FUTURE FISHERIES IMPROVEMENT PROGRAM GRANT APPLICATION

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

I. APPLICANT INFORMATION

A. Applicant Name: Clark Fork Coalition

Mailing Address: 140 S. 4th St. W. #1

City: Missoula State: MT Zip: 59801

Telephone: 406-550-5503 E-mail: brian@clarkfork.org

B. Contact Person (if different than applicant): Adam Switalski – Clark Fork Coalition Project Manager

Address: 140 S. 4th St. W. #1

City: Missoula State: MT Zip: 59801

Telephone: 406-396-1941 (cell) E-mail: adam@clarkfork.org

C. Landowner and/or Lessee Name (if different than applicant): USDA Forest Service - Missoula Ranger District

Mailing Address: 24 Fort Missoula Road

City: Missoula State: MT Zip: 59804

Telephone: 406-329-3814 E-mail: Michael.Siemiantkowski@usda.gov

II. PROJECT INFORMATION

A. Project Name: Upper O'Brien Creek Restoration Project

River, stream, or lake: O'Brien Creek

Location: Township: 13N Range: 21W Section: 26

Latitude: 46.850273 Longitude: -114.186882 *Within project (decimal degrees)*

County: Missoula

B. Purpose of Project: *(high level, focus on why the project is important)*

The purpose of this project is to increase the native westslope cutthroat trout (WCT) populations in upper O’Brien Creek. O’Brien Creek is a key spawning and rearing area for trout in the lower Bitterroot River watershed, as it is the only perennial tributary system between Lolo and the mouth of the river. O’Brien Creek supports high densities of WCT in upper reaches and a mix of WCT, *Oncorhynchus* spp. hybrids, brook trout, and brown trout in middle and lower sections. Project partners, including Clark Fork Coalition, Montana Department of Environmental Quality (DEQ), US Forest Service, and Montana Fish, Wildlife and Parks (FWP), will work to improve spawning and rearing habitat, reduce sediment loading, and restore floodplain connectivity in the upper mainstem reach of O’Brien Creek. This project supplements and complements numerous other projects implemented in the drainage since 1998.

C. Brief Project Description (attach additional information to end of application). Please include the anticipated construction schedule:

The proposed collaborative project would take place on O'Brien Creek, a tributary to Bitterroot River. O'Brien Creek has historically supported a productive coldwater fishery consisting of native and introduced salmonids. Fisheries values are highlighted by high WCT densities and other introduced trout species. Project stream reaches primarily represent spawning and rearing habitats for westslope cutthroat trout and various other coldwater species that provide recruitment for the Bitterroot River fishery.

O'Brien Creek has experienced extensive human uses for more than a century, including a railroad in the valley bottom for timber extraction, extensive road development and timber harvest in the uplands, and severe manipulation from ditching and irrigation withdrawals. These historic uses of the watershed have resulted in the degradation and simplification of fish habitat. Aquatic habitat is mostly riffle habitat features with little in-stream wood, pools, or instream complexity (see photos). The stream is also entrenched, with limited floodplain connectivity in most of the project reach.

Several aspects have been identified as limiting factors for aquatic habitat health. Thes include lack of instream wood and associated hydraulic and geomorphic complexity, limited areas of robust riparian vegetation and recruitable wood, as well as sediment loading from road prisms/fill slopes and native terrace erosion, road surface runoff, and tributary inputs.

The Bitterroot Watershed Restoration Plan (2020) and Forest Service stream and road surveys (2019), and DEQ sediment / aquatic habitat surveys have identified several current sources of sediment delivery into O'Brien Creek. A streamside Forest Service road is actively delivering sediment into the creek including large road fill failures (see attached photos). O'Brien Creek Road runs along 10.3 miles of its mainstem. In fact, 60% of the road is within 200 ft. of the stream. Several bank failures are also chronically delivering sediment into the stream. These impacts produce sediment at levels high enough to negatively affect fish spawning redds and macroinvertebrate habitat.

Project Partners propose to improve fish spawning and rearing habitat and reduce sediment inputs in upper O'Brien Creek by working closely with River Design Group (RDG), and Geum Environmental Consultants on the project. The goals of the project are to: 1) improve in-stream aquatic habitat, 2) reduce sediment loading, and 3) restore floodplain connectivity/processes. The project is focused on a 1.9 mile section that was identified by FWP as the primary fluvial WCT spawning and rearing reach where the stream is entrenched, has little in-stream wood or complexity, and is producing sediment from road fills and eroding banks.

Implementation is planned for fall 2026. Restoration treatments will include: installing at least 31 channel spanning large wood structures to increase complexity and enhance trout carrying capacity; realignment and recontouring sections of the O'Brien Creek Road and parking area to reduce encroachment and direct sediment inputs. The project will also reduce sediment contributing to O'Brien Creek from the upstream-most tributary by stabilizing the existing head cut and adding passive large wood to the channel; stabilize eroding, high-elevation terraces by lowering terraces to floodplain elevation; realigning short sections of O'Brien Creek away from eroding terraces and building an inset floodplain surface; placing passive large wood or installing large wood structures at the toe of eroding terraces; encouraging shallow emergent wetland vegetation development; and lowering existing berms to floodplain elevation to increase floodplain connectivity.

Public outreach will be coordinated by Clark Fork Coalition, including social media posts, newsletter articles, and hosting field trips for local community members and government agencies to showcase the benefits of restoration work on aquatic habitat, water quality, and watershed health.

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

These historic uses of the watershed have resulted in the degradation and simplification of fish habitat. O'Brien Creek has experienced extensive human uses for more than a century, including a railroad in the valley bottom for timber extraction, extensive road development and timber harvest in the uplands, and severe manipulation from ditching and irrigation withdrawals.

The project will correct the causes of the degradation by creating stream complexity through the addition of wood, reducing sediment inputs by re-routing roads and addressing erosive banks, and re-aligning the stream to activate floodplains.

E. Length of stream or size of lake that will be treated (project extent): 1.9 miles of O'Brien Creek

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

F. Project Budget Summary:

Grant Request (Dollars):	**$**	**44,222**
Matching Dollars:	**$**	**181,250**
Matching In-Kind Services:*	**$**	**0**

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

Other Contributions (not part of this app)	**$**	**6,000**
Total Project Cost:	**$**	**231,473**

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

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

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

I. Attach project plans:

- [X] Detailed sketches or plan views with the location and proposed restoration
- [X] 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 support letters or statements of (e.g., landowner consent, community or public support). For FWP statement, attach provided template. List any other project partners:

This project is a collaborative project between Clark Fork Coalition, Lolo National Forest, Montana Department of Environmental Quality, and Montana Fish Wildlife and Parks.

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.

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

Yes	No
[x]	[ ]

Clark Fork Coalition, public and private land managers, and project partners have been implementing and maintaining stream restoration projects since 1999. Project partners are committed to protection and restoration work, and have staff dedicated to monitoring the effectiveness of these projects.

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.*

Grazing is not currently allowed or planned in this area.

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?

Several monitoring efforts will be employed in the project. Two University of Montana classes are monitoring the effectiveness of the restoration treatments. Dr. Lisa Eby and Dr. Andrew Whiteley and their students are collecting baseline aquatic habitat data and fish population numbers. Specifically, they are collecting a subset of the PACFISH/INFISH Biological Opinion (PIBO) Effectiveness Monitoring protocol to record baseline and post-treatment habitat conditions. Dr. Whiteley and his students also sampled the stream to document fish species and estimate population sizes in new monitoring sections. This data supplements larger scale and longer-term fisheries data collected by FWP over the past 3 decades related to longitudinal fish species composition, WCT genetics, and fish density.

Pre and post project construction photo point monitoring will occur on major restoration features. Monitoring will take place pre-project in the fall of 2025 and then 2 years later at similar time of year. Additionally, Pre- and post-project Bank Erosion Hazard Index (BEHI) will be completed before the project begins and after the completion of the project on restoration treatment sites. CFC will conduct plant mortality counts on installed wetland container stock in the late summer of 2027.

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

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

The project will benefit the coldwater fish community in O'Brien Creek. Westslope cutthroat trout are the predominant fish species in upper reaches where this project is planned, but the project will also enhance habitat for brook trout and have lesser for benefit for rainbow / cutthroat hybrids, brook trout, brown trout and mountain whitefish which are more prevalent in downstream reaches.

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

Currently, fish habitat in the Upper O'Brien Creek is limited by the lack of instream large wood and the associated loss of habitat complexity and habitat benefits. Limited areas of robust riparian vegetation is limiting future wood recruitment. Additionally, sediment loading from road prism / fillslope and native terrace erosion, as well as road surface runoff, is reducing the amount of available spawning habitat.

The addition of wood into the system will enhance habitat complexity and significantly improve trout carrying capacity based on monitoring of similar projects over the past 5 years (L. Knotek, MFWP). Benefits will be realized in reaches known to be important spawning and rearing habitat for native and wild trout in the watershed. Specifically, proper installation of large wood has been demonstrated to increase overhead cover, channel complexity, physical habitat diversity, and deposition of spawning gravels in oversimplified channels, resulting in significantly higher fish densities and enhanced size structure.

Relocating roads away from the stream and re-contouring the original roadbed will eliminate chronic sediment production from surface runoff and catastrophic failures into the creek. Additionally, the erosion of terraces will be mitigated with the installation of large wood structures in several locations. Cumulatively, reducing stream sedimentation is expected to improve the quality of trout spawning and rearing habitat.

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

By improving trout spawning and rearing habitat in upper O'Brien Creek, the project is expected to benefit migratory and the stream-resident WCT populations. With higher densities of fish, angler success is expected to increase directly in O'Brien Creek and indirectly in the Bitterroot River. The entire project area will occur on public land and is open to angling. Wild trout populations and fishery quality downstream (i.e., Bitterroot River) are also expected to benefit through enhanced wild trout recruitment.

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

The entire project area lies on accessible public land just outside of Missoula and is open to angling. Wild trout populations are expected to increase as a result of the project, leading to more opportunity for angling success. The proposed project will increase trout abundance, westslope cutthroat trout conservation, and overall health, productivity and resiliency of upper O'Brien Creek, and contribute to a recruitment-limited fishery in the Bitterroot River at a larger scale.

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

Overall public benefits from this project will include increased WCT population resiliency and density, contributing to conservation efforts for this species. In addition, reducing sediment pollution, riparian enhancement, and other water quality enhancements will benefit the quality of O'Brien Creek and contribute to the improvement of downstream waterways.

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

The project will not interfere with the water rights or property rights of adjacent landowners. The entire project will take place on USFS property.

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

No, there is planned development of commercial recreational use at the site of the project.

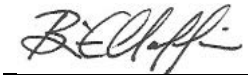
H. Is this project associated with the reclamation of past mining activity?

No, the project is not associated with mine reclamation.

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:  Date: 12 November 2025

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 appropriately or the application will be invalid. Please see the example budget sheet for clarification.

PROJECT COSTS					GRANT REQUEST AND FUNDING			
Work Items (Itemize by Category)	**Number of Units**	**Unit Description***	**Cost/Unit**	**Total Cost**	**FUTURE FISHERIES REQUEST**	**Matching Contributions (Cash or In-Kind)*** **	**Other Contributions (Funds not used as match)**	**Total Funding**
**Units = feet, hours, cubic yards, etc. Do not use lump sum unless necessary.*								
Personnel								
Survey	1	EA	$3,000.00	$ 3,000.00			3,000.00	$ 3,000.00
Engineering/Design	1	EA	$40,232.00	$ 40,232.00		$40,232.00		$ 40,232.00
Permitting	1	EA	$3,000.00	$ 3,000.00			3,000.00	$ 3,000.00
Contractor oversight	1	EA	$22,460.00	$ 22,460.00		$22,460.00		$ 22,460.00
CFC coordination, education, and oversight	1	EA	$18,400.00	$ 18,400.00		$18,400.00		$ 18,400.00
Maintenance**	1	EA	$1,600.00	$ 1,600.00		$1,600.00		$ 1,600.00
			Sub-Total	$ 88,692.00	$ -	$ 82,692.00	$ 6,000.00	$ 88,692.00
Travel								
Design firm Mileage	2000	MI	$0.70	$ 1,400.00		1,400.00		$ 1,400.00
CFC Mileage	750	MI	$0.70	$ 525.00		525.00		$ 525.00
Per diem				$ -				$ -
			Sub-Total	$ 1,925.00		$ 1,925.00	$ -	$ 1,925.00
Construction Materials								
FURNISH ALLUVIUM	485	CY	$6.00	$ 2,910.00	2,910.00			$ 2,910.00
FURNISH CATEGORY 1 ROCK	39	CY	$46.00	$ 1,794.00	1,794.00			$ 1,794.00
FURNISH BARRIER ROCKS / BOULDERS	50	EA	$200.00	$ 10,000.00		10,000.00		$ 10,000.00
FURNISH WILLOW CUTTINGS	4225	EA	$1.00	$ 4,225.00		4,225.00		$ 4,225.00
NATIVE GRASS AND FORB SEED	300	AC	$1.00	$ 300.00		300.00		$ 300.00
CONTAINAIRIZED WETLAND HERBACIOUS PLANTS	300	EA	$3.00	$ 900.00		900.00		$ 900.00
				$ -				$ -
				$ -				$ -
			Sub-Total	$ 20,129.00	$ 4,704.00	$ 15,425.00	$ -	$ 20,129.00
Equipment, Labor, and Mobilization								
MOBILIZATION, ACCESS AND STAGING AREA IMPROVEMENTS	1	EA	$20,000.00	$ 20,000.00		20,000.00		$ 20,000.00
SEDIMENT CONTROL BMPS	1	EA	$1,500.00	$ 1,500.00		1,500.00		$ 1,500.00
FURNISH WOOD AND BRUSH FROM ONSITE	80	HR	$175.00	$ 14,000.00		14,000.00		$ 14,000.00
EARTHWORK (EXCAVTE, LOAD, HAUL AND PLACE ON SITE)	1531	CY	$5.50	$ 8,420.50		8420.5		$ 8,420.50
CONSTRUCT CHANNEL STREAMBED	495	LF	$26.00	$ 12,870.00	12,870.00			$ 12,870.00
CONSTRUCT LARGE WOOD STRUCTURES	9	EA	$700.00	$ 6,300.00	6,300.00			$ 6,300.00
CONSTRUCT LARGE WOOD ARRAYS / AGGREGATES (31)	80	HR	$175.00	$ 14,000.00	14,000.00			$ 14,000.00
CONSTRUCT VEGETATED WOOD MATRIX	809	LF	$16.00	$ 12,944.00	6,348.00	6,596.00		$ 12,944.00
BERM REMOVAL	1	EA	$2,500.00	$ 2,500.00		2,500.00		$ 2,500.00
ROAD RECONTOURING	2200	LF	$4.00	$ 8,800.00		8,800.00		$ 8,800.00
ROAD CONSTRUCTION	2700	LF	$4.00	$ 10,800.00		10,800.00		$ 10,800.00
FLOODPLAIN GRADING AND ROUGHNESS TREATMENT	0.52	AC	$2,863.00	$ 1,488.76		1,488.76		$ 1,488.76
WETLAND CONSTRUCTION (SHAPING AND GRADING)	0.2	AC	$2,863.00	$ 572.60		572.60		$ 572.60
WEED MANAGEMENT	3	EA	$1,877.00	$ 5,631.00		5,631.00		$ 5,631.00
INSTALL CONTAINAIRIZED WETLAND HERBACIOUS PLANTS	300	EA	$3.00	$ 900.00		900.00		$ 900.00
				$ -				$ -
			Sub-Total	$ 120,726.86	$ 39,518.00	$ 81,208.86	$ -	$ 120,726.86
			OVERALL TOTALS	$ 231,472.86	$ 44,222.00	$ 181,250.86	$ 6,000.00	$ 231,472.86

OTHER REQUIREMENTS:

**For projects that include a maintenance request, it cannot exceed 10% of the total project cost.

***Match can include in-kind materials or labor. Justification for in-kind labor (e.g. hourly rates used) can be noted below. Do not use government salaries as match.

Additional budget detail:

APPLICATION MATCHING CONTRIBUTIONS

Total should equal match listed above; do not include requested funds

CONTRIBUTOR	IN-KIND	CASH	TOTAL	Secured? (Y/N)
Montana Department of Environmental Quality	$ -	$ 131,250.00	$ 131,250.00	Y
Montana Department of Natureal Resources	$ -	$ 50,000.00	$ 50,000.00	Y
	$ -			
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
TOTALS	$ -	$ 181,250.00	$ 181,250.00	

OTHER CONTRIBUTIONS

Total should equal other contributions listed above; these are funds not specically matched to the Future Fisheries application

CONTRIBUTOR	IN-KIND	CASH	TOTAL	Secured? (Y/N)
Forest Service survey and permitting	$ 6,000.00	$ -	$ 6,000.00	Y
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
TOTALS	$ 6,000.00	$ -	$ 6,000.00	

Decision Memo

Upper O’Brien Creek Restoration Project

U.S. Forest Service, Lolo National Forest

Missoula Ranger District

Missoula County, Montana

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Background

The proposed Upper O’Brien Creek Restoration Project consists of improvements to O’Brien Creek Road (Forest System Road (FSR) 371) where it interacts negatively with O’Brien Creek, instream habitat improvements in O’Brien Creek, and stabilization of sediment producing “hot spots” in O’Brien Creek and adjacent tributaries. The project area encompasses approximately 1.8 miles along the O’Brien Creek valley bottom and is bounded in width by the slopes that bound the valley. O’Brien Creek is one of the only perennial tributaries to the lower Bitterroot River and is designated bull trout spawning and rearing critical habitat per the US Fish and Wildlife Service. However, past land use in the watershed has degraded watershed function and aquatic species habitat.

The proposed action would mitigate negative road-stream interactions through fill slope stabilization and roadway realignment, thus reducing long-term fine sediment input to O’Brien Creek and improving Lolo National Forest administrative access to the area. At two tributaries, past channelization has led to channel erosion and fine sediment transport to O’Brien Creek. Stabilization of erosive locations would be implemented under the proposed action. The installation of large wood structures (LWS) would increase instream habitat complexity and benefit the species community. LWS can also be used to improve watershed function by promoting connection between stream channels and their floodplains. Improved floodplain connectivity leads to a more robust riparian area adjacent to the stream, improved near-surface aquifer recharge, and nutrient/carbon exchange between streams and floodplains.

Purpose and Need

Based upon the existing condition described above and consistent with the Lolo National Forest Plan direction and its goals, the Interdisciplinary Team identified that the purpose of the Upper O’Brien Creek Restoration project is to:

- Mitigate negative road-stream interactions
- Decrease fine sediment loading into O’Brien Creek
- Improve instream habitat for aquatic species, including potential spawning and rearing habitat for bull trout
- Improve watershed function

Given these purposes, there is a need to stabilize eroding fill slopes and streambanks, realign segments of FSR371, and install large wood structures in O’Brien Creek.

Decision

I have decided to approve the following actions within the Upper O’Brien Creek Restoration Project area:

Four existing segments of road, totaling approximately 2000 feet in length, are proposed to be realigned to mitigate negative effects on aquatic resources. No part of proposed realigned road segments would be further than 300 feet from the existing road location. Where feasible, the realigned road would be constructed on hillslope or terrace features to separate the road from the stream channel, floodplain, and riparian areas. As part of road realignment activities, the existing road prism would be decommissioned between the tie-in locations where the new road segment is

constructed. Road segment decommissioning would involve recontouring the cut/fill slopes to mimic the surrounding (undisturbed) topography, roughened with slash and woody debris, scarified, spread with topsoil salvaged during road realignment activities, and stabilized from erosive stream flows where necessary.

