FINAL Report

June 2022

Musselshell River Watershed Plan
"Vision 2030"

Prepared for:

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Executive Summary

This project was developed to update a Musselshell Watershed Plan that was originally completed in 2015. The update was funded by a Bureau of Reclamation WaterSMART Grant for "Improving the Musselshell Watershed Plan". The initial plan development included a series of stakeholder meetings held throughout the watershed to solicit input from local producers, agency representatives, water user associations and others regarding water resource-related project needs and opportunities. In the original 2015 plan, a total of 58 project concepts were developed and those were consolidated/winnowed to 27 projects, including 19 engineering projects and 8 studies/outreach efforts.

An implementation strategy developed in the 2015 plan identified project leads, potential funders, and aspirational timelines for each ranked project. Within four years, 25% of the identified projects had been completed with another 50% of the projects underway. Because so many projects have completed and additional challenges and opportunities have arisen, the original plan is outdated. To ensure the Plan remains a dynamic and useful tool for tracking project successes and setting new goals, the same basic strategy was taken for this update to gather stakeholder input and locally vet project priorities.

Stakeholder meetings held in 2021 generated a total of 86 project concepts. As many of the projects can be considered ongoing studies or initiatives, they were removed from the prioritization list and described as active efforts. With additional project consolidation, 40 projects were ultimately ranked. Many of these projects that relate to irrigation infrastructure upgrades/replacements are managed by individual Water User Associations (WUAs), however the involvement of managers in the ranking process allowed WUA-specific rankings to be generated. A total of 19 projects that are not within the purview of the WUAs are ranked separately. The implementation strategy includes only those 19 non-WUA projects since local water managers have their own strategy for project implementation.

The result of the planning effort includes an updated general watershed characterization (Chapter 2), a brief summary of 29 projects that have been recently completed or are underway in the basin (Chapter 3), summaries of all ranked projects and studies (Chapter 5), and an implementation strategy (Chapter 65.4). Conceptual level designs are included for two projects selected by the ranking team.

The "Musselshell Watershed Plan Vision 2030" is intended to be a living document that will assist the Musselshell Watershed Coalition in its continued water management efforts in the basin. It is also a means of acknowledging the achievements of the coalition and its partner agencies, water user associations, producers, and other organizations in recent years, while highlighting the array of issues and opportunities that continually arise.

1 Introduction

The following report summarizes the results of a watershed planning effort for the Musselshell River performed as part of a 2019 US Bureau of Reclamation Phase 1 WaterSMART grant "Growth of the Musselshell Watershed Coalition through Improving the Musselshell Watershed Plans," sponsored by the Petroleum County Conservation District (PCCD) in partnership with the Musselshell Watershed Coalition (MWC). The project was undertaken by the local sponsors to continue the long-range basin-wide water management plan developed in 2015, and to provide a strategy for project identification, prioritization, and implementation. Within this document, the planning effort is referred to as the Watershed Plan Update.

1.1 Project Need and Objectives

Since the original Musselshell River Watershed Plan was released in 2015 (Boyd et al., 2015), several of the key projects and goals outlined in the Plan have either been completed or are in the process of implementation. Additionally, new priorities, needs, and opportunities have been identified, prompting the Plan update. While the 2015 Plan was broad in scope, many of the highest ranking projects directly addressed 2011 and 2014 flood impacts to critical infrastructure. More recent priorities include irrigation system upgrades and stream and floodplain restoration projects.

This effort builds on the successful strategies implemented in the 2015 Plan by developing a longer-term strategy for project characterization, design, funding, and implementation. As such, this project aims to identify and prioritize projects that stakeholders consider to be valuable and important, and to develop a strategy for effective implementation of those projects. The project identification, characterization, and ranking can then provide a vetted basis for securing funding to support further feasibility analysis, design, implementation, and monitoring. Projects also include non-engineering work such as studies and data collection, which can then inform future project development. The plan is intended to be a living document. This effort is viewed as an update to the 2015 Plan, with a re-evaluation of project priorities and achievements, and the addition of new projects.

The work performed under the WaterSMART Grant was developed to align with the following Musselshell Watershed Coalition goals:

1. Water Quantity
    a. Meet decreed and contract water rights obligations by sustaining sufficient water in the Musselshell through cooperative flow management and a well-maintained irrigation infrastructure system.
2. Water Quantity
    a. Work with State agencies to meet State Water Standards using a voluntary local approach.
3. Support whole river management through whole river collaboration
    a. Coordinate and communicate with MWC partners, agencies, and others along the Musselshell through regular meetings, newsletters, and other means of communications.

b. Enhance beneficial use of water, conserve the resource, and strive to improve river health.

In support of those goals, WaterSMART funds were granted for updated planning, with the following subtasks:

1. Characterize the Musselshell River Watershed
2. Summarize Existing Data and Recent Projects
3. Engage Stakeholders to Identify New Concerns and Project Needs
4. Develop Goals and Identify Solutions
5. Finalize and Release the "Musselshell Watershed Plan Vision 2030"
    - Develop Preliminary Engineering Designs of Top Projects

In November of 2020, Applied Geomorphology, Inc. was contracted to oversee the Watershed Plan Update development, along with subcontractors from DTM Consulting, Inc. and Pioneer Technical Services, Inc.

1.2 Musselshell Watershed Coalition - Background

The Musselshell Watershed Coalition (MWC) was formed in 2009 as a collection of conservation districts and water user groups, with the goal of collaboratively managing water resources throughout the basin. The coalition includes three water-user groups, several conservation districts, and state and federal agencies across Musselshell, Golden Valley, Wheatland, Garfield, and Petroleum Counties. The MWC strives to apply an interdisciplinary and collaborative approach to watershed management. The three defined goals of the coalition are to protect water quantity, water quality, and riparian function in the Musselshell Watershed.

Shortly after forming in 2009, a massive flood hit in spring of 2011, which created new and unforeseen challenges for the MWC in their efforts to support collaborative river management strategies. The work of the MWC since the spring 2011 flood, and many of the key goals in the 2015 Watershed Plan, has focused to a large extent on post-flood rehabilitation projects. In the decade since the flood many of the immediate flood response projects are complete, but as the river continues to adjust many of the recent and ongoing MWC projects reflect efforts to adapt to the new conditions. These efforts are described in later sections of this report.

In 2015, the MWC received the Montana Wetland and Watershed Stewardship Group Award for their "persistence, dedication, and creativity put forth in its work within the Musselshell Watershed." In 2019, MWC facilitator Bill Milton received the Montana Leopold Conservation Award.

1.3 Musselshell Basin Water User Associations and Groups

Several Water User Associations (WUAs) collectively manage irrigation water diversion, storage, and delivery in the Musselshell Basin, and these associations were all actively involved in this planning effort.

1.3.1 Upper Musselshell Water Users Association (UMWUA)

The Upper Musselshell Water Users Association (UMWUA) operates off-stream reservoirs to supply contract water. Contracts are held on Bair Reservoir with a capacity of 7,010 acre-feet and Martinsdale Reservoir which has 23,110 acre-feet of active storage.

1.3.2 Deadman's Basin Water Users Association (DBWUA)

The Deadman's Basin Water Users Association (DBWUA) consists of 110 irrigators on the Musselshell River who are located across about 200 river miles between Shawmut and Mosby. DBWUA diverts Musselshell River water into Deadman's Basin Reservoir via an 11.5 mile supply canal and delivers contract water via two outlet canals, the 2.85 mile long Barber canal and the 9.5 mile long Careless Canal. Deadman's Basin reservoir has a total capacity of 72,220 acre feet at full pool. There are currently 40,500 acre feet of water contracted for from the reservoir.

1.3.3 Delphia-Melstone Canal Water Users Association

Delphia-Melstone Canal WUA (DMCWUA) consists of three canals and two diversions from the Musselshell River, starting at the small community of Delphia and stretching east and then north along the Musselshell River to about 12 miles north of Melstone. This system serves approximately 50 producers and irrigates 6,085 acres. It delivers natural flow water when available and stored water purchased from Deadman's Basin. DMCWUA is the largest single purchaser of Deadman's water.

1.3.4 Mosby-Musselshell Water User Group

The Mosby-Musselshell Water User Group (MMWG) was made up of landowners who own property along the Musselshell River in Petroleum and Garfield Counties with producers irrigating 2,000 to 2,500 acres. The MMWG disbanded in 2020 after deciding not to pursue the Horse Creek Coulee Storage Reservoir project.

1.4 Acknowledgements

The Musselshell Watershed Coalition was involved in all aspects of the project, including stakeholder identification, project management, meeting logistics and general support. Laura Nowlin provided invaluable assistance as the MWC local coordinator, and her enthusiasm and competence was greatly appreciated by the project team.

The Petroleum County Conservation District was instrumental in securing the planning grant for this effort, and we would like to extend our appreciation to Carrie Hess and her successor for her effective role in both contracting and project management.

This project would not have been possible without the commitment of numerous stakeholders in the basin who contributed to project development at stakeholder meetings, volunteered to assist with project ranking, collaboratively helped develop an implementation strategy, and dedicated their time to tour project sites. These stakeholders include local landowners, water-user groups, and representatives of local, state, and federal agencies.

We would also like to acknowledge the value of the collaborative environment provided by the Musselshell Watershed Coalition at their regular meetings. Attending MWC meetings to provide updates and gather feedback proved to be invaluable in this effort. To that end we extend our sincere thanks to Bill Milton and Laura Nowlin of MWC for their vision and persistence in the promotion of collaborative approaches to water management in the Musselshell River basin.

2 Watershed Characterization

The Musselshell River watershed, water use, flood history, and flood impacts were detailed in the 2015 Watershed Plan (Boyd et. al., 2015). This section will briefly summarize that characterization and describe new or continued impacts to the river corridor.

2.1 The Watershed

The Musselshell River drainage consists of approximately 8,000 square miles of central Montana (Figure 1). Elevations range from about 9,000 feet on the northern slopes of the Crazy Mountains in southern Meagher County to approximately 2,000 feet at the river mouth in northern Petroleum/Garfield Counties. The mainstem of the Musselshell River flows for nearly 340 miles from the confluence of the North and South Forks near Martinsdale to Fort Peck Reservoir. The general terrain includes expansive grass and shrub lands, broken and rolling foothills, and a low density drainage network. The largest town in the area is Roundup, which is located near the middle of the watershed in west-central Musselshell County and has a population of about 2,000 people. The Musselshell River watershed contains portions of ten counties and is managed by four conservation districts.

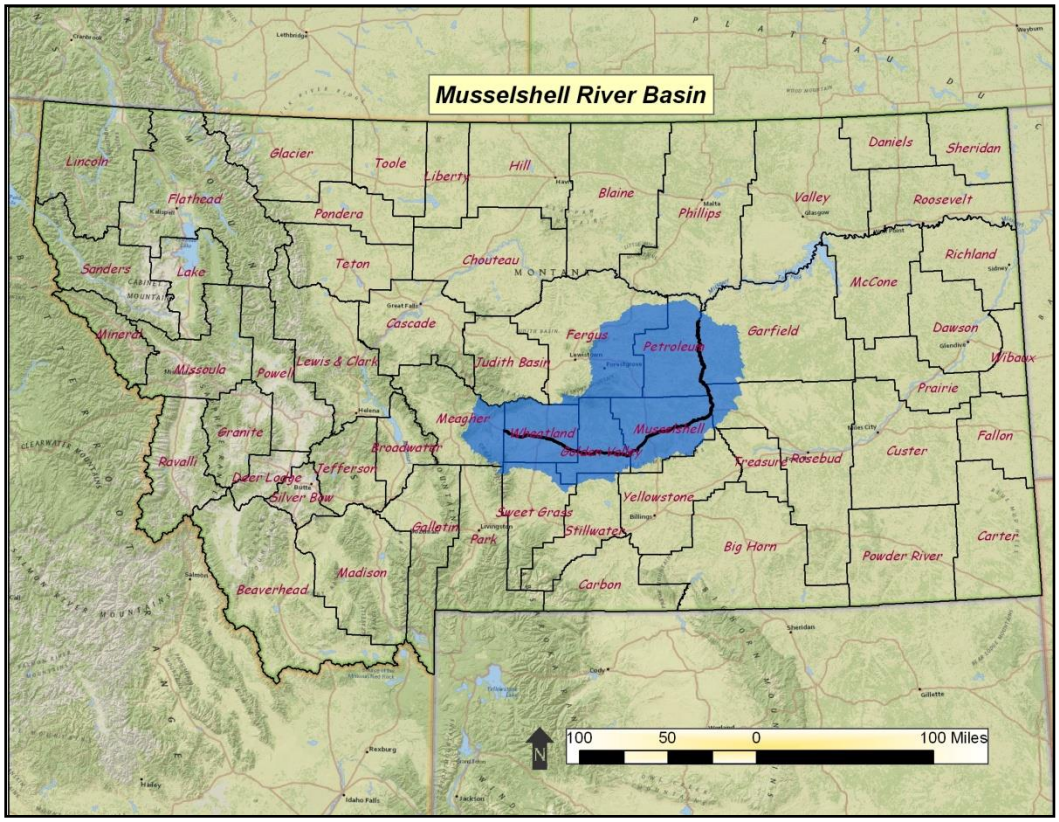


Figure 1. Musselshell Watershed in Montana, with assessment reach (black line) and counties labeled.

The Musselshell Basin can be divided into five main sub-basin areas including the Upper, Middle and Lower Musselshell, Box Elder Creek, and Flatwillow Creek (Figure 2). While this planning effort solicited input for project from anywhere in the Musselshell River watershed, the great majority of the input detailed projects on the mainstem of the Musselshell River. Projects on the tributaries were aimed at

regional water quantity and quality monitoring efforts, as well as basin-wide planning efforts such as weed control and wildfire fuels mitigation.

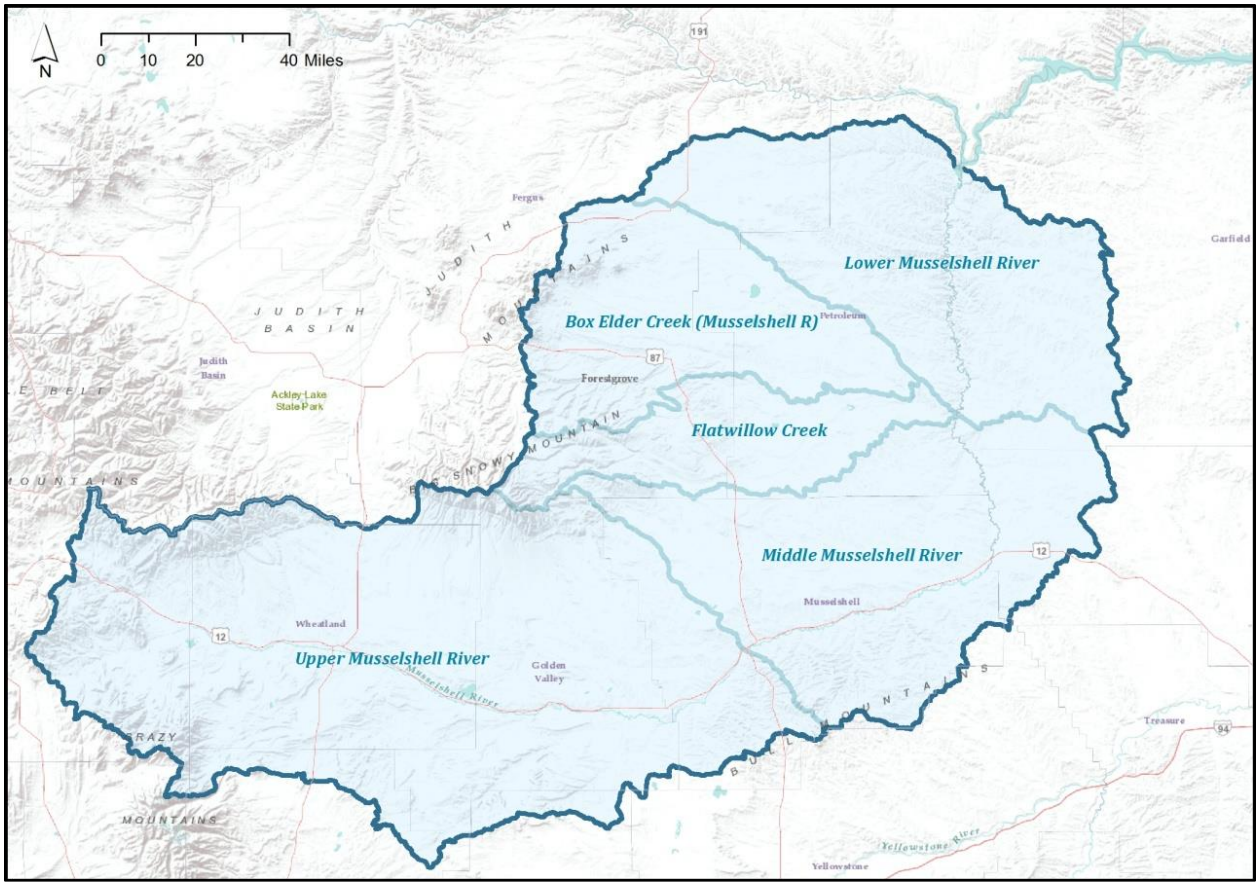


Figure 2. Musselshell River Sub-Watershed map.

2.2 Recent Floods and Their Impacts

The Musselshell River is a predominantly snowmelt-fed system that typically floods in the spring until about mid-June, when flows typically reach on the order of 800 cfs at Roundup. Flows may drop to a trickle in late summer and early fall unless off-stream storage is supporting the system. Ice jams are not uncommon and may cause localized flooding in winter months.

A more thorough summary of the geomorphic evolution of the Musselshell River as it relates to human land uses and flooding can be found in the two Musselshell River Flood Rehabilitation River Assessment Triage Team (RATT) reports (Boyd et al., 2012 and 2019). In 2011 a rain-on-snow event resulted in ~150-year flooding along the entire system (Boyd et al., 2015). This flood caused an epic "re-set" of the system, as 59 avulsions shortened the river by 37 miles over a three week period (about 10% of the channel length was lost). The historic Milwaukee Railroad grade, which was routed along the stream corridor from Harlowton to Melstone, breached in 31 places, creating additional issues as water routed behind the berm commonly stacked up and created additional breaches as the berm overtopped and flows returned to the river. The old rail grade also serves as an access road for many landowners, so land access was strongly affected by both berm breaches and avulsions. Numerous channel-spanning

diversion structures were flanked and subsequently abandoned, with water users shifting from gravity fed ditches to pumps due to the high cost of diversion dam repair.

The Musselshell River became over-steepened by the 2011 flood avulsions (mostly meander cutoffs). Headcuts generated at points of avulsion migrated upstream, driving channel incision. The natural geomorphic response to a flood-induced oversteepening event would be to regain length to recover an equilibrium slope that would lower stream energy, slowing down velocities and creating a new inset floodplain in downcut segments that would allow water to spread from the main channel. These processes of flood recovery, which necessarily requires some bank erosion to lengthen the channel, would ideally occur slowly under a typical historic flood regime. Unfortunately, a series of subsequent floods drove very rapid bank erosion which created a myriad of problems for stakeholders.

Before the river had begun to recover from the 2011 flood, a late winter 2014 ice-jam event in the upper river generated an estimated ~50-year flood event (Pioneer, 2015). Another 2014 flood occurred on the lower river near Mosby, when Flatwillow Creek flooded in August. These 2014 floods compounded damages of 2011. Another ~10-year event occurred on the upper river in 2018. Although this flood had a lower peak discharge, it exceeded a 2-year flood for 59 days at Roundup and 39 days at Mosby (Boyd et al. 2019). These long duration high flows can perform immense amounts of work on a river that is recovering from a massive prior reset.

Overall, river changes since the 2011 flood have included substantial channel lengthening and widening. Large inset floodplain surfaces were built, and thousands of feet of channel length were gained. The river's response to 2014 and 2018 flooding reflects a natural trend towards geomorphic equilibrium, but this has been at a cost to infrastructure and agricultural lands.

2.3 Drought and Fire

In addition to extreme floods, the Musselshell basin has experienced major drought conditions and wildfires over the last decade.

In 2012 the Dahl Fire burned 22,000 acres south of Roundup and the Delphia Fire burned just over 40,000 acres south of Delphia (Figure 3). The Lodgepole Complex was the largest fire of the 2017 wildfire season in the United States, burning 270,723 acres. It included four merged fires: Bridge Coulee, Barker, South Breaks and Square Butte. The Lodgepole Complex burned a ~40 mile wide swath across Garfield and Petroleum Counties, burning miles of fences and numerous outbuildings, barns, and livestock shelters. Eastern Montana was in severe drought at the time.

Severe drought in the basin in 2021 caused many ranchers to sell off their cattle due to a severe hay shortage. This 2021 event was described as the most sweeping statewide drought in 20 years, with 98% of Montana experiencing severe to exceptional drought in the late summer (Figure 4).

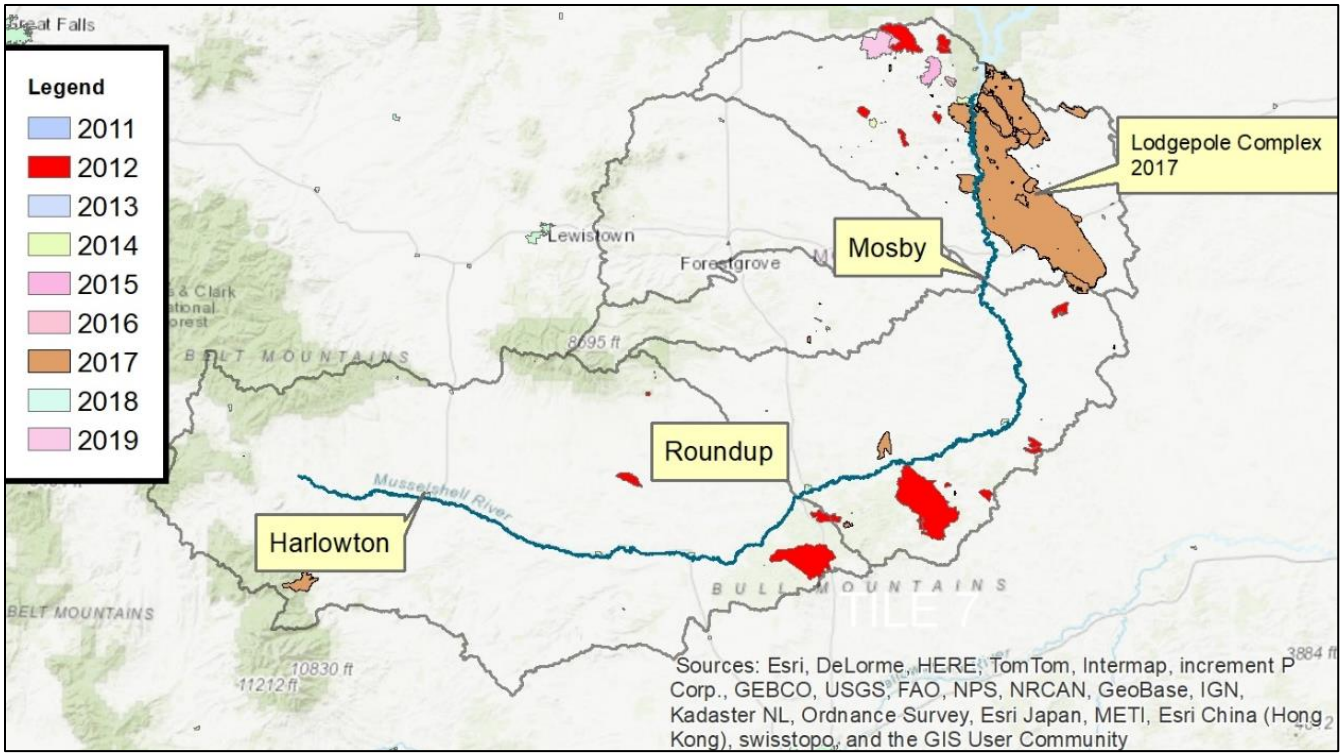


Figure 3. 2011-2019 Fire history map showing fire concentrations near Roundup in 2012 and major fires in lower basin in 2017.

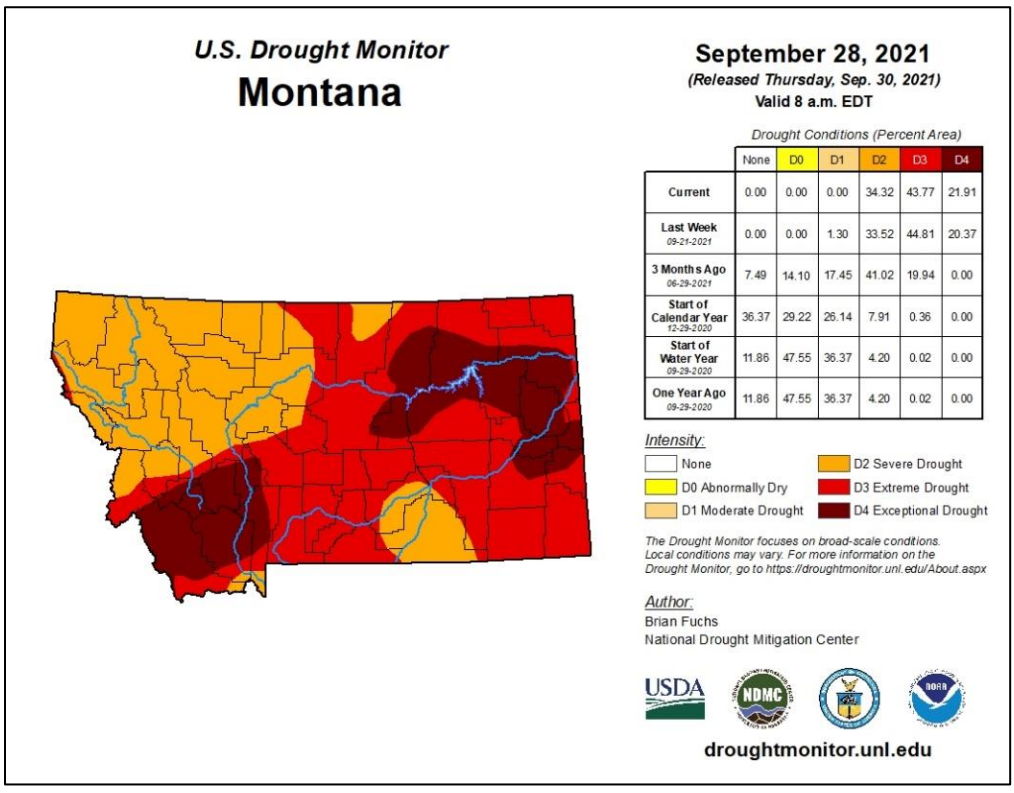


Figure 4. U.S. Drought monitor map from late September 2021 showing full extent of Extreme/Exceptional Drought in Central Montana.

3 Recent and Ongoing Projects

Since the last Watershed Plan was completed in 2015, MWC has worked to complete the projects identified in that planning process. As of November 2019, 25% of the Musselshell Watershed Plan projects had been completed and 50% of the projects were in progress (MWC). The following section describes several projects that have been recently undertaken to both showcase MWC progress and integrate current work into future project planning. The summary is based on available information and may not include all project activity in the basin.

3.1 Irrigation Infrastructure

Each of the water user groups in the project area have been actively pursuing funding for and implementing projects to upgrade their respective systems. This includes both on-the-ground projects as well as high-tech measuring devices to improve management efficiencies.

3.1.1 Deadman's Basin Diversion Dam Rehabilitation and Fish Passage (2015)

The 2011 flood severely damaged the diversion dam and headgates at the Deadman's Basin Diversion Dam which is locate at RM 278.4 between Harlowton and Shawmut. The alternatives considered to repair the dam included restoring the existing structure, replacing the existing structure with the same design, or installing a new grouted riprap Rock Ramp structure. The Rock Ramp was chosen for its long-term stability, elimination of downstream scour problems, and better accommodation of safe operation, fish passage, and river connectivity (Hice, 2016). The design also incorporated the replacement of the diversion headgates which did not fully close, resulting in an infiltration loss of an estimated 3,000 acre-feet of water per year into the 11-mile long canal Figure 5; MTFWP, 2016). The leaky headgates and dam were rehabilitated starting in August 2015. The project includes a gated sluiceway to flush sediment, four new stainless steel gates, and an electric actuator. Additional funding was secured to add a rock ramp to the dam face to provide fish passage over the structure. The passage structure consists of a rock ramp on the downstream face of the dam that has a step-pool morphology to provide areas for resting and jumping (Figure 6). Evidently construction crews saw trout move through the ramp immediately after it was opened to flow (FWP, pers. comm). The final cost of the project was just over $1 million (Hice, 2016).

The DNRC also recently awarded the Montana DNRC $125,000 through the RRGL grant program for the improvement of the canal bottom via widening and grading approximately a mile of the Deadman's Supply Canal (DNRC, 2023).

Figure 5. Reconstructed headgates at Deadman's Basin Diversion Dam (2021).

Figure 6. Rock ramp structure on downstream face of Deadman's Diversion Dam built in 2015.

3.1.2 Delphia-Melstone Telemetry (Current)

The Delphia-Melstone Water Users Association (DMWUA) has proposed an irrigation efficiency upgrade focused on the automation of their existing diversion gates in Musselshell County. The objective is to be able to remotely control and monitor flows in the DMWUA irrigation canals (Figure 7). The project includes the installation of actuators on the existing gates (Delphia, North, and South Canals), delivery of power, installation of control panels, linking the actuators to the existing telemetry system, and providing software to allow remote control and monitoring. DMWUA estimated that the project would save up to 16 acre-feet of water per day during the irrigation season, as well as over 500 man-hours per year in travel and manual control efforts. The project would also delay the release of stored water from Deadman's Basin, resulting in the augmentation of up to 12 cfs of streamflow in the Musselshell River during late August and Early September (DMWUA).

This project has a total estimated cost of $216,000. It was funded by an RRGL grant for $125,000 with the remaining funds secured from other sources. The project is underway.

Figure 7. Manually operated headgate where North Canal (left) splits off from South Canal; this site is slated for automated measuring devices, telemetry, and gate automation.

3.1.3 Horse Creek Coulee Re-regulating Reservoir (Current)

The Horse Creek Coulee Water Storage project consists of a proposed re-regulating reservoir near the town of Melstone (WWC, 2021). The project will store diverted flows within the DMWUA system to improve water management capabilities. The goal is to increase temporary water storage for the DMWUA irrigation network which will reduce losses at the end of the delivery system. The reservoir will

not exceed 50-acre feet in capacity. The reservoir consists of an earthen berm, a principal and emergency spillway, inlet and outlet canals. The bottom of the reservoir which is currently a natural swale will be excavated to create a 12.55 acre pond at maximum capacity (Figure 8).

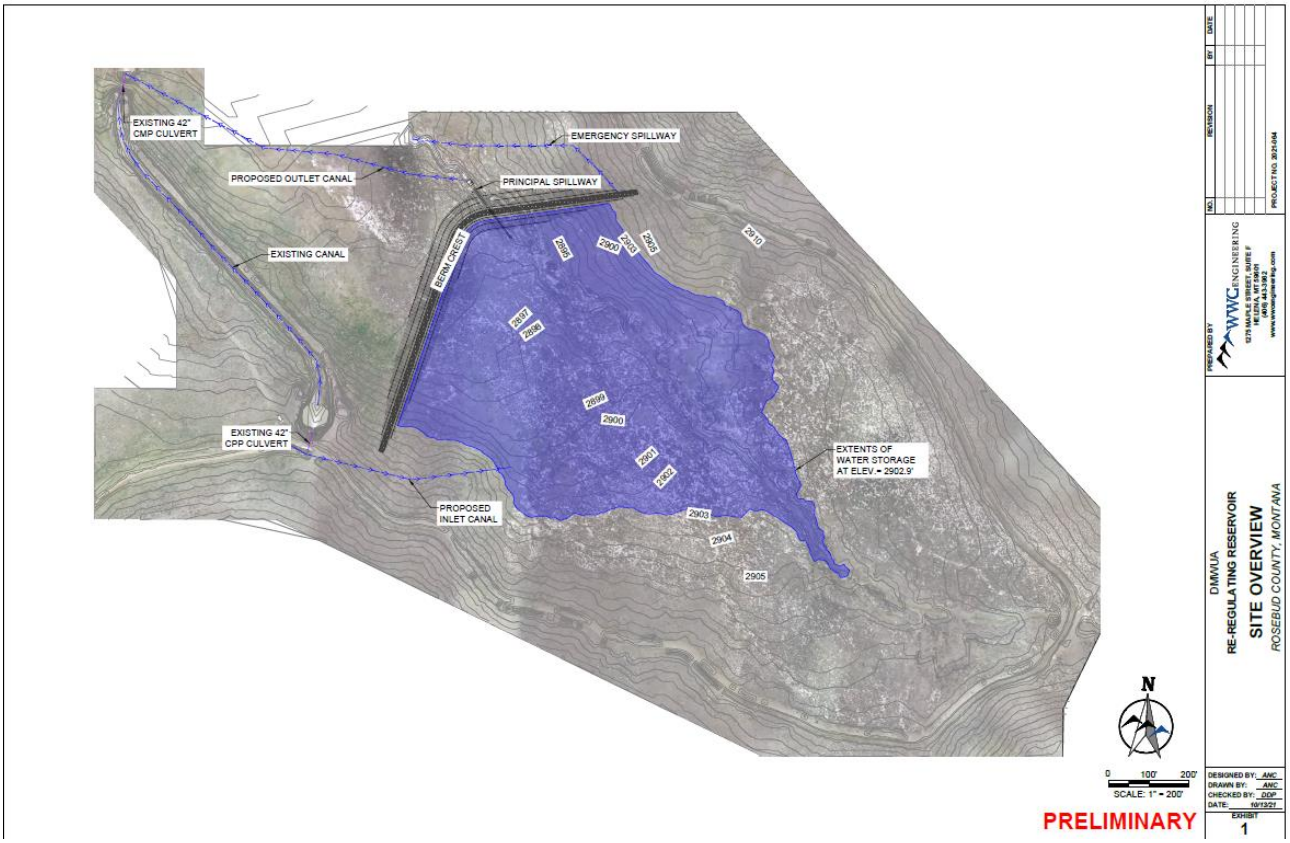


Figure 8. Preliminary Engineering Design site overview map for Horse Creek Coulee Re-Regulating Reservoir; existing South Canal is shown on left side of map (WWC, 2021).

