high value riparian corridors and wetland resources by expanding riparian and wetland mapping and on-the-ground assessments. This information will provide the foundation for implementing wetland and riparian restoration and conservation projects, with an emphasis on restoring and conserving high-value wetland and riparian corridors, improving degraded wetland and riparian areas, improving water quality, and enhancing natural water storage.

Components of this project include:

- Aerial assessment and stream reach stratification to evaluate riparian conditions at the reach scale and identify areas for riparian buffer enhancements
- Wetland and riparian mapping using the Montana Natural Heritage Program's (MTNHP) Wetland and Riparian Framework GIS data layer produced in 2017
- Wetland and riparian restoration and conservation prioritization

The results of this assessment are presented as a map book in **Attachment A** which includes a series of 19 map panels covering the entire Big Sky area depicting wetland and riparian resources as follows:

- Map Book Panel: Stream Reaches & Riparian Areas
- Map Book Panel: Riparian Health Assessment / Wetland & Riparian Priority Areas
- Stream Reaches / Wetland & Riparian Areas
- Riparian Health Assessment / Wetland & Riparian Priority Areas

In addition to the map book, an on-the-ground assessment of potential wetland and riparian restoration and conservation opportunities was conducted, with site photographs presented in **Attachment B** for 35 identified restoration and conservation opportunities.

2.0 STREAM REACH RIPARIAN HEALTH ASSESSMENT

A stream reach assessment of riparian health was conducted using aerial imagery to identify existing riparian conditions and identify areas where enhancements to the riparian buffer could be implemented. This assessment builds upon previous stream reach assessments that have been performed within the Big Sky Area over the past 20 years, including:

- *Upper Gallatin Watershed Aerial Photo Assessment and Reach Stratification* (PBS&J 2005)
    - mainstem Gallatin River
- *Aerial Assessment Reach Stratification: Upper Gallatin TMDL Planning Area* (PBS&J 2008)
    - West Fork Gallatin River watershed
- Madison River stream reach stratification and riparian assessment performed by the Montana Department of Environmental Quality (DEQ)
    - Jack Creek

Stream reaches were delineated and riparian health was assessed following the methodology developed by the Montana DEQ and described in *Sediment-Habitat Reach Stratification and Riparian Assessment Procedure* (DEQ 2015) using National Agricultural Imagery Program (NAIP) imagery from 2015 and 2017.

The following streams were included in the stream reach and riparian health assessment:

- Gallatin River mainstem between MP42 and MP55 (Corral to Karst)
- West Fork Gallatin River and tributaries, including:
    - South Fork West Fork Gallatin River
        - Muddy Creek
        - Third Yellow Mule Creek
        - Second Yellow Mule Creek
        - First Yellow Mule Creek
    - Middle Fork West Fork Gallatin River
        - "Moose" Tracks Creek
        - Beehive Creek
        - "Stony" Creek
    - North Fork West Fork Gallatin River
- Beaver Creek
- Michener Creek
- Jack Creek

During this assessment, riparian health was assigned based on the following criteria:

- **Good**: mature vegetation along entire reach, averaging 100 feet in width
- **Moderate-Good**: mature vegetation along entire reach, 30-100 feet in width
- **Fair**: mature vegetation along at least half of reach, buffer not less than 30 feet
- **Moderate-Fair**: mature vegetation along 20% or less of reach, buffer generally 10 feet or less
- **Poor**: little to no mature vegetation

In addition, the presence or absence of apparent anthropogenic influence was recorded using either "Yes" or "No".

Mapped stream reaches are presented on the Stream Reaches / Wetland & Riparian Areas maps in **Attachment A**, while the results of the riparian health assessment are presented for each stream reach on the Riparian Health Assessment / Wetland & Riparian Priority Areas maps in **Attachment A**. The riparian health assessment for each stream reach is presented in **Attachment C** and summarized for each stream segment in **Figure 2-1**.

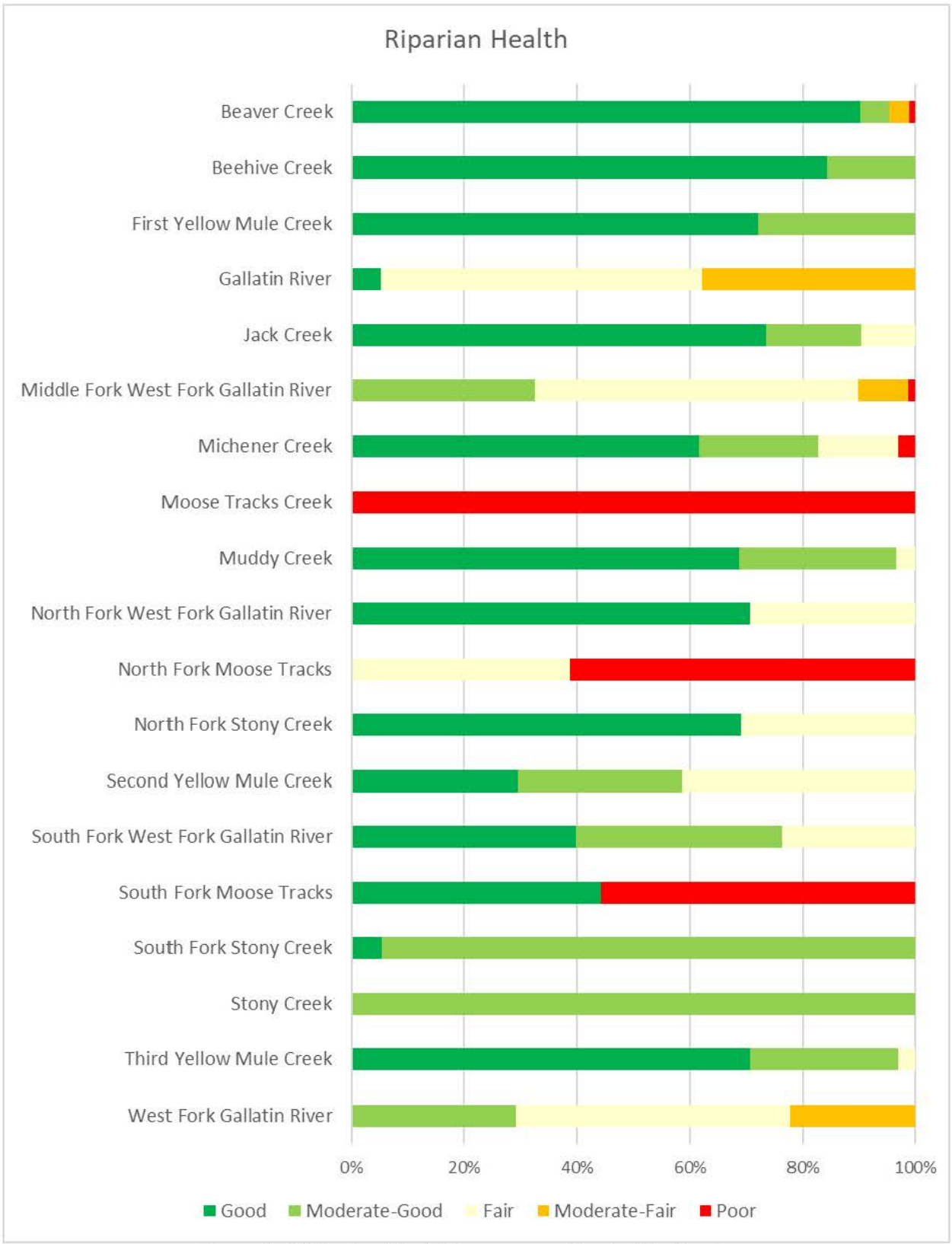


Figure 2-1. Riparian Health Assessment for the Big Sky Area

3.0 WETLAND AND RIPARIAN MAPPING

Wetland and riparian mapping was conducted using the MTNHP Wetland and Riparian Framework GIS data layer produced in 2017. The Montana Wetland and Riparian Framework represents the extent, type, and approximate location of wetlands, riparian areas, and deepwater habitats in Montana based on the areal extent of wetlands and deepwater habitats as defined by Cowardin et al. (Federal Geographic Data Committee 2013) and riparian areas as defined by the U.S. Fish and Wildlife Service (2009). Mapping was completed by the MTNHP Wetland and Riparian Mapping Center by manually digitizing from orthorectified digital color-infrared NAIP aerial imagery and represents an update to the U.S. Fish and Wildlife Service National Wetland Inventory (NWI).

A total of nine wetland, riparian and deepwater habitat types were identified within the Big Sky area as presented in **Table 3-1**.

Table 3-1. Wetland and Riparian Types in the Big Sky Area

Wetland and Riparian Type	Acres	Square Miles	Percent of Resort Tax Area	National Wetland Inventory Code
Freshwater Emergent Wetland	1,733	2.71	1.03%	PEM
Freshwater Forested Wetland	11	0.02	0.01%	PFO
Freshwater Pond	242	0.38	0.14%	PAB, PUB, PUS
Freshwater Scrub-Shrub Wetland	128	0.20	0.08%	PSS
Lake	39	0.06	0.02%	L1UB
Riparian Emergent	52	0.08	0.03%	Rp1EM
Riparian Forested	33	0.05	0.02%	Rp2FO, Rp1FO
Riparian Scrub-Shrub	42	0.07	0.02%	Rp1SS
Riverine	2,599	4.06	1.54%	R4SB, R2US, R3UB, R3US
Total	**4,878**	**7.62**	**2.89%**	

Mapped wetland and riparian areas are presented on the Stream Reaches / Wetland & Riparian Areas maps in **Attachment A**, while the results of the wetland and riparian priority rankings are presented for each wetland polygon on the Riparian Health Assessment / Wetland & Riparian Priority Areas maps in **Attachment A**. Examples of the primary wetland and riparian types within the Big Sky area are presented in **Figures 3-1** through **3-4**.

It should be noted that, while the MTNHP Wetland and Riparian GIS layer appears to accurately identify larger wetlands and riparian areas, many of the smaller wetlands that occur throughout the Big Sky area are likely not identified within the MTNHP Wetland and Riparian GIS layer. Thus, obtaining on-the-ground wetland mapping will be necessary to fully characterize the wetland resources of the Big Sky area and this information will likely lead to additional priority areas for conservation and restoration.

Figure 3-1. Freshwater Scrub-Shrub Wetland, West Fork Gallatin River

Figure 3-2. Freshwater Emergent Wetland, Jack Creek

Figure 3-3. Freshwater Pond with Freshwater Emergent Fringe, West Fork Gallatin River

Figure 3-4. Riparian Forested, Gallatin River

4.0 RESTORATION AND CONSERVATION PRIORITY AREAS

Wetland and riparian restoration and conservation priority areas were identified using information compiled in the stream reach riparian health assessment and the wetland and riparian mapping, along with on-the-ground observations. For each wetland polygon in the MTNHP Wetland and Riparian GIS layer, a numerical score was assigned to evaluate potential development impacts and natural resource values described as follows:

Infrastructure and Development Impacts: Development Impact Rating

Wetland and riparian areas were evaluated for risk of impacts from development and infrastructure in the Big Sky area based on proximity of structures and roads, type of land ownership, and location within or outside of the Big Sky County Water and Sewer District (BSCWSD) boundary. In addition, the Montana Human Disturbance Index (HDI) was included, which represents six disturbance categories: development, transportation, agriculture, resource extraction/energy development, introduced vegetation, and forestry practices and was developed to characterize the degree of human disturbance for use in selecting potentially restorable wetlands. Riparian health assessments and observed anthropogenic disturbance based on the stream reach stratification were also considered. Higher development impact rating scores indicate a greater potential risk to wetland and riparian health, water quality, and water quantity.

Natural Resource and Conservation Values: Natural Resource Rating

Natural resource and conservation values of the Big Sky area's wetland and riparian resources was evaluated based on wetland/riparian type and proximity to stream channels. In addition, location within a wilderness area, Montana Fish, Wildlife and Park's Wildlife Management Area, conservation easement, or designated parklands was also considered. Higher natural resource rating scores indicate a higher priority wetland and riparian area.

A total of 20 points was available for both the development impact rating and the natural resource rating. An overall priority ranking was then developed for each wetland and riparian polygon based on the sum of the development impact rating score and the natural resource rating score. Scoring criteria are summarized **Table 4-1** and detailed in **Attachment D.**

The results of the wetland and riparian priority rankings are presented for each wetland polygon on the Riparian Health Assessment / Wetland & Riparian Priority Areas maps in **Attachment A**. In addition, an on-the-ground assessment of potential wetland and riparian restoration and conservation opportunities was conducted, which is summarized in **Table 4-2** and presented in **Attachment B**. A total of 35 wetland and riparian restoration and conservation opportunities were identified, and they were ranked into three tiers, with Tier 1 being the most immediate need and highest priority, followed by Tier 2 and Tier 3.

Table 4-1. Wetland and Riparian Prioritization Scoring Criteria

Infrastructure and Development Impacts: Development Impact Rating		
Criteria	**Higher Risk Score**	**Score Range**
Outside of BSCWSD Boundary	2	0-2
Within 500 feet of Structure	2	0-2
Within 500 feet of Roads (250-foot buffer per side)	2	0-2
Private Ownership	2	0-2
Human Disturbance Index	5	0-5
Degraded Riparian Health (250-foot buffer per side)	5	0-5
Anthropogenic Presence Observed (250-foot buffer per side)	2	0-2
Total Possible Impact Score	**20**	
Natural Resource and Conservation Value: Natural Resource Rating		
Criteria	**Higher Value Score**	**Score Range**
WetRip2017: Wetland, Riparian, Open Water	2	0-2
WetRip2017 Wetland Type	7	0-6
Within 500 feet of 1:24K NHD Stream (250-foot buffer per side)	7	0-4
Within Conservation Easement	1	0-1
Within Designated Parklands	1	0-1
Within Designated Wilderness Area	1	0-1
Within FWP Wildlife Management Area	1	0-1
Total Possible Natural Resource Score	**20**	
Total Possible Priority Score	**40**	

Based on the wetland and riparian priority rankings, seven wetland and riparian priority areas were identified in areas with a high density of wetland and riparian areas with higher priority rankings, including:

- Jack Creek headwaters
- upper Middle Fork West Fork Gallatin River
- lower Middle Fork West Fork Gallatin River
- upper West Fork Gallatin River
- lower South Fork West Fork Gallatin River
- Gallatin River upstream of West Fork Gallatin River
- Gallatin River downstream of West Fork Gallatin River

Table 4-2. Wetland and Riparian Restoration and Conservation Opportunities

Tier	Identifier	Restoration and Conservation Opportunities
1	#4	Lack of riparian buffer at Doe Creek river access area
1	#5	Channelization and lack of riparian buffer along spring creek downstream of West Fork; road sand inputs
1	#6	Lack of riparian buffer at power line crossing at Baetis Alley river access area
1	#7	Degraded riparian condition upstream of HWY 191 crossing
1	#8	Degraded riparian condition, loss of channel length, and channel over-widening downstream of HWY 191 crossing; fish passage barrier
1	#9	Channelization and lack of riparian buffer downstream of HWY 191 crossing
1	#13	Silver Bow Pond: on-channel pond and degraded instream habitat
1	#14	Little Coyote Pond: on-channel pond and degraded instream habitat
1	#17	Channelization and lack of riparian buffer along HWY 64; road sand inputs
1	#19	Lack of riparian buffer along old West Fork Spur Road
1	#20	Lack of riparian buffer upstream of HWY 191 crossing
1	#22	Channelization and lack of riparian buffer; stream re-routed into irrigation ditch in Big Sky Golf Course pasture area
1	#23	Loss of channel length and degraded instream habitat due to Lake Levinsky dam construction
1	#24	Loss of riparian buffer and instream habitat due to historic logging
1	#25	Lack of riparian buffer at Lone Moose Triple chairlift crossing
1	#26	Degraded riparian conditions downstream of Lone Moose Meadows
1	#27	Loss of riparian buffer and instream habitat due to historic logging
1	#28	Hillslope slumping and streambank erosion in Antler Ridge HOA
1	#29	Lack of riparian buffer on unnamed tributary at Lake Condos
1	#31	Lack of riparian buffer along Lake Levinsky at Lake Condos and Big Sky base area access road
2	#3	Spring creek west of Gallatin River along HWY 191; fish passage barrier
2	#10	Lack of riparian buffer at upper HWY 64 crossing; road sand inputs
2	#15	Loss of channel length, channel over-widening, and streambank erosion
2	#16	Lack of riparian buffer at HWY 64 crossing upstream of South Fork West Fork; road sand inputs
2	#18	Lack for riparian buffer at lower HWY 64 crossing; road sand inputs
2	#21	Road sand inputs at HWY 191 crossing
2	#30	Degraded stream conditions on “Moose Tracks” Creek under the Big Sky base area, Summit at Big Sky and parking lot
2	#32	Lack of riparian buffer on Beehive Creek at HWY64 crossing; road sand inputs; fish passage barrier
2	#34	Lack of riparian buffer and streambank erosion downstream of Aspen Leaf road crossing
2	#35	Lack of riparian buffer on hillslope along Aspen Leaf road
3	#1	Channelized tributary stream lacking riparian buffer north of Corral; road sand inputs
3	#2	Wetland area and lack of riparian buffer along HWY 191; road sand inputs
3	#11	Potential site for wetland enhancements in Big Sky Golf Course pasture area
3	#12	Lack of riparian buffer along flood flow channel through Big Sky Golf Course
3	#33	Conserve naturally meandering channel section

5.0 REFERENCES

Dunn, J., Filipovich K., Ingman, G., Benn, T., Collins, Z., 2018, *Big Sky Area Sustainable Watershed Stewardship Plan*. Prepared for Gallatin River Task Force and Big Sky Sustainable Water Solutions Forum.

Federal Geographic Data Committee. 2013. *Classification of wetlands and deepwater habitats of the United States*. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington, DC.

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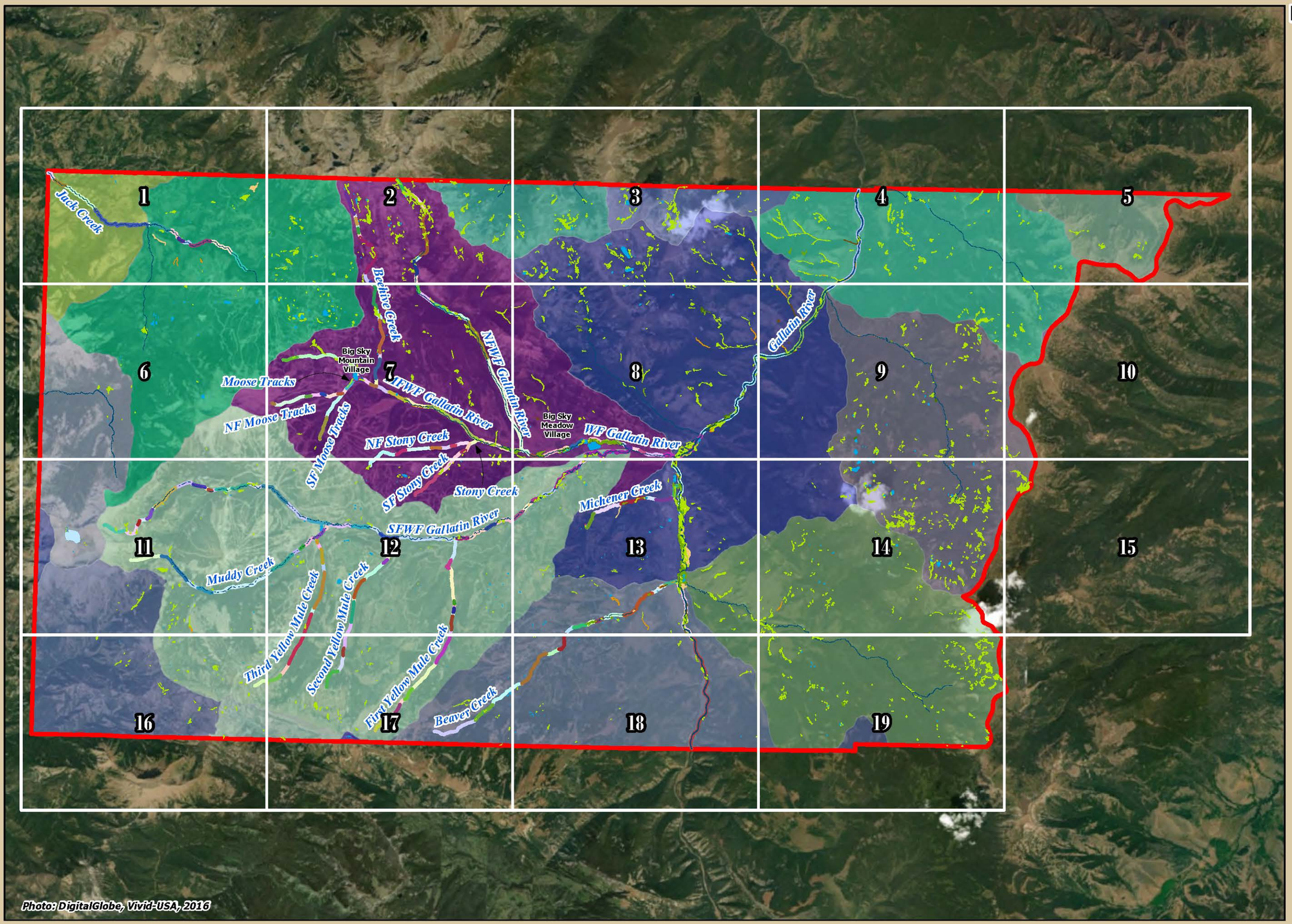
U.S. Fish and Wildlife Service. 2009. *A System for Mapping Riparian Areas in the Western United States*. Division of Habitat and Resource Conservation, Branch of Resource and Mapping Support, Arlington, VA.

Attachment A

Wetland and Riparian Map Book

Map Book Panels Stream Reaches / Riparian & Wetland Areas



Legend

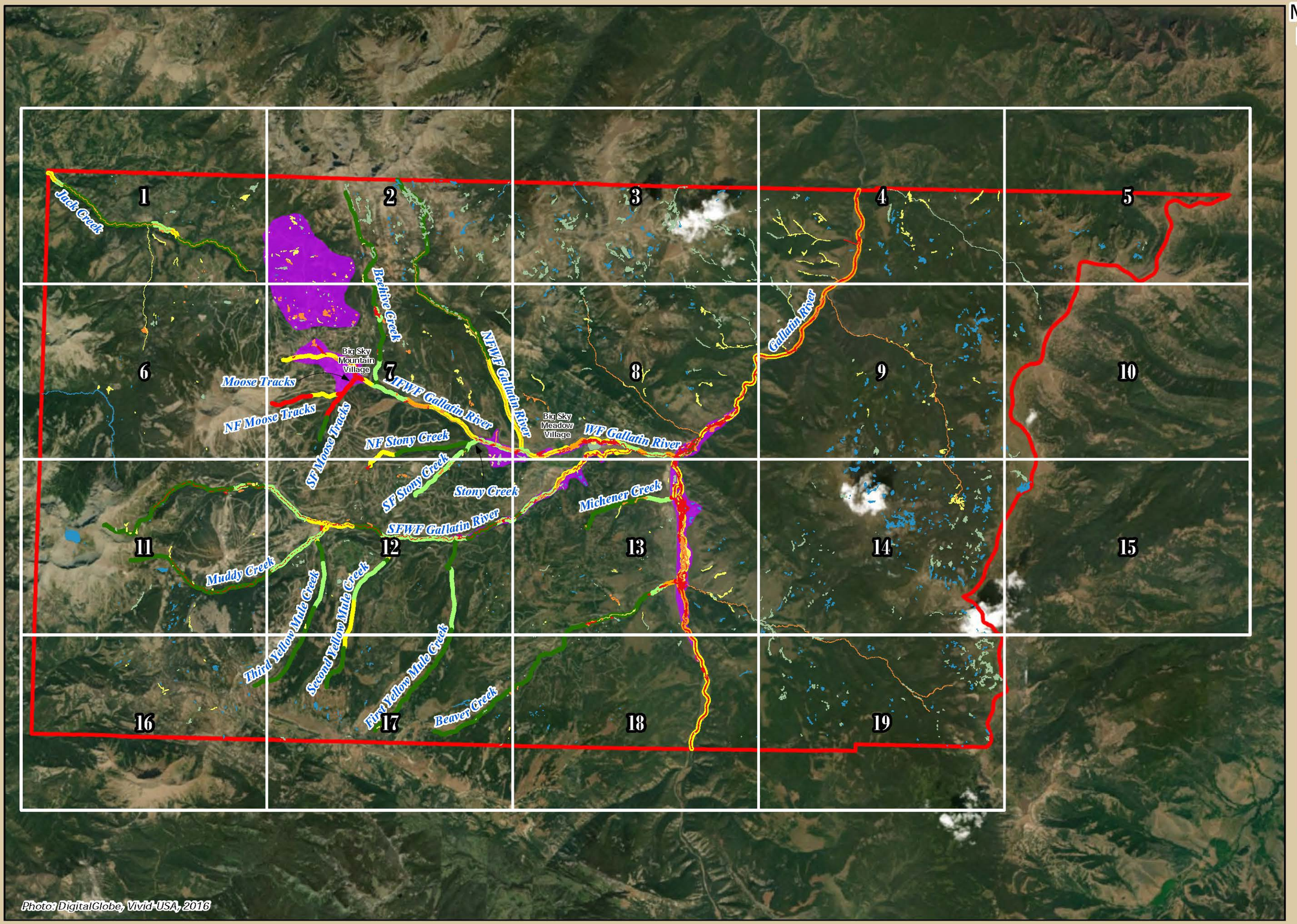
- Stream Reaches
- 2 Map Index
- Resort Tax Boundary
- Watershed Boundaries

Wetland Types (NHP, 2017)

- Freshwater Forested Wetland
- Freshwater Scrub-Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Riparian Forested
- Riparian Scrub-Shrub
- Riparian Emergent
- Lake
- Riverine

0 200 400 600 Miles

Map Book Panels
Riparian Health Assessment / Wetland & Riparian Priority Areas



Riparian Health Assessment

- Good
- Moderate-Good
- Fair
- Moderate-Fair
- Poor
- 2 Map Index
- Priority Areas
- Resort Tax Boundary

Wetland & Riparian Priority Rankings

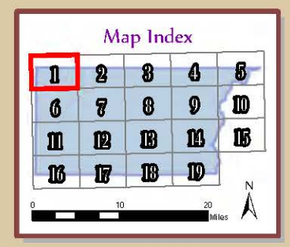
- Lower Priority
- Higher Priority

Wetland Data Source: Montana Natural Heritage Program, 2017

0 200 400 600 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 1



Jack Creek

Photo: DigitalGlobe, Vivid-USA, 2016

Legend

Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
- MR-2-1-U
- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
- MR-10-2-U
- Resort Tax Boundary

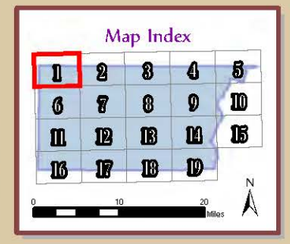
Wetland Types (NHP, 2017)

- Freshwater Forested Wetland
- Freshwater Scrub-Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Riparian Forested
- Riparian Scrub-Shrub
- Riparian Emergent
- Lake
- Riverine

0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 1



JACK 10-01
JACK 09-01
JACK 08-01
JACK 07-01
JACK 06-02
JACK 06-01
JACK 05-02
JACK 05-01
JACK 04-01
JACK 03-01
JACK 02-01
JACK 01-01
Jack Creek

Photo: DigitalGlobe, Vivid-USA, 2016

- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
- Moderate-Good
- Fair
- Moderate-Fair
- Poor
- Priority Areas
- Resort Tax Boundary

Wetland & Riparian Priority Rankings

- Lower Priority
- Higher Priority

Wetland Data Source: Montana Natural Heritage Program, 2017

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 2

Map Index

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	

0 10 20 Miles

Legend

Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
- MR-2-1-U
- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
- MR-10-2-U
- Resort Tax Boundary

Wetland Types (NHP, 2017)

- Freshwater Forested Wetland
- Freshwater Scrub-Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Riparian Forested
- Riparian Scrub-Shrub
- Riparian Emergent
- Lake
- Riverine

Beehive Creek

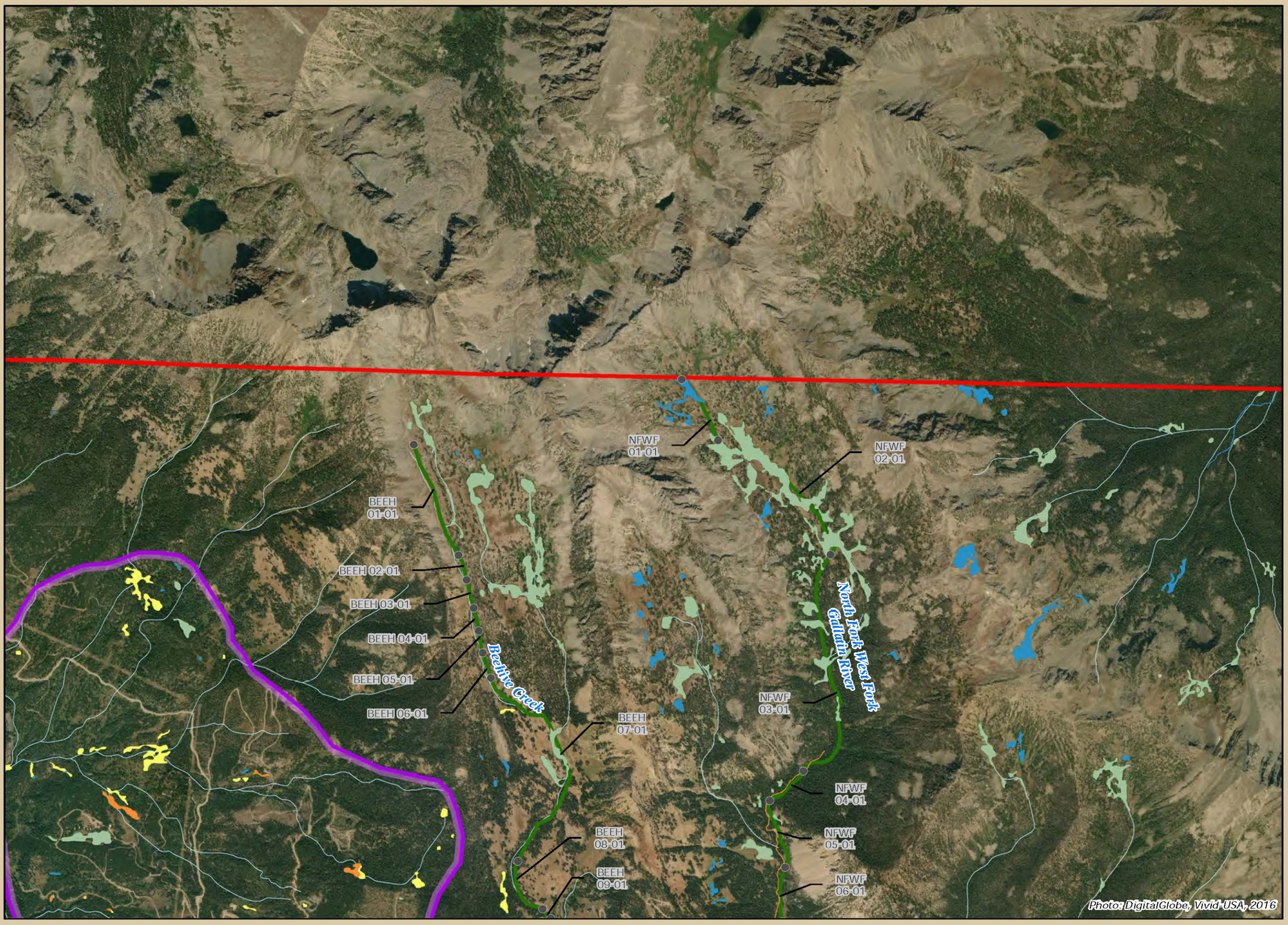
North Fork West Fork Gallatin River

Photo: DigitalGlobe, Vivid-USA, 2016

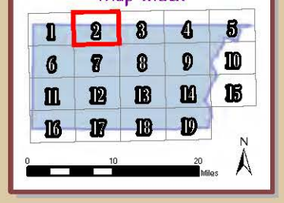
0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 2



