FUTURE FISHERIES IMPROVEMENT PROGRAM

REPORT PREPARED FOR THE 2017 MONTANA STATE LEGISLATURE AND THE FISH & WILDLIFE COMMISSION

★ *Summary of program years 2015–2016 and anticipated future expenses* ★

Montana Fish, Wildlife & Parks, Fisheries Division, Habitat Bureau

http://fwp.mt.gov/fishAndWildlife/habitat/fish/futureFisheries/legislative/

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Future Fisheries Improvement Program

SUMMARY REPORT TO THE 2017 MONTANA LEGISLATURE AND MONTANA FISH & WILDLIFE COMMISSION

INTRODUCTION

The Future Fisheries Improvement Program (FFIP; MCA 87-1-272, enacted in 1995) provides funds for "*the long term enhancement of streams and stream banks, in-stream flows, water leasing, lease or purchase of stored water, and other voluntary programs that deal with wild fish and aquatic habitats*." The FFIP was supplemented and amended in 1999 when the legislature enacted the Bull Trout and Cutthroat Trout Enhancement Program (MCA 87-1-283), which "*provides for the enhancement of spawning areas and other habitat for the natural reproduction of bull trout and cutthroat trout*." This legislation was amended again in 2013 to open the program to **all** native fish species (statute section 87-1-283), now calling for the enhancement of native fish through habitat restoration, natural reproduction, and reductions in species competition by way of the FFIP. Once called the Bull Trout and Cutthroat Trout Enhancement Program, this supplement to the FFIP encompasses all native species and is now termed the Native Species Enhancement Program (NSEP).

The enabling legislation for the FFIP calls for Montana Fish, Wildlife & Parks (FWP) to "*present a detailed report to each regular session of the legislature on the progress of the future fisheries improvement program. The legislative report must include the department's program activities and expenses since the last report and the project schedules and anticipated expenses for the ensuing 10 years' implementation of the future fisheries improvement program*."

This report summarizes program activities in 2015 to 2016, including the appointments of Future Fisheries Review Panel (Panel) members, program staffing, program appropriations, program updates, projects approved for funding, program expenditures, and a description of anticipated expenses for the ensuing 10 years. Additionally, examples of successfully completed projects funded or partially funded through the FFIP and NSEP are presented. Also included in this report is a monitoring summary and results obtained from the use of long-term photo points for completed projects.

This report can be found on the Montana Fish, Wildlife & Parks (FWP) website at:
http://fwp.mt.gov/fishAndWildlife/habitat/fish/futureFisheries/legislative/

The photos used in this document are property of FWP, or were submitted by individual project sponsors.

PROGRAM GOALS

The overall goal for the FFIP, identified in the enabling legislation (MCA 87-1-272), is "*providing for the protection and enhancement of Montana fisheries through voluntary enhancement of spawning streams and other habitats for the natural reproduction of fish and growth of populations of wild fish*." The Panel developed additional guidance in 1995, stating that potential projects must accomplish one or more of the following goals to be considered for funding: 1) improve or maintain fish passage; 2) restore or protect naturally functioning stream channels or banks; 3) restore or protect naturally functioning riparian areas; 4) prevent loss of fish into water diversions; 5) restore or protect essential habitats for spawning; 6) enhance stream flow in dewatered stream reaches to improve fisheries; 7) improve or protect genetically pure native fish populations; or 8) improve fishing in a lake or reservoir.

APPOINTED FUTURE FISHERIES REVIEW PANEL MEMBERS

The enabling legislation (MCA 87-1-272 and modified by MCA 87-1-283) calls for the establishment of the Panel and identifies specific categories of representation, including but not limited to the following:

- One member who is a representative of conservation districts;
- One member with expertise in commercial agriculture;
- One member with expertise in irrigated agriculture;
- One member from the private sector who is a fisheries restoration professional;
- Two members who are licensed Montana anglers;
- One member of the House of Representatives, chosen by the Speaker of the House;
- One member of the Senate, chosen by the Committee on Committees;
- One member with expertise in silviculture;
- One member who is a Montana high school student;
- One member with an expertise in mine reclamation techniques;
- One member with expertise in fisheries; and
- One ex-officio member from the Montana Department of Transportation who has experience in highway impact mitigation.

With the exception of legislative appointments, panel members are selected by the Governor or a Governor's designee. Members serve a two-year term on the panel and may be re-appointed for additional terms. An additional appointee was added by FWP, intending to include a member with expertise in hydrology/geomorphology. Members of the Panel serving during the period of this report are shown in Table 1. Because Panel members serve terms that begin and end at different times, this table reflects members that have served within the last 2 years.

TABLE 1. FUTURE FISHERIES IMPROVEMENT PROGRAM REVIEW PANEL MEMBERS ACTIVE WITHIN THE LAST BIENNIUM.

	Odd Year Appointments		Even Year Appointments[1]
Category	***7/2013- 7/2015***	***7/2015 – 7/2017***	***7/2014 – 7/2016***
Conservation District	C. Peck, Billings	same	
Commercial Agriculture			A. Johnstone, Wilsall
Irrigated Agriculture			J. Stone, Ovando
Restoration Professional	K. Boyd, Bozeman	same	
Licensed Angler	J. Willauer, Butte	same	
Licensed Angler	C. Fisher, Missoula	M. Johns, Bozeman	
House of Representatives	T. Washburn, Bozeman	J. Welborn, Dillon	
Senate	M. Phillips, Bozeman	J. Hinkle, Belgrade	
Silviculture/Forestry	T. Chute, Helena	same	
High School Student	C. Christman, Three Forks	M. Schroeer-Smith, Helena	
Mine Reclamation			N. Winslow, Missoula
Fisheries	G. Munther, Missoula	B. Wichers, Hamilton	
MDT ex-officio	B. Semmens, Helena	same	
Hydrologist[2]	C. Dalby, Helena	same	

[1]appointments for the time period 7/2016 to 7/2018 had not yet been announced by the Governor's Office
[2]panel member category not mandated by state statute

PROCESSES FOR APPLICATION SUBMITTAL AND FUNDING DECISIONS

Any entity that proposes a habitat project benefiting wild fish in Montana can be considered for funding under the FFIP and, if impacts to native species are significant, receive funding from the NSEP. Project applications can be submitted to FWP twice each year and are considered for the subsequent funding period; winter funding cycle applications are due prior to December 1, and summer funding cycle applications are due prior to June 1.

Since the last biennial report, the Panel met to review project proposals four times: December 2014, June 2015, December 2015, and June 2016. Funding recommendations formulated by the Panel were then forwarded to the Montana Fish & Wildlife Commission (Commission) for final action during their regularly scheduled public meetings held in March (for the winter funding cycle) and August (summer funding cycle).

For each individual funding cycle, there are several avenues for public comment prior to final approval by the Commission. All submitted project applications are posted on the FWP website to provide opportunity for public review and comment. Additionally, environmental assessments (EA's) are prepared for all projects approved for funding by the Panel and include a public comment period, except for projects that fall under categorical exclusion (ARM Rule 12.2.454). If the project is a sub-segment of a larger proposed action, or if the project takes place on federal lands, EA's occasionally are completed after Commission action through the Montana Environmental Policy Act (MEPA) or National Environmental Policy Act (NEPA). Additional opportunities for public involvement and comment include attending public meetings of the Panel and attending public meetings of the Commission. Press releases announce each upcoming grant cycle as well as the projects funded by the Commission.

PROGRAM STAFFING (MCA 87-1-272)

Future Fisheries Improvement Program

The enabling legislation for the FFIP authorized the use of program funds for up to two additional full-time employees. MCA 87-1-272 states, "*In order to implement (the program) the department may expend revenue from the future fisheries improvement program for up to two additional full-time employees.*" FWP initially allocated two full time equivalents (FTE's) to the FFIP, but then instead utilized base license dollars to fund these two FTE's and their operations. By using base license dollars rather than funds allocated to the FFIP, more program funds have been available to fund restoration projects.

Michelle McGree was employed as FFIP staff during the report period. Michelle has been the Future Fisheries Improvement Program Officer (FFIPO) since 2014. The FFIPO is responsible for reviewing project applications, visiting the sites of proposed projects, acting as FWP staff liaison for the Panel, developing and communicating FWP recommendations to the Panel, developing project proposals, coordinating with consultants and contractors who design and perform restoration projects, working with landowners and other citizens who need help developing project proposals, developing project agreements, processing and approving program payments associated with completed restoration work, monitoring project implementation, effectiveness, and compliance according to project agreements, and maintaining a comprehensive FFIP database.

Native Species Enhancement Program

MCA 87-1-283 states, "*In order to implement (the program), the department may expend revenue from the bull trout and cutthroat trout enhancement program for one additional FTE and one contractor to assist the review panel.*" In the past, the single FTE was split among three individuals who, as part of their positions, were required to organize, complete, or maintain projects that were eligible for funding under this program. Currently, base license dollars are used to fund this split FTE, rather than funds allocated to the program. The only operations costs currently used from the NSEP support the FFIP meetings and monitoring activities. Expenditures associated with the NSEP since the last report period (November 1, 2014 to October 31, 2016) equaled $21,748.71. The use of base license dollars to support both the NSEP and FFIP allows maximum program dollars to be used for restoration.

PROGRAM APPROPRIATIONS

The FFIP has been funded using general license dollars and River Restoration funds, while the NSEP has been funded primarily with Resource Indemnity Trust (RIT) funds and a small amount of general license dollars (Table 2). River Restoration funds (MCA 87-1-257-258) are derived from a $0.50 earmark on resident fishing licenses and a $1.00 earmark on non-resident fishing licenses. NSEP funds (formerly the Bull Trout and Cutthroat Trout Enhancement Program) are derived from appropriations to the RIT fund (MCA 15-38-202). Past appropriations included $510,000 specifically earmarked by the 1995 legislature (26306, EI25) for the purpose of constructing a fish screen on the T&Y Diversion located on the Tongue River to prevent the loss of fish down the irrigation canal.

Since the inception of each program, FFIP appropriations have totaled $7,735,000, and NSEP appropriations have totaled $7,900,000 (Table 2), averaging $703,182 per biennium (11 biennia) and $877,778 per biennium (9 biennia), respectively. The total amount appropriated over 22 years (11 biennia) is $15,635,000.

TABLE 2. A SUMMARY OF LEGISLATIVE APPROPRIATIONS BY FUND AND SUBCLASS MADE TO THE FUTURE FISHERIES IMPROVEMENT PROGRAM (FFIP; COMPOSED OF GENERAL LICENSE AND RIVER RESTORATION FUNDS) AND TO THE NATIVE SPECIES ENHANCEMENT PROGRAM (NSEP; COMPOSED PRIMARILY OF RIT FUNDS AND SHOWING BT/CT DESIGNATIONS). BT/CT = BULL TROUT AND CUTTHROAT TROUT ENHANCEMENT PROGRAM; RIT = RESOURCE INDEMNITY TRUST FUND.