A road segment in the vicinity of the existing USFS gate (approximate coordinates: 46.85037, -114.18758) is currently used as a turn-around. This segment is compromised by a retreating, unstable streambank. At this location the road would be realigned by cutting into the adjacent hillside and the existing road fill slope would be laid back and stabilized to prevent further erosion and retreat. The gate at this location would be moved no more than 200 feet up or down the road such that the proposed gate placement meshes with existing land management direction while serving as an effective blockade for unauthorized motorized access.

LWS would be installed in the O'Brien Creek channel at locations where instream habitat complexity is lacking, or to enhance floodplain connectivity. Specific locations and the number of structures have not been determined and would be based on pool spacing in undisturbed systems. LWS could be installed by mechanical means (i.e. heavy equipment) or by hand-felling (i.e. sawyers with chainsaws) depending on the ease and level of disturbance associated with accessing the desired locations. If installed mechanically, access routes would be naturalized and decommissioned after use by decompacting the soil and applying large wood debris and native transplants as opportunities arise. Wood for the LWS would be sourced from clearing the road realignment segments and opportunistically on site with input from forest silviculture and fuels staff.

Along an unnamed, perennial tributary to O'Brien Creek (approximate location: 46.84990, -114.21617) a remnant berm adjacent to the stream would be removed to allow the stream to flow into a clearing where past surface water flow is evidenced by relict channel forms on its surface. By promoting streamflow into the relict channels, the area would change from a "high and dry" clearing colonized by noxious weeds into a plant community associated with wet meadow ecosystems. Within this area the existing roadway would be regraded to improve drainage and prevent the roadway from becoming inundated during high water.

At another unnamed, intermittent tributary to O'Brien Creek (approximate location: 46.84966, -114.22342) a headcut[1] is propagating up a channel and producing fine sediment that is transported into O'Brien Creek. This headcut would be stabilized by re-grading the channel at the progressing front of the headcut and placing large wood debris to increase channel roughness.

At locations where O'Brien Creek is actively eroding into existing road fill slopes, and road realignment is not a feasible option, the streambanks/fill slopes would be stabilized. Stabilization methods would be "biotechnical" in nature by utilizing native rock, wood, and transplanted vegetation to provide stability while promoting a natural aesthetic.

Additionally, resource protection measures as listed below are incorporated into this decision for implementation.

[1] A headcut is an erosional feature characterized by a lowering in the streambed elevation at a starting point that progresses upstream, forming a deeper gully.

- Engineering: Lolo National Forest Engineering has participated in the development of the proposal regarding road realignment and will be consulted as necessary through implementation.
- Fisheries and Hydrology: All in-stream work will be conducted during low flow within the fish window (July 15 – September 1).

  De-watering will occur within project area during implementation. Work areas will be isolated using clearwater bypass channels and cofferdams to control sediment. Cofferdams will be constructed with bulk bags, sandbags, or approved alternative material. Bulk bags will be carefully placed to ensure no tearing or cutting of the bag(s) occurs, and post-treatment removal is possible.

  Revegetation of riparian area will occur for locations disturbed during implementation. Equipment will perform work from existing road prism to mitigate disturbance to the extent possible. Disturbed areas will be stabilized and revegetated with native materials sourced in-situ (i.e. salvaged woody debris, alder, willow, dogwood transplants, native seed mixture).
- Fuels: NA
- Recreation: Work ideally would occur during the summer months prior to big game hunting season. Coordinate with line officer, recreation, and public affairs on road closures. Perform any needed gate repair/maintenance and add any kiosks or signs needed for protection of the area.
- Soils: Plan activities and use appropriate equipment to minimize new soil disturbance (loss of soil cover, rutting, compaction, displacement of topsoil) from heavy equipment and vehicle traffic.

  Heavy equipment travel off of roads will be on dry soils. Preference will be for travel on existing disturbed areas where available.

  Soils disturbed during project activities will be rehabilitated to provide for effective drainage, ground over, revegetation, and erosion prevention. Compacted soils will be decompacted to depth of compaction, emphasizing lifting and fracturing (not deep mixing) A lighter scarification method may be applicable in less compacted or very rocky areas.

  Continuous ruts will be removed and displaced topsoil recovered.

  Ground cover will be restored using available slash, coarse woody debris, litter and other on-site organic material.

  Disturbed soils will be seeded or planted when needed to assure successful revegetation.
- Botany: If new occurrences of federally listed or Region 1 sensitive plants are detected within the project area, the botanist would be contacted immediately so protective measures may be prescribed. This could include buffers or timing restrictions.
- Weeds: Follow Lolo National Forest 2007 Weeds FEIS, USDA – FOREST SERVICE Guide to Noxious Weed Prevention BMPs to comply with Executive Order 13751 (amended EO 13112) and the Lolo Forest Plan, as amended in 1991 (Forest-wide standard 59):

  Apply the following project design features to prevent/reduce undesirable effects from the proposed management activities:

- Incorporate weed prevention and control into project layout, design, alternative evaluation, and project decisions.
  - Determine prevention and maintenance needs, to include the use of herbicides, if needed, at the onset of project planning.
  - Clean contracted and Forest Service motorized equipment before it is moved into the project area to removed weed seed, mud, or other debris that might contain noxious weed seeds.
- Minimize roadside sources of weed seed that could be transported to other areas.
- Schedule and coordinate blading or pulling of noxious weed-infested roadsides or ditches in consultation with the local weed specialist. Do not blade or pull roadsides and ditches that are infested with noxious weeds unless doing so is required for public safety or protection of the roadway.

Monitor project footprint for a minimum of three years after implementation is completed and treat noxious/invasive weeds as needed on areas impacted by ground disturbing operations.

- Wildlife: Anyone working in grizzly bear habitat will adhere to bear country safety protocols, including measures to avoid providing attractants and minimize potential for conflicts and disturbance to bears, and will comply with applicable attractant storage orders. No seeding or planting of species palatable to grizzly bears will occur. Grizzly bear sightings and/or incidents will be reported to the appropriate action agency office within 48 hours.
- Heritage: Please notify the Lolo National Forest Heritage Program if any cultural resources are located during project implementation.
- Minerals: NA
- Timber: NA
- Visuals: NA

Public Involvement and Issues

The Forest Service partnered with the Clark Fork Coalition to develop this proposal. On February 9th, 2024, a scoping letter was sent to nearby landowners, interested parties, and organizations who have requested notification about this type of project. In addition, this project was listed on the Schedule of Proposed Actions, which is posted on the Lolo National Forest website. The scoping period ended on February 22nd, 2024. Comments received were supportive of the proposed action, however several commentors mentioned the negative road-stream interactions occurring on O'Brien Creek Road. This section of road is downstream of the project area and is the jurisdiction of Missoula County. The Lolo National Forest is committed to working with Missoula County to mitigate the negative impacts occurring along this stretch of O'Brien Creek Road. Additionally, commentors mentioned that lack of clear signage and maps at 122/123 O'Brien Loop Trailhead and gate on FSR 371. The Lolo National Forest is committed to working with our partners to improve signage at these locations.

Reasons for Categorically Excluding the Action

Forest Service resource specialists reviewed this project to evaluate potential environmental effects and to determine whether any extraordinary circumstances exist. Public comments and the environmental review completed by the Forest Service were used to make the final determination on whether the Upper O'Brien Creek Restoration Project may be categorically excluded. It is my determination that this project may be categorically excluded from documentation in an Environmental Assessment or an Environmental Impact Statement because the proposed actions fit within the following categorical exclusion from the Code of Federal Regulations (Title 36, Chapter II, Part 220):

- 36 CFR 220.6(e)(25): Forest and grassland management activities with a primary purpose of meeting restoration objectives or increasing resilience. Activities to improve ecosystem health, resilience, and other watershed and habitat conditions may not exceed 2,800 acres.
    i. Activities to meet restoration and resilience objectives may include, but are not limited to:
        A. Stream restoration, aquatic organism passage rehabilitation, or erosion control;
        B. Invasive species control and reestablishment of native species;
        C. Prescribed burning;
        D. Reforestation;
        E. Road and/or trail decommissioning (system and non-system);
        F. Pruning;
        G. Vegetation thinning; and
        H. Timber harvesting.
    ii. The following requirements or limitations apply to this category:
        A. Projects shall be developed or refined through a collaborative process that includes multiple interested persons representing diverse interests;
        B. Vegetation thinning or timber harvesting activities shall be designed to achieve ecological restoration objectives, but shall not include salvage harvesting as defined in Agency policy; and
        C. Construction and reconstruction of permanent roads is limited to 0.5 miles. Construction of temporary roads is limited to 2.5 miles, and all temporary roads shall be decommissioned no later than 3 years after the date the project is completed. Projects may include repair and maintenance of NFS roads and trails to prevent or address resource impacts; repair and maintenance of NFS roads and trails is not subject to the above mileage limits.

During initial public scoping, multiple categorical exclusion authorities were recommended to encompass the road realignment and stream habitat restoration activities proposed. However, 220.6(e)(25) (listed above) covers all activities proposed in this project, and the project meets the requirements and limitations listed in part (ii) of the CE authority.

The following resource conditions were evaluated as part of our analysis with reports available in the project record.

- Federally listed threatened or endangered species or designated critical habitat, species proposed for Federal listing or proposed critical habitat, or Forest Service sensitive species.
    - ♦ Plants – There are no known occurrences of threatened or endangered plant species in the project area or suitable habitat. The project is likely to have beneficial impacts to rare plant habitat by restoring natural stream functioning. Regarding, endangered, threatened, or sensitive plants, no extraordinary circumstances exist.

      Federally Listed Species: There are no known Threatened or Endangered plants present in the project area. Forest specialists have determined that whitebark pine is not present within the project area and there is no modeled habitat for whitebark pine in the project area. Therefore, there will be no effect to any listed threatened or endangered species.

      Forest Service Sensitive Species: A determination of no impact to sensitive plant species has been made, except for Colville Indian paintbrush, western snakeroot, clustered lady's slipper, rareflower heterocodon, and western joe-pye weed, for which the project may impact individuals or habitat but is not likely to result in a trend toward federal listing or loss of viability to population or species.
    - ♦ Wildlife – A determination of "may affect, not likely to adversely affect" has been made for grizzly bear. A No Effect/Impact determination has been made pertaining to all other federally listed threatened and endangered species, designated critical habitat, or species proposed for listing or proposed critical habitat. A determination of No Impact has been made pertaining to sensitive species of the Lolo National Forest except for gray wolf, northern bog lemming, townsend's big eared bat, boreal toad, and northern leopard frog, for which a determination of "may impact individuals or habitat" has been made. Regarding wildlife, no extraordinary circumstances exist.
    - ♦ Fisheries – A determination of No Impact has been made for western pearlshell mussel, and a determination of May Impact Individuals or Habitat has been made for westslope cutthroat trout. A determination of May Affect, Likely to Adversely Affect has been made for bull trout and bull trout critical habitat. O'Brien Creek does not currently support resident or migratory bull trout, but critical habitat is present. Impacts will be short in duration and concentrated in limited, discrete locations. The actions are unlikely to result in long-term negative effects and are likely to result in long-term benefits for multiple primary constituent elements for bull trout habitat as the project will overall restore proper function and health to O'Brien Creek. Lolo National Forest Fisheries Biologists have consulted with the US Fish & Wildlife Service and support the finding that potential impacts to threatened or sensitive aquatic species and critical habitat do not constitute the existence of an extraordinary circumstance.
- Flood plains, wetlands, or municipal watersheds – While the proposed action involves short-term disturbances to stream channels and floodplains, the long-term effects will be beneficial to watershed functions. O'Brien Creek is not within a municipal watershed, and therefore no extraordinary circumstances exist.
- Congressionally designated areas such as wilderness, wilderness study areas, or national recreation areas – The project area is not within or adjacent to a wilderness area, wilderness study area, or a national recreation area, and therefore no extraordinary circumstances exist.
- Inventoried roadless areas or potential wilderness areas – There are no inventoried roadless areas or potential wilderness areas within or adjacent to the project area, and therefore no extraordinary circumstances exist.

- Research natural areas – There are no research natural areas in or near the project area, and therefore no extraordinary circumstances exist.
- American Indians and Alaska Native religious or cultural sites - There are no known sites in the proposed area. If unknown sites were encountered during implementation, these sites would be subject to appropriate Tribal Historic Preservation Officer review and comment, as per the 36 CFR 800 compliance process.
- The proposed project would cause no effect to historic properties (36 CFR 800.4(d)(1)). No field survey is required due to the nature of the proposed project, sufficiently adequate previous survey and inventory, and low potential for cultural resources within the area of potential effects.

Table 1: TEPC Effect Determinations for the Endangered Species Act

Species/Habitat	Status	Proposed or Designated Critical Habitat Present?	Determination*	Brief Rationale
Canada Lynx (Lynx canadensis)	Threatened	no	NE	Outside lynx LAU, not within lynx habitat, outside linkage area
Grizzly Bear (Ursus arctos horribilis)	Threatened	yes	NLAA	See Bull Trout Restoration Programmatic Form
Yellow-billed Cuckoo (Coccyzus americanus)	Threatened	no	NE	See Bull Trout Restoration Programmatic Form
Monarch butterfly (Danaus plexippus)	Candidate	no	NE	No habitat present
Bull Trout (Salvelinus confluentus) and Bull Trout Critical Habitat.	Threatened	yes	LAA	See Fisheries BA/BE Form
Whitebark pine (Pinus albicaulis)	Threatened	no	NE	No habitat present
Wolverine (Gulo gulo luscus)	Proposed-Threatened	yes; male dispersal habitat	NE	See Biological Assessment

***NE** = No Effect; **NLAA** = Not Likely to Adversely Affect; **LAA** = Likely to Adversely Affect

Table 2: Summary of Biological Determinations for Sensitive Species

Species/Habitat	Determination*	Brief Rationale
Bald Eagle	NI	No habitat affected
Bighorn Sheep	NI	No habitat affected
Black-backed woodpecker	NI	No habitat affected
Coeur d'Alene salamander	NI	No habitat affected

Species/Habitat	Determination*	Brief Rationale
Common Loon	NI	No habitat affected
Fisher	NI	No habitat affected
Flammulated Owl	NI	No habitat affected
Gray Wolf	MIIH	No habitat affected but individuals could experience some temporary disturbance during project actions
Harlequin Duck	NI	No habitat affected
Northern Bog Lemming	MIIH	Species may be present during season of project
Northern Leopard Frog	MIIH	Species present during season of project
Peregrine Falcon	NI	No habitat affected
Townsend's big-eared bat	MIIH	No habitat affected but actions could occur during feeding so there may be very limited disturbance
Boreal Toad	MIIH	Species present during season of project
Westslope cutthroat trout	MIIH	Instream work may have short-term impacts to population and habitat
Western Pearlshell Mussel	NI	Species not present in the project area

***NI** =No Impact; **MIIH** = May Impact Individuals or Habitat, But Will Not Likely Contribute To A Trend Towards Federal Listing Or Loss Of Viability To the Population Or Species; **WIIH** = Will Impact Individuals Or Habitat With A Consequence That The Action May Contribute To A Trend Towards Federal Listing Or Cause A Loss Of Viability To the Population Or Species

Table 3: Summary of Biological Determinations for Indicator Species

Species/Habitat	Effect on species or habitat	Brief Rationale
Northern Goshawk	no	No suitable habitat present
Elk	yes	There are no anticipated effects to this species beyond some potential noise disturbance
Pileated Woodpecker	no	No suitable habitat present

Findings and Consistency with Laws, Regulation, and FS Policies

National Forest Management Act (Consistently with the Lolo Forest Plan)

The authorized actions are consistent with the standards and guidelines as determined in the Lolo National Forest Plan (USDA Forest Service, 1986). The purpose of the project is to enhance aquatic habitat and contribute to the recovery of bull trout to a non-threatened status (Forest Plan, pages II-13 to 14). Best management practices will be applied to assure that water quality is maintained at a level that is adequate for the protection and use of the National Forest and that meets or exceeds Federal and State standards (Forest Plan, page II-12). The project was designed to have minimum adverse impacts on the aquatic ecosystem and will not cause permanent or long-term unnatural stress (Forest Plan, page II-14).

No effects to Lolo National Forest Management Indicator Species (MIS) were identified in our analysis. This project meets requirements found in, but not limited to, the National Forest Management Act, the Endangered Species Act, the Clean Water Act, and the National Environmental Policy Act.

ENDANGERED SPECIES ACT

The purpose of this project is to improve habitat for bull trout, a listed Threatened species. Consistent with Section 7 of the Endangered Species Act, consultation with the U.S. Fish and Wildlife Service was completed. The USFWS determined that project activities will likely result in incidental take of bull trout in the form of harm, harassment or mortality related to the expected short-term degradation of aquatic habitat parameters because of increased levels of activity generated sediment. Sediment from associated project activities is anticipated to have short-term adverse effects and likely result in mortality to some individuals during the juvenile and sub-adult life history stages by harming or impairing feeding and sheltering patterns of bull trout.

Biological Evaluations/Biological Assessments for threatened, endangered and sensitive terrestrial and aquatic species and their proposed or designated critical habitat are contained within the Project File and the findings are summarized in section *V – Reasons for Categorically Excluding the Action*, within this document.

NATIONAL HISTORIC PRESERVATION ACT (NHPA) – SECTION 106 REVIEW

A Forest Service archaeologist has reviewed the site and determined there will be no impacts to heritage resources. This action is consistent with Forest Plan direction and Section 106 of the National Historic Preservation Act.

TRIBAL CONSULTATION

Based on the nature of the proposal, the Line Officer/responsible official made the following determination regarding Tribal Consultation: Consultation with American Indian Tribes is not needed. A scoping letter was sent to the Confederated Salish and Kootenai Tribes and Nez Perce Tribe. No comments were received.