3.2 Fisheries Enhancement Projects

More than two dozen diversion dams have been built on the Musselshell River to divert flows into irrigation channels, blocking migratory warm water fish from their historic habitats. In recent years there has been increased attention paid to restoring aquatic habitat connectivity on the river, to assist two state fish species of concern – sauger and northern red-belly dace, as well as channel catfish, burbot, shorthead redhorse, smallmouth buffalo, and more than a dozen other native nongame fish (MT FWP, 2016).

3.2.1 Egge Dam Removal (2016)

Another fisheries-driven project completed recently on the Musselshell is the removal of Egge Dam, a diversion dam located about 10 miles downstream of Lavina. The concrete sill dam was flanked on its right (south) side during the 2011 flood (Figure 9). Shortly after it was rendered useless, landowners opted to work with Montana Fish Wildlife and Parks to remove the structure rather than replace it, as the restored connectivity would open up miles of channel to upstream fish migration. The project included removing the 120- foot long concrete structure, filling a large scour hole with over 3,000 cy of

local material, reconstructing the bank with a bioengineered bank treatment using a conifer fascine toe overlain by fabric encapsulated soil lifts, and planting over 6,000 locally sourced willow poles (Allied Engineering). The project site has since been visited by professional groups on field trips to showcase fisheries work on the Musselshell River (Figure 10).

Figure 9. View downstream of Egge Dam after being flanked by 2011 flood (Allied Engineering).

Figure 10. Field trip at Egge Dam removal site; original left (north) dam abutment is marked by arrow.

3.3 Bank Stabilization Projects

The impacts of recent flooding on the Musselshell included major channel shortening due to meander cutoffs, which has been followed by accelerated bank erosion as the river has begun to regain that lost length. There has been a strong interest by landowners to stabilize banks as a result, especially where the erosion is against infrastructure or productive agricultural lands. Although the primary approach to armoring banks on the Musselshell has been rock riprap over recent decades, there has been renewed interest in applying new techniques to stabilize banks that incorporate bioengineering construction materials and bank shaping that will support riparian recovery along the bankline. Ideally these projects will serve as demonstration projects as to the feasibility and performance of such projects.

3.3.1 Two Dot Bank Stabilization (2021)

Near the small community of Two Dot in the Upper Musselshell Basin, a bank protection project was undertaken to reduce erosion rates and facilitate riparian recovery. The project used largely native materials harvested locally. Approximately 2,000 willows were placed within two stacked fabric soil lifts to stabilize about 100 feet of bankline (Figure 11). The lifts were built on a conifer fascine toe. The project was a collaborative effort between the Upper Musselshell Conservation District; the Musselshell Watershed Coalition (MWC); Montana Fish, Wildlife, and Parks; Montana Conservation Corps; Big Sky Watershed Corps members; the Lewis and Clark County Conservation District; and the landowners.

Figure 11. Construction of the Two Dot bank stabilization project (MWC).

3.3.2 Kilby Butte Bank Stabilization (2021)

The Kilby Butte bank stabilization project was completed in early 2022 a few miles downstream of Roundup. This project approach was somewhat similar to the Two Dot project described above, however as the site was located immediately upstream of a diversion dam at the toe of a high terrace, some more difficult challenges were in play. First, the ~15 foot tall bank had to be lowered to construct a low platform on which to work. With the high bank and infrastructure protection needs, a non-deformable rock toe was used. This toe was topped with soil lifts and willows (Figure 12).

Figure 12. Kilby Butte bank protection during early (top) and late (bottom) stages of construction.

3.4 Meander Reactivation Projects

One of the most profound impacts of recent floods was the size and frequency of meander cutoffs on the river. These cutoffs are also called avulsions, which refers to the river carving a brand new channel across the core of a meander, thus creating a "shortcut" and steepening the river. The typical response for stream channels following a meander cutoff is to rapidly migrate laterally to regain length and recover an equilibrium slope that is in balance with the system. This has indeed occurred on the Musselshell, such that severe bank erosion has become a predominant and persistent challenge for stakeholders. One recommended practice in these situations is to allow this erosion to occur where

possible to help the system geomorphically recover from the flood. Another is to implement projects to lengthen the river in areas most amenable to doing so. One obvious approach to lengthening is to restore connectivity to the cut off channel segments, many of which are important to water users for pump sites.

The McCleary Meander Reactivation Project is an example of a channel restoration effort that restored channel length and water access on the Musselshell River (Figure 13; Ruggles and Blackburn, 2020). The project is located just above Harvey Road near Melstone, on a ~1.5 mile long meander that cut off during the 2018 flood. The reactivation restored water supply for a pump site and several homes, while generating substantial benefits regarding channel stability, fisheries, and natural water storage.

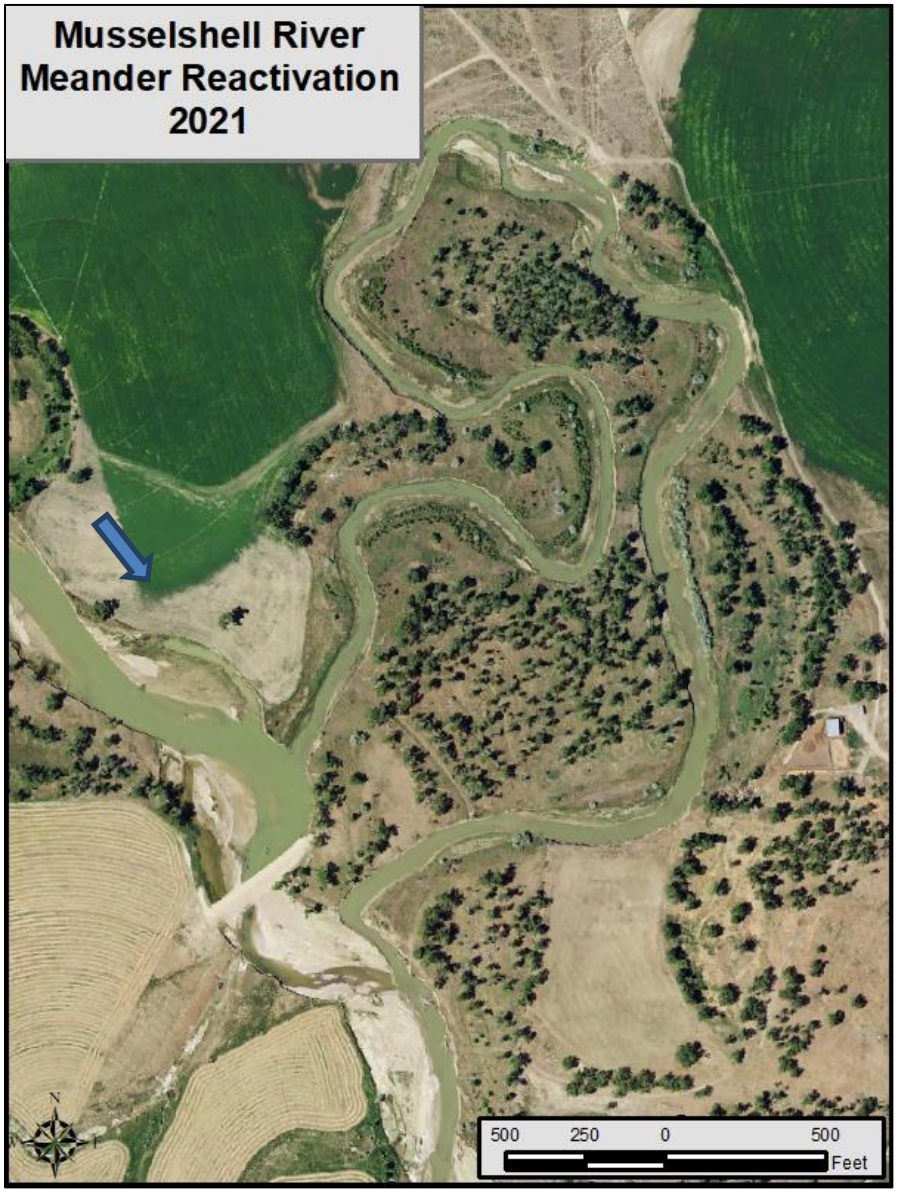
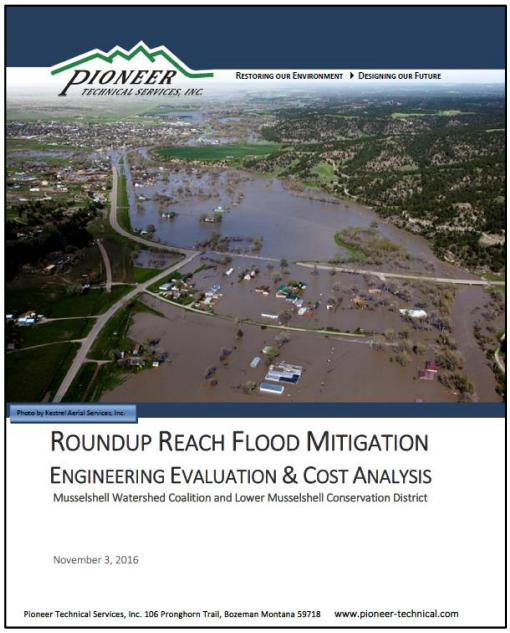


Figure 13. McCleary Meander Reactivation Project showing channel plug crossing river to reactivate meander abandoned in 2018.

3.5 Roundup Reach Flood Mitigation: Engineering Evaluation and Cost Analysis (2016)



One of the outcomes of the 2015 Watershed Plan was a recommendation to bundle several proposed projects in the Roundup area, to assess their value and feasibility more holistically. This report evaluates several different projects to mitigate flooding through the Roundup Reach and includes a full reach hydraulic model, preliminary project engineering plans, and preliminary engineer cost estimates (Pioneer, 2016). The projects included realignment and installation of culverts at the Number 4 Road, improvements to the Fairgrounds Area, Meathouse Road Area improvements, a low water crossing on the 4-H Road, and removal of the Jeffries Tipple embankment below town.

The results showed that the Fairgrounds Area Improvements and Meathouse Road Area Improvements would most strongly reduce flooding in the Roundup Reach. If implemented, the Fairgrounds project would also reduce the potential maintenance costs which reached hundreds of thousands of dollars after the 2011 flood. The Number 4 Road Realignment and Bridge Culverts project improves access and safety and reduces road maintenance. Road maintenance would also be reduced by the 4-H Road Low Water Crossing, and removal of the Tipple Embankment removes a floodplain flow impediment.

Since this report was written, the Tipple Embankment has been partially eroded out, and Meathouse Road Area improvements have been made at the Bair-Collins Mine Reclamation site which is described below.

3.6 Musselshell River Remediation/Restoration Projects

Over the past several years the Montana Department of Equality (MTDEQ) has spearheaded reclamation/restoration projects near Roundup and Harlowton.

3.6.1 Bair-Collins Mine Reclamation, Roundup (2020)

The Bair-Collins Mine Reclamation site is located along the Musselshell River floodplain on the west end of Roundup. It is just across the river from several coal mines that used the relatively flat area to store mined materials and wastes. The mine consisted of an extensive underground network that was established in 1924 and ceased production in the 1960s. The largely-abandoned contaminated site north of the river was left with berms, levees, and an elevated floodplain, all of which restricted floodplain access to about 250 feet whereas just downstream of this constriction the floodplain width is on the order of 1,100 feet (Figure 14; MTDEQ, 2018). After the 2011 flood, the Bair-Collins mine site was considered for remediation to improve floodplain access and reduce adjacent flooding issues.

Figure 14. Bair-Collins Reclamation site during the 2011 flood showing a berm (dashed line) and buildings slated for removal to improve floodplain access in Roundup (MTDEQ, 2018, Kestrel Aerial).

The Bair-Collins Mine Reclamation Project was completed in 2020. Cleanup activities included the removal of waste coal, scoria, structures, and a berm from the abandoned coal mine on Meathouse Road and Musselshell River floodplain expansion (PTI, 2021). Concrete and old vehicles protecting the berms were removed. Almost 50,000 cubic yards of material was hauled off-site, and vegetative backfill was imported as part of the revegetation efforts (Figure 15). The project was predicted to substantially drop flood levels through Roundup.

Figure 15. Bair-Collins Mine site before (left) and after (right) floodplain restoration.

3.6.2 Harlowton Railyard (Current)

The Chicago, Milwaukee, St. Paul and Pacific Railroad (CMStP&P) is often referred to as the "Milwaukee Road", is a railroad company that operated in the western United States from 1847 until 1986 (Rails to Trails Conservancy, 2004). As the company pushed westward, they extended the line from South Dakota through Montana to Seattle/Tacoma from 1906-1909. The Milwaukee Road was ground-breaking in terms of long distance rail electrification, with more than 656 miles of electrified track west of Harlowton; it supported freight and passenger trains, as well as the high-speed intercity trains such as the Hiawatha. As the eastern terminus of the electrified line, Harlowton was where electric locomotives were switched to steam and later diesel-powered engines (WWC, 2021). The system was authorized for abandonment in 1980.

The Milwaukee Road Railyard and Roundhouse at Harlowton (Harlowton Railyard) served the rail line for decades, operating as an engine repair and refueling facility from 1908-1979 (WWC, 2021; Figure 16). The facility had a collection pond that would be ignited after it routinely accumulated as much as 6 inches of diesel fuel. As the railroad owner went bankrupt at the time of abandonment, the City of Harlowton was left with the contaminated area under their ownership. For the past several years, the Montana Department of Environmental Quality Brownfields Program has been assisting the City of Harlowton in cleaning up contaminated materials at the site. Groundwater cleanup started in 2017, and additional cleanup activities includes asbestos removal from the Roundhouse and contaminated soils cleanup within the railyard. The City of Harlowton is planning to redevelop the area and a concept plan for that redevelopment was released in the fall of 2021 (WWC, 2021).

The preferred alternative in the concept plan for the Harlowton Railyard includes trails, roundhouse preservation, re-creation of a historic Japanese camp that was used by laborers, an amphitheater, a fishing access area, and a Restoration Area.

Figure 16. View upstream of Harlowton Railyard at high water; Musselshell River is to left of photo (DEQ).

The general Restoration Area concept was to restore wetlands within the Musselshell River floodplain by excavating fill and tapping the shallow groundwater source. The wetlands are proposed to mimic a natural abandoned segment of the Musselshell River (Figure 17). Ponds are also included adjacent to the constructed oxbow wetland.

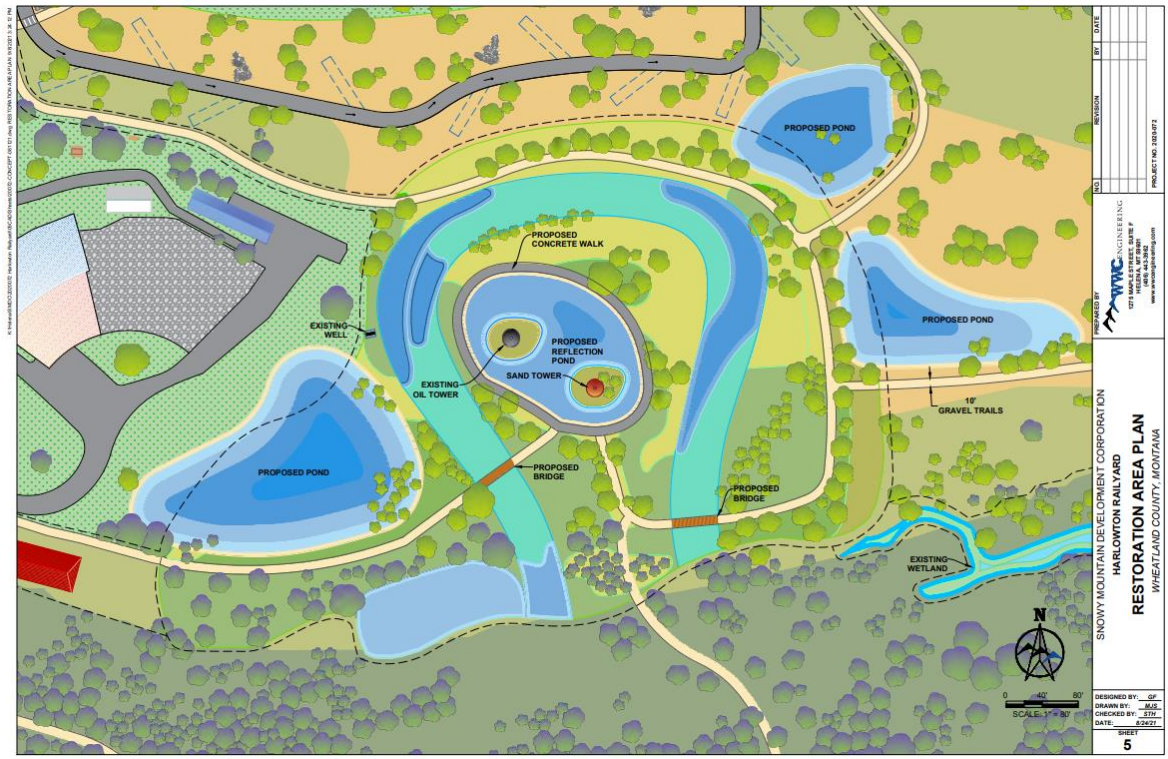


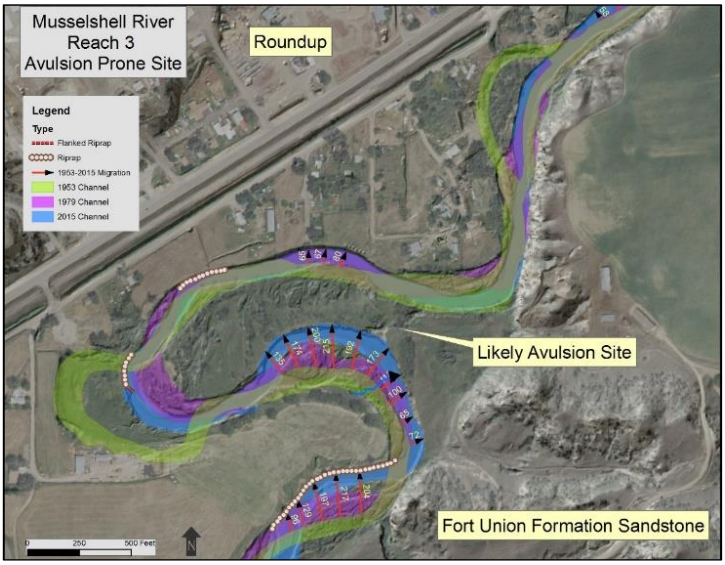
Figure 17. Schematic depiction of Restoration Area from 2021 Concept Plan (WWC, 2021).

3.7 Channel Migration Zone (CMZ) Mapping

To better understand the dynamics of the Musselshell River, there have been recent efforts to map channel changes through time and identify erosion hazards throughout the system.

3.7.1 Channel Migration Zone Mapping Pilot (2017)

In 2017, Applied Geomorphology (AGI) and DTM Consulting (DTM) were contracted by Montana Fish Wildlife and Parks to develop a Channel Migration Zone Map of the Musselshell River from Naderman Diversion Dam downstream to near Kilby Butte, a distance of 34.4 river miles (Boyd and Thatcher, 2017). The Channel Migration Zone (CMZ) includes the mapped 1953-2015 historic river footprint as well as erosion hazard areas that extend beyond that historic channel footprint based on typical migration rates. Avulsion hazard areas are also identified in the mapping. The primary findings of this mapping effort include the following:



- Within the project reach the Musselshell River has been affected by early 20th century straightening with construction of the Milwaukee Road rail line, followed by the construction of cutoff trenches several decades later, and transportation corridor confinement.
- Major floods have driven channel response to these impacts, including rapid bank erosion and channel lengthening.
- Mean migration rates from 1953-2015 range from 2.1 feet per year to 3.7 feet per year on a reach scale.
- 100-year erosion buffer widths that define an Erosion Hazard Area range from 205 feet to 368 feet.
- Avulsions have occurred both due to floods and channel manipulation; 18 avulsions have occurred in the project reach since 1953 and numerous additional sites are currently avulsion prone.
- Reach 2, which is located between Newton-Pedrazzi Dam and Kilby Butte appears the most geomorphically stable and resilient to flooding. It could potentially be used as a reference condition for other less stable channel segments.

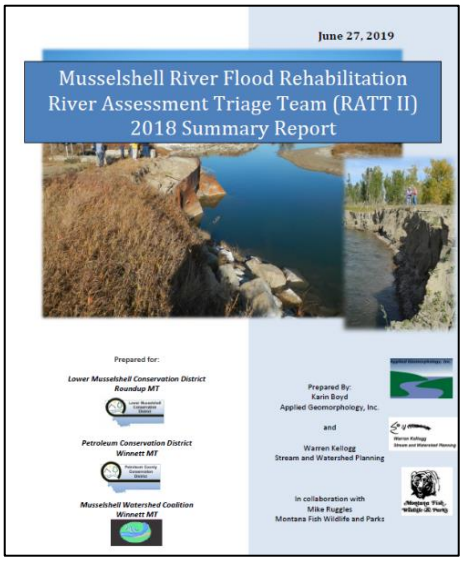
As this mapping was completed prior to the recent floods, future mapping should re-evaluate channel locations and migration rates to update areas of erosion risk.

3.7.2 US Army Corps of Engineers Silver Jackets Channel Migration Zone Mapping (2022)

The US Army Corps of Engineers supports state-lead Silver Jackets Teams through its Flood Risk Management Program. The Silver Jackets teams bring together multiple state, federal, and local agencies to work on flood risk reduction strategies (https://silverjackets.nfrmp.us/). The term "Silver Jackets" is used to underscore the common mission of the diverse agency-based team, in contrast to individual agencies, who wear different colored jackets when responding to emergencies (e.g. FEMA wears blue and USACE personnel wear red).

The Silver Jackets team has recently partnered with MWC to generate CMZ maps for 340 miles of the Musselshell River. These results will be available in 2022.

3.8 River Assessment Triage Team (RATT) Reassessment (2018)



In the fall of 2018, the Musselshell River Assessment Triage Team ("RATT") was reconvened after major flooding the previous spring to visit 29 landowners between Two Dot and Fort Peck Reservoir. This followed the RATT's initial work following the 2011 flood. In each effort, the team visited landowners on their properties to evaluate specific issues and discuss potential options for post-flood rehabilitation measures. Each landowner, all of whom had requested RATT input, was provided a site report that summarized site-specific issues and recommended treatments while providing some context as to broader flood-related processes on the river. About 50 specific issues were addressed.

During the 2018 site visits, a common theme was severe bank erosion that impacted pump sites, road crossings, field acreages, canals etc. This trend of rapid channel movement is a direct response to the 2011 flood, as the river is essentially regaining the length lost during that period of tremendous change. In 2011, 59 avulsions (channel relocations) abandoned 36.9 miles of river, shortening the river by about 10%. These avulsions ranged from 280 feet to 2.6 miles long, and were well-distributed from Harlowton to Fort Peck, with the longest occurring below Mosby. As the river shortened, it became over-steepened, which resulted in extensive bank erosion, downcutting, and re-lengthening in 2018. The sediment added to the river added erosion pressure as point bars grew. In 2018, there were some additional avulsions, so the flood was characterized by both lengthening through bank erosion but also some shortening.

The 2011, 2014, and 2018 floods have collectively exerted the strongest cumulative geomorphic force on the river since recordkeeping began at Mosby in 1929. Historic channel straightening, and riparian clearing compounded the rivers' response to these floods. As a result, this river has experienced a shift in overall morphology, and is currently in a period of continued change and long-term recovery. The RATT team provided recommendations for promoting and accommodating system recovery, focusing on reducing overall stream power and improving resiliency of the river corridor to better absorb that heightened stream power.

3.9 Planning Projects, Initiatives and Studies

The following initiatives/studies are all contributing to long-term resource management in the Musselshell River Watershed.

3.9.1 Gaging Station Funding Initiative (Current)

The Musselshell Watershed Coalition views the continued operation of gaging stations to be vital to the Musselshell River Basin. The primary objective of the MWC gaging station funding effort is to create a sustainable model for future funding and maintenance of the stream gages on the Musselshell River, as these measuring devices have proven to be essential for both human safety and effective water management. During recent floods, the stations were heavily relied upon by managers who issued warnings to residents. The data is also regularly accessed by water commissioners during the irrigation season to set and meet water right priority dates in the six river zones within the Musselshell River Distribution Project.

Since 2018, the MWC has participated in a state-wide group dedicated to securing consistent funding for gaging stations. This effort resulted in the Governor's Drought and Advisory Committee creating a subcommittee to study gaging stations. This study includes: station purpose and uses, the users of the stations, the costs of the stations, and where secure funding could come from to keep stations operating.

In January of 2022, MWC sent a letter to 18 local gaging station funding partners with a request to continue contributing to the Musselshell Gaging Station System. The resources provided by the 18 partners along the river collectively pay for about 2% of the total cost of gage station operations and maintenance, with additional support by the USGS (63%), DNRC (19%), and Bureau of Reclamation (16%). The partnership itself kept the gages operational in the face of being cut from DNRC funding during the special legislative session of fall 2017 (MWC).

3.9.2 MesoNet Station Implementation (Current)

The Montana Climate Office (MCO) is currently leading the development of a statewide soil moisture monitoring and meteorological information system (Figure 18). This system will work with existing cooperating networks and establish a minimum of 100 new remote data collection sites to develop the first state-wide soil climate network (MCO). The MesoNet stations run on solar power and users can view real-time data using cellular communications.

The data collected at 30 minute intervals at each station include the following:

ATMOSPHERE: Rainfall, Solar Intensity, Wind, Temperature, Relative Humidity, Barometric Pressure, Lightning Strikes

SOIL: (at 2", 8", 20", and 36" depths): Water Content, Temperature, Electrical Conductivity

VEGETATION: NDVI: Relative Greenness

As of March 2022, 16 new station sites have been approved for funding in the Musselshell Watershed. Thus far 14 sites have been established out of the 16 approved for funding. Further steps to establishing the sites will include a cultural survey of each; these should be completed in late spring of 2022. Barring unforeseen difficulties, the stations are slated for 2023 installation.

Figure 18. Recently installed MesoNet Station near Miles City (Montana Climate Office).

3.9.1 Aquatic Invasive Species (Current)

The Musselshell Watershed Coalition has led an effort to develop a plan to address the rising threat of quagga and zebra mussels in Central and Eastern Montana. These are two of the most devastating aquatic species to invade the fresh waters of North America. Their presence threatens water delivery systems, hydroelectric facilities, agriculture, and recreational boating and fishing. Aquatic biodiversity can be a severe ramification of an invasion due to a disruption of the food chain and out-competition with native species. As there is no way to get rid of an invasive mussel infestation, the current long-range plan (Musselshell Watershed Long Range Invasive Mussel Prevention Plan) focuses on prevention through educational campaigns and stringent regulatory roles, followed by early detection through monitoring, and rapid response.

3.9.2 Montana Drought Resiliency Planning (Current)

The Montana DNRC has recently updated its Drought Management Planning Effort, which is a "multi-agency, stakeholder-driven effort to make Montana more drought resilient" (DNRC). The project is overseen by State Agency Representatives on the Drought Task Force (Figure 19). The vision is to build statewide drought resilience with the following aims:

- Include state-wide stakeholder involvement (to assist in vulnerability assessment and adaptation strategy development)
- Develop a modern progressive plan that is accessible, engaging, and actionable
- Develop recommendations for programs, policies, and actions to lessen future impacts.

The stakeholder interaction is derived largely by regional meetings held around the state. The Musselshell is located in Region 4 (Central), and several residents of the Central Region have agreed to be involved in the stakeholder outreach, including Laura Nowlin of MWC.

The target completion date for the plan is 2023.

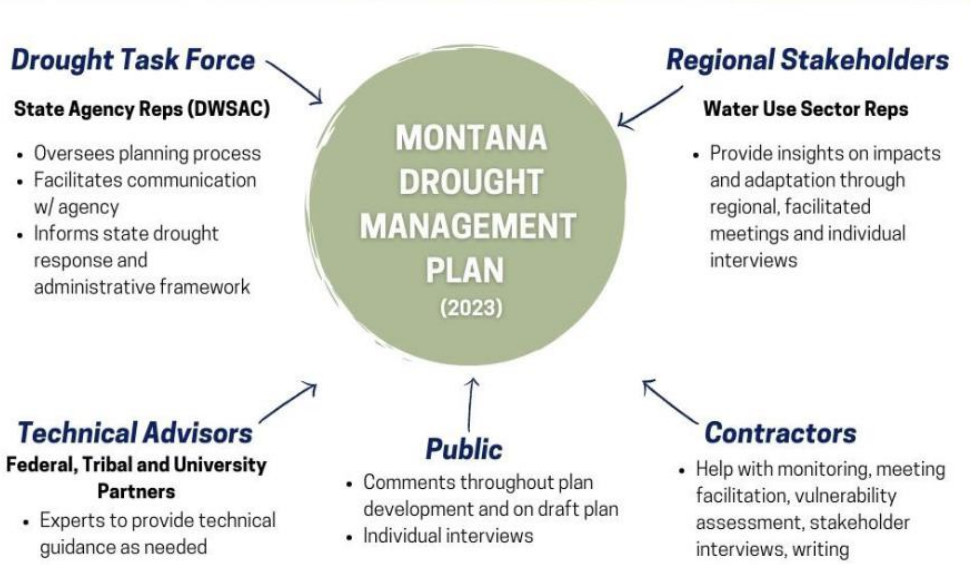


Figure 19. Montana Drought Management Plan development structure.

3.9.3 DNRC Floodplain Mapping (Current)

The Musselshell River Flood Maps Project has included mapping in Golden Valley, Wheatland County, portions of Petroleum County, Rosebud County, and Musselshell County. The maps for Musselshell, Rosebud, and Petroleum Counties became effective in November of 2019, and the Golden Valley maps went into effect in November of 2021. The Wheatland County maps, include the City of Harlowton and Antelope Creek that flows into Harlowton from the north (Figure 20)are continuing to go through public review. These maps can be viewed on the DNRC website through an interactive map viewer at this link:

https://mtdnrc.maps.arcgis.com/apps/MapSeries/index.html?appid=bdc3caae15f545b68625d2ac60ac1d7e

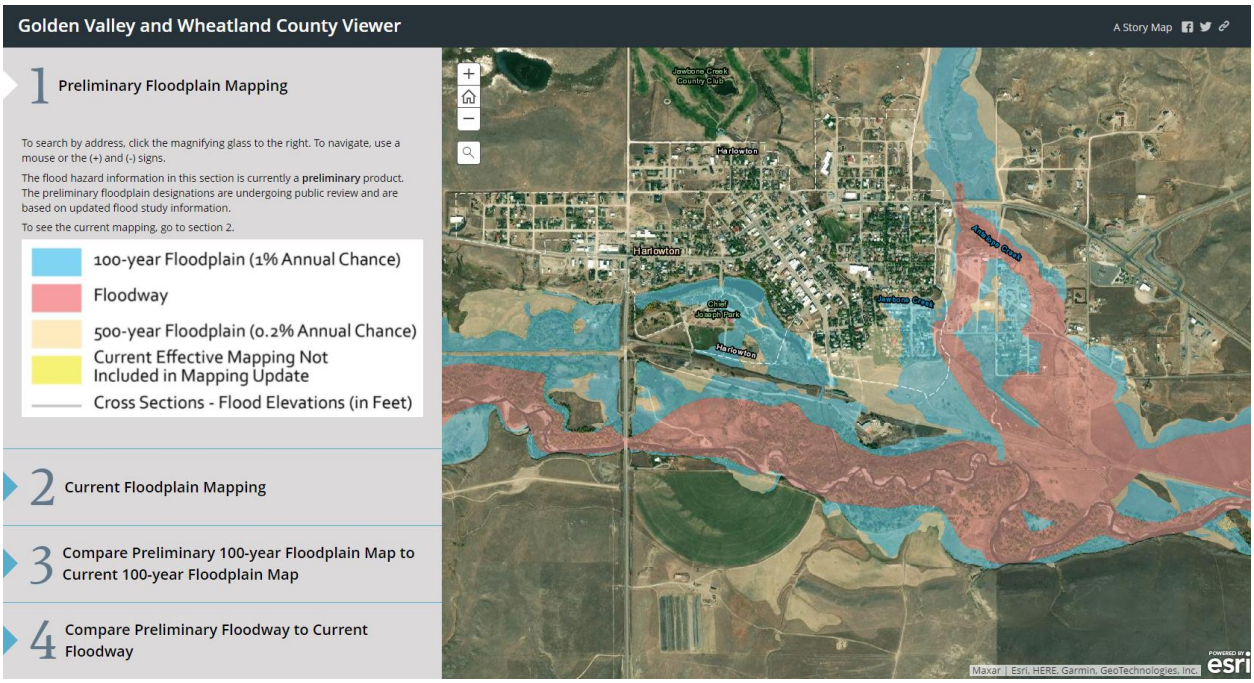


Figure 20. DNRC online map viewer showing preliminary floodplain mapping for the City of Harlowton (Antelope Creek is shown flowing north to south).