LEGISLATIVE SESSION	FUND AND SUBCLASS	AMOUNT
1995	General License, 26306, E125 (earmarked)	$510,000.00
	River Restoration, 26301	$290,000.00
	General License, 02409, ET30	$220,000.00
	General License, 02409, ET2	$1,250,000.00
1997	River Restoration, 02149, 28466	$70,000.00
	General License, 02409, E131	$1,310,000.00
1999	River Restoration, 02149, E190	$300,000.00
	General License, 02409, E131	$1,170,000.00
	General License, 02409, 38011 (BT/CT)	$750,000.00
2001	River Restoration, 02149, EI115	$260,000.00
	General License, 02409, EI115	$750,000.00
	RIT, 02022, EI115 (BT/CT)	$850,000.00
2003	River Restoration, 02149, EI131	$210,000.00
	RIT, 02022, EI131 (BT/CT)	$700,000.00
2005	River Restoration, 02149, EI150	$190,000.00
	RIT, 02022, EI150 (BT/CT)	$1,000,000.00
2007	River Restoration, 02149, EI170	$314,000.00
	RIT, 02022, EI170 (BT/CT)	$1,000,000.00
2009	River Restoration, 02149, EI109	$150,000.00
	RIT, 02022, EI109 (BT/CT)	$1,000,000.00
2011	River Restoration, 02149, EI001	$274,000.00
	RIT, 02022, EI001 (BT/CT)	$1,000,000.00
2013	River Restoration, 02149, EI003	$190,000.00
	RIT, 02022, EI003	$600,000.00
2015	River Restoration, 02149, EI005	$277,000.00
	RIT, 02022, EI005	$1,000,000.00
TOTALS	FFIP (License + River Restoration)	$7,735,000.00
	NSEP (RIT + BT/CT funds)	$7,900,000.00
		$15,635,000.00

PROGRAM SUMMARY

From the inception of the two programs until November 1, 2016, the Panel and Commission have approved funding requests (full or partial) for 730 restoration projects (Table 3). Of these projects, 570 have been completed, 54 are ongoing, none are pending, and 111 have been cancelled. All program funds previously committed to cancelled projects were subsequently reallocated to fund new habitat projects. The reasons for cancellations vary greatly, but five of the most common reasons are:

- The applicant used other funding sources to complete the project.
- The landowner was unwilling to sign a project agreement. These project agreements apply to all funded projects and are put in place to ensure that there is protection for the investment in restoration (typically 20 years).
- The applicant was unable to secure the matching funds that were identified in the application.
- The landowner was never fully on board with the proposed project and backed out after funds were approved.
- The scope of the project significantly changed after funding was secured, requiring the applicant to re-apply to the FFIP or seek other sources of funding.

Since implementation of the FFIP in 1996, the Commission approved $14,738,701 for restoration projects that are ongoing or completed (for both FFIP and NSEP) which, in turn, generated approximately $47,087,533 in available matching funds. Matching funds come from a wide array of sources, including federal agencies, state agencies, sportsman's groups, conservation groups, watershed groups, private foundations, private companies, and landowners. With FFIP and match combined, nearly $62,410,000 of habitat restoration work has been undertaken in Montana since 1996 as a result of the FFIP.

Projects have been completed statewide since 1996 (Figure 1). However, fewer projects have been completed in eastern Montana. Because the NSEP funding originally targeted cutthroat trout and bull trout projects, those funds were limited to western Montana. In 2013, NSEP funding was expanded to include all native fish, creating opportunities for funding in additional areas. Increasing habitat enhancement in eastern MT is a priority.

TABLE 3. THE STATUS OF PROJECTS FUNDED BY THE FUTURE FISHERIES IMPROVEMENT PROGRAM AND THE NATIVE SPECIES ENHANCEMENT PROGRAM, BY YEAR, FROM 1996 (START OF PROGRAM IMPLEMENTATION) THROUGH NOVEMBER 1, 2016.

YEAR	# COMPLETE	# ONGOING	# PENDING	# CANCELLED	TOTAL
1996	42			6	48
1997	39			6	45
1998	39			10	49
1999	43			7	50
2000	36			8	44
2001	27			8	35
2002	32	2*		7	39
2003	32			9	41
2004	32			7	39
2005	27			4	31
2006	25	2*		13	38
2007	34			2	36
2008	18			9	27
2009	27	1†		3	30
2010	29	1		3	33
2011	21	1		8	30
2012	16	1		1	18
2013	17	2			19
2014	12	7			19
2015	21	14			35
2016	1	23			24
TOTALS	**570**	**54**	**0**	**111**	**730**

* ongoing maintenance (siphon or fish screen)

† 10 year water lease

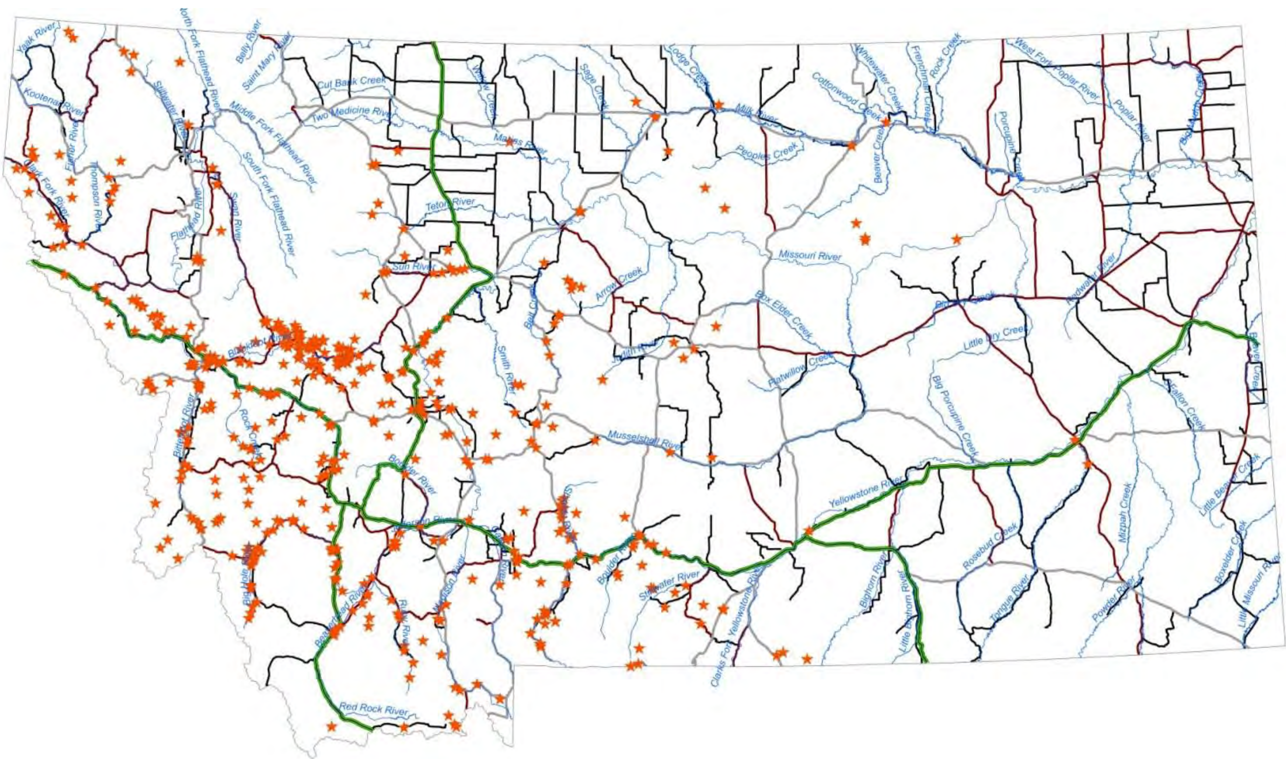


FIGURE 1. COMPLETED PROJECTS, FUNDED BY THE FUTURE FISHERIES IMPROVEMENT PROGRAM (INCLUDING THE NATIVE SPECIES ENHANCEMENT PROGRAM), AS OF NOVEMBER 1, 2016. RED STARS SYMBOLIZE PROJECT LOCATIONS.

Over the years, program funds have been used to complete many types of lake and stream habitat enhancements (Figure 2); however channel restoration and riparian fencing have been the most common components and are a part of at least 22% of all completed projects. Additional prevalent restoration activities included culvert replacement, bank stabilization, diversion modification, fish screens, barrier construction (native fish protection), and riparian restoration. Other less common types (not labeled on Figure 2) included water gaps, nonnative fish removal, pond construction, shoreline protection, maintenance, and specific types of bioengineering.

In 2015 and 2016, a majority of approved projects involved channel restoration and fish passage. Other common project activities included fish screens, riparian fencing, and instream flow. Examples of channel restoration activities include improving stream function by adding sinuosity (bends) to channelized reaches, removing mine tailings, and giving the stream space to function. Fish passage projects generally involve removal of a barrier, oftentimes undersized culverts, and replacement with a bridge or large culvert that can accommodate the stream at 100-year flood intervals. Fish screens keep fish from entering irrigation diversions, and riparian fencing projects typically involve the creation of vegetative buffer between the stream and livestock, allowing for riparian plant growth and improved stream and streambank health. Instream flow projects usually involve leases that keep water in the stream for a specified period of time.

