FUTURE FISHERIES IMPROVEMENT PROGRAM GRANT APPLICATION

All sections must be addressed, or the application will be considered invalid

I. APPLICANT INFORMATION

A. Applicant Name: Winnett ACES, Inc

Mailing Address: PO Box 118

City: Winnett State: MT Zip: 59087

Telephone: 406-429-4832 E-mail: info@winnettaces.org

B. Contact Person (if different than applicant): Laura Nowlin, Operations Coordinator (same contact as above)

Address:

City: State: Zip:

Telephone: E-mail:

C. Landowner and/or Lessee Name (if different than applicant): Rowton Brothers Partnership

Mailing Address: 617 Rowton Road

City: Mosby State: MT Zip: 59058

Telephone: 406-429-2019 E-mail: rodneyrowton9@gmail.com

II. PROJECT INFORMATION

A. Project Name: Rowton Bank Restoration

River, stream, or lake: Musselshell River

Location: Township: 14N Range: 30E Section: 28

Latitude: 46.9470 Longitude: -107.9177 *Within project (decimal degrees)*

County: Petroleum

B. Purpose of Project:

This project will restore approximately 1,050 feet of Musselshell River through implementing soft bank protection techniques to limit sediment issues that are affecting Musselshell River water quality. The project will help to stabilize the bank through the use of vegetative techniques that support the growth of woody vegetation, helping to shade the river and decrease temperatures, diminish sedimentation, and provide wildlife and aquatic habitat for this Tier 1 Prairie Stream habitat as defined in the Montana Fish, Wildlife, and Parks (FWP) Statewide Action Plan.

C. Brief Project Description (attach additional information to end of application):

The Winnett ACES mission is to “strengthen our community by enhancing the health of our land, economy, and traditions for future generations.” ACES believes in partnerships to get successful conservation projects on the ground and has organized a coalition of partners to begin addressing water quality and habitat issues on this stretch of the Musselshell River. This partnership of landowners, the Musselshell Watershed Coalition (MWC), Petroleum County Conservation District, Montana Fish, Wildlife, and Parks, and Pheasants Forever, is coordinating the Rowton Streambank Restoration Project with the plan that this project will serve as a demonstration project for coalescing partners, funding, and innovative restoration techniques for future projects across the Musselshell Watershed.

The project is located on the lower Musselshell River, near Mosby, MT. Private property surrounds the project on all sides, with the same landowner owning both sides of the river. The project will consist of a soft bank restoration approach to limit future erosion issues and spark habitat enhancement. Such stream restoration projects have both public and conservation benefits by improving recreational opportunities, protecting and improving the fish and aquatic resources in the drainage, and improving habitat conditions for numerous species in the drainage, including three Species of Greatest Conservation Need. ACES and the MWC will work together to educate a wider stakeholder group about the success and benefits of these types of restoration techniques.

The project will restore 1,050 feet of stream bank and enhance 10 acres of riparian habitat through installing a brush matrix along the riverbank to provide stream restoration as well as riparian habitat restoration and enhancement. In the short term, the proposed treatment would increase local habitat complexity and benefit the aquatic food web. The alluvial brush matrix treatment uses a mesh of woody, brush material along and extended slightly beyond the active streambank. This wood matrix functions to break up the energy profile along the streambank and in doing so, creates highly varied flow profiles, microcurrents, and cover. These attributes create loads of aquatic habitat diversity and complexity which may be used as nursery/rearing areas for juvenile fish, hiding cover for forage species, and ambush cover for predatory fish. In addition to the instream habitat development, the presence of overhanging and robust riparian vegetation benefits the base of the aquatic food web by providing important aquatic macroinvertebrate habitats and a source of detritus to fuel the base of the food web.

The assessment and recommendations provided in 2018 by the River Assessment Triage Team and the 2022 Preliminary Engineering Report for this project are attached.

D. What was the cause of habitat degradation and how will the project correct the cause?

Historically, drought and water shortages have characterized the Musselshell Basin, however, since 2011, historic flood events have come to define the Musselshell River as unpredictable and powerful. In 2011, 2014, 2018, and 2019 the Musselshell River experienced unprecedented flooding. 2017 and 2021 were extreme drought years. These natural events have capitalized on past land use practices to heavily alter the Musselshell River and to cause high rates of erosion. The project is one step towards jump starting recovery of eroding banks.

E. Length of stream or size of lake that will be treated (project extent): 1,050 feet

Length/size of impact, if larger than project extent (e.g., stream miles opened): _____

F. Project Budget Summary:

Grant Request (Dollars):	**$**	50,000.00
Matching Dollars:	**$**	78,050.00
Matching In-Kind Services:*	**$**	37,045.00

**salaries of government employees are not considered matching contributions*

Other Contributions (not part of this app)	**$**	
Total Project Cost:	**$**	165,095.00

G. Attach itemized (line item) budget – *see budget template*

H. Attach project location map(s) that include:

- ■ Extent of the project, including context (relation to major landmark or town)
- ■ Indication of public and private property
- ■ Riparian buffer locations and widths (if applicable) and grazing locations

I. Attach project plans:

- ■ Detailed sketches or plan views with the location and proposed restoration
- ■ Pre-project photographs (GPS location strongly recommended)
- ☐ If water leasing or water salvage is involved, attach a supplemental questionnaire (*https://myfwp.mt.gov/getRepositoryFile?objectID=36110*)

J. Attach letters or statements of support (e.g., landowner consent, community or public support, and fish biologist support). List any other project partners:

Additional Project Partner: Petroleum County Conservation District; Letters from: Pheasants Forever, Musselshell Watershed Coalition, Region 4 Fish Biologist, Landowner

III. MAINTENANCE AND MONITORING (attach additional information to end of application):

A. A 20-year maintenance commitment is required*. Please confirm that you will ensure this protection and describe your approach. Attach any relevant maintenance plans. Yes ■ No ☐

**If it is a water leasing project, describe the length of the agreement.*

This habitat project will mimic natural conditions and will therefore require little to no maintenance, letting natural forces do the work. The landowner will manage grazing to prevent damage to the project.

B. Will grazing be part of or adjacent to the project? If so, describe or attach land management plans, including short term and long term grazing regimes. If the landowner is not the applicant, please describe their involvement in the project. *If you want assistance with grazing plan development, note your need.*

Currently, the site is fenced with no or very limited grazing. The landowner will work with the Pheasants Forever/Winnett ACES Habitat Coordinator on a land use plan that will include seeding to reclaim bare ground, a potential haying rotation, and a plan for grazing.

C. Will the project be monitored to determine if goals were met? If so, what are the short-term and long-term plans to assess benefits and lessons learned? Were pre-project data collected? Will monitoring information be shared with FWP?

This project is intended to be a demonstration project for future bank protection projects on the Musselshell. The landowners as well as the project partners will make the project accessible to others who are contemplating soft bank protection techniques instead of a hard rip-rap bank stabilization option. The PCCD will also use this project as an opportunity to educate landowners in the area who are pursuing their own 310 permits for similar work. This will be the first project of this kind on the lower end of the Musselshell and project partners plan to replicate it both upstream and downstream. Pheasants Forever and Winnett ACES will monitor the project through photo point monitoring and will share with the Region 4 Fish Biologist.

IV. PROJECT BENEFITS (attach additional information to end of application):

A. What species of fish will benefit from this project?

Species of Greatest Conservation Need, as identified by FWP, are Blue Sucker, Saguer, and Northern Red Belly Dace. Additional Species of Concern to benefit from the project are: Sicklefin Chub, Sturgeon Chub and riparian species: grassland songbirds, including Baird's Sparrow, Great Blue Heron, Golden Eagle, Greater Sage-Grouse, and spiny softshell turtle.

B. How will the project protect or enhance wild fish habitat?

Short term benefits were included in the project description. In the long term, the proposed project attempts to mimic natural channel dynamics and riparian function. Over time, as the project naturalizes, the benefits of a functioning riparian area (water storage, water filtration, food web dynamics, habitat complexity, sources of large woody debris, shading, etc.) become more pronounced and benefit the fishery. Such attributes are not currently present at this location and likely won't be for decades without this project. The benefits of a functioning riparian area would be expected to improve the fishery by improving water quality, increasing food web diversity and abundance, increasing habitat complexity for spawning, nursery, cover, holding, and feeding areas, among numerous other characteristics.

C. What is the expected improvement to fish populations, both short term and long term? How might the project translate to angler success?

Fish require habitat complexity, and this proposed project drastically increases complexity over the existing conditions. Increasing microhabitat conditions that provide for juveniles and forage species would attract predatory fish like channel catfish, smallmouth bass, walleye, and sauger, resulting in improved angler success as more fish are in the area. Over time, the development of a functioning riparian area acts to increase the diversity of physical features present (undercuts banks, pools, large woody debris, etc.). Such features are used by fish and provide great areas for anglers to target. Additionally, increasing the overall fishery potential and productivity by providing high quality, diverse habitats would likely benefit both nongame and game fish populations in the broader section of the Musselshell. Improved habitats would result in more productive fisheries which then translates to more angler success.

D. Will the project increase public fishing opportunity for wild fish and, if so, how? Is public fishing allowed onsite? If not, describe how the public would access the project benefits.

Public access for fishing is already allowed and will continue to be provided.

E. Aside from angling, what local or large-scale public benefits will be realized from this project?

This project has large-scale public conservation benefits by improving river function, benefiting aquatic habitat as well as riparian habitat and water quality. Additionally, by serving as a demonstration project, this project will have wide-reaching impacts along the Musselshell River as well as other Eastern Montana rivers.

F. Will the project interfere with water or property rights of adjacent landowners? (explain):

No.

G. Will the project result in the development of commercial recreational use on the site (including paid access)? Explain:

No.

H. Is this project associated with the reclamation of past mining activity?

No.

Each approved project applicant must enter into a written agreement with Montana Fish, Wildlife & Parks specifying terms and duration of the project. The applicant must obtain all applicable permits prior to project construction. A competitive bid process must be followed when using State funds.