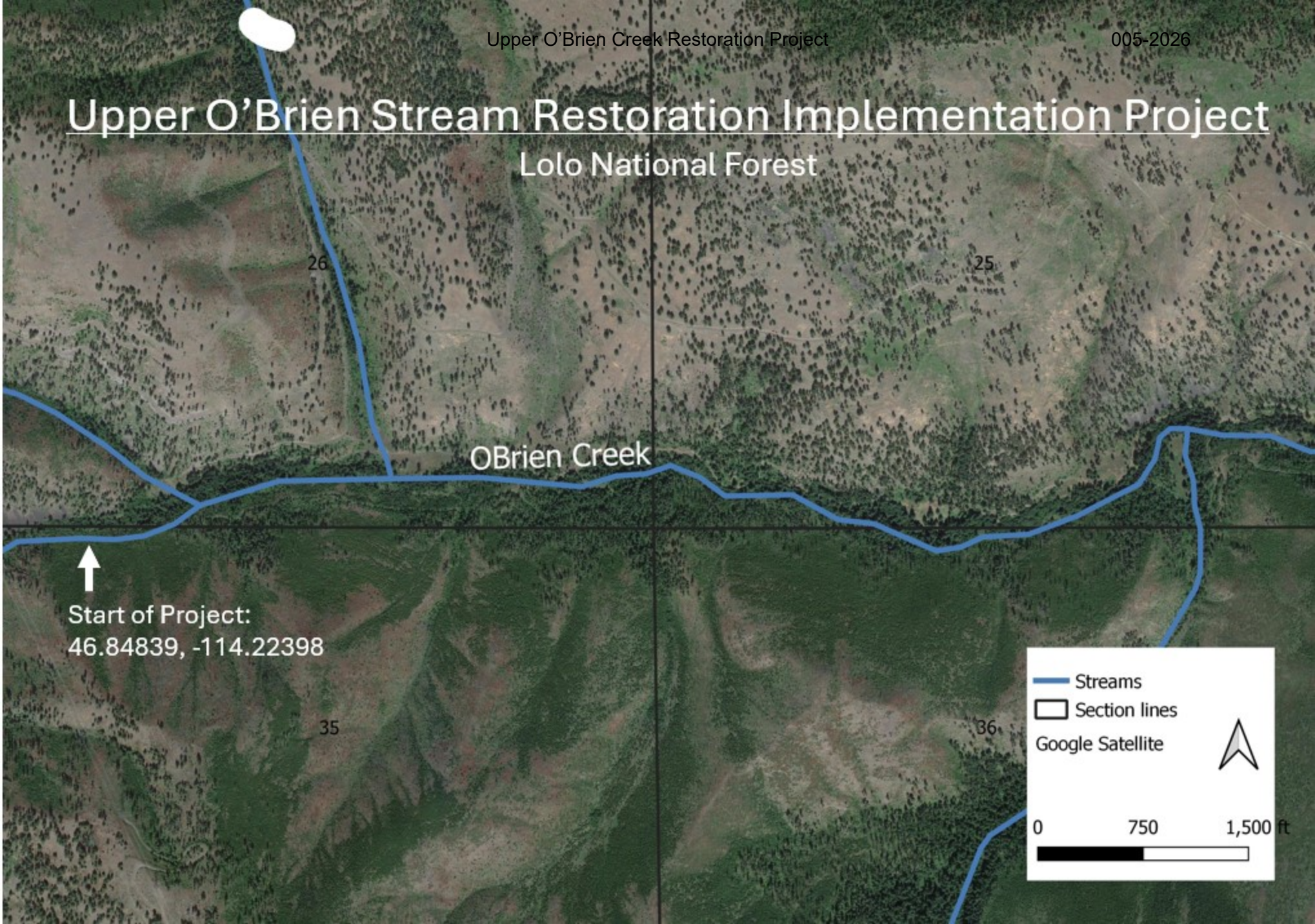
CLEAN WATER ACT (CWA)

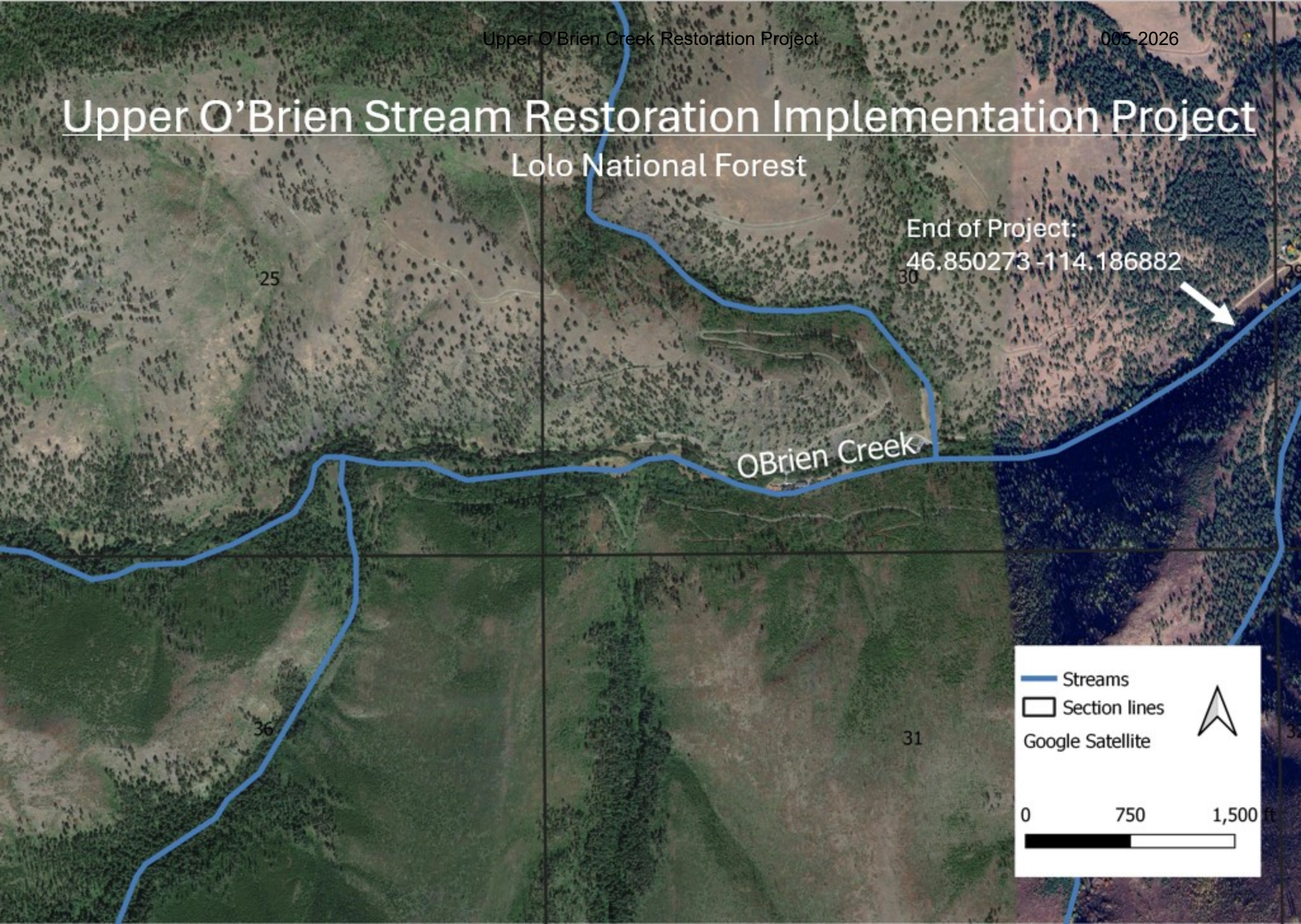
Best management practices and required mitigation measures will be used to minimize impacts to water quality. All necessary permits will be obtained prior to implementation. Thus, this project is consistent with the Clean Water Act and State water quality laws.

Implementation

This project is not subject to administrative review procedures (appeal/objection process). For specific project information, please contact Traci Sylte, Soil and Water Program Manager at 24 Fort Missoula Road, Missoula, MT 59804, 406-329-3750; or by email at traci.sylte@usda.gov.

Crystal Stonesifer Date
Missoula District Ranger


Upper O'Brien Stream Restoration Implementation Project
Lolo National Forest
26
25
OBrien Creek
Start of Project:
46.84839, -114.22398
35
36
Streams
Section lines
Google Satellite
0
750
1,500 ft


Upper O'Brien Stream Restoration Implementation Project
Lolo National Forest
End of Project:
46.850273 -114.186882
25
30
OBrien Creek
36
31
Streams
Section lines
Google Satellite
0
750
1,500 ft

Upper O’Brien Creek Restoration – Photos

Figure 1. O’Brien Creek is eroding the stream-side roadbed at several locations. This picture shows an actively eroding section of roadbed the at the beginning of the restoration reach. The road will be re-located away from the stream, and vegetated wood matrix and large wood structures will be installed creating an inset floodplain.

Figure 2: O’Brien Creek has simplified habitat with little in-stream wood. At least 31 large wood array / aggregates will be installed along the restoration reach.

Figure 3: Another example of overly simplified aquatic habitat devoid of wood and complexity.

Figure 4: Bank erosion is severe at several sections of the creek. They will be treated with vegetated wood matrix and large wood structures creating inset floodplains.

Figure 5: Another example of an actively eroding bank that will be treated.

UPPER O'BRIEN CREEK RESTORATION PROJECT
DESIGN PLAN SET

PROJECT PARTNERS

CLARK FORK COALITION
P.O. BOX 7593
MISSOULA, MONTANA 59807

US FOREST SERVICE
LOLO NATIONAL FOREST
24 FORT MISSOULA ROAD
MISSOULA, MONTANA 59804

DRAWING INDEX

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4.0 PROJECT MATERIALS AND QUANTITIES
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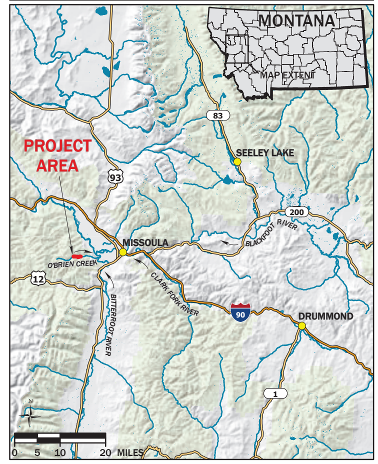
5.1 PANEL 2 PLAN VIEW AND TREATMENT LOCATIONS
5.2 PANEL 3 PLAN VIEW AND TREATMENT LOCATIONS
5.3 PANEL 4 PLAN VIEW AND TREATMENT LOCATIONS
5.4 PANEL 5 PLAN VIEW AND TREATMENT LOCATIONS
6.0 CHANNEL CROSS SECTION DIMENSIONS
7.0 CHANNEL REALIGNMENT DETAIL
7.1 INSET FLOODPLAIN DETAIL
7.2 VEGETATED WOOD MATRIX DETAIL
7.3 LARGE WOOD STRUCTURE DETAIL
7.4 LARGE WOOD AGGREGATE DETAIL
7.5 CHANNEL-SPANNING LOG ARRAY DETAIL
7.6 SINGLE LOG ARRAY DETAIL
7.7 FLOODPLAIN TREATMENT DETAIL
7.8 CONSTRUCTED CHANNEL STREAMBED DETAIL
8.0 TYPICAL ROAD SECTION DETAIL
8.1 CURVE WIDEN DETAIL
9.0 BMP DETAIL

UPPER O'BRIEN CREEK VICINITY MAP



SE¼ S26, T13N, R21W; AND S25, T13N, R21W
MISSOULA COUNTY, MONTANA

O'BRIEN CREEK WATERSHED DESCRIPTION

THE OBRIEN CREEK WATERSHED ENCOMPASSES 25.4 SQUARE MILES AND IS A MAJOR TRIBUTARY OF THE BITTERROOT RIVER UPSTREAM OF THE CONFLUENCE WITH THE CLARK FORK RIVER NEAR MISSOULA, MONTANA. O'BRIEN CREEK IS ONE OF THE MOST IMPORTANT TRIBUTARIES IN THE LOWER BITTERROOT RIVER FOR RAINBOW AND CUTTHROAT TROUT (MT FWP, 2019). LAND OWNERSHIP IN THE WATERSHED IS A MIX OF US FOREST SERVICE AND PRIVATE OWNERSHIP. SIMILAR TO MOST FORESTED WATERSHEDS IN THE REGION, O'BRIEN CREEK HAS EXPERIENCED HUMAN-CAUSED IMPACTS FROM FORESTRY, GRAZING, MILL OPERATIONS, DEWATERING, CHANNELIZATION, AND DEVELOPMENT. IN THE LOWER WATERSHED, WATER MANIPULATION AND WITHDRAWALS CREATED FLOW INTERMITTENCY AND CHANNEL DEWATERING. RECENT EFFORTS TO BRING AWRENESS TO THIS ISSUE, AND SENIOR WATER RIGHTS PURCHASES, HAVE RETURNED PERRENIAL OR YEAR-ROUND FLOW TO ALL REACHES OF O'BRIEN CREEK.

PROJECT BACKGROUND

STREAM INVENTORIES COMPLETED BY THE US FOREST SERVICE IN 2019 IDENTIFIED OPPORTUNITIES TO IMPROVE AQUATIC HABITAT AND STREAM CHANNEL CONDITIONS THROUGHOUT THE O'BRIEN CREEK WATERSHED (USFS, 2019). THESE EFFORTS WERE UNDERTAKEN, IN PART, TO SUPPORT TMDL SEDIMENT LOAD REDUCTION TARGETS FOR THE BITTERROOT RIVER, WHICH HAS BEEN IDENTIFIED AS AN IMPAIRED WATER BODY BY THE MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY. THE ENTIRE LENGTH OF O'BRIEN CREEK ROAD ENCROACHES ON O'BRIEN CREEK AND ITS FLOODPLAIN AND IS A CHRONIC SOURCE OF SEDIMENT TO THE CREEK. THE UPPER REACHES OF O'BRIEN CREEK ARE CHARACTERIZED BY ROAD PRISM/FILLSLOPE AND NATIVE TERRACE EROSION, CHANNELIZATION, AND FLOODPLAIN DISCONNECTION. THE STREAM LACKS LARGE WOODY DEBRIS AND ASSOCIATED HABITAT DIVERSITY AND COMPLEXITY.

RIVER DESIGN GROUP, INC. WAS RETAINED BY CLARK FORK COALITION, IN PARTNERSHIP WITH LOLO NATIONAL FOREST, TO PREPARE A RESTORATION PLAN FOR A 1.9-MILE REACH OF UPPER O'BRIEN CREEK ON US FOREST SERVICE LAND. PROPOSED RESTORATION ACTIONS AIM TO SUPPORT THE RECOVERY OF STREAM, FLOODPLAIN, AND AQUATIC HABITAT FUNCTIONALITY. THIS INCLUDES PROPOSED REALIGNMENTS OF O'BRIEN CREEK ROAD. WHERE LINEAR GRADING IS APPROPRIATE, THE PROPOSED ROAD CENTERLINE WILL BE SURVEYED AND FLAGGED PRIOR TO IMPLEMENTATION. WHERE SURVEY AND DESIGN IS REQUIRED, SUBSEQUENT SURVEYING AND ENGINEERING WILL BE UNDERTAKEN TO DETERMINE FINAL ROAD ALIGNMENTS, CUT AND FILL QUANTITIES, AND DESIGN CRITERIA.

GENERAL NOTES

1. SLOPES DESIGNATED AS 2:1, 1.5:1 ET CETERA, ARE THE RATIOS OF HORIZONTAL DISTANCE TO VERTICAL DISTANCE.
2. DIMENSIONS ARE GIVEN IN FEET AND TENTHS OF A FOOT.
3. ALL EXISTING CONDITIONS ARE TO BE VERIFIED IN THE FIELD PRIOR TO CONSTRUCTION AND ANY ADJUSTMENTS TO THE DRAWINGS SHALL BE COORDINATED BY RDG.
4. PROTECT ALL VEGETATION AND LAND AREAS NOT LOCATED WITHIN THE PROJECT CONSTRUCTION, STAGING, OR EARTHWORK LIMITS. EXERCISE CARE IN AREAS NOT SO MARKED TO AVOID UNNECESSARY DAMAGE TO NATURAL VEGETATION.
5. THE PROJECT SPONSOR IS RESPONSIBLE FOR COMPLYING WITH ALL PERMITS INCLUDING ALL FEDERAL, STATE, COUNTY, AND LOCAL PERMIT CONDITIONS.
6. EXCAVATION, TRENCHING, SHORING, AND SHIELDING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR PERFORMING THE WORK. THESE DRAWINGS ARE NOT INTENDED TO PROVIDE MEANS OR METHODS OF CONSTRUCTION.
7. EXCAVATION SHALL MEET THE REQUIREMENTS OF OSHA 29 CFR PART 1926, SUBPART P, EXCAVATIONS. ACTUAL SLOPES SHALL NOT EXCEED THE SLOPES AS INDICATED ON DRAWINGS.
8. RDG WILL PROVIDE SURVEY CONTROL FOR EQUIPMENT WITH GPS MACHINE CONTROL CAPABILITY. RDG SHALL PROVIDE SURVEY STAKING AND LAYOUT FOR CONSTRUCTION, INCLUDING HORIZONTAL CONSTRUCTION EXTENTS, SUBGRADE EXCAVATION EXTENTS, AND FINISHED GRADE ELEVATIONS.
9. VERTICAL TOLERANCE FOR CONSTRUCTION COMPLIANCE WILL BE 0.3 FEET. HORIZONTAL TOLERANCE WILL BE 1.0 FEET.
10. CONTRACTOR SHALL CONFIRM QUANTITIES. REPORTED VOLUMES ARE NEATLINE AND DO NOT INCLUDE ADJUSTMENTS FOR COMPACTION OR OTHER FACTORS.

REUSE OF DRAWINGS

THESE DRAWINGS, THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, ARE THE PROPERTY OF RIVER DESIGN GROUP, INC. (RDG) AND ARE NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF RDG. LIKEWISE, THESE DRAWINGS MAY NOT BE ALTERED OR MODIFIED WITHOUT AUTHORIZATION OF RDG. DRAWING DUPLICATIONS IS ALLOWED IF THE ORIGINAL CONTENT IS NOT MODIFIED.

STANDARD OF PRACTICE

RIVER DESIGN GROUP, INC. WORKS EXCLUSIVELY IN THE RIVER ENVIRONMENT AND UTILIZES THE MOST CURRENT AND ACCEPTED PRACTICES AVAILABLE FOR PLANNING AND DESIGN OF RIVER, FLOODPLAIN, AND AQUATIC HABITAT RESTORATION PROJECTS. CURRENT STANDARDS FOR THE DESIGN OF RESTORATION PROJECTS VARY DEPENDING ON PROJECT GOALS.

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fax:406.862.4963

COVER PAGE
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER
RDG-22-108
DRAWING NUMBER
1.0

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236 Wisconsin Avenue
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fax:406.862.4963

EXISTING CONDITIONS
UPPER O'BRIEN CREEK

EXISTING CONDITIONS

THE PROJECT REACH BEGINS AT AN UNNAMED SEASONAL TRIBUTARY THAT IS THE SITE OF A FORMER BURNED AREA EMERGENCY RESPONSE (BAER) GULLY STABILIZATION PROJECT. THE TRIBUTARY FEATURES A 2.5-FOOT VERTICAL HEADCUT THAT LIKELY SERVES AS A CHRONIC SOURCE OF SEDIMENT TO O'BRIEN CREEK. O'BRIEN CREEK ROAD PARALLELS O'BRIEN CREEK AND ITS FLOODPLAIN FOR THE ENTIRE 1.9-MILE LENGTH OF THE PROJECT REACH AND IS A CHRONIC SOURCE OF SEDIMENT. THE LOWER 1.5 MILES OF ROAD WITHIN THE PROJECT AREA CONSISTS OF DOUBLE-TRACK WHICH TRANSITIONS TO A SINGLE-TRACK TRAIL FOR THE UPPER 0.4 MILES. WITHIN THE PROJECT REACH, O'BRIEN CREEK IS CHARACTERIZED BY ISOLATED AREAS OF ROAD PRISM/FILLSLOPE AND NATIVE TERRACE EROSION. HISTORIC MANIPULATION OF SECTIONS OF O'BRIEN CREEK HAS RESULTED IN A STRAIGHTENED, MODERATELY ENTRENCHED CHANNEL THAT IS LACKING LARGE WOOD AND ASSOCIATED HYDRAULIC AND GEOMORPHIC COMPLEXITY. RESULTING FLOODPLAIN DISCONNECTION HAS PRODUCED LIMITED ROBUST RIPARIAN VEGETATION AND RECRUITABLE WOOD. RELIC SIDE CHANNELS AND SWALES ATTEST TO A HISTORICALLY MORE COMPLEX, HYDROLOGICALLY CONNECTED CHANNEL AND FLOODPLAIN. THE PROJECT REACH ENDS AT A US FOREST SERVICE GATE AND TURNAROUND CHARACTERIZED BY EXTREME ROAD PRISM/FILLSLOPE EROSION.

LIMITING FACTORS AND CONSTRAINTS

LIMITING FACTORS AND CONSTRAINTS TO THE STREAM, FLOODPLAIN, AND AQUATIC HABITAT CONDITIONS IN UPPER O'BRIEN CREEK INCLUDE:

- SEDIMENT LOADING FROM ROAD PRISM/FILLSLOPE AND NATIVE TERRACE EROSION, ROAD SURFACE RUNOFF, AND TRIBUTARY INPUTS;
- LACK OF INSTREAM LARGE WOOD AND ASSOCIATED HYDRAULIC AND GEOMORPHIC COMPLEXITY AND HABITAT BENEFITS;
- CHANNEL ENTRENCHMENT AND FLOODPLAIN DISCONNECTION; AND
- LIMITED AREAS OF ROBUST RIPARIAN VEGETATION AND RECRUITABLE WOOD.