Map Index



- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
- Moderate-Good
- Fair
- Moderate-Fair
- Poor
- Priority Areas
- Resort Tax Boundary

Wetland & Riparian Priority Rankings

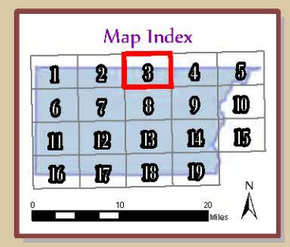
- Lower Priority
- Higher Priority

Wetland Data Source: Montana Natural Heritage Program, 2017

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 3



Legend

Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
- MR-2-1-U
- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
- MR-10-2-U
- Resort Tax Boundary

Wetland Types (NHP, 2017)

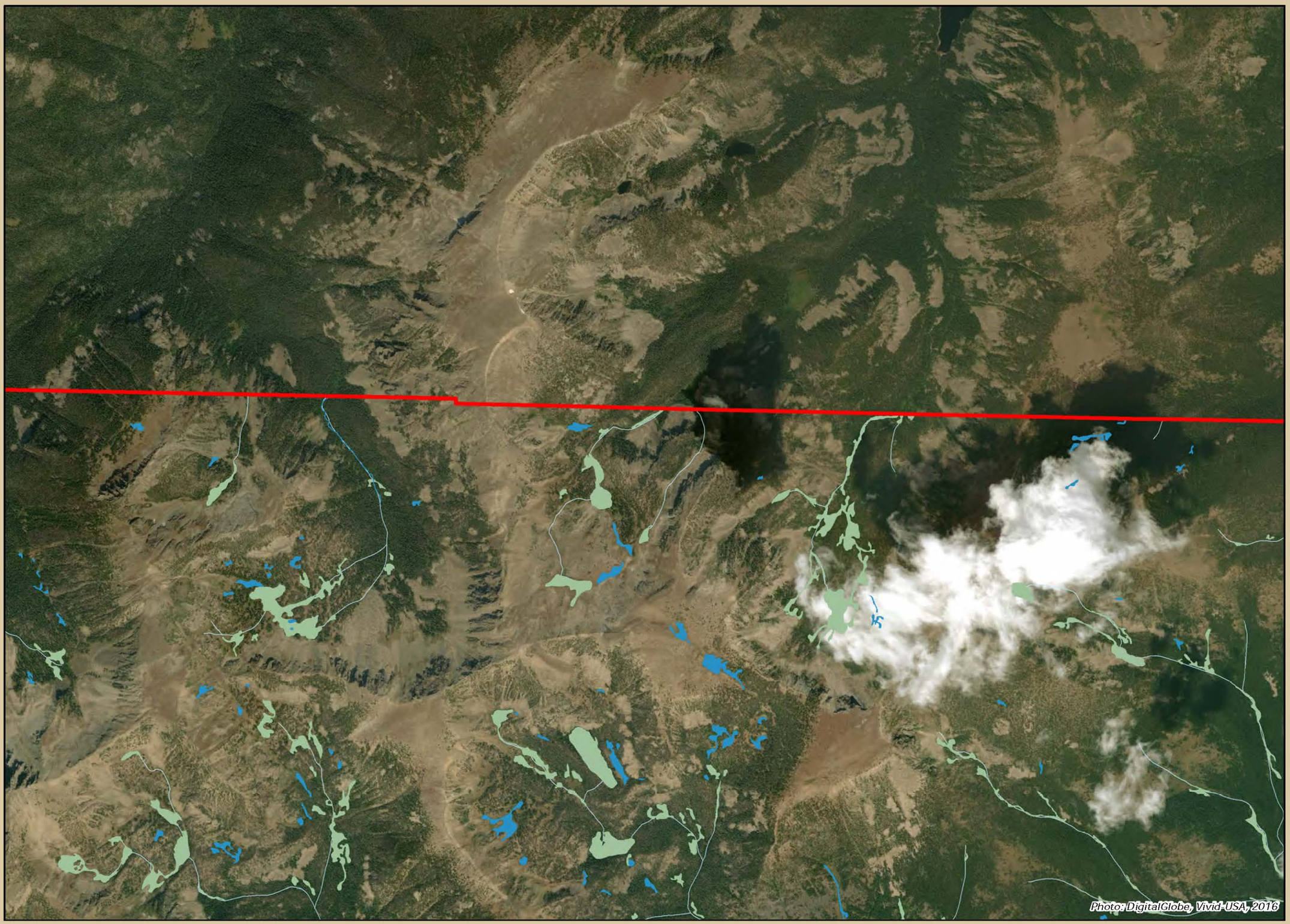
- Freshwater Forested Wetland
- Freshwater Scrub-Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Riparian Forested
- Riparian Scrub-Shrub
- Riparian Emergent
- Lake
- Riverine

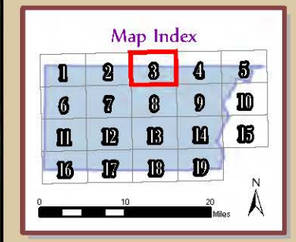
0 0.25 0.5 Miles

Photo: DigitalGlobe, Vivid-USA, 2016

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 3





- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
- Moderate-Good
- Fair
- Moderate-Fair
- Poor
- Priority Areas
- Resort Tax Boundary

Wetland & Riparian Priority Rankings

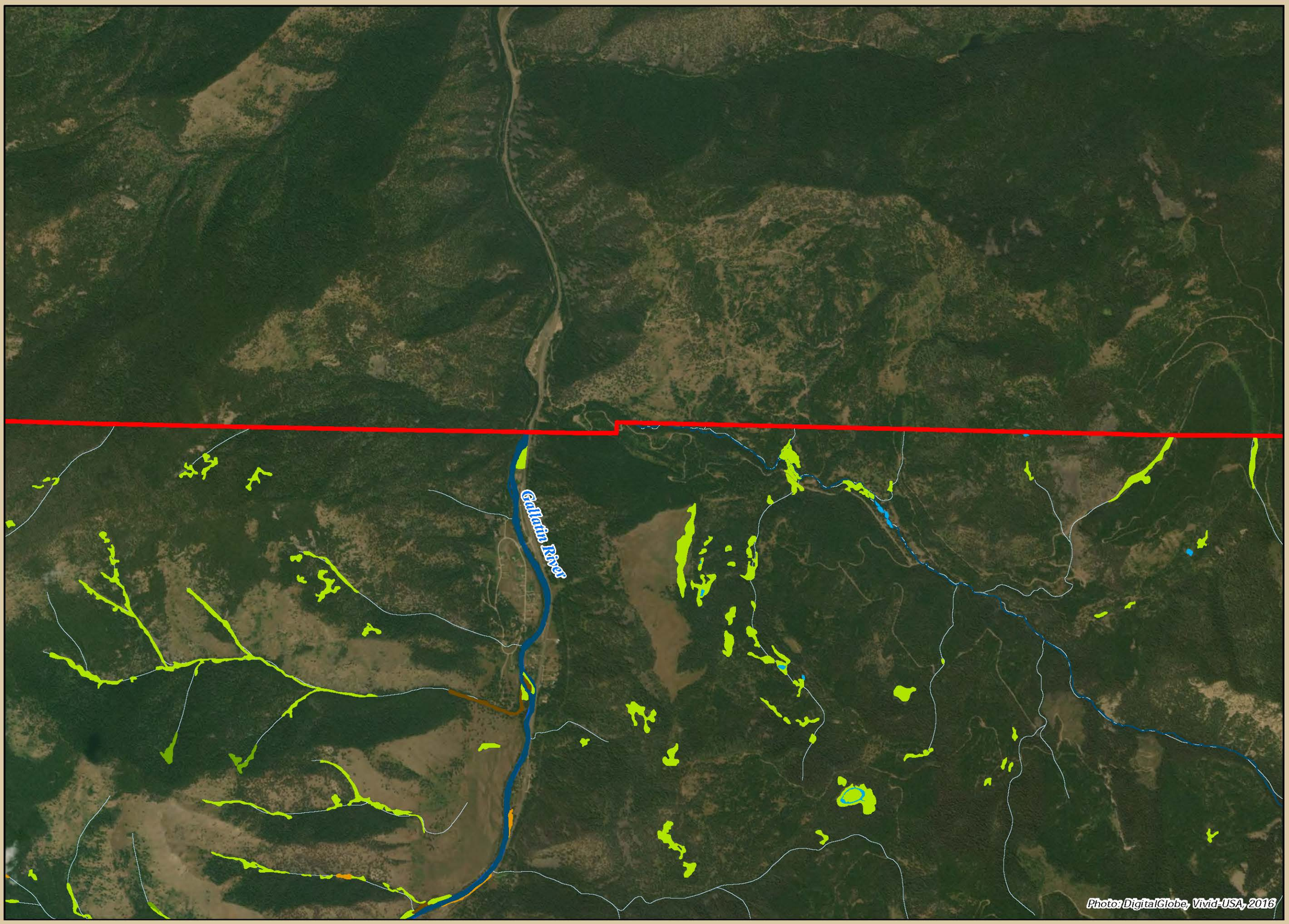
- Lower Priority
- Higher Priority

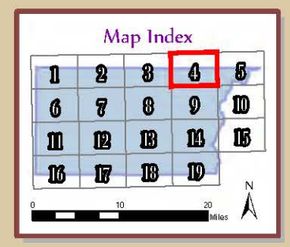
Wetland Data Source: Montana Natural Heritage Program, 2017

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 4





Legend

- Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
- MR-2-1-U
- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
- MR-10-2-U
- Resort Tax Boundary

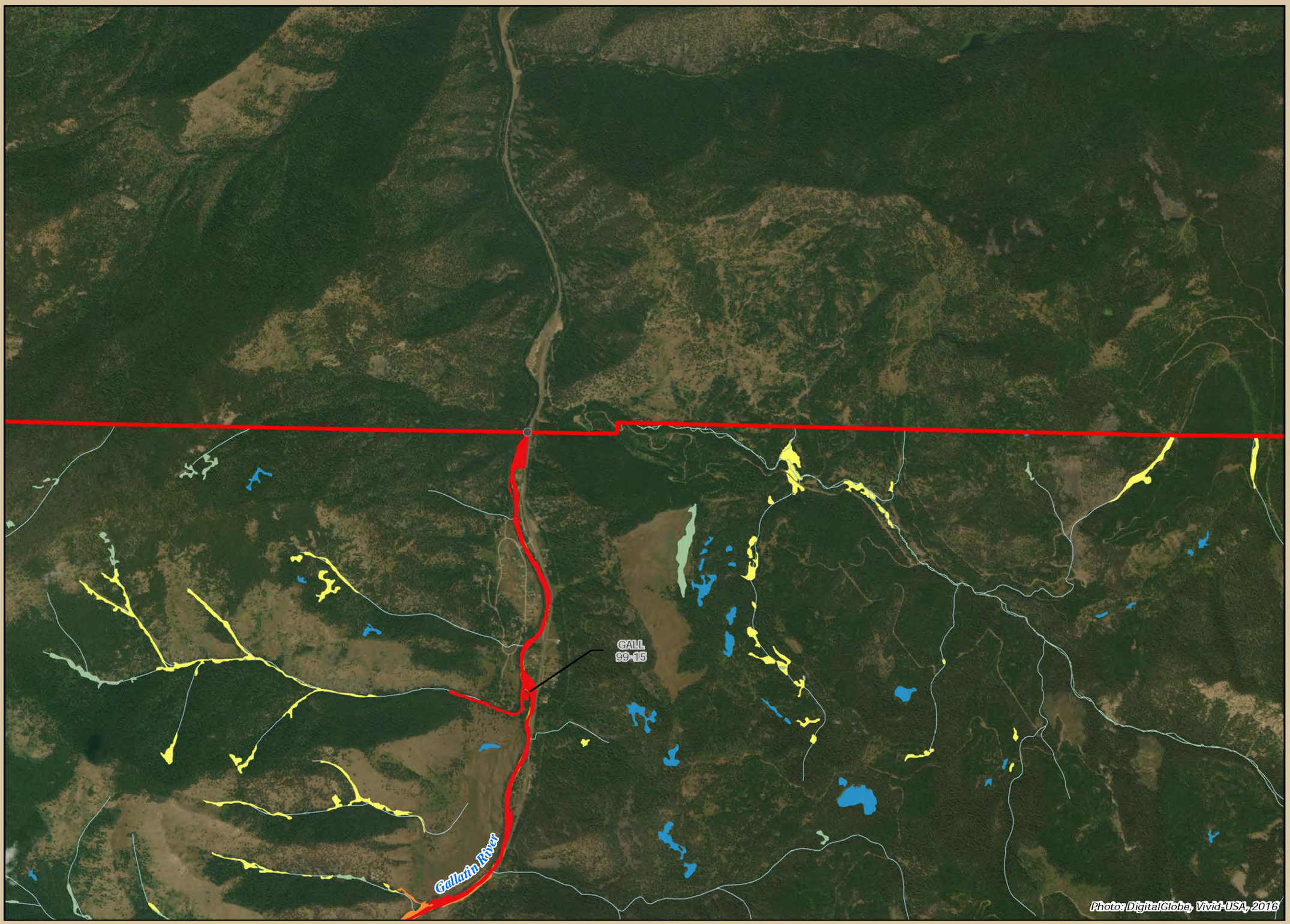
Wetland Types (NHP, 2017)

- Freshwater Forested Wetland
- Freshwater Scrub-Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Riparian Forested
- Riparian Scrub-Shrub
- Riparian Emergent
- Lake
- Riverine

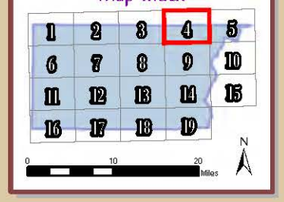
0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 4



Map Index



- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
- Moderate-Good
- Fair
- Moderate-Fair
- Poor
- Priority Areas
- Resort Tax Boundary

Wetland & Riparian Priority Rankings

- Lower Priority
- Higher Priority

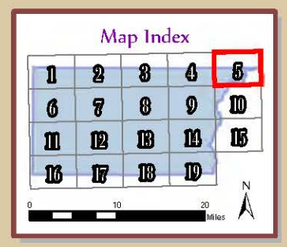
Wetland Data Source: Montana Natural Heritage Program, 2017

Photo: DigitalGlobe, Vivid-USA, 2016

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 5



Legend

Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
- MR-2-1-U
- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
- MR-10-2-U
- Resort Tax Boundary

Wetland Types (NHP, 2017)

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- Freshwater Pond
- Riparian Forested
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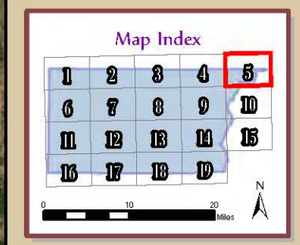
- Lake
- Riverine

Photo: DigitalGlobe, Vivid-USA, 2016

0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 5



- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
- Moderate-Good
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- Moderate-Fair
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- Priority Areas
- Resort Tax Boundary

Wetland & Riparian Priority Rankings

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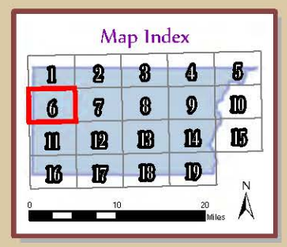
Wetland Data Source: Montana Natural Heritage Program, 2017

Photo: DigitalGlobe, Vivid-USA, 2016

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 6



Legend

- Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
- MR-2-1-U
- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
- MR-10-2-U
- Resort Tax Boundary

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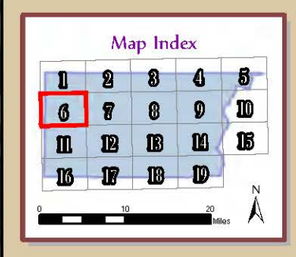
- Riverine

0 0.25 0.5 Miles

Photo: DigitalGlobe, Vivid-USA, 2016

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 6



- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
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- Moderate-Fair
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- Priority Areas
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Wetland & Riparian Priority Rankings

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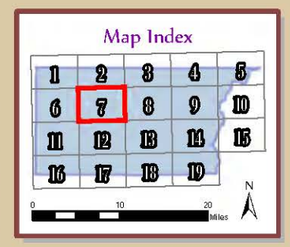
Wetland Data Source: Montana Natural Heritage Program, 2017

Photo: DigitalGlobe, Vivid-USA, 2016

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 7



Beehive Creek

North Fork West Fork Gallatin River

North Fork Moose Tracks

Moose Tracks

South Fork Moose Tracks

Middle Fork West Fork Gallatin River

North Fork Stony Creek

South Fork Stony Creek

Stony Creek

Photo: DigitalGlobe, Vivid-USA, 2016

Legend

Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
- MR-2-1-U
- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
- MR-10-2-U
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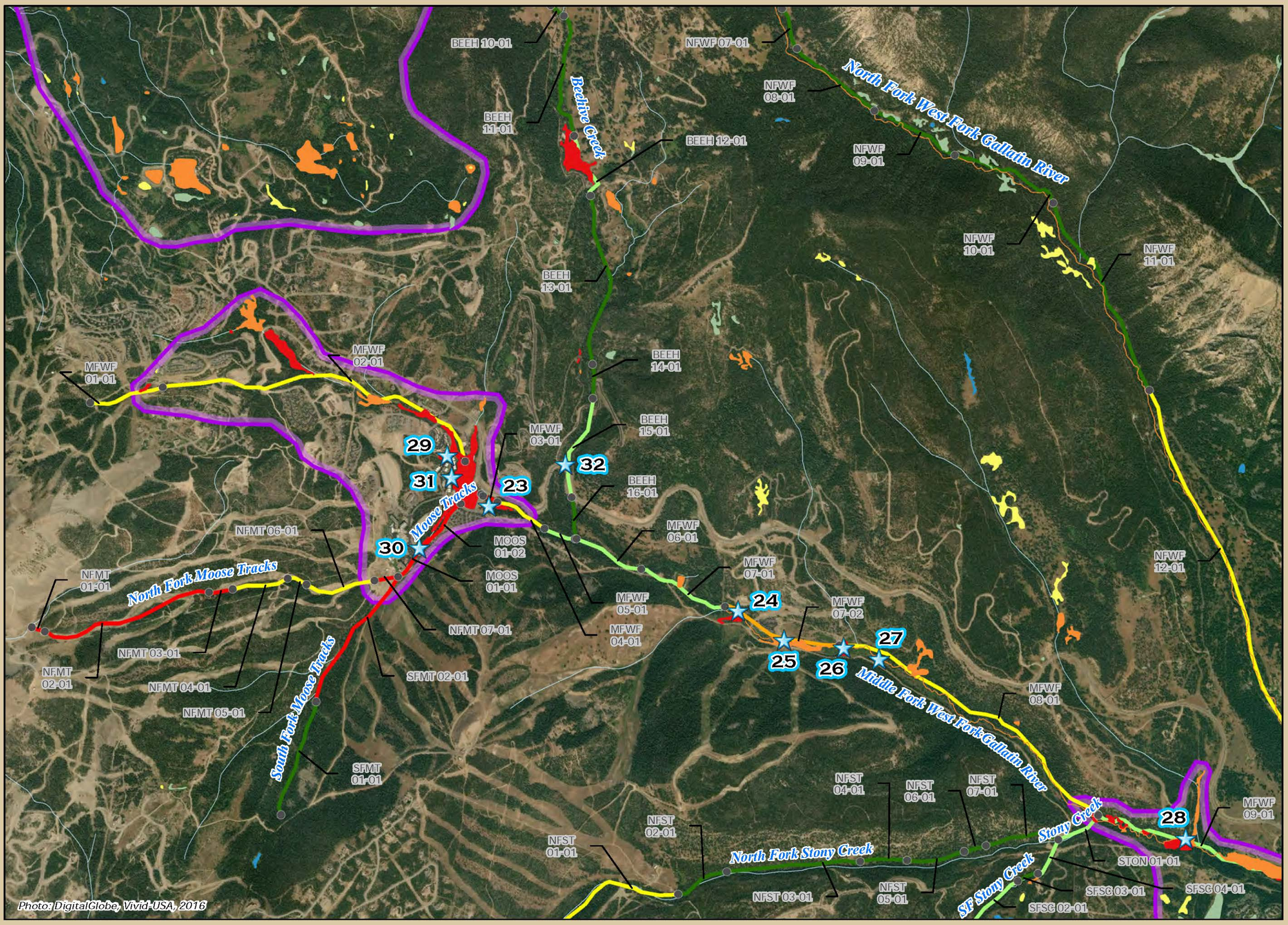
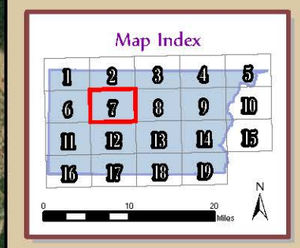
- Lake
- Riverine

0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 7





- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
- Moderate-Good
- Fair
- Moderate-Fair
- Poor
- Priority Areas
- Resort Tax Boundary

Wetland & Riparian Priority Rankings

- Lower Priority
- Higher Priority

Wetland Data Source: Montana Natural Heritage Program, 2017

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 8

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Map Index

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	

0 10 20 Miles

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Legend

Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
- MR-2-1-U
- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
- MR-10-2-U
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- Freshwater Pond
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- Riparian Scrub-Shrub
- Riparian Emergent
- Lake
- Riverine

North Fork West Fork Gallatin River

SFWF Gallatin River

West Fork Gallatin River

Gallatin River

Photo: DigitalGlobe, Vivid-USA, 2016

0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 8

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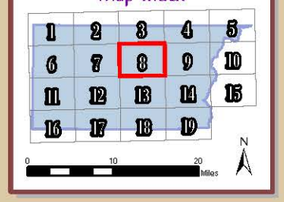
Map Index



Reach Breaks

Restoration & Conservation Opportunities

Streams

Riparian Health Assessment

- Good
- Moderate-Good
- Fair
- Moderate-Fair
- Poor

Priority Areas

Resort Tax Boundary

Wetland & Riparian Priority Rankings

- Lower Priority
- Higher Priority

Wetland Data Source: Montana Natural Heritage Program, 2017

0 0.25 0.5 Miles

Photo: DigitalGlobe, Vivid-USA, 2016

NFWF Gallatin River

NFWF 12-01

WFGR 01-03

WFGR 01-01

WFGR 01-02

WF Gallatin River

WFGR 01-04

WFGR 01-05

WFGR 02-01

WFGR 02-03

WFGR 02-02

WFGR 03-01

WFGR 03-02

WFGR 03-03

WFGR 04-01

SFWF Gallatin River

SFWF 29-04

Gallatin River

GALL 99-13

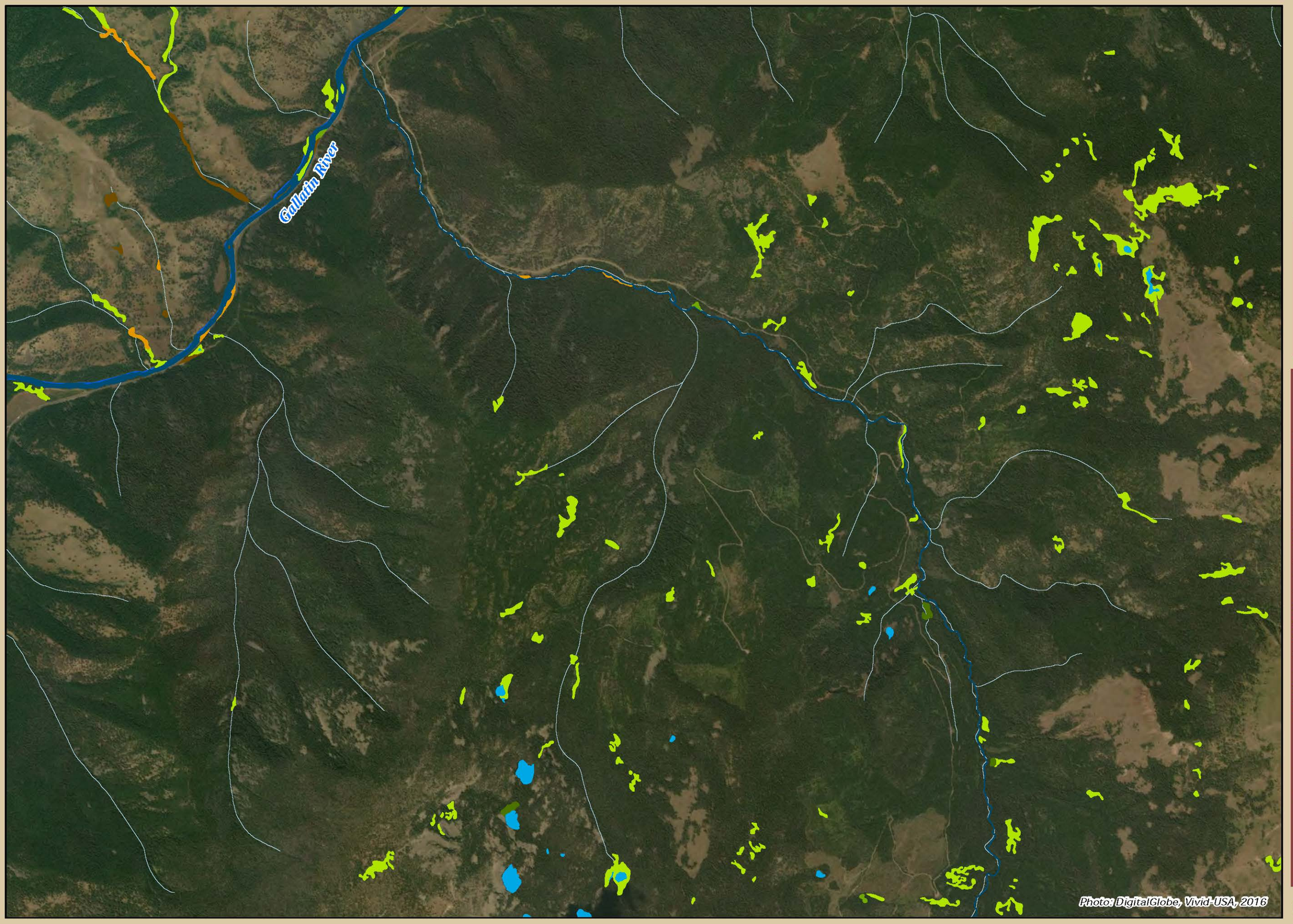
GALL 99-12

10 11 12 13 14 15 16 17 18 19 20 21 22

5

Stream Reaches / Wetland & Riparian Areas

Sheet 9



N
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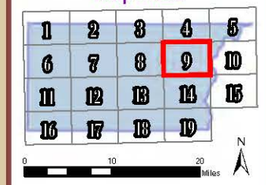
Map Index



Legend

Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
- MR-2-1-U
- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
- MR-10-2-U
- Resort Tax Boundary

Wetland Types (NHP, 2017)

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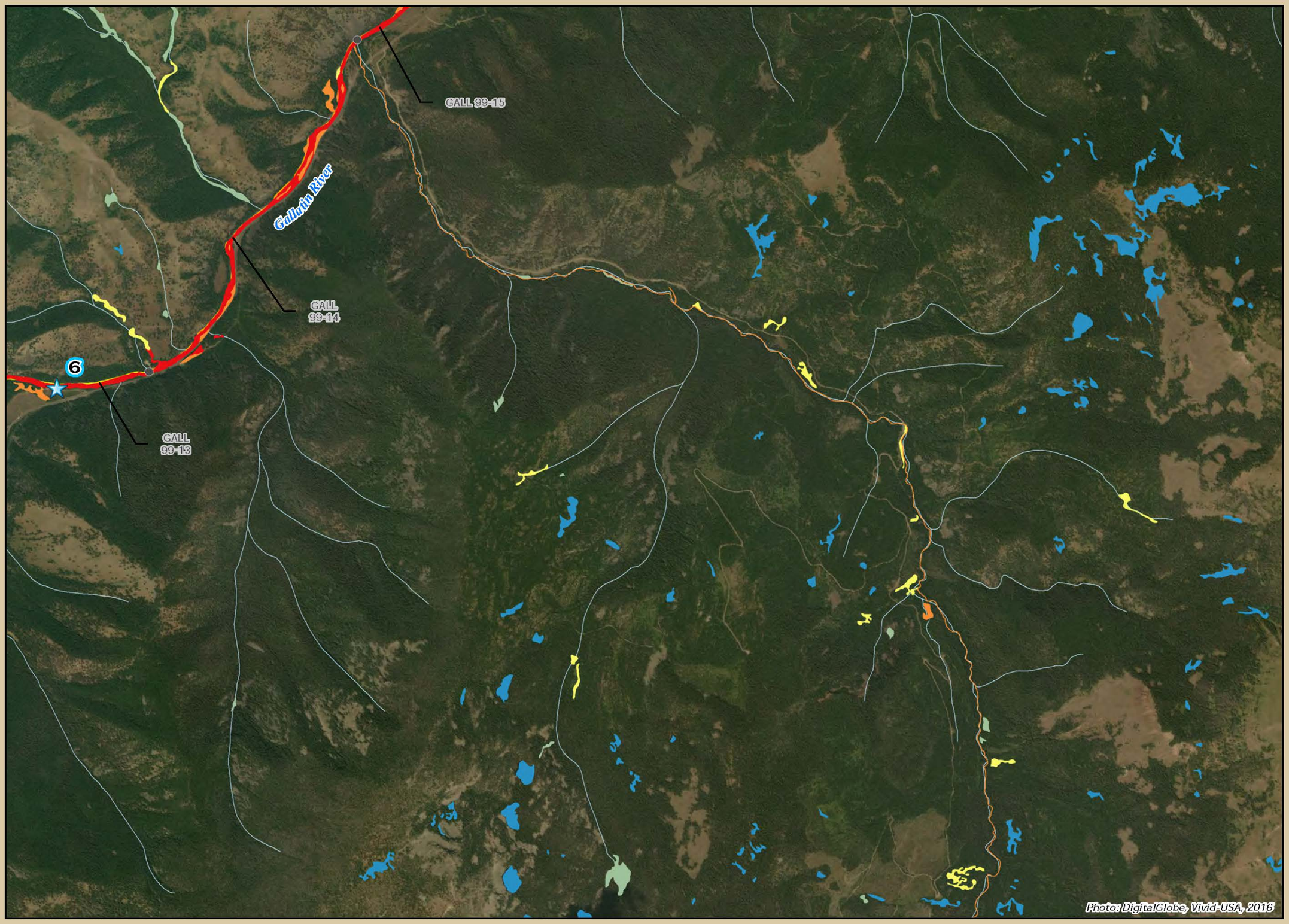
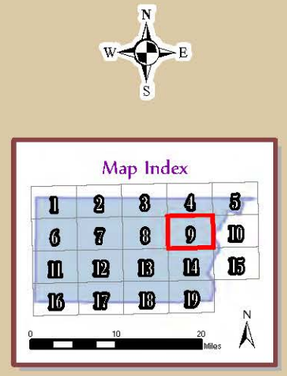
- Riparian Emergent
- Lake
- Riverine