V. AUTHORIZING STATEMENT

I (we) hereby declare that the information and all statements to this application are true, complete, and accurate to the best of my (our) knowledge and that the project or activity complies with rules of the Future Fisheries Improvement Program.

Applicant Signature: Laura Nowlin Date: 5/15/2023

Submittal: **Applications must be signed and received on or before November 15 and May 15 to be considered for the subsequent funding period**. Late or incomplete applications will be rejected.

Mail to:	FWP Future Fisheries Fish Habitat Bureau PO Box 200701 Helena, MT 59620-0701	Email:	Future Fisheries Coordinator FWPFFIP@mt.gov (electronic submissions must be signed) For files over 10MB, use https://transfer.mt.gov and send to mmcgree@mt.gov

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

Both tables must be completed or the application will be returned

PROJECT COSTS					CONTRIBUTIONS			
WORK ITEMS (Itemize by Category)	**NUMBER OF UNITS**	**UNIT DESCRIPTION***	**COST/UNIT**	**TOTAL COST**	**FUTURE FISHERIES REQUEST**	**MATCH (Cash or Services)****	**OTHER (Not part of this application)**	**TOTAL**
Personnel***								
Survey				$ -				$ -
Design	1	Design and Permitting	$20,200.00	$ 20,200.00		$ 20,200.00		$ 20,200.00
Engineering	1		$17,600.00	$ 17,600.00		$ 17,600.00		$ 17,600.00
Permitting	1	5% of total	$4,800.00	$ 4,800.00		$ 4,800.00		$ 4,800.00
Oversight				$ -				$ -
Maintenance				$ -				$ -
			Sub-Total	$ 42,600.00	$ -	$ 42,600.00	$ -	$ 42,600.00
Travel								
Mileage				$ -				$ -
Per diem				$ -				$ -
			Sub-Total	$ -	$ -	$ -	$ -	$ -
Construction Materials****								
Bank Treatment	490	W/Native toe	$34.75	$ 17,027.50		$ 17,027.50		$ 17,027.50
Bank Treatment	510	W/cobble toe	$39.25	$ 20,017.50		$ 20,017.50		$ 20,017.50
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
			Sub-Total	$ 37,045.00	$ -	$ 37,045.00	$ -	$ 37,045.00
Equipment, Labor, and Mobilization								
Mobilization	1		$12,500.00	$ 12,500.00	$ 12,500.00	$ -		$ 12,500.00
Water Management	1		$1,000.00	$ 1,000.00		$ 1,000.00		$ 1,000.00
Excavation, Grading, Misc	1		$46,000.00	$ 46,500.00	$ 37,500.00	$ 9,000.00		$ 46,500.00
Contingency	25%		$101,800.00	$ 25,450.00		$ 25,450.00		$ 25,450.00
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
			Sub-Total	$ 85,450.00	$ 50,000.00	$ 35,450.00	$ -	$ 85,450.00
			TOTALS	$ 165,095.00	$ 50,000.00	$ 115,095.00	$ -	$ 165,095.00

(Revised 5/15/2023)

OTHER REQUIREMENTS:

All of the columns in the budget table and the matching contribution table MUST be completed appropriately or the application will be invalid. Please see the example budget sheet for additional clarification.

*Units = feet, hours, inches, etc. Do not use lump sum unless there is no other way to describe the costs.

**Can include in-kind materials. Justification for in-kind labor (e.g. hourly rates used). Do not use government salaries as match. Describe here or in text.

***The Review Panel suggests that design and oversight costs associated with a proposed project not exceed 15% of the total project budget. If design and oversight costs are in excess of 15%, applications may require a justification or minimum of two competitive bids for the cost of undertaking the project. For projects that include a maintenance request, it must not exceed 10% of the total project cost.

****The Review Panel recommends a maximum fencing cost of $1.50 per foot. Additional costs may be the responsibility of the applicant and/or partners.

Additional details:

APPLICATION MATCHING CONTRIBUTIONS

(do not include requested funds or contributions not associated with the application)

CONTRIBUTOR	IN-KIND	CASH	TOTAL	Secured? (Y/N)
National Fish and Wildlife Foundation (5 Star Program)	$ -	$ 20,000.00	$ 20,000.00	N
National Fish and Wildlife Foundation (SPIRIT of Conservation)	$ -	$ 16,000.00	$ 16,000.00	Y
Landowners	$ 37,045.00	$ 22,050.00	$ 59,095.00	Y
MT DNRC CD Project Grant	$ -	$ 20,000.00	$ 20,000.00	N
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
TOTALS	$ 37,045.00	$ 78,050.00	$ 115,095.00	

OTHER CONTRIBUTIONS

(contributions not associated with the application)

CONTRIBUTOR	IN-KIND	CASH	TOTAL	Secured? (Y/N)
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
TOTALS	$ -	$ -	$ -	

Rowton Bank Restoration Site


Musselshell River Rowton Restoration
Rowton Brothers
Flatwillow Creek


Musselshell River Rowton 2018-2023 Restoration
Bank Erosion Into Field
170 Feet 2009-2017
Legend
2017 Channel
2012 Channel
2009 Channel
1996 Channel
Feet
0
250
500

May 10, 2023

Michelle McGree
Future Fisheries Program
Montana Fish, Wildlife, and Parks

Re: Winnett ACES application to the Future Fisheries Program for the Rowton Bank Restoration

Dear Ms. McGree;

The Rowton Brothers Partnership is pleased to be working with the Winnett ACES (Agricultural Community Enhancement and Sustainability), MT Fish, Wildlife, and Parks, Pheasants Forever, and the Musselshell Watershed Coalition to restore this streambank along the Musselshell River. We give consent for the Winnett ACES to apply to the Future Fisheries Program for the Rowton Bank Restoration.

The floods of 2011, 2014, 2018, and 2019 wreaked havoc on the Musselshell River – shortening the river by approximately 10%. Here on the lower end, the changes in the river channel have been massive. We recognize that the river will continue to move and change and that is why we want to try the soft techniques and bank restoration as opposed to hard rock rip-rap. We will work with Josh Hobbs, the Pheasants Forever/Winnett ACES, Habitat Coordinator on a grazing plan and will continue to offer public access for fishing.

Thank you for your consideration. Please do not hesitate to contact me or my nephew, Rodney Rowton, at 406-429-2019 for more information.

Sincerely,

Lloyd Rowton

Lloyd Rowton,

Rowton Brothers Partnership

FWP.MT.GOV THE **OUTSIDE** IS IN US ALL.

Michelle McGree
Future Fisheries Program
Montana Fish, Wildlife & Parks

Clint Smith
Fisheries Biologist – Lewistown Area
Montana Fish, Wildlife & Parks

SUBJECT: Winnett ACES application to the Future Fisheries Program – Rowton Bank Restoration

DATE: May 10, 2023

Dear Ms. McGree,

I, as the Montana FWP Lewistown Area Fisheries Biologist, am pleased to express support for the Winnett ACES application to the Future Fisheries Program for the Rowton Bank Restoration. FWP works closely with partners within the Musselshell River watershed to provide technical support and collaboration on habitat work, river management efforts, and communication between irrigators, landowners, and anglers in the Musselshell River basin.

FWP staff participated in the creation of the Musselshell Watershed Plan, a guiding document for water and land conservation across the watershed. Stream bank restoration projects ranked high, with preliminary engineering reports being completed for two such projects. This preliminary work is applicable across the watershed and informs the proposed work to be implemented with funding from this grant.

Actions that benefit riparian habitats, improve river function, and naturalize channel dynamics in the Musselshell drainage are identified priorities in FWP's Statewide Fisheries Management Plan and State Wildlife Action Plan. Such stream restoration projects have both public and conservation benefits by improving recreational opportunities, protecting, and improving the fish and aquatic resources present in the drainage, and improving habitat conditions for numerous species in the drainage. The proposed project has developed from years of collaboration and is aimed at both reestablishing the riparian buffer and vegetated streambank while also slowing the lateral migration rate of the channel at this location. In doing so, the project would enhance the local aquatic habitat to the benefit of the Musselshell River fishery.

Thank you for your consideration,

Sincerely,

Clint Smith
Lewistown Area Fisheries Biologist

Musselshell Watershed Coalition
Board members: President Shirley Parrott, Vice-President Bill Bergin, Jr., Diane Ahlgren, Shane Moe, Lynn Rettig, Leon Hammond, Craig Dalgarno
Coordinator: Laura Nowlin
P.O. Box 118
Winnett, MT 59087
http://musselshellwc.wix.com/musselshellwc

May 10, 2023

Michelle McGree
Future Fisheries Program
Montana Fish, Wildlife, and Parks

Re: Winnett ACES application to the Future Fisheries Program for the Rowton Bank Restoration

Dear Ms. McGree;

The Musselshell Watershed Coalition (MWC) is pleased to express support for the Winnett ACES (Agricultural Community Enhancement and Sustainability) application to the Future Fisheries Program for the Rowton Bank Restoration. The MWC is a voluntary partnership of water user associations, conservation districts, landowners, towns, counties, and state and federal government entities. The Musselshell River Watershed contains approximately 9,500 square miles. The main stem of the Musselshell River flows for nearly 340 miles to Fort Peck Reservoir and provides irrigation water for nearly 85,000 acres and 250 farms and ranches and 388 water rights holders, including six municipalities. The MWC serves local residents and works toward collaborative resource management of the Musselshell River Watershed.

Altogether, these watershed contributors and their management approaches are key to sustaining both the land and the communities within the watershed. Collaborative approaches can be highly successful at conserving land and water resources while also contributing to healthy economies and social well-being of local communities, something we have experienced first-hand at the MWC. Projects that tell these stories of collaboration help to inspire others to do the same and spread the impact across communities.

The MWC led the creation of the Musselshell Watershed Plan, a guiding document for water and land conservation across the watershed. Stream bank restoration projects ranked high, with preliminary engineering reports being completed for two such projects, including the Rowton Bank Restoration project. Work on this project will be applicable across the watershed and will inform additional projects in the future.

Thank you for your consideration. Please do not hesitate to contact me for more information at 406-579-6790 or musselshellwatershed@gmail.com.