3.9.4 Soil Health Workshops (2021)

> Interested in cover crops and soil health practices but unsure of their impact? Join us at this field day to observe a cover crop and learn how it benefits your soil and farm/ranching system.

Soil health has remained an educational priority of the Musselshell Watershed Coalition in the context of both drought and floods. In 2021, Garfield and Petroleum Conservation districts were part of a partnership that hosted a North-Central Montana Soil Health Tour, which featured the internationally recognized agroecologist Nicole Masters facilitating in-person workshops across north-central Montana. Carie Hess of the Petroleum CD described the workshop goal as "having more tools in the toolbox when it comes to knowing how we can help our soil hold more moisture, how we can add diversity to our soil, and how these skills will help us be more productive and profitable in the long term" (ranchstewards.org).

3.9.5 Integrated Weed Management Plan (2019)

The MWC has recently completed a "Strategic Integrated Weed Management Plan" for the Musselshell River Cooperative Weed Management Area (MWC, 2019). The effort has four central goals:

1. Prevent the introduction, reproduction, and spread of designated noxious weeds and invasive exotic plants into and within the MRCWMA.
2. Reduce the extent and density of established noxious weeks to a point that natural resource damage is within acceptable limits.
3. Put into action the most economical and effective control methods for the target weeds.

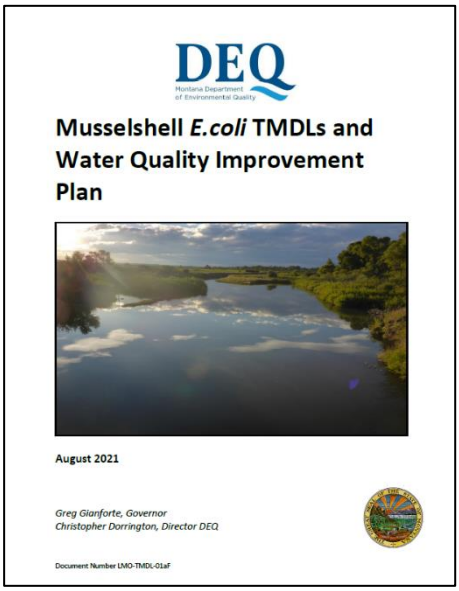
Musselshell River Cooperative Weed Management Area

4. Implement an integrated management system using all appropriate available methods or a combination of methods. The integrated management system includes the following strategies:
    a. Education/Awareness
    b. Prevention/Early Detection
    c. Inventory
    d. Treatment Methods
        i. Physical/Mechanical
        ii. Biological
        iii. Chemical
        iv. Cultural/Land Use
    e. Monitoring

Priority species identified in the plan include (listed by highest to lowest prevalence): knapweed, salt cedar, leafy spurge, Canadian thistle, Russian olive, toadflax, houndstongue, and common tansy.

3.9.6 TMDL Development for *E. Coli* (2021)

The Montana Department of Environmental Quality (DEQ) continues to work on water quality planning in the Musselshell River Watershed. In 2021 DEQ released a Water Quality Improvement Plan for *E. Coli* Total Maximum Daily Loads (TMDLs) in the basin (MTDEQ, 2021). In developing the TMDL, the state determined that eight tributaries of the Musselshell River as well as three segments of the mainstem do not meet applicable water quality standards for *E. Coli* (Table 1 and Figure 21). This pollutant is the only one evaluated thus far; DEQ also recognizes that there are other pollutant listings in the basin.



The TMDL document includes a source assessment for *E. Coli* in the basin. These sources include:

- Natural:
    - primarily wildlife excrement from species that utilize stream corridors
- Non-Point Source (Diffuse Sources):
    - Agriculture (grazing of riparian areas, field application of manure)
    - Failing or malfunctioning septic systems
    - Domestic pets and recreational use
    - Broken sewer or domestic service lines
- Point Sources (Permitted Dischargers):
    - Municipal wastewater treatment systems
    - Concentrated Animal Feeding Operations

The impaired beneficial use for each listing is Primary Contact Recreation due to the human heal hazards posed by *E. Coli*. Water quality targets were presented in the plan for Summer and Winter seasons.

Recommended strategies to reduce *E. Coli* concentrations to meet TMDL targets include (MTDEQ, 2021):

- Agricultural BMPs: riparian buffers, wetland restoration, and vegetated filter strips
- Riparian grazing management
- Restoration of riparian areas and wetlands
- Monitoring and maintenance of septic systems

Table 1. E. coli impaired waterbodies in the Musselshell TMDL project area (MTDEQ, 2021).

Waterbody (Assessment Unit)	Waterbody ID (Assessment Unit ID)	TMDL Prepared	TMDL Pollutant Category	Impaired Use(s)*
American Fork, Confluence of Middle and North Forks American Fork to mouth (Musselshell River)	MT40A002_120	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation
Big Coulee Creek, Confluence of North and South Forks Big Coulee Creek to mouth (Musselshell River)	MT40A002_130	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation
Fish Creek, Headwaters to mouth (Musselshell River)	MT40A002_070	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation
Fords Creek, East Fork Fords Creek to mouth (Box Elder Creek)	MT40B002_021	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation
Half Breed Creek, Headwaters to mouth (Musselshell River)	MT40A002_090	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation
McDonald Creek, North and South Forks to mouth (Box Elder Creek)	MT40B002_010	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation
Musselshell River, North & South Fork confluence to Deadmans Basin Diversion Canal	MT40A001_010	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation
Musselshell River, Deadmans Basin Supply Canal to HUC boundary near Roundup	MT40A001_020	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation
Musselshell River, Flatwillow Creek to Fort Peck Reservoir	MT40C003_010	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation
North Fork Musselshell River, Bair Reservoir to confluence with South Fork Musselshell River	MT40A002_012	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation
South Fork McDonald Creek, Headwaters to confluence with North Fork McDonald Creek	MT40B002_070	Escherichia coli (*E. Coli*)	Pathogens	Primary Contact Recreation

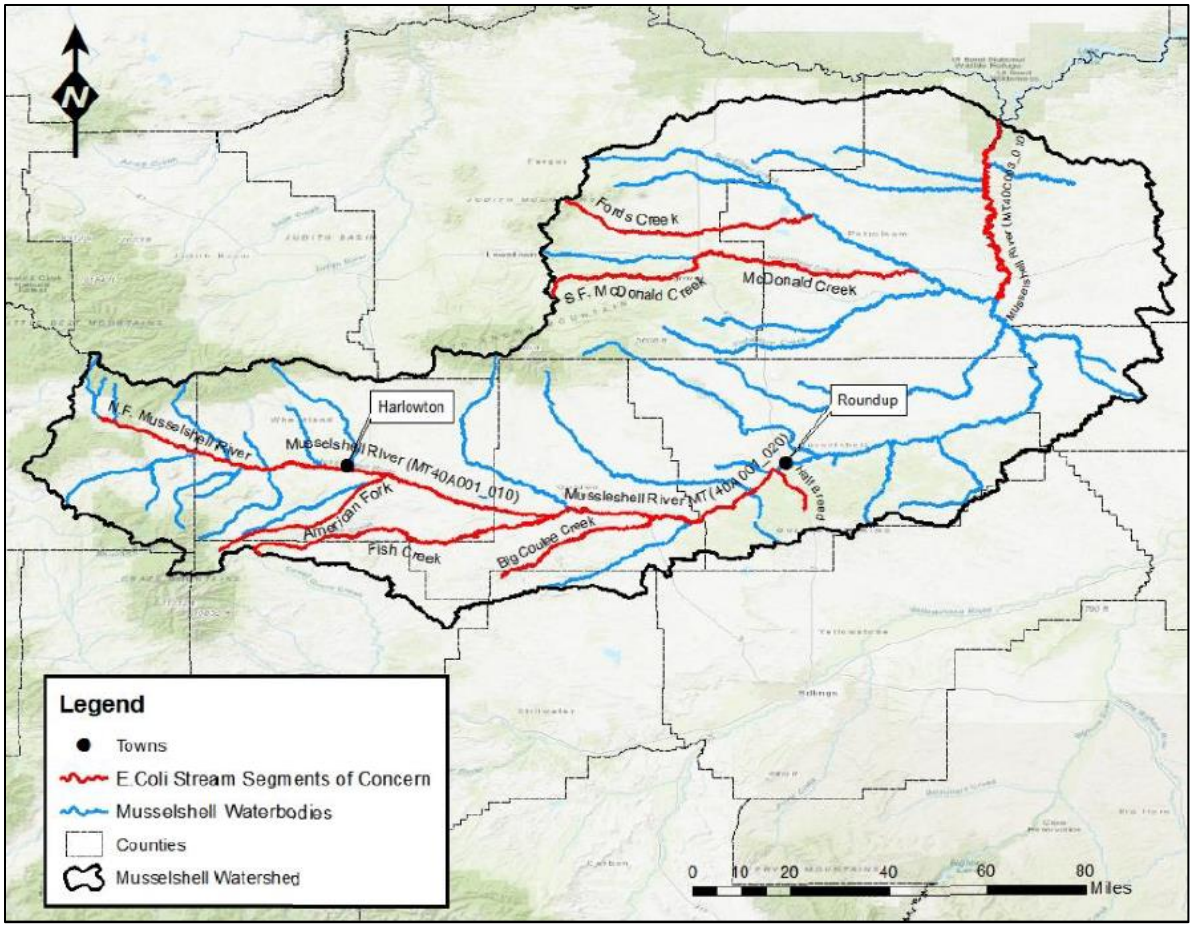


Figure 21. The Musselshell TMDL project area and *E. coli* impaired waters (MTDEQ, 2021)

3.9.1 MBMG Salinity Study - Point Sources and Agricultural Practices (2021)

At the end of 2021, The Montana Bureau of Mines and Geology (MBMG) completed a project defining sources of salinity in the lower Musselshell River from Delphia to Melstone. This reach of river represents the two major geologic formations along the lower Musselshell River (Fort Union and Bearpaw) and both flood and pivot irrigation systems. Using chemistry and elevations of groundwater and the river, the MBMG identified both natural mobilization of salt from the geology and additional salt mobilized from agricultural application of water (canal leakage and applied irrigation water). The highest river salinities occur in the spring and are caused by the natural groundwater level rise. Irrigation mobilization of salts to the river occurs during the summer and early fall months, but this is during a time when the river salinity is lowest. The report on findings is currently under review and will be available on the MBMG publications website: MBMG.mtech.edu (L. Meredith, pers. comm.).

3.9.2 Evaluation of Water Quality in Relation to Stockwater ponds/reservoirs (2020)

In 2020, Big Sky Watershed Corps member Brian Hauschild summarized issues related to high salinity in livestock ponds in Petroleum County (Hauschild, 2020). He reported that the 2011 floods flushed salts out of groundwater and into surface water in the lower Musselshell where saline conditions are naturally boosted by underlying salt-laden Cretaceous marine shales. Certain cropping systems (mainly crop-fallow) can make this problem worse by creating a local perched water table that leaves salt to concentrate on the soil surface, creating saline seeps. Compiled water quality data showed an increase in extremely high salinity readings (>8,000 µS/cm) readings after the 2011 flood, which Hauschild described as "consistent with the notion that salts in the groundwater are flushed out to the surface when the water table rises". More recent data from 2020 showed 15 of 62 samples exceeding 10,000 µS/cm which is not acceptable for livestock (Figure 22).

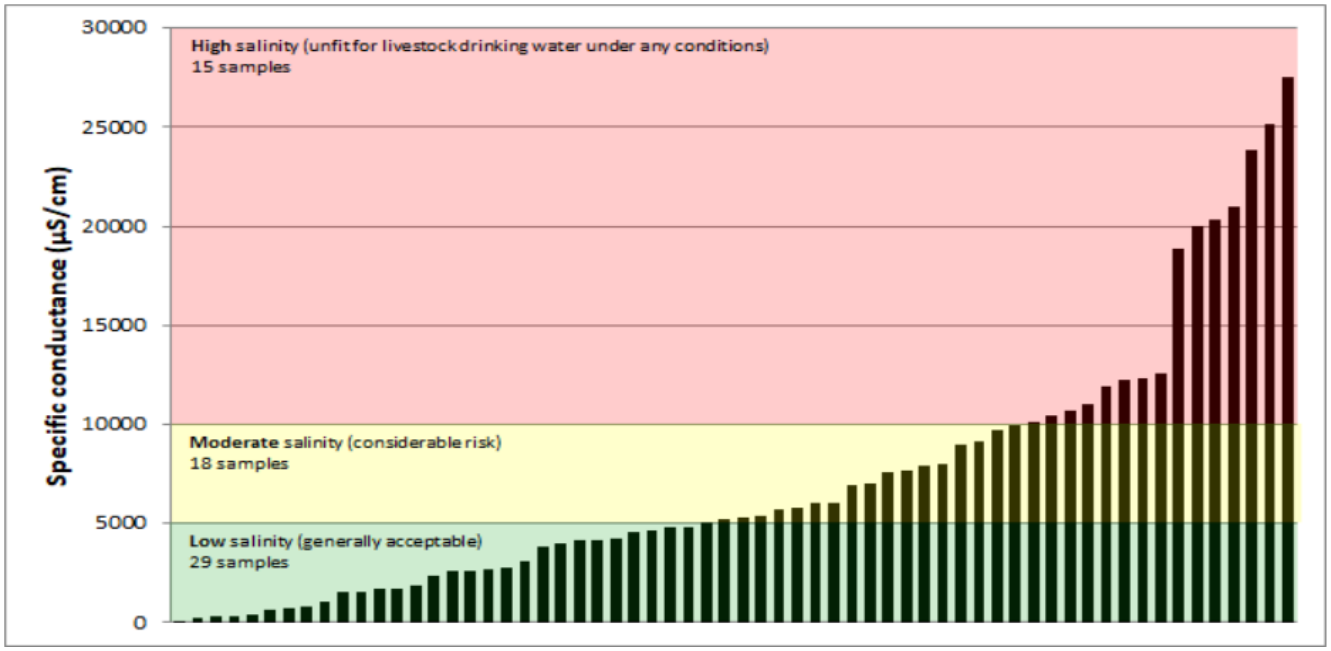


Figure 22. Petroleum County livestock pond 2020 sampling results showing number of samples falling in ranges of low (green), moderate (yellow) and high (pink) salinity (Hauschild, 2020).

3.9.1 MBMG Salinity Study - Historic Oil Wells as Saline Seep Sources (Current)

The Montana Bureau of Mines and Geology (MBMG) is currently conducting a small study looking at Musselshell River tributaries that drain old oil fields (such as North Willow Creek) to detect the presence of oil field brine signatures in the groundwater and surface water. The goal is to look for salinity point sources (old oil wells) as well as non-point sources (buried drill tailings pits), as these can serve as a diffuse source of salts.

3.9.2 Saline Seep Mitigation (2021)

Collaborating agencies such as the NRCS and Montana Salinity Control Association (MSCA) have effectively mitigated saline seeps in the Winnett area by restoring previously crop-fallowed fields into

perennial vegetation, and ongoing mitigation efforts across the state provide exemplary success stories (Figure 23). The NRCS launched the FY2021 Equip Saline Seep Reclamation RCCP for producers in designated areas that include all counties within the Musselshell River corridor.

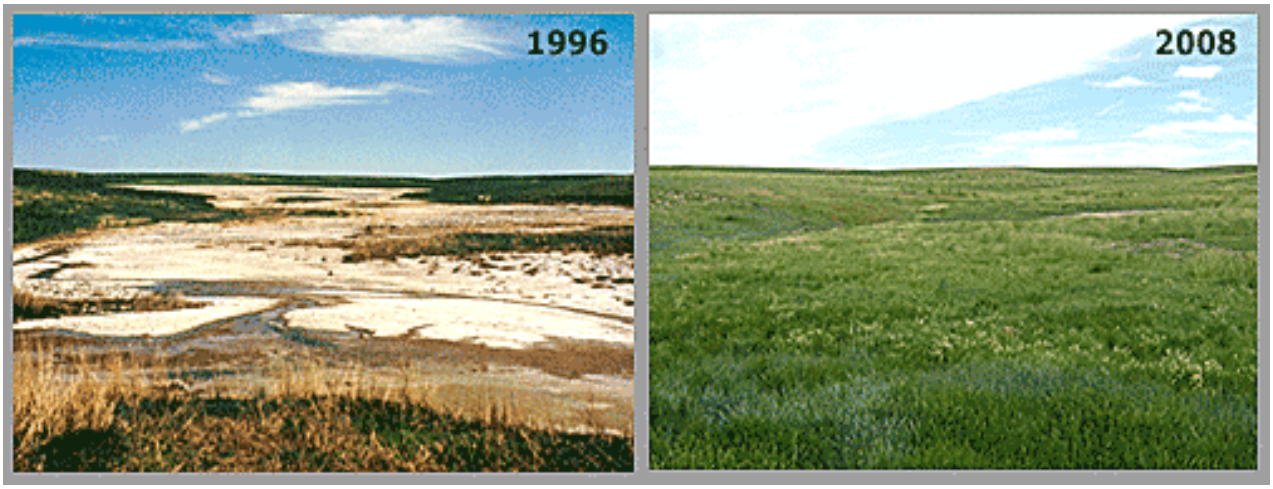


Figure 23. Saline seep mitigation project example from Pondera County where a crop-fallow system was rotated to perennial forage (grass and alfalfa) www.montanasalinity.com.

3.9.3 Fuels Reduction Cost Share Program (Current)

In response to recent wildfires, the Lower Musselshell Conservation District launched a fuels reduction cost-share program in 2019. The recently-developed Western Bull Mountains Catastrophic Wildfire Fuels Reduction Targeted Implementation Plan (TIP) is located immediately south of the Musselshell River in Golden Valley and Musselshell Counties (NRCS,2021). This builds on the earlier Central Bull Mountains Catastrophic Wildfire Fuels Reduction TIP that had multiple producers sign up, creating interest from landowners beyond the TIP boundary. The objectives for the Western Bull Mountains project include completing 5,330 acres of forest management practices over an estimated period of 5 years, in addition to improving forest health, insect and disease resilience, and productivity. Increasing wildfire preparedness through outreach and education is also highlighted (NRCS, 2021).

3.9.4 Musselshell Irrigation Efficiency Targeted Implementation Plan (TIP)

In 2021, the Musselshell Irrigation Efficiency Targeted Implementation Plan was developed by the NRCS to improve irrigation efficiencies on the Musselshell River. This primarily consisted of a conversion of acreage from flood to pivot irrigation, increasing water efficiencies on those acres by 35 to 40%.

3.9.5 Sage Grouse Initiative (Ongoing)

The NRCS Sage Grouse Initiative was first implemented in 2010. Since then, landowners in the Musselshell Watershed have seen broad success in its implementation, especially as it has been coupled with fuels mitigation. The NRCS field office in Roundup reported that it has seen an increase in producers working to thin ponderosa pine and Rocky Mountain juniper into lands that historically supported grass and sage brush. The goal of the work is to slow conifer encroachment while increasing grass production and sagebrush habitat near Roundup (Roundup NRCS field office). This work is concentrated in upland areas.

4 Data Compilation and Project Database Development

The development of this Musselshell Watershed Restoration Plan Update relied heavily on work performed for the 2015 Watershed Plan and input from stakeholders. As with the 2015 plan, some pre-meeting work was required to optimize the process of collecting and compiling that stakeholder information, though this was largely streamlined by the GIS and data compilation efforts performed earlier. This current effort focused primarily on updating the existing and proposed project sites in the GIS and revising the watershed maps with the current information.

A series of seven map tiles covering the mainstem of the Musselshell River from Martinsdale to Fort Peck Reservoir were updated for the stakeholder meetings, as well as to serve as a longer-term map resource for MWC and its partners (Figure 24). Additionally, maps were generated for each individual project site to help identify the project location.

Figure 24. Identifying project locations at a stakeholder meeting.

4.1 Fall 2021 Stakeholder Input

Stakeholder input was gathered through a mixture of on-line, phone, and in-person methods. Due to Covid-19 restrictions for in-person meetings during the early stages of the project, the initial project identification process was made virtual through an ArcGIS OnLine web-mapping interface (Figure 25). Stakeholders could enter in project details and place the location on a web map. The project team would then follow up with the stakeholder if additional information was needed. A total of 22 projects were identified via the web mapping application, including 11 completed or ongoing projects by the

Montana Department of Transportation, five projects by Montana Fish Wildlife and Parks, and six by various stakeholders.

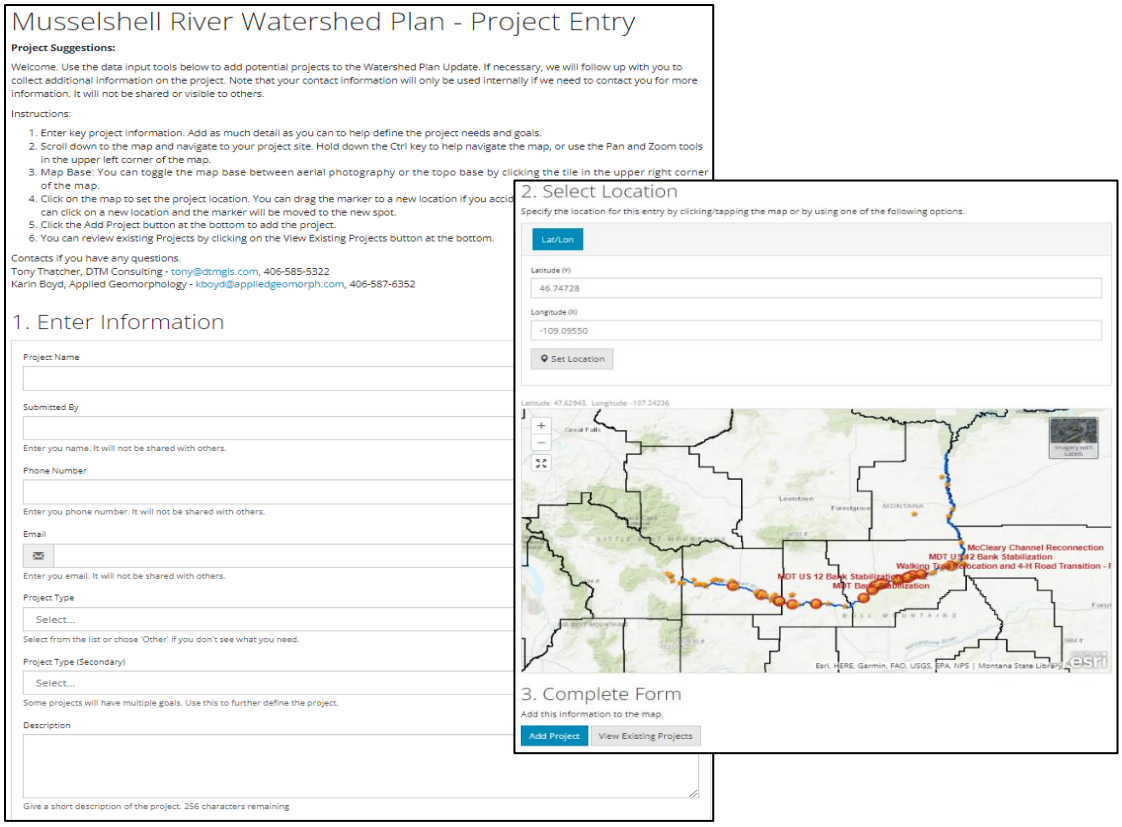


Figure 25. ArcGIS Online project entry application.

During the summer of 2021, several in-person meetings were held to gather additional stakeholder input:

June 1, 2021 – MWC, Montana Fish Wildlife and Parks, and the Montana Department of Transportation met with the Golden Valley Commissioners to discuss local issues and project concepts.

June 8, 2021 – The project team visited several project sites including Bair-Collins, Meathouse Road, Jeffries Tipple, and Kilby Butte.

June 9, 2021 – The project team met with the Wheatland County Commissioners in Harlowton to collect their input on project priorities. Our discussions focused primarily on the results of new floodplain mapping in Harlowton as well as ongoing remediation efforts at the Harlowton Railyard. Several project sites were visited including multiple MDT sites, Buffalo Trail Bridge, and Cushman Bridge.

August 9, 2021 – The project team met with three Musselshell County Commissioners in Roundup. Discussions focused mainly on needs and opportunities in and around Roundup.

August 9 and 10, 2021 - Various sites along the river between Roundup and Mosby were visited to gain understanding of issues at ongoing and proposed project sites.

August 9, 2021 – A stakeholder meeting was held in Mosby with approximately one dozen attendees. Discussions focused largely on the water quality issues for stock and irrigation water.

August 10-2021 – The project team attended the regular MWC meeting in Roundup where a broad group of stakeholders provided input on a range of projects (Figure 26).

November 1, 2021 – The Musselshell Watershed Coalition (MWC) in partnership with the NRCS conducted a watershed tour focused on irrigation infrastructure (Figure 27). Attendees included representatives from each of the Water User Associations, agency staff, and MWC members. The tour started at Martinsdale Reservoir and proceed downstream, ending with a potluck dinner in Mosby.

Figure 26. Musselshell Watershed Coalition meeting in Roundup, August 10, 2021.

Figure 27. November 1, 2021, Musselshell watershed tour, Kilby Butte.

The project list was then expanded to include sites described in the 2018 RATT review that had continued landowner interest. Following the initial project list compilation, several key stakeholders were contacted directly to gather project specific information or add additional projects.

5 Results

In total, 122 potential projects were identified through the initial project compilation. As with the 2015 Watershed Plan, they include on-the-ground projects as well as studies, data collection efforts, and programmatic concepts regarding MWC operations and outreach. These initial projects were consolidated with the help of MWC and divided into implementable ground projects versus study/planning efforts. Some projects that were considered inappropriate for the Watershed Plan (e.g. construction of private infrastructure such as bridges), projects that have been completed, and projects that are no longer active were removed from the list. This process resulted in 86 projects presented for ranking. The number of projects for each project type is shown in Table 2.

Table 2. Types and number of projects originally proposed through stakeholder outreach.

Project Type	Number of Projects Submitted
Bank Stabilization	17
Bridge	1
Channel Remediation	1
Dam Removal	1
Data	1
Fish Passage	2
Fisheries	1
Flood Control	1
Floodplain Reconnection	1
Irrigation Infrastructure	35
Legislation	1
Meander Reactivation	4
Recreation	1
Remediation	2
Study	15
Tributary	1
Water Quality	1
Grand Total	**86**

5.1 Project Consolidation and Ranking

In January 2021, MWC assembled a Ranking Team to refine and rank proposed projects. The team represents local water managers, Conservation District administrators and supervisors, partners from Federal and State Agencies, and local landowners. A total of 17 attendees participated in the ranking effort (**Table 3).**

Table 3. Ranking Team members and affiliations.

Representation	Members
Water Managers	• Greg Seder: Deadman's Basin Water Users Association Board President • Leon Hammond: Deadman's Basin Water Users Association Manger • Lynn Rettig: Delphia-Melstone Canal Users Association Manager
Conservation District Administrators or Board Members	• Shirley Parrott: Lower Musselshell Conservation District
Federal Agency Partners	• Nikki Rife (NRCS District Conservationist, Roundup-Harlowton) • Mike Lucas (NRCS District Conservationist, Winnett)
State Agency Partners	• Michael Downey: Montana DNRC Water Planning Section Supervisor • Tiffany Lyden: Montana DNRC Floodplain Management Outreach Specialist • Jennifer Davis: Montana Department of Transportation Hydraulic Engineer, Billings District • Scott Graham: Montana Department of Environmental Quality Abandoned Mine Lands Program Project Officer • John Connors: Montana Department of Natural Resources and Conservation Civil Engineering Specialist • Clint Smith: Montana Fish Wildlife and Parks Fisheries Biologist, Lewistown
Local Landowners/Representative	• Shane Moe: Upper Musselshell River Reach Landowner Representative • Bill Bergin: Middle Musselshell River Reach Landowner Representative
Musselshell Watershed Coalition	• Bill Milton: MWC Facilitator and Local Rancher • Laura Nowlin: MWC Coordinator and Local Rancher
Project Team	• Karin Boyd: Geomorphologist, Applied Geomorphology • Tony Thatcher: GIS Specialist, DTM Consulting

The Ranking Team met for a day-long meeting in Roundup on January 26, 2022, with participants attending both in-person and remotely. To assist with the ranking process, projects were grouped by the following themes:

- Irrigation Infrastructure Associated with Water User Associations (Upper Musselshell, Deadman's Basin, and Delphia-Melstone)
- Bank Stabilization
- Fisheries Health and Public Opportunities
- Floodplain Restoration
- Infrastructure Protection – Bridges
- Initiatives and Studies Supported by MWC – River Corridor Focus
- Initiative and Studies Supported by MWC – Upland/Range Focus

The group discussed and evaluated each project with respect to its potential benefits, including:

- Aquatic Habitat Benefit
- Water Quality
- Riparian Benefit
- Water Use/Delivery Efficiency
- Community Benefit
- Short-Term Economic Risk

- Long-Term Economic Benefit
- Scale of Benefit
- Level of Support

After projects were consolidated and studies/initiatives that are already underway were removed from the list, a total of 40 projects were ranked (Table 4). Over half of the projects relate to irrigation infrastructure, with bank stabilization clearly an important need as well. The ongoing studies/initiatives that had been noted in the project development phase were not ranked but are described in Chapter 3 of this report.

Table 4. Types and number of projects ranked by ranking team.

Project Type	Number of Projects Ranked
Irrigation Infrastructure	21
Bank Stabilization	6
Fish Passage	2
Floodplain Remediation	2
Bank Stabilization at Bridge	2
Floodplain Reconnection	1
Recreation	1
Data Collection	1
Fisheries Management	1
Bridge Replacement	1
Flanked Dam Removal	1
Bridge Removal	1
Grand Total	**40**

Table 5 lists the scoring criteria used to evaluate each potential project benefit. To ensure ranking consistency between similar project types, several general project concepts were provided a baseline ranking in certain categories; these project types are also listed in Table 5. Initiatives and Studies were identified as efforts supported by MWC but generally not ranked. The only exception to this was the MWC-led initiative to sustain stream gaging station funding. The project team also pre-scored all projects in several categories as an additional baseline.

At the scoring meeting, each project was qualitatively discussed in terms of its likelihood to provide high, medium, low, or no benefits for each criterion. Pre-scored items were open for adjustment by the Ranking Team. In the process of describing and evaluating each project, the original list of 89 projects was consolidated and trimmed to a final list of 62 projects, including 54 engineering projects and 8 studies. The reduction in the number of projects reflects the following changes:

- Projects that did not comply with original objectives of addressing water management and river health issues were removed
- Similar types of projects that had insufficient detail to address independently were grouped as general concepts/actions (e.g., bank protection)

- Integrated projects such as diversion structure rehabilitation that would also provide fish passage were bundled as a single effort.

Table 5. Project ranking criteria.