EXISTING CONDITIONS, UPPER O'BRIEN CREEK. LEFT: ROAD PRISM/FILLSLOPE EROSION AND BLOCK FAILURE. RIGHT: ENTRENCHED, SIMPLIFIED CHANNEL LACKING LARGE WOOD.

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER
RDG-22-108
DRAWING NUMBER
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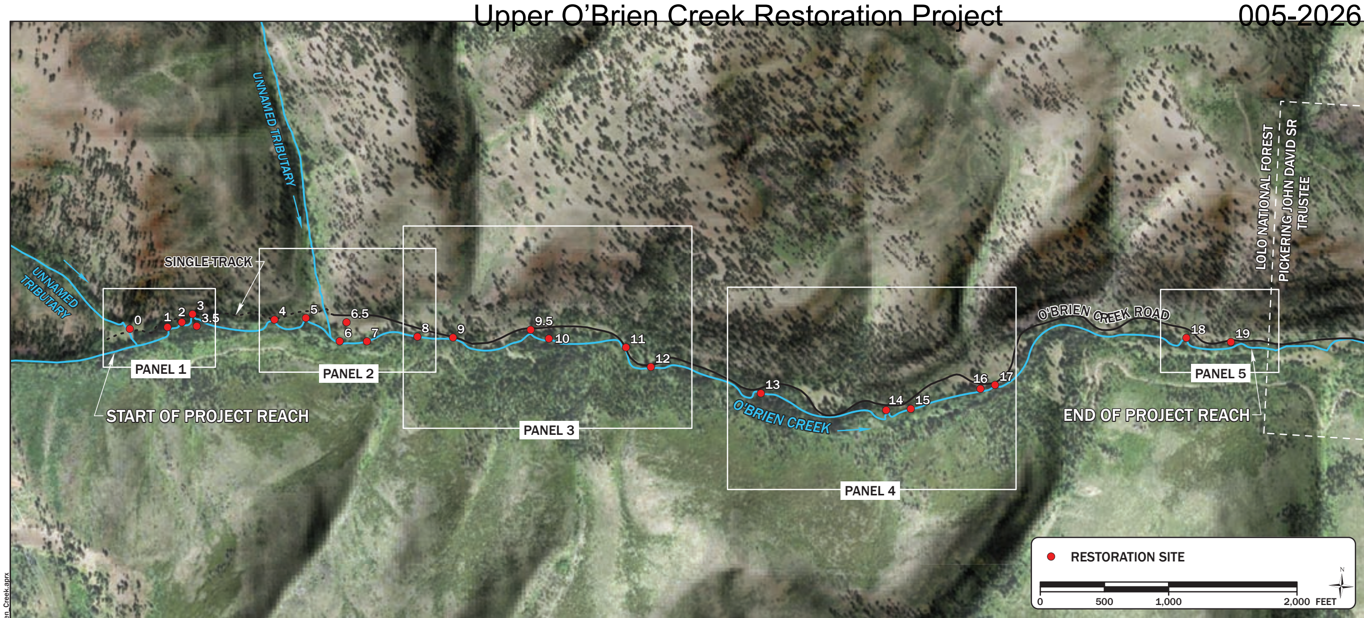

RESTORATION GOALS

THE GOALS OF THE UPPER O'BRIEN CREEK RESTORATION PROJECT WERE DEVELOPED BY PROJECT STAKEHOLDERS BASED ON PREVIOUS STUDIES AND SITE VISITS, AND INCLUDE:

- IMPROVE SPAWNING AND REARING HABITAT FOR RAINBOW AND CUTTHROAT TROUT BY ENHANCING HYDRAULIC AND GEOMORPHIC COMPLEXITY, INCREASING COVER AND SHADE, AND PROMOTING GRAVEL RETENTION;
- REDUCE SEDIMENT LOADING, PARTICULARLY COARSE SEDIMENT SUPPLY, FROM TRIBUTARIES AND EROSION ASSOCIATED WITH O'BRIEN CREEK ROAD AND HIGH-ELEVATION TERRACES; AND
- RESTORE FLOODPLAIN CONNECTIVITY WHERE FEASIBLE BY RECONNECTING AND CREATING FLOODPLAIN SURFACES, INCLUDING SIDE CHANNELS, WETLANDS, AND HIGH-QUALITY RIPARIAN HABITATS.

RESTORATION TREATMENTS

SPECIFIC RESTORATION TREATMENTS FOR THE 1.9 MILE PROJECT REACH OF UPPER O'BRIEN CREEK INCLUDE:

- REALIGNING AND RECONTOURING SECTIONS OF O'BRIEN CREEK ROAD AND PARKING AREA TO REDUCE SEDIMENTATION FROM EROSION AND ROAD RUNOFF;
- REDUCE SEDIMENT CONTRIBUTIONS TO O'BRIEN CREEK FROM THE UPSTREAM-MOST TRIBUTARY BY STABILIZING THE EXISTING HEADCUT AND ADDING PASSIVE LARGE WOOD TO THE CHANNEL TO INCREASE ROUGHNESS, REDUCE SHEAR STRESS, AND ENCOURAGE COARSE SEDIMENT DEPOSITION;
- STABILIZING ERODING, HIGH-ELEVATION TERRACES BY LOWERING TERRACES TO FLOODPLAIN ELEVATION TO CREATE AN INSET FLOODPLAIN, INCORPORATING VEGETATED WOOD MATRIX STRUCTURES AND FLOODPLAIN TREATMENTS;
- REALIGNING SHORT SECTIONS OF O'BRIEN CREEK AWAY FROM ERODING TERRACES AND BUILDING AN INSET FLOODPLAIN SURFACE DAYLIGHTING TO THE EXISTING TERRACE, INCORPORATING VEGETATED WOOD MATRIX STRUCTURES AND FLOODPLAIN TREATMENTS;
- PLACING PASSIVE LARGE WOOD OR INSTALLING LARGE WOOD STRUCTURES AT THE TOE OF ERODING TERRACES TO REDIRECT FLOW PATHS AND REDUCE NEAR-BANK STRESS;
- ENCOURAGING SHALLOW EMERGENT WETLAND DEVELOPMENT BY REDIRECTING TRIBUTARY FLOWS TO A TOPOGRAPHIC DEPRESSION IN A DRY FLOODPLAIN AND USING SELECTIVE GRADING;
- OPPORTUNISTICALLY PLACING PASSIVE LARGE WOOD OR INSTALLING LARGE WOOD STRUCTURES IN THE CHANNEL TO INCREASE POOL FREQUENCY, ENHANCE HYDRAULIC AND GEOMORPHIC COMPLEXITY, ADD COVER AND SHADE, AND PROMOTE GRAVEL RETENTION;
- INSTALLING CHANNEL-SPANNING, LOW-PERMEABILITY LARGE WOOD STRUCTURES WHERE APPROPRIATE TO INCREASE FLOODPLAIN CONNECTIVITY, PARTICULARLY WHERE RELIC SIDE CHANNELS CAN BE REACTIVATED; AND
- LOWERING EXISTING BERMS TO FLOODPLAIN ELEVATION TO INCREASE FLOODPLAIN CONNECTIVITY.

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SITE PLAN AND INDEX
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108

DRAWING NUMBER 3.0

SHEET 3 OF 22

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TOTAL MATERIALS							
SITE NUMBER	CATEGORY 1 WOOD	CATEGORY 2 WOOD	CATEGORY 3 WOOD	WILLOW CUTTINGS	STREAMBANK ALLUVIUM (CY)	STREAMBED ALLUVIUM (CY)	BARRIER ROCKS/ BOULDERS
0	16	40	-	-	-	-	-
1	9	23	-	-	-	-	-
2	5	11	-	-	-	-	-
3	5	143	286	365	41	22	-
3.5	2	6	-	-	-	-	-
4	5	11	-	-	-	-	-
5	5	73	146	190	20	-	-
6	7	17	-	-	-	-	-
6.5	0	7	-	-	-	-	-
7	7	17	-	-	-	-	-
8	7	17	-	-	-	-	-
9	0	257	508	635	76	-	-
9.5	2	6	-	-	-	-	-
10	5	157	314	400	46	-	-
11	5	386	770	970	114	-	-
12	5	153	306	390	44	-	-
13	5	82	166	215	23	-	-
14	5	123	246	315	35	18	-
15	0	0	-	-	-	-	-
16	9	23	-	-	-	-	-
17	2	6	-	-	-	-	-
18	5	191	382	485	56	-	-
19	5	100	202	260	29	-	50
TOTAL	117	1,849	3,326	4,225	485	39	50

MATERIAL SPECIFICATIONS		
ITEM	QUANTITY	DIAMETER
CATEGORY 1 WOOD	117	10" - 14"
CATEGORY 2 WOOD	1,849	6" - 12"
CATEGORY 3 WOOD	3,326	< 3"
WILLOW CUTTINGS	4,225	0.25" - 1"
STREAMBANK ALLUVIUM (CY)	485	10" MINUS
STREAMBED ALLUVIUM (CY)	39	10" MINUS
BARRIER ROCKS/BOULDERS	50	2' PLUS

EARTHWORK		
SITE NUMBER	EXCAVATION (CY)	BACKFILL (CY)
0	-	-
1	-	-
2	-	-
3	67	306
3.5	-	-
4	-	-
5	60	30
6	-	-
6.5	320*	0
7	-	-
8	-	-
9	226	113
9.5	-	-
10	90	45
11	225	113
12	88	44
13	46	23
14	54	124
15	24	0
16	-	-
17	-	-
18	110	55
19	57	28
TOTAL	1,047	881

*INCLUDES EXCAVATION OF BERM, WETLAND INFLOW/OUTFLOW CHANNEL, AND WETLAND.

TREATMENT QUANTITY BY CATEGORY AND SITE									
SITE NUMBER	VEGETATED WOOD MATRIX (LF)	LARGE WOOD STRUCTURES	LARGE WOOD ARRAYS / AGGREGATES	CHANNEL CONSTRUCTION (LF)	BERM REMOVAL (LF)	ROAD RECONTOURING (LF)	ROAD CONSTRUCTION (LF)	FLOODPLAIN ROUGHNESS (AC)	WETLAND CREATION (AC)
0	-	-	7	-	-	-	-	-	-
1	-	-	4	-	-	-	-	-	-
2	-	-	2	-	-	-	-	-	-
3	69	1	-	62	-	-	-	0.02	-
3.5	-	-	1	-	-	-	-	-	-
4	-	-	2	-	-	-	-	-	-
5	34	1	-	-	-	-	-	0.02	-
6	-	-	3	-	-	-	-	-	-
6.5	-	-	-	383	127	203	-	0.20	0.20
7	-	-	3	-	-	-	-	-	-
8	-	-	3	-	-	-	-	-	-
9	127	-	-	-	-	479	723	0.08	-
9.5	-	-	1	-	-	-	-	-	-
10	76	1	-	-	-	-	-	0.03	-
11	190	1	-	-	-	695	691	0.05	-
12	74	1	-	-	-	-	-	0.04	-
13	39	1	-	-	-	-	132	0.01	-
14	59	1	-	50	-	-	-	0.02	-
15	-	-	-	-	43	-	-	-	-
16	-	-	4	-	-	-	-	-	-
17	-	-	1	-	-	-	-	-	-
18	93	1	-	-	-	-	-	0.04	-
19	48	1	-	-	-	-	133	0.01	-
TOTAL	809	9	31	495	170	1,377	1,679	0.52	0.20

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PROJECT MATERIALS AND QUANTITIES
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108

DRAWING NUMBER 4.0

SHEET 4 OF 22

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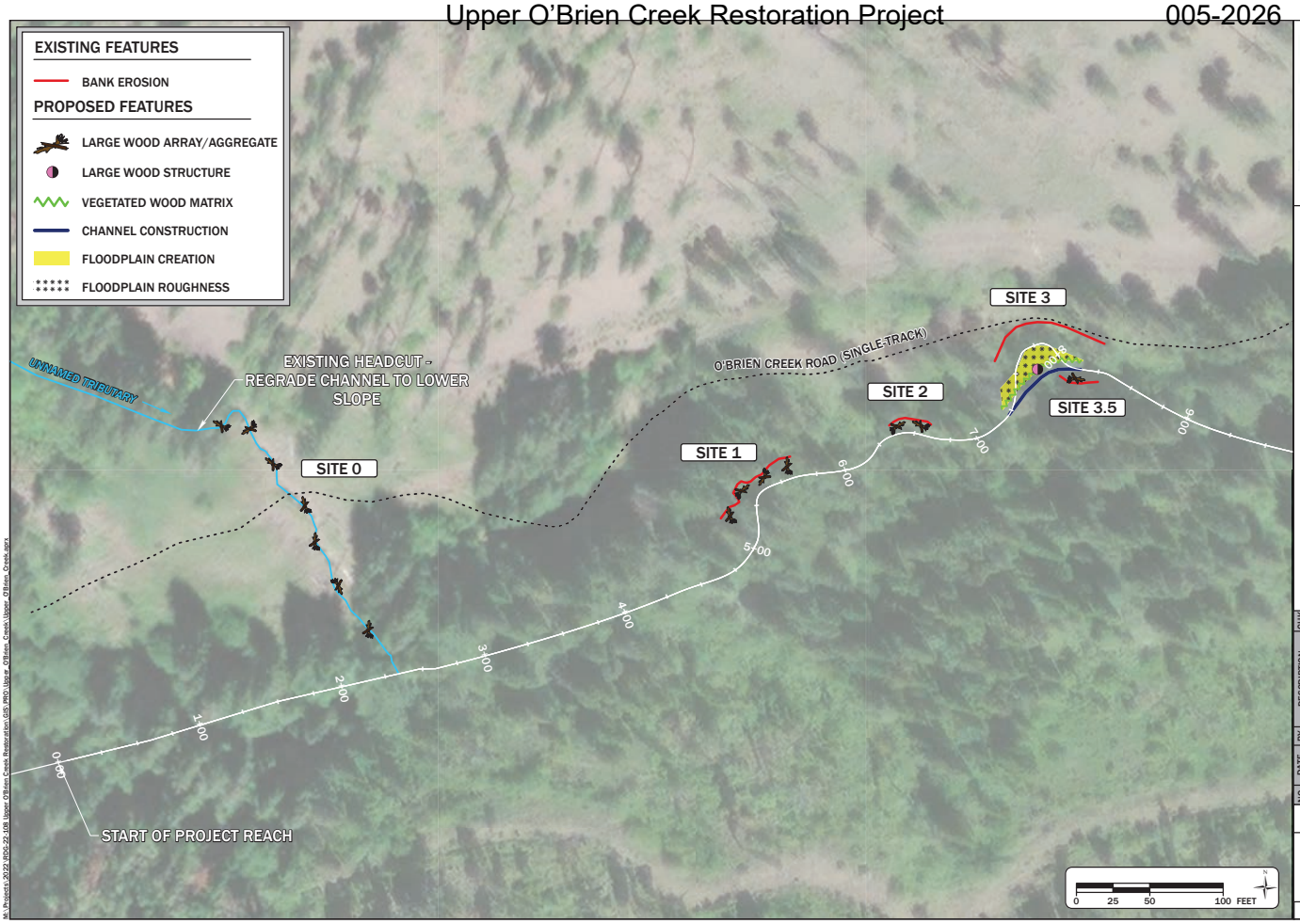


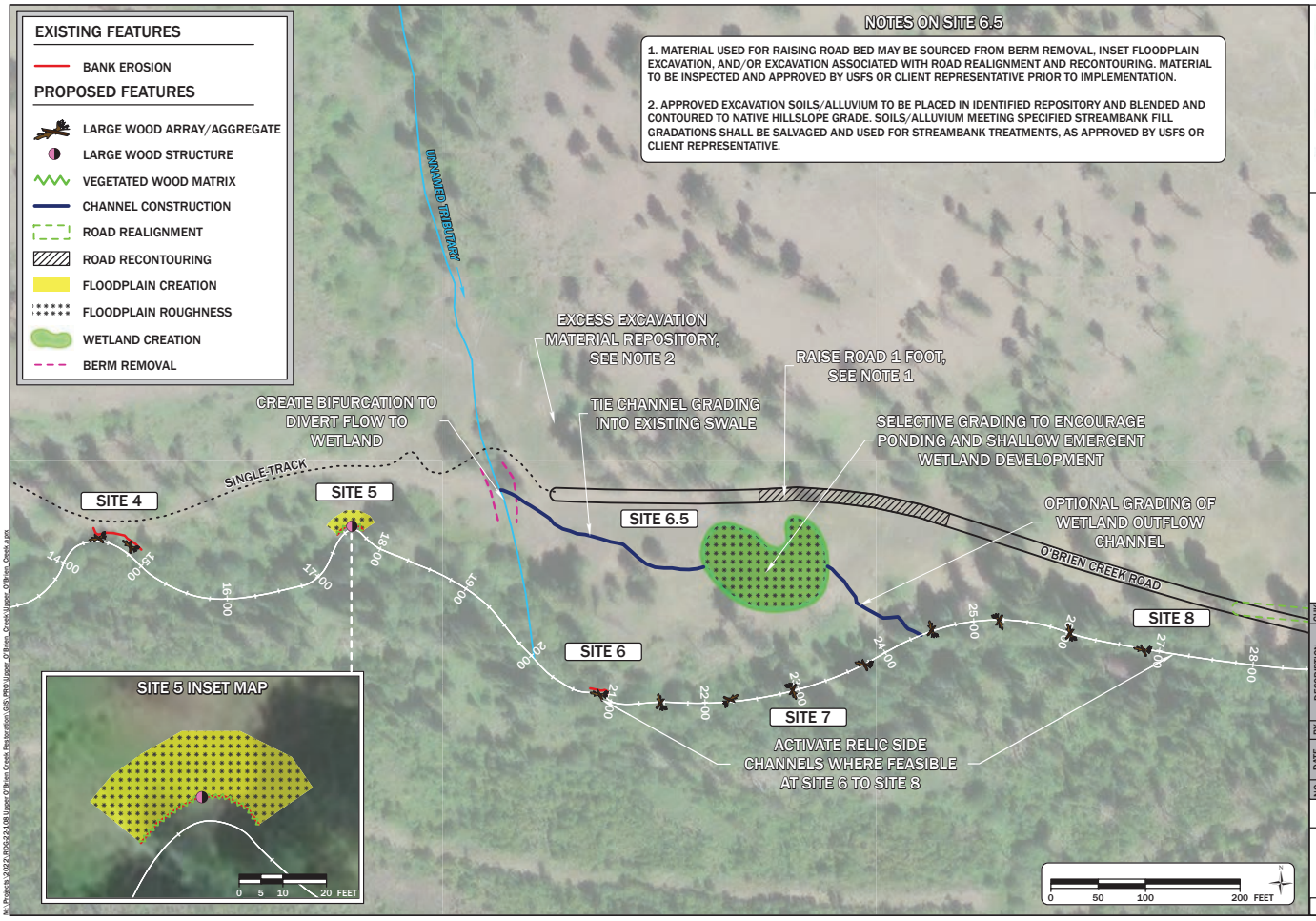
PANEL 1 PLAN VIEW
AND TREATMENT LOCATIONS
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER
RDG-22-108