Sincerely,

Allison Martin

Allison Martin, Coordinator
Musselshell Watershed Coalition

May 09, 2023

Michelle McGree
Future Fisheries Program
Montana Fish, Wildlife, and Parks

Re: Winnett ACES application to the Future Fisheries Program for the Rowton Bank Restoration

Dear Ms. McGree;

Pheasants Forever is pleased to express support for the Winnett ACES (Agricultural Community Enhancement and Sustainability) application to the Future Fisheries Program for the Rowton Bank Restoration. We have been a supporter and work closely with the partners within the Musselshell River Watershed to provide technical support and collaboration regarding habitat work, flood recovery efforts from multiple high-water events in the 2010s, and communication between irrigators, landowners, and anglers in the Musselshell River basin.

Pheasants Forever has been working with landowners in the Musselshell Plains to address water quality issues and improve habitat for aquatic and wildlife species. As adoption of these Mesic, Riparian and Aquatic habitat practices spread, Pheasants Forever has been committed to providing technical assistance for project implementation.

Stream bank and Riparian restoration projects have both public and conservation benefits by improving river function, riparian corridors, benefitting aquatic habitat as well as riparian habitat and water quality. The habitat restoration work is supported by Pheasants Forever and the Pheasants Forever regional Wildlife Biologist, Josh Hobbs, based out of Winnett. Pheasants Forever supports the Rowton Ranch Bank Restoration project and the ranch's continued support of sportsman access through their continued enrollment and support of the Block Management program.

Thank you for your consideration,

Joshua Hobbs, Coordinating Wildlife Biologist
Pheasants Forever Inc, Quail Forever
jhobbs@pheasantsforever.org
PO Box 68, Winnett, MT 59087
406-429-6646

Natural Resource Benefits of the Rowton Bank Restoration Project

This project will restore approximately 1,050 feet of Musselshell River, equating to approximately 10 acres of riparian and wetland habitat, through implementing soft bank protection techniques to limit sediment issues that are affecting Musselshell River water quality. The Musselshell River is impaired for sediment and recent flood events have exacerbated this issue. This project will restore the Rowton Bank using vegetative armor techniques that support the growth of woody vegetation, which will help to shade the river and decrease temperatures, diminish sedimentation, and provide wildlife and aquatic habitat for this Tier 1 Prairie Stream habitat as defined in the Montana Fish, Wildlife, and Parks (FWP) Statewide Action Plan. Species of Greatest Conservation Need, as identified by FWP, are Blue Sucker, Saguer, and Northern Red Belly Dace. Additional Species of Concern to benefit from the project are: Sicklefin Chub, Sturgeon Chub and riparian species: grassland songbirds, including Baird's Sparrow, Great Blue Heron, Golden Eagle, Greater Sage-Grouse, and spiny softshell turtle.

The key **natural resource benefits** from this project will result from the **vegetative bank armor** that will be created through the brush matrix technique.

Restoring **streambank vegetation** will create riparian buffers along the streambank consisting of deep-rooting, flood-tolerant plants and trees that provide multiple benefits: Streambank stabilization; dense, deep, intertwined root systems that physically strengthen soils; root systems that remove excess moisture from the soil, making banks more resistant to erosion or slumping; exposed root systems that provide roughness that dissipates the water's erosive energy along the banks while the plant stems and leaves provide roughness during flood flows; water quality protection through decreased sedimentation; vegetated buffers intercept and filter out much of the overland flow of water, nutrients, sediment, and pollutants.

Riparian vegetation will have the opportunity to establish once the bank is stabilized. These habitat benefits will result from diverse riparian vegetation that provides shade, shelter, leafy or woody debris, and other nutrients needed by fish and other aquatic organisms. Wide, continuous, vegetated floodplains help dissipate flood flows, provide storage for floodwaters, retain sediment and nutrients, and provide shelter, forage, and migration corridors for wildlife.

River Assessment Triage Team (RATT) Site Report-- 2018

Site: Rodney Rowton/Rowton Brothers

Impacts: Bank Erosion
Date of Field Visit: October 24, 2018
Latitude: 46.948059 Longitude: --107.915194

1 Introduction

In the fall of 2018, the RATT team was reconvened after major flooding the previous spring to evaluate a series of sites on the Musselshell River from above Harlowton to below Mosby. We have been asked to provide individual landowners a brief summary of our site visit, to describe observations and alternative approaches to address flood damages. We have brought in additional data where possible, including some drone flight images, high resolution topography and post-flood air photos provided by the Corps of Engineers. Our recommendations are conceptual, and any work done may require detailed designs, permits, and potential changes in points of diversion. We haven't provided project costs, although unit costs for bank armor estimated in a separate document that describes bank armor alternatives. By the early summer of 2019, we anticipate completing a more comprehensive report of system-wide flood impacts.

We hope that these site summaries help landowners who plan on post-2018 flood rehabilitation work understand some of the larger processes at work on the Musselshell River. A common theme at most sites was severe bank erosion and other channel changes that have impacted pump sites, road crossings, field acreages, canals etc. To that end, it is important to briefly describe these widespread 2018 damages in terms of river evolution. The incessant cutting and bank erosion of 2018 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 channel erosion 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 river will continue to respond to these floods for years. The 2011, 2014, and 2018 floods were an unprecedented combination of high flows and long durations of those flows, resulting in the strongest cumulative geomorphic force exerted 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, which "used to behave itself", is in a period of continued change and long-term recovery.

> *"Seems like the straighter this river gets, the more problems we have…"*
>
> *-Musselshell Valley Producer*

This poses unique challenges to the Musselshell Watershed community in that channel lengthening and associated energy dissipation (slower water) are important aspects of 2011 flood recovery. Lengthening should be allowed or encouraged where possible, otherwise armoring projects on the steep channel will become costlier and more prone to failure or damage, and severe bank erosion will continue on unarmored banks for decades. Financial and ecological consequences would be high. As a result, our approach here is to avoid locking

the channel into place where possible while recognizing that strategic armor placement is an important tool in maintaining infrastructure such as roads, pump sites, residences, and diversion dams. As an alternative to bank armoring, opportunities to promote natural recovery and reduce in-stream power are also considered.

1.1 Site Location

This summary is for the Rowton Brothers site located about 3.5 miles upstream of the Highway 200 Bridge at Mosby, and about two miles downstream of the mouth of Flatwillow Creek (Figure 1).

Note: All right or left bank references in this report refer to the bank as viewed downstream.

The flood history of this area includes three major recent events. The 2011 flood peaked at 25,100 cfs at Mosby on May 23. In August of 2014, the Flatwillow Creek flood created a peak of 20,800 cfs on the Musselshell River at Mosby. And in early June of 2018, the river peaked at a minimum of 9,200 cfs at Mosby. This 9,200 cfs value is the highest mean daily flow recorded at the gage in 2018; the instantaneous peak discharge for this flood has not yet been published by the USGS and will be higher than the mean daily value. At any rate, there have been three major floods in this reach in 8 years.

During the 2011 flood, the river was shortened by 11 miles between this point and Fort Peck. Two large avulsions occurred just upstream of the site, and another two just downstream; these cutoffs collectively shortened the river by over three and a half miles (Figure 1).

At the site itself (RM 62.3 on Figure 1), the river is relatively straight, although there has been some left bank erosion into an irrigated field and pump site. We visited this site in the fall of 2013 and this erosion was a concern then. The pump has since been moved downstream (Figure 2).

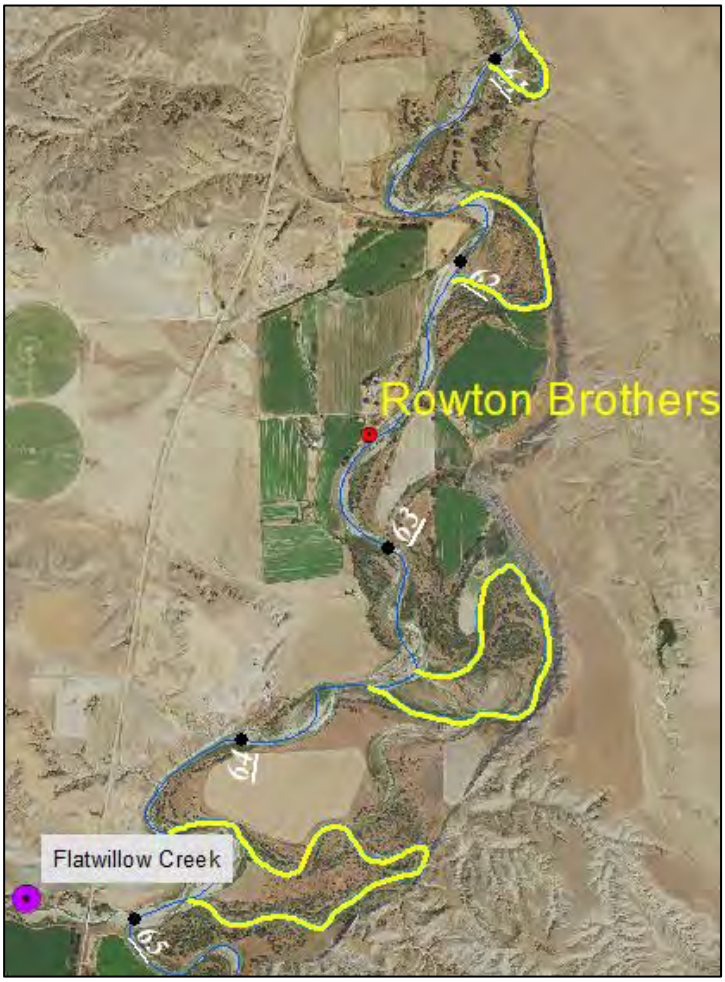


Figure 1. Location map for Rowton Site; yellow lines show channels abandoned during 2011 flood.

The main characteristics we saw on site include the following:

- Major channel shortening (meander cutoffs) during the 2011 flood causing the channel to steepen;
- Persistent exposure of a shale reef in the bed of the river at the pump site that may help hold grade;
- Continued bank erosion since 2011 into the left bank field/pump site;
- Relocation of the pump to a good location downstream.