I. Aquatic Habitat Benefits- Reduced temperature, instream flow, physical habitat improvements, recovery of natural processes		
Score	**Criteria**	**Examples**
0	Project will have ***no*** Aquatic Habitat Benefit	• Full bank rock riprap
1	May have ***indirect*** Aquatic Habitat Benefit	• Non-deformable rock toe with soil lifts/willows • Riparian bank plantings
2	Will have ***some direct*** Aquatic Habitat Benefit	
3	Will have ***substantial direct*** Aquatic Habitat Benefit	• Bioengineered bank stabilization (deformable) • Instream flows, lower temperatures • Meander reactivation • Channel morphology/habitat improvements • Dam removal • Wetland Restoration
II. Water Quality Benefits- Temperature, salinity, nutrients, metals, etc.		
Score	**Criteria**	**Examples**
0	Project will have ***no*** Water Quality Benefit	
1	May have ***indirect*** Water Quality Benefit	
2	Will have ***some direct*** Water Quality Benefit	
3	Will have ***substantial direct*** Water Quality Benefit	
III. Riparian Benefit - Project will result in increased quantity of quality of riparian habitat		
Score	**Criteria**	**Examples**
0	Project will have ***no*** Riparian Benefit	
1	***Low likelihood*** that Riparian conditions or functions will be improved	
2	***Moderate likelihood*** that Riparian conditions or functions will be improved	
3	***High likelihood*** that Riparian conditions or functions will be improved	• Meander reactivations
IV. Water Use/Delivery Efficiency - Project will result in increased efficiency of water delivery and use through the irrigation system. Reducing returns to Muddy Creek?		
Score	**Criteria**	**Examples**
0	***No benefit*** to water delivery or efficiency	
1	***Some improvement to delivery system*** but not critical for delivering water	• Bank stabilization at pump sites • Climate data, soil moisture data • Canal linings • Other irrigation infrastructure on very small ditches
2	***Substantial improvement*** to delivery system, but not critical for delivering water	• Projects ranked 6-10 from Irrigation Districts • Bank stabilization protecting minor ditches • Meander reactivation to access PODs • Other irrigation infrastructure on minor ditches

3	***Major improvements*** to delivery system, and/or failure will cause major ***delivery challenges***	• Projects ranked 1-5 from Districts • Bank stabilization that protects major ditches, canals, or diversions • Re-regulation, automation of major infrastructure • Other irrigation infrastructure involving major ditches/canals (e.g. drop structures)
V. Increased Community Benefit - Opportunities and/or Use for General Public		
Score	**Criteria**	**Examples**
0	***No significant*** public benefit	
1	***Indirect*** public benefit	• Fish passages, fisheries enhancements • Good visibility to general public
2	***Some direct*** public benefit	• Public demonstration potential • Community involvement - hands on! • Commodity production (food and fiber) • Salinity reductions, fish reintroductions, CMZ mapping, TMDL
3	***Broad*** public benefit	• Outreach efforts - Weed control, soil health, AIS • Widely applied projects: Fuels mitigation, Mesonet stations • Improved access for general public (e.g. new fishing access site) • Resource improvements to sites currently accessed by the general public
VI. Short-term Economic Risk - 1 to 3 years		
Score	**Criteria**	**Examples**
0	No impact from No-Action	
1	Minimal impact from No-Action and/or few impacted	
2	Moderate impact from No-Action and/or many impacted	
3	Major short-term impact from No-Action effecting a broad sector	
VII. Long-term Economic Benefit		
Score	**Criteria**	**Examples**
0	No lasting economic benefit	
1	Benefits last several years	
2	Benefits last 5 to 10 years	
3	Long-term, lasting impact	• Stream gaging stations
VIII. Scale of Benefit (Define with Group)		
Score	**Criteria**	**Examples**
0	No people directly benefiting or impacted and/or small spatial extent	
1	Few people impacted and/or small spatial extent	
2	Moderate number of people impacted or benefiting and/or moderate spatial extent	
3	Large number of people impacted or benefiting and/or large spatial extent	

5.2 Water User Association/Group Project Ranking Results

As described in Section 1.3, there are three active Water User Associations/Groups on the Musselshell River: Upper Musselshell WUA, Deadman's Basin WUA, and Delphia-Melstone WUA. These associations tend to work independently from the Musselshell Watershed Coalition as they have discreet priorities developed to maintain and upgrade their individual irrigation infrastructure. Although they are uniquely poised to identify and prioritize their own needs, they engaged in this ranking process to allow inclusion of their work into the overall Plan. Since each WUA has a series of projects that will be implemented under their own management, their relative rankings are WUA-specific and thus described independently below.

5.2.1 Previous WUA Project Prioritization Efforts (2018)

An independent project Inventory and Assessment was recently completed for each WUA with the expressed goal of "optimizing water conservation and water delivery within the [WUA] by prioritizing existing infrastructure that should be repaired or replaced" (WWC Engineering, 2018a). These studies were performed by WWC Engineering in 2018, with funding by the Montana Department of Natural Resources and Conservation (DNRC) Irrigation Development Grant program and the Montana Association of Conservation Districts (MACD) 223 Grant Program. Each study inventoried all infrastructure within the delivery systems, including canals, diversion structures, drops, wasteways, etc. Each structure was photographed and evaluated according to its condition (very good, good, fair, poor, or very poor). Structures identified with problems that should be addressed were then ranked according to criteria established for the assessment: Water Conservation (20%), Extent of Benefit/Risk of Failure (20%), O&M Functionality (20%), Project Cost (10%), and Public Health and Safety (30%). Performing these inventories was identified as the 3rd highest priority for Planning Projects and Studies in the 2015 Watershed Plan.

The 2018 WWC inventories resulted in the identification and ranking of projects, but those results already need updating. The current WUA project priorities are discussed below.

5.2.1 Upper Musselshell WUA Priorities

Seven priority projects were identified by the Upper Musselshell WUA and ranked by the Ranking Team (Table 6). The top ranked projects are all related to the core water delivery structures that supply water to and deliver water from Martinsdale Reservoir (Figure 28 and Figure 29). Repair/replacement of the Martinsdale Supply Canal drop structure is of highest priority as the concrete structure is decaying due to undermining of the stilling basin at the toe of the ~15 foot drop (Figure 30). This structure is located about 0.3 miles southeast of Martinsdale where the supply canal enters the head of Martinsdale Reservoir. At the head of the canal itself, the channel-spanning diversion structure on the Musselshell River that feeds the Martinsdale Supply Canal was also ranked as a top-priority project. This structure is plagued with high maintenance needs and poor fish passage, so the proposed project is to repair or replace the structure (Figure 31). Outlet/drop structures below Martinsdale Reservoir are also in poor condition and in need of repair. Wasteways that bleed from the canals can be prone to failure during the irrigation season; such failures would potentially result in the capture of all canal water by the wasteway, severely affecting water delivery capabilities. Several stretches of the canal system have also been noted as having seepage issues (Figure 32). These seepage-mitigation projects were combined as

a single project, some portions of which are in active stages of implementation. The Ranking Team suggested that the potential benefits of canal seepage should also be taken into account at each site.

Figure 29 shows the locations of all WUA-related priority projects; the Upper Musselshell WUA project identification numbers all begin with UM.

Table 6. Upper Musselshell WUA priority projects.

Project ID	Project	Description	Score
UM-10	Martinsdale Supply Canal Drop Structure Repair/Replace	The supply canal drop structure is aging and is known to have erosion under the stilling basin concrete slabs. Repair to the existing drop structure, or replacement are possible. There is an existing preliminary engineering design for a canal reroute through a replacement drop structure that comes off the supply canal about 0.6 miles east (est. cost $1million)	15
UM-9	Martinsdale Supply Canal Diversion Structure Rehabilitation	Reduce maintenance and improve fish passage at Martinsdale Diversion Structure	15
UM-11	Replacement of the Martinsdale Outlet Drop Structures	Evaluate options to repair or replace the Martinsdale outlet structure. Inventory noted one drop structure (2061+50) is in poor condition and a second drop (2136+57) as very poor condition. Other elements of the outlet canal are in poor to very poor condition.	13
UM-7	Two Dot Canal Wasteway Rehabilitation (Sta. 3018+30.71)	Rehabilitate wasteways to prevent failure during the irrigation season. Failed wasteways can capture all canal water and severely impact delivery.	13
UM-6	Two Dot Canal Diversion Structure Rehabilitation	Rehabilitate headgate and wasteway	12
UM-1, 2, 4, 5, 8	Canal Seepage Mitigation	Evaluate specific segments for appropriateness of linings; take benefits of seepage into account. These projects are very site specific and expensive. Liners are prone to damage by livestock, excavators, etc. Note that a 700 lineal foot section of the Two Dot Canal is currently under bid and scheduled to be completed in Fall 2022.	5
UM-3	Canal Culvert Maintenance	Maintain all culverts on/beneath canals, some need replacement (e.g. Two Dot Canal 42” CMP at Sta. 4756+17.55	3

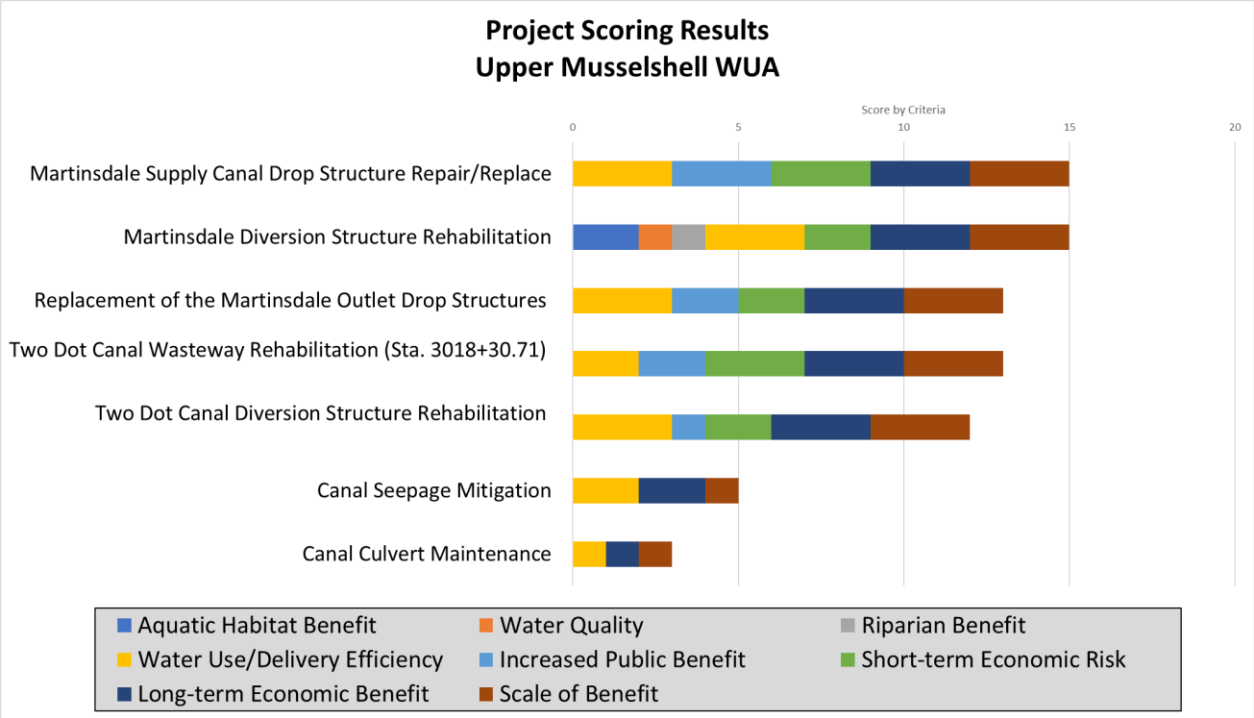


Figure 28. Upper Musselshell WUA project scoring results showing anticipated benefits for each project and resulting total score.

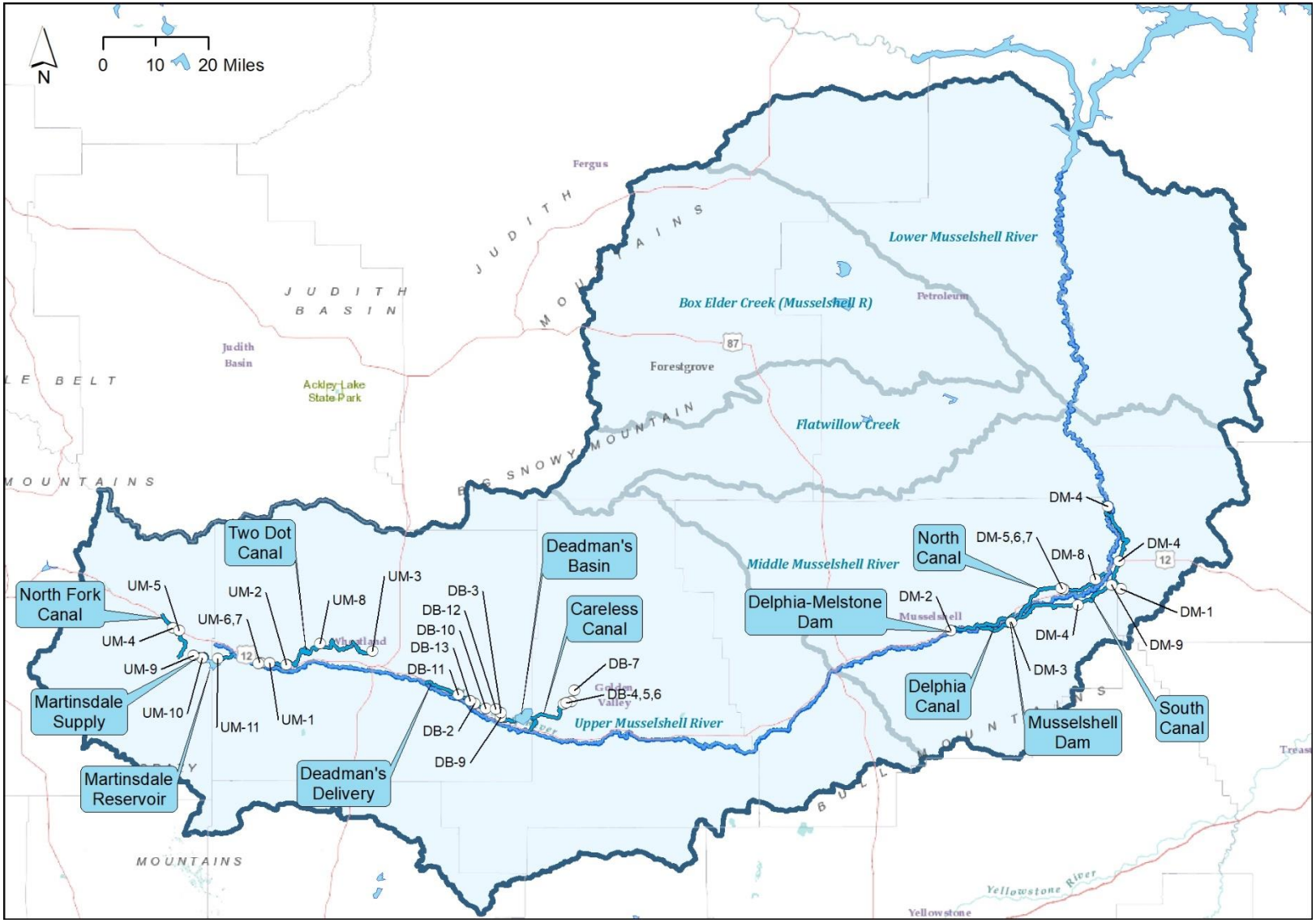


Figure 29. WUA project locations labeled by Project ID.

Figure 30. Martinsdale Supply Canal drop structure showing steep rocked face on lower end of structure.

Figure 31. View downstream of Martinsdale Supply Canal diversion structure on Musselshell River.

Figure 32. Two-Dot Canal segment (Mexican John Section) prone to seepage losses.

5.2.2 Deadman's Basin WUA Priorities

Six projects were identified by the Deadman's Basin WUA (Table 7). The top-ranking projects are all related to the core water delivery structures that supply water to and deliver water from Deadman's Basin Reservoir (Figure 34). The 11.5 mile-long Deadman's Basin Supply Canal conveys water from the Musselshell River to the reservoir, which is located about 3.5 miles east of Shawmut. The canal largely follows gradual hillslope contours north of the river, but in places it has steep drops that require concrete drop structures. Failure of any of these structures would result in significant water delivery to producers. The top-ranked project is replacement of a steep drop structure located on the Deadman's Basin Supply Canal about 2.8 miles west of the reservoir. The concrete structure is deteriorating, and since failure would result in downstream flooding and long-term interruptions in water delivery, complete replacement was recommended by WWC at an estimated cost of $268,000 (WWC, 2018). Several wasteways all along the Supply Canal were also prioritized for rehabilitation, ranking third in overall priority as a bundled project. Two other prioritized projects are on the 9.5 mile- long Careless Canal, which is one of two outlet canals from the reservoir (the second is the Barber Canal). Between the reservoir and Careless Creek, the Careless Canal flows over three major drop structures, all of which were identified for potential replacement. The highest priority of the three drops was identified as Drop #3 which is about 1,000 feet west of Careless Creek (Figure 34). Drop #1 is located about a mile west of Drop #3 on the Careless Canal, and replacing this structure was ranked highly as well. Another concern raised in the Deadman's Basin WUA is seepage through canal embankments; this issue was identified as a potential project requiring evaluation by DNRC.

Figure 29 shows the locations of all WUA-related priority projects; the Deadman's Basin WUA project identification numbers all begin with DB.

Table 7. Deadman's Basin WUA priority projects.

Project ID	Project	Description	Score
DB-3	Deadman's Basin Replacement of the Supply Canal Drop Structure (Sta. 1429+28)	DBWUA Priority #5 (Revised)	15
DB-6	Deadman's Basin - Replacement of the Careless Canal Drop #3 (Sta. 2404+27)	DBWUA Priority #3 (Revised)--Worst structure	14
DB-2, DB-9, DB-10, DB-11, DB-12	Deadman's Basin Supply Canal Wasteway/Spillway Rehabilitation	Five projects bundled - Wasteways are most at risk during storm events. If they fail it will take substantial time to get the canal back on line	13
DB-4	Deadman's Basin - Replacement of the Careless Canal Drop #1 (Sta. 2344+19)	DBWUA Priority #4 (Revised)	13
DB-13	Deadman's Basin Supply Canal Earthen Embankment Rehabilitation (Sta. 1170+80)	General concern regarding seepage through earthen embankment. DNRC needs to look at.	12
DB-7	Deadman's Basin Access Road Improvements	DBWUA Priority #1 (Revised)--Roads and Bridges	7

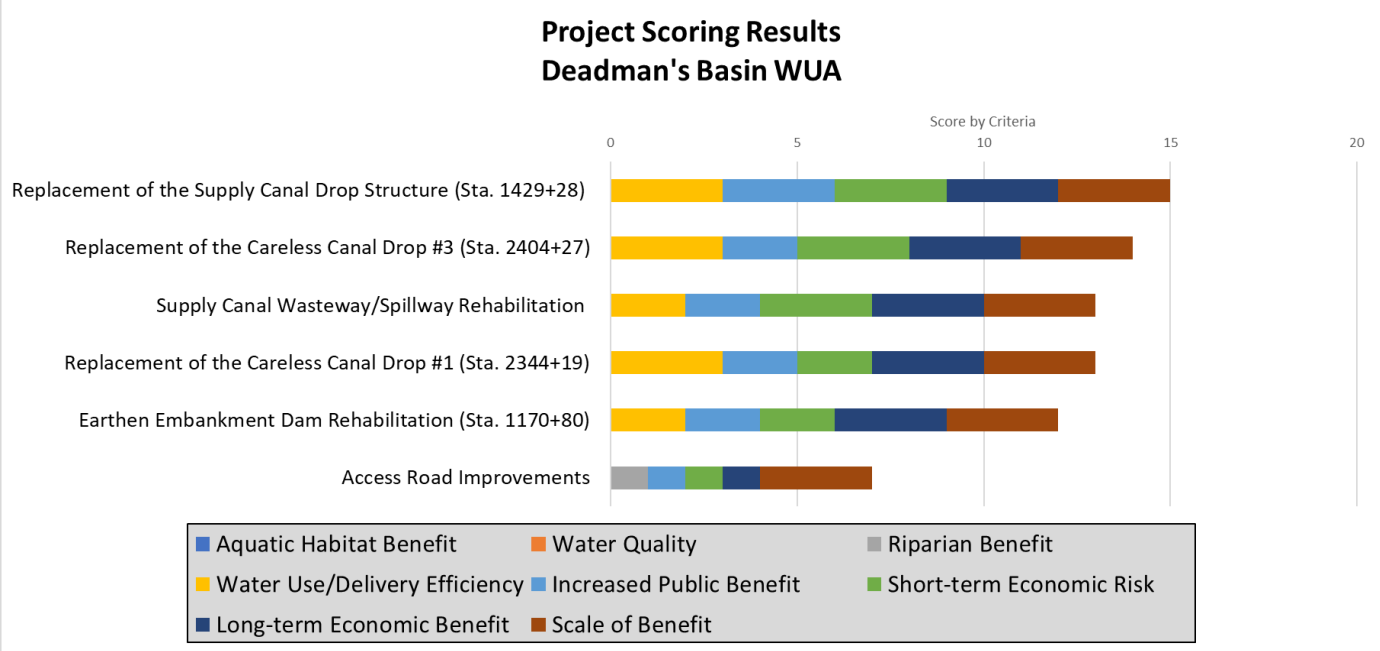


Figure 33. Deadman's Basin WUA project scoring results showing anticipated benefits for each project and resulting total score.

Figure 34. View up-gradient of Careless Canal Drop #3.

5.2.3 Delphia-Melstone WUA Priorities

Eight projects were identified by the Delphia-Melstone WUA (Table 8). The top-ranking projects focus on delivery of water from the Musselshell River and water management efficiencies within the canal system (Figure 35). The top-ranked project is rehabilitation of Delphia Dam which is located about 8 miles upstream of Musselshell (Figure 36). The structure has had issues with undermining and associated toe seepage; in 2019 there was so much water flowing under the dam it affected canal delivery capabilities. The second highest-ranking project is to automate headgates and install Telemetry project at several locations in the Delphia-Melstone system. This project is currently funded and is being implemented (Section 3.1.2). Additionally, the Horse Creek Coulee Re-regulating Reservoir has a completed Preliminary Engineering Report and is moving forward with only partial funding secured (Section 3.1.3).

Figure 29 shows the locations of all WUA-related priority projects; the Delphia-Melstone WUA project identification numbers all begin with DM.

Table 8. Delphia-Melstone WUA priority projects.

Project ID	Project	Description	Score
DM-2	Delphia Dam Rehabilitation	Address bank stability and dam integrity.	15
DM-4	Musselshell Dam and North, South, and Delphia Canal Telemetry	Headgate automation the diversion headgate and telemetry at multiple locations throughout the canal system. Currently funded through RRGL and in the process of implementation.	13
DM-1	Horse Creek Coulee Re-regulating Reservoir	Canal water regulation reservoir on South Canal near Horse Creek Coulee. Preliminary engineering is under way (WWC). Water right and funding being in the process of being transferred from the original Horse Creek Coulee Reservoir project.	10
DM-9	South Canal Seepage Mitigation #1 (Sta. 5857+50 to 5984+00)	WWC proposed lining 0.5 mile sections in phases until the full 2.4-mile section is rehabilitated.	5
DM-5	Replacement of the North Canal Drop Structure #1 (Sta. 6453+08)	Continued maintenance is required on this drop structure on the North Canal.	3
DM-6	Replacement of the North Canal Siphon #1 (Sta. 6454+72)	Siphon has reached the end of its design life. Replacement was recommended in the WWC report.	3
DM-8	Replacement of the North Canal Siphon #2 (Sta. 6725+51)	Siphon is in extremely poor condition. Failure would result in extended interruption of water delivery.	3
DM-7	Rehabilitation of the North Canal Drop Structure #2 (Sta. 6426+38)	Frequent maintenance is required on this drop. Failure could result in downstream flooding and extended interruption of water delivery.	3

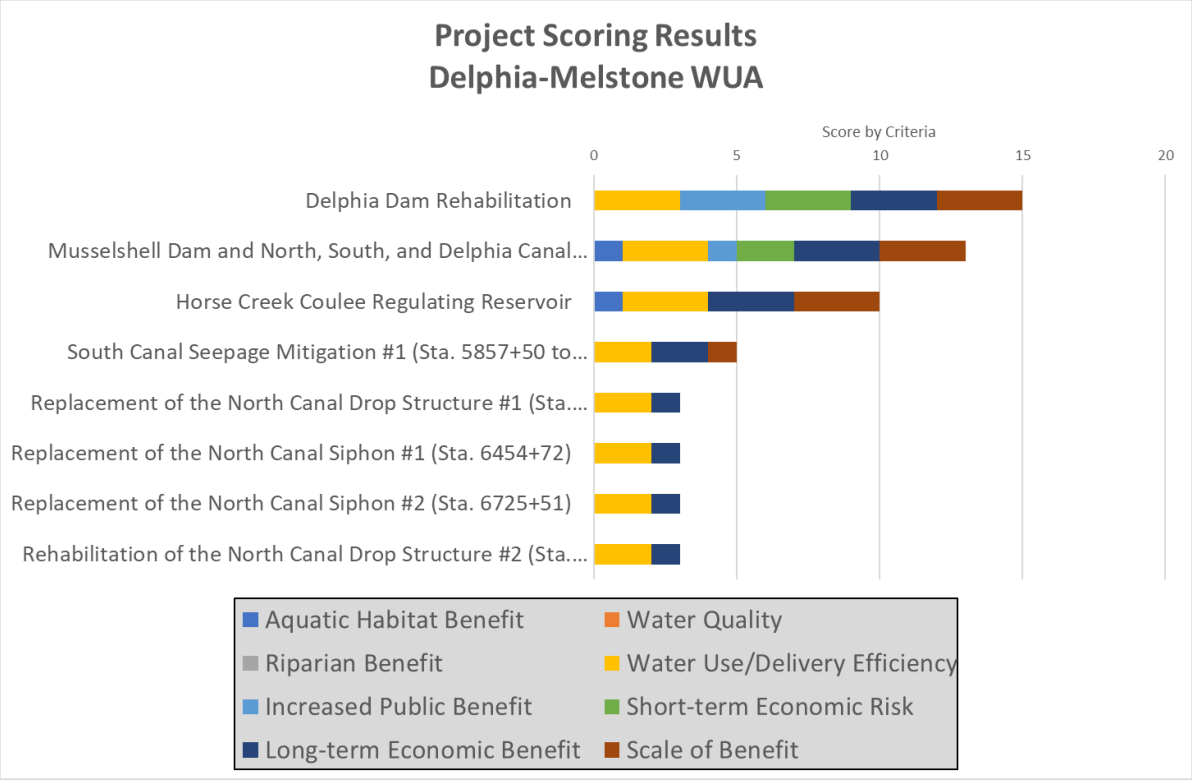


Figure 35. Delphia-Melstone WUA project scoring results showing anticipated benefits for each project and resulting total score.

Figure 36. Delphia Dam and Canal; flow direction is left to right (Kestrel Aerial Services, 2012).

5.3 Musselshell River Corridor Project Ranking Results

In addition to the irrigation infrastructure projects that are managed by Water Users Associations, an additional 19 Musselshell River corridor projects were ranked using a qualitative (high, medium, low, none) score for each anticipated benefit. Where multiple projects received the same total score, they were each given the same rank in the prioritization list and the next ranking numbers are skipped. Table 9 and Figure 37 list the projects and their rankings. These project types are much broader in scope than the irrigation projects described above, and include stream restoration, fish passage, contaminant remediation, bank protection, and recreational development. The locations of Musselshell River Corridor projects are shown in Figure 38.

Table 9. List of prioritized Musselshell River Corridor projects showing score and rank.

Project ID	Project	Project Type	Score	Rank
SG1-8	Stream Gages	Data	24	1
HA-1	Harlowton Roundhouse Reclamation	Remediation	20	2
R1, R7	Jeffries Tipple	Remediation	19	3
MR-7	Cushman Rd Bridge - Rt Bank (RM228.4) Bridge Approach Erosion	Bank Stabilization	14	4
R-4	Walking Trail Relocation, Signage and Fairgrounds Area Improvements. Floodplain Reconnection	Floodplain Reconnection	13	5
MR-2	Kilby Butte Fish Bypass and Diversion Dam	Fish Passage	12	6
MR-1	Davis Dam Fish Passage	Fish Passage	10	7
MR21	Native Fish Species Re-introduction	Fisheries	10	7
MR-4	Buffalo Trail Bridge	Bank Stabilization	10	7
MR-3	Goffena Bridge Replacement	Bridge	10	7
R-2	Bair-Collins Bank Stabilization Project	Bank Stabilization	9	11
MR-10	MDOT Bank Stabilization Repairs at Hwy 12 Milepost 164 - RM187L (MDT#6)	Bank Stabilization	9	11
R-8	Roundup Bank Stabilization and Return Pipe (Meathouse Rd)	Bank Stabilization	9	11
R-5	Roundup Fishing Access Site	Recreation	9	11
R-3	Pedrazzi Diversion Removal and Channel Restoration	Dam Removal	8	15
MR-6	Goffena Railroad Bridge Removal	Channel Remediation	8	15
MR-10	Muir Ranch / Winnecook Ditch (RATT 2018)	Bank Stabilization	5	17
MR-5, MR-19, R-6	Erosion Control at Pump Sites	Bank Stabilization	4	18
MR-9, MR-12, MR-13, MR-16, MR-18, MR-20	General Bank Stabilization at Multiple Sites	Bank Stabilization	3	19

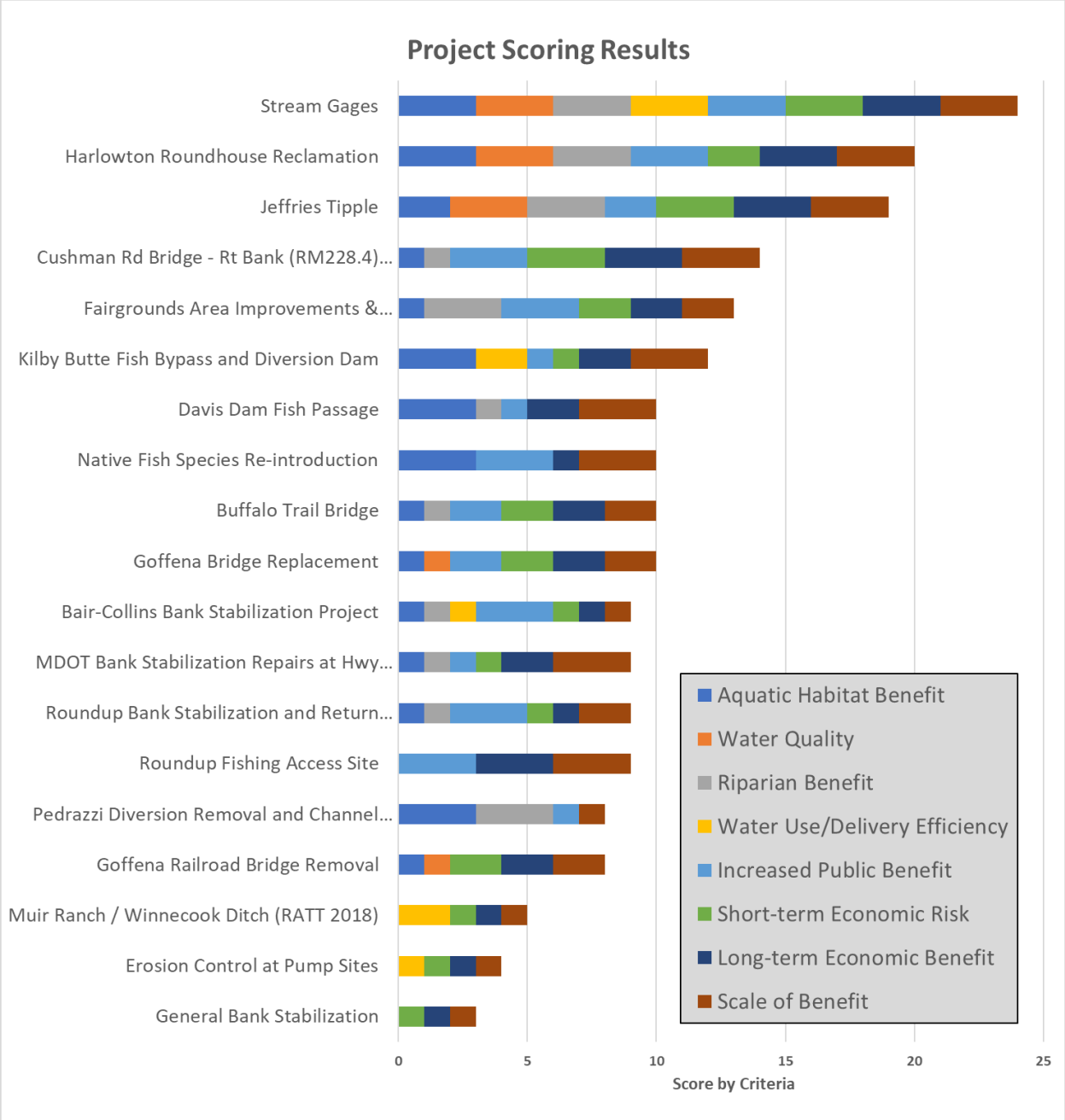


Figure 37. Musselshell River Corridor project scoring results showing resulting total score based on anticipated benefits.