DRAWING NUMBER
5.0

SHEET 5 OF 22



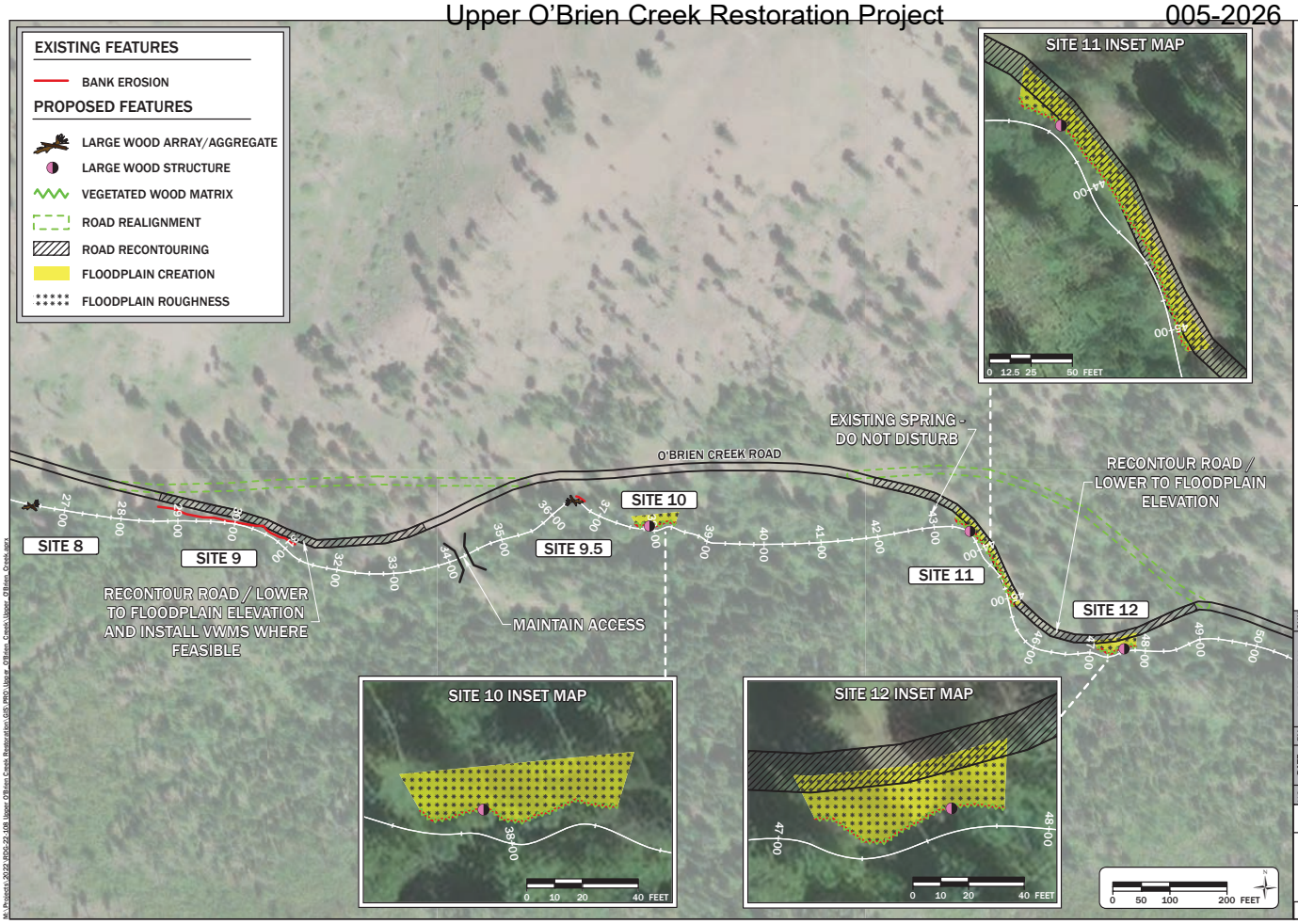
PANEL 2 PLAN VIEW
AND TREATMENT LOCATIONS
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER
RDG-22-108

DRAWING NUMBER
5.1

SHEET 6 OF 22



PANEL 3 PLAN VIEW
AND TREATMENT LOCATIONS
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER
RDG-22-108

DRAWING NUMBER
5.2

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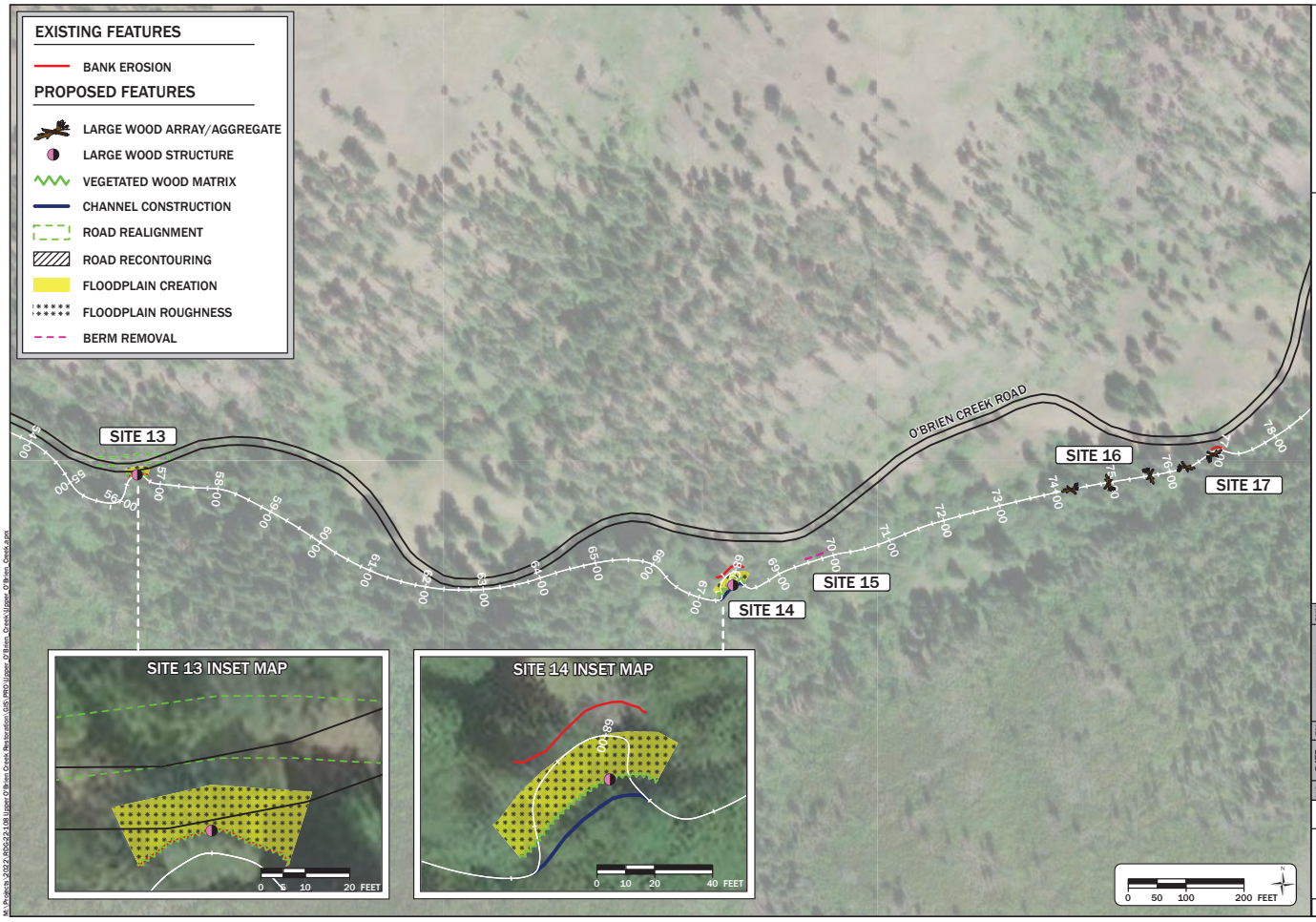


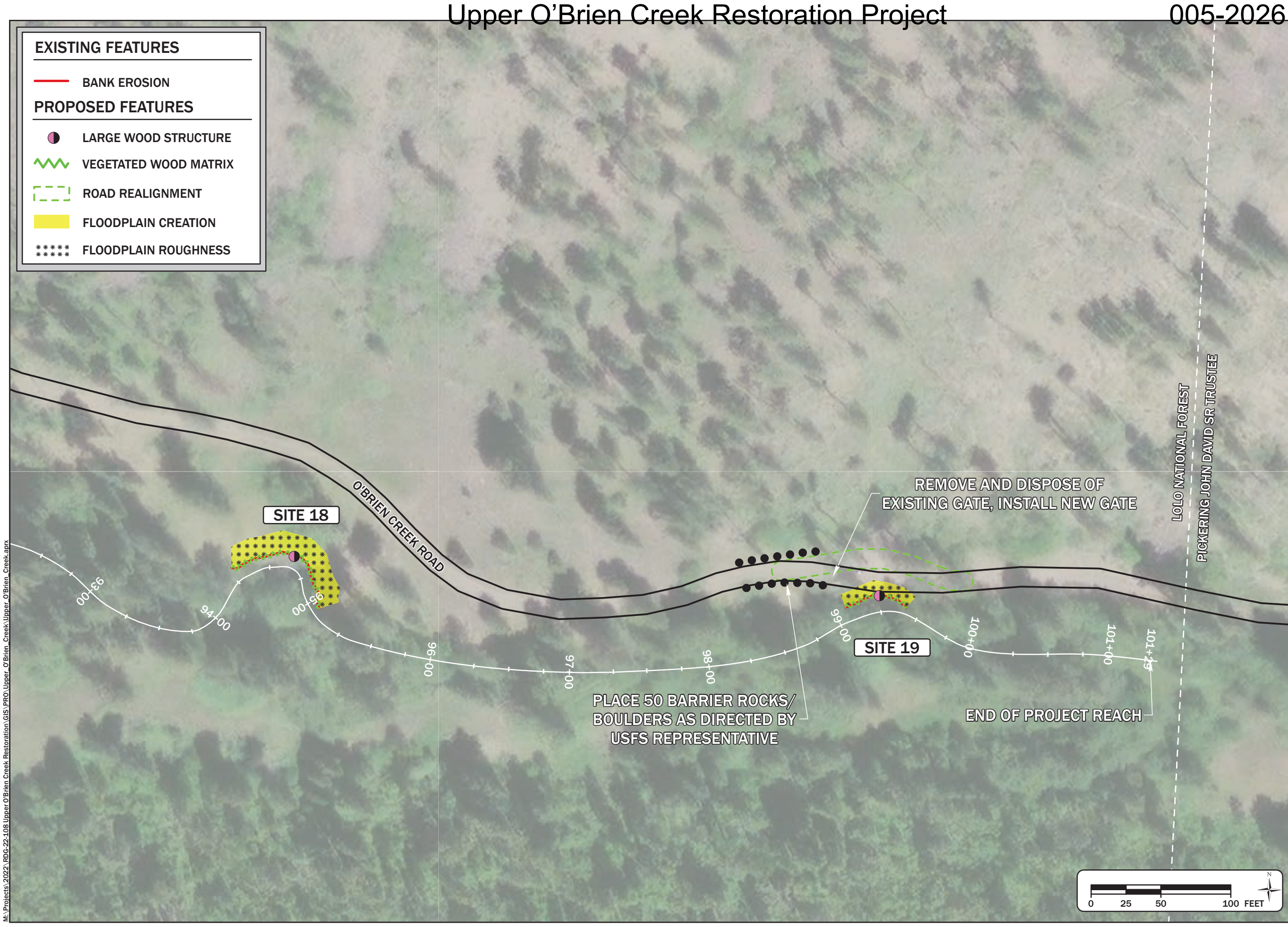
PANEL 4 PLAN VIEW
AND TREATMENT LOCATIONS
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER
RDG-22-108

DRAWING NUMBER
5.3

SHEET 8 OF 22



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PANEL 5 PLAN VIEW AND TREATMENT LOCATIONS
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108
DRAWING NUMBER 5.4
SHEET 9 OF 22

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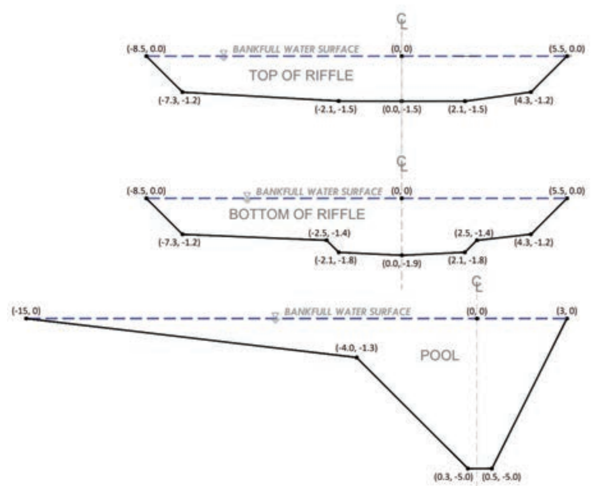
BANKFULL CROSS SECTION DESIGN DIMENSIONS

	Riffle Value (ft)	Run Value (ft)	Pool Value (ft)
Area	17	18	24
Width/Depth	12	9	14
Range (Low)	10	7	12
Range (High)	14	11	16
Width			
Average	14	13	18
Range (Low)	13	11	17
Range (High)	16	14	20
Avg. Depth			
Average	1.2	1.4	1.3
Range (Low)	1.1	1.3	1.2
Range (High)	1.3	1.6	1.4
Max.Depth			
Average	1.8	2.4	4.3
Range (Low)	1.6	2.1	3.7
Range (High)	2.1	2.8	4.9
Max. Scour	2.4	3.0	5.1



CHANNEL CROSS SECTIONS TYPICAL
0' 1.5' 3'

NOTE: COORDINATES ARE REFERENCED FROM TOP OF BANK THALWEG

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CHANNEL CROSS SECTION DIMENSIONS
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
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2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108
DRAWING NUMBER 6.0
SHEET 10 OF 22

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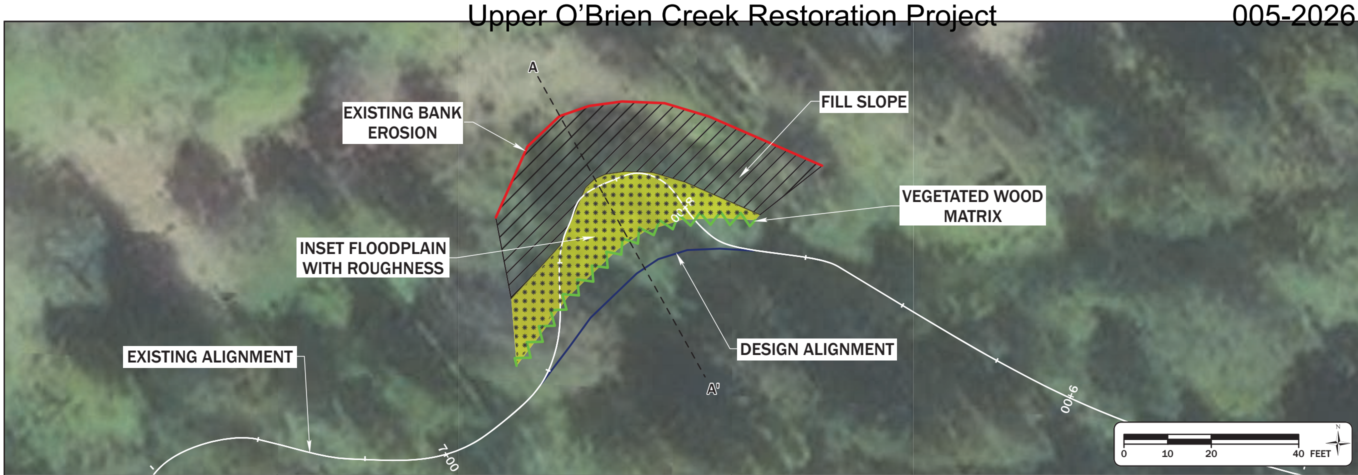
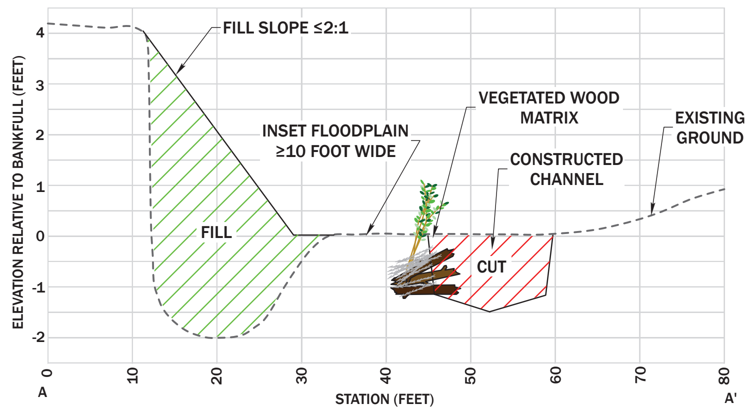


PLAN VIEW

NOTES ON CHANNEL REALIGNMENT

1. CHANNEL REALIGNMENT TREATMENT TO BE IMPLEMENTED AT SITE 3 AND SITE 14.

2. MATERIAL USED FOR STREAMBANK TREATMENTS MAY BE SOURCED FROM BERM REMOVAL, INSET FLOODPLAIN EXCAVATION, AND/OR EXCAVATION ASSOCIATED WITH ROAD REALIGNMENT AND RECONTOURING. MATERIAL TO BE INSPECTED AND APPROVED BY USFS OR CLIENT REPRESENTATIVE PRIOR TO IMPLEMENTATION.



CROSS SECTION A-A'

CHANNEL REALIGNMENT DETAIL

UPPER O'BRIEN CREEK

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NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108

DRAWING NUMBER 7.0

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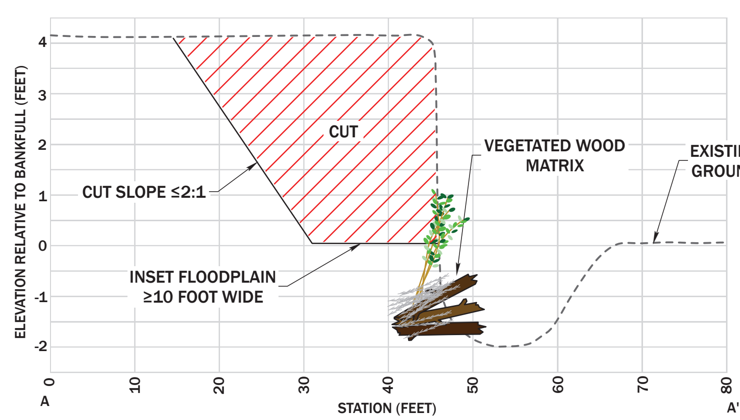
PLAN VIEW

NOTES ON INSET FLOODPLAIN CONSTRUCTION

1. INSET FLOODPLAIN TREATMENT TO BE IMPLEMENTED AT SITES 5, 10, 11, 12, 13, 18, AND 19.

2. MATERIAL USED FOR STREAMBANK TREATMENTS MAY BE SOURCED FROM BERM REMOVAL, INSET FLOODPLAIN EXCAVATION, AND/OR EXCAVATION ASSOCIATED WITH ROAD REALIGNMENT AND RECONTOURING. MATERIAL TO BE INSPECTED AND APPROVED BY USFS OR CLIENT REPRESENTATIVE PRIOR TO IMPLEMENTATION.