The primary remaining issue at the site is the continued bank erosion and loss of irrigated ground. This erosion reflects the tendency for the river to regain length after the abrupt shortening of 2011. Unfortunately, this lengthening commonly occurs in areas that are economically important for landowners and thus create challenges regarding cost-effective river management.

Figure 2. General site location map shown on 2017 air photo; flow direction is bottom to top.

Figure 3 and Figure 4 and shows digitized banklines from 1996 through 2017 overlain on a LiDAR hillshade layer that was collected in 2012. Note that the movement shown in this figure does not include the 2018 flood. Figure 3 shows that the 2011 cutoffs just above and below the site shortened the river by about 1.7 miles. A closeup of the field area (Figure 4) shows that the bank moved about 170 feet between 1996 and 2017.

Figure 5 shows the general site conditions in 2018. Across from the eroding bank, a large point bar has developed, and recent expansion of the cottonwood corridor into the upper point bar is evident. Based on this image, it appears that the bank migrated another ~70 feet into the field during the 2018 flood. The eroding bank is about 950 feet long, and the shale exposure is in the lower part of the bend (Figure 6).

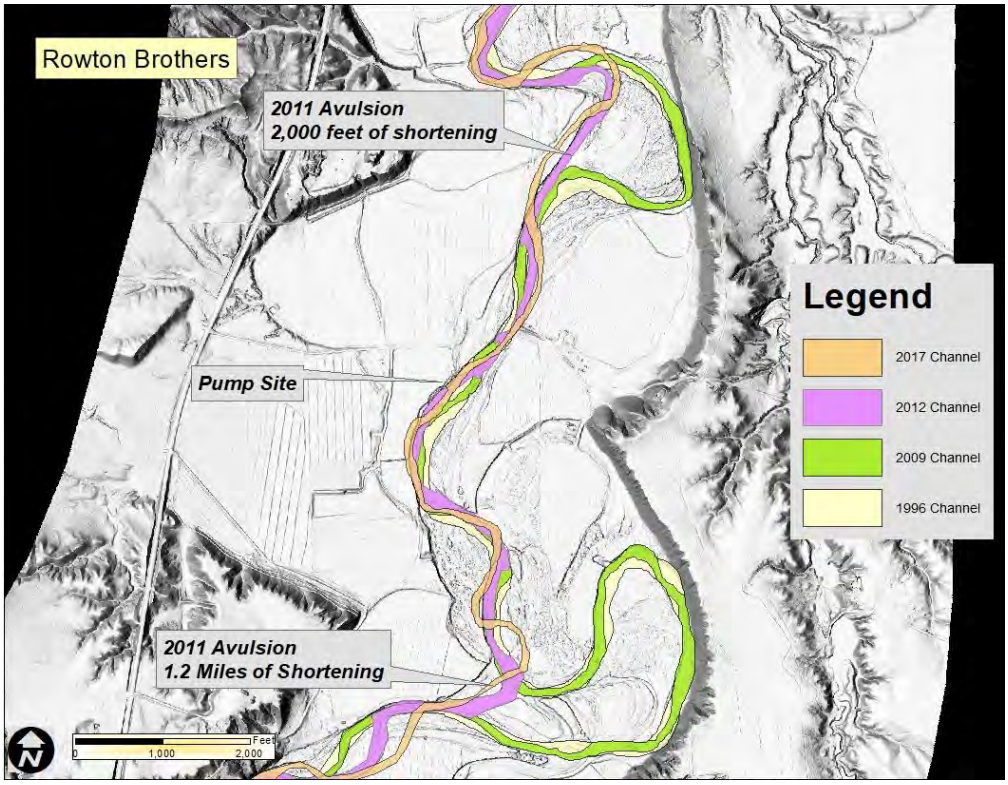


Figure 3. 2012 LiDAR hillshade showing bank movement through time.

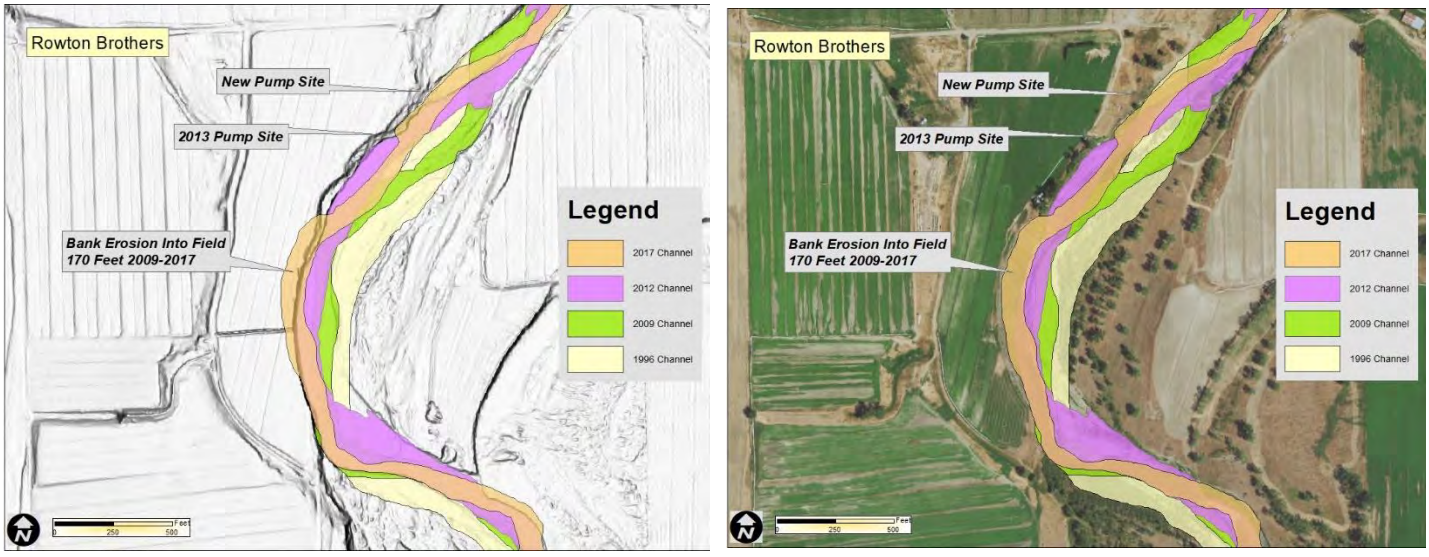


Figure 4. Digitized banklines on LiDAR hillshade layer (left) and 2017 air photo (right) showing 1996-2017 erosion into field.

Figure 5. View downstream of 2018 conditions captured by drone at Rowton site.

Figure 6. View downstream of shale in riverbed (2018 drone flight).

Figure 7 shows the extents and rates of maximum bank movement into the irrigated field since 1996. Between 1996 and 2017, about 2.6 acres of field had been eroded out, and more has been lost since then. Although the greatest mapped loss of acreage was from 2012-2017 (Figure 7 left), the highest local rate of bank movement was during the 2011 flood (Figure 7 right). This is because the 2011 erosion was fast but irregular, creating a high local rate of movement, whereas the post 2012 erosion "smoothed" the bend out, taking over an acre of the field in the process.

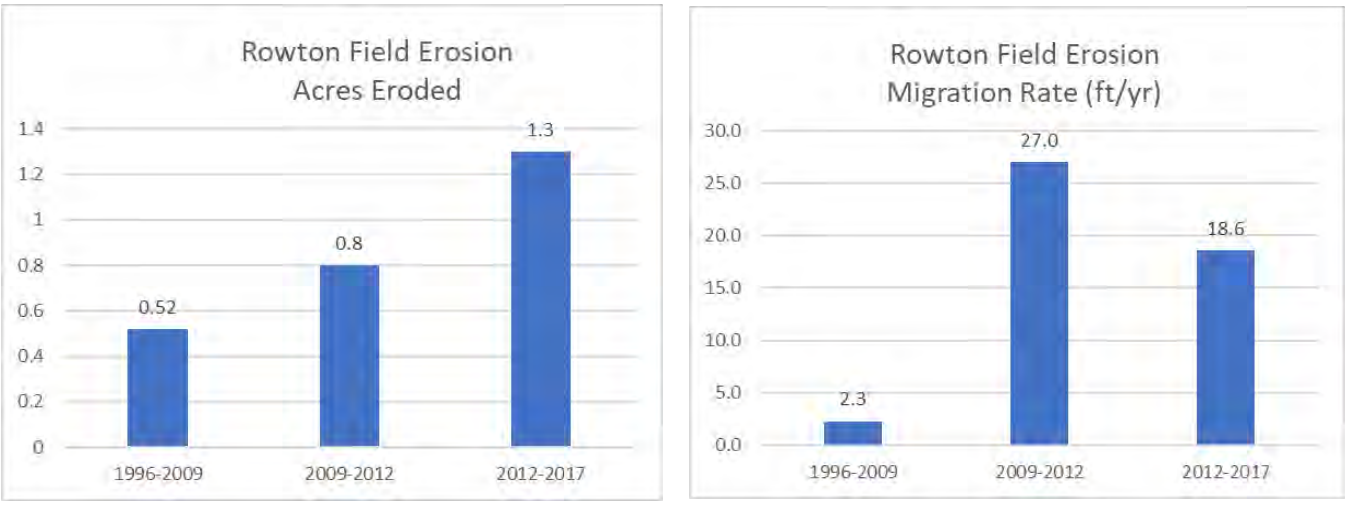


Figure 7. Area eroded along field (left) and maximum migration rates (right) at Rowton site; no data are available for the 2018 flood.

The LiDAR data show that the two avulsions immediately upstream and downstream of the site caused the river to steepen from 0.08% before 2011 (4.2 feet per mile) to 0.13% in 2012 (7.2 fee per mile). That means the slope has almost doubled. Fortunately, it appears that, although the river is shorter, it was extremely flat prior to the 2011 flood such that doesn't appear to be dramatically oversteepened in this area relative to other reaches today. That said, one consequence of steepening is bank erosion, which is happening at a moderate rate in this area.