0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 9





- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
- Moderate-Good
- Fair
- Moderate-Fair
- Poor
- Priority Areas
- Resort Tax Boundary

Wetland & Riparian Priority Rankings

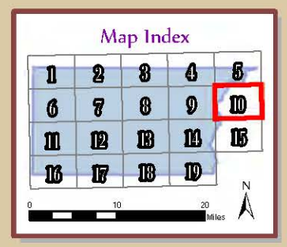
- Lower Priority
- Higher Priority

Wetland Data Source: Montana Natural Heritage Program, 2017

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 10



Legend

Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
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- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
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- MR-10-2-U
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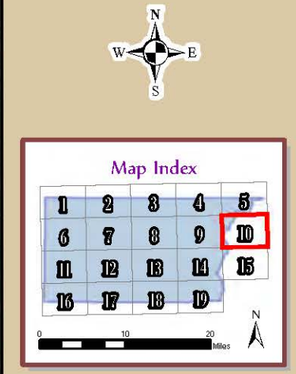
0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 10



- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
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Wetland & Riparian Priority Rankings

- Lower Priority
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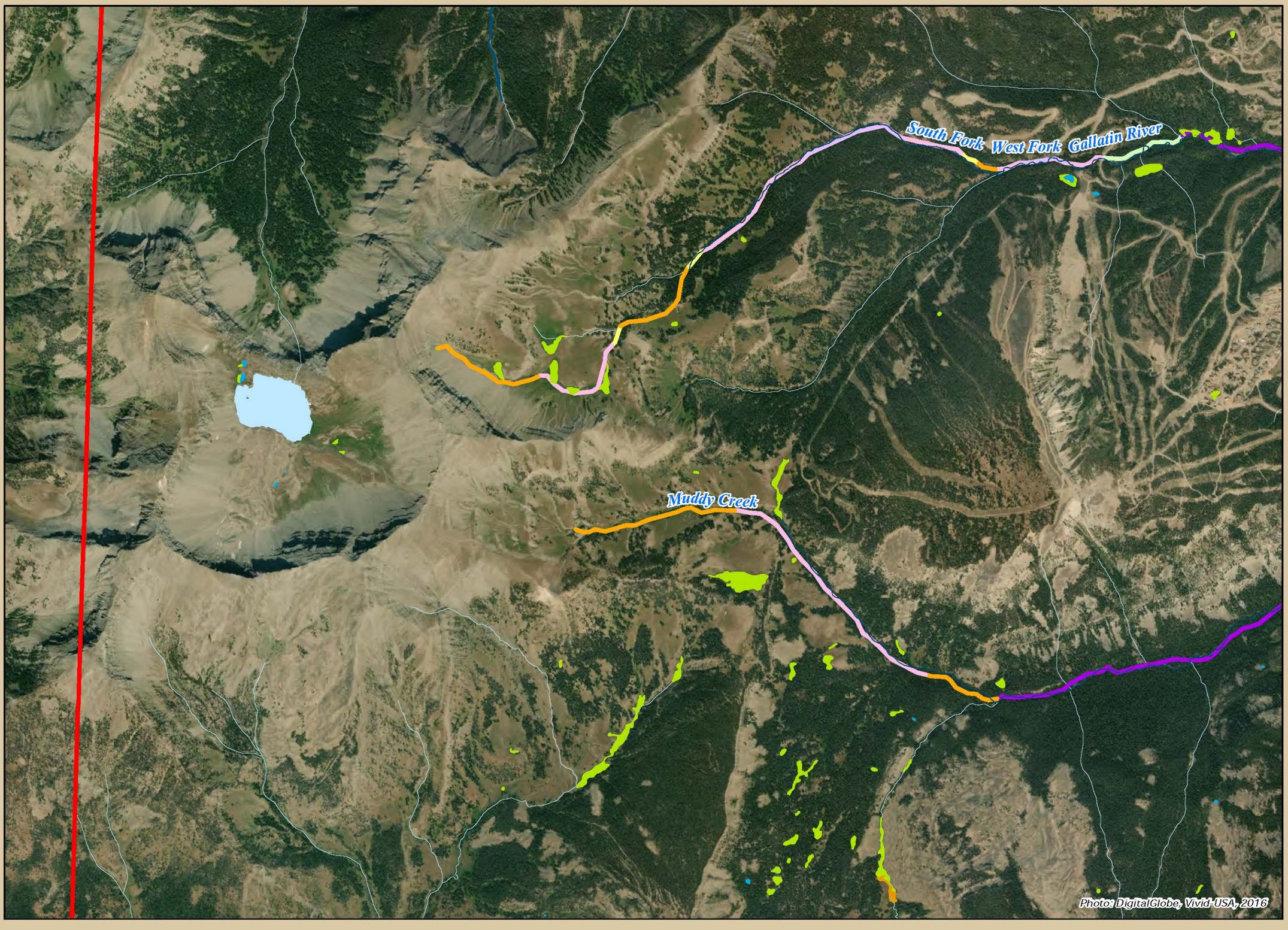
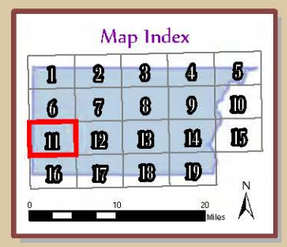
Wetland Data Source: Montana Natural Heritage Program, 2017

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 11





Legend

- Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
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- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
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- MR-10-1-U
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0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 11

South Fork West Fork Gallatin River

Muddy Creek

SFWF 01-01
SFWF 02-01
SFWF 03-01
SFWF 04-01
SFWF 05-01
SFWF 06-01
SFWF 07-01
SFWF 08-01
SFWF 09-01
SFWF 10-01
SFWF 11-01
SFWF 12-01
SFWF 13-01
SFWF 14-01
SFWF 15-01
SFWF 16-01
SFWF 16-02

MUDD 01-01
MUDD 02-01
MUDD 03-01
MUDD 04-01
MUDD 05-01

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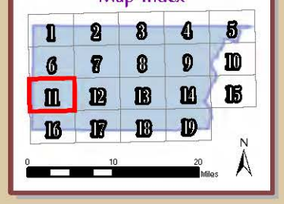
W E
S

Map Index



- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
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Wetland & Riparian Priority Rankings

- Lower Priority
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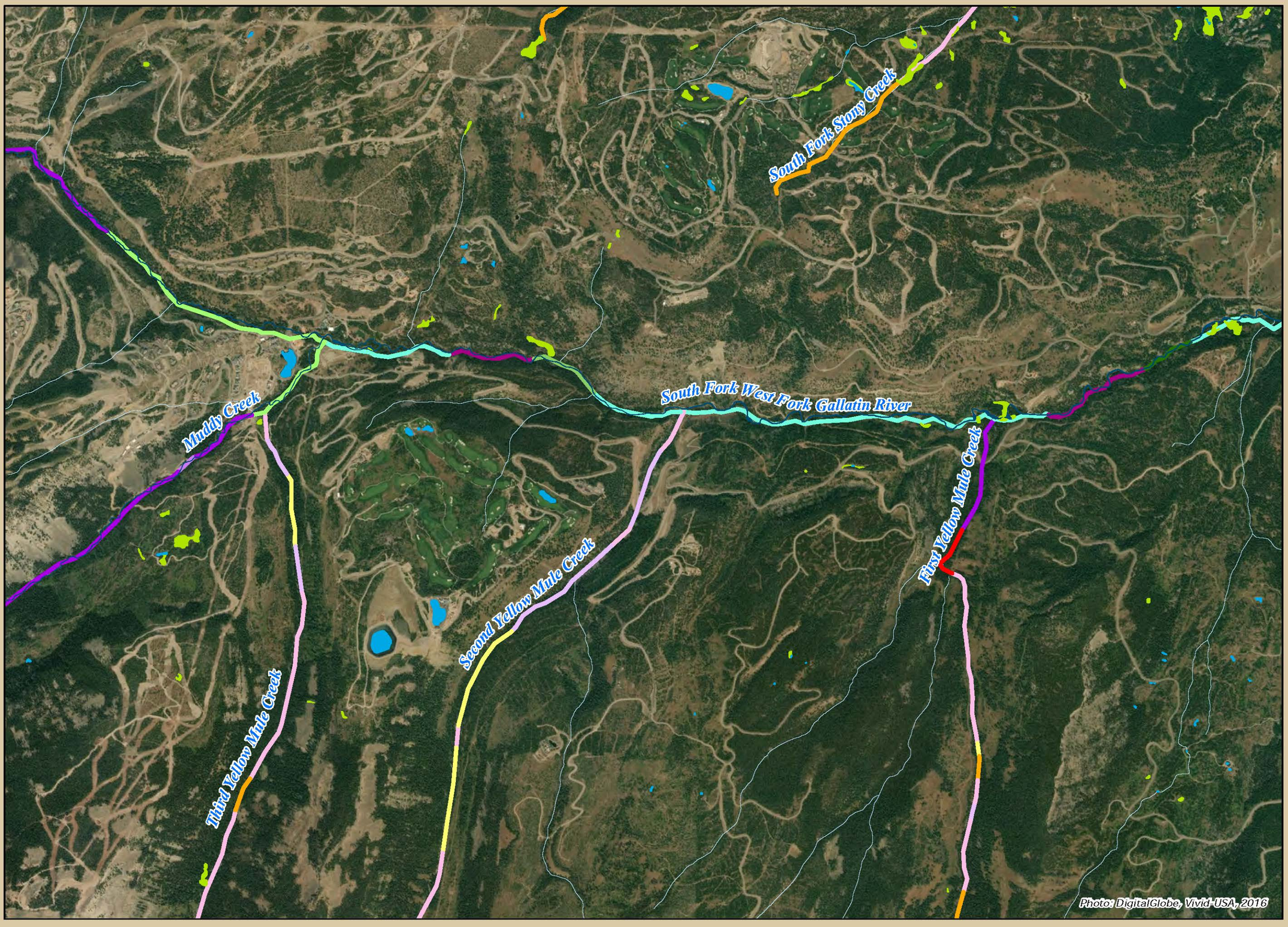
Wetland Data Source: Montana Natural Heritage Program, 2017

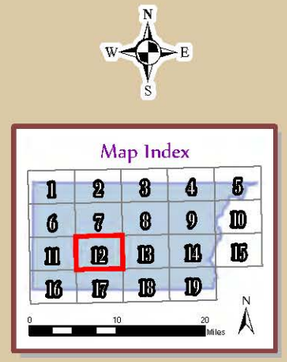
Photo: DigitalGlobe, Vivid-USA, 2016

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 12





Legend

Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
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- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
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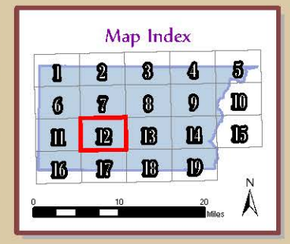
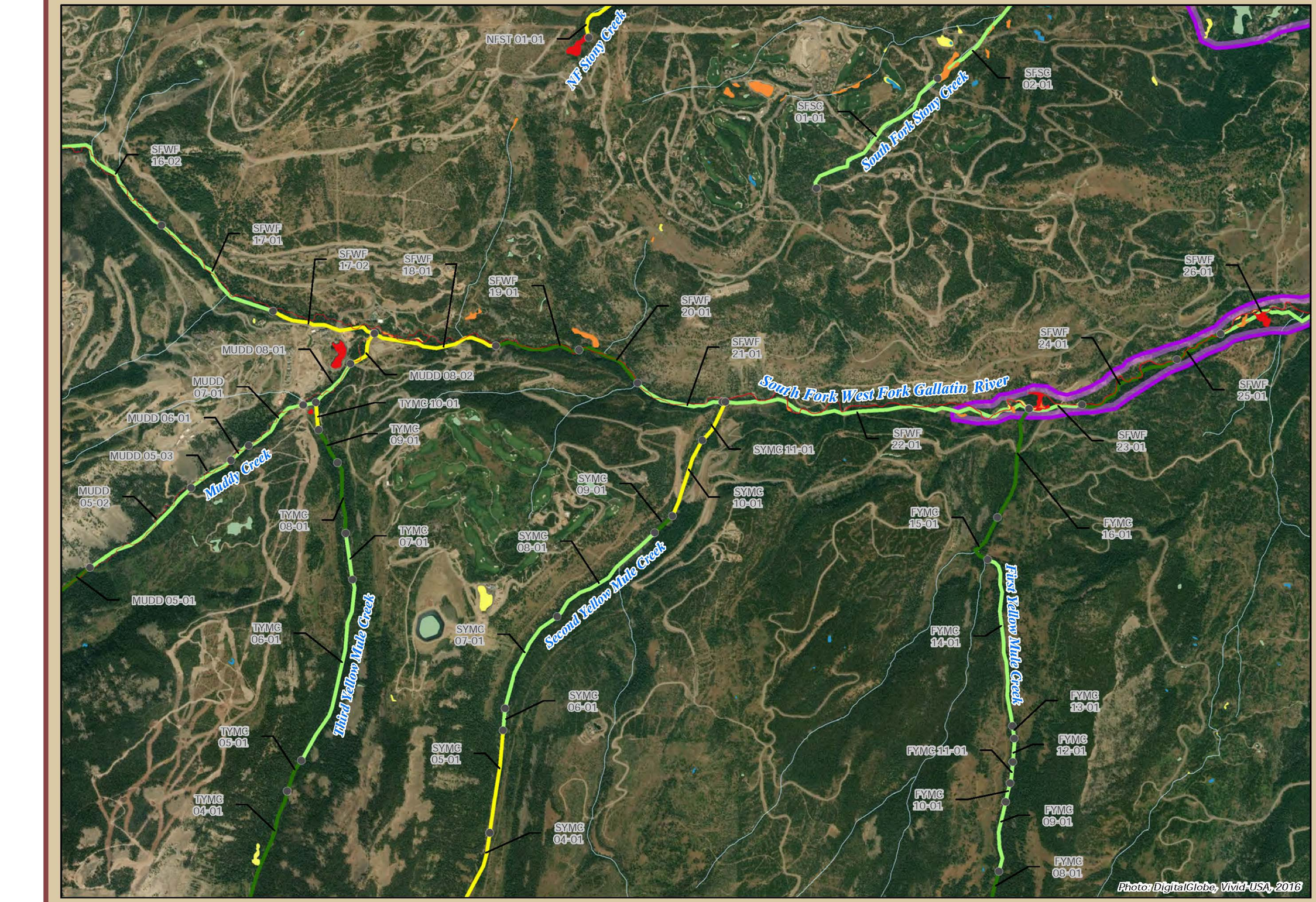
0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 12





- Reach Breaks
- Restoration & Conservation Opportunities
- Streams

Riparian Health Assessment

- Good
- Moderate-Good
- Fair
- Moderate-Fair
- Poor
- Priority Areas
- Resort Tax Boundary

Wetland & Riparian Priority Rankings

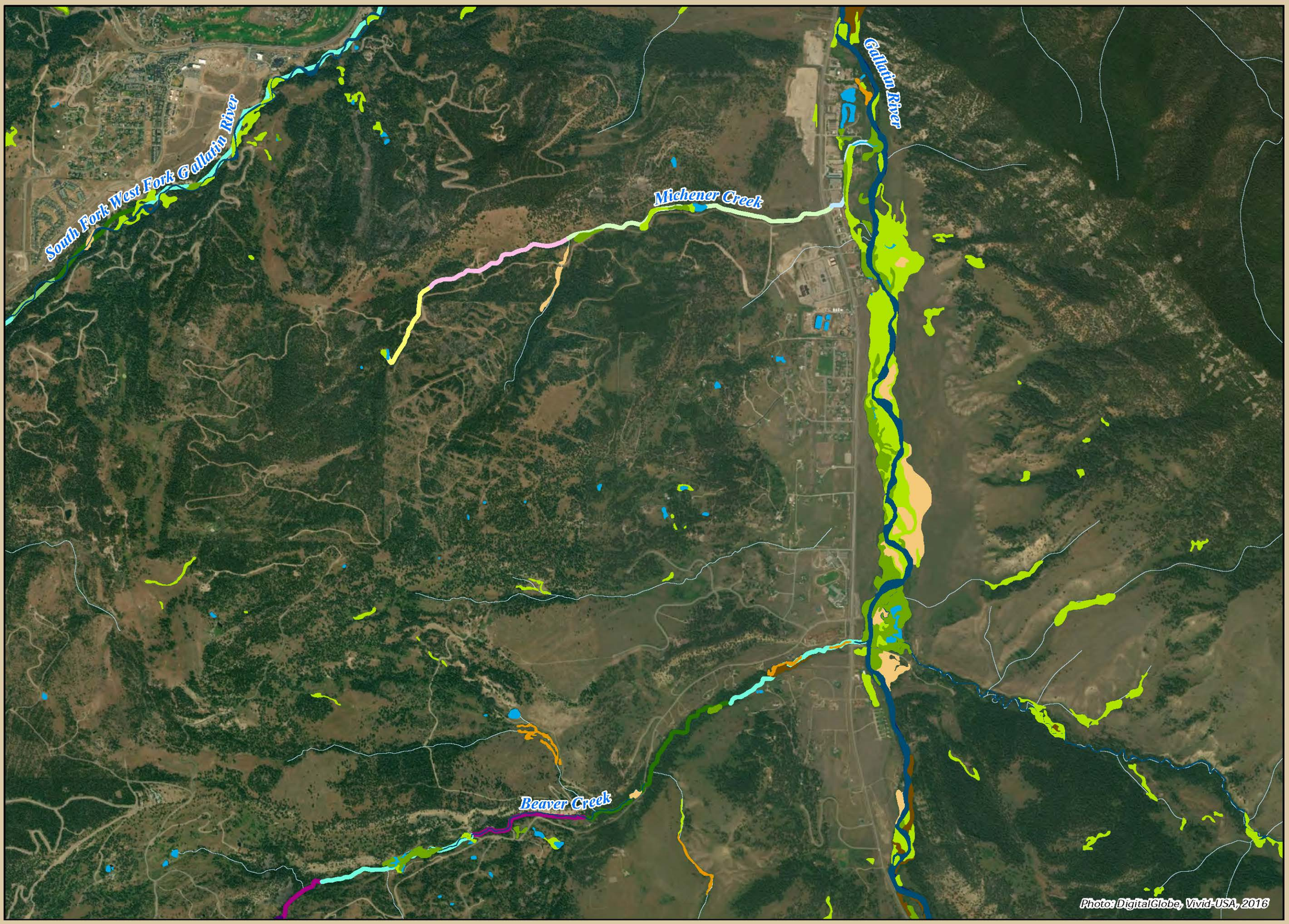
- Lower Priority
- Higher Priority

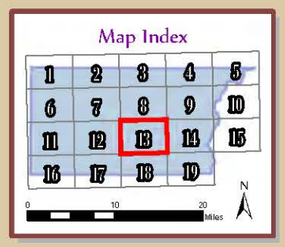
Wetland Data Source: Montana Natural Heritage Program, 2017

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 13





Legend

Streams

Stream Reach Types

- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
- MR-2-1-U
- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
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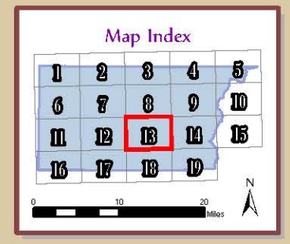
0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

Sheet 13



South Fork West Fork Gallatin River
Michener Creek
Beaver Creek
Gallatin River
35
34
33
9
8
7
4
SFWF 29-03
SFWF 29-02
SFWF 29-01
SFWF 28-02
SFWF 28-01
SFWF 27-01
SFWF 26-01
MICH 02-01
MICH 01-01
MICH 04-01
MICH 05-02
MICH 05-01
MICH 03-01
MICH 04-02
GALL 99-11
GALL 99-10
GALL 99-09
BEAV 11-03
BEAV 11-02
BEAV 11-01
BEAV 10-01
BEAV 09-01
BEAV 08-03
BEAV 08-01
BEAV 08-02
BEAV 07-01

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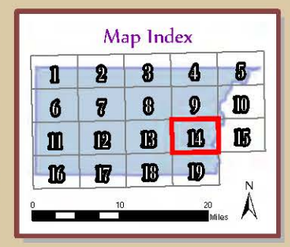
Wetland Data Source: Montana Natural Heritage Program, 2017

Photo: DigitalGlobe, Vivid-USA, 2016

0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 14



Legend

Streams

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- MR-0-1-U
- MR-0-3-U
- MR-0-4-U
- MR-0-5-C
- MR-0-5-U
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- MR-2-2-U
- MR-2-3-C
- MR-2-3-U
- MR-4-1-C
- MR-4-1-U
- MR-4-2-C
- MR-4-2-U
- MR-4-3-C
- MR-4-3-U
- MR-10-1-C
- MR-10-1-U
- MR-10-2-U
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0 0.25 0.5 Miles

Photo: DigitalGlobe, Vivid-USA, 2016

Riparian Health Assessment / Wetland & Riparian Priority Areas

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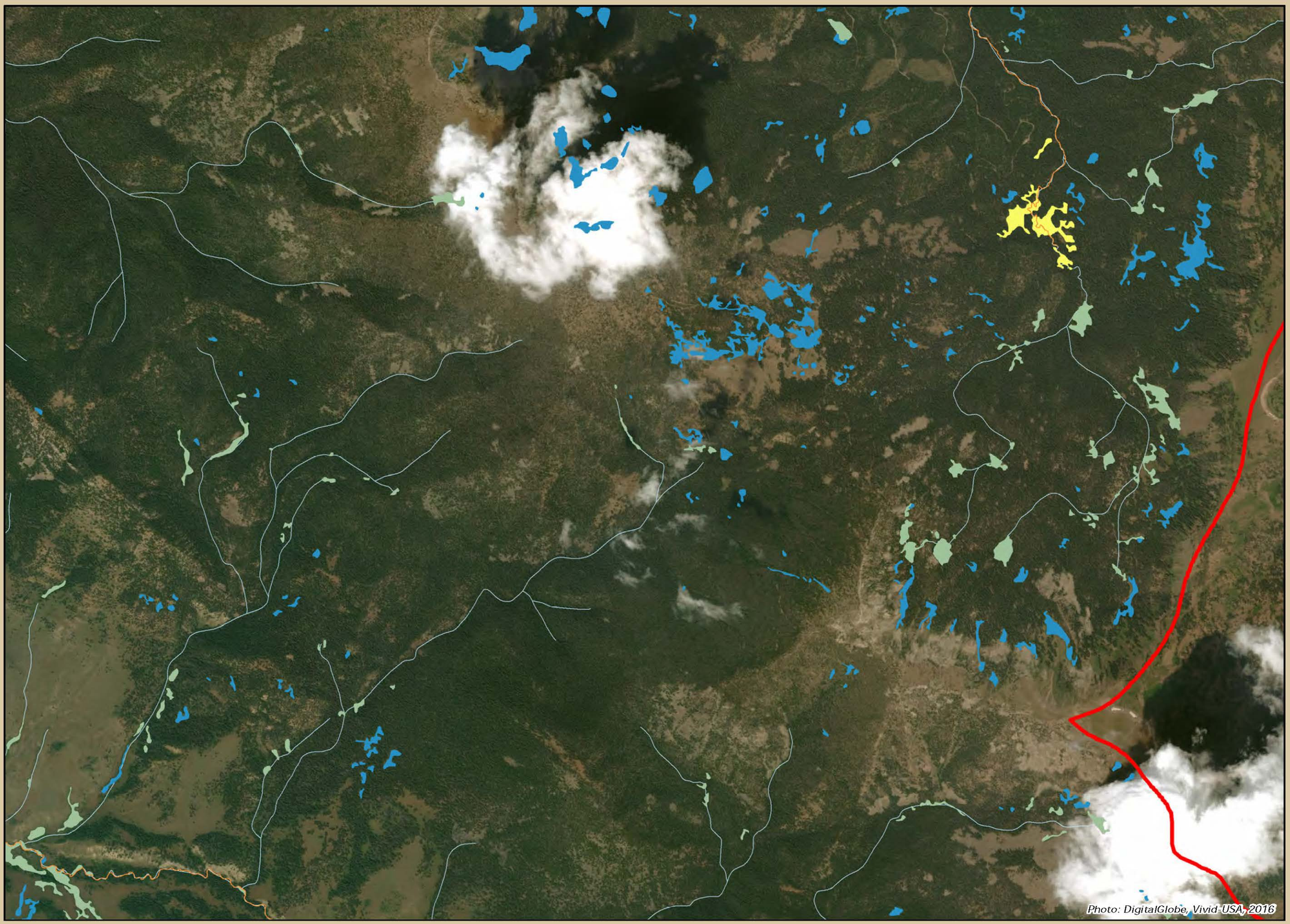

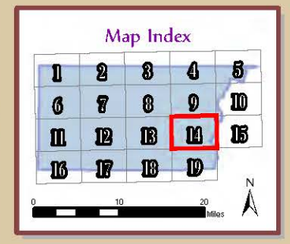

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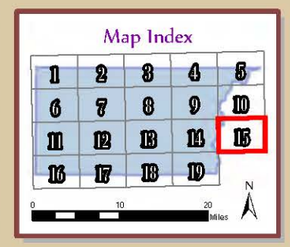
Stream Reaches / Wetland & Riparian Areas

Sheet 15



Legend

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Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

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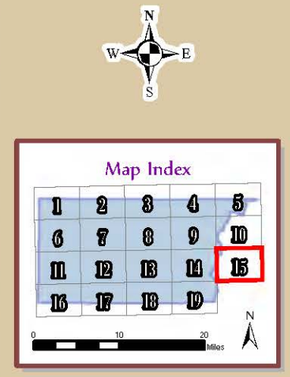

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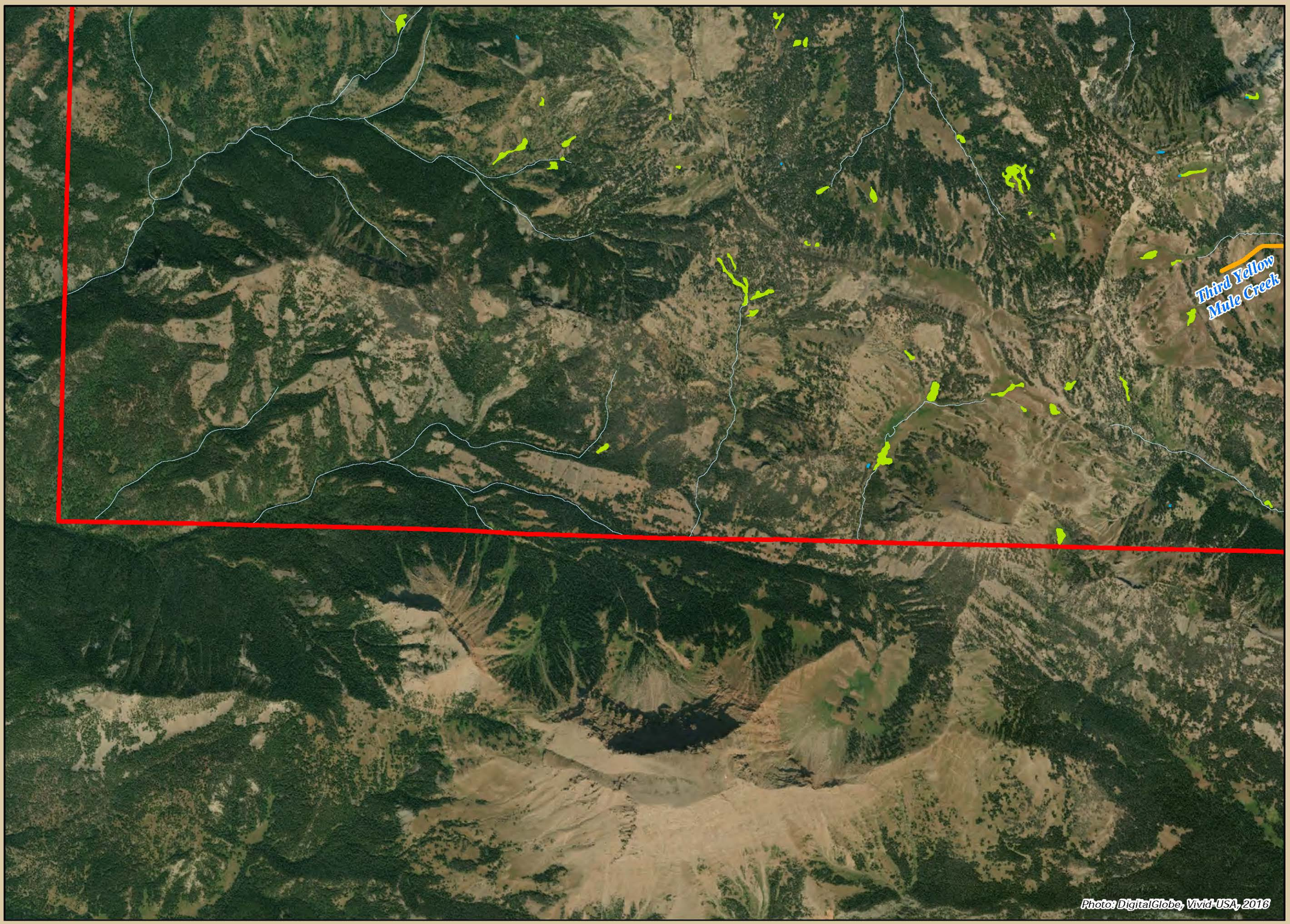
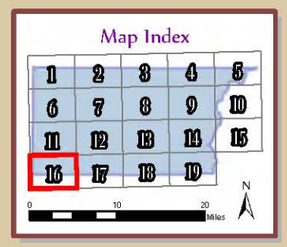
Stream Reaches / Wetland & Riparian Areas

Sheet 16





Legend

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Riparian Health Assessment / Wetland & Riparian Priority Areas