CROSS SECTION A-A'

INSET FLOODPLAIN DETAIL

UPPER O'BRIEN CREEK

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1	02-01-24	DB	DESIGN	JM
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PROJECT NUMBER RDG-22-108

DRAWING NUMBER 7.1

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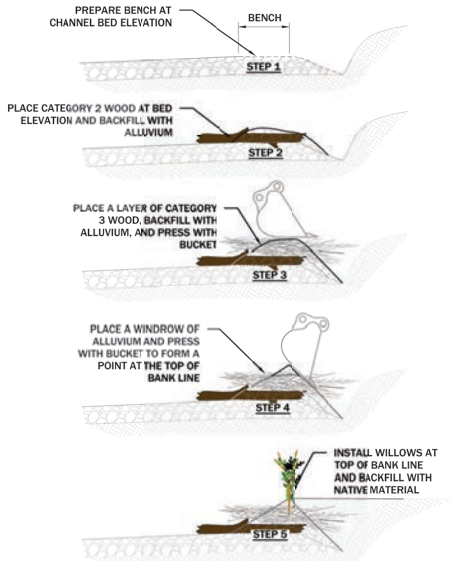
NOTES ON VEGETATED WOOD MATRIX INSTALLATION

1. EXCAVATE TO THE EXCAVATION LIMITS AS SHOWN. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
2. PREPARE THE BENCH OF THE STRUCTURE BY PLACING CHANNEL STREAMBED ALLUVIUM FROM THE BASE OF THE EXCAVATION DEPTH/BOTTOM OF EXCAVATION TO WITHIN 1.0-FT. ABOVE EXISTING STREAMBED GRADE.
3. CATEGORY 2 AND CATEGORY 3 WOOD, AND CHANNEL STREAMBED ALLUVIUM SHALL BE PLACED IN ALTERNATING LAYERS AND BUCKET COMPACTED UP TO THE TOP OF BANK ELEVATION AS SHOWN BELOW IN THE INSTALLATION SEQUENCE. PLACE SIX (6) FT TO EIGHT (8) FT. DORMANT WILLOW CUTTINGS AT A DENSITY OF 5 PER LINEAR FT ALONG THE TOP OF BANK LINE ELEVATION. WILLOW CUTTINGS SHALL SLOPE AT AN APPROXIMATE 1:1 SLOPE AS SHOWN IN SECTION VIEW. STEMS MAY OVERLAP. THE CUT ENDS SHALL BE PLACED AT THE BASE OF THE SLOPES WITH THE UN-CUT ENDS EXTENDING BEYOND THE EDGE OF THE TRENCH SO NO GREATER THAN ONE-THIRD OF THE TOTAL CUTTING LENGTH IS EXPOSED BEYOND THE TOP OF BANK EDGE. WILLOW CUTTINGS SHOULD INTERCEPT THE DESIGN TOP OF BANK LINE AS SHOWN IN STEP 5 OF THE INSTALLATION SEQUENCE.
4. THE UPSTREAM AND DOWNSTREAM ENDS OF THE STRUCTURE SHALL TRANSITION SMOOTHLY INTO ADJACENT STREAMBANK STRUCTURES TO MINIMIZE EROSION, FLANKING, AND BANK FAILURE. STRUCTURE ENDS MAY BE STABILIZED WITH LARGE ROCK AS APPROVED BY ENGINEER.
5. AFTER INSTALLATION OF THE VEGETATED WOOD MATRIX, BACKFILL THE STRUCTURE WITH STOCKPILED MATERIAL TO FINISHED GRADE, AND BUCKET COMPACT. INSTALL WILLOW TRENCHES AT A RATE OF 2 PER LINEAR FOOT (OR 20 PER TRENCH) AS SHOWN. NO AREAS BEHIND THE FINISHED BANKLINE ARE TO BE LEFT BELOW FINISHED GRADE.

GENERAL NOTES

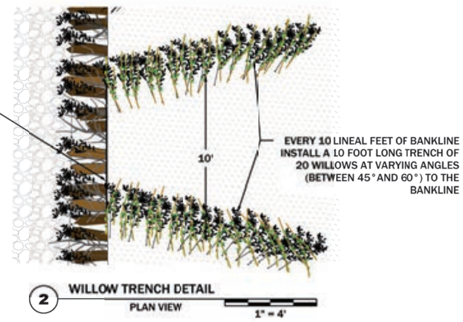
1. CONSTRUCTION OF THE VEGETATED WOOD MATRIX WILL OCCUR AFTER THE STREABANK SUBGRADE IS EXCAVATED AND APPROVED BY ENGINEER.
2. INSTALLATION OF FLOODPLAIN TREATMENT SHALL BE COMPLETED AFTER VEGETATED WOOD MATRIXES ARE INSTALLED.
3. IF VEGETATED WOOD MATRIX STRUCTURES ARE INSTALLED PRIOR TO OCTOBER 1, LEAVE BACK TRENCH UNFILLED AND COMPLETE STRUCTURE WHEN DORMANT WILLOWS ARE AVAILABLE.
4. IT IS CONTRACTOR'S RESPONSIBILITY TO CUT WOOD INTO APPROPRIATE SIZE LENGTHS TO FIT STRUCTURE DIMENSIONS.
5. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED BY CONSTRUCTION MANAGER.
6. CONTRACTOR SHALL MARK AND CONSTRUCTION ENGINEER SHALL APPROVE THE GENERAL LOCATION FOR EACH VEGETATED WOOD MATRIX STRUCTURE PRIOR TO CONSTRUCTION.



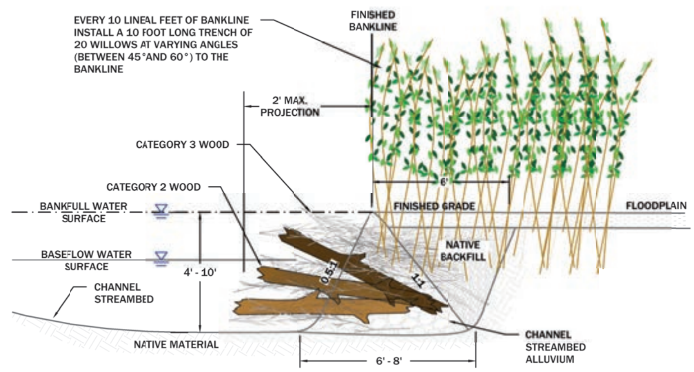
3 RECOMMENDED VEGETATED WOOD MATRIX INSTALLATION SEQUENCE
SECTION VIEW 1" = 5'

STREAMBED ALLUVIUM GRADATION

SIZE (INCHES)	PERCENT PASSING	REPRESENTATIVE SIZE CLASS
10	95	D100
8	90-95	D95
5	85-90	D84
3	65 - 85	D65
2	50 - 65	D50
1	30 - 50	D35
0.5	10 - 30	D15
FINES	0-10	



2 WILLOW TRENCH DETAIL
PLAN VIEW 1" = 4'



1 VEGETATED WOOD MATRIX
SECTION VIEW 1" = 3'

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VEGETATED WOOD MATRIX DETAIL
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108
DRAWING NUMBER 7.2
SHEET 13 OF 23

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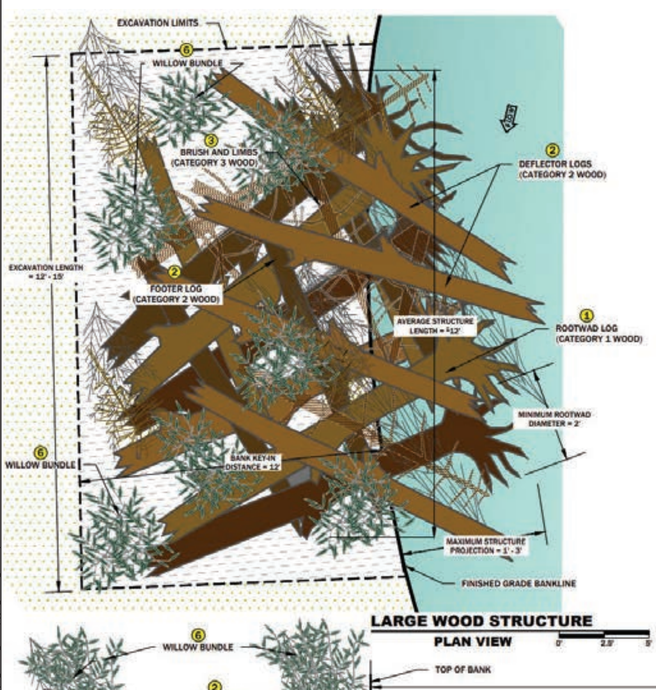


LARGE WOOD STRUCTURE
PLAN VIEW 0' 2.5' 5'

GENERAL NOTES

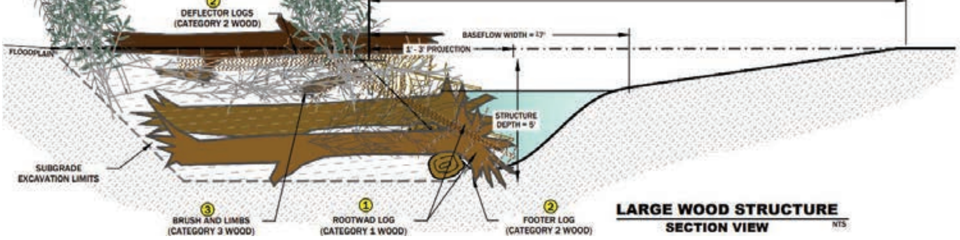
1. CONSTRUCTION OF THE LARGE WOOD STRUCTURE WILL OCCUR BEFORE THE CONSTRUCTED CHANNEL STREAMBED AND VEGETATED WOOD MATRIX BANK TREATMENTS ARE INSTALLED. INSTALLATION OF FLOODPLAIN TREATMENT SHALL BE COMPLETED AFTER THE LARGE WOOD STRUCTURES ARE INSTALLED.
2. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED BY THE CONSTRUCTION MANAGER.
3. CONSTRUCTION MANAGER SHALL MARK THE GENERAL CONSTRUCTION LOCATION FOR EACH LARGE WOOD STRUCTURE PRIOR TO CONSTRUCTION.

NOTES ON LARGE WOOD STRUCTURE INSTALLATION

1. EXCAVATE TO THE EXCAVATION LIMITS. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
2. INSTALL TWO FOOTER LOGS (CATEGORY 2 WOOD) AT THE BASE OF THE EXCAVATED TRENCH AT THE ORIENTATIONS NOTED IN PLAN VIEW. FOOTER LOGS SHALL PROJECT INTO THE DESIGN CHANNEL NO GREATER THAN 3 FT OR AT DISTANCE DIRECTED BY THE CONSTRUCTION MANAGER. EXPOSED ENDS OF FOOTER LOGS SHALL BE BROKEN/ROUGHENED SO AS TO APPEAR NATURAL. SAWED ENDS OF FOOTER LOGS SHALL NOT BE EXPOSED.
3. INSTALL TWO ROOTWAD LOGS (CATEGORY 1 WOOD) INTERSECTING BOTH FOOTER LOGS AT THE ORIENTATION NOTED IN PLAN VIEW. THE UPSTREAM ROOTWAD SHALL NOT PROJECT INTO THE CHANNEL AND SHALL BE FLUSH WITH THE FINISHED BANK LINE. THE DOWNSTREAM ROOTWAD SHALL PROJECT NO GREATER THAN 1 - 3 FT. BEYOND THE FINISHED BANK LINE.
4. BACKFILL TRENCH WITH STOCKPILED MATERIAL UP TO THE TOP OF THE ROOTWAD LOGS. BACKFILL SHALL BE BUCKET COMPACTED.
5. INSTALL BRUSH AND LIMBS (CATEGORY 3 WOOD) AT APPROXIMATE 45° ANGLE TO ROOTWAD STEMS. BRUSH AND LIMBS SHALL PROJECT NO GREATER THAN 3 FT BEYOND THE FINISHED BANK LINE.
6. INSTALL ONE ROOTWAD LOG (CATEGORY 1 WOOD) ON TOP OF THE BRUSH AND LIMBS AT THE ORIENTATION NOTED IN PLAN VIEW. THE TOP OF THE ROOTWAD STEMS SHALL SIT AT OR BELOW BASEFLOW ELEVATION. THE UPSTREAM ROOTWAD SHALL NOT PROJECT INTO THE CHANNEL AND SHALL BE FLUSH WITH THE FINISHED BANK LINE. THE DOWNSTREAM ROOTWAD SHALL PROJECT NO GREATER THAN 3 FT. BEYOND THE FINISHED BANK LINE.
7. INSTALL BRUSH AND LIMBS (CATEGORY 3 WOOD) UP TO TOP OF BANK AT APPROXIMATE 45° ANGLE TO ROOTWAD STEMS. BRUSH AND LIMBS SHALL PROJECT NO GREATER THAN 3 FT BEYOND THE FINISHED BANK LINE.
8. PLACE TWO WILLOW BUNDLES INTERWOVEN INTO WOOD MATRIX AS SHOWN IN THE PLAN VIEW. WILLOW BUNDLES SHALL BE SET AS TO BE IN CONTACT WITH LOW FLOW WATER SURFACE ELEVATION.
9. BACKFILL STRUCTURE WITH STOCKPILED MATERIAL UP TO THE TOP OF BANK LINE ELEVATION. BACKFILL SHALL BE BUCKET COMPACTED.
10. INSTALL TWO DEFLECTOR LOGS (CATEGORY 2 WOOD) AT APPROXIMATE 45° ANGLE TO ROOTWAD STEMS. TOP OF DEFLECTOR LOGS CAN BE UP TO 0.5 FT ABOVE TOP OF BANK ELEVATION AND SHALL PROJECT NO GREATER THAN 3 FT. BEYOND THE FINISHED BANK LINE. EXPOSED ENDS OF FOOTER LOGS SHALL BE BROKEN/ROUGHENED SO AS TO APPEAR NATURAL. SAWED ENDS OF FOOTER LOGS SHALL NOT BE EXPOSED.
11. PLACE AND BUCKET COMPACT STOCKPILED MATERIAL TO THE FINISHED BANK LINE. NO AREAS BEHIND THE FINISHED BANKLINE ARE TO BE LEFT BELOW FINISHED GRADE.

MATERIAL SCHEDULE (PER STRUCTURE)

	ITEM	DIA.	QUANTITY
1	CATEGORY 1 WOOD	10" - 14"	5
2	CATEGORY 2 WOOD	6" - 12"	4
3	CATEGORY 3 WOOD	< 3"	10
6	WILLOW BUNDLES	0.25" - 1"	4



LARGE WOOD STRUCTURE
SECTION VIEW NTS

EXAMPLE OF A LARGE WOOD STRUCTURE

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LARGE WOOD STRUCTURE DETAIL
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108
DRAWING NUMBER 7.3
SHEET 14 OF 23

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NOTES ON LARGE WOOD AGGREGATE INSTALLATION

1. PLACE KEY PIECES (MINIMUM OF 2 KEY PIECES) PARALLEL TO FLOW WITH ROOT FAN POINTED UPSTREAM AND STEM POINTED DOWNSTREAM. ANCHOR KEY PIECES TO EXISTING MATURE TREES, BOULDERS, ESTABLISHED LWD OR OTHER KEY PIECES. ANCHOR KEY PIECES BY PLACING KEY PIECES UPSTREAM OF THE ESTABLISHED ANCHORING STRUCTURE.

2. IF NO STABILIZING STRUCTURE IS PRESENT, A MINIMUM OF 3 KEY PIECES ARE NECESSARY. KEY PIECES WILL BE SET FLUSH WITH THE STREAMBED TO THE EXTENT POSSIBLE BY MINIMALLY EXCAVATING AROUND THE ROOT FAN SO THAT THE STEM IS IN CONTACT WITH THE BED.

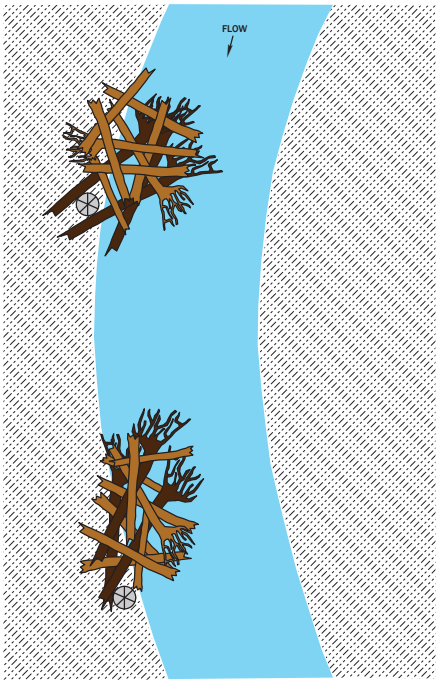
3. AUGMENT KEY PIECES WITH ADDITIONAL HABITAT/DEFLECTOR PIECES. PLACE HABITAT/DEFLECTOR PIECES TO INCREASE HYDRAULIC INFLUENCE AND ANCHOR TO KEY PIECES AND EXISTING ANCHORING STRUCTURES.

4. AGGREGATES WILL BE COMPRISED OF APPROXIMATELY 4 TO 5 KEY PIECES AND A MINIMUM OF 10 HABITAT/DEFLECTOR PIECES TO AUGMENT THE KEY PIECES. TOTAL PIECES OF WOOD PER ARRAY WILL VARY ACCORDING TO SITE CONDITIONS, AVAILABLE ON-SITE LWD, AND LWD IMPORTATION LIMITATIONS (E.G., CANOPY DENSITY, FLOODPLAIN WIDTH).

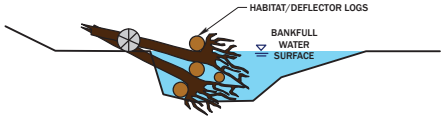
5. LIMBS WILL BE LEFT INTACT ON TREES, ALTHOUGH LIMBS ARE NOT DEPICTED IN THE TYPICAL DRAWING FOR CLARITY.

MATERIAL SCHEDULE (PER STRUCTURE)

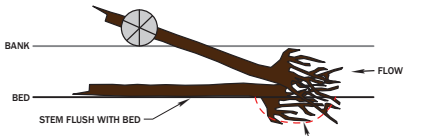
ITEM	DIA.	MIN. STEM LENGTH	QUANTITY	ROOTWAD?
CATEGORY 1 WOOD	10" - 14"	12'	4	YES
CATEGORY 2 WOOD	6" - 12"	6'	10	OPTIONAL



LARGE WOOD AGGREGATE
PLAN VIEW NTS



LARGE WOOD AGGREGATE
SECTION VIEW NTS



KEY PIECE PLACEMENT
PROFILE VIEW NTS

EXAMPLE LARGE WOOD AGGREGATE

LEGEND
- STANDING MATURE TREE, BOULDER, OR STABLE LWD
- KEY PIECE LOG (CATEGORY 1 WOOD)
- HABITAT/DEFLECTOR PIECE LOG (CATEGORY 2 WOOD)

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LARGE WOOD AGGREGATE DETAIL
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER
RDG-22-108

DRAWING NUMBER
7.4

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NOTES ON CHANNEL-SPANNING LOG ARRAY INSTALLATION

1. PLACE KEY PIECE(S) PERPENDICULAR TO FLOW AND ANCHOR TO EXISTING MATURE TREES, BOULDERS, ESTABLISHED LWD OR OTHER KEY PIECES. ANCHOR KEY PIECES BY PLACING KEY PIECES UPSTREAM OF THE ESTABLISHED STABLE STRUCTURE. IF NO STABILIZING STRUCTURE IS PRESENT, SPANNING LOG TAPERED END MAY BE ANCHORED INTO THE BANK BY EXCAVATING THE STREAMBANK, PLACING THE LOG, AND BACKFILLING WITH THE EXCAVATED MATERIAL. STABLE ARRAY ANCHORING WILL BE THE PRERRED METHOD OF ARRAY ANCHORING.