2 Options and Recommendations

The two main issues we saw on site were the pump site relocation and the eroding bankline along the irrigated field.

2.1 Pump Site

The new pump site is located downstream of the area of major field erosion (Figure 8). It is portable and uses a ramp to access the river. We strongly support this approach, as there may be continued lateral and vertical adjustments to the river in coming years. Based on measured bank movements, the relocated pump is in a good location.

Figure 8. View upstream of pump site in 2018; people are standing on ramp. Eroding bankline is behind cottonwood in center right of photo.

2.2 Bank Erosion into Field

The eroding bank is over 10 feet high in places, and erosion-resistant shale is exposed in the streambed that forms a prominent bench at the toe of the bank (Figure 9). Sometimes erosion can be rapid across a non-erodible streambed as the river "skates" laterally across its floodplain. If there is an interest in armoring the bank, we would recommend you consider a range of options in terms of cost and risk. Because of the concentration of 2011 avulsions in this reach, we would expect some continued channel lengthening in this area, although it may not be as aggressive as it has been in other areas because of the relatively low post-flood channel slope.

We would also recommend that you consider stopping irrigation on the south half of the eroding field to reduce bank saturation and provide a buffer for channel movement. The shape of the field appears to make irrigation difficult. Moving the mainline away from the eroding bank would remove that threat, and one potential cost-effective option would be to convert the fields west of the eroding bank area to sprinklers to recoup lost production on the field next to the river.

For additional descriptions of erosion control options, please see the Bank Armor Supplement provided with this report.

2.3 No Action

One real option is to do nothing on the eroding bankline. You could monitor changes in coming years and identify at what point you feel you need to stop any additional movement (such as erosion into infrastructure).

2.4 Rock Riprap

If you feel that additional bank movement is unacceptable, rock riprap will provide the most robust armor, although it may not prove to be cost effective when the value of the lost production is compared to the cost of the armor and any required mitigation. With the shale toe along much of the bank, it will be important to have an engineer consider the risk of toe failure of the armor if it is built directly on top of the shale toe or if it extends into an excavated toe trench along the bank. Toe loss is the most common type of riprap failure, so ensuring a strong toe is critical in any project.

Above the toe, the armor should be placed on a bank no steeper than 2:1. As far as the upper bank goes, it would not be necessary to carry large rock to the top of the sloped bank. The Bank Armor Supplement shows examples of transitioning to less aggressive treatments above a rock toe, to provide a better chance for establishing vegetation on the bank and to reduce costs.

2.5 Bank Toe Reconstruction

The Bank Armor Supplement describes other ways to protect the bank by building a bench along the bank toe using fabric lifts or alluvium mixed with wood. These treatments can be catered to meet your tolerance for risk and financial constraints; if you would like to speak further to professionals who have good experience in these sorts of treatments please let us know. Whereas these "softer" treatments will probably not provide 100-year flood protection, they can be very effective where some tolerance for continued bank adjustment is tolerable, and there is an interest in re-establishing vegetation below the high top of bank.

Figure 9. View upstream of eroding bank and shale exposure in 2013; bank moved another ~30 feet by 2017.

We would be happy to discuss our findings with you. Feel free to call or email either of us:

Karin Boyd (406)-587-6352 kboyd@appliedgeomorph.com
Warren Kellogg (406)-437-3028 warrenkellogg@q.com

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**

	Alternative #1 - Construction Costs					
Work Item	**Desc.**	**Unit**	**Quantity**	**Unit Cost**	**Total Cost**	**Notes**
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.

1 Rounded up to the nearest $100

Cushman Alternative #1 Total[1] **$ 92,800**

Table 4 - Cushman Bridge Alternative #2

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

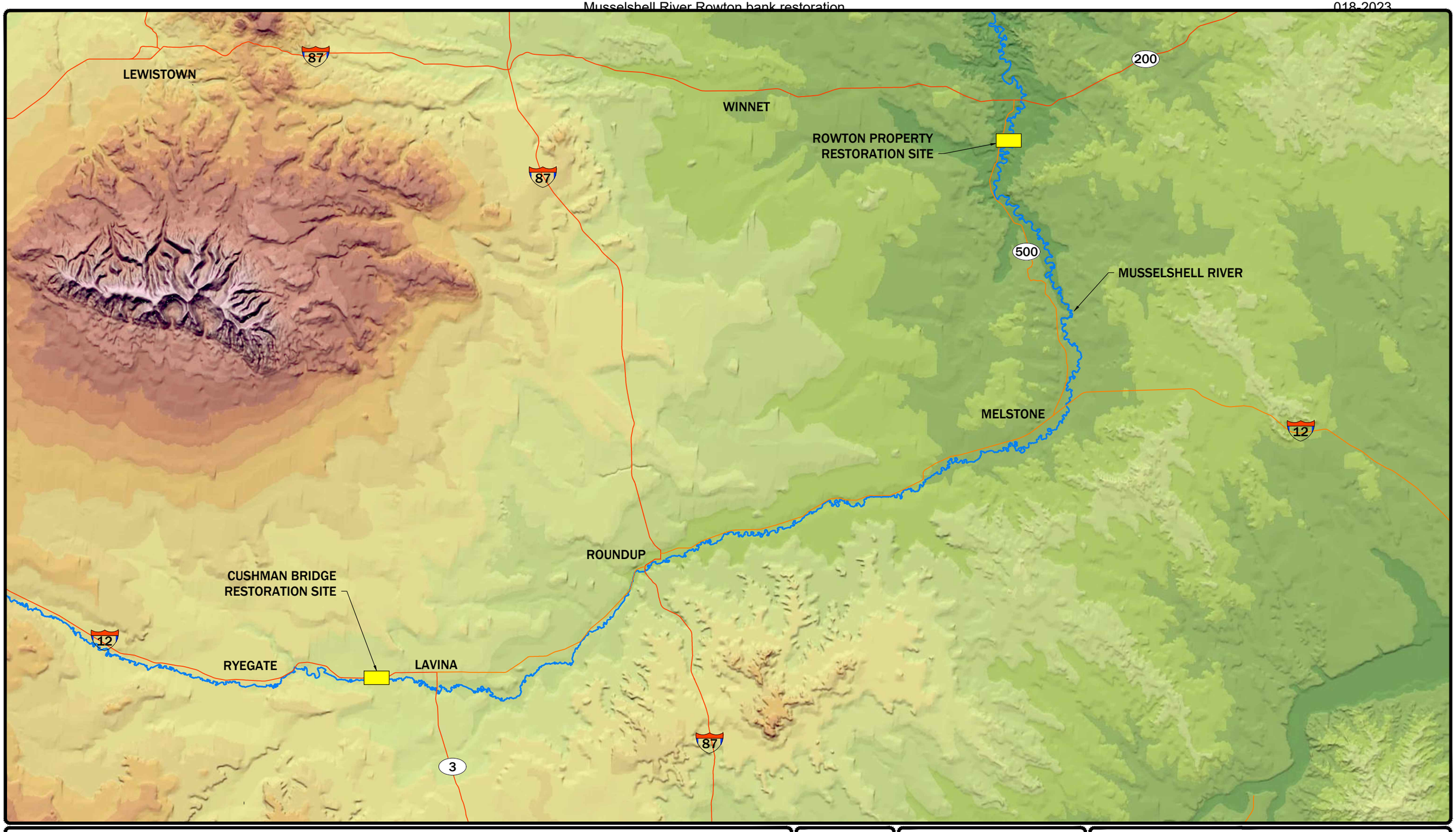
	Alternative #2 - Construction Costs					
Work Item	**Desc.**	**Unit**	**Quantity**	**Unit Cost**	**Total Cost**	**Notes**
1	Mobilization	LS	1	$ 9,400	$ 9,400	Includes all prep work for transport and movement of personal, equipment, supplies and incidentals to/from the project site.
1a	Bonding	LS	1	$ 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