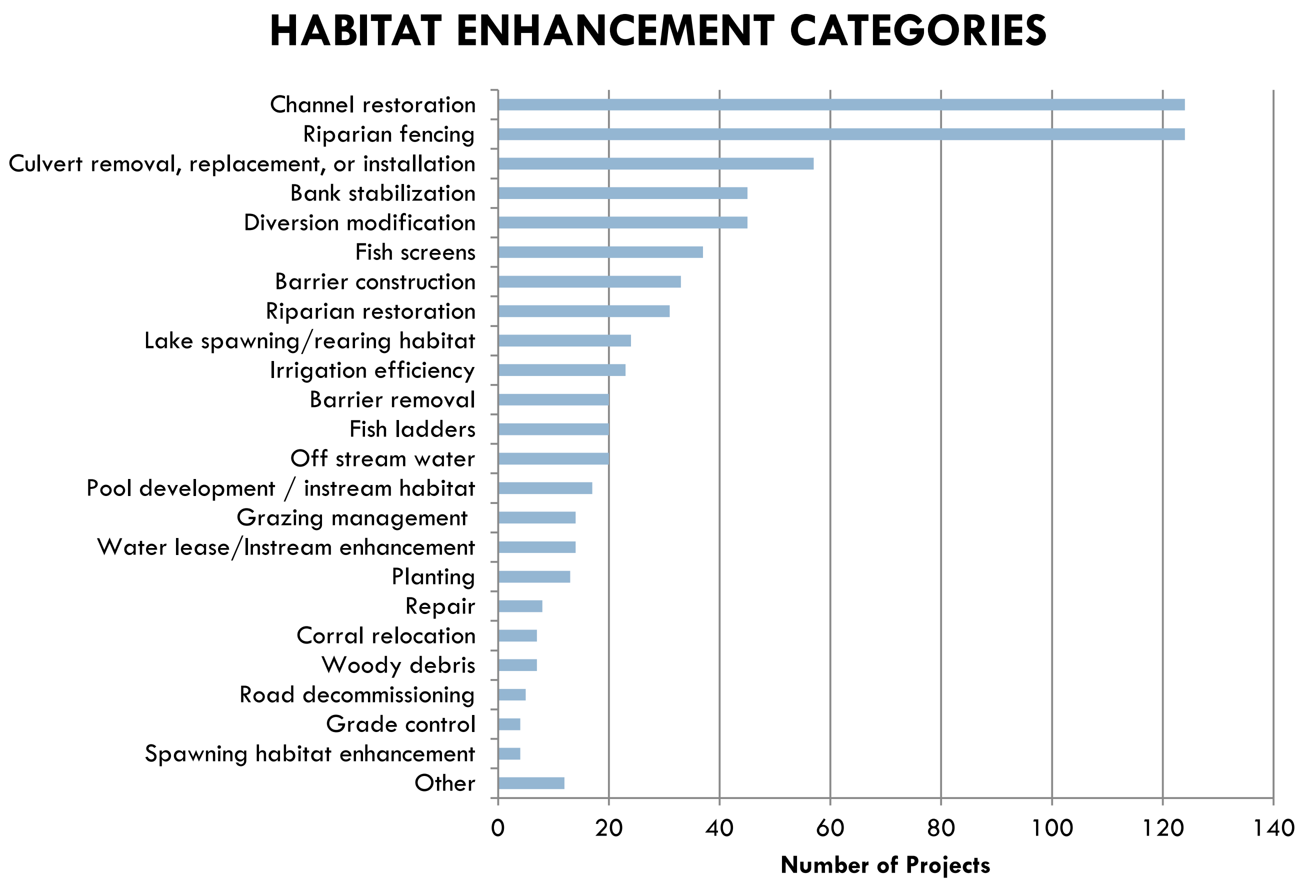


FIGURE 2. HABITAT ENHANCEMENT CATEGORIES ASSOCIATED WITH FUTURE FISHERIES IMPROVEMENT PROGRAM PROJECTS, AND THE NUMBER OF PROJECTS ASSOCIATED WITH EACH TYPE. SOME PROJECTS INCLUDE MULTIPLE CATEGORIES.

PROGRAM UPDATES

Recent changes to the program include an update of the FFIP website, which provides accurate and clear information for grant applicants and people interested in learning more about the program. The format is now compatible with mobile devices. Projects in development include the merging of the FFIP database with the FWP fisheries information system, which will improve efficiency in reporting and allow restoration and fisheries data to be linked. Once the databases are linked, developing a method for FFIP data to be more interactive and available for the public will be a priority.

PROGRAM PROJECTS, FUNDED 11/01/14 TO 10/31/16

During the period of this report, the Commission approved funding or partial funding for 59 restoration projects in 18 Montana counties totaling $1,601,800 (Table 4). These projects derived an additional $8,324,667 in matching funds and in-kind services from outside sources and had a total value of more than $11 million dollars. Of the 59 restoration projects approved, 13 were funded under the FFIP, and 46 were funded under the NSEP. Narrative descriptions of individual projects can be found in the following section.

TABLE 4. A LISTING OF FUTURE FISHERIES IMPROVEMENT PROGRAM (FFIP) PROJECTS APPROVED BY THE FISH & WILDLIFE COMMISSION AND THEIR STATUS FOR THE REPORT PERIOD 11/01/14 TO 10/31/16. PROJECTS IN BOLD WERE FUNDED BY THE NATIVE SPECIES ENHANCEMENT PROGRAM (NSEP).

FFIP #	#	PROJECT NUMBER, NAME & YEAR	APPLICANT	PROGRAM FUNDS COMMITTED BY FWP COMMISSION ($)	MATCHING FUNDS ($)	TOTAL FUNDS COMMITTED ($)
001-2015	**1**	**Barker-Hugesville fish barrier**	**FWP**	**30,000**	**212,200**	**242,200**
002-2015	2	Bitterroot River riparian fencing	Landowner	4,990	3,200	8,190
003-2015	**3**	**Bull River riparian restoration**	**Conservation district**	**29,282**	**174,770**	**204,052**
004-2015	4	Deep Creek riparian habitat & streamflow improvement	FWP	20,000	106,208	126,208
005-2015	**5**	**Douglas Creek fish ladders**	**FWP**	**2,497**	**2,497**	**4,993**
006-2015	**6**	**French Gulch channel relocation**	**FWP**	**114,061**		**114,061**
010-2015	7	Moores Creek grazing and water quality enhancement	Conservation district	10,478	29,587	40,065
011-2015	**8**	**Mulherin Creek fish screen**	**FWP**	**20,000**		**20,000**
012-2015	**9**	**Musselshell River egge diversion removal**	**FWP**	**20,000**	**141,810**	**161,810**
013-2015	10	Ruby Creek channel relocation	FWP	2,475	12,600	15,075
014-2015	**11**	**Shanley Creek restoration**	**TU**	**12,100**	**26,932**	**39,032**
016-2015	**12**	**Stonewall Creek restoration**	**TU**	**41,000**	**283,050**	**324,050**
017-2015	**13**	**T&Y fish screen repair**	**Water user/FWP**	**9,335**	**11,565**	**20,900**
018-2015	**14**	**Theodore Creek fish passage improvement**	**TU**	**20,000**	**140,395**	**160,395**
019-2015	**15**	**Upper Lolo Creek sediment reduction**	**Watershed group**	**43,000**		**43,000**
020-2015	16	Upper Sleeping Child / Rye Creek sediment reduction	Watershed group	42,900	417,800	460,700
021-2015	**17**	**West Fork Jacobsen Spring Creek restoration**	**TU**	**7,500**	**30,700**	**38,200**
022-2015	**18**	**Yukon Creek fish passage improvement**	**TU**	**23,400**	**139,178**	**162,578**
		SUBTOTAL 2015 winter funding cycle		453,018	1,732,490	2,185,509
023-2015	19	Big Otter Creek fencing and stock tank	Landowner	7,029	4,350	11,379
024-2015	**20**	**Braziel Creek instream flow**	**TU**	**10,400**	**48,432**	**58,832**
025-2015	**21**	**Cherry Creek fish passage**	**Landowner**	**7,080**	**8,804**	**15,884**
026-2015	22	Deep Creek streamflow improvement	FWP	8,950	129,000	137,950
027-2015	**23**	**Devil's Dip Spring Creek channel restoration**	**TU**	**8,500**	**21,810**	**30,310**
028-2015	**24**	**French Gulch channel restoration**	**Watershed group/FWP**	**90,000**		**959,061**
029-2015	**25**	**La Marche Creek fish passage improvement**	**FWP**	**5,500**	**2,700**	**8,200**
030-2015	**26**	**Martina Creek channel restoration**	**TU**	**30,000**	**126,879**	**156,879**
031-2015	27	Moose Creek riparian fencing	Watershed group	3,000	13,500	16,500
033-2015	28	Poindexter Slough Channel Restoration	Conservation district	75,000	984,362	1,059,362
034-2015	**29**	**Rattlesnake Creek fish screen**	**TU**	**11,865**	**15,500**	**15,500**
035-2015	**30**	**Reese Creek instream flow enhancement**	**TU**	**55,000**	**71,000**	**71,000**
036-2015	31	Smith Slough spawning enhancement	FWP	40,000	325,995	365,995
038-2015	**32**	**Stonewall Creek fish screen**	**TU**	**13,300**	**25,600**	**38,900**
039-2015	**33**	**Trail Creek fish screen**	**TU**	**21,175**	**38,800**	**59,975**
040-2015	**34**	**Upper Lolo Creek sediment reduction**	**Watershed group**	**44,000**	**112,650**	**156,650**
041-2015	**35**	**Van Houten Lake fish barrier and spawning channel**	**FWP**	**10,000**	**20,000**	**30,000**
		SUBTOTAL 2015 summer funding cycle		440,799	1,949,382	3,192,377

TABLE 4. CONTINUED.

001-2016	1	Big Spring Creek Machler restoration	FWP	50,000	1,115,468	1,420,468
002-2016	**2**	**Bostwick Creek fish barrier**	**FWP**	**5,000**	**34,812**	**93,332**
003-2016	**3**	**Carpenter Creek fish barrier**	**FWP**	**75,000**	**101,000**	**165,000**
005-2016	**4**	**French Creek riparian fencing**	**FWP**	**10,000**	**28,113**	**38,113**
006-2016	**5**	**French Gulch channel restoration**	**Watershed group**	**70,000**	**774,500**	**1,108,687**
008-2016	6	Hells Canyon Creek instream flow	FWP	7,395	7,000	14,395
009-2016	**7**	**Little Blackfoot and Ontario Creek road relocation / floodplain restoration**	**USFS**	**30,000**	**465,675**	**515,675**
010-2016	**8**	**Long Creek channel restoration**	**Environmental group**	**15,000**	**36,010**	**61,010**
011-2016	**9**	**North Fork Dry Cottonwood Creek culvert replacement**	**Watershed group**	**26,310**	**38,910**	**65,220**
012-2016	**10**	**Sucker Creek fish passage**	**TU**	**16,500**	**38,257**	**54,757**
013-2016	**11**	**Telegraph Creek Lilly Orphan Boy mine reclamation**	**TU**	**29,600**	**301,940**	**386,600**
014-2016	**12**	**Vermillion River Miners Gulch restoration**	**Conservation district**	**50,000**	**336,600**	**386,600**
015-2016	**13**	**Warm Springs Creek fish passage**	**TU**	**43,703**	**157,107**	**200,810**
016-2016	14	West Fork Gallatin River stream and pond improvement	Community group	30,000	379,777	479,777
		SUBTOTAL 2016 winter funding cycle		458,508	3,815,168	4,990,443
018-2016	**15**	**Big Hole River fencing project**	**Watershed group**	**4,000**	**16,625**	**20,625**
020-2016	**16**	**Elk Springs Creek habitat restoration**	**FWP**	**45,000**	**61,708**	**106,708**
021-2016	**17**	**Marias River Sanford Park fish habitat enhancement**	**FWP**	**15,075**	**35,698**	**49,973**
022-2016	**18**	**Monture and Dunham Creeks riparian fencing**	**TU**	**10,000**	**37,633**	**48,533**
023-2016	**19**	**Mulherin Creek fish screen**	**FWP**	**13,550**	**50,870**	**84,420**
024-2016	**20**	**North Fork Spanish Creek fish barrier**	**Landowner**	**60,000**	**307,700**	**239,700**
025-2016	**21**	**Rattlesnake Creek Williams fish screen**	**TU**	**9,600**	**9,330**	**19,330**
026-2016	**22**	**Shanley Creek fish screen and water conservation**	**TU**	**15,250**	**21,425**	**36,675**
027-2016	**23**	**Shields River watershed YCT passage**	**USFS**	**57,000**	**206,000**	**260,000**
028-2016	**24**	**Wasson Creek water rights lease renewal**	**TU**	20,000	80,638	100,638
		SUBTOTAL 2016 summer funding cycle		249,475	827,626	966,601
		GRAND TOTAL 2015-2016		1,601,800	8,324,667	

NARRATIVE DESCRIPTIONS OF FUNDED PROJECTS

The followings projects describe the projects funded in the last biennium, and correspond with Table 4. Project status is as of October 31, 2016. Completion photos are presented when available.