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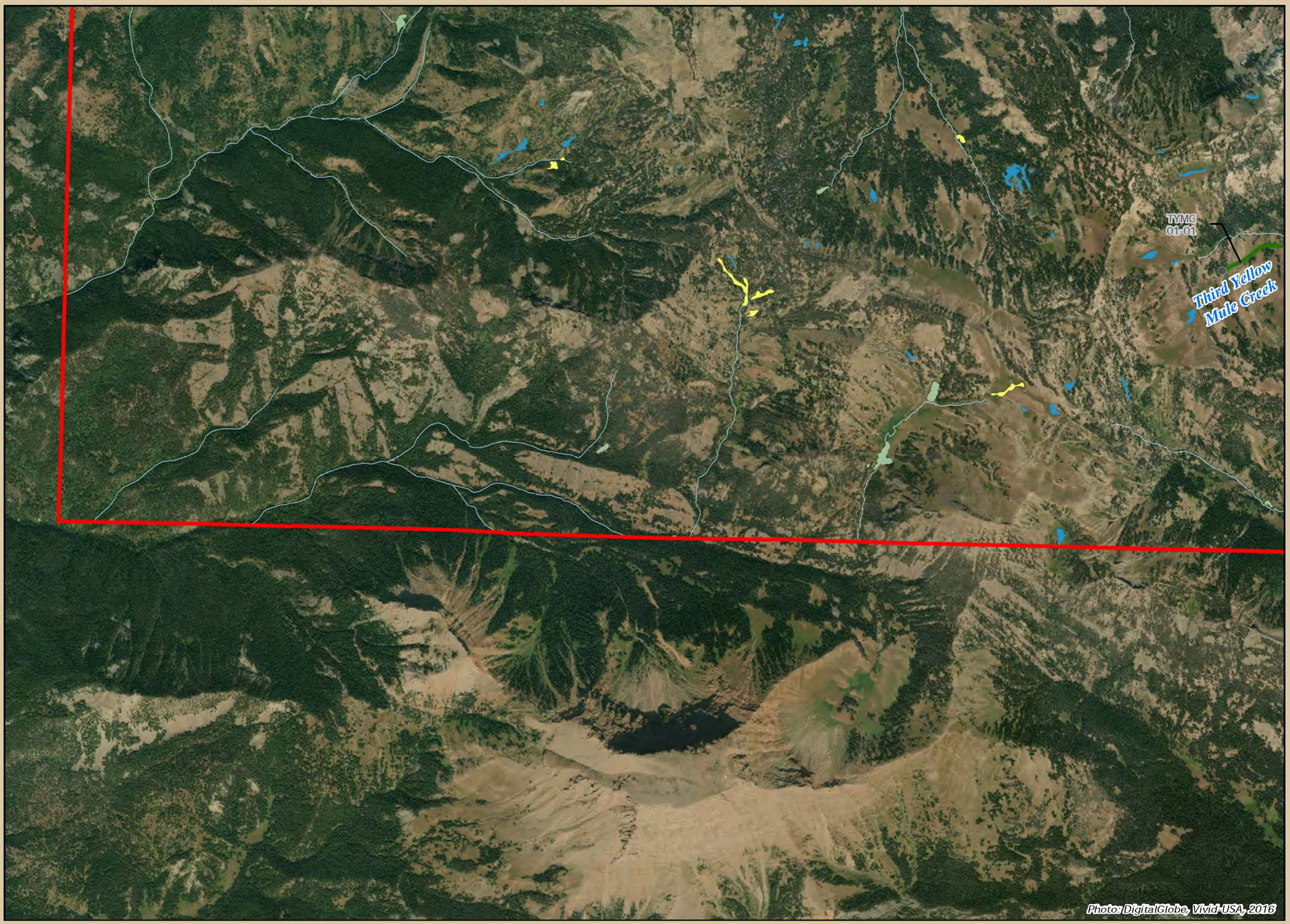

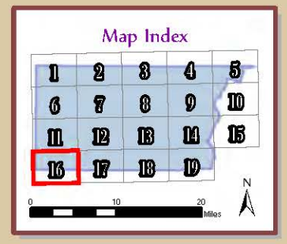

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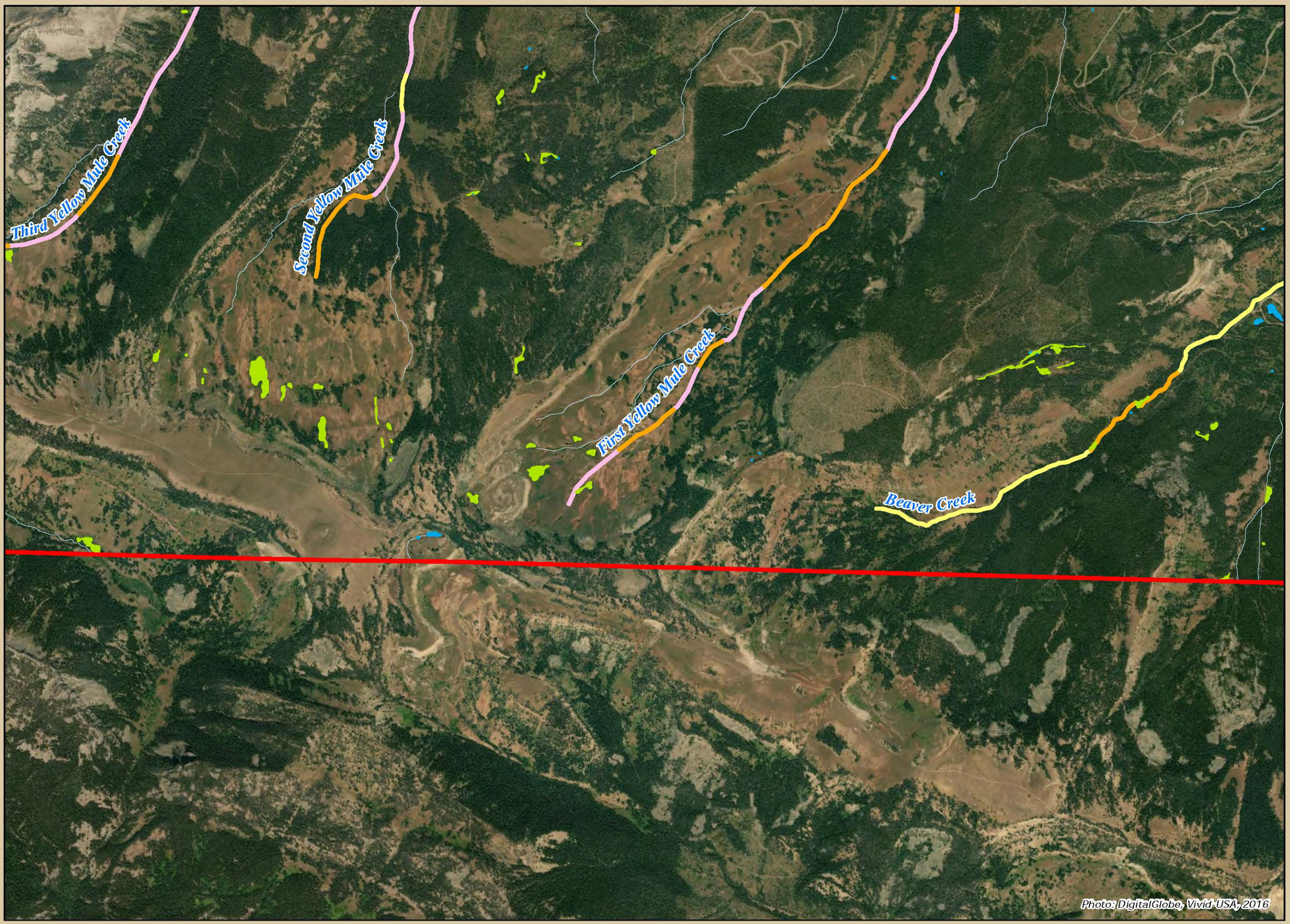
Stream Reaches / Wetland & Riparian Areas

Sheet 17



Map Index

1	2	3	4	5
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11	12	13	14	15
16	17	18	19	

0 10 20 Miles

Legend

Streams

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Riparian Health Assessment / Wetland & Riparian Priority Areas

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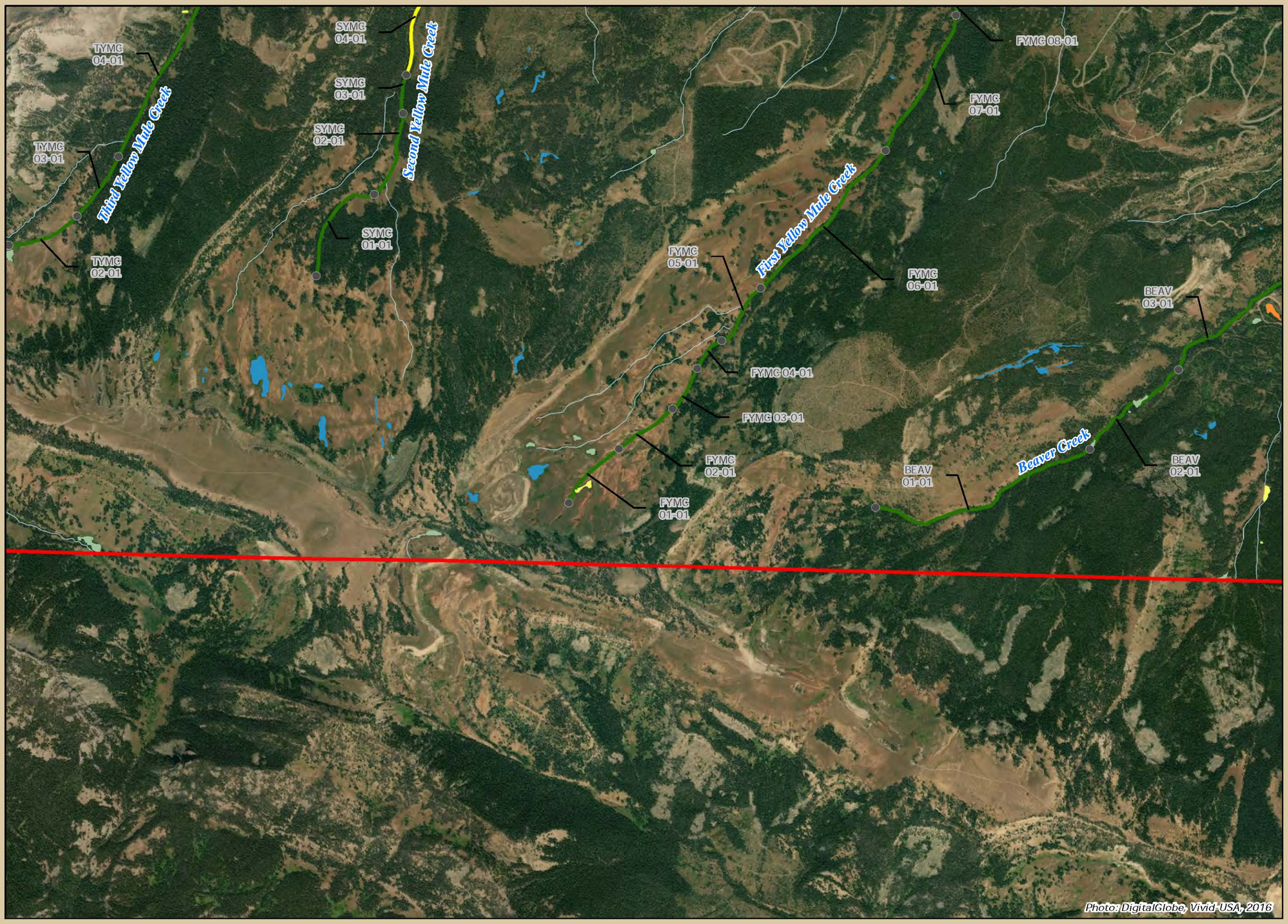

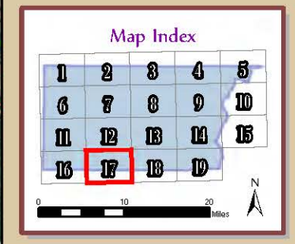

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Stream Reaches / Wetland & Riparian Areas

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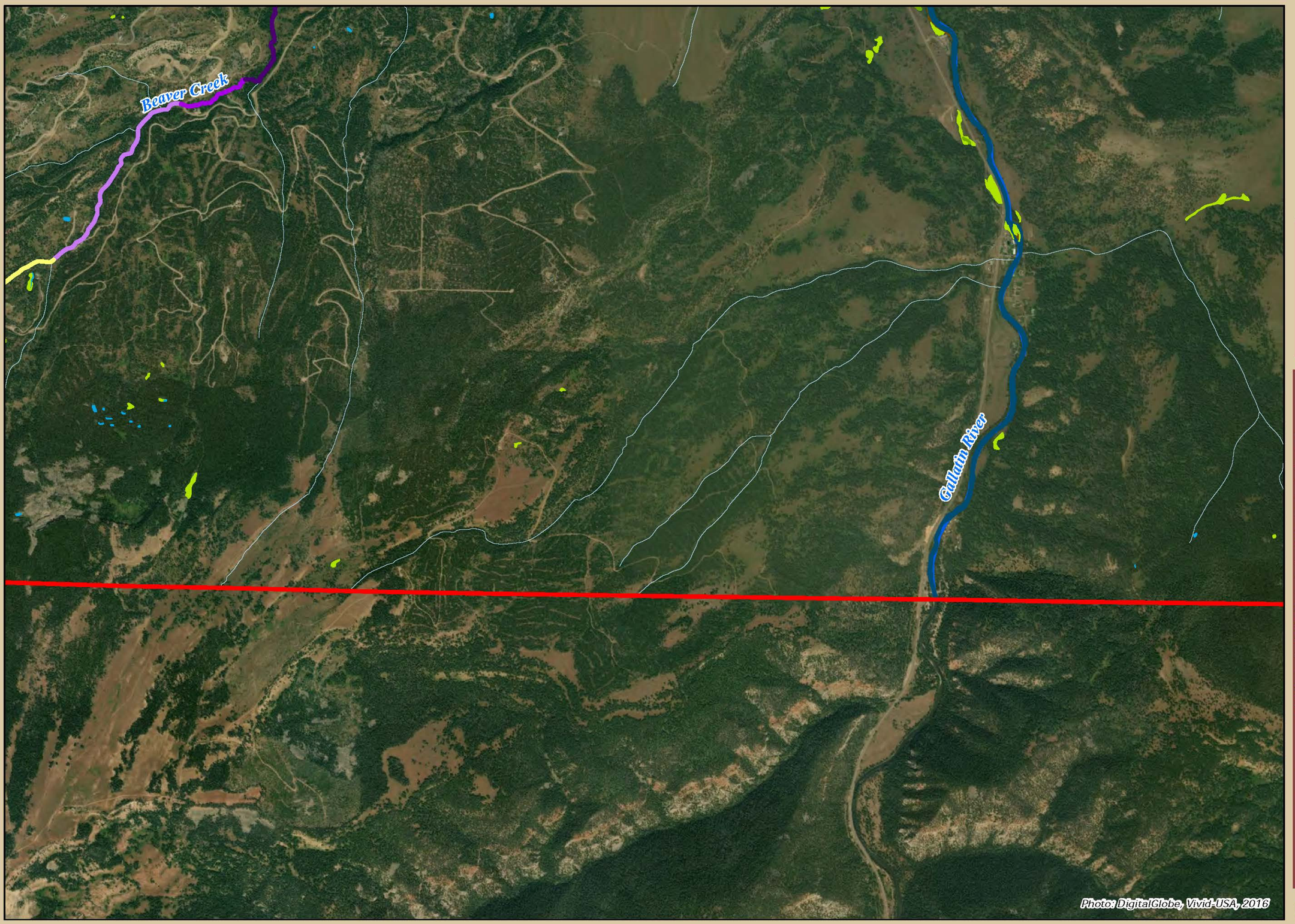

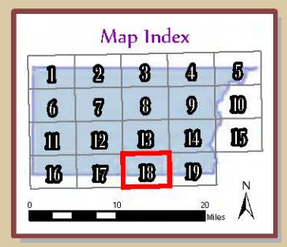

Legend

- Streams

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- MR-0-1-U
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0 0.25 0.5 Miles

Riparian Health Assessment / Wetland & Riparian Priority Areas

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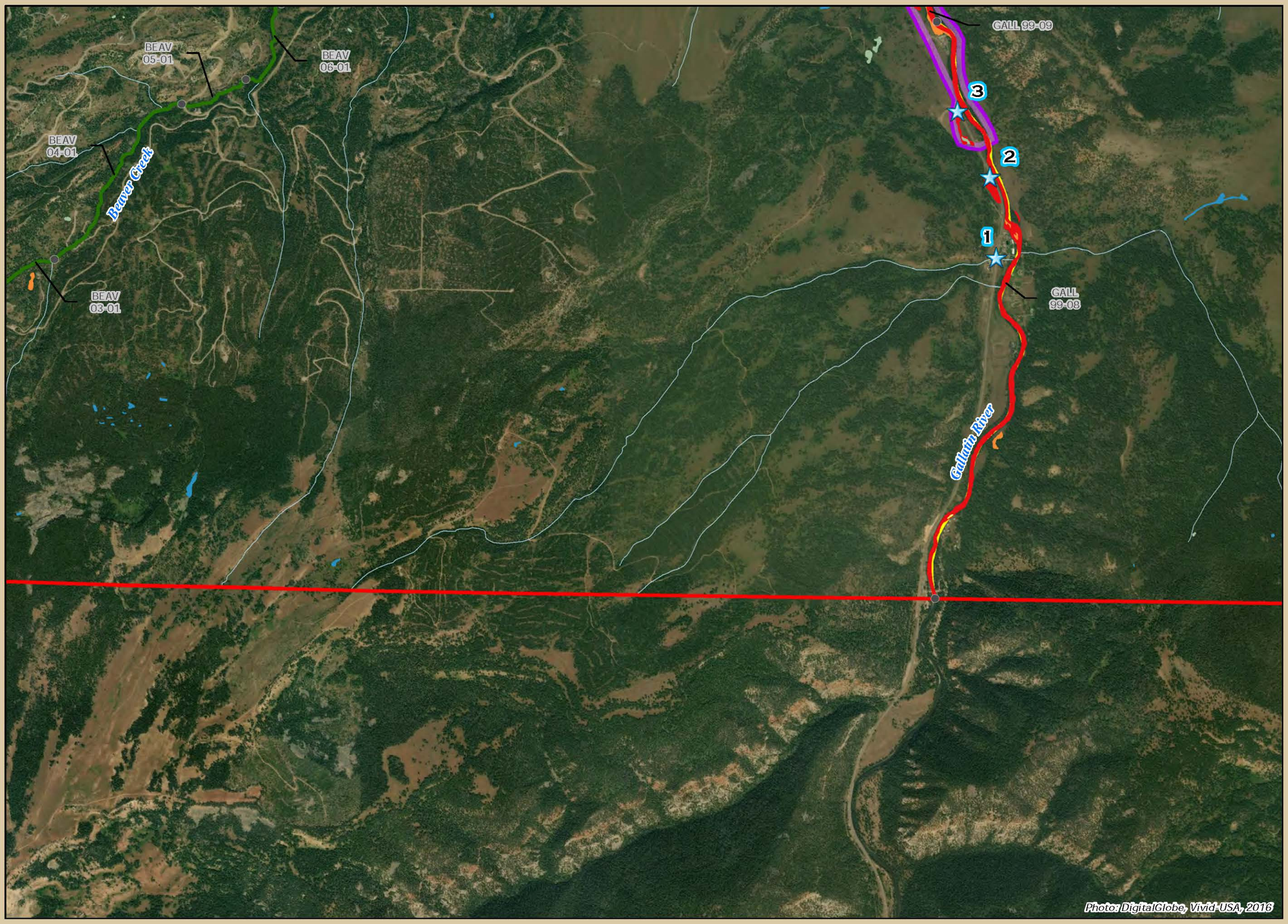
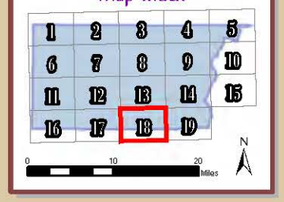


Map Index



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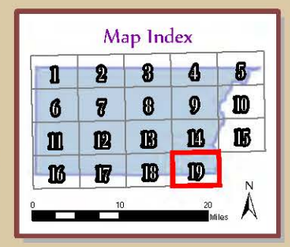
0 0.25 0.5 Miles

Stream Reaches / Wetland & Riparian Areas

Sheet 19



Legend

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- MR-0-1-U
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- MR-0-5-C
- MR-0-5-U
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Miles

Photo: DigitalGlobe, Vivid-USA, 2016

Riparian Health Assessment / Wetland & Riparian Priority Areas

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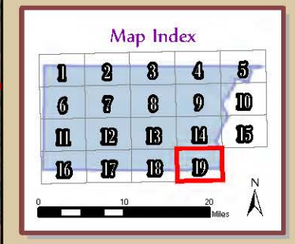

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0 0.25 0.5 Miles

Attachment B

Wetland and Riparian Restoration and Conservation Opportunities

Wetland and Riparian Restoration and Conservation Opportunities

Gallatin River (Corral to Karst)

#1 - Channelized tributary stream lacking riparian buffer north of Corral; road sand inputs

#2 - Wetland area and lack of riparian buffer along HWY 191; road sand inputs

#3 - Spring creek west of Gallatin River along HWY 191; fish passage barrier

#4 - Lack of riparian buffer at Doe Creek river access area

#5 - Channelization and lack of riparian buffer along spring creek downstream of West Fork; road sand inputs

#6 - Lack of riparian buffer at power line crossing at Baetis Alley river access area

Beaver Creek

#7 - Degraded riparian condition upstream of HWY 191 crossing

#8 - Degraded riparian condition, loss of channel length, and channel over-widening downstream of HWY 191 crossing; fish passage barrier

Beaver Creek confluence with the Gallatin River circa 1947

Michener Creek

#9 - Channelization and lack of riparian buffer downstream of HWY 191 crossing

Lower Michener Creek confluence with the Gallatin River circa 1971

West Fork Gallatin River

#10 - Lack of riparian buffer at upper HWY 64 crossing; road sand inputs

#11 - Potential site for wetland enhancements in Big Sky Golf Course pasture area

#12 - Lack of riparian buffer along flood flow channel through Big Sky Golf Course

#13 - Silver Bow Pond: on-channel pond and degraded instream habitat

#14 - Little Coyote Pond: on-channel pond and degraded instream habitat

#15 - Loss of channel length, channel over-widening, and streambank erosion

Upper West Fork Gallatin River circa 1971

#16 - Lack of riparian buffer at HWY 64 crossing upstream of South Fork West Fork; road sand inputs

#17 - Channelization and lack of riparian buffer along HWY 64; road sand inputs

#18 - Lack for riparian buffer at lower HWY 64 crossing; road sand inputs

#19 - Lack of riparian buffer along old West Fork Spur Road

Lower West Fork Gallatin River circa 1971

#20 - Lack of riparian buffer upstream of HWY 191 crossing

#21 - Road sand inputs at HWY 191 crossing

Crail Creek

#22 - Channelization and lack of riparian buffer; stream re-routed into irrigation ditch in Big Sky Golf Course pasture area

Middle Fork West Fork Gallatin River

#23 - Loss of channel length and degraded instream habitat due to Lake Levinsky dam construction


#24 - Loss of riparian buffer and instream habitat due to historic logging



#25 - Lack of riparian buffer at Lone Moose Triple chairlift crossing


#26 - Degraded riparian conditions downstream of Lone Moose Meadows



#27 - Loss of riparian buffer and instream habitat due to historic logging

#28 - Hillslope slumping and streambank erosion in Antler Ridge HOA

Middle Fork West Fork Gallatin River Tributaries

#29 - Lack of riparian buffer on unnamed tributary at Lake Condos

#30 - Degraded stream conditions on "Moose Tracks" Creek under the Big Sky base area, Summit at Big Sky and parking lot

#31 - Lack of riparian buffer along Lake Levinsky at Lake Condos and Big Sky base area access road

#32 - Lack of riparian buffer on Beehive Creek at HWY64 crossing; road sand inputs; fish passage barrier

South Fork West Fork Gallatin River

#33 - Conserve naturally meandering channel section



#34 - Lack of riparian buffer and streambank erosion downstream of Aspen Leaf road crossing



#35 - Lack of riparian buffer on hillslope along Aspen Leaf road



Attachment C

Stream Reach Riparian Health Assessment

Stream	Reach ID	Length (Feet)	Length (Miles)	Reach Type	2018 Riparian Health Assessment	2018 Anthropogenic Disturbance Assessment
Beaver Creek	BEAV 01-01	5,310	1.01	MR-10-1-C	Good	No
Beaver Creek	BEAV 02-01	2,833	0.54	MR-10-1-U	Good	No
Beaver Creek	BEAV 03-01	4,413	0.84	MR-10-1-C	Good	Yes
Beaver Creek	BEAV 04-01	4,854	0.92	MR-4-2-C	Good	Yes
Beaver Creek	BEAV 05-01	1,679	0.32	MR-4-2-U	Good	Yes
Beaver Creek	BEAV 06-01	2,305	0.44	MR-4-3-U	Good	Yes
Beaver Creek	BEAV 07-01	1,332	0.25	MR-4-3-C	Good	No
Beaver Creek	BEAV 08-01	1,437	0.27	MR-0-3-U	Good	Yes
Beaver Creek	BEAV 08-02	1,622	0.31	MR-0-3-U	Good	Yes
Beaver Creek	BEAV 08-03	851	0.16	MR-0-3-U	Good	Yes
Beaver Creek	BEAV 09-01	2,722	0.52	MR-4-3-C	Good	Yes
Beaver Creek	BEAV 10-01	4,730	0.90	MR-2-3-U	Good	Yes
Beaver Creek	BEAV 11-01	1,943	0.37	MR-0-3-U	Moderate-Good	Yes
Beaver Creek	BEAV 11-02	1,353	0.26	MR-0-3-U	Moderate-Fair	Yes
Beaver Creek	BEAV 11-03	390	0.07	MR-0-3-U	Poor	Yes
Beaver Creek		37,774	7.15			
Beehive Creek	BEEH 01-01	2,648	0.50	MR-10-1-U	Good	No
Beehive Creek	BEEH 02-01	582	0.11	MR-10-1-U	Good	No
Beehive Creek	BEEH 03-01	641	0.12	MR-4-1-U	Good	No
Beehive Creek	BEEH 04-01	507	0.10	MR-10-1-U	Good	No
Beehive Creek	BEEH 05-01	497	0.09	MR-4-1-U	Good	No
Beehive Creek	BEEH 06-01	586	0.11	MR-10-1-U	Good	No
Beehive Creek	BEEH 07-01	5,251	0.99	MR-4-1-U	Good	No
Beehive Creek	BEEH 08-01	1,394	0.26	MR-10-1-U	Good	No
Beehive Creek	BEEH 09-01	280	0.05	MR-10-1-C	Good	No
Beehive Creek	BEEH 10-01	368	0.07	MR-10-1-U	Good	Yes
Beehive Creek	BEEH 11-01	2,896	0.55	MR-4-1-U	Good	Yes
Beehive Creek	BEEH 12-01	1,629	0.31	MR-2-1-U	Moderate-Good	Yes
Beehive Creek	BEEH 13-01	3,899	0.74	MR-4-1-U	Good	Yes
Beehive Creek	BEEH 14-01	760	0.14	MR-10-1-U	Good	Yes
Beehive Creek	BEEH 15-01	2,350	0.45	MR-4-1-U	Moderate-Good	Yes
Beehive Creek	BEEH 16-01	927	0.18	MR-10-1-U	Good	Yes
Beehive Creek		25,216	4.78			
First Yellow Mule Creek	FYMC 01-01	1,657	0.31	MR-4-1-U	Good	No
First Yellow Mule Creek	FYMC 02-01	1,494	0.28	MR-10-1-U	Good	No
First Yellow Mule Creek	FYMC 03-01	1,052	0.20	MR-4-1-U	Good	No
First Yellow Mule Creek	FYMC 04-01	837	0.16	MR-10-1-U	Good	No
First Yellow Mule Creek	FYMC 05-01	1,514	0.29	MR-4-1-U	Good	No
First Yellow Mule Creek	FYMC 06-01	4,147	0.79	MR-10-1-U	Good	No
First Yellow Mule Creek	FYMC 07-01	3,409	0.65	MR-4-1-U	Good	No

Stream	Reach ID	Length (Feet)	Length (Miles)	Reach Type	2018 Riparian Health Assessment	2018 Anthropogenic Disturbance Assessment
First Yellow Mule Creek	FYMC 08-01	820	0.16	MR-10-1-U	Good	No
First Yellow Mule Creek	FYMC 09-01	1,606	0.30	MR-4-1-U	Moderate-Good	Yes
First Yellow Mule Creek	FYMC 10-01	437	0.08	MR-4-1-C	Moderate-Good	Yes
First Yellow Mule Creek	FYMC 11-01	482	0.09	MR-4-1-U	Moderate-Good	Yes
First Yellow Mule Creek	FYMC 12-01	527	0.10	MR-10-1-U	Moderate-Good	Yes
First Yellow Mule Creek	FYMC 13-01	295	0.06	MR-10-1-C	Moderate-Good	Yes
First Yellow Mule Creek	FYMC 14-01	3,926	0.74	MR-4-1-U	Moderate-Good	Yes
First Yellow Mule Creek	FYMC 15-01	1,280	0.24	MR-10-2-U	Good	No
First Yellow Mule Creek	FYMC 16-01	2,632	0.50	MR-4-2-U	Good	Yes
First Yellow Mule Creek		26,116	4.95			
Gallatin River	GALL 99-08	14,124	2.67	MR-0-5-C	Fair	Yes
Gallatin River	GALL 99-09	7,735	1.47	MR-0-5-U	Moderate-Fair	Yes
Gallatin River	GALL 99-10	8,773	1.66	MR-0-5-U	Fair	Yes
Gallatin River	GALL 99-11	7,076	1.34	MR-0-5-U	Fair	Yes
Gallatin River	GALL 99-12	4,314	0.82	MR-0-5-U	Good	Yes
Gallatin River	GALL 99-13	16,733	3.17	MR-0-5-C	Fair	Yes
Gallatin River	GALL 99-14	9,327	1.77	MR-0-5-C	Moderate-Fair	Yes
Gallatin River	GALL 99-15	13,844	2.62	MR-0-5-C	Moderate-Fair	Yes
Gallatin River		81,925	15.52			
Jack Creek	JACK 01-01	2,555	0.48	MR-4-3-C	Good	No
Jack Creek	JACK 02-01	3,222	0.61	MR-2-3-C	Good	No
Jack Creek	JACK 03-01	2,554	0.48	MR-4-3-C	Good	No
Jack Creek	JACK 04-01	1,101	0.21	MR-2-3-C	Good	No
Jack Creek	JACK 05-01	657	0.12	MR-2-3-U	Good	Yes
Jack Creek	JACK 05-02	1,784	0.34	MR-2-3-U	Fair	Yes
Jack Creek	JACK 06-01	3,708	0.70	MR-0-3-U	Moderate-Good	Yes
Jack Creek	JACK 06-02	509	0.10	MR-0-3-U	Good	No
Jack Creek	JACK 07-01	7,596	1.44	MR-2-3-C	Good	Yes
Jack Creek	JACK 08-01	4,657	0.88	MR-4-3-C	Good	Yes
Jack Creek	JACK 09-01	1,447	0.27	MR-2-3-U	Moderate-Good	Yes
Jack Creek	JACK 10-01	1,233	0.23	MR-2-3-U	Fair	Yes
Jack Creek		31,024	5.88			
MFWF Gallatin River	MFWF 01-01	1,665	0.32	MR-10-1-U	Fair	Yes
MFWF Gallatin River	MFWF 02-01	7,623	1.44	MR-4-1-U	Fair	Yes
MFWF Gallatin River	MFWF 03-01	399	0.08	MR-4-1-U	Poor	Yes
MFWF Gallatin River	MFWF 04-01	1,221	0.23	MR-4-1-C	Fair	Yes
MFWF Gallatin River	MFWF 05-01	722	0.14	MR-10-1-U	Moderate-Good	Yes
MFWF Gallatin River	MFWF 06-01	1,637	0.31	MR-10-2-U	Moderate-Good	Yes
MFWF Gallatin River	MFWF 07-01	2,102	0.40	MR-4-2-U	Moderate-Good	Yes
MFWF Gallatin River	MFWF 07-02	2,741	0.52	MR-4-2-U	Moderate-Fair	Yes