2. AUGMENT KEY PIECE(S) WITH ADDITONAL HABITAT/DEFLECTOR PIECES. PLACE HABITAT/DEFLECTOR PIECES TO INCREASE HYDRAULIC INFLUENCE AND ANCHOR TO KEY PIECES AND EXISTING ANCHORING STRUCTURES.

3. PLACE CHANNEL-SPANNING LOG ARRAYS WHERE THE CHANNEL IS MORE CONFINED TO ENSURE THAT CHANNEL-SPANNING LOG EXTENDS ACROSS THE ENTIRE CHANNEL.

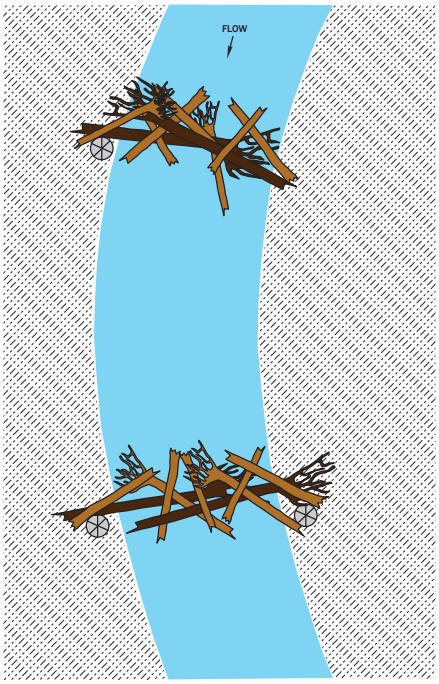
4. CHANNEL-SPANNING LOGS MAY BE PLACED AT VARIOUS ELEVATIONS AND ANGLES RELATIVE TO THE CHANNEL BED. ARRAY PLACEMENT IS UP TO THE DISCRETION OF THE CONSTRUCTION MANAGER.

5. TOTAL NUMBER OF KEY PIECES AND HABITAT/DEFLECTOR PIECES WILL VARY PER ARRAY ACCORDING TO SITE CONDITIONS AND IS UP TO THE DISCRETION OF THE PROJECT MANAGER.

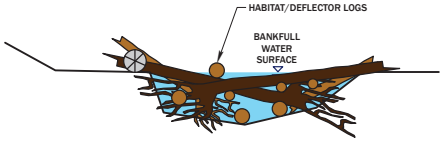
6. LIMBS WILL BE LEFT INTACT ON TREES, ALTHOUGH LIMBS ARE NOT DEPICTED IN THE TYPICAL DRAWING FOR CLARITY.

MATERIAL SCHEDULE (PER STRUCTURE)

ITEM	DIA.	MIN. STEM LENGTH	QUANTITY	ROOTWAD?
CATEGORY 1 WOOD	10" - 14"	16'	2	YES
CATEGORY 2 WOOD	6" - 12"	6'	6 - 8	OPTIONAL



CHANNEL-SPANNING LOG ARRAY
PLAN VIEW NTS



CHANNEL-SPANNING LOG ARRAY
SECTION VIEW NTS

EXAMPLE CHANNEL-SPANNING LOG ARRAY

LEGEND
- STANDING MATURE TREE, BOULDER, OR STABLE LWD
- KEY PIECE LOG (CATEGORY 1 WOOD)
- HABITAT/DEFLECTOR PIECE LOG (CATEGORY 2 WOOD)

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CHANNEL-SPANNING LOG ARRAY DETAIL
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER
RDG-22-108

DRAWING NUMBER
7.5

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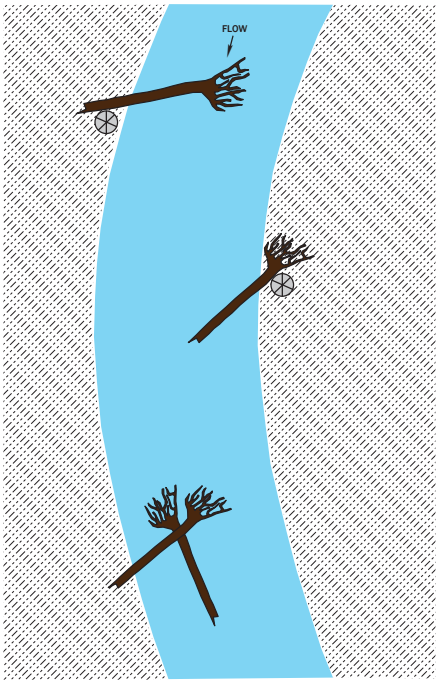


SINGLE LOG ARRAY
PLAN VIEW NTS

NOTES ON SINGLE LOG ARRAY INSTALLATION

1. KEY PIECES MAY BE PLACED AT VARIOUS ANGLES RELATIVE TO FLOW TO MAXIMIZE HYDRAULIC INFLUENCE. ANCHOR KEY PIECES TO EXISTING MATURE TREES, BOULDERS, ESTABLISHED LWD OR OTHER KEY PIECES. ANCHOR KEY PIECES BY PLACING KEY PIECES UPSTREAM OF THE ESTABLISHED ANCHORING STRUCTURE. KEY PIECES MAY ALSO BE SET FLUSH WITH THE STREAMBED TO THE EXTENT POSSIBLE BY MINIMALLY EXCAVATING AROUND THE ROOT FAN SO THAT THE STEM IS IN CONTACT WITH THE BED.

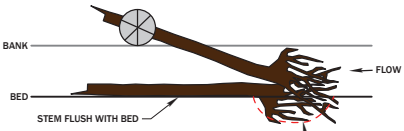
2. SINGLE LOG ARRAYS MAY BE PLACED IN CONJUNCTION WITH OTHER ARRAYS TO INCREASE ARRAY STABILITY AND HYDRAULIC INFLUENCE.

3. LIMBS WILL BE LEFT INTACT ON TREES, ALTHOUGH LIMBS ARE NOT DEPICTED IN THE TYPICAL DRAWING FOR CLARITY.

MATERIAL SCHEDULE (PER STRUCTURE)

ITEM	DIA.	MIN. STEM LENGTH	QUANTITY	ROOTWAD?
CATEGORY 1 WOOD	10" - 14"	8'	1	YES

SINGLE LOG ARRAY
SECTION VIEW NTS



KEY PIECE PLACEMENT
PROFILE VIEW NTS

LEGEND
- STANDING MATURE TREE, BOULDER, OR STABLE LWD
- KEY PIECE LOG (CATEGORY 1 WOOD)
- HABITAT/DEFLECTOR PIECE LOG (CATEGORY 2 WOOD)

EXAMPLE SINGLE LOG ARRAY

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SINGLE LOG ARRAY DETAIL
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108

DRAWING NUMBER **7.6**

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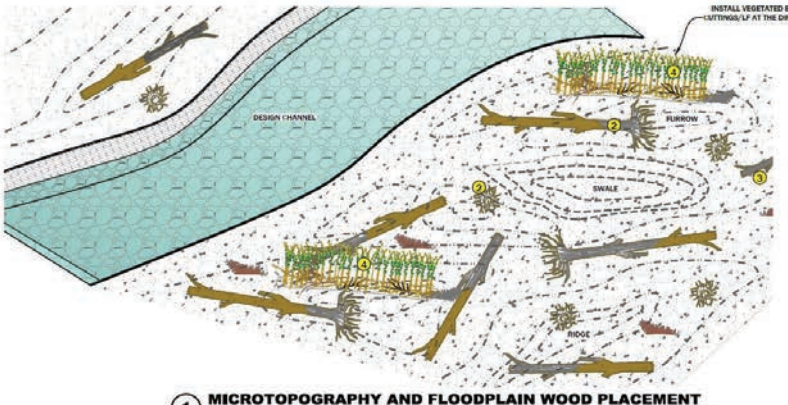


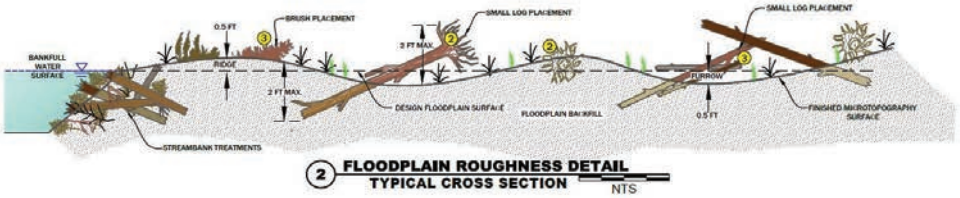
1 MICROTOPOGRAPHY AND FLOODPLAIN WOOD PLACEMENT
3D VIEW NTS

GENERAL NOTES

1. CONSTRUCTION OF FLOODPLAIN TREATMENT WILL OCCUR AFTER CONSTRUCTION OF THE CHANNEL STREAMBED, INSTALLATION OF LARGE WOOD STRUCTURE BANK TREATMENT, INSTALLATION OF VEGETATED WOOD MATRIX BANK TREATMENT.
2. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED BY THE CONSTRUCTION MANAGER.

NOTES ON FLOODPLAIN ROUGHNESS INSTALLATION

1. CONTRACTOR SHALL DEVELOP MICROTOPOGRAPHY AND PLACE WOODY MATERIAL IN THE CONSTRUCTED FLOODPLAIN.
2. INSTALL VEGETATED BRUSH TRENCHES ACROSS THE FLOODPLAIN PER THE DIRECTION OF THE PROJECT MANAGER AND SHEET 7.4. BACKFILL TRENCH TO FLOODPLAIN GRADE AND COMPACT TO REMOVE ANY AIR VOIDS.
3. TRANSPORT CATEGORY 2, AND CATEGORY 3 WOOD FROM FROM DESIGNATED STOCKPILE AREAS. PLACE CATEGORY 2 WOOD AT A RATE OF 35 PIECES PER ACRE AND SPACED AT AN AVERAGE DISTANCE OF 20 FEET FROM OTHER CATEGORY 2 WOOD. PLACE CATEGORY 3 WOOD SO IT COVERS 25 PERCENT OF THE FLOODPLAIN SURFACE (APPROXIMATELY 250 PIECES PER ACRE).
4. BURY CATEGORY 2 WOOD WITHIN THE FLOODPLAIN SURFACE, WITH ONE HALF OF THE LENGTH BURIED TO A DEPTH OF 3-FT., AND ONE HALF EXPOSED A MAXIMUM OF 3-FT ABOVE FINISHED GRADE AS SHOWN ON DRAWING. PLACE CATEGORY 3 WOOD ON THE SURFACE. CATEGORY 3 WOOD DOES NOT NEED TO BE BURIED.
5. CONSTRUCT LOW AND HIGH FEATURES (RIDGES AND FURROWS) AS SHOWN ON THE DRAWINGS. MAXIMUM HEIGHT OF RIDGES AND DEPTH OF FURROWS SHALL BE NO GREATER THAN 0.5-FT. RELATIVE TO FINISHED FLOODPLAIN SURFACE.



2 FLOODPLAIN ROUGHNESS DETAIL
TYPICAL CROSS SECTION NTS

MATERIAL SCHEDULE (PER ACRE)

	ITEM	DIA.	LENGTH	QUANTITY	UNIT
2	CATEGORY 2 WOOD	3" - 6"	10' - 12'	35	EA
3	CATEGORY 3 WOOD	<3"	10' - 12'	25	% COVER*
4	VEGETATED BRUSH TRENCH	SEE SHEET 7.4			

*APPROXIMATELY 250 PIECES/ACRE

EXAMPLE OF CONSTRUCTED FLOODPLAIN ROUGHNESS

EXAMPLE OF CONSTRUCTED FLOODPLAIN ROUGHNESS

EXAMPLE OF CONSTRUCTED FLOODPLAIN SWALE

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236 Wisconsin Avenue Whitefish, MT 59937 ph 406.862.4949 fx 406.862.4949

FLOODPLAIN TREATMENT DETAIL
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108

DRAWING NUMBER **7.7**

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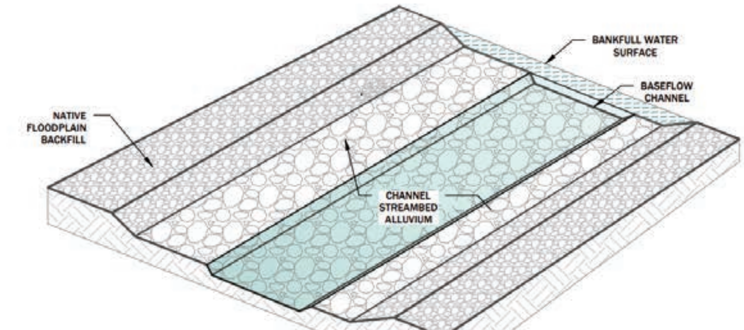
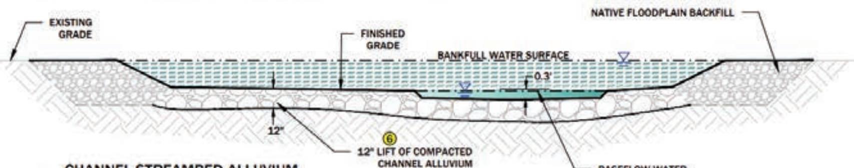


1 CHANNEL STREAMBED ALLUVIUM AND FRAMEWORK INSTALLATION
3D VIEW 1" = 6'



2 CHANNEL STREAMBED ALLUVIUM AND FRAMEWORK INSTALLATION
SECTION VIEW 1" = 5'

GENERAL NOTES

1. CONSTRUCTION OF THE CHANNEL STREAMBED WILL OCCUR AFTER THE CHANNEL SUBGRADE IS PREPARED.
2. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED THE CONSTRUCTION MANAGER.
3. IT IS THE CONTRACTORS RESPONSIBILITY TO CUT WOOD INTO APPROPRIATE SIZE LENGTHS TO FIT STRUCTURE DIMENSIONS.
4. CONTRACTOR SHALL MARK THE UPSTREAM AND DOWNSTREAM EXTENTS OF THE LOCATIONS OF THE CONSTRUCTED CHANNEL STREAMBED STRUCTURES.

NOTES ON CONSTRUCTED CHANNEL STREAMBED INSTALLATION

1. PRIOR TO CONSTRUCTION OF THE CHANNEL STREAMBED, CONSTRUCTION MANAGER SHALL VERIFY CHANNEL SUBGRADE ELEVATIONS. CHANNEL SUBGRADE SERVES AS THE FOUNDATION FOR THE CONSTRUCTED CHANNEL STREAMBED.
2. CONTRACTOR SHALL STOCKPILE CHANNEL ALLUVIUM PER SPECIFICATIONS NOTED ON THE DRAWING.
3. PREPARE THE MATRIX. PLACE APPROPRIATE CHANNEL STREAMBED ALLUVIUM GRADATION AND WASH FINES INTO STREAMBED. CHANNEL STREAMED ALLUVIUM SHALL BE PLACED TO THE FULL COURSE THICKNESS OF 12-INCHES TO FINISHED GRADE.

STREAMBED ALLUVIUM GRADATION

SIZE (INCHES)	PERCENT PASSING	REPRESENTATIVE SIZE CLASS
10	95	D100
8	90-95	D95
5	85-90	D84
3	65 - 85	D65
2	50 - 65	D50
1	30 - 50	D35
0.5	10 - 30	D15
FINES	0-10	

TYPICAL CONSTRUCTED STREAMBED THROUGH A RIFFLE FEATURE

MATERIAL SCHEDULE (PER LINEAR FOOT)

	ITEM	DIA.	QUANTITY
6	CHANNEL STREAMBED ALLUVIUM	10" MINUS	0.35 CY

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311 SW Jefferson Avenue Corvallis, OR 97333 tel.541.738.2920 fax.541.758.8524

CONSTRUCTED CHANNEL STREAMBED DETAIL
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108
DRAWING NUMBER 7.8
SHEET 19 of 22

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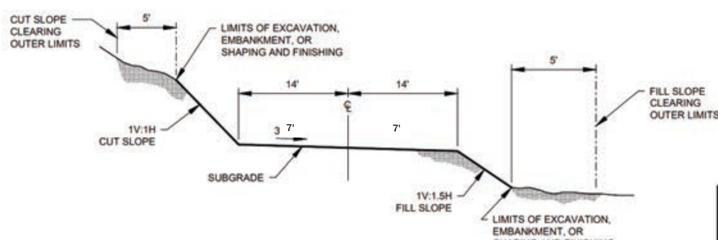
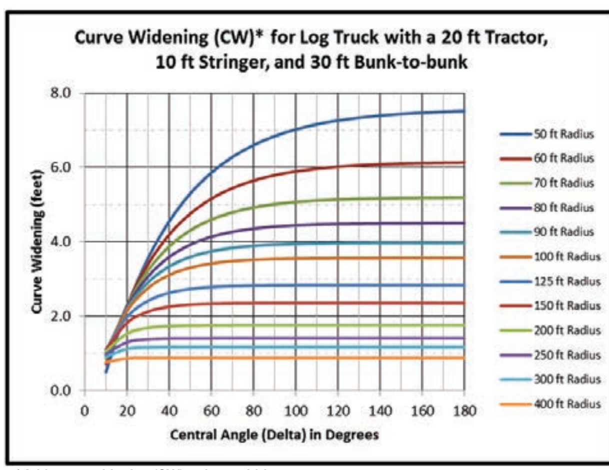


TYPICAL SECTION 1
NOT TO SCALE

ROADSIDE CLEARING AND ROAD RECONDITIONING
NOT TO SCALE



Add curve widening (CW) to lane width.

NOTES ON COMPACTION METHOD

1. ADJUST THE MOISTURE CONTENT OF THE MATERIAL TO A MOISTURE CONTENT SUITABLE FOR COMPACTION.
2. FILL THE INTERSTICES AROUND THE ROCK WITH EARTH OR OTHER FINE MATERIAL AS PRACTICAL.
3. OPERATE HAULING AND SPREADING EQUIPMENT UNIFORMLY OVER THE FULL WIDTH OF EACH LAYER UNTIL THERE IS NO VISIBLE EVIDENCE OF FURTHER CONSOLIDATION. MAKE AT LEAST THREE COMPLETE PASSES.

USDA
SOURCE: US FOREST SERVICE

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TYPICAL ROAD SECTION DETAIL
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108
DRAWING NUMBER 8.0
SHEET 20 of 22

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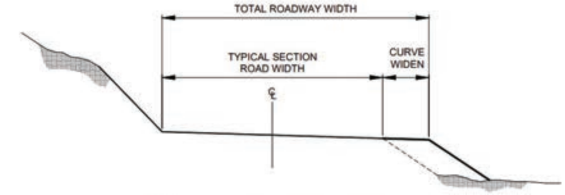
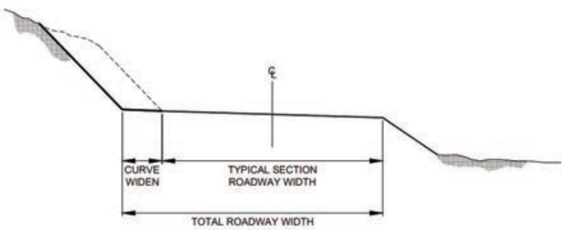
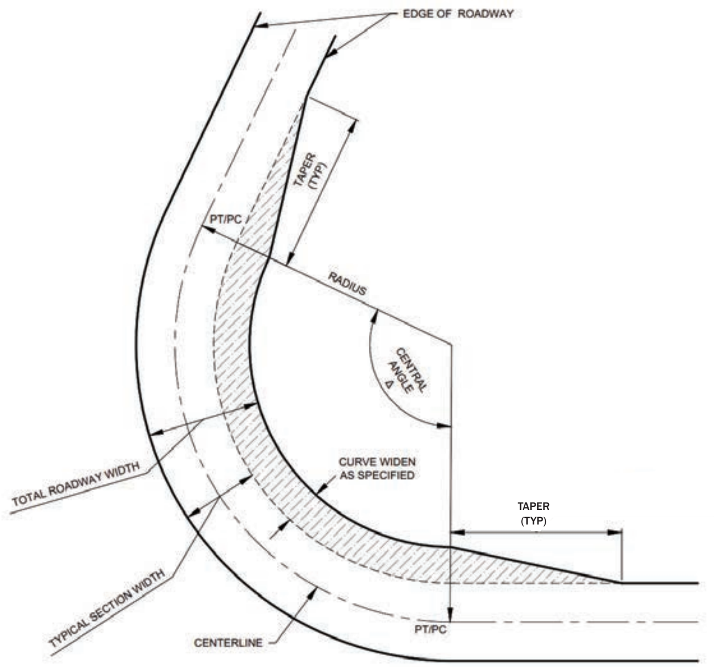


FILL SLOPE CURVE WIDENING
NOT TO SCALE



CUT SLOPE CURVE WIDENING
NOT TO SCALE



Curve Widening Taper Lengths	
Radius (in feet)	*Taper Length (in feet)*
<70	60
70-85	50
86-100	40
>100	30

NOTES:
1. ADD HORIZONTAL CURVE WIDENING TO THE INSIDE OF CURVES. WIDENING APPLIES TO THE ROADWAY THROUGH THE ENTIRE CURVE FROM PC TO PT.