2015 PROJECT DESCRIPTIONS

- **BARKER-HUGHESVILLE FISH BARRIER (001-2015)**. Dry Fork Belt Creek (Cascade County) is a tributary to Belt Creek near Monarch that supports five tributary populations of westslope cutthroat trout (WCT) with over 99% genetic purity. This project involved construction of a fish barrier near the mouth of the Dry Fork Belt Creek and the subsequent removal of existing non-native fishes from the mainstem and some tributaries. The overall goal was to prevent upstream movement of non-native fishes, and expand the potential miles of stream available to WCT. This project is a supplement to a previous project. However, the project came in under budget and funds were returned to the program. **COMPLETED; SEE PHOTOS BELOW.**

002-2013 & 001-2015 BARKER HUGHESVILLE / DRY FORK BELT CREEK BARRIER

This project greatly expanded habitat available for a very important population of cutthroat trout. FFIP granted $40,000 to the project but only $10,000 was used as the project was completed under budget. The total cost was approximately $212,200.

Before

After

- **BITTERROOT RIVER RIPARIAN FENCING (002-2015).** This project is located on the Bitterroot River (Missoula County), on Sapphire Ranch and State property. The applicant (lessee) proposed to convert existing riparian fence to wildlife-friendly fence, repair dilapidated sections of fence, and build new fence on the east side of the river, excluding cattle from the riparian areas. The fenced areas are located in three sections of land in township 11 north, range 20 w est. The fence in section 24 was partially washed out in a high flow event and was not functional. The riparian fence within sections 12 and 13 was functional, but not wildlife friendly. The applicant installed a new fence on the opposite (east) side of the river in section 12. The existing fenced areas were previously funded with FFIP dollars (the first project was expired). **COMPLETED.**

- **BULL RIVER RIPARIAN RESTORATION (003-2015).** Bull River (Sanders County) is a tributary to the lower Clark Fork River and supports a community of brown trout, bull trout, and mountain whitefish with westslope cutthroat trout present. The Bull River drainage provides the most important spawning and rearing habitat for native westslope cutthroat trout and bull trout in the Cabinet Gorge reach of the lower Clark Fork River. However, Bull River is impaired by sedimentation and physical habitat alterations caused by bank erosion, roads, and upland load. This project addresses the bank erosion by controlling non-native reed canary grass through the use of weed barrier, and by planting native shrubs and trees along approximately 11,000 linear feet of river. The goal is to improve streambank stability over time and re-establish a healthy riparian area to reduce sediment loading and enhance wild fish habitat. **ONGOING.**

- **DEEP CREEK RIPARIAN HABITAT AND STREAMFLOW IMPROVEMENT (004-2015).** Deep Creek (Broadwater County) is a tributary to the Missouri River that primarily supports brown trout and rainbow trout, and has been the focus of restoration projects for many years. Sediment inputs, high temperatures, and reduced streamflow were all factors that have affected the stream. Riparian fencing was installed along Deep Creek in the past, but was often located too close to the stream. Flooding in 2011 damaged the existing fence in many locations along the lower 15 miles of Deep Creek. This project plans to repair or replace 15 miles of fence and locate it further from the stream. The applicant has eliminated a major irrigation diversion from Deep Creek, improving streamflow, reducing temperature, eliminating fish loss, and restoring upstream fish passage. **ONGOING.**

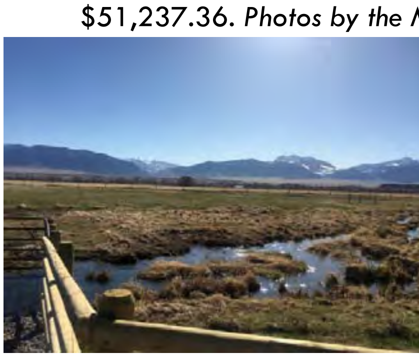
- **DOUGLAS CREEK FISH LADDERS (005-2015).** Douglas Creek (Powell County) is a tributary to Nevada Creek, within the Blackfoot River drainage. Westslope cutthroat trout are located near the mouth of Douglas Creek where they are now increasing in abundance. Improving fish passage is intended to promote recovery of cutthroat trout in this location. This project was developed in conjunction with the 310 permitting process and represents an opportunity to ensure fish passage at existing diversions in conjunction with landowner irrigation needs, potentially restoring corridors for trout movement. This is a cost-share project between FWP and the U.S. Fish and Wildlife Service, and maintenance and operation of the ladders will be the responsibility of Myers Company Ranch. **ONGOING.**

- **FRENCH GULCH CHANNEL RELOCATION (006-2015).** French Gulch (Deerlodge County) is a tributary to French Creek, which flows into Deep Creek and the Big Hole River. Placer mining activities occurred in the French Gulch drainage from the mid 19th century to the early 1990's, resulting in stream habitat that has been degraded by stream channel straightening, the presence of large dredge spoils, increased stream gradient, reduced riparian area width, and isolation of the stream from its floodplain. The purpose of this project is to restore habitat impacted by placer mining. Restoration activities include reconstruction of the floodplain and stream channel, redirecting the streamflow, and plugging the old channel. The new channel would be vegetated with transplanted material or bioengineering techniques. The goal is to increase the number of westslope cutthroat trout and arctic grayling in French Gulch by addressing the habitat limitations and potentially opening habitat to fluvial fish from French Creek. This project would be located upstream of the French Creek fish barrier. This project is tied to two other ongoing grants. **ONGOING.**

- **MOORES CREEK GRAZING AND WATER QUALITY ENHANCEMENT (FFI-010-2015).** Moore's Creek (Madison County), is a tributary to the Madison River with perennial streamflow. It is believed to contain rainbow, brown, and brook trout, and will be sampled to collect more specific fish data when the project is established. In a 3,200-foot section of Moore's Creek on the Goggins Ranch, the applicant installed electric riparian fencing, hardened crossings, two water gaps in areas where livestock are rotated, and off-channel water sources for the pastures and corrals. The ranch adopted a rest-rotation grazing program. This project also involved working with the Ennis High School Science club to plant willows. The project was expected to have potential for fishery improvement and to serve as a step forward in developing additional, similar projects in coming years. **COMPLETED; SEE PHOTOS BELOW.**

010-2015 MOORE'S CREEK GRAZING AND WATER QUALITY ENHANCEMENT

The project applicant has photo monitoring stations in place. FFIP contributed $10,478 and the total cost was $51,237.36. *Photos by the Madison Conservation District.*



Before

After

- **MULHERIN CREEK FISH SCREEN (011-2015).** Mulherin Creek (Park County) is a tributary to the Yellowstone River and the third greatest producer of Yellowstone cutthroat fry to the Yellowstone River. Trapping data indicated that a substantial portion of outmigrating fry are entrained in the canal.

Spawning adults have also been found in the canal or irrigated fields. A fish screen was installed in the 1990's at this location, but failed because a clogged infiltration gallery led to a water user cutting the pipe to ensure water delivery. This project proposes to install a more functional, low-maintenance fish screen (Farmer's fish screen) to stop entrainment of Yellowstone cutthroat trout while allowing for delivery of diverted water. Another, supplemental application funded in 2016. **ONGOING.**

- **MUSSELLSHELL RIVER EGGE DIVERSION REMOVAL (012-2015).** The Egge Diversion (Golden Valley County), on the Musselshell River, has been in place for nearly 100 years. A 2011 flood flanked the diversion and led to severe erosion on the adjacent bank. This project proposes to maintain the recent connectivity in the Musselshell River by removing the former fish barrier and allowing for natural streamflow. Removal would open up a continuous 24-mile reach for fish passage, connecting the tributaries Big Coulee Creek and Painted Robe Creek, which contain northern redbelly dace and hybrid finescale dace (species of concern), and many other native fish species. Spiny softshell turtles (species of concern) and fatmucket clams are also found in this region. The erosion on the bank adjacent to the diversion would be repaired using bioengineered soil lifts rather than traditional rock riprap or rubble. **ONGOING.**

- **RUBY CREEK CHANNEL RELOCATION (013-2015).** Ruby Creek (Madison County) is a tributary to the Madison River and the site of an ongoing westslope cutthroat restoration project. Chemical treatments from 2012 to 2014 removed non-native trout, and westslope cutthroat trout introductions are planned. Along Ruby Creek, within the FWP Wall Creek Management Area, an actively eroding vertical bank was in danger of collapsing at the McAtee Homestead site, potentially leading to impeded stream flow and riparian scour and erosion. This project relocated the active stream channel away from a vertical eroding bank by constructing a new stream channel, bringing in fill material, and using riparian soils and vegetation from the channel excavation to develop a riparian floodplain at the location of the existing channel (against the vertical bank). The purpose of this project was to establish proper stream channel form and function, develop the riparian floodplain, and prevent the historic cabin from collapsing into Ruby Creek. **COMPLETED; SEE PHOTOS BELOW.**

013-2015 RUBY CREEK CHANNEL RELOCATION

FFIP contributed $2,475 to this project, and the total cost was $15,075. *Photos by FWP.*

Before

After

- **SHANLEY CREEK RESTORATION (014-2015).** Shanley Creek (Powell County) is a second-order tributary to Cottonwood Creek, is a bull trout core area stream, and supports pure populations of westslope cutthroat trout. Poor road locations and undersized stream crossings negatively affected the stream. This project involved relocating nearly one mile of road out of the Shanley Creek floodplain and replaced two undersized culverts with a single crossing capable of passing a 100-year flood event. The bed and banks of the stream at each crossing were restored. An unimproved ford was upgraded with a short-span bridge to accommodate the new road system location. The goal of this project was to correct the road damage problems, eliminate sources of excessive sediment, provide for fish passage, and restore natural channel morphology at the impaired crossings. **COMPLETED, SEE PHOTOS BELOW.**

014-2015 SHANLEY CREEK RESTORATION

FFIP contributed $13,300 to the project (10% overrun), which had a total cost of $52,072.81 (adjusted balance). *Photos by Big Blackfoot Chapter of Trout Unlimited and FWP.*

Before (ford)

After (bridge)

Before (culvert)

After (culvert removed)

- **STONEWALL CREEK RESTORATION (016-2015).** Stonewall Creek (Lewis and Clark County) is a tributary to Keep Cool Creek, within the Blackfoot River drainage, and contains westslope cutthroat trout. This project is located in an area that has been impacted by placer mining. Tailing piles confine the creek, the floodplain has limited connectivity, and the riparian area does not function well. This project seeks to restore this section of Stonewall Creek by removing tailings piles, adding woody debris complexes to the stream, and restoring the adjacent floodplain and riparian area. The goals of this project include contributing to the recovery of westslope cutthroat trout by expanding suitable habitat and improving water quality on-site and downstream of the project. **ONGOING.**

- **T&Y DIVERSION FISH SCREEN REPAIR (017-2015).** The T&Y diversion fish screen (Custer County) is located on the Tongue River and was installed in 1999 to reduce fish entrainment into the T&Y Irrigation Canal. Prior to installation, the metal louvers were coated with a 30-year protective coating, which is failing after only 15 years. This project proposes to remove, clean, and galvanize the louvers. Repairing the louvers will prevent the fish screen from failing and ensure that fish continue to be screened at the diversion. This fish screen has prevented entrainment of an average of 17,225 fish per year representing 20 species. **ONGOING.**