Stream	Reach ID	Length (Feet)	Length (Miles)	Reach Type	2018 Riparian Health Assessment	2018 Anthropogenic Disturbance Assessment
MFWF Gallatin River	MFWF 08-01	7,109	1.35	MR-2-2-U	Fair	Yes
MFWF Gallatin River	MFWF 09-01	5,506	1.04	MR-2-3-U	Moderate-Good	Yes
MFWF Gallatin River		30,726	5.82			
Michener Creek	MICH 01-01	2,028	0.38	MR-10-1-C	Good	Yes
Michener Creek	MICH 02-01	3,483	0.66	MR-4-1-U	Good	Yes
Michener Creek	MICH 03-01	3,054	0.58	MR-2-1-U	Good	Yes
Michener Creek	MICH 04-01	976	0.18	MR-2-1-U	Moderate-Good	Yes
Michener Creek	MICH 04-02	1,957	0.37	MR-2-1-U	Moderate-Good	Yes
Michener Creek	MICH 05-01	422	0.08	MR-0-1-U	Poor	Yes
Michener Creek	MICH 05-02	1,986	0.38	MR-0-1-U	Fair	Yes
Michener Creek		13,906	2.63			
Moose Tracks	MOOS 01-01	754	0.14	MR-4-2-U	Poor	Yes
Moose Tracks	MOOS 01-02	1,401	0.27	MR-4-2-U	Poor	Yes
Moose Tracks		2,155	0.41			
Muddy Creek	MUDD 01-01	3,643	0.69	MR-10-1-U	Good	No
Muddy Creek	MUDD 02-01	4,134	0.78	MR-4-1-U	Good	No
Muddy Creek	MUDD 03-01	1,637	0.31	MR-4-1-U	Good	No
Muddy Creek	MUDD 04-01	1,757	0.33	MR-10-1-U	Good	No
Muddy Creek	MUDD 05-01	7,781	1.47	MR-4-2-U	Good	No
Muddy Creek	MUDD 05-02	2,944	0.56	MR-4-2-U	Moderate-Good	Yes
Muddy Creek	MUDD 05-03	1,100	0.21	MR-4-2-U	Moderate-Good	Yes
Muddy Creek	MUDD 06-01	530	0.10	MR-4-2-C	Moderate-Good	Yes
Muddy Creek	MUDD 07-01	1,591	0.30	MR-4-2-U	Moderate-Good	Yes
Muddy Creek	MUDD 08-01	1,480	0.28	MR-2-2-U	Moderate-Good	Yes
Muddy Creek	MUDD 08-02	945	0.18	MR-2-2-U	Fair	Yes
Muddy Creek		27,541	5.22			
North Fork Moose Tracks	NFMT 01-01	302	0.06	MR-10-1-U	Poor	Yes
North Fork Moose Tracks	NFMT 02-01	3,890	0.74	MR-10-1-U	Poor	Yes
North Fork Moose Tracks	NFMT 03-01	523	0.10	MR-4-1-U	Poor	Yes
North Fork Moose Tracks	NFMT 04-01	1,260	0.24	MR-10-1-U	Fair	Yes
North Fork Moose Tracks	NFMT 05-01	456	0.09	MR-10-1-C	Fair	Yes
North Fork Moose Tracks	NFMT 06-01	1,578	0.30	MR-10-1-U	Fair	Yes
North Fork Moose Tracks	NFMT 07-01	527	0.10	MR-4-1-U	Poor	Yes
North Fork Moose Tracks		8,535	1.62			
North Fork Stony Creek	NFST 01-01	3,872	0.73	MR-10-1-U	Fair	Yes
North Fork Stony Creek	NFST 02-01	1,224	0.23	MR-4-1-U	Good	Yes
North Fork Stony Creek	NFST 03-01	2,960	0.56	MR-10-1-C	Good	Yes
North Fork Stony Creek	NFST 04-01	1,038	0.20	MR-4-1-C	Good	Yes
North Fork Stony Creek	NFST 05-01	1,296	0.25	MR-10-1-C	Good	Yes
North Fork Stony Creek	NFST 06-01	495	0.09	MR-10-1-U	Good	Yes

Stream	Reach ID	Length (Feet)	Length (Miles)	Reach Type	2018 Riparian Health Assessment	2018 Anthropogenic Disturbance Assessment
North Fork Stony Creek	NFST 07-01	1,661	0.31	MR-4-1-C	Good	Yes
North Fork Stony Creek		12,546	2.38			
NFWF Gallatin River	NFWF 01-01	1,784	0.34	MR-10-1-U	Good	No
NFWF Gallatin River	NFWF 02-01	3,947	0.75	MR-4-1-U	Good	No
NFWF Gallatin River	NFWF 03-01	5,443	1.03	MR-10-1-U	Good	No
NFWF Gallatin River	NFWF 04-01	1,024	0.19	MR-4-1-U	Good	No
NFWF Gallatin River	NFWF 05-01	1,588	0.30	MR-4-2-U	Good	No
NFWF Gallatin River	NFWF 06-01	1,220	0.23	MR-4-2-U	Good	No
NFWF Gallatin River	NFWF 07-01	965	0.18	MR-4-2-C	Good	No
NFWF Gallatin River	NFWF 08-01	2,192	0.42	MR-4-2-U	Good	No
NFWF Gallatin River	NFWF 09-01	2,054	0.39	MR-4-2-U	Good	No
NFWF Gallatin River	NFWF 10-01	2,576	0.49	MR-2-2-U	Good	No
NFWF Gallatin River	NFWF 11-01	4,758	0.90	MR-4-2-U	Good	No
NFWF Gallatin River	NFWF 12-01	11,365	2.15	MR-4-2-U	Fair	Yes
NFWF Gallatin River		38,915	7.37			
South Fork Moose Tracks	SFMT 01-01	2,661	0.50	MR-10-1-U	Good	Yes
South Fork Moose Tracks	SFMT 02-01	3,363	0.64	MR-4-1-U	Poor	Yes
South Fork Moose Tracks		6,024	1.14			
South Fork Stony Creek	SFSC 01-01	3,939	0.75	MR-10-1-U	Moderate-Good	Yes
South Fork Stony Creek	SFSC 02-01	3,620	0.69	MR-4-1-U	Moderate-Good	Yes
South Fork Stony Creek	SFSC 03-01	487	0.09	MR-10-1-U	Good	No
South Fork Stony Creek	SFSC 04-01	908	0.17	MR-4-1-U	Moderate-Good	Yes
South Fork Stony Creek		8,955	1.70			
SFWF Gallatin River	SFWF 01-01	2,592	0.49	MR-10-1-U	Good	No
SFWF Gallatin River	SFWF 02-01	2,420	0.46	MR-4-1-U	Good	No
SFWF Gallatin River	SFWF 03-01	480	0.09	MR-10-1-C	Good	No
SFWF Gallatin River	SFWF 04-01	869	0.16	MR-10-1-U	Good	No
SFWF Gallatin River	SFWF 05-01	1,365	0.26	MR-10-1-U	Good	No
SFWF Gallatin River	SFWF 06-01	417	0.08	MR-10-1-C	Good	No
SFWF Gallatin River	SFWF 07-01	3,279	0.62	MR-4-1-U	Good	No
SFWF Gallatin River	SFWF 08-01	2,212	0.42	MR-4-1-C	Good	No
SFWF Gallatin River	SFWF 09-01	1,426	0.27	MR-4-1-U	Good	No
SFWF Gallatin River	SFWF 10-01	473	0.09	MR-10-1-C	Good	No
SFWF Gallatin River	SFWF 11-01	404	0.08	MR-10-1-U	Good	Yes
SFWF Gallatin River	SFWF 12-01	550	0.10	MR-4-1-U	Good	Yes
SFWF Gallatin River	SFWF 13-01	1,127	0.21	MR-4-1-C	Good	Yes
SFWF Gallatin River	SFWF 14-01	776	0.15	MR-4-1-U	Good	Yes
SFWF Gallatin River	SFWF 15-01	1,948	0.37	MR-2-1-U	Moderate-Good	Yes
SFWF Gallatin River	SFWF 16-01	1,869	0.35	MR-4-2-U	Good	No
SFWF Gallatin River	SFWF 16-02	3,619	0.69	MR-4-2-U	Moderate-Good	Yes

Stream	Reach ID	Length (Feet)	Length (Miles)	Reach Type	2018 Riparian Health Assessment	2018 Anthropogenic Disturbance Assessment
SFWF Gallatin River	SFWF 17-01	3,294	0.62	MR-2-2-U	Moderate-Good	Yes
SFWF Gallatin River	SFWF 17-02	2,418	0.46	MR-2-2-U	Fair	Yes
SFWF Gallatin River	SFWF 18-01	2,894	0.55	MR-0-3-U	Fair	Yes
SFWF Gallatin River	SFWF 19-01	1,965	0.37	MR-4-3-C	Good	Yes
SFWF Gallatin River	SFWF 20-01	1,630	0.31	MR-2-3-C	Good	Yes
SFWF Gallatin River	SFWF 21-01	2,077	0.39	MR-0-3-U	Moderate-Good	Yes
SFWF Gallatin River	SFWF 22-01	7,218	1.37	MR-0-3-U	Moderate-Good	Yes
SFWF Gallatin River	SFWF 23-01	1,248	0.24	MR-0-3-U	Moderate-Good	Yes
SFWF Gallatin River	SFWF 24-01	2,530	0.48	MR-4-3-C	Good	Yes
SFWF Gallatin River	SFWF 25-01	1,173	0.22	MR-2-3-U	Good	Yes
SFWF Gallatin River	SFWF 26-01	2,486	0.47	MR-0-3-U	Moderate-Good	Yes
SFWF Gallatin River	SFWF 27-01	1,338	0.25	MR-2-3-C	Good	Yes
SFWF Gallatin River	SFWF 28-01	1,589	0.30	MR-2-3-U	Moderate-Good	Yes
SFWF Gallatin River	SFWF 28-02	834	0.16	MR-2-3-U	Moderate-Good	Yes
SFWF Gallatin River	SFWF 29-01	2,459	0.47	MR-0-3-U	Moderate-Good	Yes
SFWF Gallatin River	SFWF 29-02	4,080	0.77	MR-0-3-U	Fair	Yes
SFWF Gallatin River	SFWF 29-03	1,097	0.21	MR-0-3-U	Fair	Yes
SFWF Gallatin River	SFWF 29-04	6,591	1.25	MR-0-3-U	Fair	Yes
SFWF Gallatin River		72,748	13.78			
Stony Creek	STON 01-01	1,060	0.20	MR-4-2-U	Moderate-Good	Yes
Stony Creek		1,060	0.20			
Second Yellow Mule Creek	SYMC 01-01	2,553	0.48	MR-10-1-U	Good	No
Second Yellow Mule Creek	SYMC 02-01	1,966	0.37	MR-4-1-U	Good	No
Second Yellow Mule Creek	SYMC 03-01	868	0.16	MR-10-1-C	Good	No
Second Yellow Mule Creek	SYMC 04-01	3,151	0.60	MR-4-1-U	Fair	Yes
Second Yellow Mule Creek	SYMC 05-01	2,333	0.44	MR-10-1-C	Fair	Yes
Second Yellow Mule Creek	SYMC 06-01	495	0.09	MR-4-1-U	Moderate-Good	Yes
Second Yellow Mule Creek	SYMC 07-01	2,457	0.47	MR-10-1-C	Moderate-Good	Yes
Second Yellow Mule Creek	SYMC 08-01	2,945	0.56	MR-4-1-C	Moderate-Good	Yes
Second Yellow Mule Creek	SYMC 09-01	550	0.10	MR-4-1-U	Good	No
Second Yellow Mule Creek	SYMC 10-01	1,839	0.35	MR-4-1-C	Fair	Yes
Second Yellow Mule Creek	SYMC 11-01	1,018	0.19	MR-4-1-U	Fair	Yes
Second Yellow Mule Creek		20,176	3.82			
Third Yellow Mule Creek	TYMC 01-01	1,615	0.31	MR-10-1-U	Good	No
Third Yellow Mule Creek	TYMC 02-01	1,687	0.32	MR-4-1-U	Good	No
Third Yellow Mule Creek	TYMC 03-01	1,608	0.30	MR-10-1-U	Good	No
Third Yellow Mule Creek	TYMC 04-01	6,322	1.20	MR-4-1-U	Good	No
Third Yellow Mule Creek	TYMC 05-01	769	0.15	MR-10-1-U	Good	No
Third Yellow Mule Creek	TYMC 06-01	4,336	0.82	MR-4-1-U	Moderate-Good	Yes
Third Yellow Mule Creek	TYMC 07-01	1,058	0.20	MR-4-1-C	Moderate-Good	Yes

Stream	Reach ID	Length (Feet)	Length (Miles)	Reach Type	2018 Riparian Health Assessment	2018 Anthropogenic Disturbance Assessment
Third Yellow Mule Creek	TYMC 08-01	1,631	0.31	MR-10-1-C	Good	No
Third Yellow Mule Creek	TYMC 09-01	859	0.16	MR-4-1-C	Good	No
Third Yellow Mule Creek	TYMC 10-01	623	0.12	MR-4-1-U	Fair	Yes
Third Yellow Mule Creek		20,509	3.88			
WF Gallatin River	WFGR 01-01	1,407	0.27	MR-2-3-U	Moderate-Good	Yes
WF Gallatin River	WFGR 01-02	1,426	0.27	MR-2-3-U	Fair	Yes
WF Gallatin River	WFGR 01-03	3,043	0.58	MR-2-3-U	Fair	Yes
WF Gallatin River	WFGR 01-04	2,342	0.44	MR-2-3-U	Moderate-Fair	Yes
WF Gallatin River	WFGR 01-05	2,227	0.42	MR-2-3-U	Fair	Yes
WF Gallatin River	WFGR 02-01	2,042	0.39	MR-0-3-U	Fair	Yes
WF Gallatin River	WFGR 02-02	617	0.12	MR-0-3-U	Moderate-Good	Yes
WF Gallatin River	WFGR 02-03	558	0.11	MR-0-3-U	Fair	Yes
WF Gallatin River	WFGR 03-01	1,150	0.22	MR-0-4-U	Moderate-Good	Yes
WF Gallatin River	WFGR 03-02	602	0.11	MR-0-4-U	Moderate-Fair	Yes
WF Gallatin River	WFGR 03-03	2,367	0.45	MR-0-4-U	Moderate-Good	Yes
WF Gallatin River	WFGR 04-01	1,284	0.24	MR-0-4-U	Moderate-Fair	Yes
WF Gallatin River		19,064	3.61			

Attachment D

Wetland and Riparian Priority Ranking Criteria

Infrastructure and Development Impacts: Development Impact Rating		
Criteria	**Scoring Category**	**Score**
Outside of BSCWSD Boundary	Partially in	0
	Completely in	0
	Not in	2
Within 500 feet of Structure	Partially in	2
	Completely in	2
	Not in	0
Within 500 feet of Roads (250-foot buffer per side)	Partially in	2
	Completely in	2
	Not in	0
Private Ownership	Public	0
	Partially in Private	2
	Completely in Private	2
Human Disturbance Index	0	0
	1-500	1
	501-1000	2
	1001-1500	3
	1501-2000	4
	2001+	5
Degraded Riparian Health (250-foot buffer per side)	Good	0
	Moderate-Good	1
	Moderate	2
	Fair	3
	Moderate-Fair	4
	Poor	5
Anthropogenic Presence Observed (250-foot buffer per side)	Yes	2
	No	0
Natural Resource and Conservation Value: Natural Resource Rating		
Criteria	**Scoring Category**	**Score**
WetRip2017: Wetland, Riparian, Open Water	Wetland	2
	Riparian	1
	Water	0
WetRip2017 Wetland Type	Freshwater Forested Wetland	7
	Freshwater Scrub-Shrub Wetland	6
	Freshwater Emergent Wetland	5
	Freshwater Pond	4
	Riparian Forested	4
	Riparian Scrub-Shrub	3
	Riparian Emergent	2
	Riverine	1
	Lake	1
Within 500 feet of 1:24K NHD Stream (250-foot buffer per side)	Partially in	7
	Completely in	7
	Not in	0
Within Conservation Easement	Partially in	1
	Completely in	1
	Not in	0
Within Designated Parklands	Partially in	1
	Completely in	1
	Not in	0
Within Designated Wilderness Area	Partially in	1
	Completely in	1
	Not in	0
Within FWP Wildlife Management Area	Partially in	1
	Completely in	1
	Not in	0

Middle Fork West Fork Gallatin River Restoration Project Plan

June 28, 2019

MIDDLE FORK WEST FORK GALLATIN RIVER RESTORATION PROJECT PLAN

by

Jeff Dunn, Upper Missouri / Yellowstone Project Manager
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Prepared in partnership with

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June 28, 2019

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ATTACHMENTS

INTRODUCTION

The *Middle Fork West Fork Gallatin River Restoration Plan* examines water quality improvement projects for the Middle Fork West Fork Gallatin River in five discreet project areas extending from the headwaters on Lone Mountain downstream to the confluence with the North Fork West Fork Gallatin River. Projects include:

- Project 1 - Upper Middle Fork West Fork Road Sediment BMPs
- Project 2 - Upper Middle Fork West Fork Riparian Buffer Enhancement around Lake Levinsky
- Project 3 - Middle Fork West Fork Restoration downstream of Lake Levinsky
- Project 4 - Middle Fork West Fork Restoration in Lone Moose Meadows
- Project 5 - Middle Fork West Fork Restoration in Aspen Groves/Antler Ridge

The *Middle Fork West Fork Gallatin River Restoration Plan* provides a foundation for an application to the Montana Department of Environmental Quality's (DEQ) 319 grant program to address identified water quality impairments and improve conditions so that the Middle Fork West Fork Gallatin River meets water quality standards and fully supports the aquatic life and primary contact recreation beneficial uses, which are currently only partially supported. The *Middle Fork West Fork Gallatin River Restoration Plan* provides a holistic approach for addressing water quality impairments within the Middle Fork West Fork Gallatin River watershed, while also promoting natural stream and riparian processes. Additional opportunities for watershed improvements are discussed within the "future opportunities" section at the end of this report.

PROBLEM DESCRIPTION

The Middle Fork West Fork Gallatin River is a tributary to the West Fork Gallatin River flowing approximately 6 miles from its headwaters on Lone Mountain to its confluence with the North Fork West Fork Gallatin River. The Middle Fork West Fork Gallatin River watershed is effectively divided into "upper" and "lower" segments by Lake Levinsky, which is a man-made impoundment in the Mountain Village that provides water storage for snowmaking at Big Sky Resort. The 2008 303(d) List of Impaired Waterbodies identified solids (suspended/bedload), alteration in stream-side or littoral vegetation covers, nitrate/nitrite, and fecal coliform as causes for impairment in the Middle Fork West Fork Gallatin River, which impact the aquatic life, cold water fishery, and primary contact recreation beneficial uses (DEQ 2010). In 2010, *The West Fork Gallatin River Watershed Total Maximum Daily Loads (TMDLs) and Framework Watershed Water Quality Improvement Plan* (DEQ 2010) provided TMDLs for sediment, nitrate+nitrite (NO^3+NO^2) and *E. coli* in the Middle Fork West Fork Gallatin River.

Pollutants identified in the 2010 TMDL document leading to water quality impairments in the Middle Fork West Fork Gallatin River include sediment, nutrients, and pathogens. Excess sediment is contributed from roads, resort development, recreation, and historic riparian vegetation removal. Sediment impairments, including the non-pollutant "alteration in stream-side or littoral vegetation covers" impairment, are described in the TMDL document as excess fine sediment in riffles and pool tails and low residual pool depths upstream of Lake Levinsky and decreased pool and large woody debris frequency downstream of Lake Levinsky. Excess nutrients (nitrate+nitrite) are identified in the TMDL document as derived from residential and resort land and vegetation clearing, residential and commercial landscape and maintenance and management, and sewer or service line failures or leaks.

The TMDL document indicates that controlling and limiting nitrate+nitrite from lands in the developed and residential areas upstream of Lake Levinsky are the focus of nutrient load reductions. Excess pathogens *(E. coli*) are identified in the TMDL document as derived from domestic pets, geese and waterfowl, wildlife, and refuse and runoff from streets, parking lots and other impervious surfaces in the developed area, along with sewer line failures or leaks, particularly downstream of Lake Levinsky. Percent reductions in pollutant loading necessary to meet water quality standards and restore full support of beneficial uses are presented in **Table 1**.

Table 1. Middle Fork West Fork Gallatin River TMDL Percent Reductions

Pollutant	Stream Segment	Percent Reduction	Anthropogenic Source Categories
Sediment	entire length	29%	road crossings, traction sand, streambank erosion, upland erosion, point sources
Nitrate+nitrite	upper	33%	residential and resort landscape management and maintenance, on-site septic systems
	lower	0%	
E. coli	entire length	55%	wastewater, residential and recreational land uses

In 2012, the Blue Water Task Force, which is now the Gallatin River Task Force (Task Force), prepared the *Upper Gallatin Watershed Restoration Plan* (BWTF 2012), which outlines a restoration strategy for addressing the identified water quality impairments in the West Fork Gallatin River watershed. In 2018, the Task Force, in partnership with a diverse group of stakeholders comprising the Big Sky Sustainable Water Solutions Forum, completed the *Big Sky Area Sustainable Watershed Stewardship Plan* (Dunn et al. 2018). The Watershed Stewardship Plan identifies action items for sustaining the ecological health of the river systems, water supply and availability, and wastewater treatment and reuse. The Task Force also recently completed the *Big Sky Area Wetland and Riparian Mapping* (Dunn and Pettit 2018) report, which identifies wetland and riparian restoration and conservation priorities based on natural resource and conservation values, along with wetland and riparian areas with a high potential for impacts from infrastructure and development.

PROJECT LOCATION AND IMPAIRMENT CAUSE ADDRESSED

The five proposed projects on the Middle Fork West Fork Gallatin River are within the West Fork Gallatin River HUC12 (100200080202) in the Upper Gallatin TMDL Planning Area in Madison (Projects 1, 2 and 3) and Gallatin (Projects 4 and 5) counties. Projects address sediment, nutrient and pathogen inputs, with specific project areas presented in **Figure 1** and the water quality impairment cause addressed presented in **Table 2**. In addition, Projects 1, 2, 3 and 5 are located within wetland and riparian priority areas identified in the 2018 *Big Sky Area Wetland and Riparian Mapping* report (**Figure 1**).

Table 2. Middle Fork West Fork Gallatin River Project Impairment Addressed

Project	Impairment Cause Addressed	Latitude	Longitude
1	Sediment, (*E. coli*, nitrate+nitrite)	45.29192	-111.40438
2	Nitrate+nitrite, (sediment, *E. coli*)	45.28904	-111.39657
3	Sediment, alteration in stream-side or littoral vegetation covers	45.28729	-111.39264
4	Sediment, alteration in stream-side or littoral vegetation covers	45.27927	-111.36258
5	Sediment, alteration in stream-side or littoral vegetation covers	45.26795	-111.33333

Parentheses indicate secondary benefits of the project

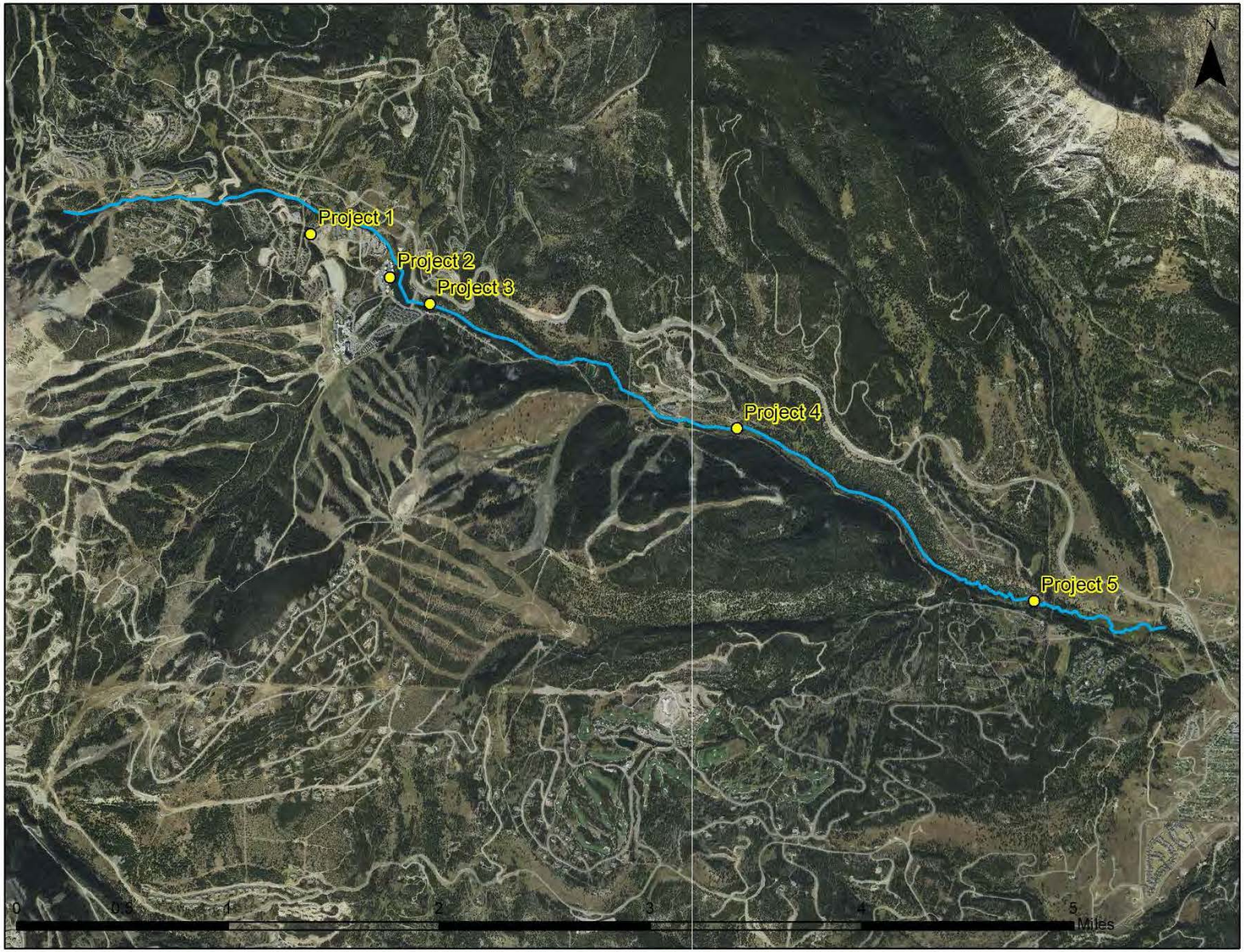

Figure 1. Project Area Overview

PROJECT 1 - UPPER MIDDLE FORK WEST FORK ROAD SEDIMENT BMPS

Project 1 Description:

Project 1 addresses sediment inputs from the road network within the headwaters of the Middle Fork West Fork Gallatin River watershed, with additional potential to reduce nutrient and pathogen inputs. Sediment contributions addressed in Project 1 include runoff from unpaved roads, along with traction sand inputs from both paved and unpaved roads. Project 1 sites include road crossings and near-stream road segments on the Middle Fork West Fork Gallatin River and its tributary streams in the headwaters of the Middle Fork West Fork Gallatin River watershed upstream of Lake Levinsky in the Big Sky Resort base area. Project 1 involves implementation of Best Management Practices (BMPs) by installation of barriers to sediment contributions and recontouring road shoulders where possible. A summary of Project 1 sites is provided in **Table 3** and **Figure 2**, with photographs of each site presented in **Attachment A – Road Sediment Reduction Sites**.

Project 1 Goal and Objectives:

The goal of Project 1 is to reduce sediment loading to streams at road crossings and near-stream road segments in the headwaters of the Middle Fork West Fork Gallatin River watershed upstream of Lake Levinsky. To attain this goal, the following objectives will be accomplished: 1) install and maintain BMPs at 16 road crossings and near-stream road segments on the Middle Fork West Fork Gallatin River (4 sites) and its tributaries (12 sites) upstream of Lake Levinsky (**Table 3** and **Figure 2**).

Project 1 Partners:

Potential Project 1 partners include the Gallatin River Task Force, Trout Unlimited, Big Sky Resort, Moonlight Basin, Montana Department of Transportation, Madison County, and private landowners.

Project 1 Methods:

To address sediment inputs at road crossings, coir wattles will be installed, and the road shoulder will be recontoured where possible. Sites will be maintained annually, and long-term solutions will be developed where possible to reduce the risk of sediment inputs due to culvert failures, enhance fish passage, and improve connectivity within the upper Middle Fork West Fork Gallatin River watershed.

Project 1 Ownership and Access:

Ownership is primarily Big Sky Resort LLC / Boyne Resorts Inc. and Moonlight Basin, along with the Montana Department of Transportation and private landowners (Quam Jay M, Harbaugh Darla L Trust). (**Table 3**). Access is provided by adjacent roadways.

Table 3. Project 1 Road Crossings

Site	Stream	Road Name	Road Surface	Ownership / Responsibility	Latitude	Longitude
MFX-01	tributary	Turkey Leg Road	Gravel	Big Sky Resort LLC	45.29021	-111.39948
MFX-02	Middle Fork	Sitting Bull Road	Paved	Big Sky Resort LLC	45.29211	-111.39796
MFX-03	tributary	Sitting Bull Road	Gravel	Big Sky Resort LLC	45.29030	-111.40294
MFX-04	tributary	Rising Bull Road	Paved	Big Sky Resort LLC / Boyne Properties Inc	45.29176	-111.40469
MFX-05	tributary	unnamed	Gravel	Big Sky Resort LLC	45.29011	-111.40097
MFX-06	tributary	Lone Mountain Trail (HWY64)	Paved	Montana Department of Transportation	45.29224	-111.39460
MFX-07	tributary	White Otter Road	Paved	Quam Jay M / Harbaugh Darla L Trust	45.29474	-111.40415
MFX-08	Middle Fork	White Otter Chair Lift Access	Gravel	Big Sky Resort LLC	45.29405	-111.40513
MFX-09	tributary	Rising Bull Road	Gravel	Big Sky Resort LLC	45.29745	-111.41301
MFX-10	Middle Fork	Rising Bull Road	Gravel	Boyne Properties Inc	45.29400	-111.41309
MFX-11	tributary	Mountain Loop Road	Paved	MB MT Acquisition LLC	45.29918	-111.41557
MFX-12	tributary	Mountain Loop Road	Paved	MB MT Acquisition LLC	45.29707	-111.41735
MFX-13	Middle Fork	Mountain Loop Road	Paved	MB MT Acquisition LLC	45.29408	-111.41632
MFX-14	tributary	Big Sky Resort Road	Paved	Big Sky Resort LLC	45.28449	-111.39906
MFX-15	tributary	parking lot	Gravel	Big Sky Resort LLC	45.29021	-111.39700
MFX-16	tributary	Lone Mountain Trail (HWY64)	Paved	Montana Department of Transportation	45.29580	-111.40402

Figure 2. Project 1 Road Crossings

PROJECT 2 - UPPER MIDDLE FORK WEST FORK RIPARIAN BUFFER

Project 2 Description:

Project 2 addresses nutrient inputs along the margin of Lake Levinsky, with additional potential to reduce sediment and pathogen inputs. Project 2 entails planting riparian shrubs and conifers to enhance the riparian buffer along Lake Levinsky, which is an impoundment on the Middle Fork West Fork Gallatin River. Riparian buffer enhancement will filter surface and subsurface runoff from adjacent areas. Project 2 specifies 0.43 acres of riparian buffer enhancement along Lake Levinsky at five sites (**Figures 3** and **4**).