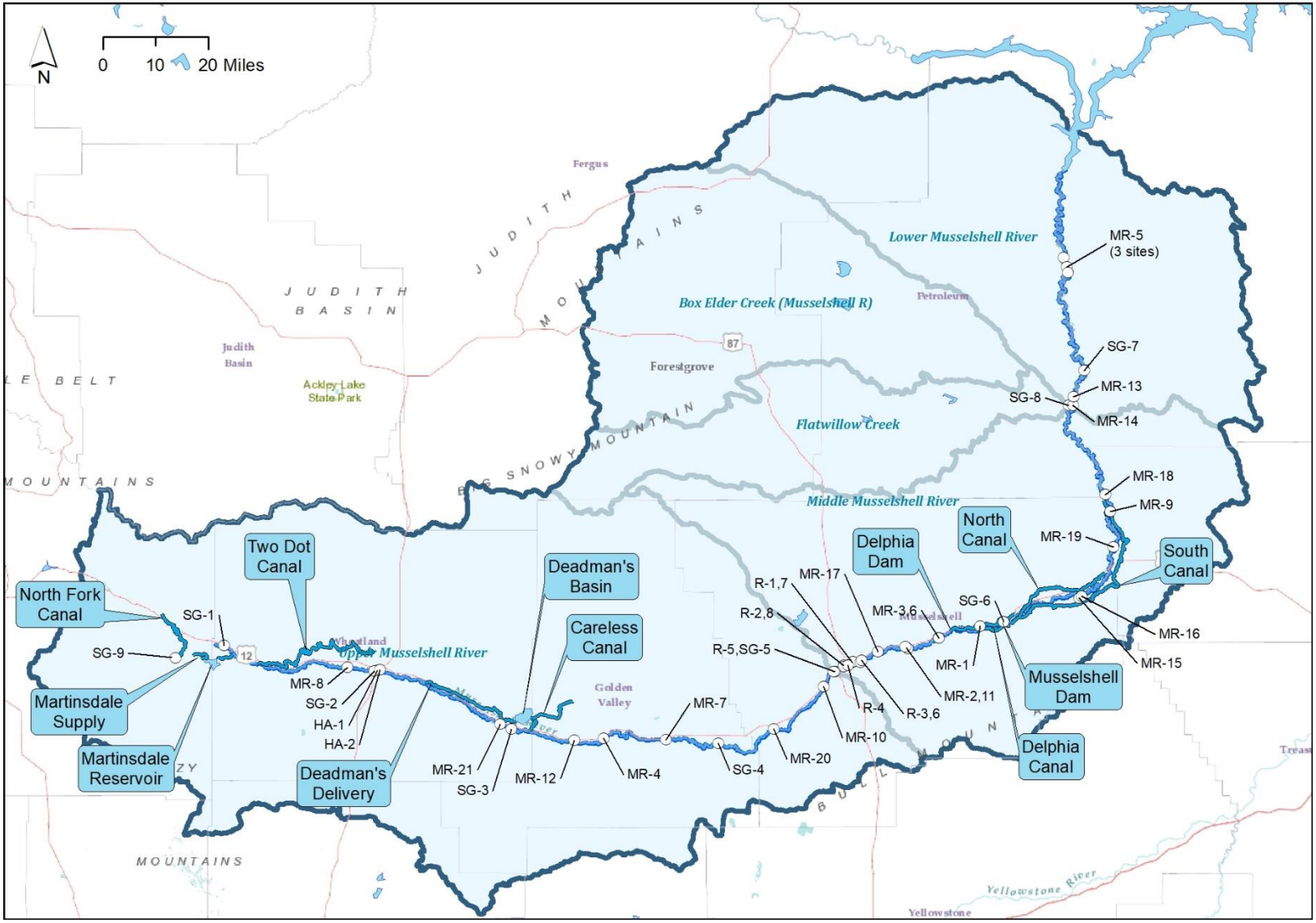


Figure 38. Project locations labeled by Project ID.

5.3.1 Stream Gage Funding (Ranked #1)

The USGS uses the spelling "gage" for stream gages, therefore that spelling is used by water management entities, including the Musselshell River network.

The USGS operates 8,200 stream gages across the country and 112 in Montana, which gather data such as stream discharge, water temperature, and water quality (Figure 39). In 2016 it cost about $184 million to operate the gages nation-wide (USGS). In recent years, however, hundreds of gaging stations throughout the US have mothballed because the federal agency has insufficient funding for their operations. And although the USGS is primarily responsible for gage maintenance and data, many of the gages in Montana are additionally financially supported by cost-share agreements between state agencies, private entities, and/or tribes (Nowlin, 2018). Recent budget cuts in the state of Montana have thus exacerbated gaging station funding challenges.

Figure 39. USGS stream gaging station on Big Wood River near Bellevue ID during a flood.

In the Musselshell Basin, these gages track data vital to water supply, water delivery, and flood protection. Table 10 lists the gaging stations that have published data available (waterdata.usgs.gov); in its entirety the dataset extends back to the early 1900s. There are a total of six currently active year-round gages on the mainstem and another at the mouth of Flatwillow Creek. One gage on the South Fork above Martinsdale was active through 2019 but no recent data have been published from the site. The gage at Lavina is seasonal, only operating from April through October.

These gages are critical for managing water supply within the watershed and the MWC continues to support their operation. Each gage costs approximately $18,000 per year to operate year-round. In recent years 18 partners have contributed annually to fund the gages on the Musselshell River.

Table 10. Musselshell River gaging stations showing data available as of May 2022; active gages are highlighted.*

Gage Number	Gage Name	Daily Flow Data	Annual Peak Flow Data	Temperature Data	Water Quality	Status
		Period of Record			# of Samples	
6118500	**South Fork Musselshell above Martinsdale**	**1941-2019**	**1942-2019**		**1**	**Active (through 10/1/2019)**
6119500	South Fork Musselshell River near Martinsdale	1907-1914	1908-1932	---	0	Inactive
6119600	**Musselshell River near Martinsdale**	**2003-2022**	**2003-2020**	**---**	**75**	**Active**
6120500	**Musselshell River at Harlowton**	**1907-2022**	**1909-2020**	**2001-2002**	**264**	**Active**
6122800	Musselshell River near Shawmut	1986-1997	1986-1997	---	105	Inactive
6123030	**Musselshell River above Mud Cr near Shawmut**	**1998-2022**	**1998-2020**	**---**	**101**	**Active**
6123500	Musselshell River near Ryegate	1946-1979	1947-1979	---	1	Inactive
6126050	Musselshell River near Lavina	1992-2011	1992-2011	---	115	Inactive
6125600	**Musselshell River above Big Coulee Creek at Lavina**	**2012-2021**	**2012-2020**		**12**	**Active (April-Oct)**
6126500	**Musselshell River near Roundup**	**1946-2022**	**1946-2020**	**---**	**314**	**Active**
6127500	**Musselshell River at Musselshell**	**1928-2022**	**1929-2020**	**---**	**194**	**Active**
6127600	Musselshell River near Mosby	1962-1966		---	128	Inactive
6130500	**Musselshell River at Mosby**	**1929-2022**	**1929-2020**	**2000-2003**	**489**	**Active**
6130000	**Flatwillow Creek near Mosby**	**1964-2022**	**2013-2020**	**---**	**94**	**Active**

***data availability at waterdata.usgs.gov/nwis**

The importance of accessible gaging station data has been reiterated by numerous water managers and landowners in the basin (Nowlin, 2018). This state-wide issue has prompted a broad stakeholder group to convene over recent years to explore means of sustaining Montana's gaging station network. The group wants to ensure that users can be well-informed regarding stream gage priorities, and that additional funding sources to maintain the system can be secured. In 2018 the group developed a draft Joint Resolution for the state legislature to designate an interim committee "to review the role of stream gauges in Montana's water supply system and suggest ways to ensure the network of stream gauges remains relevant and robust into the future". (https://leg.mt.gov/content/Committees/Interim/2017-2018/Water-Policy/Meetings/LCw006-public-comment.pdf).

Montana's 2015 State Water Plan supports the stream gaging station network by "recognizing that accurate, near real-time, publicly accessible information on stream flows assists both day to day decision making and long-term planning, as well as emergency planning and notification" (MTDNRC, 2022).

5.3.2 Harlowton Roundhouse Reclamation (Ranked #2)

The Harlowton Roundhouse Reclamation Project consists of the redevelopment of an historic 190-acre rail property at Harlowton. It ranked #2 as it provides substantial benefits to aquatic and riparian habitats, water quality, and recreational opportunities. Petroleum contaminated soils were excavated from the site in 2016, 2019, and 2021, and in spring of 2021 asbestos-contaminated soils were removed. Most recently, DEQ secured an additional $500K grant for fall 2022 to work with the City of Harlowton and EPA on visions for restoring the abandoned roundhouse (Figure 40). As the project has been launched and is ongoing, it is described in more detail in Section 3.6.2.

Figure 40. View west of Harlowton Roundhouse; Musselshell River is to left.

5.3.3 Jeffries Tipple (Ranked #3)

The Jeffries No. 18 Mine Tipple is a structure that was used to load coal for transport a few miles downstream of Roundup. Coal mining in the area started in the 1920s, and the mine was acquired by the Jeffries Coal Mining Company in 1928 (MTDEQ, 2018). The mine was flooded in 1940 and production ceased. The Montana Abandoned Mine Land Program has been working to reclaim the tipple structure and associated waste coal that is exposed in the banks of the Musselshell River (Figure 41). The proposed project includes removing the railroad grade, road prism, tipple foundation, and waste coal. Following those removals, the river's floodplain and banklines would be restored.

This site was partially self-mitigated by the 2018 flood, as high water eroded out some of the concrete tipple and high road prism shown in Figure 41. The tipple structure is now presumed to be buried under a point bar on the other side of the river although some of the concrete foundation is currently exposed in the bank (Figure 42). The current plan is to excavate and dispose of approximately 3,700 cubic yards of remaining waste material from the road prism, remove the tipple foundation, and restore the Musselshell River through excavation, shaping, and grading of the floodplain to its approximate pre-mining condition (MTDEQ, 2018). However, some of these components are being reconsidered to integrate any actions with ongoing bank erosion into the county right of way just upstream of the tipple site (Figure 43). Post-flood expansion of salt cedar in the area has also become an additional concern since 2018.

Figure 41. View downstream of Jeffrey's Tipple following the floods of 2011 and 2014; note the high road prism behind the concrete tipple foundation (MTDEQ).

Figure 42. View downstream following the 2018 flood showing remaining concrete tipple foundation.

Figure 43. View upstream from Jeffrey's Tipple showing bank erosion and rock riprap stacked along county road self-launching into channel.

5.3.4 Cushman Road Bridge (Ranked #4—SUPPLEMENTAL PER)

Cushman Bridge is located 4 miles upstream of Lavina. Between 2011 and 2021 the right bank of the Musselshell River immediately upstream of the bridge eroded approximately 175 feet to the south (Figure 44). This has changed the approach angle of the river to the bridge to somewhat of a "dogleg" configuration, which is progressively getting worse (Figure 45). As this is an important access bridge for landowners and emergency services, addressing the alignment/bank stability problem at Cushman Bridge ranked #4 overall, and the project was selected for a Supplemental Preliminary Engineering Report that is attached as Appendix A.

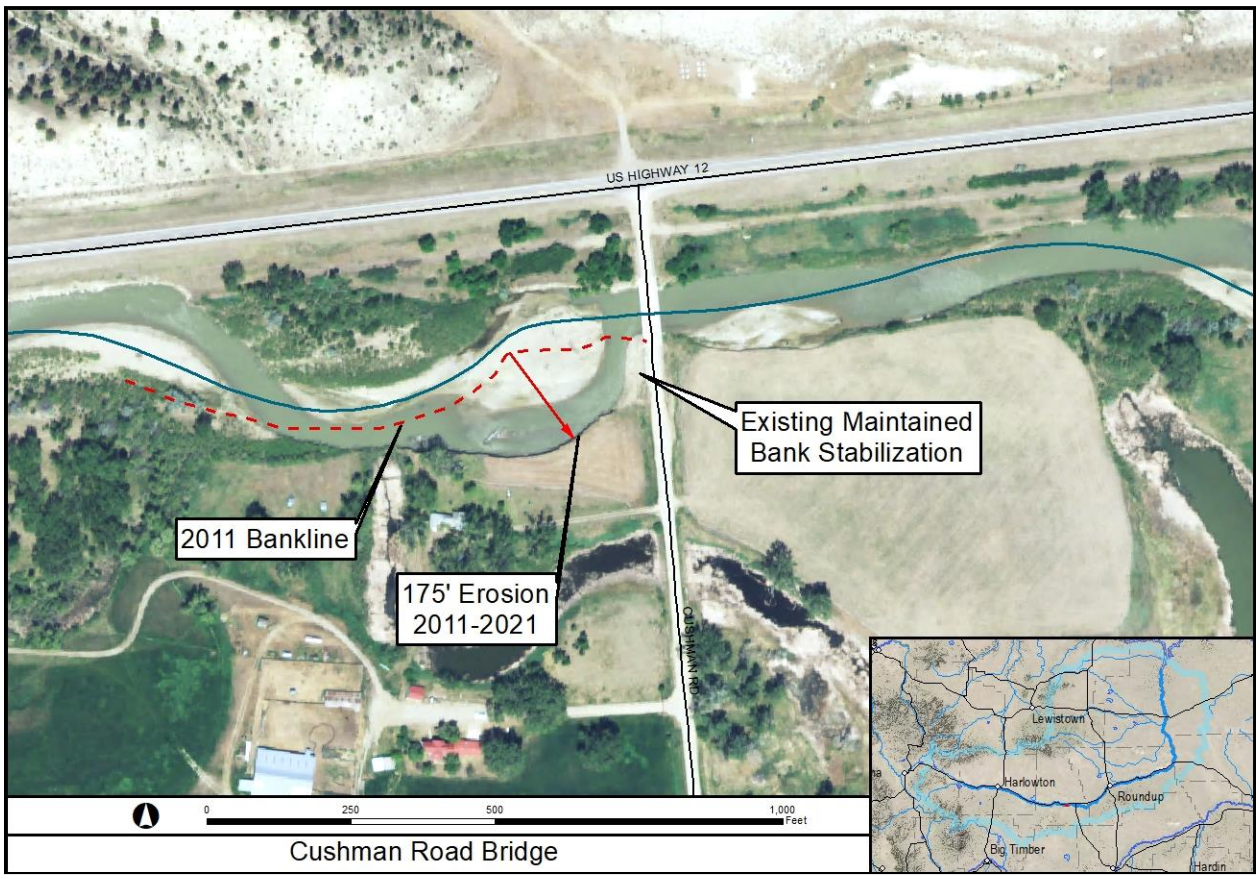


Figure 44. Cushman Road Bridge showing 175 feet of right bank erosion between 2011 and 2021.

Figure 45. View upstream from the Cushman Road Bridge showing right bank erosion and current stabilization efforts, August 9, 2021.

5.3.5 Fairgrounds Area Improvements and Floodplain Reconnection (Ranked #5)

The proposed project at the Musselshell County Fairgrounds consists of integrating floodplain reconnection with walking trails, signage, and fairground area improvements. There is currently a raised berm between the fairgrounds and the river that creates a floodplain constriction downstream of the 2nd Street Bridge (Figure 46, Pioneer, 2016). Some of the isolated area behind the floodplain berm is used for truck and trailer parking during fairground events. The Fairgrounds Improvement Area Project consists of moving the berm and walking trail to the south, maintaining access via the 2nd Street Bridge but opening up additional floodplain area to help mitigate flooding in town (Figure 47). Hydraulic modeling (Pioneer, 2016) shows the area upstream of the bridge gets flooded by a base flood event, at least in part due to the constriction. The modeling of a proposed condition with the berm relocation indicated a drop in the base flood water surface elevation of 0.8 to 0.9 feet against the realigned berm.

Figure 46. View downstream from 2nd Street Bridge showing rocked berm on right bank at Roundup Fairgrounds, February 10, 2015.

Figure 47. Proposed southward berm relocation (green) at Fairgrounds (Pioneer, 2016).

5.3.6 Kilby Butte Fish Bypass and Diversion Dam (Ranked #6)

The Kilby Butte Diversion Dam, which is located about 8.5 miles east of Roundup, currently impedes fish passage on the Musselshell River (Figure 48). Recent efforts by Montana Fish Wildlife and Parks have included developing cost estimates for design/construction of a bypass channel around the structure. As such, a preliminary scope of work has been developed for site survey and structural assessment, design and costing, contractor procurement support, and construction oversight.

Figure 48. Kilby Butte diversion dam, November 1, 2021; a bypass channel has been proposed around the diversion on the far side of the river.

5.3.7 Davis Dam Fish Passage (Ranked #7)

The 2011 flood damage to several diversion dams on the Musselshell River prompted Montana Fish Wildlife and Parks to explore means of integrating fish passage into any dam repairs. The Davis Dam is a prime example of such a project, as flood damages have compromised the structure, and it is the lowermost passage barrier in the system (Figure 49). In 2013 FWP hired Allied Engineering to develop an alternatives analysis to evaluate retrofitting the structure to provide fish passage (Allied, 2013). The goal of the project was to develop concepts that would provide reliable diversion capabilities while providing fish passage for select warm water species, including adult sauger and channel catfish. The following alternatives were evaluated (Figure 50):

Alternative 1 – Remove Dam and Establish Pump Stations: This alternative was considered sub-optimal due to issues with stored sediment behind the dam, loss of grade control, and increased costs to operate pumps, but it was also considered "the most beneficial with respect to river function and aquatic organism passage for the full range of species present in the Musselshell River" (Allied, 2013).

Alternative 2 – Fish Passage Right of Structure: Alternative 2 would involve constructing a bypass channel in the right floodplain area. Flow into the channel would be controlled by an entrance structure. Structural improvement to the dam would be included.

Alternative 3 – Fish Passage Left of Structure: This alternative is similar to Alternative 2, but it is located at the head of the diversion ditch, as such it has a high potential to entrain fish into the ditch.

Alternative 4 – Rock Ramp: The rock ramp alternative consists of the conversion of the steep downstream dam face to a broad rock ramp that can pass fish. It was not pursued due to the costs associated with the massive amount of rock required.

Alternative 5 – Modify Dam: The 4th alternative considered was to notch or remove a section of the existing dam and building fish passage through the notch. This was not pursued further due to a lack of demonstrated success for the target fish species, construction challenges, and stability concerns.

Alternative 6 – Replace Dam: The final alternative considered was to replace the dam and rebuild it as a fish-friendly structure. This was not considered further due to costs and performance uncertainty.

Allied (2013) concluded that the design criteria established for the alternatives analysis, which include irrigation capabilities and specific hydraulic conditions, would be best met via Alternatives 1 and 2.

Figure 49. View upstream of Davis Dam (Kestrel Aerial Services).

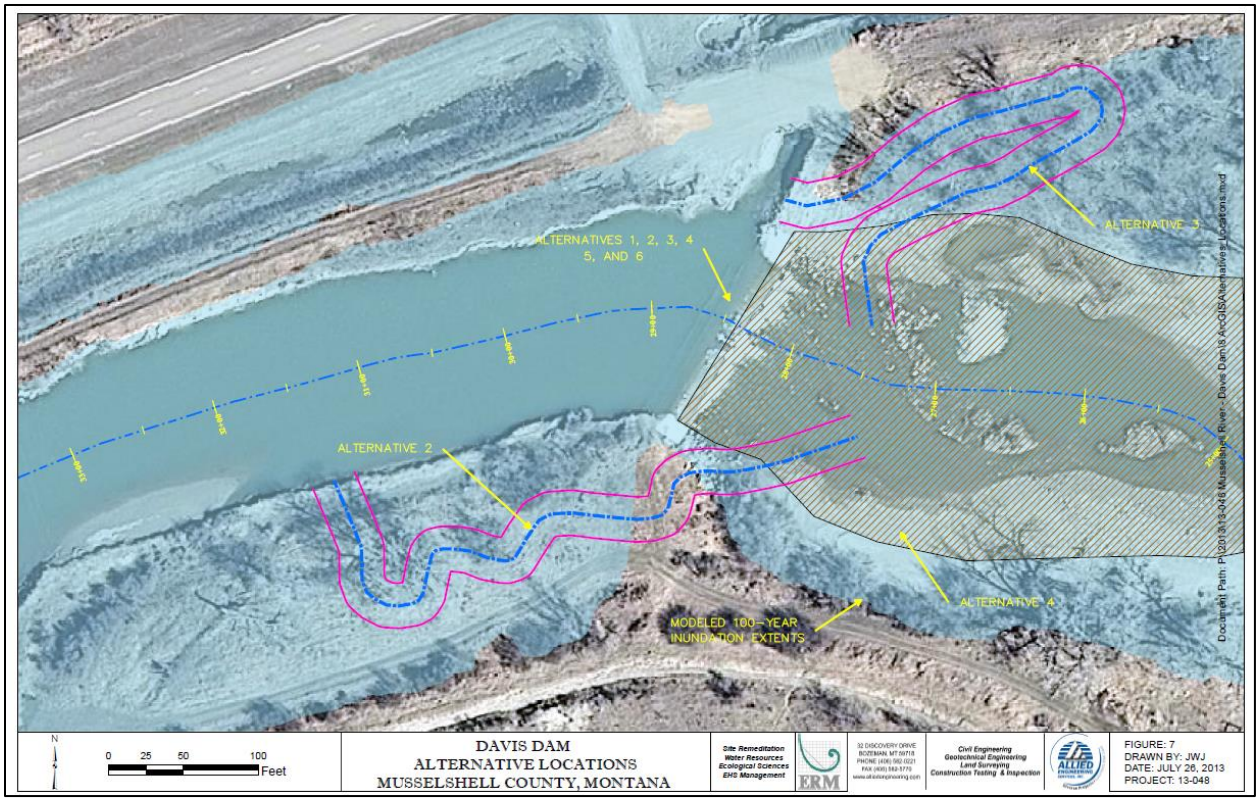


Figure 50. Schematic drawing of alternatives considered at Davis Dam (Allied, 2013).

5.3.8 Native Species Reintroduction (Ranked #7)

The Musselshell River transitions to a warmwater fishery just below Harlowton. FWP has been working to reintroduce channel catfish in this area. In 2015, FWP crews trapped 20 catfish in the lower river and moved them upstream to near Deadman's Diversion. FWP noted that the upper river has "great minnow populations and suckers for forage, but because they were cut off from the Missouri by years of dewatering, catfish in this stretch never could get established" (French, 2016). This native species reintroduction effort has been proposed for expansion.

5.3.9 Buffalo Trail Bridge (Ranked #7)

Buffalo Trail Bridge is located about 2.5 miles east of Ryegate. Bank erosion upstream of the bridge is starting to flank some bank armor on its upstream end (Figure 51 and Figure 52). This has the potential to rapidly destabilize if the river continues to erode behind the armor.

Figure 51. Aerial imagery from 2009 and 2021 showing left bank erosion just upstream of bridge.

Figure 52. View upstream from Buffalo Trail Bridge showing channel migrating to right (northward), flanking rock riprap that currently extends up to Russian olive. The mid-channel turbulence is caused by flanked armor that is now in the channel.

5.3.10 Goffena Bridge Replacement (Ranked #7)

Goffena Bridge, also known as Brockway Ford Bridge, is located about 13 miles downstream from Roundup. It has been described as "possibly the last remaining timber truss in the state of Montana" (MDT, 2020). The bridge was originally built on the south edge of Roundup in 1893 and moved to this location in 1912. The structure was condemned due to structural deficiencies in 2003 and is currently closed. The Montana Department of Transportation plans to construct a new bridge on or very near the existing bridge location in 2024; Musselshell County intends to salvage parts of the structure in recognition of its historic significance. Public meetings were held in 2020 to discuss bridge design alternatives.

Figure 53. View downstream of the condemned Goffena Bridge, August 9, 2021.

5.3.11 Bair-Collins Bank Stabilization (Ranked #11)

This project consists of a small bank stabilization effort on the south (right) bank of the Musselshell River to protect a pump site across from the Bair-Collins project described in Section 3.6.1. Montana DEQ is leading the effort.

5.3.12 MDOT Bank Stabilization Repairs at Hwy 12 Milepost 164 - RM187L (MDT#6) (Ranked #11)

An MDT bank armoring project near Roundup has experienced substantial scour downstream of the riprap. This project would consider means of mitigating that scour, potentially demonstrating the use of alternative, habitat treatments with high roughness as a transitional treatment back to the native bankline.

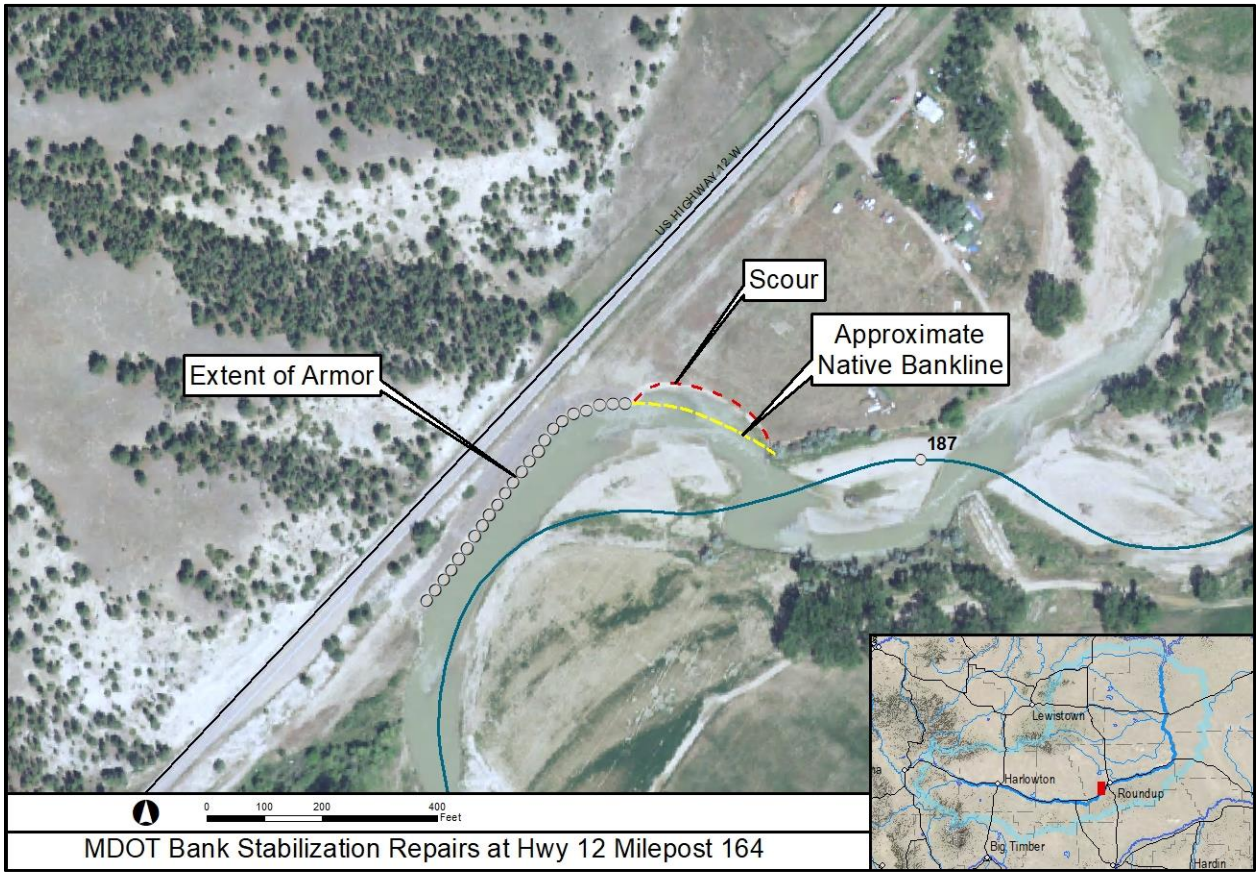


Figure 54. Left bank scour pocket formed on downstream end of MDT riprap project, RM 187L.

Figure 55. View downstream of eroding bank below MDT riprap placed to protect highway.

5.3.13 Roundup Bank Stabilization and Return Pipe (Ranked #11)

The Meathouse Road Bank Stabilization and Return Pipe project is located on the upstream edge of the Bair-Collins Remediation site at Roundup. There is currently an 8-foot diameter culvert on the north side (left bank) of the Musselshell River that allows floodwaters on the west end of town to return to the main channel (Figure 56). This project was originally included with a Preliminary Engineering workup in the 2015 Plan. The culvert is aging and losing its effectiveness, so a cost opinion was developed for its replacement. The preliminary replacement design consisted of extending the existing culvert approximately 35 feet riverward, moving the existing backflow gate to the end of the extension and incorporating a better alignment of the culvert with the river. A rock apron was proposed at the culvert outfall. The estimated cost for this work in 2016 was $62,100.

Figure 56. View north from bank of Musselshell River to floodwater return flow culvert pipe at Meathouse Road in Roundup, February 10, 2015.

5.3.14 Pedrazzi Diversion Removal and Channel Restoration (Ranked #15)

The Pedrazzi Diversion Dam was flanked during the 2018 flood. The river now flows to the south of the structure which has become partially buried. FWP has shown interest in removing the dam remnant and restoring the area.

Figure 57. View upstream of Pedrazzi Diversion Dam prior to flanking (2013).

Figure 58. View upstream of abandoned Pedrazzi Diversion Structure; channel is to the left of image (2018).

5.3.1 Roundup Fishing Access (Ranked #11)

Musselshell County has agreed to lease land to Montana Fish Wildlife and Parks for a fishing access site on the north bank, just upstream of the Hwy 87 bridge in Roundup. The project is slowly moving forward.

5.3.2 Goffena Railroad Bridge Removal (Ranked #15)

A second bridge built as part of the Milwaukee Road is located just downstream of the Goffena Bridge slated for replacement in 2024 (Section 5.3.10). Since this structure is known to constrain hydraulics and exacerbate ice jamming on the river, Musselshell County is pursuing funding to remove the bridge when the new Goffena Bridge is built and open to the public. (MDT, 2020, Figure 59).

Figure 59. View downstream from Goffena Bridge showing poorly aligned historic Milwaukee Road bridge about 250 feet downstream.

5.3.3 Muir Ranch/Winnecook Ditch (Ranked #17)

The Muir Ranch is located about 3.5 miles upstream of Harlowton. In November of 2018, the RATT II team visited the ranch due to landowner concerns regarding the potential abandonment of the Muir/Winnecook Ditch. During the field visit it was clear that without any action, an avulsion channel that was rapidly forming to the south would soon capture all the river flow, resulting in the Musselshell River completely bypassing the diversion structure. The RATT team suggested two potential treatments to secure the ability to continue diverting water at the site: 1) either relocate the point of diversion upstream away from the avulsion risk, allowing the avulsion to happen, or 2) block the avulsion channel at its entrance (Boyd and Kellogg, 2019). The 2021 NAIP imagery indicates that the second option has been taken, and the avulsion channel has been plugged at its entrance (Figure 60). As such this project may be considered completed unless additional work is warranted on site. Regardless, as this is a common issue on the Musselshell River since the 2011 flood, it would be beneficial to monitor the

overall performance of this projects and to perhaps explore its utility as a design/implementation case study.

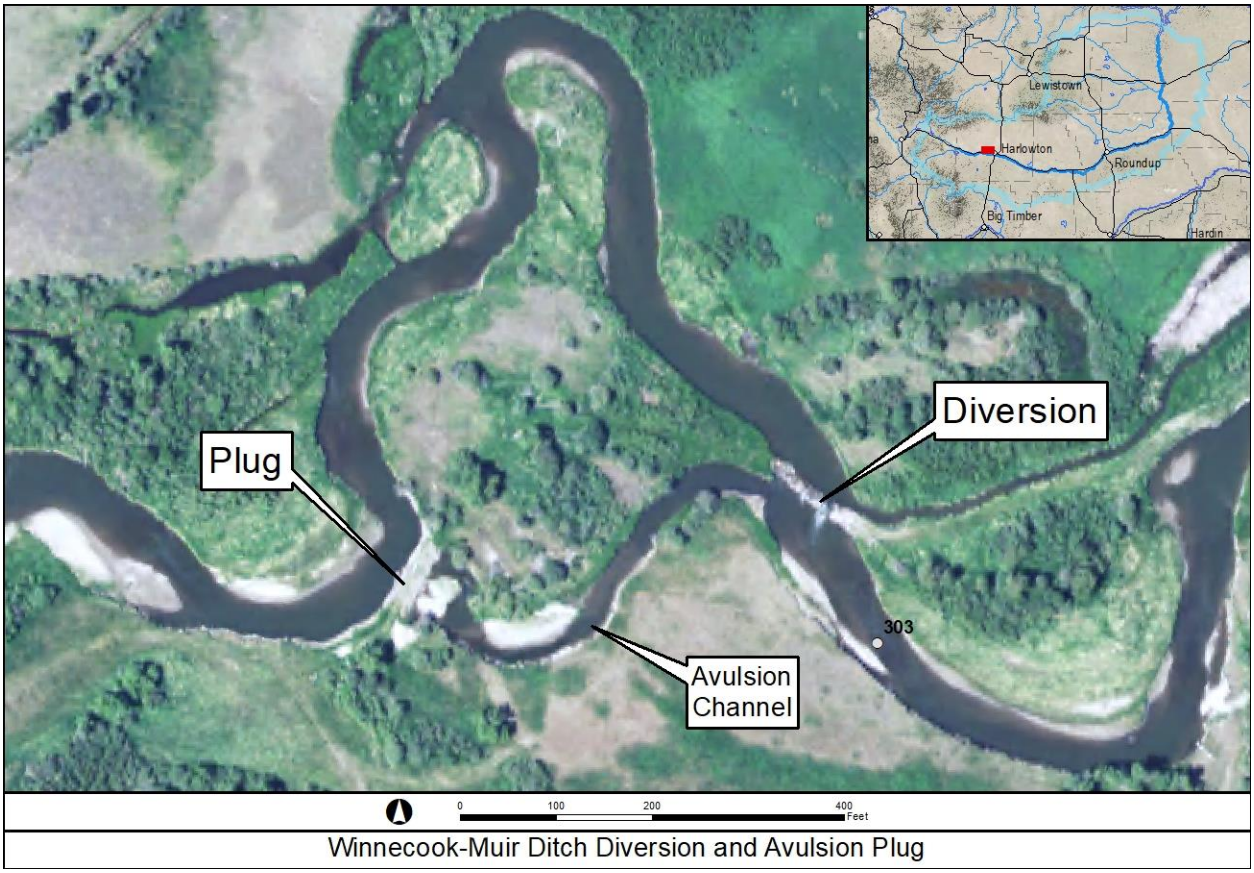


Figure 60. 2021 image showing plugged avulsion channel to maintain flow path to Winnecook-Muir Ditch Diversion.