- **THEODORE CREEK FISH PASSAGE IMPROVEMENT (018-2015).** Theodore Creek (Lewis and Clark County) is a tributary to Beaver Creek and supports fluvial, genetically pure westslope cutthroat trout. Bull trout were also historically found in the system. This project replaced an undersized culvert that impeded fish passage during high flows with a pre-stressed concrete bridge structure that creates year-round connectivity and natural stream conditions. **COMPLETED, SEE PHOTOS BELOW.**

018-2015 THEODORE CREEK FISH PASSAGE IMPROVEMENT

FFIP contributed $20,000 to the project, which had a total cost of $160,738.19. *Photos by Big Blackfoot Chapter of Trout Unlimited and FWP.*

Before

After

- **UPPER LOLO CREEK SEDIMENT REDUCTION (019-2015).** The Upper Lolo Creek watershed (Missoula County) was significantly impacted by sediment generated by forest roads and failing culverts. This area is considered important habitat for bull trout, and the project is part of a long-term restoration effort to remove culverts that are fish barriers and reclaim excess forest roads that add sediment to the Upper Lolo Creek system. The project re-contoured 12-14 miles of forest roads and removed at least 8 culverts, reducing sediment and improving fish passage in the drainage. Supplemented by a grant approved in 2016. **COMPLETED.**

- **UPPER SLEEPING CHILD/RYE CREEK SEDIMENT (020-2015).** Sleeping Child Creek and Rye Creek (Ravalli County) are tributaries of the Bitterroot River and contain populations of bull trout and westslope cutthroat trout. The project areas, near the headwaters of each stream, were heavily roaded and clear-cut in the 1980's and 1990's. High intensity fires burned the areas in 2000, exacerbating chronic sediment loading. Sleeping Child and Rye Creeks are both 303(d)-listed and have completed TMDLs for sediment. This project is part of a larger plan to restore the area, which will be completed in phases. The applicant decommissioned at least 20 miles of roads to reduce sediment and restored the watershed, and removed at least 19 stream crossing culverts. The recontoured road was seeded with grasses. **COMPLETED.**

- **WEST FORK JACOBSEN SPRING CREEK RESTORATION (021-2015).** West Fork Jacobsen Spring Creek (Powell County) is a tributary to Jacobsen Spring Creek, which contains bull trout and westslope cutthroat trout, and feeds the North Fork of the Blackfoot River. West Fork Jacobsen Spring Creek was over-wide and shallow, impacted by livestock hoof sheer. Three undersized culverts caused backwater ponding issues, further affecting water temperature and stream flow. This project restored the stream channel to a more natural channel width, depth, and dimension, and riparian vegetation was installed to stabilize the streambanks. The three undersized stream crossings were be upgraded, and a grazing management plan was incorporated. **COMPLETED, SEE PHOTOS BELOW.**

021-2015 WEST FORK JACOBSEN SPRING CREEK RESTORATION

FFIP contributed $7,500 to this project, and the total project cost was $38,200. *Photos by Big Blackfoot Chapter of Trout Unlimited and FWP.*


Before


After

- **YUKON CREEK FISH PASSAGE IMPROVEMENT (022-2015).** Yukon Creek (Lewis and Clark County) is a tributary to Beaver Creek and supports fluvial, genetically pure westslope cutthroat trout. This project addressed an existing stream crossing that was undersized, impeded fish passage during high flows, and impaired the channel. The 60-inch culvert was replaced with a bottomless arch structure large enough to pass 100-year flood events. The goals of this project were to develop a stable stream crossing that would correct road drainage problems, eliminate delivery of excessive sediment, provide fish passage, and restore natural channel morphology to the site. **COMPLETED, SEE PHOTOS BELOW.**

022-2015 YUKON CREEK FISH PASSAGE IMPROVEMENT

FFIP contributed $23,400 to the project, which had a total cost of $169,004.69. *Photos by Big Blackfoot Chapter of Trout Unlimited and FWP.*


Before


After

- **BIG OTTER CREEK FENCING AND STOCK TANK (023-2015)**. Big Otter Creek (Judith Basin County) is a tributary to Belt Creek that supports populations of brook trout, brown trout, and rainbow trout. The project involved the rehabilitation of a highway underpass for livestock use, the building of a bridge, installation of fencing, and addition of a stock tank. The landowner can now use a new route to move cattle and protect the stream from livestock impacts. The goal of this project was to prevent stream degradation and represents a proactive approach to protect the stream from imminent negative impacts. **COMPLETED, SEE PHOTOS BELOW.**

023-2015 BIG OTTER CREEK FENCING AND STOCK TANK

FFIP contributed $7,028.55 and the total project cost was $11,378.55. *Photos by landowner.*


After (both photos)

- **BRAZIEL CREEK INSTREAM FLOW (024-2015).** Braziel Creek (Powell County) is a tributary to Nevada Creek and supports a nearly pure strain of westslope cutthroat trout. Flow monitoring in the area indicated dewatering due to irrigation demand, and this project aims to lease water and secure minimum flows for resident fish. In this project, a 0.5 cfs split-season water-rights lease will be obtained from the landowner, coupled with reduced irrigation withdrawal. The goal of this project is to protect and enhance native fish habitat by securing additional water for instream flow. **ONGOING.**

- **CHERRY CREEK FISH PASSAGE (025-2015).** Cherry Creek (Madison County) is a tributary to the Madison River and is now home to genetically pure westslope cutthroat trout. Nearly 62 miles of stream and 7 acres of lake habitat are now available to cutthroat trout due to the renovation work that has occurred in the drainage. This project, located within the westslope cutthroat trout restoration area, connected the lowest portion of stream (8 miles) with the upper portion of stream (52+ miles). An irrigation structure separated the two sections. Downstream, a waterfall separates the restoration area from non-native species in the Madison River. The applicant installed two rock-weir structures immediately downstream of the existing irrigation dam, creating two ascending step pools. The step pools allow westslope cutthroat trout to successfully pass over the barrier and allow unobstructed movement within the cutthroat trout restoration area. **COMPLETED, SEE PHOTOS BELOW.**

025-2015 CHERRY CREEK FISH PASSAGE

FFIP contributed $7,080 to the project; total cost was $15,884. *Photos by Turner Enterprises Inc. and FWP.*

Before

After

- **DEEP CREEK STREAMFLOW IMPROVEMENT (026-2015).** Deep Creek (Broadwater County) is a tributary to the Missouri River near Townsend that primarily supports brown trout and rainbow trout, and has been the focus of restoration projects for many years. Sediment inputs, high temperatures, and reduced streamflow are all factors that have affected the stream. This project eliminated an open ditch and installed a screened pump to deliver water to irrigators. The applicant predicts this will improve stream flow along two miles of Deep Creek, reduce water temperature, and eliminate fish entrainment into the former ditch. **COMPLETED.**

026-2015 DEEP CREEK STREAMFLOW IMPROVEMENT

FFIP contributed $8,950 to this project, and the total project cost was $137,950. *Photos by NRCS and FWP.*

During construction

After

- **DEVILS DIP SPRING CREEK CHANNEL RESTORATION (027-2015).** Devil's Dip Spring Creek (Powell County) is a tributary to Nevada Spring Creek near Helmville. The Nevada Creek drainage has been the focus of past restoration projects that have resulted in improved habitat, decreased water temperature, and westslope cutthroat trout population enhancement. However, Devil's Dip Spring Creek remained isolated from Nevada Spring Creek. In this project, the Devil's Dip Spring Creek stream channel was restored, the adjacent pond and wetlands areas were isolated, fish passage was improved, and the stream was reconnected to Nevada Spring Creek. The goals of this project were to restore the spring creek, reconnect it to Nevada Spring Creek, and provide uninhibited fish passage through the restored reach. **COMPLETED.**

- **FRENCH GULCH CHANNEL RESTORATION (028-2015).** French Gulch (Deerlodge County) is a tributary to French Creek, which flows into Deep Creek and the Big Hole River. Placer mining activities occurred in the French Gulch drainage from the mid 19th century to the early 1890's, resulting in stream habitat that has been degraded by stream channel straightening, the presence of large dredge spoils, increased stream gradient, reduced riparian area width, and isolation of the stream from its floodplain. The purpose of this project is to restore habitat impacted by placer mining. Restoration activities include reconstructing of the floodplain and stream channel, redirecting the streamflow, and plugging the old channel. The new channel would be vegetated with transplanted material or bioengineering techniques. The goal is to increase the number of westslope cutthroat trout and arctic grayling in French Gulch by addressing the habitat limitations and potentially opening habitat to fluvial fish from French Creek. This project is tied to two other supplemental grant applications. **ONGOING.**

- **LA MARCHE CREEK FISH PASSAGE IMPROVEMENT (029-2015).** La Marche Creek (Powell County) is a headwaters stream in the Upper Clark Fork River basin that supports approximately 1.5 miles of westslope cutthroat trout habitat. Low population size has been attributed to habitat degradation and impaired movement, as a perched culvert currently divides the reach in two. This project aims to replace the perched culvert with a timber, clear-span bridge and allow unobstructed westslope cutthroat trout movement throughout La Marche Creek. **ONGOING.**

- **MARTINA CREEK CHANNEL RESTORATION (030-2015).** Martina Creek (Missoula County) is a tributary to Ninemile Creek and supports populations of westslope cutthroat trout and brook trout. It has been heavily altered by mining and some logging, and the creek contains dredge ponds, cascading channels, and braiding. The current impairments include impeded upstream fish migration, dredge ponds that contribute to increased water temperature, and placer mine tailings leading to sedimentation and impacted floodplains. This project aims to address these issues by moving large piles of dredge mining tailings, filling mining cutslopes and dredge ponds, and reconstructing the stream channel to connect Martina Creek to Ninemile Creek. **ONGOING.**

- **MOOSE CREEK RIPARIAN FENCING (031-2015).** Moose Creek (Silver Bow County) is a tributary to the Big Hole River near Melrose that currently supports brook, rainbow, and brown trout but contains Yellowstone cutthroat trout upstream, above a barrier. The project involved the installation of 0.9 miles of wildlife-friendly, riparian fencing along Moose Creek, as part of a stewardship fence program. The applicant installed a wildlife-friendly fence, and the cost included bracing, gates, and water breaks. The goals of this project were to allow for natural bank stabilization, promote healthy channel geometry, reduce sediment inputs, and decrease water temperatures. **COMPLETED, SEE PHOTOS BELOW.**

031-2015 MOOSE CREEK RIPARIAN FENCING

FFIP contributed $3,000; the total project cost was $16,500. *Photos by Big Hole River Foundation and FWP*.