SOURCE: US FOREST SERVICE

RDG RIVER DESIGN GROUP

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CURVE WIDEN DETAIL
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108
DRAWING NUMBER 8.1
SHEET 21 of 22

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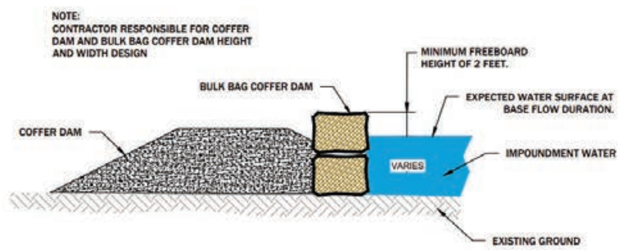
EXAMPLE OF BULK BAGS



BULK BAG FILL GRADATION

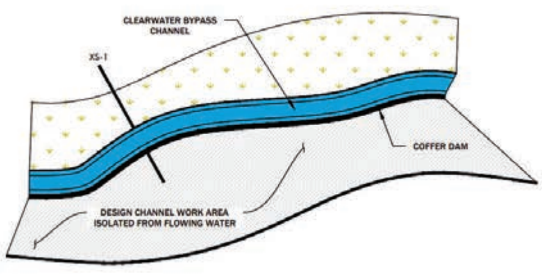
BULK PERCENTAGE	AVERAGE PARTICLE SIZE (INCHES)
20	1 1/2
30	3/4
30	1/2
20	3/8

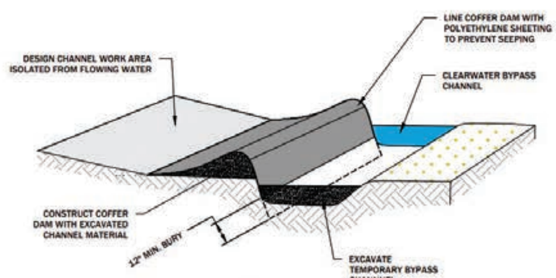
GENERAL NOTES:

1. WORK AREA TO BE ISOLATED USING COFFERDAMS CONSTRUCTED WITH BULK BAGS, SAND BAGS, OR APPROVED ALTERNATIVE. BULK BAGS ARE ALSO CALLED FLEXIBLE INTERMEDIATE BULK CONTAINERS (FIBC) THAT CAN BE CUSTOM MADE FROM VARIOUS FABRIC. THE FOLLOWING REQUIREMENTS ARE NECESSARY FOR THE RIVER ENVIRONMENT:
2. LARGE BULK BAGS SHALL BE CONSTRUCTED OF 8 oz WOVEN FABRIC, 1200 HOUR UV RESISTANT WITH SEWN LIFTING LOOPS. FILL MATERIAL SHALL BE COMPRISED OF SPAWNING GRAVEL AND MEET THE GRADATION SHOWN IN FILL GRADATION TABLE. THE BAGS ARE APPROXIMATELY 6' WIDE x 6' LONG x 4' HIGH WHEN FILLED.
3. SMALL BULK BAGS SHALL BE CONSTRUCTED OF 8 oz WOVEN FABRIC, 1200 HOUR UV RESISTANT WITH SEWN LIFTING LOOPS. FILL MATERIAL SHALL BE COMPRISED OF SPAWNING GRAVEL AND MEET THE GRADATION GIVEN BY THE CITY OF BOISE SPECIFICATIONS (SHOWN BELOW). THE BAGS ARE APPROXIMATELY 3' WIDE x 3' LONG x 2.5' HIGH WHEN FILLED.
4. BULK BAGS SHALL BE CAREFULLY PLACED TO ENSURE NO TEARING OR CUTTING OF THE BAGS OCCURS.
5. BULK BAGS SHALL BE PLACED USING A HYDRAULIC CRANE OR TRACKHOE USING LIFTING BARS AND STEEL CABLES TO EQUALIZE LOAD ON LIFTING LOOPS.

1 BULK BAG INSTALLATION
DETAIL NTS

BMP'S SHALL BE INSTALLED AT THE DIRECTION OF THE CONSTRUCTION MANAGER





SECTION XS-1

1 TEMPORARY COFFER DAM WITH BYPASS CHANNEL
DETAIL NTS

BMP'S SHALL BE INSTALLED AT THE DIRECTION OF THE CONSTRUCTION MANAGER

RDG RIVER DESIGN GROUP

311 SW Jefferson Avenue Corvallis, OR 97333 tel 541.738.2920 fax 541.758.8524
236 Wisconsin Avenue Whitefish, MT 59937 tel 406.862.4927 fax 406.862.4963

BMP DETAIL
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	DESIGN	JM
2	02-15-24	DB	DESIGN	JM

PROJECT NUMBER RDG-22-108
DRAWING NUMBER 9.0
SHEET 22 OF 22

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Date: December 1, 2023

To: Adam Switalski, Clark Fork Coalition

From: John Muhlfeld, River Design Group

Subject: Upper O'Brien Creek Rapid Assessment
Site Descriptions and Recommendations

Draft Project Goals

1. Improve spawning and rearing habitat for westslope cutthroat trout (physical and hydraulic complexity, cover, shade, gravel retention)
2. Reduce sediment loading, with a focus on coarse sediment supply
3. Reconnect floodplain surfaces where feasible including side channels and high-quality riparian habitats

Site Descriptions and Preliminary Recommendations

Site I.D.	Description	Preliminary Recommendations
0	Project begins at former Burned Area Emergency Response (BAER) gully stabilization project – possible chronic source of sediment due to headcut propagation upstream of site.	- Characterize upslope/gully conditions to determine if upland sources are contributing sediment to O'Brien Creek.
1	45'(L)x6'(H) Left bank erosion (Extreme Bank Erodibility Hazard Index [BEHI] rating) at outside meander bend into native terrace, terrace vegetated with mature conifers, existing inset floodplain on river-right, **low priority**	- Install lateral Large Woody Debris (LWD) structures at toe of river-left terrace to redirect flow path and reduce near bank stress (NBS)
2	25'(L)x6'(H) Left bank erosion (Extreme BEHI) at outside meander bend into native terrace, inset floodplain on river-right, **moderate priority**	- Option 1: Install lateral LWD structures at toe of river-left terrace to redirect flow paths and reduce NBS - Option 2: Realign channel ~10' thru river-right inside meander tab and construct bankfull/low terrace bench on river-left daylighting to existing terrace, integrate vegetated wood matrix (VWM) streambank treatments
3	50'(L)x10'(H) Left bank erosion (Extreme BEHI) at outside meander bend into road prism, inset floodplain on river-right, **high priority**	- Realign channel ~10' thru river-right inside meander tab and construct bankfull/low terrace bench on river-left daylighting to top of road prism, integrate VWM streambank treatments and slope treatments
3.5 (NEW)	25'(L)x5'(H) Right bank erosion (High BEHI) into native terrace opposite Site 3, terrace vegetated with mature conifers, **moderate priority**	- Install lateral LWD structures at toe of river-right terrace to redirect flow paths and reduce NBS
4	25'(L)x5'(H) Channel abuts toe of road prism, left bank is stable and well vegetated with grasses and sapling conifers (Low BEHI), channel aggraded with multiple active channels and flow paths, **low priority**	- Install coarse wood at toe of road embankment to reduce NBS and encourage alternative flow path

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Site I.D.	Description	Preliminary Recommendations
5	25'(L)x5'(H) Left bank erosion (High BEHI) at outside meander bend into terrace, terrace vegetated with grasses, inset floodplain on river-right, **high priority**	- Lower river-left terrace and construct ~10'-wide bankfull/low terrace bench daylighting to top of terrace, integrate VWM streambank treatments, maintain radius - Transplants and wood available on site
6	80'(L)x4'(H) Right bank erosion (Moderate BEHI) into native terrace, **low priority**	- No recommendations, very low priority given access constraints
6.5 (NEW)	Tributary of O'Brien Creek, ditched and leveed for 200', vegetation dominated by knapweed, **high priority**	- Option 1: Grade ditch and berms, build appropriately sized channel to O'Brien Creek - Option 2: Grade ditch and berms, redirect channel southeast towards topographic depression, allow flow to spread across floodplain, flood knapweed, encourage wetland formation
7 & 8	~400' reach of channel, moderately incised, lacking instream LWD and hydraulic and geomorphic complexity, vegetation consists of mature birch and conifers, bankfull width≈15', Pool:Pool spacing 30'-45', ~9-13 pools total, **moderate priority**	- Install instream LWD structures to increase pool frequency and habitat complexity - This treatment can be applied opportunistically throughout the reach to achieve similar goals
9	180'(L)x6'(H) Left bank erosion (Moderate BEHI) where channel abuts road prism, bank is moderately vegetated with mature birch and conifers, **high priority**	- Lower road prism and construct bankfull/low terrace bench on river-left daylighting to top of road, integrate VWM streambank treatments - Consider realigning ~200' of road to upper terrace
9.5 (NEW)	10'(L)x5'(H) Left bank erosion (Moderate BEHI) at outside meander bend into native terrace, inset floodplain on river-right, **moderate priority**	- Install lateral LWD structures at toe of river-left terrace to redirect flow paths and reduce NBS
10	60'(L)'x4'(H) Left bank erosion (Moderate BEHI rating) into native terrace, **high priority**	- Lower river-left terrace and construct ~10'-wide bankfull/low terrace bench daylighting to top of terrace, integrate VWM streambank treatments and clump shrub transplants available on site
11	100'(L)'x4'(H) Left bank erosion (Moderate BEHI) where channel abuts road prism, **high priority**	- Option 1: Install VWM streambank treatments in river-left bank/road bed - FS expressed concern with long-term stability - Option 2: Realign channel ~15' from road embankment and construct B3c stream type, construct bankfull/low terrace bench daylighting to top of road, integrate VWM streambank treatments - Option 3: Install lateral wood jam with spanning members at head of road-stream interaction site to encourage alternative flow path (no channel construction), could be coupled with Option 1
12	10'(L)x4'(H) Left bank erosion (Moderate BEHI) into native terrace, terrace vegetated with grasses, **high priority**	- Lower river-left terrace and construct ~10'-wide bankfull/low terrace bench daylighting to top of terrace, integrate VWM streambank treatments and clump shrub transplants available on site
13	40'(L)x4'(H) Left bank erosion (Moderate BEHI) at outside meander bend into road prism, existing wood at toe of bank, **high priority**	- Place passive LWD at toe of road embankment to redirect flow paths and reduce NBS, use existing wood as anchor points
14	50'(L)x4'(H) Left bank erosion (Very High BEHI) at outside meander bend into terrace adjacent to road, inset floodplain on river-right, terrace is vegetated with alders on downstream third of meander bend, **high priority**	- Realign channel thru river-right inside meander tab and construct bankfull/low terrace bench on river-left daylighting to existing terrace, integrate vegetated wood matrix (VWM) streambank treatments, preserve alders
15	Existing berm in river-left floodplain parallels channel for 45', berm is vegetated with grass, **moderate priority**	- Remove berm and grade to floodplain elevation
16	~200' reach of channel, plane bed morphology, lacking instream LWD and hydraulic and geomorphic complexity, riparian vegetation consists of mature birch, **low priority**	- Install LWD structures or place passive LWD to increase pool frequency and habitat complexity
17	10'(L)x5'(H) Left bank erosion (High BEHI) into terrace adjacent to road, large tree/rootfan recruited at toe of bank, **high priority**	- Place passive LWD at toe of river-left terrace to redirect flow paths and reduce NBS, use existing wood as anchor points
18	70'(L)x4'(H) Left bank erosion (High BEHI) at outside meander bend into native terrace, terrace vegetated with grass, **high priority**	- Lower river-left terrace and construct ~10'-wide bankfull/low terrace bench daylighting to top of terrace, integrate VWM streambank treatments

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Site I.D.	Description	Preliminary Recommendations
19	40'(L)x4.5'(H) Left bank erosion (High BEHI) where channel abuts parking area at FS gate	- Option 1: Decommission parking area, lower river-left terrace and construct 10' bankfull/low terrace bench daylighting to top of terrace, integrate VWM streambank treatments - Option 2: Decommission parking area, lower river-left terrace to bankfull elevation, integrate VWM streambank treatments

Site Photos

Figure 1. View downstream (left) and upstream (right) at Site 0.

Figure 2. View downstream (left) and upstream (right) at Site 1.

Figure 3. View upstream at Site 2.

Figure 4. View upstream (left) and downstream (right) at Site 3.

Figure 5. View of Site 3.5 on river-right bank.

Figure 6. View upstream at Site 4.

Figure 7. View downstream (left) and upstream (right) at Site 5.

Figure 8. View upstream (left) and downstream (right) at site 6.5 (ditched tributary of O’Brien Creek).

Figure 9. View downstream at Site 7 (left) and Site 8 (right).

Figure 10. View upstream at Site 9.

Figure 11. View downstream at Site 9.5.

Figure 12. View downstream at Site 10.

Figure 13. View downstream at Site 11.

Figure 14. View upstream at Site 12.

Figure 15. View upstream (left) and downstream (right) at Site 13.

Figure 16. View upstream (left) and downstream (right) at Site 14.

Figure 17. View upstream (left) and downstream (right) at Site 15.

Figure 18. View downstream at Site 16.

Figure 19. View upstream (left) and downstream (right) at Site 17.

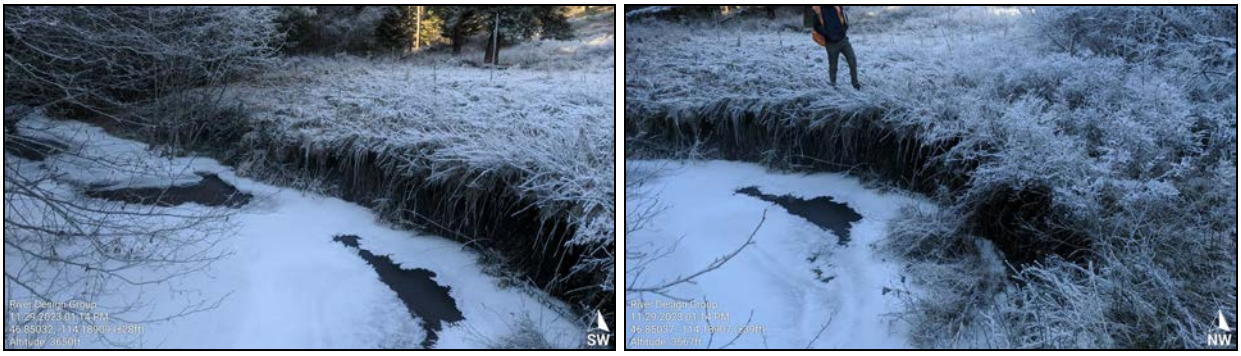

Figure 20. Views upstream at Site 18.

Figure 21. View upstream (left) and downstream (right) at Site 19.

United States Department of Agriculture **Forest Service** **Lolo Nat'l Forest Missoula Ranger District** **Bldg. 24 Fort Missoula Rd. Missoula, MT 59804 (406) 329-3814**

Date: October 30, 2025

C/O Michelle McGree
P.O Box 200701
1420 E. 6th Avenue
Helena, MT 59620

Dear Ms. McGree,

The Lolo National Forest supports the Clark Fork Coalition's grant application for the Upper O'Brien Stream Restoration Project. The Clark Fork Coalition is applying for grant funds from the Future Fisheries Improvement Program to work with the US Forest Service to improve spawning and rearing habitat for trout, reduce sediment loading, and restore floodplain connectivity. Furthermore, the strategic road and gate realignment would provide permanent benefits not only to O'Brien Creek, but to road infrastructure and public safety as well.

The Clark Fork Coalition and the Lolo National Forest have been working on cooperative restoration projects for several years, including upsizing AOP culverts, installing large wood jams, and decommissioning roads and stream crossings. The CFC has also worked on establishing temperature monitoring stations, collecting stream discharge data for instream flow management, and monitoring beaver activity on the Lolo National Forest.

The Clark Fork Coalition and the Lolo National Forest have a track record of proven success and are now continuing the partnership with the Upper O'Brien Steam Restoration Project. Funds from the Future Fisheries Improvement Program are essential to completing on-the-ground aquatic restoration projects.

Thank you for the funding opportunity and your continued work for the conservation of natural resources. Please do not hesitate to contact me at crystal.s.stonesifer@usda.gov if you have any questions.

Sincerely,

Crystal Stonesifer
Missoula District Ranger

MONTANA FISH, WILDLIFE & PARKS

Future Fisheries Improvement Program

Appendix: FWP Statement

Project Title: Upper O'Brien Creek Restoration Project – Clark Fork Coalition

Please describe the potential impact of the project, including the priorities of the Fisheries Division and the importance to Montana's anglers.

The proposed project is planned on upper O'Brien Creek, a small tributary of the lower Bitterroot River located just outside Missoula. This stream is the only perennial tributary between Lolo and the river mouth. The stream is a key spawning and rearing area for migratory trout that support the fishery in that river reach and the Clark Fork River located just downstream.

O'Brien Creek supports a mixed salmonid fish community that varies in composition longitudinally. The lower end of the stream is dominated by various non-native trout species and mountain whitefish, while upper reaches (where this project is proposed) transition to predominantly westslope cutthroat trout (WCT) with higher genetic purity (> 95% WCT contribution).

The proposed project is planned for upper reaches of O'Brien Creek on USFS lands. This project was conceived more than 20 years ago by aquatic resource and land managers as numerous enhancement actions on private and public lands were being implemented in other lower and middle stream reaches (e.g., riparian fencing, fish passage improvements, channel reconstruction, instream flow conservation etc). The proposed project addresses instream habitat deficiencies, water quality impacts, and road encroachment that are a logical extension of past projects (many of which were funded through FFIP) and focus more on stream sections supporting native WCT.

The project design concepts were developed collaboratively among public resource managers, NGO project sponsors (CFC), and private consultants to address pervasive limiting factors. In terms of anticipated fisheries benefits, the large-scale addition of LWD and cover will address obvious deficiencies in habitat complexity and surely increase fish abundance based on FWP monitoring of similar projects. Other listed objectives and benefits (e.g. water quality and floodplain) are expected to provide indirect fisheries benefits as well through enhanced overall stream and floodplain health.

Name of FWP Biologist W. Ladd Knotek Date: 11/7/2025

Please attach to the FFIP application and materials and submit according to listed deadlines.