5.3.4 Erosion Control at Pump Sites (Ranked #18)

Chronic erosion at pump sites has plagued Musselshell River producers since 2011. Whereas some producers have shifted to portable pumps (Figure 61), others have opted to protect fixed pump locations. Any erosion control at pump sites should consider options to shift to a mobile system or relocate the POD locally. If those options aren't feasible, pump site protection typically consists of relatively short extents of rock riprap to stabilize the banks at the pump. Any such project should take channel planform into account to make sure the protection is not at risk of flanking, which is typically the original cause of the problem (Figure 62).

Figure 61. Mobile irrigation pump setup, lower Musselshell River.

Figure 62. View downstream of damaged pump site; note flanked riprap in channel.

5.3.5 General Bank Stabilization (Ranked #19 – SUPPLEMENTAL PER)

Bank erosion since 2011 has not only plagued pump sites as described above. It has created issues with bridge stability, loss of fences, loss of utility poles supplying energy to pumps, road stability, and general loss of productive land. Landowners have expressed these concerns which has prompted multiple project suggestions to be bundled here as general bank stabilization. Two recent bank stabilization projects are described in Section 3.3 (Two Dot and Kilby Butte) both employ bioengineering methods to incorporate fish habitat and riparian recovery into the project. Additional projects by Fish Wildlife and Parks and Montana Department of Transportation have used bioengineering fabrics and incorporation of willows into bank treatments.

Although bundled general bank stabilization projects ranked low due to their site specificity and uncertainty regarding their design and potential benefits, one such project was selected for a supplemental Preliminary Engineering Report (Appendix A) to provide landowners with example designs and costs for bank protection treatments. The project selected is in the lower Musselshell above Mosby, where severe erosion into a field has created the opportunity to demonstrate treatments that can be more ecologically functional than traditional full bank rock riprap (Figure 63).

Figure 63. View downstream of eroding left bank selected for preliminary design of erosion control.

5.4 Supplemental Engineering Evaluations

This planning effort included funding to develop conceptual level engineering reports for two projects identified by the public outreach and discovery process. The projects were selected for additional engineering considerations and feasibility level cost opinions by the ranking team. Preliminary engineering and cost estimates for the following three projects are contained in **Error! Reference source not found.**:

1. Cushman Bridge Right Bank Erosion (described in Section 5.3.4)
2. Rowton Bank Stabilization (described in Section 5.3.5)

Each project is addressed in terms of objectives, design alternatives, and estimated cost.

6 Implementation Strategy- Musselshell River Corridor Projects

While the ranking process identified projects that may have the greatest benefits to the watershed and its residents, implementing the watershed plan is contingent on identifying leadership roles, timeline objectives, and likely funding opportunities. Leadership roles may include state or federal agencies, water user associations, non-profits, or private citizens. Timelines can be considered both realistic and aspirational; broad timelines have been assigned to each project based on overall momentum, need, and level of support. Several prioritized projects are already underway but will require continued efforts to see them through to completion. And lastly, although multiple funding sources may be appropriate for a single project, we have identified likely sources based on project objectives and leadership roles. Funding sources can also be fluid; while many sources have persisted from year to year, recent federal actions have created new opportunities to fund projects.

Table 11 shows a general layout for project timelines, funding sources and leads for each of the Musselshell River Corridor Projects described in Section 5.3. Since the Water User Associations work independently, they each develop their own implementation strategies and thus are not included here. It is also presumed that the WUAs or DNRC will be project leads for any WUA-related infrastructure improvements described in Section 5.2.

Potentially applicable funding programs are summarized in Appendix B.

Figure 64 shows a schematic layout of potential project leads for each ranked project and Figure 65 shows what might be considered to be realistic timelines for initiating those projects. The majority of projects already have some baseline work completed, including preliminary designs and cost estimates. Appendix A contains preliminary designs and cost opinions for the Cushman Bridge project as well as a private landowner erosion control demonstration project near Mosby.

Table 11. Overall Implementation Strategy for Musselshell River Corridor Ranked Projects

Rank	Project	Timeline	Potential Funding Source(s)	Lead
1	**Stream Gage Funding**	Ongoing	Eighteen partners contribute annually to fund the gages on the Musselshell River. MWC can provide local leadership role to state-wide efforts to secure funding	MWC
2	**Harlowton Roundhouse Reclamation**	Active (0-5 years)	Montana DEQ Brownfields Program	DEQ City of Harlowton
3	**Jeffries Tipple**	0-5 Years	Montana DEQ Brownfields Program Musselshell County for road protection	DEQ Musselshell County
4	**Cushman Rd Bridge Erosion Control**	0-5 Years	Golden Valley County	Golden Valley County
5	**Fairgrounds Area Improvements & Floodplain Reconnection**	0-5 Years	RRGL (DNRC)	Musselshell County Lower Musselshell CD
6	**Kilby Butte Fish Bypass and Diversion Dam**	0-5 years	FWP RCCP	FWP
7	**Davis Dam Fish Passage**	>5 Years	Future Fisheries RCCP	FWP
7	**Native Fish Species Re-introduction**	Ongoing	FWP	FWP
7	**Buffalo Trail Bridge**	>5 Years	Golden Valley County	Golden Valley County
7	**Goffena Bridge Replacement**	Active (0-5 years).	MDT	MDT
11	**Bair-Collins Bank Stabilization Project**	0-5 Years	Montana Department of Equality Brownfields Program	DEQ
11	**MDOT Bank Stabilization Repairs**	>5 Years	Local Landowner	MWC
11	**Roundup Bank Stabilization and Return Pipe (Meathouse Rd)**	0-5 Years	Musselshell County	Musselshell County
11	**Roundup Fishing Access Site**	Active (0-5 years)	FWP	FWP
15	**Pedrazzi Diversion Removal and Channel Restoration**	>5 Years	FWP	Lower Musselshell CD
15	**Goffena Railroad Bridge Removal**	>5 Years	FEMA Musselshell County MDT	Musselshell County
17	**Muir Ranch / Winnecook Ditch**	Active (0-5 Years)	Landowners	Landowners
18	**Erosion Control at Pump Sites**	Ongoing	Landowners	Landowners
19	**General Bank Stabilization**	Ongoing	Landowners FWP	Landowners

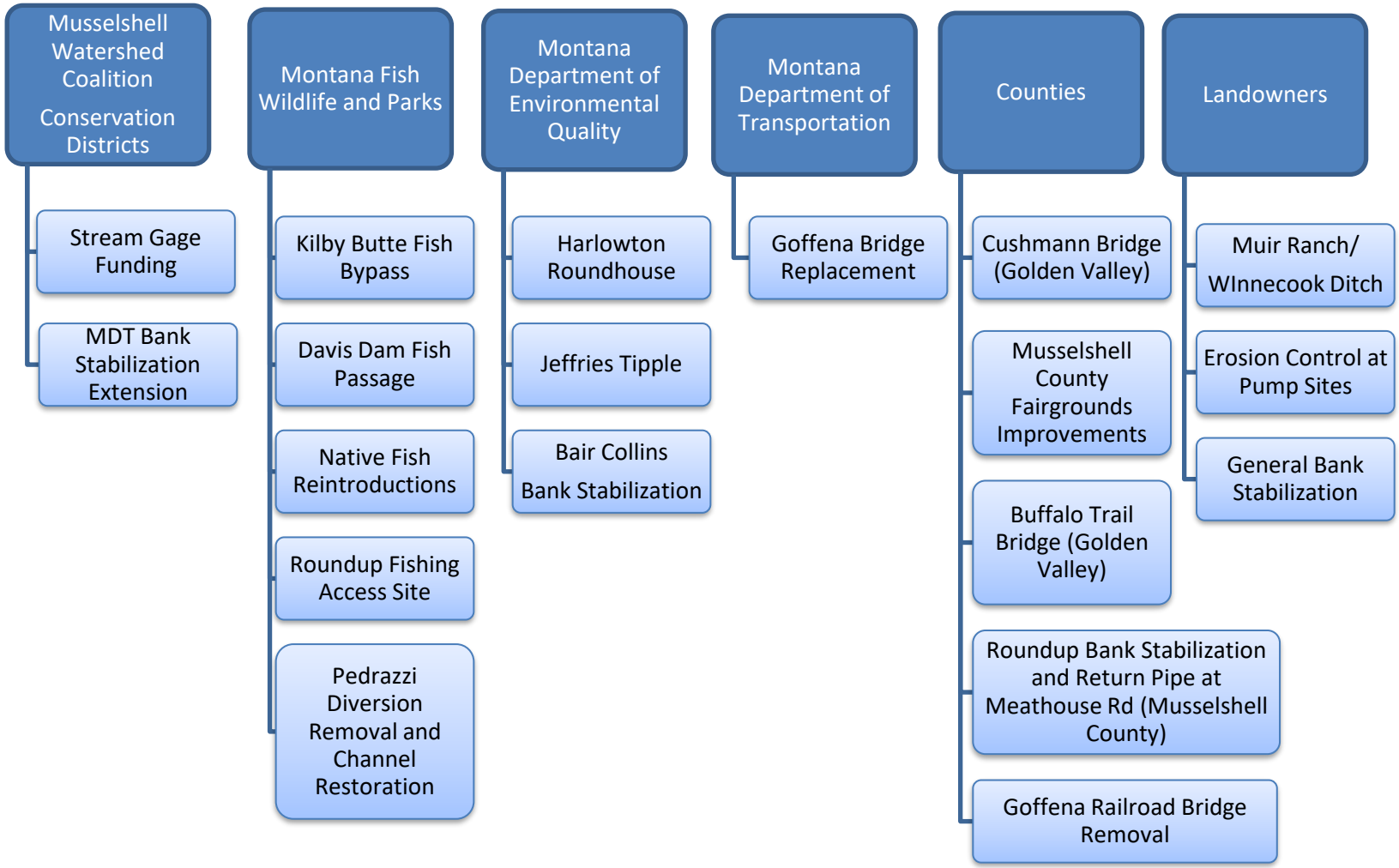


Figure 64. Schematic layout of potential project leads.

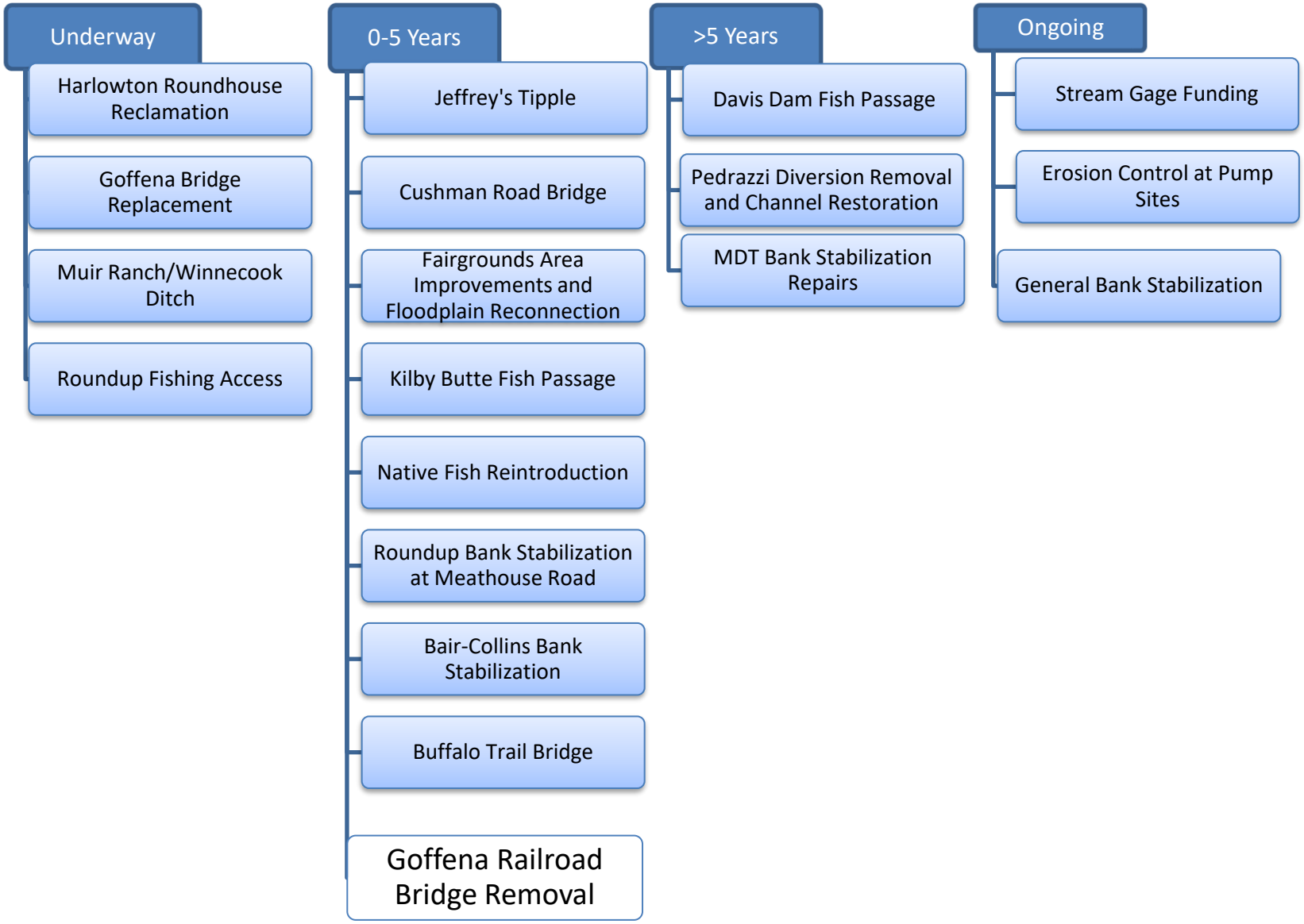


Figure 65. Schematic layout of potential project initiation timelines.

7 Summary

As described in the introduction of this report, Petroleum County received US Bureau of Reclamation WaterSMART funds to achieve the following:

1. Characterize the Musselshell River Watershed
2. Summarize Existing Data and Recent Projects
3. Engage Stakeholders to Identify New Concerns and Project Needs
4. Develop Goals and Identify Solutions
5. Finalize and Release the "Vision 2030 Musselshell Watershed Plan"
6. Develop Preliminary Engineering Designs of Top Projects

This document describes the results of that effort. Since the original plan was finalized in 2015, the watershed has experienced additional severe flooding and drought. The river was still destabilized by the 2011 flood when additional floods followed in 2014 and 2018, driving rapid bank erosion and damaging infrastructure. The Lodgepole Complex fire was the largest of the 2017 wildfire season in the United States, burning 270,723 acres. Challenges clearly persist in the watershed, but the collaboration that has been established between local, state, and federal agencies and watershed residents has allowed a comprehensive and equitable assessment of needs and opportunities throughout the system.

The three Water User Associations in the Musselshell Basin work somewhat independently from the Musselshell Watershed Coalition in terms of project implementation, but each were fully engaged in this process to share their knowledge and understanding of limitations and needs with respect to irrigation infrastructure. State agencies have been deeply involved in the basin, as they own some of the larger irrigation structure components, but also with respect to water quality and drought resiliency planning. The Montana Bureau of Mines and Geology is engaged in salinity studies in the lower river, working with landowners to understand salinity sources and mitigation opportunities, which has had additional involvement from the Montana Salinity Control Association. The NRCS has been active in the development of Targeted Implementation Plans, including one for irrigation efficiencies. The breadth of ongoing projects described in Chapter 3 demonstrates the range of activities that affect an array of primarily water resource management issues, from fish passage to erosion control, floodplain mine waste reclamation, and flood hazard assessment.

Although there is strong momentum for numerous ongoing projects throughout the basin, there are clearly additional unfunded needs. Many projects have some baseline planning/design work completed, but no established resources for implementation. The Water Users Associations have a broad suite of needs that they continue to work on through infrastructure repairs, upgrades, or replacement. The stakeholder group that was convened for this effort generated another 19 projects they consider worthy of pursuit, which again cover a wide range of resource management issues within the Musselshell River corridor. The highest ranked project is to maintain a stable source of stream gage funding on the river, demonstrating the careful attention that the communities and producers pay to water availability and flood risk information. Other projects reflect the specific issues related to things such as bridge stability, fish passage, contaminant remediation, and bioengineered erosion control.

The intent of this document is to provide a management map for the Musselshell River Watershed that identifies vetted project prioritizations, project leads, timeline aspirations, and potential funding sources.

At the time of this project initiation in 2021, the 2015 plan clearly required updating, as 25% of the projects identified as priorities in that effort had been completed, with another 50% underway. This plan is similar in that provides an expanded update of recent projects, as well as a strategy to implementation new project goals that have been locally generated and locally vetted. It also captures the perseverance and dedication of Musselshell Watershed stakeholders towards supporting the ecological function of the Musselshell River and the economic health of its users.

8 References

AGI and DTM, 2017. Musselshell River CMZ Pilot: Technical Memorandum Prepared for Montana Fish Wildlife and Parks, April 10, 2017, 43p.

Allied Engineering Services, Inc. and ERM-West, 2013. Final Technical Report—Davis Irrigation Dam Fish Passage Project, FWP #13-14—Alternatives Analysis Report to Evaluate Retrofit of the Diversion Structure to Provide Fish Passage on the Musselshell River, MT. Report prepared for Montana Fish Wildlife and Parks, 28p.

Beye, W.J.R, 2013. Drought, Flood, Saving, and Sharing: A History of Water Resource Supply, Conservation, and Distribution in the Musselshell River Basin: Report funded by grants from Montana DNRC and The Musselshell Valley Community Foundation, 41p.

Boyd, K., T. Thatcher, W. Kellogg, and G. Austiguy, 2015. Musselshell River Watershed Plan: Report prepared for Petroleum County Conservation District and Musselshell Watershed Coalition, Winnett MT, 81p.

Boyd, K., W. Kellogg, T. Pick, M. Ruggles, and S. Irvin, 2012. Musselshell River Flood Rehabilitation River Assessment Triage Team (RATT) Summary Report: Report prepared for Lower Musselshell Conservation District, Roundup Montana, 112p.

Boyd, K. and W. Kellogg, 2019: River Assessment Triage Team (RATT) Site Report—2018; Muir Ranch: site report prepared for Travis Jacobson and Musselshell Watershed Coalition, 7p.

French, B., 2016. Musselshell Makeover: How the people in this central Montana watershed found a way to share water from- and restore function to- the river running through their lives. Montana Outdoors, May/June 2016.

Graetz, R. and S., 2003. Take a journey down Montana's Musselshell River: Billings Gazette, October 25, 2003.

Hauschild, B., 2020. Salinity in Livestock Ponds Summary Report: report prepared for Musselshell Watershed Coalition, 7p.

Hice, T., 2016. Deadman's Basin Diversion Dam & Headgate Rehabilitation: MADCS Newsletter, 1st Quarter, 2016, Issue 21.

Lower Musselshell Conservation District, 2004. Musselshell River Assessment Report, 57p.

Montana Bureau of Mines and Geology (MBMG), 2020. Groundwater Investigation Program Project Summary Fact Sheet, October 2020, 4p.

Montana Department of Environmental Quality (MTDEQ), 2018. Draft Environmental Assessment-- Bair-Collins Mine Reclamation and Musselshell River Restoration Project, Musselshell County, Montana, December 2018.

Montana Department of Environmental Quality (MTDEQ), 2018. Jeffries No. 18 Mine Tipple Reclamation and Musselshell River Restoration Project, Musselshell County, Montana: Final Environmental Assessment, 18p.

Montana Department of Environmental Quality (MTDEQ), 2021. Musselshell E.coli TMDLs and Water Quality Improvement Plan, Document Number LMO-TMDL-01af.

Montana Department of Natural Resources and Conservation (MTDNRC), 2014. Montana State Water Plan: A Watershed Approach to the 2015 Montana State Water Plan, report prepared for Montana Department of Natural Resources and Conservation, December 2014, 80p.

Montana Department of Natural Resources and Conservation (MTDNRC), 2021. Renewable Resource Grant and Loan Program Project Evaluations and Funding Recommendations for the 2023 Biennium, v. 6.

Montana Department of Natural Resources and Conservation (MTDNRC), 2022. Measuring Montana's Streams: the role of stream gages in managing Montana's water resources, Jan 3, 2022.
https://storymaps.arcgis.com/stories/cad16fffea8942a48b3d0d6caabd636a
Montana Department of Transportation (MDT), 2020. Newsline, June, 2020.

Montana Fish Wildlife and Parks (MTFWP), 2016. "Musselshell Makeover", article by Brett French in Montana Outdoors Magazine (fwp.mt.gov/mtoutdoors).

Morrison-Maierle, Inc. 2014. 90% Design Report—Deadman's Basin Diversion Dam and Headgate Replacement Project: Report prepared for Montana Department of Natural Resources and Conservation, State Water Projects Bureau, 34p.

Musselshell Watershed Coalition (MWC), 2019. Strategic Integrated Weed Management Plan—a Strategy for Integrated Weed Management in the Musselshell River Cooperative Weed Management Area, 11/8/2019.

Natural Resource Conservation Service (NRCS), 2021. Western Bull Mountains Catastrophic Wildfire Fuels Reduction Targeted Implementation Plan, Roundup Field Office., 9p.

Nowlin, L., 2018. "How do I love, thee? Let me count the ways": The Need for Gaging Stations in Montana: Montana Watershed Coordination Council, September 6, 2018.

Pioneer Technical Services (Pioneer), 2016. Roundup Reach Flood Mitigation—Engineering Evaluation and Cost Analysis: Report prepared for Musselshell Watershed Coalition and Lower Musselshell Conservation District, November 2016.

Pioneer Technical (PTI), 2021. Roundup Reach Projects Summary, 2001-2011, report prepared for Musselshell Watershed Coalition, 9p.

Rails to Trails Conservancy, 2004: The Great American Rail-Trail: Milwaukee Road Segment—Montana, Inventory and Assessment Phase I and II, 96p.

United States Bureau of Reclamation (USBR), Montana Department of Natural Resources and Conservation (DNRC), Upper Musselshell Water Users Association, and Deadman's Basin Water User's Association, 1998. Musselshell River Basin Water Management Study, June 1988.

United States Geological Survey (USGS), 2004. Estimated Water Use in Montana in 2000. Scientific Investigations Report 204-5223, 40p.

WWC Engineering, 2009. Preliminary Engineering Report—Horse Creek Coulee Water Storage Project: Report prepared for Petroleum Conservation District and Mosby-Musselshell Watershed Group, 28p.

WWC Engineering, 2018. Inventory and Assessment Report for the Deadman's Basin Water Users Association prepared Lower Musselshell Conservation District.

WWC Engineering, 2021. RRG-21-1781 for Petroleum County Conservation District Horse Creek Coulee Water Storage Phase 1 Renewable Resource Grant Final Report, December 2021.

WWC Engineering, 2021. Harlowton Railyard Concept Plan, Report prepared for Snowy Mountain Development Corporations, September 10, 2021.

PIONEER TECHNICAL SERVICES, INC.

Technical Memorandum

To: Musselshell Watershed Coalition

From: Jon Jupka, P.E., CFM

CC: Karin Boyd and George Austiguy, P.E.

Date: 6/3/2022

Re: Rowton and Cushman Bridge Preliminary Engineering Report

This Memorandum provides preliminary design and cost opinions for (2) projects selected by The Musselshell River Watershed Coalition. Two alternatives are provided for each project. The (2) projects that were evaluated are:

- Rowton Property, and
- Cushman Bridge

Figure 1 shows the projects' locations. Each proposed project's objective, design criteria, method and cost estimate are discussed in this memo.

Rowton Property Bank Restoration

Rowton Property looking North

Background and Objective

In response to the 2011 Musselshell River flood event a meander bend stream bank on the Rowton property experienced significant erosion and migration. Additional high flow events since the 2011 event have continued to erode to the channel banks and the river has migrated to the west and the north. The erosion has resulted in loss of agricultural land and if it continues, may endanger multiple structures on the Rowton property. The project objective is to use vegetation to increase streambank and floodplain roughness. Flattening and vegetating the steep cut bank will help reduce channel migration and provide a more resilient floodplain and streambank. The Rowton property is not located in a regulatory mapped floodplain area of the Musselshell River.

Method

The proposed bank restoration method will involve building a brush matrix bank and grading the steep cut bank back to a milder slope (3 horizontal to 1 vertical [3:1]).

A brush matrix bank treatment consists of constructing a new channel bank with coarse alluvium, dormant willow cuttings and woody debris (branches, roots, or small trees not expected to grow). Once the willow cuttings have been established, they will increase roughness by providing riparian vegetation within the floodplain and streambank. This vegetation will improve bank stability and provide shade/cover, improving aquatic habitat. The woody debris adds roughness to the bank, reducing erosive forces until the willows are established. As part of the brush matrix bank treatment a bench 10-15 feet wide will be constructed at the floodplain elevation to provide additional floodplain conveyance capacity. This bench will be planted with willow cuttings to add floodplain roughness during out of bank flood events. Finally, grading the cut bank to a milder slope and vegetating will provide a more geotechnically stable slope that is easier for vegetation to become established and will help to reduce erosion during flood events.

The brush matrix bank treatment is designed to be constructed to bankfull flow elevation. The brush matrix and bench will be planted with locally harvested willows and the slope will be planted with native grasses. The proposed bank design was based on April 2022 GPS survey data, 2011 LiDAR, and site observations.

Results

Two alternatives were proposed for the Rowton Property Bank restoration project, as shown in Figure 2 and Figure 3. The first alternative would provide bank treatment for the more actively eroding reach of bank. This alternative would start at the meander bend's downstream end and continue ~1,000ft upstream. The second alternative would provide bank treatment for entire ~1,800 ft of eroding meander bend. Two brush matrix bank treatment variations are proposed. For areas that are expected to see higher erosive forces an erodible rock toe will be placed in the channel beneath the brush matrix. This rock toe is intended to withstand more frequent flood events but can be mobilized at less frequent flood events. This will provide a better chance for the new vegetation to establish, while still allowing the river the ability to adjust during large flood events. Figure 7 shows the typical brush matrix bank treatments. Additional detailed survey and engineering analysis will be required for final construction level design.

The brush matrix bank treatment is proposed as a bank restoration technique. Per the State of Montana Model Floodplain Ordinances Section 9.14 stream bank restoration is categorized as "*projects intended to reestablish the terrestrial and aquatic attributes of a natural stream and not for protection of a structure or development*". The Rowton bank restoration is not intended or designed to protect a structure but to reduce future erosion and improve aquatic and riparian habitat by promoting vegetation. The bank treatments are not designed to

withstand a specific flow but will be designed to "*not increase velocity or erosion upstream, downstream, across from or adjacent to the site;*" (ARM 36.15.606(1)(b)). A floodplain permit and approval will be required as part of the project permits.

A feasibility level cost opinion (+25%) was developed based on the preliminary design. The cost opinion assumes cut material will be disposed of locally, fill material will be available locally and willow cuttings can be harvested on or near the site. Due to the cut banks height a large volume of bank material will need to be excavated. Installing a narrower bench may save cost on the overall project. The total cost could be reduced by using volunteer labor to harvest and plant the willows.

Where available, local rates were used to calculate the expected costs. Where local data was not readily available costs from RS Means and other similar projects were used for the estimate. The cost opinion includes cost of construction and a 25% contingency.

Table 1 and Table 2 summarizes the itemized breakdown of the total feasibility cost opinion for Alternative 1 at $165,100 and Alternative 2 at $245,500, respectfully.

Cushman Bridge

Cushman Bridge Site Looking West

Background and Objective

When the Cushman Bridge was installed, the Musselshell River upstream of the crossing was relatively straight and streamflow traveled perpendicular to Cushman Road. Since the 2011 flood event, the south bank has started eroding as the river attempts to lengthen. The river has abandoned the old channel and now flows in a new channel to the south and has created a meander bend just west of Cushman Road (Figure 4). The erosion has resulted in loss of land and if continues, may endanger Cushman Road. The project objective is to reduce the erosion potential, improve aquatic and riparian habitat, and improve the hydraulic bridge approach. The Cushman Bridge site objective will be to have a less deformable toe than Rowton, the degree of protection will be determined by stake holders during final design. The Cushman Bridge is in a mapped Zone AE (no Floodway) reach of the Musselshell River.

Method

Two alternatives were analyzed for the Cushman Bridge site.

The first alternative consists of a similar brush matrix bank treatment as proposed for on the Rowton Property (Figure 6), new bank will be constructed with coarse alluvium, willow cuttings and woody debris. The treatment will also include a small bench (10'-15') with willow cuttings and grading the steep cut bank back to a milder slope (3 horizontal to 1 vertical [3:1]). The brush matrix bank treatment will be placed near bankfull flow elevation and planted with locally harvested willow cuttings (Figure 5).

The second alternative would realign the river back into the abandoned channel with the use of a large woody debris plug and new channel banks would be constructed using the brush matrix bank treatment (Figure 6).

A large woody debris plug is an embankment placed in the active river channel to divert the flow into a newly constructed or re-activated channel. Large logs and/or root wads will be partially embedded within the embankment with the root ball side exposed to the river (Figure 8). The roughness from the woody debris provides habitat and reduces the erosive forces on the plug to help establish the new channel.

Excess material from the re-activated channel excavation will be placed in the current active channel to create a floodplain and wetland areas. Locally harvested willow clumps (large, salvaged willow plants) will be placed in the new floodplain. The existing cut bank to the south will be graded back to a 3:1 slope and seeded to reduce the chance of additional erosion during large flood events. Both proposed alternatives were based on April 2022 GPS survey data, 2011 LiDAR, and site observations.

Results

The first alternative would provide bank treatment for approximately 475 feet. Figure 7 shows the typical brush matrix bank treatment. This alternative would not move the river from its current alignment. Additional detailed survey and engineering analysis will be required for final construction level design.

For the second alternative approximately 500 feet of channel will be re-constructed to realign the channel to the pre-2011 channel alignment. A brush matrix bank treatment will be installed on both relocated channel banks where erosive forces are expected to occur. The existing cut bank would be graded and seeded. Additional detailed survey and analysis will be required for final construction level design.

Both alternatives could be considered streambank restoration projects as discussed above for the Rowton Project or designed as bank stabilization protecting the bank for flows up to the 100-year storm event. Since the

Cushman Bridge site falls within a mapped Zone AE flood zone and encroachment analysis will be required along with the project permits. The first alternative may allow for a less expensive qualitative encroachment analysis (if treated as a bank restoration project).

The second alternative would require placing fill in the existing channel and construction within an effective Special Flood Hazard Area. The placement of fill and channel re-alignment will require a quantitative encroachment analysis to demonstrate the re-aligned channel will not raise the BFE water surface more than 0.5 feet during a 100-year storm event. In addition to the encroachment analysis, placing fill within the active channel will require approval from the Army Corps of Engineers. Both additional requirements will be addressed under the Joint Application permits but will require extra design effort and federal agency approval to proceed.

A feasibility level cost opinion (+25%) was developed based on the preliminary design. The cost opinion assumes cut material will be reused to fill in the channel and willow cuttings/clumps can be harvested on or near the site. The total cost may be reduced by using volunteer labor to harvest and plant the willows. Reinforcing the toe to withstand the 100-year storm event would add additional cost for the larger stone.

When available, local rates were used to calculate the expected costs. Where local data was not readily available costs from RS Means and other similar projects were used for the estimate. The cost opinion includes cost of construction and a 25% contingency.

Table 3 and Table 4 summarizes the itemized breakdown of the total feasibility cost opinion for Alternative 1 at $92,800 and Alternative 2 at $176,100 respectfully.