Before

After

- **POINDEXTER SLOUGH CHANNEL RESTORATION (033-2015).** Poindexter Slough (Beaverhead County) is 4.7-mile-long channel of the Beaverhead River, located near Dillon, fed by a combination of groundwater and water diverted from the river. The project area supports a very popular fishery for rainbow trout and brown trout. FWP surveys on this slough have documented a steady decline in trout numbers over the last 12 years. This decline was attributed to impaired riparian conditions and the loss of instream habitat, primarily as a result of stream flow management that has restricted high spring flushing flows. The slough was traditionally fed by groundwater returning from flood irrigation. As landowners converted from flood to sprinkler irrigation, groundwater inputs decreased and the slough was supplemented with more water from the Beaverhead River to meet water rights. The diverted water deposited sediment into the slough, which filled pools and inundated riffle habitat. To effectively mobilize and transport these fine sediment deposits, a larger head gate at the top of the slough was installed. Appropriately sized channel dimensions were achieved and backwatered reaches were eliminated in most of the project area. The lower 2.1 miles of the slough were narrowed, allowing maintenance of riffle and pool habitat with sediment-flushing flows. The project is located on FWP fishing access site property. This project is tied to two other supplemental grant applications. **COMPLETED, SEE PHOTOS BELOW.**

POINDEXTER SLOUGH RESTORATION (040-2010 & 011-2013 & 033-2015)

This project was three-phase project. Future Fisheries provided $163,626 to this project (total cost $1,059,362). Fishing opportunities on this public reach of stream are expected to increase. *Photos by Beaverhead Watershed Committee.*


Before


After

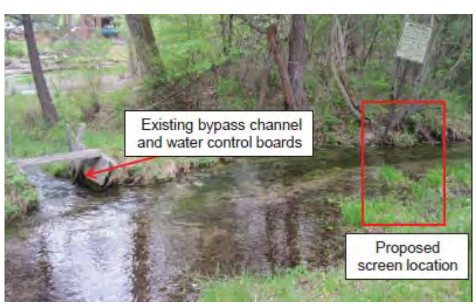

Before


After

- **RATTLESNAKE CREEK FISH SCREEN (034-2015).** Rattlesnake Creek (Missoula County) is a tributary to the Clark Fork River and contains bull trout, westslope cutthroat trout, rainbow trout, brook trout, brown trout, and mountain whitefish. Within Rattlesnake Creek, several irrigation diversions are active, and most of them are screened. This project addressed the Hughes-Fredline diversion, which was unscreened and entrained many salmonids. This project involved the installation of fish screen on the side channel upstream of the ditch to prevent fish entrainment. Additionally, the existing culvert was replaced and a formal headgate was installed, allowing water levels to be controlled. The bank was graded and revegetated. **COMPLETED, SEE PHOTOS BELOW.**

034-2015 RATTLESNAKE CREEK FISH SCREEN

FFIP contributed $11,865 to the project; total cost was $27,365. *Photos by Trout Unlimited and FWP.*



Before


After

- **REESE CREEK INSTREAM FLOW ENHANCEMENT (035-2015).** Reese Creek (Park County) is a tributary to the Yellowstone River near the northern boundary of Yellowstone National Park that supports both a resident population of Yellowstone cutthroat trout at its headwaters and a migratory spawning population that originates in the mainstem Yellowstone River. This project intends to install a pipeline between the existing diversion and intake pond, which would decrease the necessary diverted flow volume and salvage seepage losses, providing additional instream flow to Reese Creek. The goal of this project is to ensure minimum instream flows are available in Reese Creek year-round, which will increase survival of Yellowstone cutthroat trout fry and increase recruitment to the Yellowstone River. **ONGOING.**

- **SMITH SLOUGH SPAWNING ENHANCEMENT (036-2015).** Smith Slough (Madison County) is located approximately 3.5 miles southwest of Twin Bridges and supports rainbow and brown trout. This project involves a 2-mile-long slough channel of the Big Hole River and a 1-mile segment of the connected Smith Ditch. Smith Slough currently comes off the Big Hole River, where it is controlled by a headgate. Downstream of the headgate, the ditch/slough system is split in half, and water is divided between the slough and Smith Ditch. The ditch and slough run parallel for more than a mile before converging and discharging into the Big Hole River. The purpose of this project is to improve wild brown trout and rainbow trout spawning (as well as habitat for adult fish), water quality, and water quantity in the slough and Big Hole River, where there are few spawning tributaries. This project would relocate the headgate and ditch, redirect irrigation return flows away from the slough, narrow and deepen the channel, and realign portions of the ditch and slough. Subsequently, a water management plan would be developed, and fertilized eggs would be stocked to jump-start the fishery. **ONGOING.**

- **STONEWALL CREEK FISH SCREEN (038-2015).** Stonewall Creek (Lewis and Clark County) is a tributary to Keep Cool Creek located near Lincoln and contains westslope cutthroat trout. Near stream mile five, an unscreened irrigation diversion caused channel impairments and entrainment of cutthroat trout. This project upgraded the existing diversion with a fish screen and instream cross vane. These upgrades are expected to permit fish passage, bedload movement, and keep fish from entering the ditch. A flat-plate fish screen with a paddlewheel was installed. **COMPLETED, SEE PHOTOS BELOW.**

038-2015 STONEWALL CREEK FISH SCREEN

FFIP contributed $13,300 to this project and the total cost was $41,000. *Photos by Big Blackfoot Chapter of Trout Unlimited and FWP.*

Before

After (screen)

After (headgate)

- **TRAIL CREEK FISH SCREENING AND PASSAGE (039-2015).** Trail Creek (Missoula County) is a tributary to Morell Creek near Seeley Lake. Trail Creek supports westslope cutthroat trout, bull trout, and brook trout populations. This project screened the last of three unscreened diversions within the Trail/Morrell Creek watershed. This diversion entrained trout and acted as an obstruction to upstream fish passage. The pin-and-plank check dam and a denil ladder were removed and replaced with a rock cross vane and armored riffle that will allow fish passage, stream channel function, and bedload movement. A McKay-style, flat-plate fish screen with a paddlewheel was installed with flow measuring devices in each ditch and downstream of the diversion. **COMPLETED, SEE PHOTOS BELOW.**

039-2015 TRAIL CREEK FISH SCREEN

FFIP contributed $21,175, and the total project cost was $75,000. *Photos by FWP.*

Before (fish ladder)

After (fish ladder)

Before (diversion)

After (diversion)

- **UPPER LOLO CREEK SEDIMENT REDUCTION (040-2015).** The Upper Lolo Creek watershed (Missoula County) is significantly impacted by sediment generated by forest roads and failing culverts. This area is considered important habitat for bull trout, and the project is part of a long-term restoration effort to remove culverts that are fish barriers and reclaim excess forest roads that add sediment to the Upper Lolo Creek system. The project re-contoured 12-14 miles of forest roads and removed at least 8 culverts, reducing sediment and improving fish passage in the drainage. This was a supplemental application and was partially funded in the previous funding cycle. **COMPLETED.**

- **VAN HOUTEN LAKE FISH BARRIER AND SPAWNING CHANNEL (041-2015).** Van Houten Lake (Beaverhead County) is located on the Beaverhead Deerlodge National Forest near the town of Jackson in the Big Hole valley. The lake is 12.1 acres in size with a maximum depth of 9 feet. Two spring-fed inlet streams are located on the west and north sides of the lake. The outlet feeds into the Big Hole River approximately 0.5 miles downstream of the lake. Van Houten Lake supported a brook trout fishery, but white and longnose suckers were abundant and contributed to slow growth of fish. An introduction of burbot did not control the sucker population. This project intended to expand the range of Arctic grayling into Van Houten Lake, establish a lake brood source for westslope cutthroat trout, and improve the fishery. This project installed a fish barrier in the outlet stream to preclude fish passage and keep non-natives out of the lake. An outlet spawning channel was installed above the barrier near the current lake outlet. **COMPLETED, SEE PHOTOS BELOW.**

041-2015 VAN HOUTEN LAKE

FFIP contributed $10,000, and the total project cost was $30,000. *Photos by FWP.*

Before (barrier location)

After (barrier)

2016 PROJECT DESCRIPTIONS

- **BIG SPRING CREEK MACHLER RESTORATION (001-2016).** Big Spring Creek (Fergus County) supports a very popular rainbow trout and brown trout fishery. A reach of Big Spring Creek, located on property owned by Mark Machler immediately downstream of Lewistown, was channelized in the 1960's, resulting in a straight and entrenched channel with degraded habitat characteristics. In part, this channelization project created the impetus for the ultimate passage of the Montana Natural Streambed and Land Preservation Act (310 law). The project calls for returning meanders to the straightened channel and creating a functional floodplain for 3,200 feet of the stream, resulting in the addition of about 1,200 feet of new channel. The project is located on a new FWP fishing access site that has a permanent walk-in public easement. The FFIP previously committed $155,000 to this project in 2010 and 2011. The project is expected to enhance habitat in a very accessible reach of Big Spring Creek located at the edge of Lewistown. **ONGOING.**

- **BOSTWICK CREEK FISH BARRIER (002-2016).** Bostwick Creek (Gallatin County) is a tributary to Trout Creek and the East Gallatin River near Bozeman that currently supports populations of brook trout, hybrid (westslope x rainbow) trout, and pure westslope cutthroat trout (WCT). Two years ago, pure WCT were moved from Bostwick Creek to Placer Creek, also within the Gallatin watershed. Bostwick Creek likely still holds a number of pure WCT. The applicant proposes to build a concrete fish barrier to isolate WCT from non-native fish species. After barrier construction, the biologist would perform two non-native fish removals upstream of the barrier per year for 2-3 years using intensive electrofishing methods. The goal is to retain only pure WCT upstream of the barrier and preserve the native population. **ONGOING.**

- **CARPENTER CREEK FISH BARRIER (003-2016).** Carpenter Creek (Cascade County) is a tributary to Belt Creek near the town of Neihart that currently supports two non-hybridized populations of westslope cutthroat trout. These genetically distinct populations were isolated from Belt Creek over 60 years ago when mining activities produced a stream reach with poor enough water quality that fish did not survive. The cutthroat trout have persisted above the chemical barrier, and nonnative fish have been restricted to Belt Creek. Current and future efforts to clean up the mine will remove the chemical barrier and the cutthroat trout will not be protected from nonnative fish in Belt Creek. Monitoring efforts already have found rainbow trout in lower Carpenter Creek where they had not been observed from 2011 to 2013. The applicant proposes to build a concrete barrier to maintain isolation of the non-hybridized populations of westslope cutthroat trout. It would also expand habitat to the area once devoid of fish due to poor water quality. The applicant requests funds for structure construction. **ONGOING.**

- **FRENCH CREEK RIPARIAN FENCING (005-2016).** French Creek (Deer Lodge County) is a tributary to Deep Creek in the Big Hole watershed that currently supports populations of rainbow trout and eastern brook trout, but is part of a larger project to restore westslope cutthroat trout and arctic grayling. The applicant proposes to install riparian fencing around an area that has experienced highway improvements. The existing fence is in poor condition, no longer functions in some locations, and would be difficult to repair. The new fence would be above the riparian area, allowing for unimpeded wildlife movement through the riparian area, minimize livestock impacts, and allow for easier maintenance. The goal of the project is to keep livestock off the stream and riparian areas, particularly when native species are established. **ONGOING.**