Project 2 Goal and Objectives:

The goal of Project 2 is to reduce nutrient loading to Lake Levinsky, which is an impoundment on the Middle Fork West Fork Gallatin River. To attain this goal, the following objectives will be accomplished: 1) install riparian shrubs and conifers at five sites totaling 0.43 acres.

Project 2 Partners:

Potential project partners include the Gallatin River Task Force, Trout Unlimited, Big Sky Resort, and Montana Department of Transportation, along with homeowners in the Lake Condominiums.

Project 2 Methods:

To address nutrient inputs, riparian shrubs and conifers will be planted to enhance the riparian buffer.

Project 2 Ownership and Access:

Ownership is primarily Big Sky Resort LLC and Big Sky Montana Inc. and access is provided by adjacent roadways.

Figure 3. Project 2 Existing Conditions along Lake Levinsky

Figure 4. Project 2 Riparian Buffer Enhancement Areas

PROJECT 3 - MIDDLE FORK WEST FORK RESTORATION DOWNSTREAM OF LAKE LEVINSKY

Project 3 Description:

Project 3 addresses sediment impairments, including "alteration in stream-side or littoral vegetation covers", in the Middle Fork West Fork Gallatin River by improving in-stream habitat in a channelized reach downstream of Lake Levinsky. Project 3 entails stream channel restoration and floodplain reconnection along approximately 420 feet of stream channel as depicted in **Figures 5** through **8** and **Attachment B – Projects 3 and 5 Conceptual Design Drawings**.

Project 3 Goal and Objectives:

The goal of Project 3 is to address sediment impairments by improving in-stream habitat within a channelized reach downstream of Lake Levinsky. To attain this goal, the following objectives will be accomplished: 1) approximately 420 feet of stream will be restored to a natural meandering riffle-pool sequence with increased floodplain connectivity and 2) develop wetland features and natural water storage within the existing channel.

Project 3 Partners:

Potential project partners include the Gallatin River Task Force, Trout Unlimited, and Big Sky Resort.

Project 3 Methods:

To address sediment and "alteration in stream-side or littoral vegetation covers" impairments, bioengineering techniques will be used to restore a natural meandering riffle-pool sequence with increased floodplain connectivity, including wetland creation and natural water storage features. Restoration will utilize native materials harvested on-site and appropriate to the landscape setting. Channel data collected within the project reach at monitoring site MFWF04-01 during the 2008 sediment and habitat assessment conducted by DEQ and the Task Force as presented in the *Upper Gallatin Base Parameter Report* (PBS&J 2009a) will provide a starting point for channel design (**Table 4**).

Table 4. 2008 Stream Channel Survey Data Summary for Monitoring Site MFWF04-01

Reach ID	Bankfull Channel Width (Feet)	Cross-Sectional Area (Square Feet)	Bankfull Mean Depth (Feet)	Width / Depth Ratio	Field Slope (Percent)	GIS Calculated Sinuosity	Riffle Pebble Count D50 (mm)	Mean Residual Pool Depth (Feet)	Number of Pools per 1000 Feet	Total Number of LWD per 1000 Feet
MFWF04-01	17.8	20.1	1.1	15.7	3.5	1.14	61	1.1	15	100
MFWF04-01	16.0	21.0	1.3	12.2	3.5	1.14	27			
MFWF04-01	21.2	19.8	0.9	22.7	3.5	1.14	55			

Project 3 Ownership and Access:

Ownership is primarily Big Sky Resort LLC, along with private landowners (Cliffhanger #9 LLC, Behm's Big Dog Lodge LLC). The site can be accessed from the downstream side of the dam at Lake Levinsky.

Figure 5. Project 3 Existing Channel Conditions within Project Reach

Figure 6. Project 3 Existing Conditions within Restored Channel Location

Figure 7. Project 3 Potential Natural Conditions Observed Downstream of Project Reach

Figure 8. Project 3 Channel Restoration Conceptual Design

PROJECT 4 - MIDDLE FORK WEST FORK RESTORATION IN LONE MOOSE MEADOWS

Project 4 Description:

Project 4 addresses sediment impairments, including "alteration in stream-side or littoral vegetation cover", in the Middle Fork West Fork Gallatin River by reducing streambank erosion, enhancing the riparian buffer, and improving in-stream habitat through the addition of large woody debris along approximately 1.3 miles of a historically logged reach. Project 4 entails riparian shrub and conifer plantings in historically logged areas along the channel, along with large woody debris placement as depicted in **Figures 9** through **12**.

Project 4 Goal and Objectives:

The goal of Project 4 is to address sediment impairments by enhancing the riparian buffer and improving in-stream habitat within a historically logged reach of the Middle Fork West Fork Gallatin River. To attain this goal, the following objectives will be accomplished: 1) riparian shrub and conifer plantings in historically logged areas within 50 feet of the channel margin and 2) large woody debris additions, including approximately six large woody debris clusters, along with the addition of individual trees. Riparian shrubs and conifers will be planted in open areas within 50 feet of the channel margin to reduce streambank erosion, increase streamside shading, and restore natural rates of large woody debris recruitment. Approximately 1.3 miles of stream will be addressed by Project 4.

Project 4 Partners:

Potential Project 4 partners include the Gallatin River Task Force, Trout Unlimited, and the Lone Moose Meadow Home Owners Association (HOA).

Project 4 Methods:

To address sediment and "alteration in stream-side or littoral vegetation covers" impairments, riparian shrubs and conifers will be planted along the channel margin and adjacent areas and large woody debris will be added along approximately 1.3 miles of stream, including large woody debris clusters and the addition of individual trees. Large woody debris will be obtained from development-related clearing the Big Sky area and from on-site as opportunities arise. Large woody debris targets presented in the 2010 TMDL document, along with data and observations from reference reaches in the North Fork West Fork Gallatin River (**Figure 11**), will provide a starting point for project design. Riparian plantings will include shrubs along the channel margin and conifers within 50 feet of the channel margin and will be targeted to enhance areas currently lacking natural regeneration post-logging.

Project 4 Ownership and Access:

Ownership is primarily Lone Moose Meadows and access is provided by adjacent roadways.

Figure 9. Project 4 Degraded Riparian Conditions in Monitoring Reach MFWF07-02

Figure 10. Project 4 Degraded Riparian Conditions in Monitoring Reach MFWF08-01

Figure 11. Project 4 Potential Natural Conditions Observed in the North Fork West Fork Gallatin River

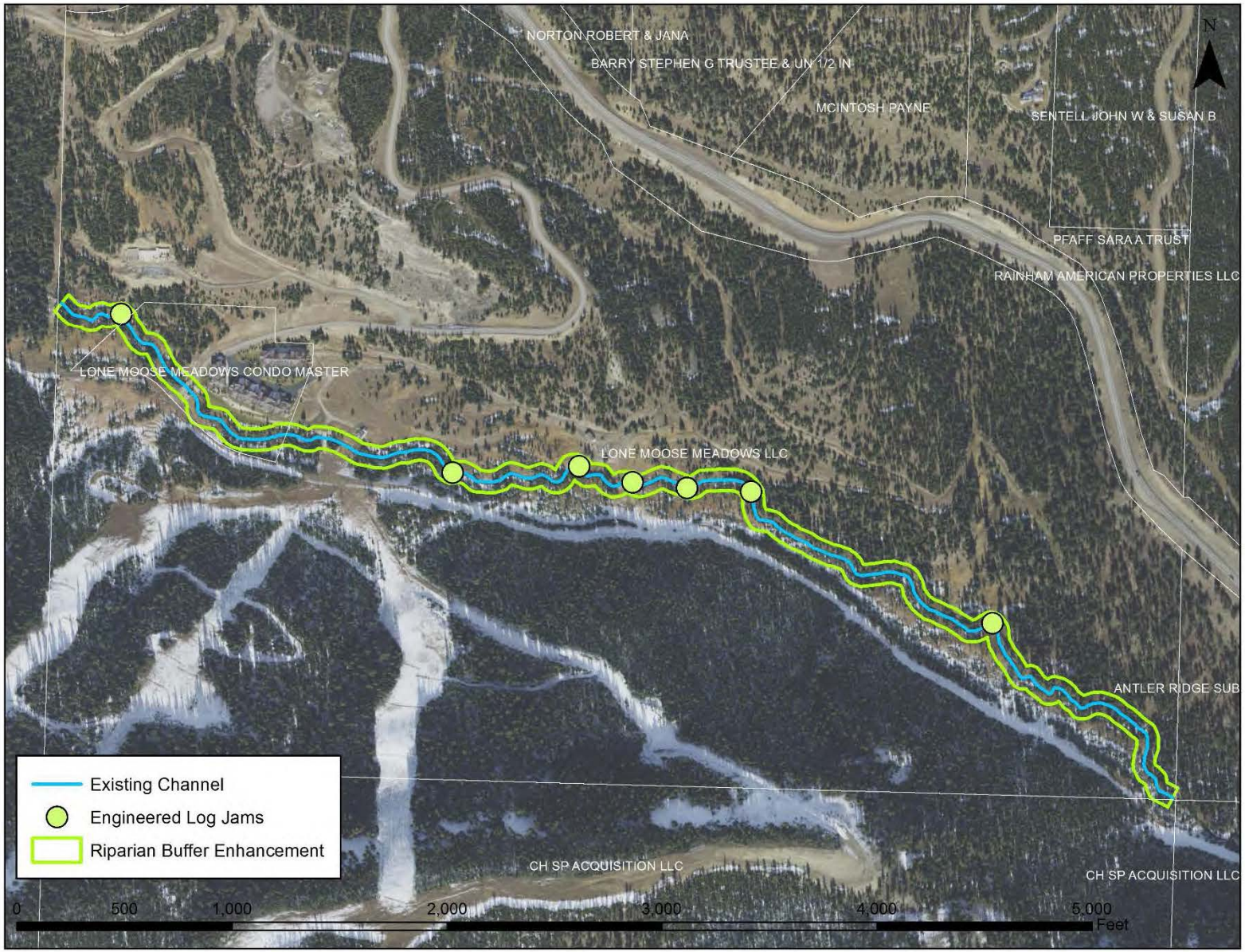

Figure 12. Project 4 Riparian Buffer Enhancement and Large Woody Debris Placement Conceptual Design

PROJECT 5 - MIDDLE FORK WEST FORK RESTORATION IN ASPEN GROVES/ANTLER RIDGE

Project 5 Description:

Project 5 addresses sediment impairments, including "alteration in stream-side or littoral vegetation covers", in the Middle Fork West Fork Gallatin River by reducing streambank erosion and improving in-stream habitat. Project 5 entails channel relocation away from a large eroding streambank and restoration into a historic channel within the center of the meadow. Within the project reach, a large streambank is eroding along the toe of an abandoned logging road that has been converted to a hiking and biking trail that is located within designated parkland in the Big Sky Area. There is silt fence hanging from the top of the streambank into the channel, indicating previous efforts to reduce sediment contributions at the site. The project reach was evaluated during the 2008 sediment and habitat assessment conducted by DEQ and the Task Force and streambank erosion was determined to contribute 26.2 tons/year (PBS&J 2009b). In addition, the channel along the eroding streambank is a continuous riffle lacking diverse in-stream habitat. Project 5 will restore approximately 540 feet of channel into the center of the meadow and will be accompanied by riparian plantings, wetland creation, and side channel-reconnection as depicted in **Figures 13** through **16**. This project is anticipated to increase the water level within the meadow through floodplain reconnection and wetland creation, which will enhance the potential for natural water storage. In addition, improvements to the trail and bridge crossing could be performed, which will enhance user safety and reduce long-term impacts to the stream channel and riparian corridor.

Project 5 Goal and Objectives:

The goal of Project 5 is to address sediment impairments by reducing sediment loading from streambank erosion and improving in-stream habitat. To attain this goal, the following objectives will be accomplished: 1) relocate the channel away from a large eroding streambank and restore the channel into a historic channel in the center of the meadow, totaling approximately 540 feet of restored channel, 2) enhance the riparian buffer, totaling approximately 1 acre, and 3) develop wetland features and natural water storage within existing channel.

Project 5 Partners:

Potential Project 5 partners include the Gallatin River Task Force, Trout Unlimited, Antler Ridge HOA, and Aspen Groves HOA.

Project 5 Methods:

To address sediment and "alteration in stream-side or littoral vegetation covers" impairments, bioengineering techniques will be used to restore a natural meandering riffle-pool sequence with increased floodplain connectivity. Restoration will utilize native materials appropriate to the landscape setting. Channel data collected within the project reach at monitoring site MFWF09-01 and immediately downstream in MFWF09-02 during the 2008 sediment and habitat assessment conducted by DEQ and the Task Force as presented in the *Upper Gallatin Base Parameter Report* (PBS&J 2009a) will provide a starting point for restoration design (**Table 5**).

Table 5. 2008 Stream Channel Survey Data Summary for Monitoring Sites MFWF09-01 and 02

Reach ID	Bankfull Channel Width (Feet)	Cross-Sectional Area (Square Feet)	Bankfull Mean Depth (Feet)	Width / Depth Ratio	Field Slope (Percent)	GIS Calculated Sinuosity	Riffle Pebble Count D50 (mm)	Mean Residual Pool Depth (Feet)	Number of Pools per 1000 Feet	Total Number of LWD per 1000 Feet
MFWF09-02	25.7	32.0	1.2	20.7	1.2	1.29	28	1.9	9	15
MFWF09-02	20.2	29.8	1.5	13.7	1.2	1.29				
MFWF09-02	28.5	36.4	1.3	22.3	1.2	1.29	69			
MFWF09-02	20.8	30.7	1.5	14.1	1.2	1.29				
MFWF09-02	31.8	40.8	1.3	24.8	1.2	1.29	51			
MFWF09-01	18.6	24.9	1.3	13.9	2.3	1.24	73	1.3	4	34
MFWF09-01	19.1	28.1	1.5	13.0	2.3	1.24				
MFWF09-01	24.3	34.3	1.4	17.2	2.3	1.24	47			
MFWF09-01	28.4	29.6	1.0	27.3	2.3	1.24				
MFWF09-01	22.9	30.3	1.3	17.3	2.3	1.24	76			

Project 5 Ownership and Access:

Ownership is Aspen Groves Development Corp and Antler Ridge Homeowners Assoc Inc, with access on abandoned logging roads that have been converted to a trail system that includes several private landowners (Olson John L and Marilyn J, Anderson Aileen &, Shnider Robert and Amy, and Hogan Jedediah K and Elizabeth A). The project is located within designated parklands in the Big Sky area.

Figure 13. Streambank Erosion along Former Logging Road and Current Trail

Figure 14. Streambank Erosion and Culvert along Former Logging Road and Current Trail

Figure 15. Project 5 Reach Overview and Historic Channel Location to be Restored

Figure 16. Project 5 Channel Restoration and Riparian Buffer Enhancement Conceptual Design

FUTURE OPPORTUNITIES IN THE MIDDLE FORK WEST FORK GALLATIN RIVER WATERSHED

1) Identify road crossing sites in Project 1 that may benefit from culvert removal and replacement with structures that facilitate fish passage to enhance connectivity.
2) Map and evaluate unassessed road and trail crossings on Big Sky Resort ski runs.
3) Address Low Dog Road (aka "Poop Chute") crossing at the base of Thunder Wolf chair lift.
4) Identify areas for wetland and riparian enhancement and the creation of natural water storage features on Big Sky Resort ski runs.
5) Evaluate opportunity to restore native Westslope Cutthroat Trout in the upper Middle Fork West Fork Gallatin River upstream of Lake Levinsky.
6) Improve stormwater management during construction activities and post-construction
7) Convert to making snow with treated wastewater effluent instead of water from the Middle Fork West Fork Gallatin River.
8) Examine the potential to convert Lake Levinsky into a lined storage pond to store treated wastewater effluent for use during snowmaking and restore the Middle Fork West Fork to a naturally flowing stream around the storage pond.
9) Identify additional opportunities for wetland and riparian conservation and restoration for priority sites and priority areas identified in the 2018 *Big Sky Area Wetland and Riparian Mapping* report.

REFERENCES

Blue Water Task Force, 2012. *Upper Gallatin River Watershed Restoration Plan*, prepared by the Blue Water Task Force Inc., Big Sky, MT.

Dunn, J., Filipovich K., Ingman, G., Benn, T., and Collins, Z., 2018. *Big Sky Area Sustainable Watershed Stewardship Plan*. Prepared for Gallatin River Task Force and Big Sky Sustainable Water Solutions Forum.

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Montana Department of Environmental Quality, 2010. *The West Fork Gallatin River Watershed Total Maximum Daily Loads (TMDLs) and Framework Watershed Water Quality Improvement Plan*, prepared by the Montana Department of Environmental Quality, MO5-TMDL-01A-F.

PBS&J, 2009a. *Base Parameter Report: Upper Gallatin TMDL Planning Area.* Prepare for Montana Department of Environmental Quality.

PBS&J, 2009b. *Streambank Erosion Source Assessment: Upper Gallatin TMDL Planning Area.* Prepare for Montana Department of Environmental Quality.

Attachment A

Project 1 Road Sediment Reduction Sites

Figure A-1. MFX-01 Middle Fork West Fork Gallatin River Tributary at Turkey Leg Road

Figure A-2. MFX-01 Middle Fork West Fork Gallatin River Tributary at Turkey Leg Road during Spring Runoff

Figure A-3. MFX-02 Middle Fork West Fork Gallatin River at Sitting Bull Road

Figure A-4. MFX-02 Middle Fork West Fork Gallatin River at Sitting Bull Road during Spring Runoff

Figure A-5. MFX-03 Middle Fork West Fork Gallatin River Tributary at Sitting Bull Road

Figure A-6. MFX-03 Middle Fork West Fork Gallatin River Tributary at Sitting Bull Road during Spring Runoff

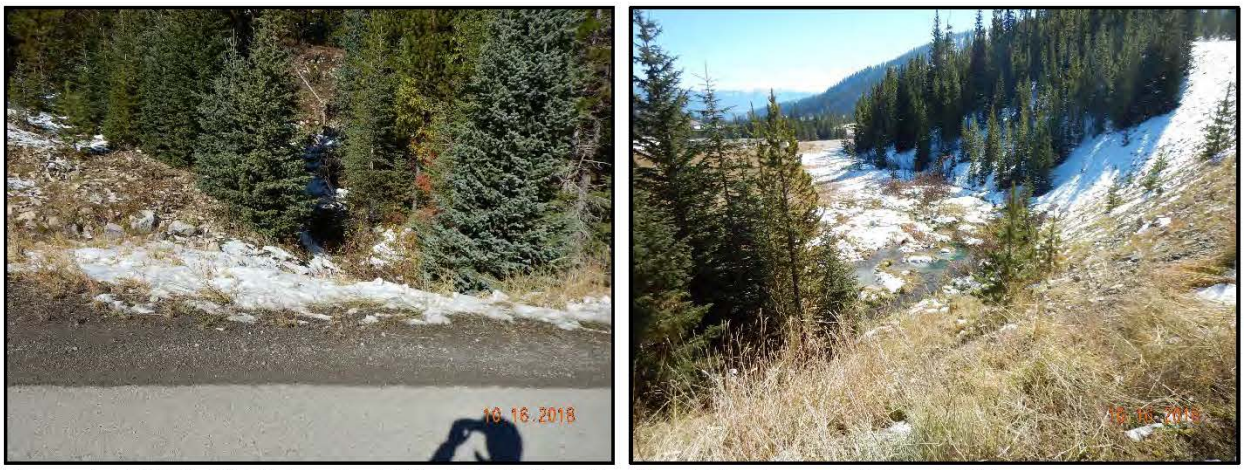


Figure A-7. MFX-04 Middle Fork West Fork Gallatin River Tributary at Rising Bull Road

Figure A-8. MFX-05 Middle Fork West Fork Gallatin River Tributary

Figure A-9. MFX-06 Middle Fork West Fork Gallatin River Tributary at Lone Mountain Trail (HWY64)

Figure A-10. MFX-07 Middle Fork West Fork Gallatin River Tributary at White Otter Road

Figure A-11. MFX-08 Middle Fork West Fork Gallatin River at White Otter Chair Lift Access

Figure A-12. MFX-09 Middle Fork West Fork Gallatin River Tributary at Rising Bull

Figure A-13. MFX-10 Middle Fork West Fork Gallatin River at Rising Bull Road

Figure A-14. MFX-11 Middle Fork West Fork Gallatin River Tributary at Mountain Loop Road

Figure A-15. MFX-12 Middle Fork West Fork Gallatin River Tributary at Mountain Loop Road

Figure A-16. MFX-12 Middle Fork West Fork Gallatin River Tributary at Mountain Loop Road during Spring Runoff

Figure A-17. MFX-13 Middle Fork West Fork Gallatin River at Mountain Loop Road

Figure A-18. MFX-13 Middle Fork West Fork Gallatin River at Mountain Loop Road during Spring Runoff

Figure A-19. MFX-14 Middle Fork West Fork Gallatin River Tributary at Big Sky Resort Road

Figure A-20. MFX-15 Middle Fork West Fork Gallatin River Tributary at Lake Condos

Note: No photo available for MFX-16 on a Middle Fork West Fork Gallatin River Tributary Lone Mountain Trail Crossing (HWY 64)

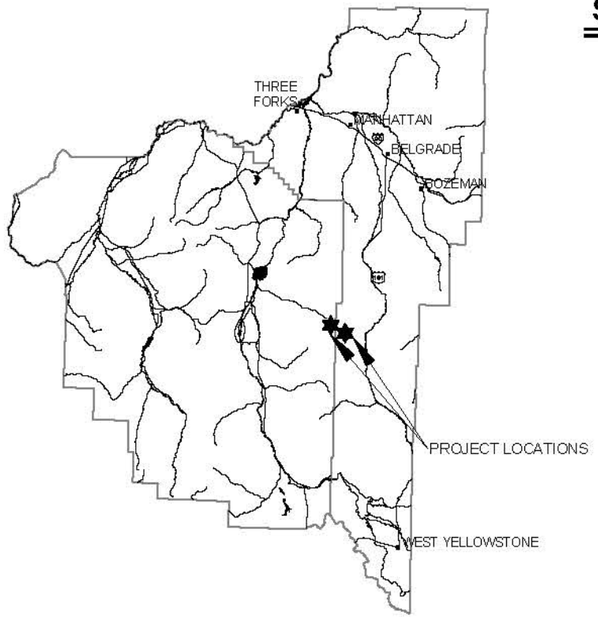
Attachment B

Projects 3 and 5 Conceptual Design Drawings

MIDDLE FORK WEST FORK GALLATIN RIVER CONCEPTUAL DESIGN

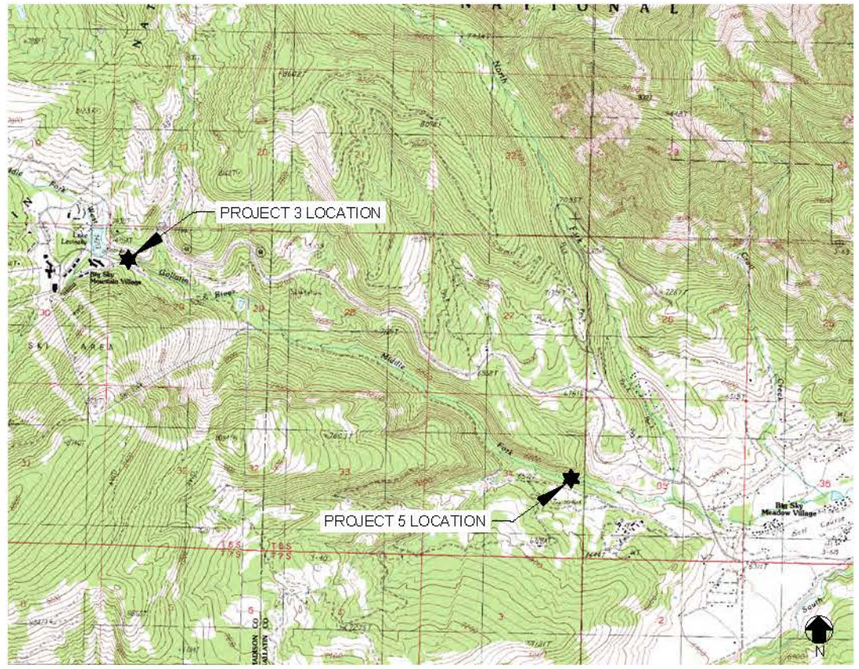
NOT FOR CONSTRUCTION

TROUT UNLIMITED
June 28, 2019
RESPEC PROJECT NO. 03542



MADISON AND GALLATIN COUNTIES, MONTANA
N.T.S.

SHEET INDEX



VICINITY MAP
N.T.S.

NOT FOR CONSTRUCTION

MATTHEW WYNN JOHNSON
REGISTERED PROFESSIONAL ENGINEER
STATE OF MONTANA NO. PEL-PE-LIC-32820

DATE

RESPEC
WATER & NATURAL RESOURCES
310 VALLEY COMMONS DR. SUITE 4
BOZEMAN, MT 59718
PHONE (406) 284-2525

REVISION

-	-	-	-	-	-

DESIGNED MJ
DRAWN JR
CHECKED MJ
DATE 6/28/2019

STAMP

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TROUT UNLIMITED
321 EAST MAIN STREET, STE 411
BOZEMAN, MT 59715

MIDDLE FORK WEST FORK GALLATIN RIVER

COVER SHEET

SHEET NUMBER: 1
SHEET ---

NAME: G:\SHARED DRIVES\MT\03542 - TU GRTF - 2018 - 2019\CAD\TASK 2 - MIDDLE FORK WEST FORK GALLATIN RIVER 319 GRANT DEVELOPMENT\SHEETS\03542-MFWF-S-COVER.DWG
PLOT DATE: June 28, 2019 8:56 AM, BY: JUDY ROSENBAUM

NAME: G:\SHARED DRIVES\MT\03542 - TU GRTF - 2018 - 2019\CAD\TASK 2 - MIDDLE FORK WEST FORK GALLATIN RIVER 319 GRANT DEVELOPMENT\SHEETS\03542-MFWF-S-OVERVIEW.DWG
PLOT DATE: June 28, 2019 8:10 AM, BY: JUDY ROSENBAUM

SHEET NUMBER: 2 SHEET ...

PROJECT OVERVIEW

MIDDLE FORK WEST FORK GALLATIN RIVER

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BOZEMAN, MT 59715

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3810 VALLEY COMMONS DR.
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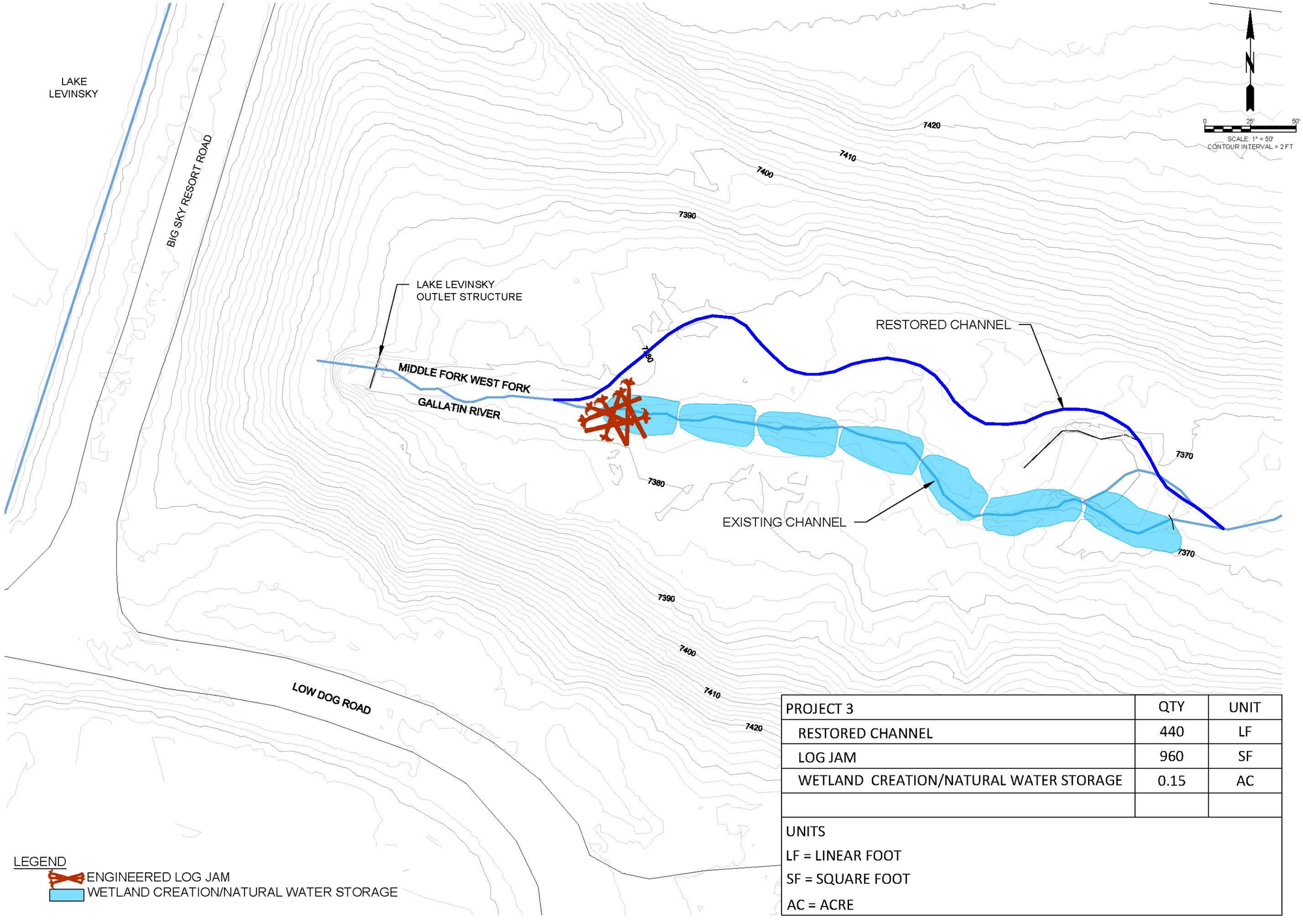
DESIGNED	MJ	--
DRAWN	JR	--
CHECKED	MJ	--
DATE	6/28/2019	--