Tables

Table 1 - Rowton Property Alternative #1

Project: **Rowton Property**
Date: **6/1/2022**

Work Item	Desc.	Unit	Quantity	Unit Cost	Total Cost	Notes
	Alternative #1 - Construction Costs					
1	Mobilization	LS	1	$ 12,500	$ 12,500	Includes all prep work for transport and movement of personal, equipment, supplies and incidentals to/from the project site.
1a	Bonding	LS	1	$ 4,800	$ 4,800	Construction Bonding 5% of project total
2	Water Management	LS	1	$ 1,000	$ 1,000	Includes work area stormwater management and sediment control
3	Bank Treatment					Includes brush matrix bank construction, bank excavation, slope grading, fill materials, plantings, seeding and labor
3a	Type 1 Bank Treatment	LS	1	$ 17,000	$ 17,000	Brush matrix construction with native toe (490 lf, ~$34.75/ft)
3b	Type 2 Bank Treatment	LS	1	$ 20,000	$ 20,000	Brush matrix construction with cobble toe (510 lf, ~39.25/ft)
3c	Excavation, Grading, Miscellaneous	LS	1	$ 46,500	$ 46,500	Bank excavation, slope grading, fill materials, plantings, seeding
	Construction Subtotal				**$ 101,800**	
	Construction Contingency				**$ 25,450**	25% construction cost contingency
	Construction Total				**$ 127,250**	Total construction cost estimate with 20% contingency.
	Alternative #1 - Engineering Costs					
4	Final Design and Permitting	T&M			**$ 20,200**	Includes finalizing (100%) construction drawings and specifications, Bid package support, attendance at Pre-bid Meeting and issue clarifications\addenda to the bid documents as needed.
5	Construction Services	T&M			**$ 17,600**	Includes Design Engineer or Engineer Representative on-site inspections during river diversion, for milestone inspection and support ,(6 days total) substantial completion, submittal reviews, design clarifications\adjustments and pay request reviews.
	Rowton Alternative #1 Total[1]				**$ 165,100**	

1 Rounded up to the nearest $100

Table 2 - Rowton Property Alternative #2

Project: **Rowton Property**
Date: **6/1/2022**

Work Item	Desc.	Unit	Quantity	Unit Cost	Total Cost	Notes
	Alternative #2 - Construction Costs					
1	Mobilization	LS	1	$ 17,900	$ 17,900	Includes all prep work for transport and movement of personal, equipment, supplies and incidentals to/from the project site.
1a	Bonding	LS	1	$ 7,700	$ 7,700	Construction Bonding 5% of project total
2	Water Management	LS	1	$ 2,000	$ 2,000	Includes work area stormwater management and sediment control
3	Bank Treatment					Includes brush matrix bank construction, bank excavation, slope grading, fill materials, plantings, seeding and labor
3a	Type 1 Bank Treatment	LS	1	$ 35,400	$ 35,400	Brush matrix construction with native toe (1,020 lf, ~$34.75/ft)
3b	Type 2 Bank Treatment	LS	1	$ 30,600	$ 30,600	Brush matrix construction with cobble toe (780 lf, ~39.25/ft)
3c	Excavation, Grading, Miscellaneous	LS	1	$ 69,300	$ 69,300	Bank excavation, slope grading, fill materials, plantings, seeding
	Construction Subtotal				**$ 162,900**	
	Construction Contingency				**$ 40,725**	25% construction cost contingency
	Construction Total				**$ 203,625**	Total construction cost estimate with 20% contingency.
	Alternative #2 - Engineering Costs					
4	Final Design and Permitting	T&M			**$ 20,200**	Includes finalizing (100%) construction drawings and specifications, Bid package support, attendance at Pre-bid Meeting and issue clarifications\addenda to the bid documents as needed.
5	Construction Services	T&M			**$ 21,600**	Includes Design Engineer or Engineer Representative on-site inspections during river diversion, for milestone inspection and support ,(10 days total) substantial completion, submittal reviews, design clarifications\adjustments and pay request reviews.
				Rowton Alternative #2 Total[1]	**$ 245,500**	

1 Rounded up to the nearest $100

Table 3 - Cushman Bridge Alternative #1

Project: **Cushman Bridge**
Date: **6/1/2022**

Work Item	Desc.	Unit	Quantity	Unit Cost	Total Cost	Notes
	Alternative #1 - Construction Costs					
1	Mobilization	LS	1	$ 7,800	$ 7,800	Includes all prep work for transport and movement of personal, equipment, supplies and incidentals to/from the project site.
1a	Bonding	LS	1	$ 2,200	$ 2,200	Construction Bonding 5% of project total
2	Water Management	LS	1	$ 600	$ 600	Includes work area stormwater management and sediment control
3	Bank Treatment					Includes brush matrix bank construction, bank excavation, slope grading, fill materials, plantings, seedings and labor
3a	Type 1 Bank Treatment	LS	1	$ 9,600	$ 9,600	Brush matrix construction with native toe (275 lf, ~$34.75/ft)
3b	Type 2 Bank Treatment	LS	1	$ 7,900	$ 7,900	Brush matrix construction with cobble toe (200 lf, ~39.25/ft) [Type 2 bank treatment costed with cobbles, larger, less mobile stone will add cost to bank treatment]
3c	Excavation, Grading, Miscellaneous	LS	1	$ 19,400	$ 19,400	Bank excavation, slope grading, fill materials, plantings, seeding
	Construction Subtotal				**$ 47,500**	
	Construction Contingency				**$ 11,875**	25% construction cost contingency
	Construction Total				**$ 59,375**	Total construction cost estimate with 20% contingency.
	Alternative #1 - Engineering Costs					
4	Final Design and Permitting	T&M			**$ 17,800**	Includes finalizing (100%) construction drawings and specifications, Bid package support, attendance at Pre-bid Meeting and issue clarifications\addenda to the bid documents as needed.
5	Construction Services	T&M			**$ 15,600**	Includes Design Engineer or Engineer Representative on-site inspections during river diversion, for milestone inspection and support ,(4 days total) substantial completion, submittal reviews, design clarifications\adjustments and pay request reviews.
				Cushman Alternative #1 Total[1]	**$ 92,800**	

1 Rounded up to the nearest $100

Table 4 - Cushman Bridge Alternative #2

Project: **Cushman Bridge**
Date: **6/1/2022**

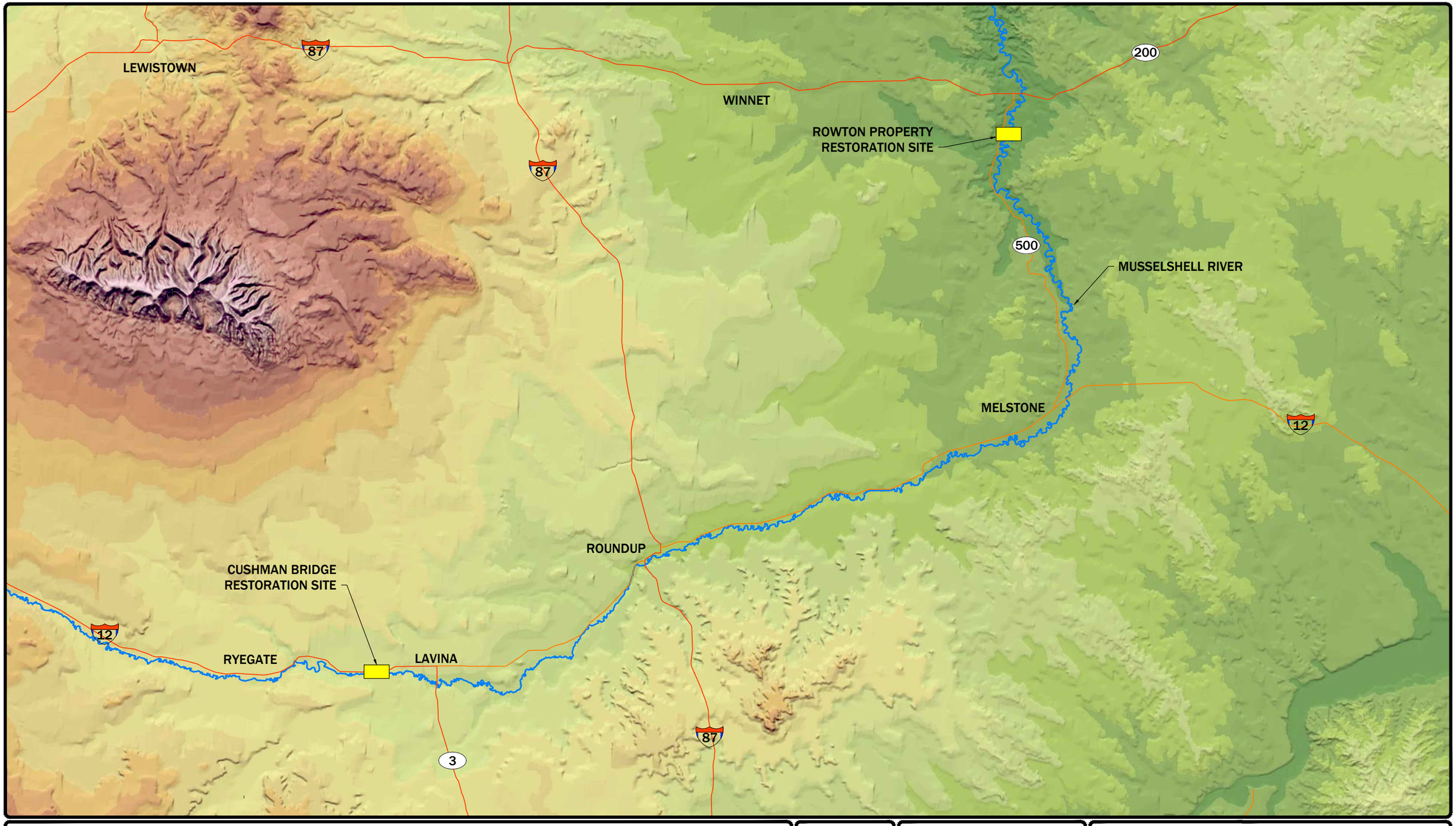
	Alternative #2 - Construction Costs					
Work Item	**Desc.**	**Unit**	**Quantity**	**Unit Cost**	**Total Cost**	**Notes**
1	Mobilization	LS	1	$ 9,400	$ 9,400	Includes all prep work for transport and movement of personal, equipment, supplies and incidentals to/from the project site.
1a	Bonding	LS	1	$ 4,800	$ 4,800	Construction Bonding 5% of project total
2	Water Management	LS	1	$ 3,600	$ 3,600	Includes work area dewatering, stormwater management and sediment control
3	Channel Construction					Includes channel excavation, brush matrix bank construction, and slope grading
3a	Type 1 Bank Treatment	LS	1	$ 5,200	$ 5,200	Brush matrix construction with native toe (185 lf, ~$28.00/ft)
3b	Type 2 Bank Treatment	LS	1	$ 10,300	$ 10,300	Brush matrix construction with cobble toe (320 lf, ~32.25/ft) [Type 2 bank treatment costed with cobbles, larger, less mobile stone will add cost to bank treatment]
3c	Excavation, Grading, Miscellaneous	LS	1	$ 27,900	$ 27,900	Channel excavation and slope grading
4	Active Channel Plug and Backfill	LS	1	$ 40,800	$ 40,800	Includes fill materials, constructing channel plug, backfill, habitat grading, plantings, seedings and labor
	Construction Subtotal				**$ 102,000**	
	Construction Contingency				**$ 25,500**	25% construction cost contingency
	Construction Total				**$ 127,500**	Total construction cost estimate with 20% contingency.

	Alternative #2 - Engineering Costs					
4	Final Design and Permitting	T&M			**$ 27,000**	Includes finalizing (100%) construction drawings and specifications, Bid package support, attendance at Pre-bid Meeting and issue clarifications\addenda to the bid documents as needed.
5	Construction Services	T&M			**$ 21,600**	Includes Design Engineer or Engineer Representative on-site inspections during river diversion, for milestone inspection and support ,(10 days total) substantial completion, submittal reviews, design clarifications\adjustments and pay request reviews.

1 Rounded up to the nearest $100

Cushman Alternative #2 Total[1] **$ 176,100**

Figures



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DATUM: NAD83/NAVD88
UNITS: INTL. FEET
SOURCE: PIONEER

SCALE IN FEET
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FIGURE 1

ROWTON AND CUSHMAN BRIDGE SITE LOCATION

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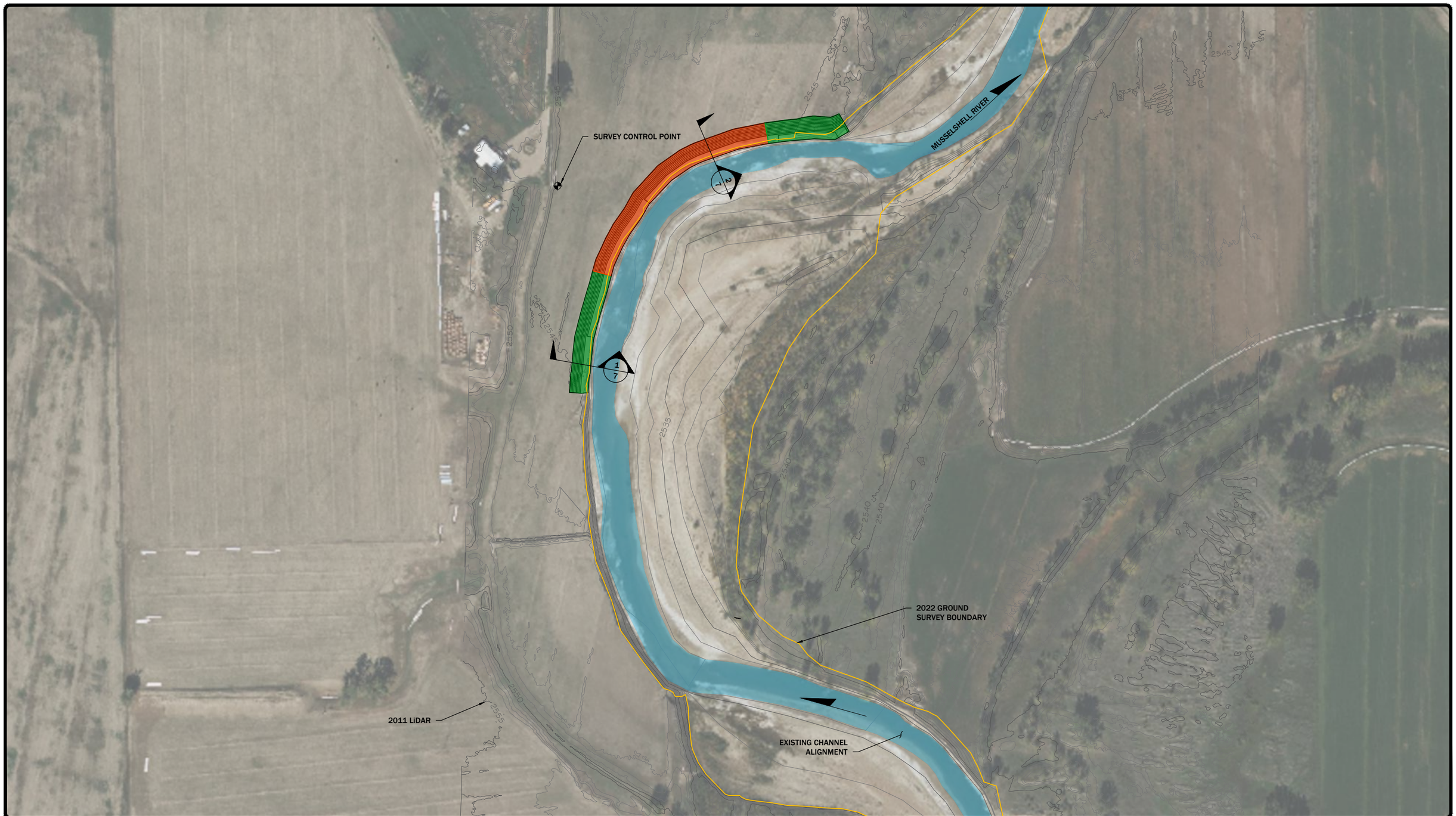

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- TYPE 1 BANK TREATMENT
- TYPE 2 BANK TREATMENT

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UNITS: INTL. FEET
SOURCE: PIONEER, BING

SCALE IN FEET
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FIGURE 2

ROWTON PROPERTY
BANK RESTORATION
ALTERNATIVE 1
PLAN VIEW

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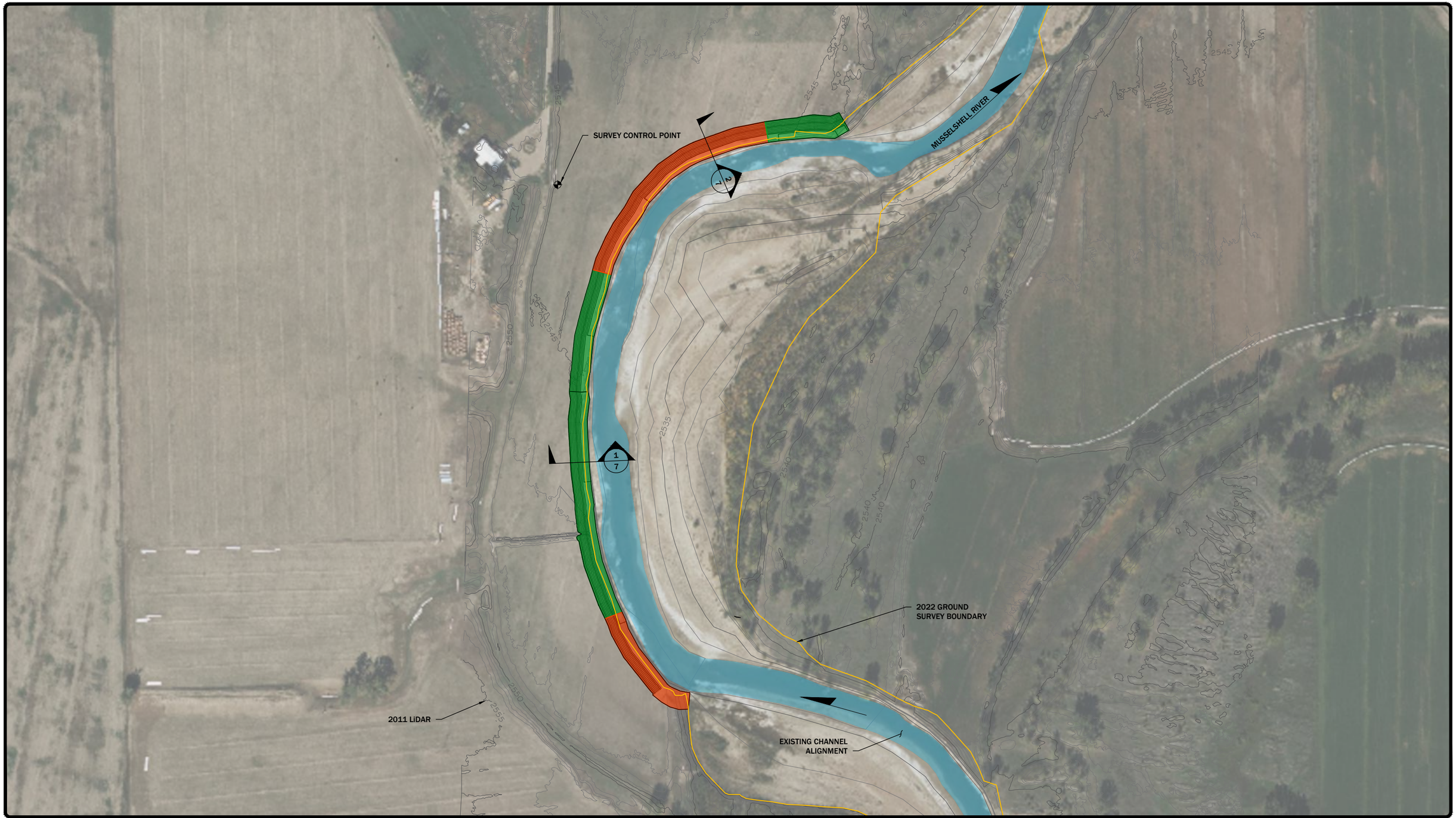

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DATUM: NAD83/NAVD88
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FIGURE 3

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ROWTON PROPERTY BANK RESTORATION ALTERNATIVE 2 PLAN VIEW

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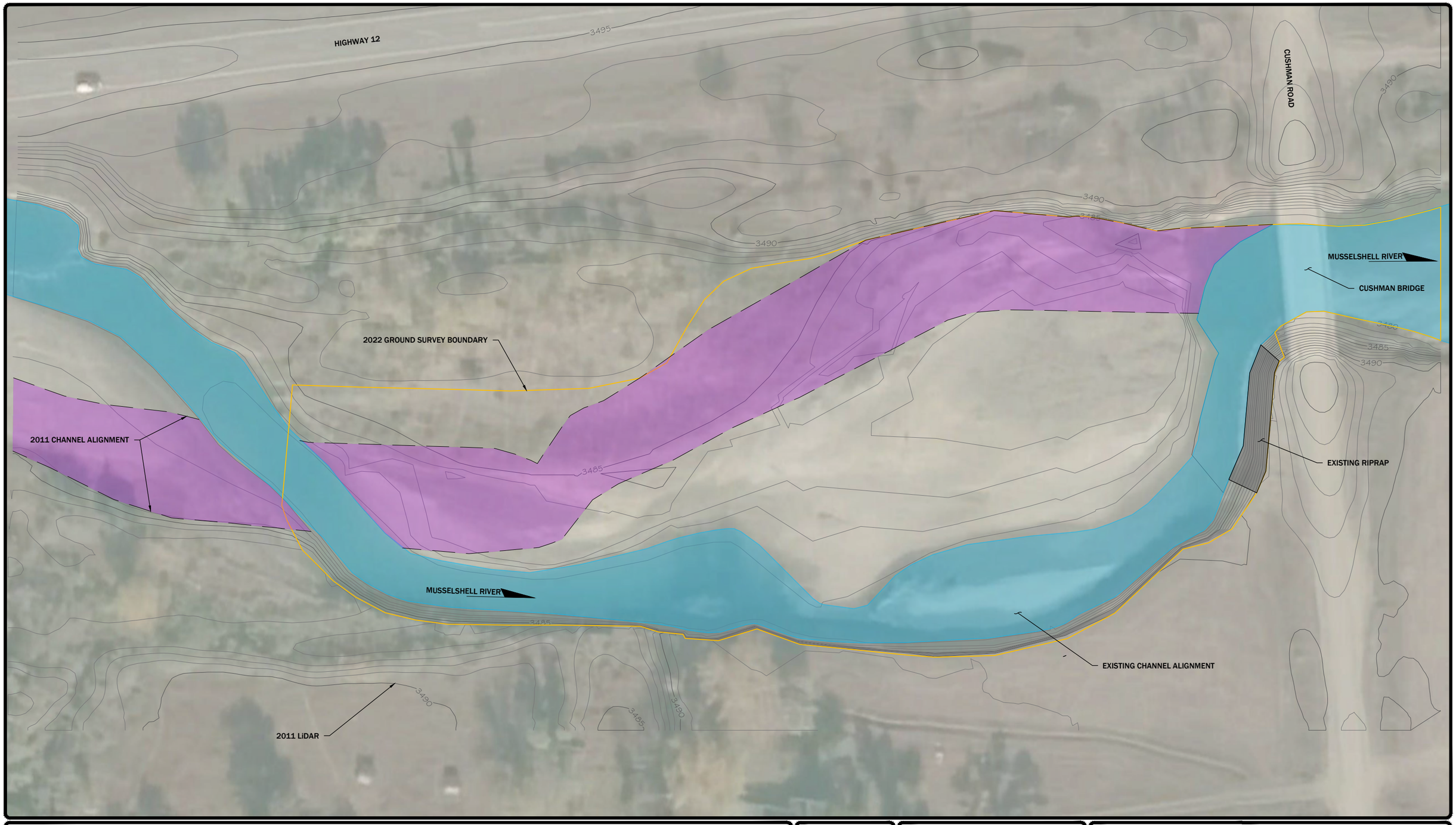

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UNITS: INT. FEET
SOURCE: PIONEER

SCALE IN FEET
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FIGURE 4

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CUSHMAN BRIDGE SITE MAP EXISTING CONDITIONS

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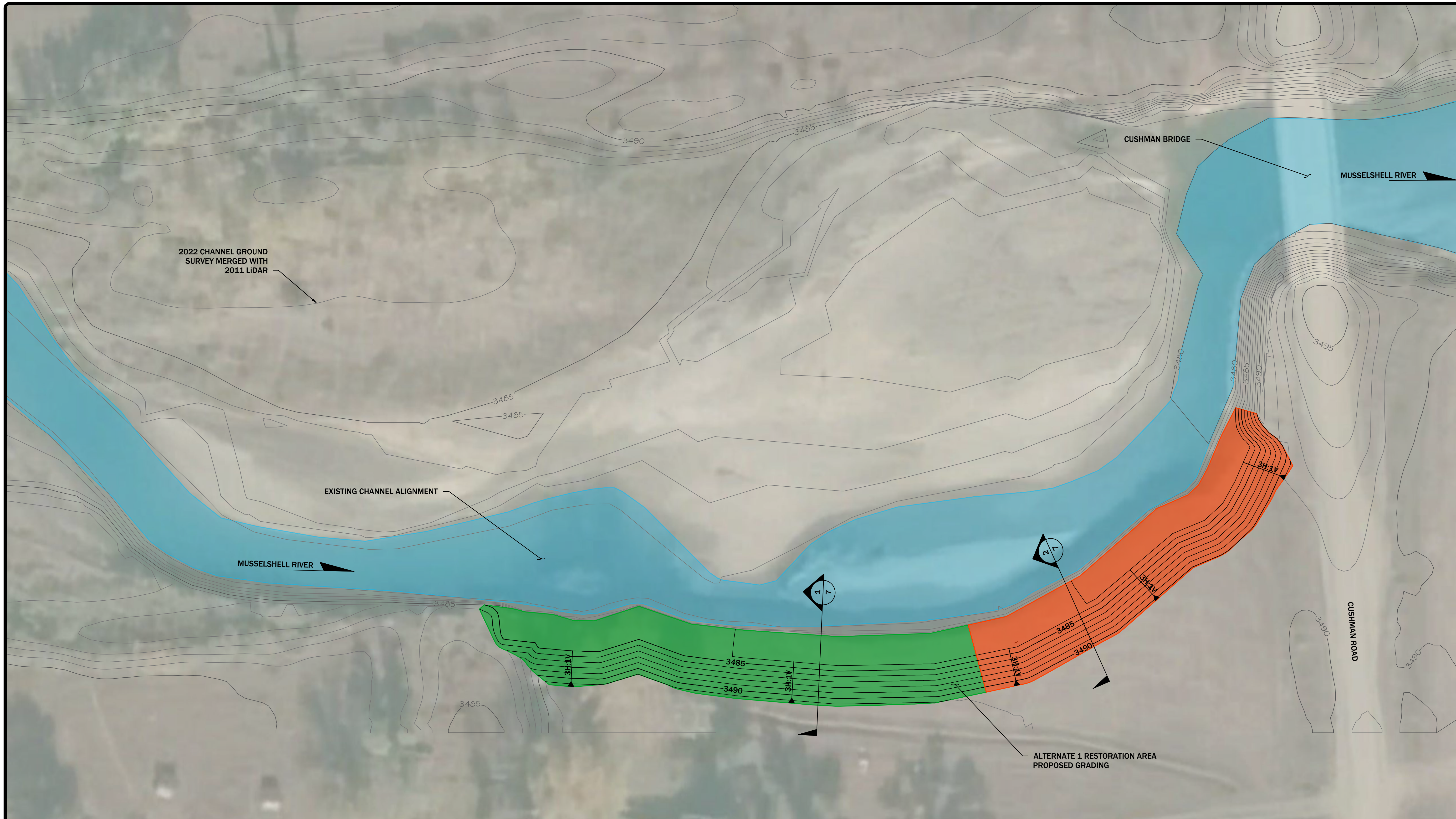

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TYPE 2 BANK TREATMENT

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DATUM:	NAD83/NAVD88
UNITS:	INT. FEET
SOURCE:	PIONEER

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FIGURE 5

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CUSHMAN BRIDGE BANK RESTORATION ALTERNATIVE 1 PLAN VIEW

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HIGHWAY 12

CUSHMAN BRIDGE

MUSSELSHELL RIVER

RE-ALIGNED MUSSELSHELL RIVER

PROPOSED CHANNEL
RE-ALIGNMENT GRADING

WILLOW CLUMPS

LEAVE EXISTING
CHANNEL TO CREATE
BACKWATER AREA

2022 CHANNEL GROUND
SURVEY MERGED WITH
2011 LiDAR

MUSSELSHELL RIVER

LEAVE PORTION OF
EXISTING CHANNEL
TO CREATE WETLAND

LARGE WOODY DEBRIS/
VEGETATION ON FACE OF PLUG

PROPOSED LARGE
WOODY DEBRIS PLUG

CUSHMAN ROAD

3495 3490 3485 3484 3483 3482 3481 3480

LEGEND:

- TYPE 1 BANK TREATMENT
- TYPE 2 BANK TREATMENT
- ALTERNATIVE 2 RESTORATION AREA PROPOSED GRADING

N

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DATUM:	NAD83/NAVD88
UNITS:	INT. FEET
SOURCE:	PIONEER

SCALE IN FEET
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FIGURE 6

CUSHMAN BRIDGE BANK RESTORATION ALTERNATIVE 2 PLAN VIEW

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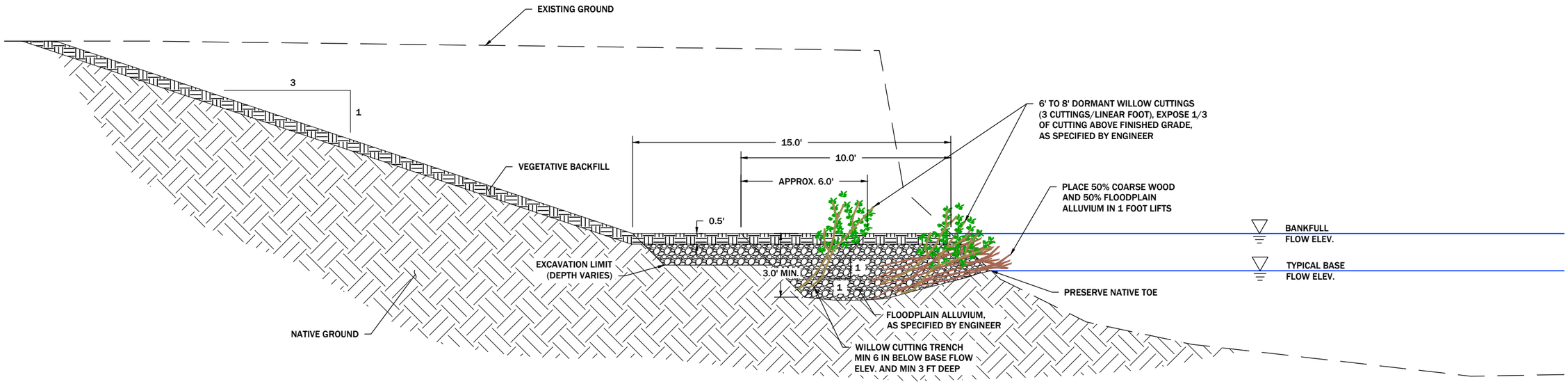
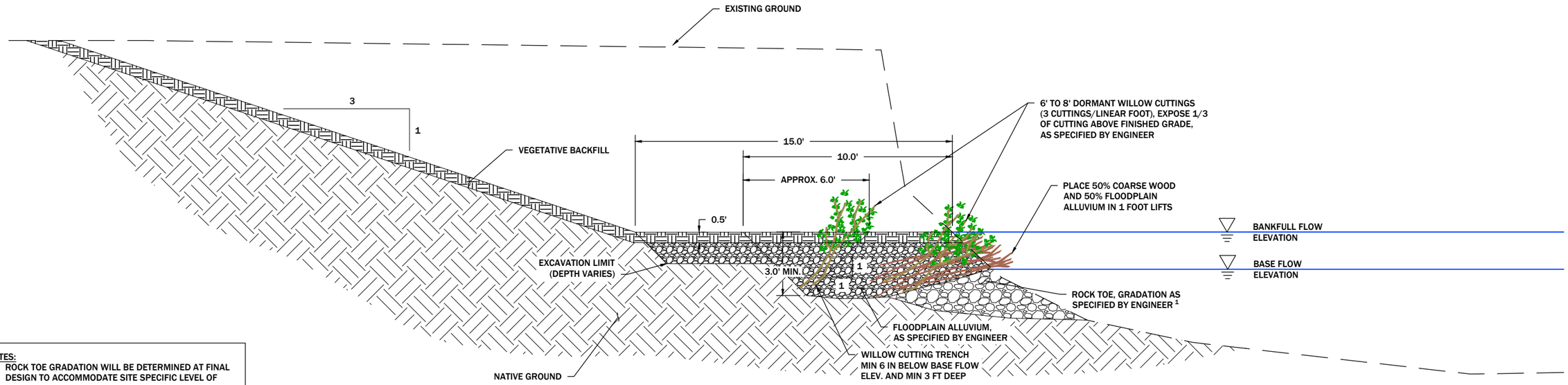


TYPE 1 BANK TREATMENT

1

TYPICAL SECTION
SHEETS: 2, 3, 5, 6
N.T.S.



NOTES:
1. ROCK TOE GRADATION WILL BE DETERMINED AT FINAL DESIGN TO ACCOMMODATE SITE SPECIFIC LEVEL OF DEFORMABLILITY/PROTECTION.

TYPE 2 BANK TREATMENT

2

TYPICAL SECTION
SHEETS: 2, 3, 5, 6
N.T.S.