- **FRENCH GULCH CHANNEL RESTORATION (006-2016).** French Gulch (Deer Lodge County) is a tributary to French Creek, which flows into Deep Creek and the Big Hole River. Placer mining activities occurred in the French Gulch drainage from the mid 19th century to the early 1890's, resulting in stream habitat that has been degraded by channel straightening, the presence of large dredge spoils, increased stream gradient, reduced riparian area width, and isolation of the stream from its floodplain. The purpose of this project is to restore habitat impacted by placer mining. Restoration activities include reconstruction of the floodplain and stream channel, redirecting the streamflow, and plugging the old channel. The new channel would be vegetated with transplanted material or bioengineering techniques. The goal is to increase the number of westslope cutthroat trout and arctic grayling in French Gulch by repressing the existing non-native fishery, addressing the habitat limitations, and potentially opening habitat to fluvial fish from French Creek. This project was awarded two grants in 2015. **ONGOING.**

- **HELLS CANYON INSTREAM FLOW (008-2016).** Hells Canyon Creek (Madison County) is a tributary to Ruby River near Twin Bridges that currently supports populations of rainbow trout, rainbow/cutthroat trout hybrids, brown trout, and non-game species. In 1995, three landowners converted open ditches into a single gravity pipeline system. FWP and Natural Resources Conservation Service (NRCS) provided cost share, and FWP has been leasing the water for 20 years. Because the lease is expiring, FWP negotiated a 3-year extension while a long-term lease is negotiated. In addition to the lease, a gravity pipeline was screened and has been preventing the loss of thousands of trout. This project would fund the lease extension, keep water in the stream, and maintain the fish screen. In the last 20 years, the stream was never dewatered, and juvenile trout abundance has remained healthy. The stream has also been used for spawning runs. **ONGOING.**

- **LITTLE BLACKFOOT & ONTARIO CREEK ROAD RELOCATION/ FLOODPLAIN RESTORATION (009-2016).** Ontario Creek (Powell County) is a tributary to the Little Blackfoot River south of Elliston. The Little Blackfoot River is a tributary to the Clark Fork River. Within the project area, near the confluence of Ontario Creek and the Little Blackfoot River, the primary target species include westslope cutthroat trout and bull trout. Other species present include brook trout, brown trout, and slimy sculpin. An inadequate ford and an approximately ¼-mile segment of road that includes three inadequate crossing structures have contributed fine sediment, impaired floodplain function, and affected connectivity and natural channel function. Fish habitat has been degraded through sedimentation and vehicles crossing the stream. This project would eliminate the ford on Forest Service Road (FSR) 4100, re-route FSR 4100 over a bridge, create a section of road that would connect FSR 123 (also known as Ontario Creek Road) to FSR 4100 outside of the Ontario Creek and Little Blackfoot River floodplains, and remove the old segment of FSR 123 that impacted the channels and floodplains. The stream channel and floodplain areas would be restored. The overall goal of the project is to reduce sediment delivery and restore floodplain function to this section of the Little Blackfoot River. **ONGOING.**

- **LONG CREEK CHANNEL RESTORATION (010-2016).** Long Creek (Beaverhead County) is a tributary to the Red Rock River, upstream of Lima Reservoir, which supports a small population of Arctic grayling. The stream functionality has been described as poor due to channel incision, high rates of bank erosion and fine sediment export, partial dewatering, absence of low-water habitat diversity, and absence of recruiting streamside woody vegetation. This project would install nine armored riffle-and-sod grade controls over approximately 3.7 miles of channel, eventually resulting in a pool/riffle morphology. Runoff and low-flow water elevations would be raised through the installation of hardened riffles, increasing floodplain connectivity. Abandoned side-channel areas would be re-activated, and fish and aquatic species will be able to migrate at baseflow conditions. Grazing in the riparian area would be managed. The overall goal is to re-establish a self-maintaining floodplain environment that would result in an improved and more resilient ecological condition for Arctic grayling. **ONGOING.**

- **NORTH FORK DRY COTTONWOOD CREEK CULVERT REPLACEMENT (011-2016).** North Fork Dry Cottonwood Creek (Deer Lodge County) is a tributary to Dry Cottonwood Creek and the Clark Fork River near Racetrack that currently supports westslope cutthroat trout (92-97% pure). The applicant proposes to replace an undersized culvert with a larger, arch culvert with a bankfull-width channel inside the structure. The project would reconnect 4 miles of fish habitat to the mainstem Dry Cottonwood Creek, and potentially to the upper Clark Fork River. The overall goal is to improve fish passage and habitat connectivity for westslope cutthroat trout in the upper Clark Fork River watershed. **ONGOING.**

- **SUCKER CREEK FISH PASSAGE (012-2016).** Sucker Creek (Lewis & Clark County) is a tributary to Keep Cool Creek in the Blackfoot River watershed north of Lincoln. The stream supports populations of pure-strain westslope cutthroat trout. The applicant replaced an undersized culvert that caused channel impairment and depression of migratory life histories with a pipe-arch culvert. The culvert replacement should result in a stable stream crossing, eliminate delivery of excess sediment, provide year-round fish passage, and restore natural channel morphology to the site. The overall goal was to reconnect migration corridors for native trout and correct stream channel impairments. **COMPLETED.**

- **TELEGRAPH CREEK LILLY ORPHAN BOY MINE RECLAMATION (013-2016).** Telegraph Creek (Powell County) is a tributary to the Little Blackfoot River south of Elliston that currently supports brook trout, brown trout, and westslope cutthroat trout. Lilly Orphan Boy mine is an abandoned hard rock mine that has contaminated Telegraph Creek. Initial sampling results showed that elevated levels of heavy metals exist in waste rock and sediments of Telegraph Creek and surface water quality standards are exceeded for arsenic, cadmium, copper, lead, and zinc. The applicant proposes to remove the mine waste and reconstruct the stream to restore natural dimension, pattern, and profile. The overall goal is to restore the ecological function of Telegraph Creek and improve sediment and water routing, diversity of habitat, water quality, and water temperatures. **ONGOING.**

- **VERMILLION RIVER MINERS GULCH (014-2016).** The Vermillion River (Sanders County) is a tributary to the Clark Fork River and is the primary spawning stronghold for bull trout, which is on the federally threatened list and a Montana species of concern. Westslope cutthroat trout are also present in the project area. Historically, land use activities impacted the stream and riparian areas of the Vermillion River and included placer mining, timber harvest, riparian vegetation removal, and road construction. Miners Gulch is a section of the Vermillion River that is a priority for restoration, as the habitat is pool-limited and lacks adequate large woody debris both instream and on the floodplain. The applicant proposes to stabilize 1,600 feet of bank, install instream wood and rock structures, and re-establish the floodplain. Reference reaches were used in development of the Miners Gulch restoration design plan. The overall goal is to increase pool frequency and habitat complexity in this stream reach, increase the carrying capacity of fish, redistribute spawning gravel, create additional spawning sites, and reduce sediment in redds. **ONGOING.**

- **WARM SPRINGS CREEK FISH PASSAGE (015-2016).** Warm Springs Creek (Deer Lodge County) is a tributary to the Clark Fork River, located within the Beaverhead Deerlodge National Forest, and contains bull trout and westslope cutthroat trout. An existing culvert is undersized, acts as a velocity barrier for fish, promotes bedload deposition upstream, and increases scour downstream. This project proposes to replace an undersized culvert with a precast concrete bridge. The goals are to replace the structure, thereby allowing unimpeded fish movement throughout much of the Warm Springs Creek headwaters, and increase access to 10 miles of stream habitat. **ONGOING.**

- **WEST FORK GALLATIN RIVER STREAM AND POND IMPROVEMENT (016-2016).** West Fork Gallatin River (Gallatin County) is a tributary to the Gallatin River near Big Sky that primarily supports populations of rainbow and brook trout. Within the West Fork Gallatin River floodplain are two instream ponds, Little Coyote and Silverbow, created during the development of the Big Sky golf course. Construction of the golf course also led to reduced sinuosity in the West Fork. Sediment has filled the ponds and affected the stream channel. The applicant proposes to restore the stream channel, create a floodplain, disconnect the ponds from the stream channel, and dredge the ponds to improve fish habitat. A trail system and docks will accompany the habitat improvements. The overall goal is to improve fish habitat in the West Fork Gallatin River and Little Coyote and Silver Bow ponds and increase access to the fisheries. **ONGOING.**

- **BIG HOLE RIVER FENCING PROJECT (018-2016).** The Big Hole River (Silver Bow County) supports populations of Arctic grayling, westslope cutthroat trout, rainbow trout, brown trout, and mountain whitefish. On a 1.1 mile (privately owned) section of the Big Hole River, two miles west of Dewey, the applicant proposes to construct a 4-strand, wildlife-friendly, riparian fence. Although water sources for livestock are available off-stream, they also propose two water breaks. The intent of the project is to manage grazing and promote bank stabilization, maintain healthy channel geometry, and provide cold water to a critical reach of the Big Hole River. **ONGOING.**

- **ELK SPRINGS CREEK HABITAT RESTORATION (020-2016).** Elk Springs Creek (Beaverhead County) is located in the Centennial Valley and flows into Upper Red Rock Lake. The stream was historically populated by Arctic grayling, and was one of Montana's most prolific Arctic grayling spawning populations. In the early 1900's, the stream was altered and habitat was fragmented and degraded, leading to the diversion of Elk Springs Creek into a shallow wetland mash. The stream was reconnected to Upper Red Rock Lake in 2016 as part of a separate, but related, project. The intent of the project is to improve grayling populations by improving connectivity, restoring stream function, and improving suitable spawning areas. The project would remove sediment deposited by McDonald Pond, import spawning gravels where needed, and restore natural channel dimensions and sinuosity to the stream. Because of this project, Elk Springs Creek could be an additional major spawning tributary for Arctic grayling. **ONGOING.**

- **MARIAS RIVER SANFORD PARK FISH HABITAT ENHANCEMENT (021-2016).** The Marias River (Liberty County) is located in north central Montana and is impounded by Tiber dam. Wild brown trout, stocked rainbow trout, and burbot are located within the project area, approximately one mile downstream of Tiber dam. This project would restore approximately 360 feet of eroding bank with a 3-tiered willow soil lift, re-grade an additional 40 feet of bank to improve stability, and add two engineered log jams to provide trout habitat through pool scour and cover. The goal is to provide trout habitat and prevent further erosion. The project is located at a public campground. A second goal of the project is to stabilize the bank so that high flow dam releases, which are necessary for pallid sturgeon recovery, are possible and do not lead to further bank erosion. **ONGOING.**

- **MONTURE AND DUNHAM CREEKS RIPARIAN FENCING (022-2016).** Monture Creek (Powell County) is a tributary to the middle Blackfoot River originating in the Bob Marshall Wilderness. Dunham Creek is a tributary to Monture Creek. Both streams are bull trout core areas, listed as critical bull trout habitat, and support spawning areas for fluvial westslope cutthroat trout and bull trout. Dunham Creek also supports pure populations of westslope cutthroat trout. This project occurs on private land on the lower reaches of Monture and Dunham Creeks, within the Two-Creek Ranch. A portion of the riparian area in the project area was included in a previous grazing management system (including the bull trout spawning reaches) but the existing fence is no longer functional. This project would replace old fence and install new fence to protect two miles of Dunham Creek and eight miles of Monture Creek. Three-strand electric fence would be used in areas of higher use, and single-strand electric would be used in lower pressure areas. The intent is to protect critical native fish habitat and ensure recruitment potential for wild populations. **ONGOING.**