DISPLAYED AS:
COORD SYS/ZONE: MONTANA STATE PLANES
DATUM: NAD83/NAVD88
UNITS: INTL. FEET
SOURCE: PIONEER

SCALE IN FEET
0 20,000 40,000

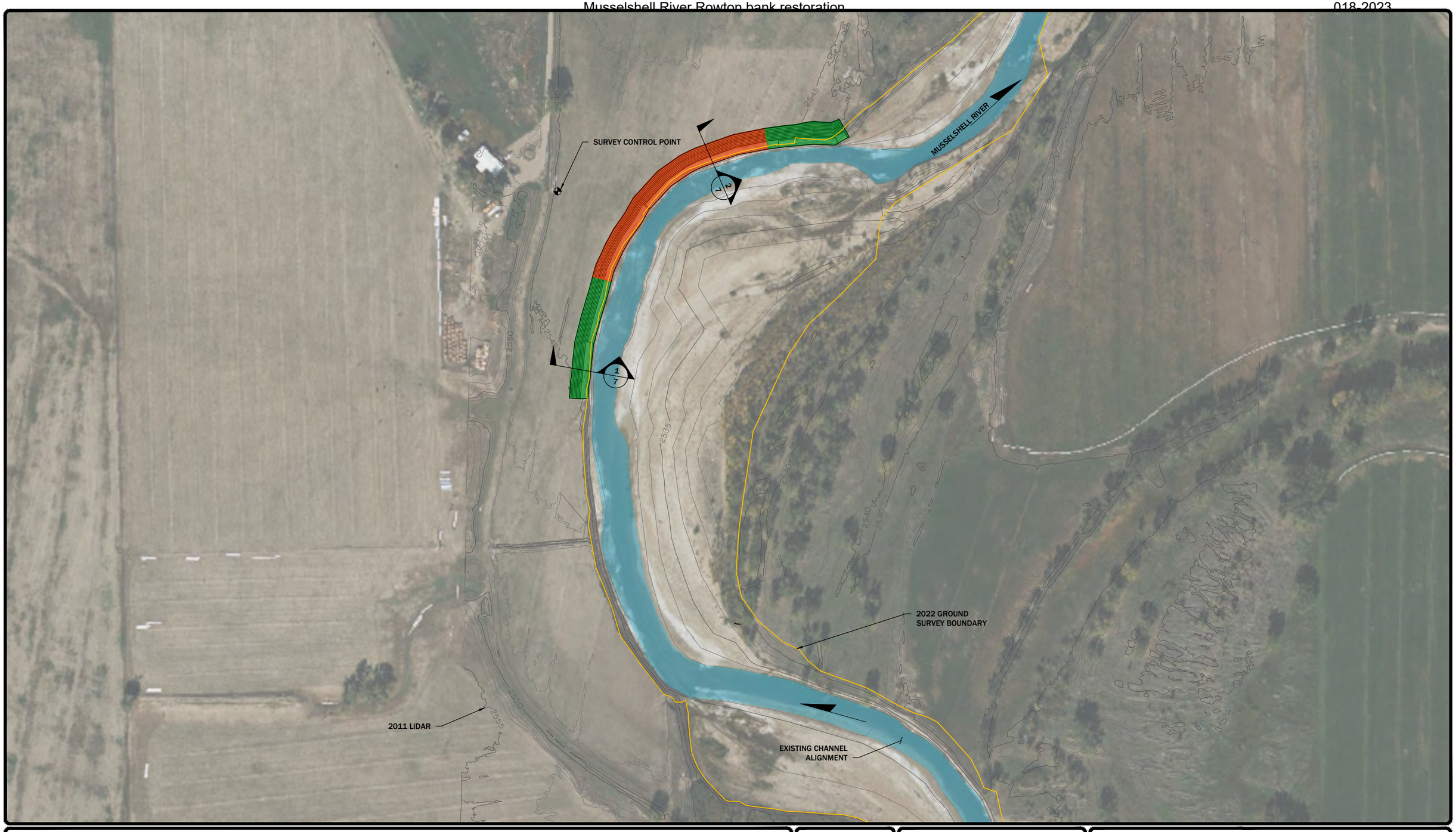
FIGURE 1

ROWTON AND CUSHMAN BRIDGE SITE LOCATION

PIONEER TECHNICAL SERVICES, INC.
www.pioneer-technical.com
(406) 782-5177

DATE: 6/01/2022

6/2/2022 4:12:42 PM G:\AGI\ROWTON_CUSHMAN_PER\DRAWINGS\ACAD\ROWTON_SITE_PLAN.DWG



LEGEND:

- TYPE 1 BANK TREATMENT
- TYPE 2 BANK TREATMENT

N

DISPLAYED AS:
COORD SYS/ZONE: MONTANA STATE PLANES
DATUM: NAD83/NAVD88
UNITS: INTL. FEET
SOURCE: PIONEER, BING

SCALE IN FEET
0 100 200

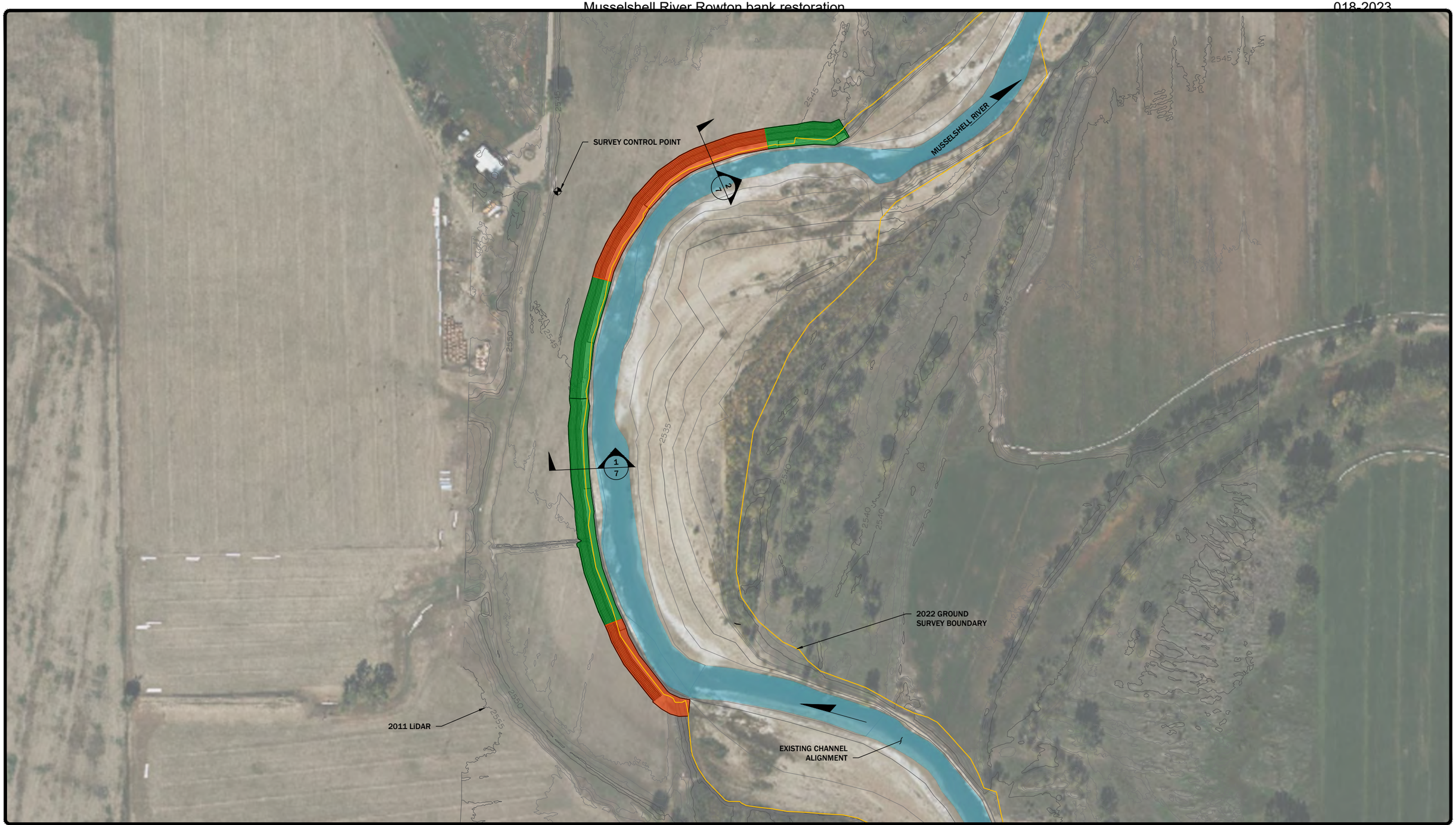
FIGURE 2

ROWTON PROPERTY
BANK RESTORATION
ALTERNATIVE 1
PLAN VIEW

PIONEER TECHNICAL SERVICES, INC.
www.pioneer-technical.com
(406) 782-5177

DATE: 6/01/2022

6/2/2022 2:12:02 PM G:\AGI\ROWTON_CUSHMAN_PER\DRAWINGS\ACAD\ROWTON.DWG



LEGEND:

- TYPE 1 BANK TREATMENT
- TYPE 2 BANK TREATMENT

N

DISPLAYED AS:
COORD SYS/ZONE: MONTANA STATE PLANES
DATUM: NAD83/NAVD88
UNITS: INTL. FEET
SOURCE: PIONEER, BING

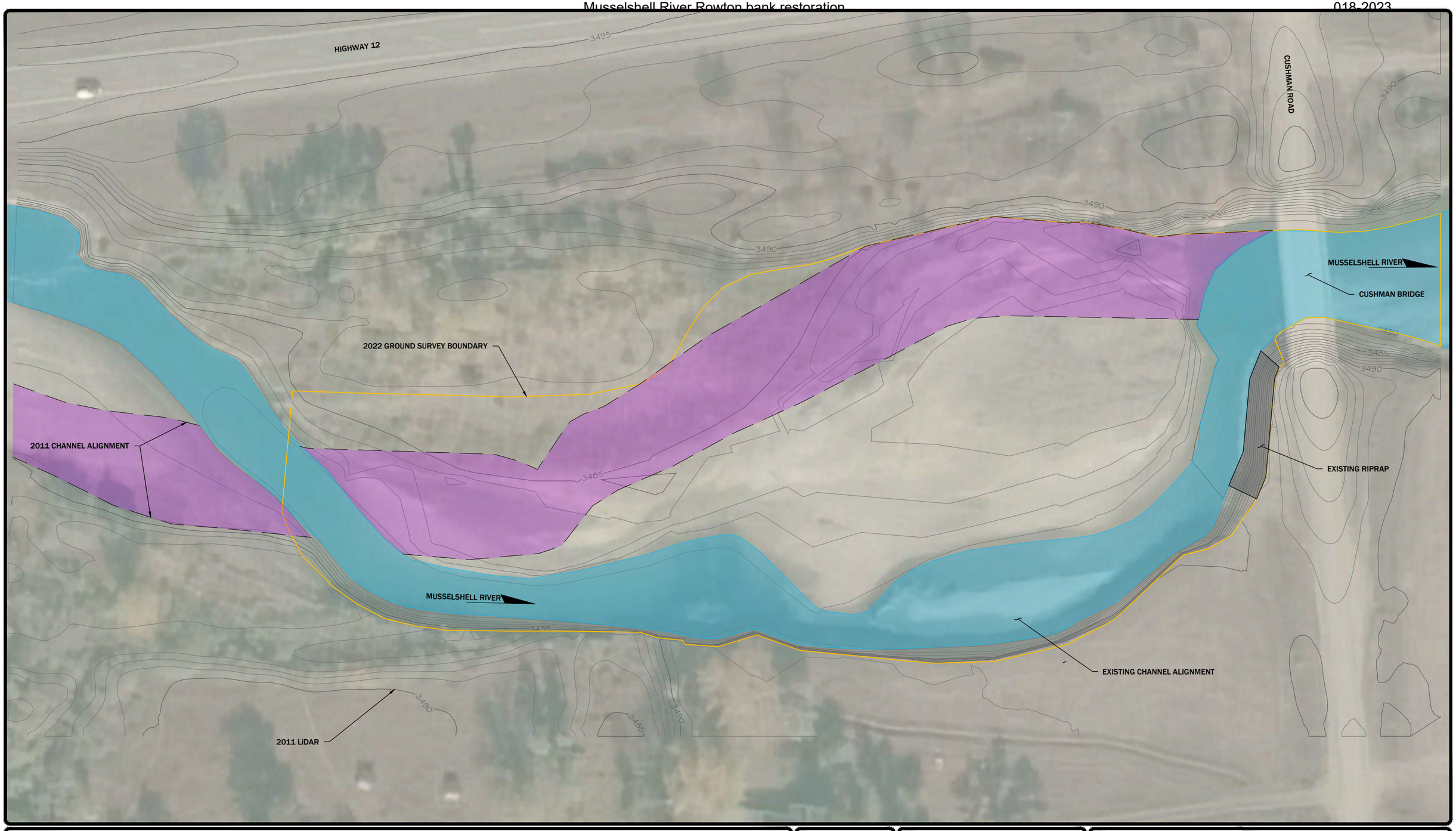
SCALE IN FEET
0 100 200

FIGURE 3

ROWTON PROPERTY
BANK RESTORATION
ALTERNATIVE 2
PLAN VIEW

PIONEER TECHNICAL SERVICES, INC.
www.pioneer-technical.com
(406) 782-5177

DATE: 6/01/2022



DISPLAYED AS:
COORD SYS/ZONE: MONTANA STATE PLANES
DATUM: NAD83/NAVD88
UNITS: INT. FEET
SOURCE: PIONEER

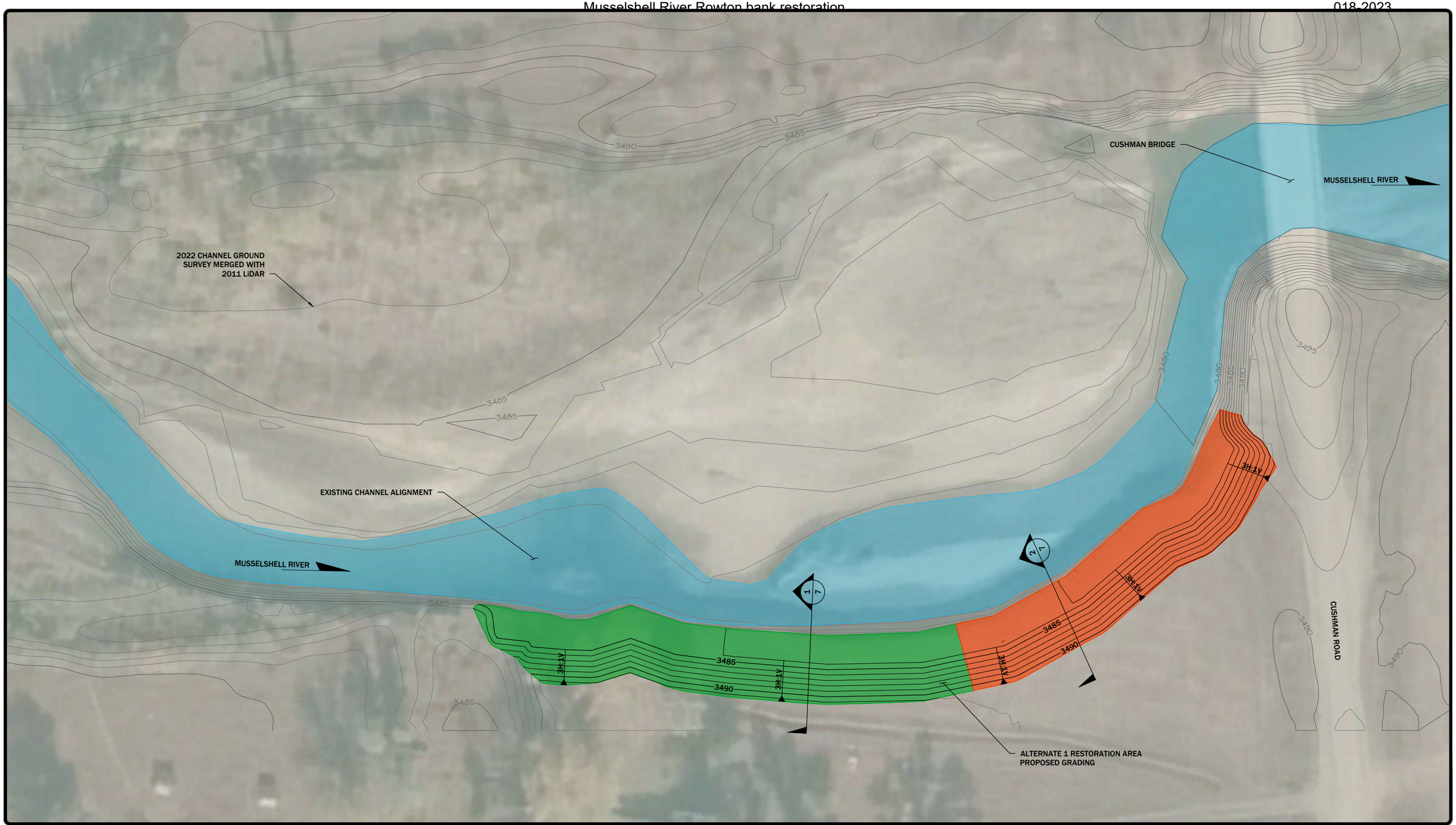
SCALE IN FEET
0 30 60

FIGURE 4

CUSHMAN BRIDGE
SITE MAP
EXISTING
CONDITIONS

PIONEER
TECHNICAL SERVICES, INC.
www.pioneer-technical.com
(406) 782-5177

DATE: 6/01/2022



LEGEND:

- TYPE 1 BANK TREATMENT
- TYPE 2 BANK TREATMENT

N

DISPLAYED AS:
COORD SYS/ZONE: MONTANA STATE PLANES
DATUM: NAD83/NAVD88
UNITS: INT. FEET
SOURCE: PIONEER

SCALE IN FEET
0 25 50

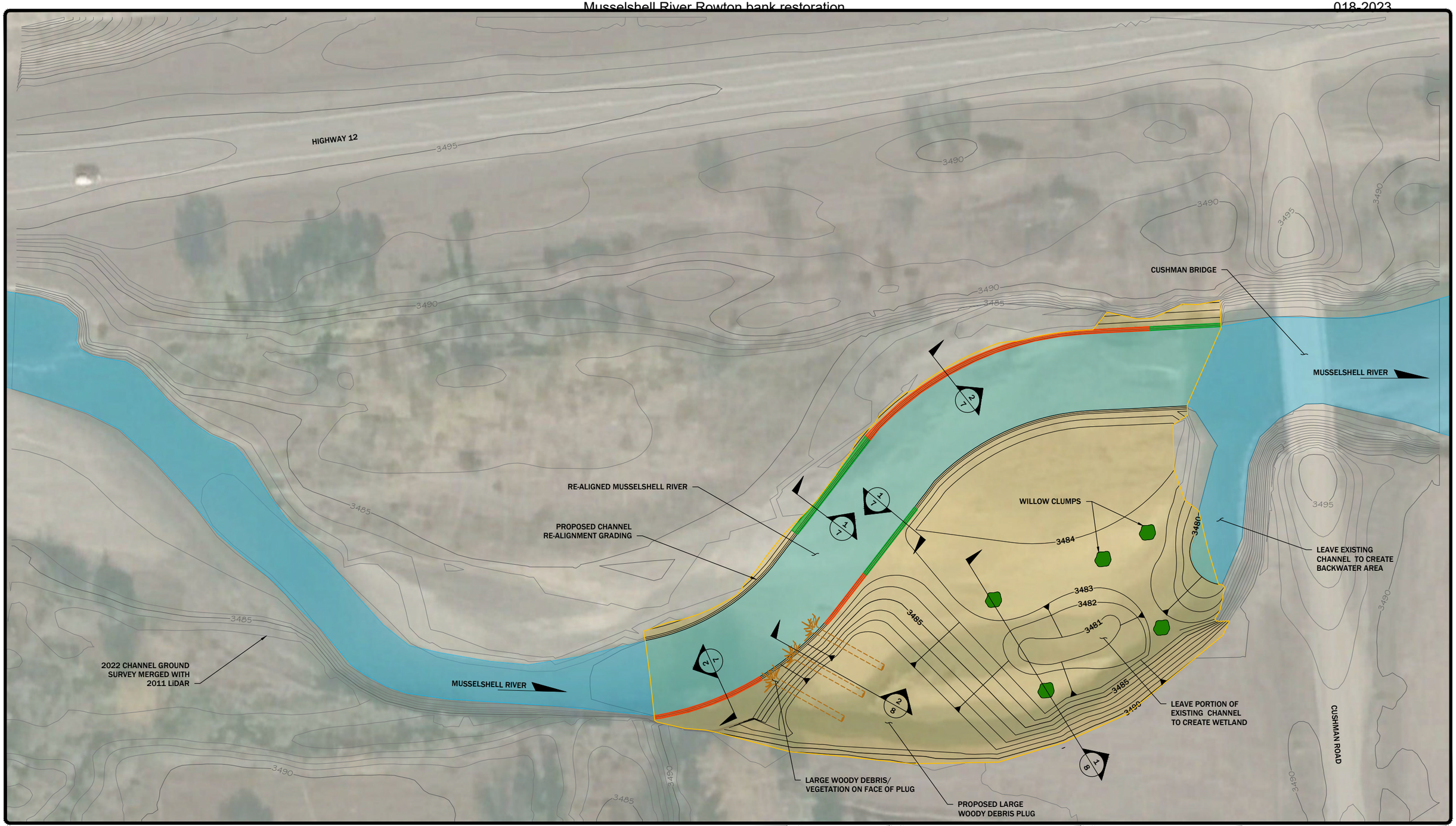
FIGURE 5

PIONEER TECHNICAL SERVICES, INC.
www.pioneer-technical.com
(406) 782-5177

CUSHMAN BRIDGE BANK RESTORATION ALTERNATIVE 1 PLAN VIEW

DATE: 6/01/2022

6/2/2022 2:10:15 PM G:\AGI\ROWTON_CUSHMAN_PER\DRAWINGS\ACAD\CUSHMAN.DWG



LEGEND:

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

N

DISPLAYED AS:
COORD SYS/ZONE: MONTANA STATE PLANES
DATUM: NAD83/NAVD88
UNITS: INT. FEET
SOURCE: PIONEER

SCALE IN FEET
0 30 60

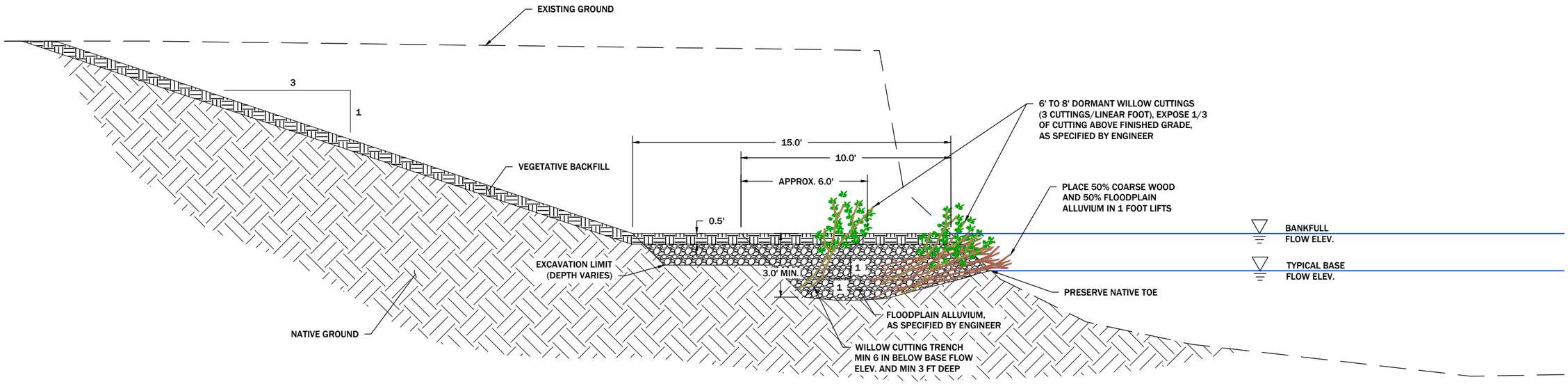
FIGURE 6

CUSHMAN BRIDGE
BANK RESTORATION
ALTERNATIVE 2
PLAN VIEW

PIONEER
TECHNICAL SERVICES, INC.
www.pioneer-technical.com
(406) 782-5177

DATE: 6/01/2022

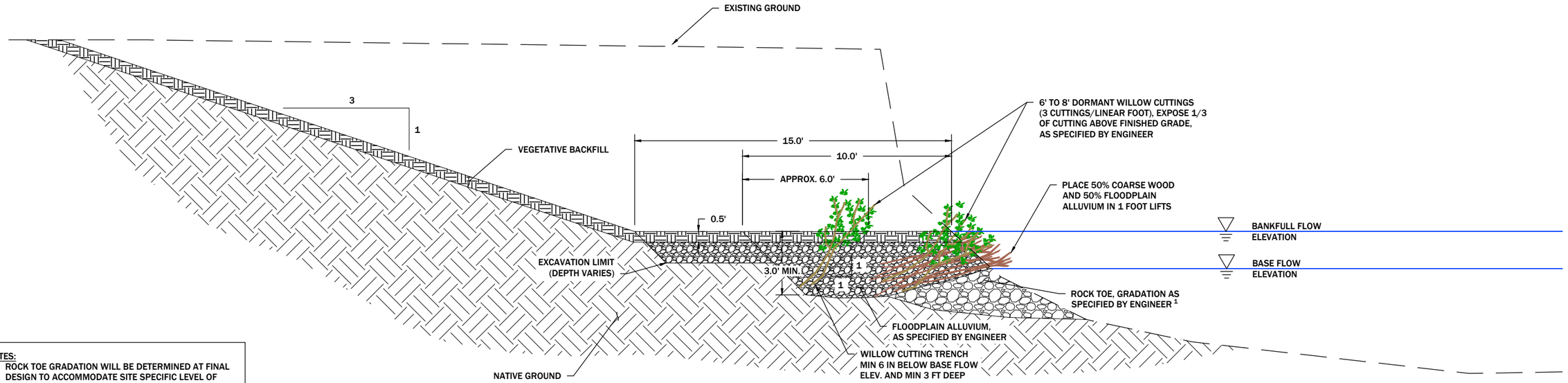
6/2/2022 2:10:42 PM G:\AGI\ROWTON_CUSHMAN_PER\DRAWINGS\ACAD\CUSHMAN.DWG



TYPE 1 BANK TREATMENT

1

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



TYPE 2 BANK TREATMENT

2

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.

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

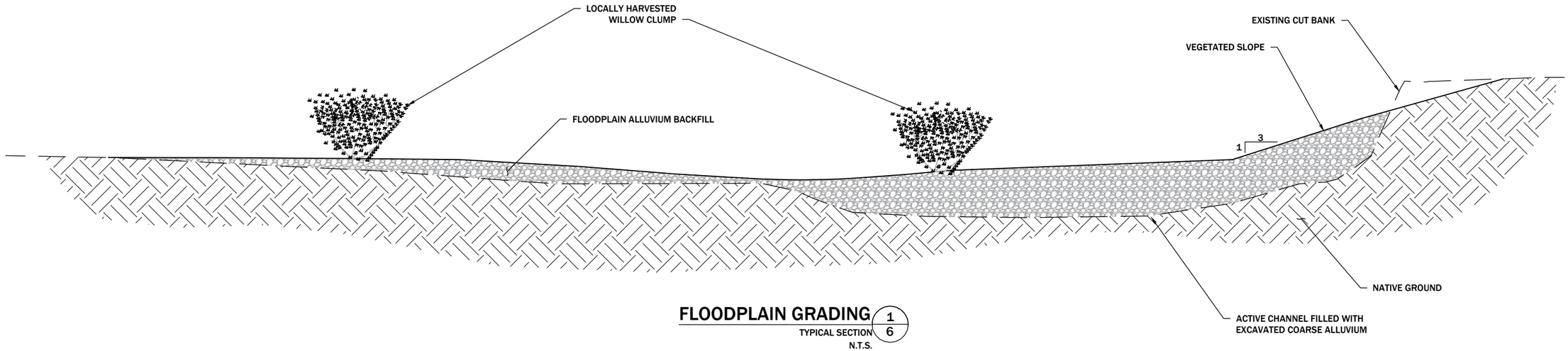
SCALE IN FEET
0 NA

FIGURE 7

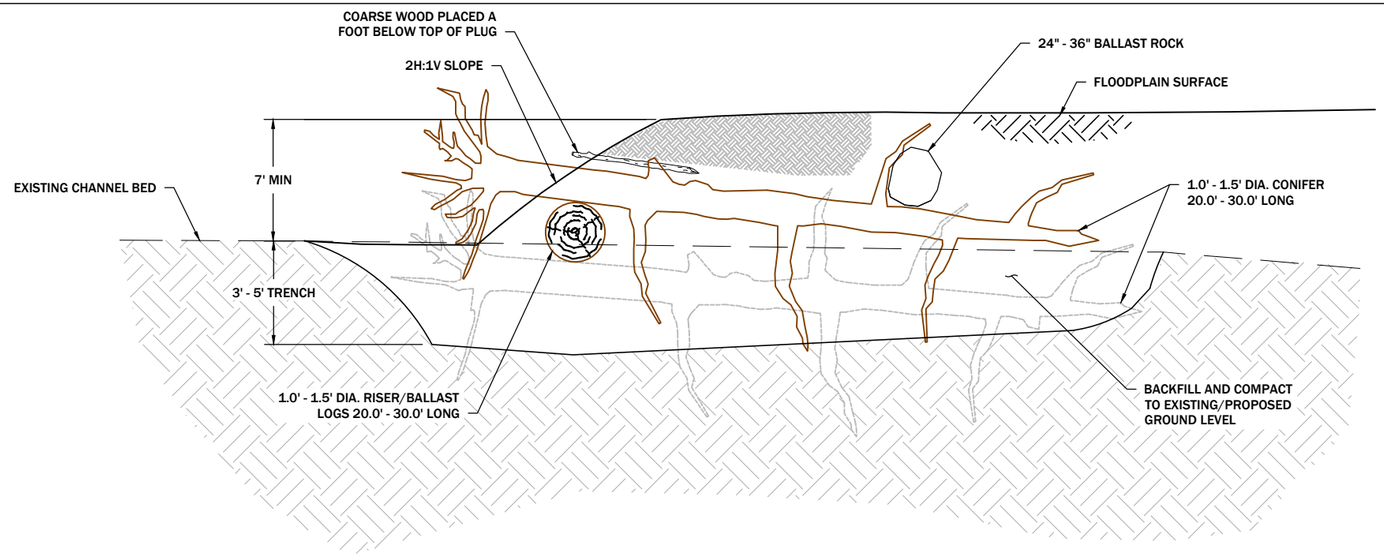
BRUSH MATRIX
BANK TREATMENT
TYPICAL SECTIONS

PIONEER
TECHNICAL SERVICES, INC.
www.pioneer-technical.com
(406) 782-5177

DATE: 6/01/2022



FLOODPLAIN GRADING 1/6
TYPICAL SECTION
N.T.S.



LARGE WOODY DEBRIS PLUG 2/6
TYPICAL SECTION
N.T.S.

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

SCALE IN FEET
0 NA

FIGURE 8

PIONEER TECHNICAL SERVICES, INC.
www.pioneer-technical.com
(406) 782-5177

CUSHMAN BRIDGE
FLOODPLAIN
GRADING AND
LWD PLUG
TYPICAL SECTIONS
DATE: 6/01/2022

6/2/2022 2:11:10 PM G:\AGI\ROWTON_CUSHMAN_PER\DRAWINGS\ACAD\CUSHMAN.DWG