DISPLAYED AS:
COORD SYS/ZONE: NA
DATUM: NA
UNITS: FEET
SOURCE: PIONEER

SCALE IN FEET
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FIGURE 7

BRUSH MATRIX
BANK TREATMENT
TYPICAL SECTIONS

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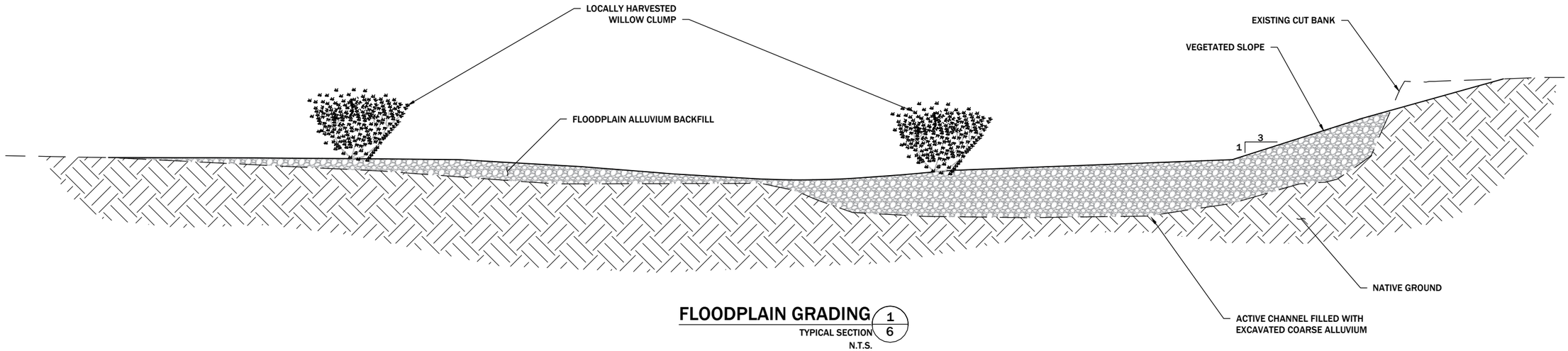
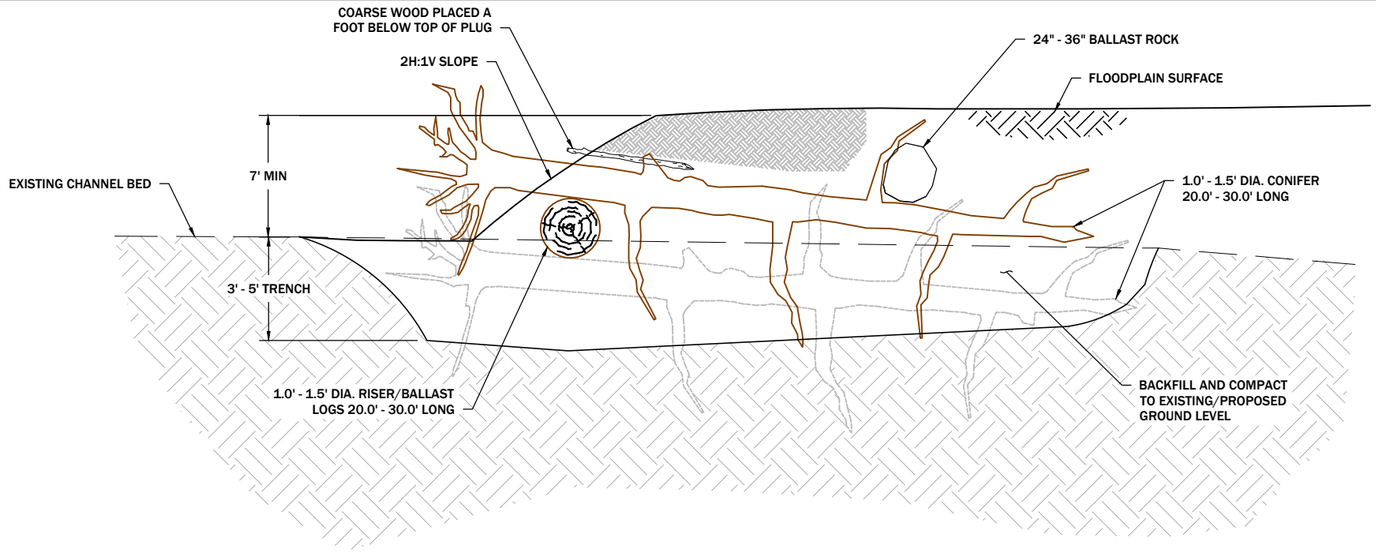


FLOODPLAIN GRADING 1/6

TYPICAL SECTION

N.T.S.



LARGE WOODY DEBRIS PLUG 2/6

TYPICAL SECTION

N.T.S.

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COORD SYS/ZONE: NA

DATUM: NA

UNITS: FEET

SOURCE: PIONEER

SCALE IN FEET

0 NA

FIGURE 8

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CUSHMAN BRIDGE FLOODPLAIN GRADING AND LWD PLUG TYPICAL SECTIONS

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Appendix B: Summary of Potential Funding Sources

Numerous federal, state, and local programs are available to government entities, NGOs, and private landowners to assist with project funding. Many programs change from year to year or with each new Farm Bill, so it is best to check with the appropriate agencies to determine which program best suits a particular restoration need and the applicable timelines. Several funding sources require substantial cost-share, so it is commonly best to pursue multiple sources, especially for larger projects.

More detailed information can be found at each agency's website as noted below. A table is included at the end of this section with expanded information on funding limits and timelines.

B.1 American Rescue Plan Act (ARPA)

In March, the American Rescue Plan Act of 2021 (ARPA) allocated $350 billion for infrastructure improvements across the country. The rules for allocating ARPA funds were outlined in Montana HB 632 which appropriates $2.1 billion for use in Montana. HB 632 created four commissions with oversight over federal EPA funds, including an "Infrastructure Advisory Commission" which is staffed by the DNRC. This commission will likely be the most relevant to future work on the Musselshell River, as it assigns $582 million towards Infrastructure and State/Local Water and Wastewater projects. More information on accessing ARPA funds can be found at www.arpa.mt.gov.

B.2 Infrastructure Investment and Jobs Act (IIJA)

In November of 2021, the Federal Government allocated nearly $1.2 trillion towards Infrastructure Investment and Jobs Act (IIJA) which may also be relevant to Musselshell River corridor work.

The following is a description from DNRC as to how IIJA funds may be accessed in Montana (DNRC, 2022):

Unlike ARPA, the majority of IIJA will not be delivered directly to states for use determination, distribution, and implementation. Funds are allocated according to a formula and distributed through cabinet-level agencies. Communities likely will not have similar outreach as with ARPA. The Montana legislature is not in session during 2022, so the state is unable to allocate IIJA funds until next session. Community officials seeking IIJA resources may need to proactively initiate dialog with state and federal agencies. The US Conference of Mayors drafted a federal investment guide for local leaders. Likewise, the National Association of Counties drafted a list of the major provisions for counties. Communities can prepare to compete for or implement incoming IIJA funds by prioritizing infrastructure deficiencies, identifying actionable solutions, and strengthening relationships with relevant state and federal agencies.

B.3 US Department of Interior

Bureau of Reclamation WaterSMART Program

The WaterSMART program administered by the Bureau of Reclamation (BOR) includes program funding for water efficiency improvements, drought resiliency and planning projects, environmental water

resource projects, and watershed management. Between January 2021 and spring of 2022, the BOR selected 255 projects to be funded with $93 million in WaterSMART funding, in conjunction with $314 million in non-federal funding across the western states.

A WaterSMART grant was awarded to the Petroleum County Conservation District to fund this Watershed Plan Update.

B.4 United States Department of Agriculture

The USDA often creates unique programs to address specific resource concerns within a particular area such as in a flood-affected watershed. It is always best to check with the local USDA Service Center to find what programs are available and which program will work best for you. The USDA assistance programs most commonly used in support of water resource management are described below.

Montana Focused Conservation: NRCS Regional Conservation Partnership Program (RCPP)

The Regional Conservation Partnership Program (RCPP) promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements.

Assistance is delivered in accordance with the rules of EQIP, CSP, ACEP and HFRP; and in certain areas the Watershed Operations and Flood Prevention Program.

The RCPP program provides funding work for Critical Conservation Areas (CCAs), providing opportunities for many stakeholders to come together to address common natural resource goals while maintaining or improving agricultural productivity. Partners, working closely with producers and communities, define and propose projects that will achieve collective natural resource goals while also meeting complementary local conservation priorities. Some of the eligible partners are producer associations, state or local governments, and water and irrigation districts.

The Musselshell Watershed is part of the geographic footprint established for the ongoing RCPP developed for Saline Seep Reclamation; the NRCS lead partner for the RCPP is the Montana Salinity Control Association.

https://www.nrcs.usda.gov/wps/portal/nrcs/mt/programs/financial/rcpp/9aa43aef-a460-4a07-ab1f-ab6ff135be69/

Montana Focused Conservation: NRCS Targeted Implementation Plan (TIPs)

The NRCS has a program called "Montana Focused Conservation" that begins with county-level Long Range Plans. Based on those plans, the NRCS can create Targeted Implementation Plans (TIPs) to guide project implementation. Currently active TIPs in the Musselshell Watershed include the following:

- Musselshell River Irrigation Efficiency
- Central Bull Mountains Catastrophic Wildfire Fuels Reduction Project southeast of Roundup
- Western Bull Mountains Catastrophic Wildfire Fuels Reduction Project southwest of Roundup

- Judith Gap Grassland Conservation Project
- Southwestern Wheatland County Noxious Weed Treatment Project
- Tin Can Hill Road Fuels Reduction Project north of Winnett
-

USDA Rural Development

The USDA Rural Development Program invests in businesses and infrastructure in Montana. These improvements include water infrastructure-related grant assistance. The Water and Waste Disposal Gant and Loan Program, for example, provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and storm water drainage to households and businesses in eligible rural areas. These funding sources could potentially be accessed to protect public water or sewer systems along the Musselshell River. Most state and local entities, private non-profits, and federally-recognized tribes can apply.

In 2020 the USDA announced a $1.3 million investment to modernize critical wastewater infrastructure in Harlowton. The project includes a $750,000 loan and $596,00 grant to finance improvements to the City of Harlowton's wastewater system including an ultraviolet disinfection system, a non-potable water system, sludge removal, and telemetry.

In April of 2022 the USDA announced an $800 million investment into climate-smart infrastructure in forty states, which includes funding for Montana's rural small business to purchase and install renewable energy systems and make energy efficiency improvements.

More information can be found at: http://www.rd.usda.gov/programs-services.

NRCS Emergency Watershed Protection Program (EWP)

The NRCS Emergency Watershed Protection (EWP) Program may be available for local sponsors (units of government and irrigation districts only) to aid in recovery work on private and public property following a natural disaster. NRCS provides technical and financial assistance, and fifty percent matching funds are required to install measures that reduce post-flood and fire damage. The measures are intended to reduce threats to life or property, retard runoff, restore capacity of waterways, prevent flooding and/or soil erosion and reduce damage from sediment and debris. The removal of debris deposited by the disaster that is a health or safety hazard can be a part of such measures as well.

Information regarding the application process and contacts is at:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/programs/planning/ewpp/.

NRCS Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program, administered by NRCS, for farmers and ranchers who face serious threats to soil, water, and related natural resources. EQIP provides technical and financial assistance to deal with significant conservation needs in targeted

areas. Areas with severe damage to the floodplain are targeted. Conservation practices such as fences, access control, watering facilities, critical area plantings, riparian area recovery, and weed control are typically offered to allow for the recovery of the floodplain.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/programs/financial/eqip/

After the 2011 flood, landowners in the Musselshell River corridor took advantage of EQIP funds to grow cover crops on fields eroded by the flood. EQIP funds were also used in the Musselshell after the 2011 flood to create an incentive program for landowners to protect flood-related cottonwood regeneration.

NRCS Wetlands Reserve Enhancement Partnership (WREP)

The Wetlands Reserve Enhancement Partnership (WREP), administered by NRCS, is a voluntary conservation program that offers landowners the means to restore, enhance, and protect wetlands on their property through permanent easements. Easements can be placed to protect the agricultural use and conservation values of eligible land. The NRCS also provides technical and financial assistance to private landowners and Indian tribes to restore, protect, and enhance wetlands through the purchase of a wetland reserve easement.
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/easements/acep/?cid=stelprdb1242695.

FSA Continuous Conservation Reserve Program (CCRP)

The Continuous Conservation Reserve Program (CCRP), administered by FSA, is a voluntary program for eligible, agricultural landowners. CCRP protects millions of acres of topsoil from erosion and is designed to safeguard the Nation's natural resources. Through CCRP, a landowner can receive annual rental payments and cost-share assistance to establish long-term, resource conserving covers on eligible farmland. Environmentally desirable land devoted to certain conservation practices may be enrolled at any time under CCRP continuous sign-up. Certain eligibility requirements still apply, but offers are not subject to competitive bidding. Cropland, including field margins, planted or considered planted to an agricultural commodity or marginal pastureland that is suitable for use as a riparian buffer (the vegetated area next to a river or stream) or for similar water quality purposes, may be eligible.

More information can be found at: http://www.fsa.usda.gov/mt.

FSA Emergency Conservation Program (ECP)

The USDA Farm Service Agency's (FSA) Emergency Conservation Program (ECP) provides emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland damaged by natural disasters and for carrying out emergency water conservation measures in periods of severe drought. Funding for ECP is appropriated by Congress. More information can be found at:
http://www.fsa.usda.gov/FSA/ .

B.5 United States Fish and Wildlife Service State Wildlife Grant Program (SWG)

The State Wildlife Grants program provides federal grant funds for developing and implementing programs that benefit wildlife and their habitats, including species not hunted or fished. Priority is placed on projects that benefit species of greatest conservation need. The funds must be used to address needs identified within a State's Comprehensive Wildlife Conservation Plan/Strategy. Funds are apportioned to states.

B.6 Montana Fish Wildlife and Parks

With nearly 65 percent of the State's lands held in private ownership, landowners are central to the work of conserving Montana's wildlife, fish and important habitats. Landowners help strengthen Montana's traditions by providing public hunting and fishing access to their lands and by helping to preserve key recreational and historical sites. Montana Fish, Wildlife & Parks is committed to working with Montana's landowners through a variety of programs that acknowledge and support their role in maintaining Montana's rich conservation legacy. For a more comprehensive list of available MTFWP programs available for landowners please visit http://fwp.mt.gov/fishAndWildlife/habitat/wildlife/programs/landownersGuide.html

Future Fisheries Improvement Program (FFIP)

For more than a decade, FWP's Future Fisheries Improvement Program (FFIP) has worked to restore rivers, streams and lakes to improve and restore Montana's wild fish habitats. About $750,000 are available each year for projects that revitalize wild fish populations. Future Fisheries applications are considered every year in June and December. An independent review panel recommends Future Fisheries projects to fund to the Montana Fish, Wildlife & Parks Commission. Applicants are strongly urged to contact their local fisheries biologist prior to submitting an application. Floods can both help and hinder efforts to restore and recover native fisheries. The local biologist typically understands the limiting factors associated with fish populations in their management area and is likely familiar with the impacts of a particular flood event. Information for FFIP applicants is available online at: https://fwp.mt.gov/ffip.

Habitat Montana

The goal of the Habitat Montana program is to preserve and restore important habitat for fish and wildlife. FWP offers incentives to landowners to conserve habitat on private land, including, in some cases, the purchase of a conservation easement. Landowners interested in using a conservation easement to protect traditional farm and ranch land, and to preserve natural resources such as wildlife habitat, may partner with FWP. A variety of funding sources enable FWP to protect seriously threatened habitats and provide recreational opportunities through purchased or donated conservation easements and purchases of land. Annually, about $5-6 million from primarily out of state hunting licenses goes to fund projects selected by the Montana Fish, Wildlife & Parks Commission from among those recommended by the FWP staff. In addition to monetary compensation, landowners may: realize tax

benefits from a conservation easement; gain help in pursuing habitat-friendly agricultural practices; and ensure the protection of scenic and open spaces. For more information contact Montana Fish Wildlife and Parks Wildlife Bureau.

https://fwp.mt.gov/conservation/landowner-programs/habitat-montana

Montana's Upland Game Bird Habitat Enhancement Program

In the Musselshell River corridor, landowners may be interested in linking riparian land management with that of larger upland areas adjacent to the river. These adjacent upland areas may provide opportunities to enhance habitat for upland game birds such as turkeys, pheasant, sharp tail grouse and/or sage grouse. Under Montana's Upland Game Bird Habitat Enhancement Program, Montana Fish, Wildlife & Parks works directly with landowners-and other individuals, groups and organizations-to improve private and public lands for Montana's native sharp-tailed grouse, sage grouse, and mountain grouse, as well as the state's adopted game birds-ring-necked pheasants, Hungarian Partridge, and wild turkeys. Landowners can apply to enroll in the updated cost-share program to develop, enhance, and conserve Montana's upland game bird habitats if the land in the project area remains open to a reasonable level of public hunting. Up to 75 percent of the cost of the Landowner's Upland Game Bird Habitat Enhancement project can be reimbursed. Projects eligible for funding under the Upland Game Bird Habitat Enhancement Program should comprise at least 100 contiguous acres of land, with some exceptions. The local FWP wildlife biologist should be contacted to determine if any specific land can be improved to provide habitat components such as winter cover, food plots, nesting cover, and shelterbelts. Range management, conservation easements, and wetland restoration can also benefit upland game bird populations.

https://fwp.mt.gov/conservation/habitat/upland-game-bird-enhancement-program#:~:text=About%20the%20Program,for%20present%20and%20future%20generations.

B.7 DNRC—Reclamation and Development Grants (RDG), Renewable Resource Grants and Loans (RRGL)

The Montana Department of Natural Resources and Conservation has several programs that may be applicable to landowners in the Musselshell River Valley.

Reclamation and Development Grants (RDG):

The ***Reclamation and Development Grants Program*** is funded by the State of Montana and funds projects that either compensates Montana citizens for the effects of exploration and mining on Montana lands. Or serve the public interest and the state of Montana. The funding is from interest income from the Resource Indemnity Trust fund, which receives proceeds from mineral production taxes. Eligible applicants are cities, counties, or other political subdivision Tribal governments in

Montana, and divisions of state government. Currently DNRC will recommend no more than $300,000 for most projects but they may recommend up to $500,000 if the project can clearly demonstrate multiple natural resource benefits.

The DNRC will also award up to $50,000 for planning grants under this program.

RDG Program information and application forms can be accessed at:

http://dnrc.mt.gov/divisions/cardd/resource-development/reclamation-and-development-grants-program

Renewable Resource Grant and Loan Program (RRGL)

The ***Renewable Resource Grant Program*** was established by the Montana Legislature to fund the conservation, management, development, and preservation of Montana's renewable resources. Types of projects that have been funded by this program include public drinking water improvements, irrigation structure rehabilitation, dam repair, and soil and water conservation. Eligible applicants include state, local, and tribal government entities. Grants are limited to $125,000 per project. Applications are due on or before May 15th of even-numbered years.

RRGL Grant Program information and access forms can be accessed at:

http://dnrc.mt.gov/divisions/cardd/resource-development/renewable-resource-grant-program

Irrigation Development Grants

Irrigation development grants range from $300 to $20,000 and are available to private for-profit, non-profit, governmental and Tribal entities and individual groups in Montana. Projects typically address irrigation efficiency, expansion of irrigated acreage, improved production, improved management, and/or improved inter-basin cooperation among water users. Information for this program can be obtained at:

http://dnrc.mt.gov/divisions/cardd/resource-development/loan-and-grant-programs-for-irrigation-development

B.8 Montana Department of Environmental Quality 319

The Montana Department of Environmental Quality (DEQ) 319 grant program funds projects related to watershed restoration and education/outreach. DEQ issues a Call for Grant Applications every year under Section 319(h) of the Federal Clean Water Act (CWA). Applicants must be either a governmental entity or a nonprofit organization. Project proposals for 2012 are due to DEQ on July 27, 2012.

Information regarding the DEQ 319 Grant Program can be accessed at:

https://deq.mt.gov/

B.9 Montana Coal Endowment Program (MCEP)

As a result of the 2021 Legislative session, the Treasure State Endowment Program (TSEP) has been renamed the Montana Coal Endowment Program (MCEP). MCEP is a state-funded program that provides funding for public facilities projects. The program was originally authorized in 1992. Project types that are eligible for TSEP funding include drinking water systems, wastewater treatment facilities, sanitary or storm sewer systems, solid waste disposal and separations systems, and bridges. Eligible applicants include incorporated cities and towns; counties; consolidated governments; tribal governments; water, sewer or solid waste districts; and other authorities defined in the program.

The $900,000 allocated to the program by the 2021 Legislature for the 2023 biennium (HB 11) has been awarded.

The MCEP program includes also includes Infrastructure Planning Grants that provide awards up to $15,000. These Planning Grants are designed to fund infrastructure planning documents such as preliminary engineering reports and capital improvement plans.

https://comdev.mt.gov/Programs-and-Boards/Montana-Coal-Endowment-Program/Project-Grants

B.10 US Department of Homeland Security (FEMA)

Federal Emergency Management Agency (FEMA)

FEMA has grant programs that relate to Hazard Mitigation and Preparedness. FEMA funding contributed to floodplain mapping for over 200 miles of the Musselshell River after the 2011 flood.

FEMA currently has a special program called Nature-Based Solutions that includes a “natural infrastructure” component that could be especially relevant to Musselshell River floodplain connectivity projects, which would be funded under the Hazard Mitigation Program.

https://www.fema.gov/sites/default/files/documents/fema_riskmap-nature-based-solutions-guide_2021.pdf

Montana Watershed Planning, Management, and Restoration: Relevant Funding Sources 2022

Source	Description	Project Types	Timing	Funding Caps	Who Can Apply?	URL
			FEDERAL SOURCES			
American Rescue Plan Act (ARPA)	HB 632 created four commissions with oversight over federal EPA funds, including an "Infrastructure Advisory Commission" which is staffed by the DNRC. This commission assigns $582 million towards Infrastructure and State/Local Water and Wastewater projects.	Infrastructure Improvements, water planning	Water and Sewer Program accepting apps thru November 1, 2022. (Minimum allocation grants)	Varies	Cities, towns, counties	https://arpa.mt.gov
USBR WaterSMART: Water and Energy Efficiency Grants	The Water and Energy Efficiency Grants of the USBR WaterSMART Program will fund on-the -ground water management improvement projects, including projects to conserve water and address water supply liability.	Water Efficiency	Varies; Current round of applications due July 28 2022	Up to $500,000 for projects completed within two years; up to $2 million for projects to be completed within three years, and up to $5 million for large projects to be completed within three years. Non-Federal Costs Share: 50% or greater.	States, Indian tribes, irrigation districts, water districts, or other organizations with water or power delivery authority. Also includes non-profit conservation organizations partnering with those entities.	https://www.usbr.gov/watersmart/index.html
USBR WaterSMART: Drought Resiliency Projects	Funding for on-the-ground projects and modeling tools that will increase water reliability and improve water management.	Drought Resiliency, Water Management	Varies; check website	Up to $200,000 per year up to two years for Phase 1. Up to $100,000 per year per project for a two year project for Phase 2. No non-federal cost share reaquired for Phase 1; 50% required for Phase 2.		
USBR WaterSMART: Environmental Resources Projects	Funding for projects that result in quantifiable and sustained water savings and benefit ecological values; water management or infrastructure improvements to mitigate drought-related impacts to ecological values; and watershed management or restoration projects benefiting ecological values that have a nexus to water resources or water resource management.	Ecological restoration that contributes to drought resiliency.	Varies; check website	Up to $2 million for a project to be completed within three years; up to $5 million for large projects to be completed within three years. Non-Federal Cost Share: 25-50%		
USBR WaterSMART: Applied Science Grants	Funding for projects that develop hydrologic information and water management tools and to improve modeling and forecasting capabilities.	Data collection and modeling	Varies; check website	Up to $200,000 per agreement for a project that can be completed within two years. Non-Federal Cost Share: 50% or greater.		

Source	Description	Project Types	Timing	Funding Caps	Who Can Apply?	URL
USBR WaterSMART: Cooperative Watershed Management Program Phase 1	Watershed group development, watershed restoration planning, and watershed management project design.	Watershed group capacity, planning, and design	Varies; check website	Up to $200,000 may be awarded to an applicant per year, for a period of up to two years. **NO** non-federal cost share required.	States, Indian tribes, irrigation districts, water districts, or other organizations with water or power delivery authority. Also includes non-profit conservation organizations partnering with those entities.	https://www.usbr.gov/watersmart/index.html
USBR WaterSMART: Drought Contingency Planning	Funding for developing or updating comprehensive drought plans.	Drought Planning	Varies; check website	Up to $200,000 per project. Non-Federal Cost Share: 50% or greater.		
Federal Emergency Management Agency (FEMA)	FEMA has grant programs that relate to Hazard Mitigation and Preparedness. FEMA currently has a special program called Nature-Based Solutions that includes a "natural infrastructure" component that could be especially relevant to floodplain connectivity projects, which would be funded under the Hazard Mitigation Program.	Natural Infrastructure Floodplain Connectivity Flood Hazard Mitigation	Varies	Varies	State, local or tribal governments	https://www.fema.gov/grants/mitigation
FSA Continuous Conservation Reserve Program (CRP)	Land conservation program administered by the Farm Service Agency (FSA) . In exchange for a yearly payment, farmers agree to remove environmentally sensitive land from agricultural production. Includes CRPs for grasslands, rivers, wildlife enhancement, and wetlands.	Agricultural lands protection	Varies	Varies; payments generally range from $10 per acre to nearly $300 per acre.	Landowners	http://www.fsa.usda.gov/mt
FSA Emergency Conservation Program (ECP)	Helps farmers and ranchers to repair damage to farmlands caused by natural disasters and to help implement methods for water conservation during severe drought	Agricultural lands protection, drought resiliency	Varies	Limited to $500,000 per person or legal entity per disaster. Cost Share: 10%-25%	Landowners	http://www.fsa.usda.gov/FSA/
NRCS Environmental Quality Incentives Program (EQIP)	NRCS provides agricultural producers with financial resources and one-on-one help to plan and implement NRCS Conservation Practices.	Agricultural Conservation Practices	Continuous	Varies by program	Private landowners who meet approval requirements	http://www.nrcs.usda.gov
NRCS Montana Focused Conservation: Targeted Implementation Plans (TIPS)	The NRCS has a program called "Montana Focused Conservation" that begins with county-level Long Range Plans. Based on those plans, the NRCS can create Target Implementation Plans (TIPs) to guide project implementation.	High priority resource needs	Varies	Varies	Organized by NRCS	

Source	Description	Project Types	Timing	Funding Caps	Who Can Apply?	URL
NRCS Regional Conservation Partnership Program	The Regional Conservation Partnership Program (RCPP) promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. Partners, working closely with producers and communities, define and propose projects that will achieve collective natural resource goals while also meeting complementary local conservation priorities.	Agricultural Conservation Practices	Varies	Varies	Some of the eligible partners are producer associations, state or local governments, and water and irrigation districts.	http://www.nrcs.usda.gov
NRCS Wetlands Reserve Enhancement Partnership (WREP)	WREP offers landowners the means to restore, enhance, and protect wetlands on their property through permanent easements. The NRCS also provides technical and financial assistance to private landowners and Indian tribes to restore, protect, and enhance wetlands through the purchase of a wetland reserve easement.	Wetland protection, restoration, enhancement	Continual	Varies	Landowners Much of east-central Montana is prioritized as part of a Greater Sage Grouse Landscape Conservation Initiative	
US Fish and Wildlife Service State Wildlife Grant Program (SWG)	The State Wildlife Grants program provides federal grant funds for developing and implementing programs that benefit wildlife and their habitats, including species not hunted or fished. Priority is placed on projects that benefit species of greatest conservation need. The funds must be used to address needs identified within a State's Comprehensive Wildlife Conservation Plan/Strategy.	Wildlife habitat		Varies: $992 K allocated to Montana for FY 2022	State entities	https://www.fws.gov/program/state-wildlife-grants
USDA Rural Development	The USDA Rural Development Program invests in businesses and infrastructure in Montana. In April of 2022 the USDA announced an $800 million investment into climate-smart infrastructure in forty states, which includes funding for Montana's rural small business to purchase and install renewable energy systems and make energy efficiency improvements.	Climate smart infrastructure, Energy efficiency				http://www.rd.usda.gov/programs-services
STATE SOURCES						
DEQ/SWCDM Ranching for Rivers	Funding for riparian pasture management for improvement of fish habitat, instream flows, and riparian areas	Fencing materials, off-site water infrastructure, and grazing management plans	Applications accepted on a rolling basis; check website	Cost share covers up to 50% of a project	Private Landowners, Conservations Districts and Watershed Groups Priority given where a DEQ approved Watershed Restoration Plan has been completed	https://swcdm.org/programs/r4r/ https://swcdm.org/wp-content/uploads/sites/7/2021/01/R4R_Overview2021.pdf

Source	Description	Project Types	Timing	Funding Caps	Who Can Apply?	URL
DNRC HB223 Grants	Funding for Conservation District projects	Any CD- sponsored project.	Biannual-- fall and spring	$20,000 for on-the-ground projects/$10,000 for education projects	Conservation Districts	
DNRC Irrigation Development Grants	Projects typically address irrigation efficiency, expansion of irrigated acreage, improved production, improved management, and/or improved inter-basin cooperation among water users.	Irrigation	Varies: Check with Program Manager	$300-$20,000 Private individuals are eligible for 50% of project costs up to a program maximum of $20K.	Private for-profit, non-profit, governmental and Tribal entities	
DNRC Reclamation and Development Grants (RDG) **Planning Grants** **Project Grants**	Projects that repair, reclaim, and mitigate environmental damage to public resources from non-renewable resource extraction. Also funds projects that protect Montana's environment and ensure the quality of public resources for the benefit of all Montanans. Planning grants are available to prepare the project grant application.	Mining impacts, public resource protection	Planning Grants: Spring Project Grants: May 15th of even numbered years	Planning Grants: up to $50,000 Project Grants: up to $500,000	Local government, counties, tribes, and conservation districts.	http://dnrc.mt.gov/grants-and-loans
DNRC Renewable Resource Grants (RRGL) **Planning Grants** **Project Grants**	Projects that conserve, manage, develop, or protect Montana's renewable resources. Planning grants are available to prepare the project grant application.	Renewable resource conservation, management, development, or preservation	Planning Grants: Cycles updated quarterly Project Grants: May 15th of even numbered years	Planning Grants: up to $15,000 Project Grants: up to $125,000	State, local, or tribal government entities, conservation districts, irrigation districts.	
DNRC Watershed Management Grant	Watershed planning and management activities that conserve, develop, manage, or preserve Montana's renewable resources and/or support the implementation and development of the Montana State Water Plan.	Watershed planning	April	$35,000	Local, state, and tribal government entities.	
DEQ-SWCDM Mini Grants	Water quality related outreach and education	Water quality related outreach and education	Annually	$3,000	Governmental entities or a nonprofit organization	https://swcdm.org/programs/mini-grants/
FWP Future Fisheries	For more than a decade, FWP's Future Fisheries Improvement Program (FFIP) has worked to restore rivers, streams and lakes to improve and restore Montana's wild fish habitats. Funding is for on-the-ground projects.	Fisheries, aquatic habitat	May and November of each year.	Limited by availability, typically there are 10-20 applications per cycle with ~$300,000 available.	Any group or individual. Should include consultation with local FWP biologist.	https://fwp.mt.gov/ffip

Source	Description	Project Types	Timing	Funding Caps	Who Can Apply?	URL
Montana Department of Environmental Quality 319	The Montana Department of Environmental Quality (DEQ) 319 grant program funds projects related to watershed restoration and education/outreach. DEQ issues a Call for Grant Applications every year under Section 319(h) of the Federal Clean Water Act (CWA).	Addresses non-point-source (NPS) pollution in waterbodies listed as impaired.	Annually in the fall	$300,000 per project	Governmental entities or a nonprofit organization; watersheds must have DEQ-accepted Watershed Restoration Plan	https://deq.mt.gov
OTHER SOURCES						
National Wildlife Foundation (Private non-profit)	The NWF funds projects that sustain, restore, and enhance the nation's fish, wildlife, and plants and their habitats. Several programs are available for Montana	Habitat	Typically annually	Varies	Federal, state, and local governments, educational institutions, non-profits	https://www.nfwf.org/programs
Monitoring Montana Waters: Flathead Lake Biological Station	FLBS program that provides scientific expertise and guidance to citizen-led watershed monitoring groups.	Citizen water quality monitoring	Annually on March 1st	Varies	Watershed groups with approved SAPs or SOPs	https://flbs.umt.edu/newflbs/outreach/mmw/monitoring-montana-waters/
Cinnabar Foundation Special Projects Grants	Funding for programs, projects, and campaigns that address issues related to climate action, conservation, public lands, sustainable agriculture, water quality, fisheries.	A wide range of natural resource conservation projects	Varies; contact grant manager	$1,000 to $15,000 50% match required	Non-Profits that serve Montana or the Greater Yellowstone Ecosystem.	https://www.thecinnabarfoundation.org/special-project-grants.html