PROJECT 3	QTY	UNIT
RESTORED CHANNEL	440	LF
LOG JAM	960	SF
WETLAND CREATION/NATURAL WATER STORAGE	0.15	AC

UNITS
LF = LINEAR FOOT
SF = SQUARE FOOT
AC = ACRE

RESPEC
WATER & NATURAL RESOURCES
3910 VALLEY COMMONS DR
SUITE 4
BOZEMAN, MT 59718
PHONE (406) 284-2525

REVISION

	DESIGNED	DRAWN	CHECKED	DATE
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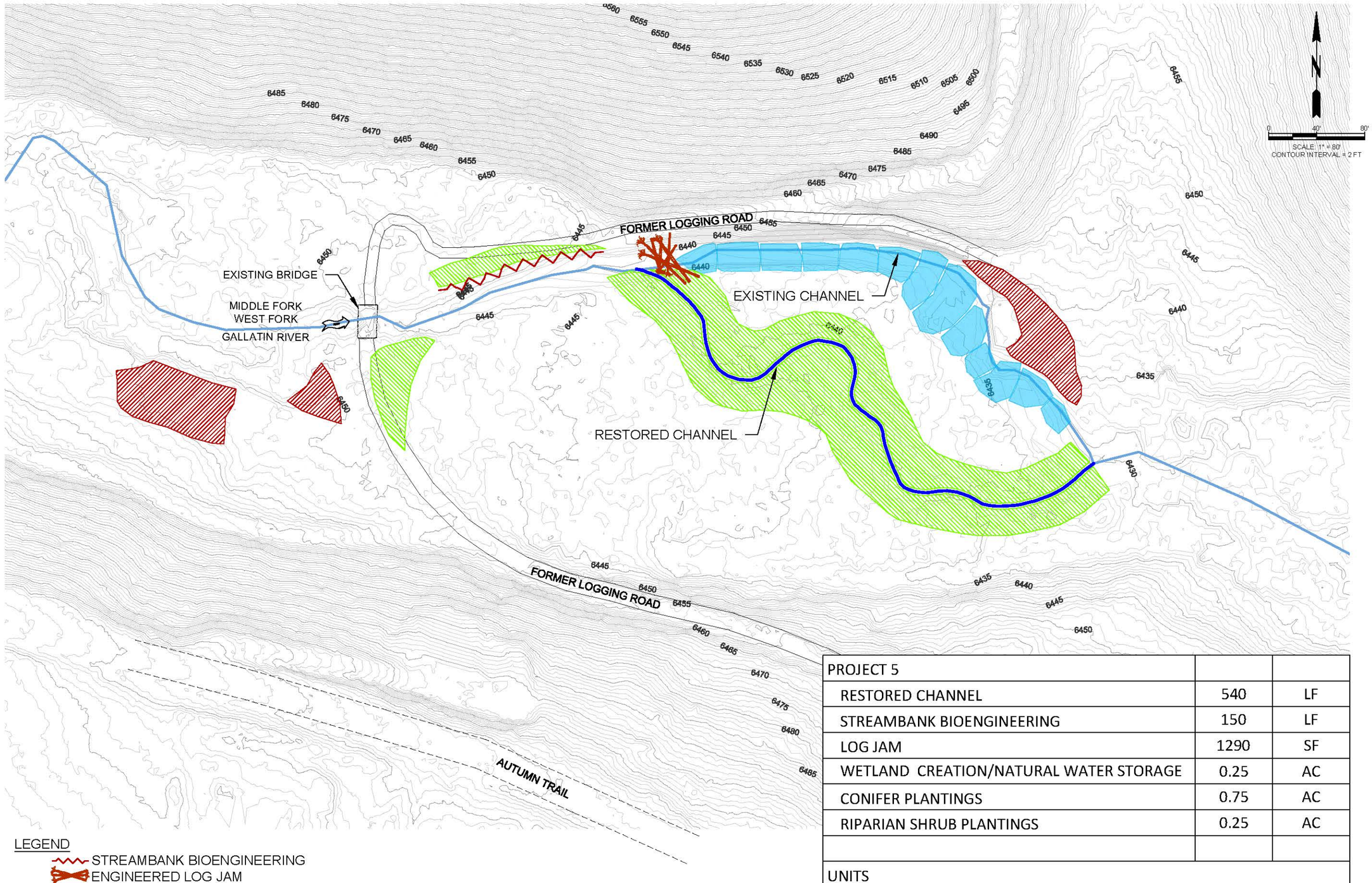
MIDDLE FORK
WEST FORK
GALLATIN RIVER

PROJECT 3- MIDDLE FORK WEST FORK RESTORATION DOWNSTREAM OF LAKE LEVINSKY CONCEPTUAL DESIGN

SHEET NUMBER:
3
SHEET ---

NAME: G:\SHARED DRIVES\MT\03542 - TU GRTF - 2018 - 2019\CAD\TASK 2 - MIDDLE FORK WEST FORK GALLATIN RIVER 319 GRANT DEVELOPMENT\SHEETS\03542-MFWF-S-CONCEPTUAL.DWG
PLOT DATE: June 28, 2019 8:32 AM, BY: JUDY ROSENBAUM



LEGEND

- STREAMBANK BIOENGINEERING
- ENGINEERED LOG JAM
- WETLAND CREATION/NATURAL WATER STORAGE
- CONIFER PLANTINGS
- RIPARIAN SHRUB PLANTINGS

PROJECT 5		
RESTORED CHANNEL	540	LF
STREAMBANK BIOENGINEERING	150	LF
LOG JAM	1290	SF
WETLAND CREATION/NATURAL WATER STORAGE	0.25	AC
CONIFER PLANTINGS	0.75	AC
RIPARIAN SHRUB PLANTINGS	0.25	AC

UNITS
LF = LINEAR FOOT
SF = SQUARE FOOT
AC = ACRE

RESPEC
WATER & NATURAL RESOURCES
3910 VALLEY COMMONS DR
SUITE 4
BOZEMAN, MT 59718
PHONE (406) 284-2525

REVISION

-	-	-	-	-

DESIGNED	MJ
DRAWN	JR
CHECKED	MJ
DATE	6/28/2019

STAMP

811 Know what's below. Call before you dig.

TROUT UNLIMITED
321 EAST MAIN STREET, STE 411
BOZEMAN, MT 59715

MIDDLE FORK
WEST FORK
GALLATIN RIVER

PROJECT 5 - MIDDLE FORK WEST FORK RESTORATION IN ASPEN GROVES/ ANTLER RIDGE CONCEPTUAL DESIGN

SHEET NUMBER:
4
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NAME: G:\SHARED DRIVES\MT\03542 - TU GRTF - 2018 - 2019\CAD\TASK 2 - MIDDLE FORK WEST FORK GALLATIN RIVER 319 GRANT DEVELOPMENT\SHEETS\03542-MFWF-S-CONCEPTUAL.DWG
PLOT DATE: June 28, 2019 8:33 AM, BY: JUDY ROSENBAUM

UPPER GALLATIN RIVER WATERSHED RESTORATION PLAN

PREPARED BY:
THE BLUE WATER TASK FORCE, INC.
MAY 2012

The Blue Water Task Force is a nonprofit organization with a mission to promote public stewardship of aquatic resources in the Gallatin River Watershed through community education, citizen involvement in water quality monitoring, and scientific data collection. For more information, please visit www.bluewatertaskforce.org.

Table of Contents

LIST OF TABLES

LISTOF FIGURES

EXECUTIVE SUMMARY
Upper Gallatin Watershed Restoration Plan

The Upper Gallatin Watershed Restoration Plan is a blueprint to improve water quality and habitat conditions of the Upper Gallatin River. The Upper Gallatin River extends from the confluence with Spanish Creek to the headwaters at Gallatin Lake in Yellowstone National Park. This watershed restoration plan was built from data collected as part of the Montana Department of Environmental Quality's (MTDEQ) Total Maximum Daily Load (TMDL) Program mandated by the Clean Water Act. The local organization that coordinated the Upper Gallatin TMDL was the Blue Water Task Force (BWTF), a nonprofit 501(c)(3) organization headquartered in Big Sky, with a mission to promote the aquatic stewardship of the Gallatin River through community education, citizen involvement in water quality monitoring, and scientific data collection.

After the Upper Gallatin TMDL was accepted by the Environmental Protection Agency in the fall of 2010, the BWTF took the lead on developing the Upper Gallatin Watershed Restoration Plan. This plan has a scope of three to five years, in which time; BWTF chose to focus restoration efforts on the West Fork of the Gallatin ("West Fork") Watershed because of its failure to meet water quality standards set by the MTDEQ for nitrogen, E. coli, and sediment. Specific restoration strategies within this plan include: 1) developing and implementing a plan to reduce sources of nitrogen in the West Fork Watershed, 2) working with the Montana Department of Transportation to reduce the impacts of winter maintenance activities on rivers and streams, and 3) assessing and prioritizing culvert replacement projects to reduce sediment loading and improve fish passage. BWTF and interested watershed stakeholders will review and update this plan within the next three to five years.

This Upper Gallatin Watershed Restoration Plan has been reviewed and accepted by the Montana Department of Environmental Quality. Opportunity for comment was provided to watershed stakeholders and to the public at the BWTF Annual Meeting on April 12, 2012.

1.0 Introduction

The Upper Gallatin Watershed Restoration Plan ("UGWRP") seeks to improve water quality in the Upper Gallatin Watershed (Figure 1), with a focus on the West Fork of the Gallatin Watershed ("West Fork") (Figure 2) over the next **three to five years**. After three to five years, the BWTF and interested watershed stakeholders will review and revise the UGWRP. The UGWRP provides initial structure for interested groups and government agencies to implement a watershed restoration and enhancement effort. The intent is to engage a range of watershed stakeholders in seeking scientifically based voluntary solutions to improve water quality, and instream and riparian habitat.

The UGWRP contains the essential requirements of the United States Environmental Protection Agency (USEPA) to achieve improvements in water quality. Specifically, the USEPA requires that watershed plans funded by Clean Water Act Section 319 funds contain a minimum of nine critical elements [USEPA, 2008]. These minimum requirements are summarized in the box below.

Nine Minimum Elements of an EPA Watershed Restoration Plan

1. Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan.
2. An estimate of the load reductions expected from management measures.
3. A description of the nonpoint source management measures that will need to be implemented to achieve load reductions in # 2, and a description of the critical areas in which those measures will be needed to implement this plan.
4. Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.
5. An information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.
6. Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.
7. A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.
8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.
9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item 8 immediately above.

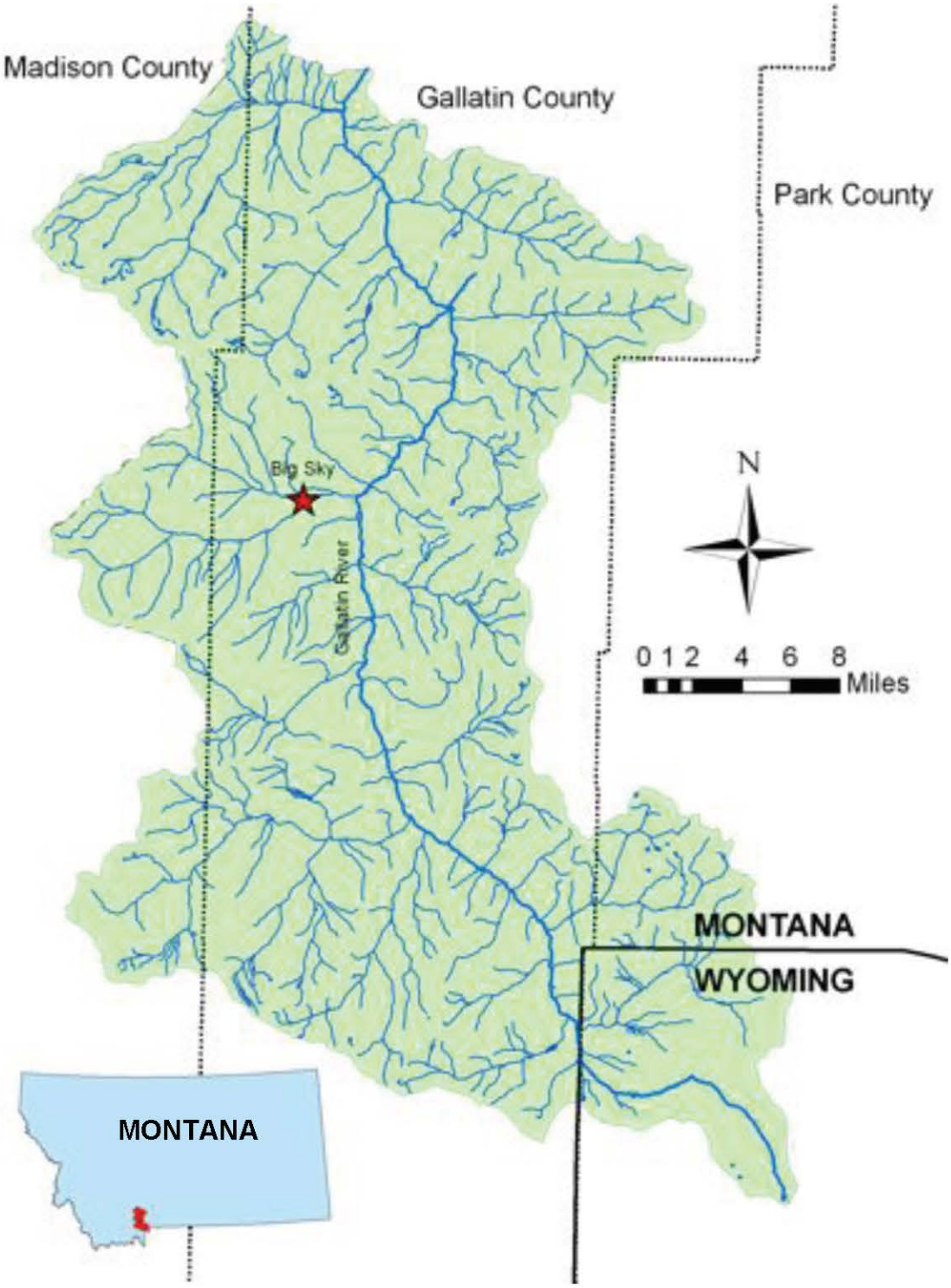

Figure 1: Location of the Upper Gallatin Watershed

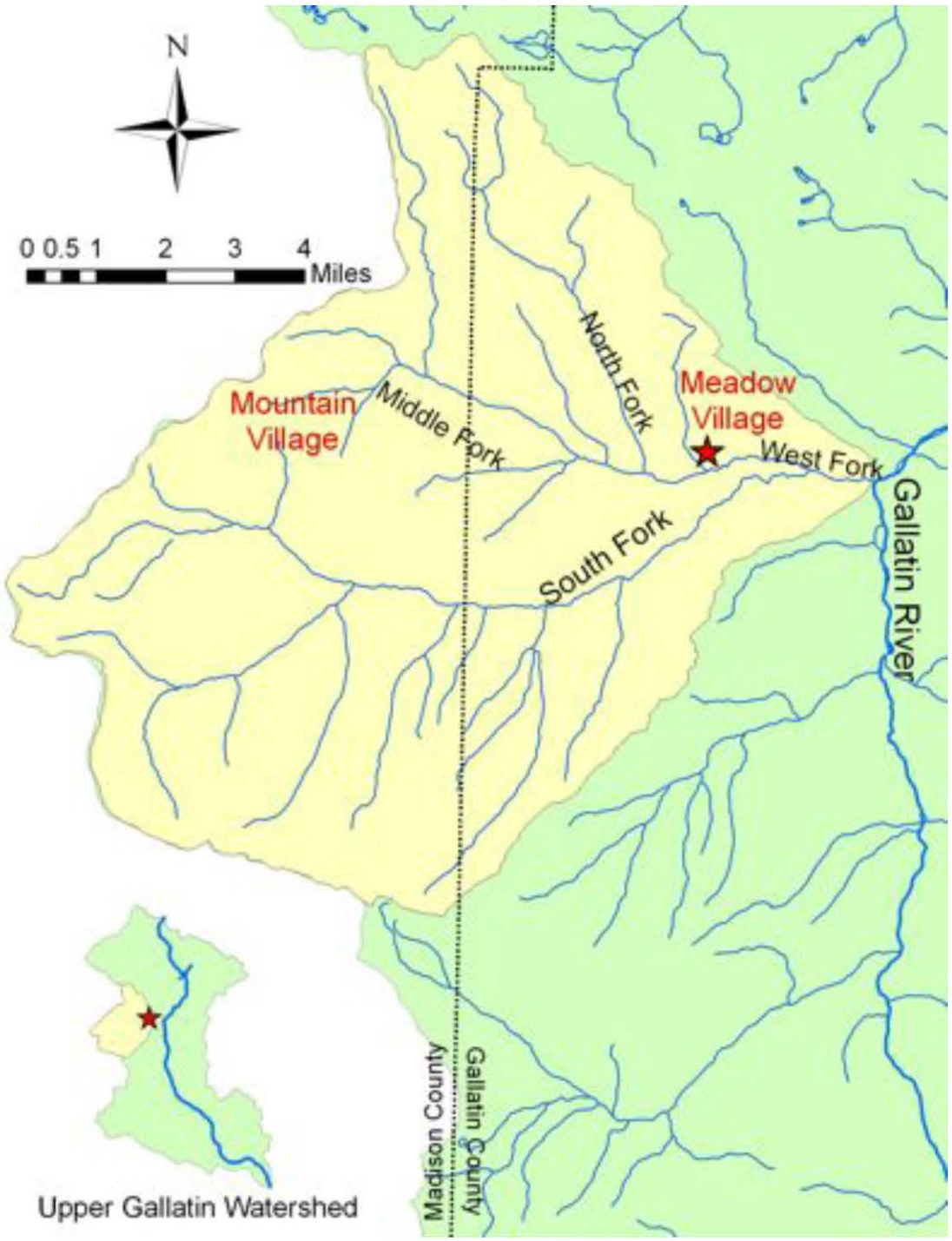

Figure 2: Location of the West Fork Watershed

2.0 Description of the Upper Gallatin River Watershed

This section describes the physical, ecological, and cultural characteristics of the Upper Gallatin River Watershed, which extends in the south from the Spanish Peaks to its

headwaters at Gallatin Lake in Yellowstone National Park and is bordered by the Gallatin Mountain range to the east and the Madison Mountain Range to the west (Figure 1).

2.1 Physical Characteristics

2.1.1 Topography

Elevations in the Upper Gallatin Watershed range from approximately 1,582 to 3,403 meters above mean sea level. The geography is characterized by alpine valleys draining into the Gallatin River canyon.

2.1.2 Climate

Climate in the Upper Gallatin Watershed is typical of high-elevation mountain valleys in southern Montana. Precipitation is most abundant in May and June. Annual average precipitation ranges from 19 inches in the lower elevations to 61 inches in the upper elevations.

2.1.3 Soils

The US Geological Survey (USGS) Water Resources Division (Schwartz and Alexander, 1995) created a dataset of hydrology-relevant soil attributes, based on the US Department of Agriculture Natural Resources Conservation Service (NRCS) STATSGO soil database. The STATSGO data is intended for small-scale (watershed or larger) mapping, and is too general to be used at scales larger than 1:250,000. It is important to realize, therefore, that each soil unit in the STATSGO data may include up to 21 soil components. Soil analysis at a larger scale should use NRCS SSURGO data. The soil attributes considered in this characterization are erodibility and slope.

The soil permeability of the majority of the Upper Gallatin Watershed (78%) is less than 2 inches per hour. Thirteen percent of the Upper Gallatin Watershed is mapped with infiltration rates of 6.53 inches per hour. These higher- permeability areas are associated with the highest elevations and probably correspond to exposed fractured bedrock or areas with very thin soil cover.

Soil erodibility is based on the Universal Soil Loss Equation (USLE) K-factor (Wischmeier & Smith 1978). K-factor values range from zero to one, with a greater value corresponding to greater potential for erosion.

The majority of the Upper Gallatin Watershed (78%) is covered with moderate-low susceptibility soils. A small percentage (15%) is covered with low susceptibility, and only 7% is mapped with moderate-high susceptibility soils.

2.1.4 Geology

The bedrock within the Upper Gallatin Watershed includes Precambrian metamorphic and metasedimentary rocks, aleozoic and Mesozoic sedimentary rocks, Cretaceous igneous intrusions, and Tertiary volcanic rocks (Ross et al., 1955). Lone Mountain is an igneous intrusion of dacite porphyry, and this erosion-resistant rock is responsible for the high topography. North of the Spanish Peaks Fault, Precambrian metamorphic rocks dominate the Madison Range; south of the fault the bedrock is mostly Mesozoic sedimentary rocks, with the underlying Paleozoic sedimentary rocks exposed in the southern and lower elevation portions of the watershed. The Gallatin Range is dominated by volcanic rocks.

The Mesozoic sedimentary rocks, particularly those of Cretaceous age, are more susceptible to erosion as they are not as indurated as the other units. The Cretaceous units include terrestrial, nearshore and offshore facies, and commonly feature weakly lithified fine-grained sediments. In contrast, the older sedimentary rocks, by virtue of their greater age, have been subject to further consolidation and lithification. The watersheds of the West Fork Gallatin River, Taylor Fork and Cache Creek are underlain predominantly by Mesozoic sedimentary rocks.

Sediments in the valleys are primarily alluvial and glacial deposits. Due to the narrow width of these high-elevation valleys, the alluvial deposits are limited in extent. Glacial deposits are more widespread.

Landslide deposits are widespread in the West Fork Gallatin (Vuke, 2009). These deposits consist largely of reworked glacial sediments and eroded sedimentary rock. By their nature, landslide deposits are likely to be more susceptible to erosion than alluvium or glacial deposits.

2.1.5 Surface Water

The United States Geological Survey (USGS) maintains one gaging station within the Upper Gallatin TMDL Planning Area. This station is at the mouth of Gallatin canyon (http://waterdata.usgs.gov/mt/nwis/inventory?search_site_no=06043500). The following statistics are based on data available online. Streamflow varies considerably over a calendar year. Historical peak annual discharges in the Gallatin River vary over nearly an order of magnitude. Statistically, flow peaks in July (2,920 cfs) and is lowest in February (300 cubic feet per second (cfs)). During the period of record annual peaks have ranged from 9,160 (cfs) (June 2, 1997) to 1,740 cfs (May 8, 1934). The mean peak annual discharge during the period of record is 5,234 cfs. Of the annual peak discharges, 20 occurred in May, one occurred in July, and the rest in June. Annual peaks have occurred as early as May 8 and late as July 4.

The Blue Water Task Force maintains four real-time streamflow stations in the West Fork Watershed (http://www.bluewatertaskforce.org/test-sites.php).

2.1.6 Ground Water

Ground water occurs in both shallow alluvial and bedrock aquifers. Porosity in bedrock aquifers is of two types: primary (interstitial spaces between sediment grains) and secondary (void space created by dissolution or structural deformation). Natural recharge occurs from infiltration of precipitation, stream loss, and flow out of the adjacent bedrock aquifers.

The average ground water flow velocity in the bedrock is probably several orders of magnitude lower than in the valley fill sediments. Bedrock ground water flow is complicated by variability in lithology and geologic structures. However, carbonate and siliciclastic sedimentary rocks in the mountains may have zones of significant permeability. The hydrologic role of the structural geology (faults and folds) is uncertain. Faults may act as flow conduits or flow barriers. No studies of the Gallatin Canyon hydrogeology were identified.

Due to the commercial development in and around Big Sky, the West Fork of the Gallatin watershed is better studied. In general, ground water flows from the margins of the West

Fork valley towards the center, where flow is along the axis of the valley. The Middle Fork of the Gallatin River is a gaining stream to its confluence with the North Fork West Fork of the Gallatin where it forms the West Fork of the Gallatin and infiltration into the alluvial aquifer beneath the Meadow Village area results in a losing reach of the West Fork (Baldwin, 1996) for approximately three-quarters of a mile and then the West Fork is strongly connected again until its confluence with the Gallatin mainstem.

2.1.7 Vegetation

Vegetation below tree line consists of coniferous forest (lodgepole pine, Sub-alpine fir, Engelmann spruce, and Douglas-fir), grasslands, shrublands, and willow and aspen groves in the riparian areas. The watershed has a brief growing season from mid-June through mid-September (75 – 90 frost free days), decreasing with elevation [USDA FS, 1994].

2.1.8 Aquatic Life

Native fish species present in the Upper Gallatin Watershed include westslope cutthroat trout, mountain whitefish, longnose dace, longnose sucker, mountain sucker, white sucker, and mottled sculpin. Westslope cutthroat trout are designated "Species of Concern" by Montana Department of Fish, Wildlife and Parks (FWP). Introduced species are also present in streams, including brook, brown, golden and rainbow trout. Hybrids (rainbow-cutthroat) are reported in streams. Data on fish species distribution are collected, maintained and provided by Montana Fish Wildlife & Parks.

2.1.9 Population

An estimated 2,200 persons lived within the Upper Gallatin Watershed in 2010. Population estimates are derived from census data (US Census Bureau, 2010), based upon the populations reported from census blocks within and intersecting the watershed boundary. The majority of the population is located within the West Fork Watershed. The remainder of the population is sparsely distributed and much of the watershed is unpopulated.

2.1.10 Land Use/ Land Cover

Land cover within both the Upper Gallatin Watershed is dominated by evergreen forest. Information on land use is based on the USGS National Land Cover Dataset. As the restoration strategies for the next three to five years focus primarily on the West Fork (see section 3.0), Table 2 and Figure 3 show land use/ land cover within the West Fork Watershed. Figure 4 illustrates land ownership within the West Fork watershed.

Table 1: Land Use and Land Cover in the Upper Gallatin Watershed.

Land Use	Acres	% of Total
Evergreen Forest	319,314	66.03%
Shrub/Scrub	118,674	24.54%
Herbaceous	32,549	6.73%
Barren Land	3,305	0.68%
Emergent Herbaceous Wetlands	3,171	0.66%
Developed Open Space	1,999	0.41%
Woody Wetlands	1,673	0.35%
Deciduous Forest	1,641	0.34%
Developed Low Intensity	263	0.05%
Hay Pasture	251	0.05%
Mixed Forest	224	0.05%
Open Water	452	0.09
Cultivated Crops	46	0.01%
Developed Moderate Intensity	9	0.00%

Table 2: Land Use and Land Cover in the West Fork Watershed.

Land Use	Acres	% Of Total
Evergreen Forest	26,232	51.08%
Shrub/Scrub	16,473	32.08%
Grassland/Herbaceous	6,602	12.86%
Developed, Open Space	1,159	2.26%
Barren Land	212	0.41%
Emergent Herbaceous Wetlands	188	0.37%
Deciduous Forest	171	0.33%
Developed, Low Intensity	132	0.26%
Woody Wetlands	117	0.23%
Mixed Forest	40	0.08%
Open Water	11	0.02%
Developed, Medium Intensity	8	0.02%
Pasture/Hay	6	0.01%
Cultivated Crops	4	0.01%

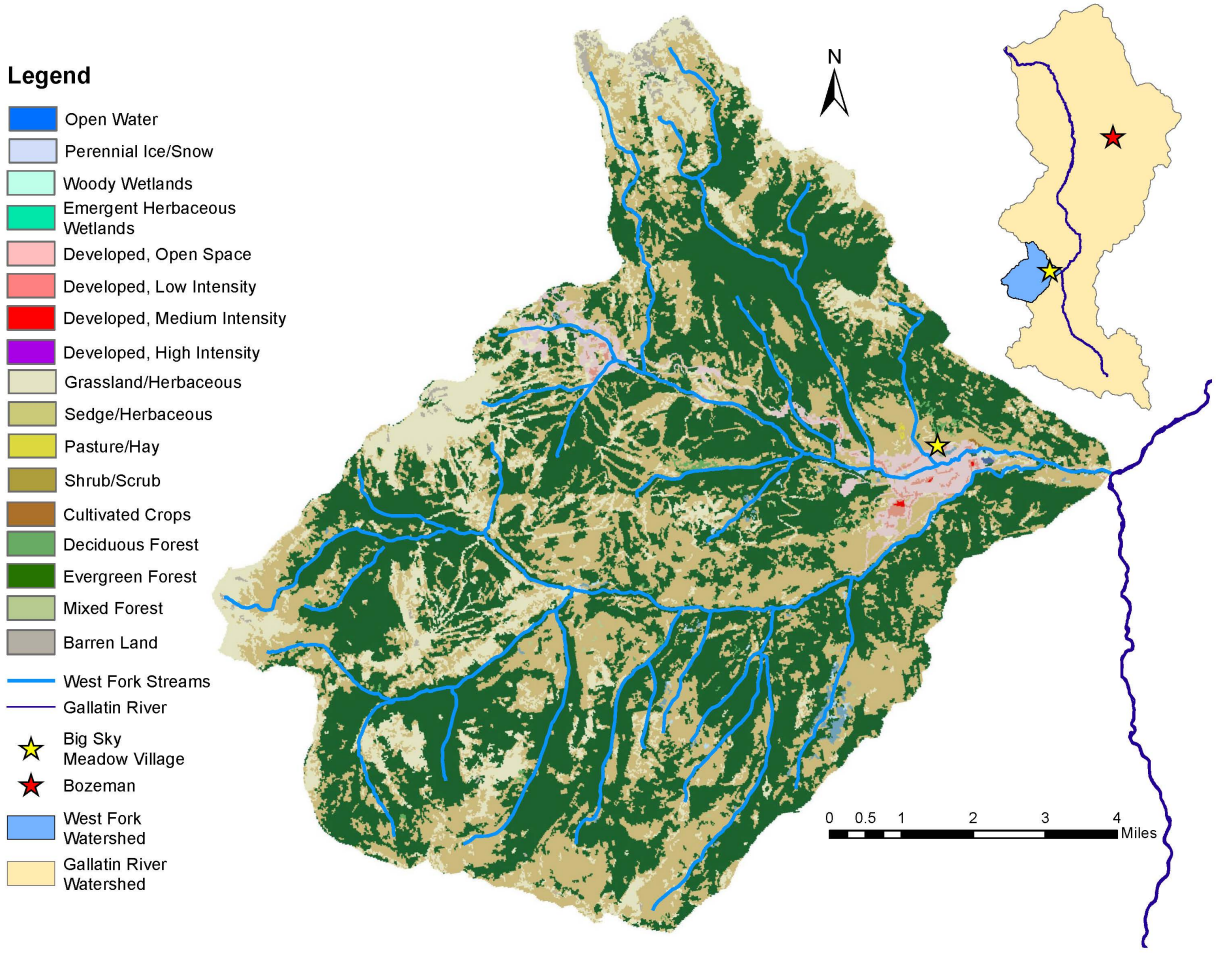

Figure 3: Land Use/ Land Cover within the West Fork Watershed.

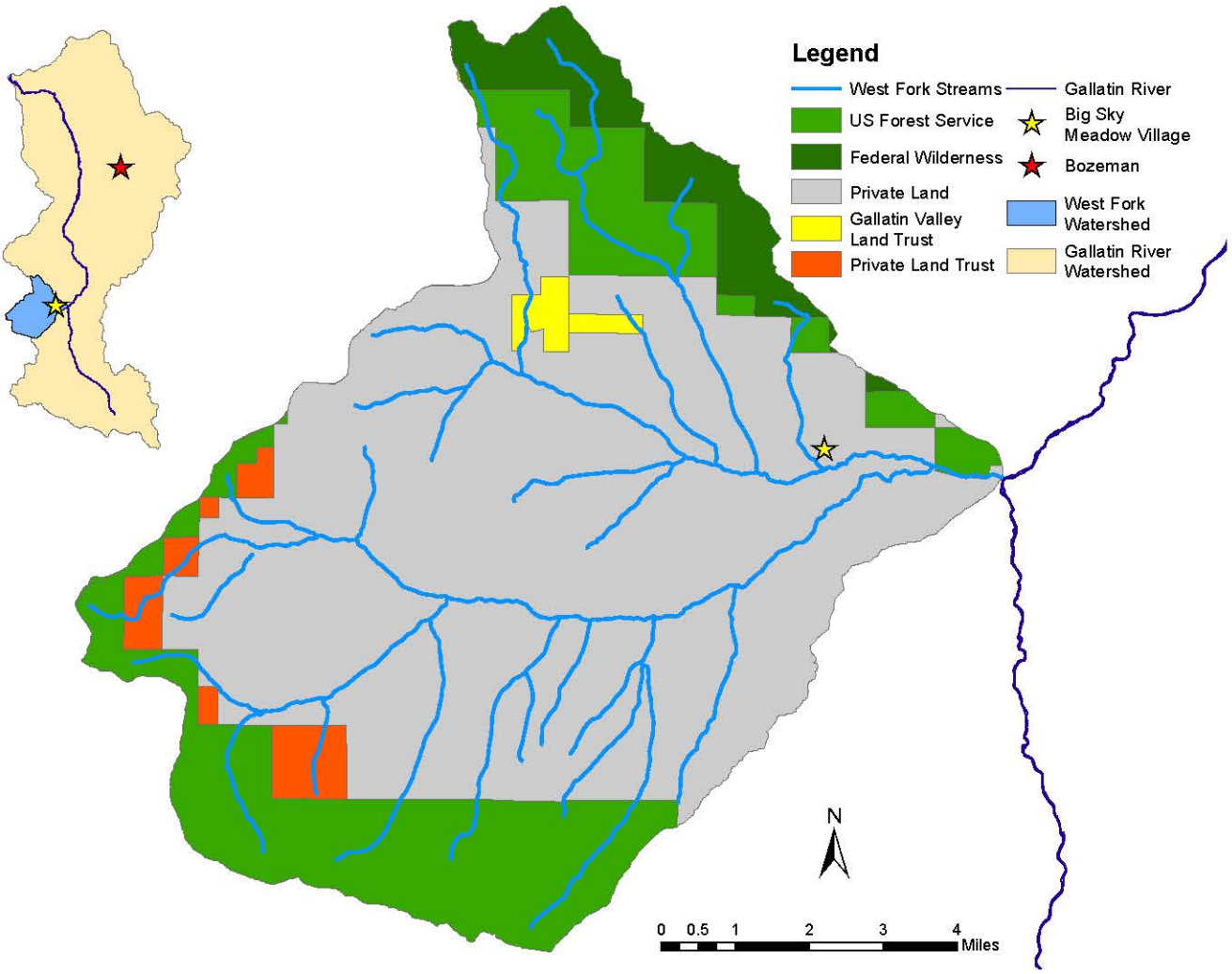

Figure 4: Land Ownership within the West Fork Watershed.

2.2 Water Resource Conditions

This section focuses on the conditions of the West Fork Watershed because it was the primary focus of the Upper Gallatin TMDL [MTDEQ, 2010] and because it shows the most anthropogenic impacts on water quality. To date, the water quality data collected by BWTF indicates the mainstem Gallatin generally has good water quality between the Yellowstone Park boundary and the confluence of the West Fork. Although, the focus of the UGWRP is the West Fork Watershed, future restoration planning may expand the scope of the area to the entire Upper Gallatin Watershed.

2.2.1 Nutrients

Extensive nutrient data (nitrogen and phosphorous) were collected in the West Fork Watershed between 2005 and 2008 as part of the Upper Gallatin TMDL assessments and Montana State University research. In addition to water chemistry, the Upper Gallatin

TMDL assessments collected algal samples in 2005 and in 2008 that were analyzed for chlorophyll-a density.

Total nitrogen and nitrate-nitrogen exceeded MTDEQ target levels (0.25 and 0.1 mg/L-N, respectively) [MTDEQ, 2011] in the Upper Middle Fork and the West Fork [Gardner and McGlynn, 2009; MTDEQ, 2010]. Water quality data collected as part of the Blue Water Task Force volunteer water quality program confirmed the elevated levels of nitrate (www.bluewatertaskforce.org). In addition, Chlorophyll-*a* levels were above state recommended concentrations (120 mg/m^3) in the South Fork and the West Fork.

2.2.2 E. coli Data

E. coli concentrations measured as part of the Upper Gallatin TMDL were above Montana state standards at some sites in the Middle Fork and West Fork; however, since the high levels of E. coli were sporadic in space and time it is difficult to determine any spatial or temporal trends.

2.2.3 Sediment

Through the Upper Gallatin TMDL assessments, significant anthropogenic sources of excess sediment in the West Fork, Middle Fork, and South Fork were identified. Major sources include roads and residential development, undersized or improperly installed culverts, and road traction sand [MTDEQ, 2010].

2.2.4 Instream Habitat

PBS&J conducted a habitat assessment in the West Fork Watershed as part of the TMDL assessments [PBS&J, 2009]. Overall channel morphology was within the expected range. In the Middle Fork, upstream of Lake Levinsky, excess fine sediment in riffles and pool tails was found with probable effects to aquatic life. In the West Fork, excess fine sediment was found near the Big Sky Golf Course and near the confluence with the Gallatin River with probable impacts on aquatic life. Low pool and large woody debris frequencies were documented in Middle Fork, South Fork, and West Fork and are likely impacting aquatic life. Target pool and woody debris frequencies are listed in Table 3.

2.2.5 Riparian Health

Riparian health was assessed through aerial photography as part of the Upper Gallatin TMDL assessments [MTDEQ, 2010]. Sections of the Lower West Fork, Upper Middle Fork and Upper South Fork were estimated to have poor riparian buffering capacity for sediment.

2.2.6 Macroinvertebrates

Macroinvertebrate data collected by BWTF from the West Fork of the Gallatin River has shown impacts from excess nutrients (http://www.bluewatertaskforce.org/docs.php). Macroinvertebrate indices determined through the Upper Gallatin TMDL assessments indicate sediment impacts on macroinvertebrates in the Lower South Fork, Upper and Lower West Fork and one upstream site on the Upper Middle Fork [MTDEQ, 2010].

Table 3: Sediment Targets for the West Fork Watershed

Sediment Target	Criterion
Fine sediment < 2mm based on the reach average of riffle pebble counts	Comparable with reference values for the appropriate Rosgen stream type based on the BDNF channel morphology dataset (Table 4)
Fine sediment <6mm in riffles based on reach average of riffle pebble counts	≤ 7% for B3 stream types ≤ 8% for all other stream types
Fine sediment <6mm based on the reach average of grid tosses in riffles and pool tails	≤ 5% for riffles and ≤ 7% for pools
Pool frequency	≥39 pools/mile for reaches <4% gradient ≥ 72 pools/mile for reaches >4% gradient
Large woody debris (LWD) frequency	≥188 LWD/mile for reaches <2% gradient ≥222 LWD/mile for reaches 2-4% gradient ≥330 LWD/mile for reaches >4% gradient

Table 4: Beaver Deerlodge National Forest Reference Dataset Median Percent Fine Sediment <6mm

Parameter	B3	B4	B	C3	C4	C	E3	E4	Ea	E
Sample Size (n)	26	14	40	11	19	30	12	64	23	115
% Surface Fines <6 mm	7	18	9	8	22	17	17	30	28	30

2.3 Pollution Sources

2.3.1 Nonpoint Sources

Nitrogen

The primary sources of nitrogen to the Upper Gallatin Watershed are associated with resort and residential development, with wastewater, from both septic systems and public disposal of wastewater effluent on the Big Sky Golf Course, being the largest source. The Big Sky Water and Sewer District provides central sewer to both Big Sky Mountain Village and Big Sky Meadow Village. Wastewater treatment is provided via a tertiary type treatment plant. Wastewater effluent is transported to a lagoon system located near Big Sky Meadow Village and is land-applied during the summer months to the Big Sky Golf Course at Meadow Village.

Outside of Big Sky Mountain and Meadow Villages, wastewater treatment systems are largely limited to individual residences with a few community systems. Wastewater treatment and disposal is via on-site septic system drain fields. Gallatin County septic

system records show 864 septic systems installed within the Upper Gallatin Watershed. Of these, 34 are commercial systems. 226 septic systems (8 commercial) are recorded in the West Fork Gallatin River watershed. Aside from wastewater, other sources of nitrogen associated with resort and residential development include fertilizer, horse manure, pet waste and stormwater runoff.

E. coli

Potential sources of E. coli to streams in the West Fork watershed include anthropogenic sources (wastewater from septic systems, horse corrals, pet waste, and sewer/storage pond leaks) and natural sources (wildlife excrement).

Sediment

The primary sources of sediment to the West Fork watershed are upland and bank erosion associated with resort and residential development, ski areas, logging, historic riparian vegetation removal, stormwater from construction sites, unpaved roads, culvert failure, and road traction sand.

2.3.2 Point Sources

There are no point sources of pollution in the Upper Gallatin Watershed.

2.4 Pollution Reduction Goals

Pollution reductions goals were largely taken from the Upper Gallatin TMDL [MTDEQ, 2010]. The exceptions are noted. Loading estimates can be found in Appendix A.

2.4.1 Nitrogen

Anthropogenic sources of nitrogen accounted for in the TMDL assessments were residential and resort sources, septic system effluent, and wastewater irrigation. Residential and resort nitrogen sources were defined "as a variety of variable and diffuse nitrogen sources associated with widespread land clearing and development that may include nitrogen derived from: 1) vegetative decay of detritus derived from land clearing or land maintenance activities, 2) residential landscape and/or golf course fertilizer application, and 3) general refuse inherent in residential development (animal waste, garbage etc.)". The Upper Gallatin TMDL combined the residential and resort and septic sources to determine the percent reduction goals and therefore, these two sources were combined for the UGWRP (Table 5).

Table 5: Nitrogen Reduction Goals for the West Fork Watershed [MTDEQ, 2010].

Stream Segment	Source	Percent Reduction	Restoration Strategies
Upper Middle Fork	Residential/Resort Septic	44%	Development and Implementation of West Fork Nitrogen Reduction Plan and associated BMP's Education/ Outreach Further Assessment
South Fork	Residential/Resort and Septic	44%[1]	
	Wastewater	100%	
West Fork	Residential/Resort Septic	44%[2]	
	Wastewater	100%	

[1] Although total nitrogen and $NO_3^-+NO_2^-$ concentrations did not exceed state water quality targets in the South Fork, high algal densities were observed in 2005 [PBS&J, 2005] verifying impairment [MTDEQ, 2010]. To lessen nuisance algal growth, we propose to reduce the nitrogen load to the South Fork. We suggest a loading reduction from the Residential/Resort source equivalent to that of the West Fork (44%).

[2] The Upper Gallatin TMDL did not recommended reduction in the residential/resort and septic source from the West Fork; however, recognizing that the TMDL's are rough estimates, 44% reduction goal in the Residential/Resort/Septic source was set to be consistent with the Upper Middle Fork and the South Fork.

2.4.2 E. coli

E. coli reductions goals are stated in Table 6. Since the E. coli concentrations were quite variable in space and time and the sources not well defined by the TMDL, the BWTF has chosen not to focus on reducing E. coli loads over the timeline of this WRP; however, we do expect some reductions in E. coli load from nitrogen reduction strategies described in Section 3.0. BWTF does recognize that other measures will most likely be needed to reach a pollution reduction goal of 66% and will address this in the next version of the UGWRP.

Table 6: E. coli reduction goals for the West Fork Watershed [MTDEQ, 2010].

Stream Segment	Source	Percent Reduction	Restoration Strategy
Middle Fork	Residential/Resort	66%	Education/Outreach

2.4.3 Sediment

Sediment reduction goals are stated in Table 7.

Table 7: Sediment Reduction Goals for the West Fork Watershed [MTDEQ, 2010].

Stream Segment	Source	Percent Reduction	Restoration Strategies
Middle Fork	Culverts[3]	Not quantified	Assess and prioritize culverts Work with winter maintenance crews to reduce road traction sand Assess and prioritize riparian areas Education & Outreach
	Road crossings	65%	
	Traction sand	75%	
	Streambank erosion (human)	41%	
	Upland erosion (resi/ski area)	37%	
	Construction storm water permits[4]	36%	
South Fork	Culverts[3]	Not quantified	
	Road crossings	67%	
	Traction sand	72%	
	Streambank erosion (human)	21%	
	Upland erosion (residential and ski area)	33%	
	Construction storm water permits[4]	35%	
West Fork[5]	Culverts[3]	Not quantified	
	Road Crossings	64%	
	Traction Sand	73%	
	Streambank erosion (human caused)	31%	
	Upland erosion (residential and ski area)	37%	
	Construction storm water permits[4]	36%	

[3] For culverts, passing the 25-year event is the minimum requirement but passing the 100-year event is recommended for fish-bearing streams or those with a high level of existing or anticipated development upstream.

[4] The loads for construction storm water permits are a portion of the human loads from the upland erosion source assessment.

[5] West Fork incorporates sources from the entire watershed including the Middle Fork and the South Fork.

3.0 Restoration Strategies (3-5 year outlook)

The BWTF has produced the following list of watershed restoration strategies to improve water quality in the Upper Gallatin Watershed, with the focus on the West Fork Watershed. The BWTF has chosen to primarily focus on the West Fork Watershed because recent water quality assessments have shown several streams in the West Fork Watershed to have

elevated levels of nitrogen, E. coli, and sediment [MTDEQ, 2012]. For the implementation schedule of these restoration strategies, see Appendix B.

3.1 West Fork Nitrogen Reduction Plan/Implementation – High Priority

The West Fork Nitrogen Reduction Plan will produce a detailed nitrogen budget for the West Fork Watershed using the Upper Gallatin TMDL as a guide. Nitrogen sources in the West Fork watershed include: natural sources, horse corrals, residential and golf course fertilizer, wastewater irrigation, septic system effluent, and sewer leaks. The detailed nitrogen budget developed in this plan will be used to prioritize the order in which nitrogen sources are addressed. The BWTF will work individually with watershed stakeholders to develop and implement strategies to reduce nitrogen loading. Additional implementation activities will include analyzing video of the Meadow Village sewer system and mapping and prioritizing riparian areas for restoration based on existing condition and potential for water quality improvement.

Potential BMP's: plant native vegetation, test soils for nutrients and use this information to apply fertilizer, maintain riparian buffer with appropriate vegetation, control stormwater runoff, inspect septic system every three years, pick up pet waste, move horse corrals away from the stream.

Estimate of Reduction: With the execution of the West Fork Nitrogen Reduction Plan and Implementation project, we expect the South Fork, Middle Fork, and West Fork to meet the nitrogen reduction goals recommended by the Upper Gallatin TMDL and listed in Table 5. In addition, E. coli loads may be reduced; however, quantification of a reduction estimate is difficult.

3.2 Develop and Implement a Plan to Reduce Traction Sand/Salt Loading – High Priority

BWTF will work with Montana Department of Transportation and other private snow plowers to develop and implement a plan to reduce transport of road traction sand to rivers and streams.

Potential BMP's: sediment catch basins, road signage to indicate river sensitive areas, traction sand pick-up.

Estimate of Reduction: We expect to meet the Upper Gallatin TMDL recommendations for reduction for road traction sand listed in Table 7.

3.3 Map Culverts and Prioritize for Replacement – Medium Priority

BWTF will map culvert conditions and prioritize for repair and/or replacement based on adequate size, ability for fish passage, and the potential for sediment reduction. Emphasis will be placed on some combination of the potential for sediment reduction and ability for fish passage. This combination will be decided by discussions with the BWTF technical advisors group.

Potential BMP's: NA

Estimate of Reduction: We do not expect to meet any sediment reduction goals with the prioritized list of culvert repair/replacement; however, this list will be the first step to implement future projects to reduce sediment from inadequately sized culverts.

4.0 Water Quality and Water Quantity Monitoring

4.1 Water Quality

To the extent possible, BWTF will restructure its current volunteer water quality monitoring program to assess the success and/or failures of restoration projects. Currently, BWTF collects the following water quality parameters: nitrate, temperature, E. coli, conductivity, turbidity, and dissolved oxygen. By the end of 2012, BWTF will add monitoring for chloride and sediment distribution to its volunteer water quality monitoring program to assess for wastewater contamination and excess sediment. Prior to the launch of the revised BWTF volunteer monitoring program, BWTF will work with the MTDEQ to develop a MTDEQ accepted Sampling Analysis Plan (SAP) for the volunteer water quality monitoring program. If additional sites should be monitored to assess the success failures of restoration projects then funding will be sought to cover monitoring those sites.

In addition to monitoring to evaluate the success/failure of restoration projects, BWTF will monitor sites along the South Fork and the Upper Middle Fork to better define sources of nitrate as recommended in the Upper Gallatin TMDL [MTDEQ, 2010].

4.2 Water Quantity

Surface water and ground water quantity will be monitored to assess for trends and surface water flows will be used for pollutant load calculations. Surface water is currently being monitored at the mouth of the South Fork, North Fork, Middle Fork, and West Fork (http://www.bluewatertaskforce.org/test-sites.php). Ground water will be monitored as part of Montana Bureau of Mines and Geology's long-term monitoring network. BWTF will routinely analyze the MBMG data for trends.

5.0 Criteria to Determine Achievement of Load Reductions

Water quality monitoring targets set by the MTDEQ determine whether water bodies are achieving pollutant load reduction goals; however, we do not expect water bodies to meet water quality criteria/standards immediately. Instead, we anticipate a lag time in creating instream conditions that will meet water quality monitoring targets/standards due to historical N loading and travel times from N source areas to stream.

6.0 Implementation Schedule and Measurable Milestones

The intent is for the UGWRP to be fully implemented by 2017. At that time, BWTF will review the UGWRP and revise/make additions as necessary. For a detailed implementation schedule, see Appendix B, Table B-1. The interim measureable milestones are described in Appendix B, Table B-2.

7.0 Public Information and Educational Component

Stakeholder involvement and Input will be a key component to restoration planning and implementation. Stakeholders will be informed of all restoration planning and implementation activities through email, newsletters, website, press releases, and public events.

In addition to the routine updates to stakeholders regarding restoration activities, BWTF will be implementing the following education and outreach activities as part of the UGWRP:

1. *Septic system maintenance outreach* – work with Ophir middle school students on septic maintenance outreach project. Ideas include making a video for BWTF website and working with septic system company to develop incentives for homeowners to inspect/maintain septic system. **High Priority**
2. *Demonstration rain garden at Ophir School* to capture stormwater runoff, promote water infiltration to groundwater, and focus on the use of native plants, which will survive in existing rainfall patterns. The rain garden will serve as an educational tool for Ophir students and as a model for the broader Big Sky Community. **High Priority**
3. *Education & Outreach to winter maintenance crews* regarding river sensitive areas on the Upper Gallatin and potential impacts of winter maintenance activities on water quality and aquatic organisms. **High Priority**
4. *Education & Outreach on Nitrogen Reduction Strategies* for local watershed stakeholders (e.g. ski resorts and their associated golf courses, local businesses, homeowners associations, residents). **High Priority**
5. *Interpretive signage on water resource topics relevant to the Big Sky area* along the Big Sky Community Park Trail, which meanders along the Upper West Fork. **Medium Priority**

8.0 Technical and Financial Assistance

8.1 Technical Assistance

Technical assistance will be requested routinely from the appropriate state agencies and regional scientists (Montana Fish, Wildlife and Parks, US Forest Service, Natural Resources Conservation Service, Montana DEQ, Gallatin Local Water Quality District, Gallatin Conservation District, Montana State University). These folks are part of the Technical Advisory Committee organized during the Upper Gallatin TMDL assessments.

8.2 Financial Assistance

We expect that a wide range of funding sources will be used to implement the UGWRP. Each management measure or restoration project will generally call for a different funding approach. A partial list of potential funding sources includes:

1. 319 Grant funding from MTDEQ
2. Big Sky Resort Tax District

3. Montana Fish Wildlife and Parks - Future Fisheries Improvement Program
4. Various types of funding from the USFS including: RAC (Secure Rural Schools and Community Self-Determination Act of 2000) and USFS Partnership Grant
5. National Fish and Wildlife Foundation
6. Department of Natural Resources and Conservation Grants (Watershed Planning Assistance Grant Program, Renewable Resource Grant and Loan Program, Reclamation and Development Grant Program)
10. Individual and business donations

Cost estimates for the restoration strategies defined in Section 3 are listed in Table 8. It is difficult to provide an estimate for the total costs associated with implementation of the West Fork Nitrogen Reduction Plan (WFNRP) and the Traction Sand/Salt Reduction Plan (TSSRP). This is because the implementation costs will depend on the elements listed in the associated plan, which are unknown at this time. Cost estimates will be updated once the WFNRP and TSSRP plans have been developed.

Table 8: Cost Estimates for Restoration Strategies Described in Section 3.0.

Restoration Strategy	Expected Cost
3.1 West Fork Nitrogen Reduction Plan	$25,000
3.1 West Fork Nitrogen Reduction Plan Implementation	Costs will depend on projects defined in the plan.
3.2 Traction Sand/Salt Reduction Plan	$10,000
3.2 Traction Sand/Salt Reduction Plan Implementation	Costs will depend on projects defined in the plan.
3.3 Culvert Mapping and Prioritization	$30,000

9.0 References

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APPENDIX A
Existing Pollutant Load Estimates

Table A-1: Existing Nitrogen Load Estimates for the West Fork Watershed.

Stream Segment	Source	Existing Load
Upper Middle Fork	Residential/Resort	0.589 lbs/day
	Septic	0.015 lbs/day
South Fork	Residential/Resort and Septic	6.8 lbs/day
	Wastewater	0.2 lbs/day
West Fork	Residential/Resort	11.2 lb/day
	Septic	negligible
	Wastewater	9.0 lb/day

Table A-2: Existing E. coli Load Estimates for the West Fork Watershed.

Stream Segment	Source	Existing Load	Percent Reduction
Middle Fork	Residential/Resort	9,543 Mcfu/day	66%

Table A-3: Existing Sediment Load Estimates for the West Fork Watershed.

Stream Segment	Source	Existing Load	Percent Reduction
Middle Fork	Culverts[3]	Not quantified	Not quantified
	Road crossings	4.8 tons/year	65%
	Traction sand	8.4 tons/year	75%
	Streambank erosion (human)	145 tons/year	41%
	Upland erosion (resi/ski area)	6,007 lb/day	37%
	Construction storm water permits[4]		36%
South Fork	Culverts[3]	Not quantified	Not quantified
	Road crossings	2.1 tons/year	67%
	Traction sand	6.5 tons/year	72%
	Streambank erosion (human)	338 tons/year	21%
	Upland erosion (residential and ski area)	3,491 lb/day	33%
	Construction storm water permits[4]	202	35%
West Fork[5]	Culverts[3]	Not quantified	Not quantified
	Road Crossings	8.1 tons/year	64%
	Traction Sand	155 tons/year	73%
	Streambank erosion (human caused)	604 tons/year	31%
	Upland erosion (residential and ski area)	11,495 lbs/day	37%
	Construction storm water permits[4]	568	36%

[3] For culverts, passing the 25-year event is a minimum but passing the 100-year event is recommended for fish-bearing streams or those with a high level of existing or anticipated development upstream.

[4] The loads for construction storm water permits are a portion of the human loads from the upland erosion source assessment.

[5] West Fork incorporates sources from the entire watershed including the Middle Fork and the South Fork.

APPENDIX B
Implementation Schedule and Measureable Milestones

Table B-1: Upper Gallatin Watershed Restoration Plan Implementation Schedule

Restoration Strategy	2012	2013	2014	2015	2016	2017
West Fork Nitrogen Reduction Plan						
West Fork Nitrogen Reduction Plan Implementation						
Traction Sand Reduction Plan						
Map Culverts and Prioritize for Replacement						
Water Quality Monitoring						
Education and Outreach						

Table B-2: Upper Gallatin Watershed Restoration Plan Measureable Milestones

Measureable Milestones	2012	2013	2014	2015	2016	2017
West Fork Nitrogen Reduction Plan (WFNRP)						
- DEQ Approved Plan						
WFNRP Implementation						
- Implementation of 2 WFNRP projects each year						
- Riparian mapping and prioritization						
- Meet nitrogen loading reduction goals (Section 2)						
Traction Sand Reduction Plan/Implementation						
- Traction Sand Reduction Plan approved by						
MDOT and local snow plowers						
- Plan implementation						
Water Quality Monitoring						
- 50 data points collected each year						
Education and outreach						
- Annual meeting presentation						
- Email, newsletters, website, Facebook						
- Annual press release in local newspaper						
- Winter Maintenance E&O						
- Nitrogen Reduction E&O						
- Septic System E&O						
- Demonstration Rain Garden						
- Water quality interpretive signage						

APPENDIX C
Glossary of Terms and Abbreviations

Algae: referring to aquatic plants (algae).

Alluvial: relating to, composed of or found in alluvium.

Alluvium: clay, silt, sand, or gravel deposited by running water

Anthropogenic: caused or produced by humans

BDNF: "Beaver Deerlodge National Forest" is the largest of the national forests in Montana covers 3.35 million acres, and lies in eight Southwest Montana counties (Granite, Powell, Jefferson, Deer Lodge, Silver Bow, Madison, Gallatin and Beaverhead).

BMP: "Best Management Practices" are measures taken to reduce water pollution. For example, installing a silt fence during construction is a BMP to reduce sediment transported to a water body (river, lake, stream, ocean).

BWTF: The Blue Water Task Force (www.bluewatertaskforce.org) is a nonprofit watershed group in Big Sky, Montana whose mission is to promote public stewardship of aquatic resources in the Gallatin River Watershed through community education, citizen involvement in water quality monitoring, and scientific data collection

Chlorophyll *a*: a green pigment found in plants and algae necessary to conduct photosynthesis. Monitoring chlorophyll levels is a direct way of tracking algal growth.

Conductivity: is a measurement of the ability of water to pass an electric current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar do not conduct electrical current very well and therefore have a low conductivity when in water. Conductivity in streams and rivers is affected primarily by the geology of the area through which the water flows. In addition, discharges to streams can change the conductivity depending on their make-up. For example, a failing septic system would raise the conductivity because of the presence of chloride, phosphate, and nitrate; while, an oil spill would lower the conductivity. Conductivity is measured in microsiemens per centimeter (µmhos/cm). Distilled water has a conductivity in the range of 0.5 to 3 µmhos/cm. The conductivity of rivers in the United States generally ranges from 50 to 1500 µmhos/cm. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 µhos/cm. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or macroinvertebrates.

Confluence: The meeting of two or more bodies of water.

Cretaceous: A geologic period within the Mesozoic era between approximately 145 and 65 million years ago.

Emergent: as in "emergent herbaceous wetland" (Table 1) means above water.

Fine sediment: is sediment less than 6.35 mm in diameter which can be harmful to the health of aquatic ecosystems. Excess fine sediment can destroy habitat for fish spawning and aquatic insects.

FWP: Montana "Fish, Wildlife & Parks" (http://fwp.mt.gov/) is a government agency in the executive branch state of Montana with responsibility for protecting sustainable fish, wildlife, and state-owned park resources in Montana for the purpose of providing recreational activities.

Herbaceous: referring to a type of plant that has leaves and stems that die down at the end of the growing season to the soil level. Herbaceous plants have no persistent woody stem above ground.

Hydrologic: referring to the scientific study of water.

Interstitial: referring to the empty space between particles.

K-factor: is a relative number describing the potential for soils to erode due to rainfall or runoff. Easily erodible soils have a K-factor close to zero (0.05-0.15) while less erodible soils have a K-factor greater than 0.4.

Lithology: A description of the physical characteristics of rocks.

Load reductions: A decrease in the amount of pollution released.

Mcfu/day: "Mega coliform units per day" is the measuring unit E. Coli in.

Macroinvertebrates: aquatic insects (e.g. mayfly, stonefly, caddisfly)

Mesozoic: Geologic era from approximately 250 to 65.5 million years ago. Dinosaurs lived during the Mesozoic era.

Metamorphic: rocks formed by heat and pressure causing physical or chemical change.

Morphology: a branch of biology dealing with structure and form of organisms. This includes aspects of the outward appearance (shape, structure, color, pattern) as well as the form and structure of the internal parts like bones and organs.

MTDEQ: the "Montana Department of Environmental Quality" (www.deq.mt.gov) is a government agency in the executive branch state of Montana with a mission to protect, sustain, and improve a clean and healthful environment to benefit present and future generations.

Nitrogen: is a common chemical element required by living organisms. Too much nitrogen in streams can cause excessive algal growth.

Nutrient: A nutrient is a substance that an organism needs to live and grow. Common nutrients considered in stream ecosystems include nitrogen, phosphorous, and carbon.

NRCS: the "Natural Resource Conservation Service" (www.nrcs.usda.gov) formerly known as the Soil Conservation Service (SCS), is an agency of the United States Department of Agriculture (USDA) that provides technical assistance to farmers and other private landowners and managers.

Order of magnitude: is an estimate of size expressed as a power of ten.

PBS&J: is an environmental consulting firm acquired by Atkins in 2010.

Paleozoic: Geologic era 542 to 251 million years ago.

Phosphorous: is a common chemical element required by living organisms. Too much phosphorous in streams can cause excessive algal growth.

Porosity: The ratio of empty space to total volume – commonly used in soils. Water flows quickly through soil with high porosity.

Precambrian: The Precambrian (Pre-Cambrian) is the name which describes the large span of time in Earth's history before the current Phanerozoic Eon,- approximately between 4600 million years ago to 542 million years ago.

RAC: a "Resource Advisory Committee" is a committee developed as part of the Secure Rural Schools Act, which decides on local community collaboration with federal land managers in recommending Title II projects on federal lands or that will benefit resources on federal lands.

Reach: a stream reach is the length of the stream selected for a project, (e.g. monitoring)

Restoration: the return of a landscape, ecosystem, or other ecological entity to a predefined historical state.

Riparian: is the interface between land and a river or stream.

Riparian buffering capacity: is the ability of riparian zone to capture or transform pollution.

SAP: a "Sampling Analysis Plan" is often required for water quality sampling programs funded by government agencies.

SSURGO: The "Soil Survey Geographic" database is one of two of the most commonly used soil databases (SSURGO and STATSGO) used for planning, management, and monitoring. SSURGO data are much more detailed than STATSGO.

STATSGO: The "State Soil Geographic" database is one of two of the most commonly used soil databases (SSURGO and STATSGO) used for planning, management, and monitoring. SSURGO data are much more detailed than STATSGO.

Sediment loading: sediment transported to a water body.

Siliciclastic: Siliciclastic sedimentary rocks are clastic (consisting of rock fragments) rocks rich in silica (e.g. quartz, feldspar, biotite).

Tertiary treatment: Tertiary treatment is the wastewater treatment process succeeding secondary treatment. Tertiary treatment removes stubborn contaminants that secondary treatment is not able to clean up. Tertiary processes include filtration, lagooning, nutrient removal, and disinfection.

Turbidity: Turbidity is a measure of water clarity and is measured by the waters ability to allow the passage of light.

TMDL: A "Total Maximum Daily Load" is a regulatory term in the U.S. Clean Water Act, describing the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards.

UGWRP: Upper Gallatin Watershed Restoration Plan (this document)

USEPA: The "United States Environmental Protection Agency" (www.epa.gov) is an agency of the U.S. government created for the purpose of protecting human health and the environment

USLE: The "Universal Soil Loss Equation" predicts the long term average annual rate of erosion on a field slope based on rainfall pattern, soil type, topography, crop system and management practices.

USGS: The "United States Geological Survey" (www.usgs.gov) is a scientific agency of the United States government. The scientists of the USGS study the landscape of the United States, its natural resources, and the natural hazards that threaten it.

Upper Gallatin watershed: The southern section of the Gallatin Watershed south of Spanish Creek (see Figure 1).

WFNRD: The "West Fork Nitrogen Reduction Plan" is a plan to be developed by the Blue Water Task Force in collaboration with watershed stakeholders to reduce excess nitrogen in the West Fork of the Gallatin River.

Wastewater effluent: is the discharge of wastewater after treatment from a wastewater treatment plant or a septic system.

Watershed: All of the land which drains precipitation in the form of rain or snow to a specific point.

Wetlands: A wetland is an area of the landscape that is inundated or saturated by surface or groundwater and supports vegetation adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.