- **MULHERIN CREEK FISH SCREEN (023-2016).** Mulherin Creek (Park County) is a tributary to the Yellowstone River and the third greatest producer of Yellowstone cutthroat fry to the Yellowstone River. Trapping data indicated that a substantial portion of outmigrating fry are entrained in the canal. Spawning adults have also been found in the canal or irrigated fields. A fish screen was installed in the 1990's at this location, but failed because a clogged infiltration gallery led to a water user cutting the pipe to ensure water delivery. This project proposes to install a more functional, low-maintenance fish screen (Farmer's fish screen) to stop entrainment of Yellowstone cutthroat trout while allowing for delivery of diverted water. This project was partially funded previously (011-2015). The applicant agreed to incorporate strong language into the agreement regarding the consequences of a vandalized fish screen. **ONGOING.**

- **NORTH FORK SPANISH CREEK FISH BARRIER (024-2016).** North Fork Spanish Creek (Gallatin County) located on property owned by Turner Enterprises, Inc. aims to restore westslope cutthroat trout (WCT) to previously 12 miles of historical stream habitat and 9 acres of high mountain lake habitat. The project would install a fish barrier on North Fork Spanish Creek, and use piscicides to remove non-native brook trout and hybridized WCT. The habitat will be re-colonized with fish from "nearest neighbor" WCT populations within the Madison or Gallatin drainage. This project would increase the miles of stream supporting WCT in the Gallatin River drainage by at least threefold and greatly reduce the risk of extinction of WCT in this area. **ONGOING.**

- **RATTLESNAKE CREEK WILLIAMS FISH SCREEN (025-2016).** Rattlesnake Creek (Missoula County) is a tributary to the Clark Fork River that is a primary spawning tributary for native bull trout and westslope cutthroat trout, as well as fluvial rainbow and brown trout. Rattlesnake Creek has several ditches, most of which were screened in 2002 with brencail-type screens. The brencail screen on the Williams ditch is undersized and does not function as intended; this project would replace the brencail-type with a coanda-type fish screen. A coanda-type fish screen was installed on a previously unscreened ditch of Rattlesnake Creek in 2015. The intent of the project is to prevent fish entrainment and increase spawning habitat for salmonids in the Rattlesnake Creek drainage. **ONGOING.**

- **SHANLEY CREEK FISH SCREEN AND WATER CONSERVATION (026-2016).** Shanley Creek (Missoula County) is a tributary to Cottonwood Creek in the Blackfoot River drainage. It is a bull trout core area stream and supports pure populations of westslope cutthroat trout. Several other projects have been completed in Shanley Creek, including road decommissioning and stream crossing upgrades on the University of Montana (UM) Bandy Experimental Ranch in 2015. This project would also take place on the UM Bandy Ranch and would replace a paddlewheel fish screen that is no longer functional. The fish screen would be replaced with a flat panel screen. The goal of the project is to eliminate fish entrainment and improve control of diverted stream flow. **ONGOING.**

- **SHIELDS RIVER WATERSHED YCT PASSAGE (027-2016).** This project takes place in the Upper Shields River watershed, specifically Buck Creek and Lodgepole Creek (Park County) above Crandall Creek. This area is rated as the highest priority for Yellowstone cutthroat trout (YCT) habitat because rainbow trout are not yet present, it is publicly owned land, habitat is in good condition, and the threat of brook trout can be eliminated. This project ties into other work in the area, including installation of a fish barrier to isolate YCT habitat (partially funded by FFIP in 2014). This project would construct two bottomless pipe arches, on Buck Creek and Lodgepole Creek, to restore full passage for aquatic organisms. The goal is to improve fish passage and, in combination with other projects, reconnect 28 stream miles above the Shields River fish barrier. This extensive habitat would be used for YCT conservation. **ONGOING.**

- **WASSON CREEK WATER RIGHTS LEASE RENEWAL (028-2016).** Wasson Creek (Powell County) is a tributary to Nevada Spring Creek in the Blackfoot River drainage. Historically, Wasson Creek was habitat for westslope cutthroat trout (WCT) and upper Wasson Creek hosts an isolated population of pure-strain westslope cutthroat trout. However, irrigation on lower Wasson Creek dewatered the creek and the WCT were largely isolated from the rest of the drainage. High temperatures and lack of flow represented barriers to migration in and out of Wasson Creek. The instream flow lease achieved in 2007 led to a substantial success—in both reduced water temperature and increased numbers of WCT. Monitoring has also shown an increase in migration and spawning activity. This project intends to renew the instream flow lease and continue the success in restoration for another ten years. **ONGOING.**

PROGRAM EXPENDITURES

Table 5 details all of the FFIP restoration projects that have expended funds during the report period (November 1, 2014 to October 31, 2016); a total of $1,407,657 was expended on 58 restoration projects. Of these projects, four addressed long-term maintenance, 27 were granted funding prior to 2015, and 27 were granted funding between 2015 and 2016. Additionally, $21,748.71 was expended on program operations during this time period. The operations expenditures were used for project monitoring assistance and to facilitate Review Panel meetings. The majority of operations expenditures are absorbed by the FWP budget, which allows maximum FFIP funding to be available for on-the-ground projects.

TABLE 5. PROGRAM EXPENDITURES FROM NOVEMBER 1, 2014 TO OCTOBER 31, 2016. EXPENDITURES ARE SEPARATED BY THE PROGRAM (NATIVE SPECIES ENHANCEMENT PROGRAM, RIT FUNDS = 02022 (IN BOLD); FUTURE FISHERIES IMPROVEMENT PROGRAM = 02149) AND SPENDING AUTHORITY SUBCLASS (EI001-EI170).

Program Expenditures (November 1, 2014 - October 31, 2016)

Projects			02022			02149				
Proj ID	**Project Name**	**Status**	**EI001**	**EI003**	**EI005**	**EI001**	**EI003**	**EI109**	**EI170**	**Grand Total**
048-2002	**Skalkaho Creek fish screens**	**Ongoing***	**$452.05**							**$452.05**
039-2006	**Skalkaho Creek Hedge siphon supplement**	**Ongoing***	**$9,900.00**							**$9,900.00**
040-2006	**Skalkaho Creek Republican siphon supplement**	**Ongoing***	**$9,900.00**							**$9,900.00**
001-2009	**Big Creek water lease extension**	**Ongoing***	**$31,000.00**							**$31,000.00**
012-2010	Mandeville Creek channel restoration	Completed						$23,908.00		$23,908.00
040-2010	Poindexter Slough channel restoration & flow	Completed							$25,000.00	$25,000.00
037-2011	Wegner/Missouri River riparian fencing	Completed						$24,204.00		$24,204.00
006-2012	Little Otter Creek corral relocation	Completed							$2,622.00	$2,622.00
007-2012	Racetrack Creek channel stabilization	Completed				$10,235.73		$4,500.00		$14,735.73
008-2012	Ruby River channel stabilization	Completed						$40,661.00		$40,661.00
013-2012	**Browns Gulch fish passage/channel stabilization****	**Ongoing**	**-$1,025.38**							**($1,025.38)**
020-2012	Smith River riparian fencing	Completed				$10,000.00				$10,000.00
021-2012	Swamp Creek siphon	Completed				$28,494.60		$793.40		$29,288.00
002-2013	**Dry Fork Belt Creek fish barrier**	**Completed**	**$3,876.85**							**$3,876.85**
003-2013	**Harvey Creek fencing and fish screen**	**Completed**	**$16,126.00**							**$16,126.00**
004-2013	**Kennedy Creek mine reclamation**	**Completed**	**$37,240.00**							**$37,240.00**
007-2013	**Lost Horse Creek siphon**	**Completed**	**$66,732.00**							**$66,732.00**
011-2013	Poindexter Slough channel restoration & flow	Completed				$63,643.00				$63,643.00
012-2013	**Sawpit Creek mine reclamation**	**Completed**	**$28,200.00**							**$28,200.00**
016-2013	**SF Sixteenmile fish barrier**	**Completed**	**$61,681.36**							**$61,681.36**
002-2014	**Cabin Creek fish barrier**	**Completed**	**$74,775.94**							**$74,775.94**
006-2014	Keep Cool Creek fish passage	Completed				$6,000.00				$6,000.00
009-2014	**Stony Creek fish passage and screen**	**Completed**	**$23,774.00**							**$23,774.00**
010-2014	**Browns Gulch channel restoration**	**Ongoing**	**$23,576.04**							**$23,576.04**
011-2014	**Bean Creek channel restoration**	**Completed**	**$14,945.00**							**$14,945.00**
012-2014	**Deadmans Basin diversion dam fishway**	**Completed**	**$82,400.00**							**$82,400.00**
013-2014	East Gallatin restoration at Story Mill	Completed						$51,953.00		$51,953.00
014-2014	Keep Cool Creek fish passage improvement	Completed							$8,500.00	$8,500.00
016-2014	**Liverpool Creek fish passage/entrainment/flow**	**Completed**	**$11,255.00**							**$11,255.00**
020-2014	Prickly Pear Spring Creek bank stabilization	Completed						$3,980.60	$2,342.40	$6,323.00

TABLE 5. CONTINUED

Projects			02022			02149				
Proj ID	Project Name	Status	EI001	EI003	EI005	EI001	EI003	EI109	EI170	Grand Total
021-2014	Sauerkraut Cr phase 2 channel restoration	Completed	$34,500.00							$34,500.00
002-2015	Bitterroot River riparian fencing	Completed				$4,990.40				$4,990.40
004-2015	Deep Creek riparian habitat and streamflow improvement	Ongoing				$10,000.00				$10,000.00
006-2015	French Gulch channel relocation	Ongoing	$5,600.00	$83,394.09						$88,994.09
010-2015	Moores Creek grazing and water quality enhancement	Completed				$10,478.00				$10,478.00
012-2015	Musselshell River Egge diversion removal	Ongoing	$92.00							$92.00
013-2015	Ruby Creek channel relocation	Completed				$2,475.00				$2,475.00
014-2015	Shanley Creek restoration	Completed	$13,300.00							$13,300.00
016-2015	Stonewall Creek restoration	Ongoing		$20,000.00						$20,000.00
018-2015	Theodore Creek fish passage improvement	Completed	$20,000.00							$20,000.00
019-2015	Upper Lolo Creek sediment reduction	Completed		$43,000.00						$43,000.00
020-2015	Upper Sleeping Child / Rye Creek sediment reduction	Completed				$18,430.00	$24,470.00			$42,900.00
021-2015	West Fork Jacobsen Spring Creek restoration	Completed	$5,159.61							$5,159.61
022-2015	Yukon Creek fish passage improvement	Completed	$23,400.00							$23,400.00
023-2015	Big Otter Creek fencing and stock tank	Completed					$7,028.55			$7,028.55
025-2015	Cherry Creek fish passage	Completed	$7,080.00							$7,080.00
026-2015	Deep Creek streamflow improvement	Completed				$8,950.00				$8,950.00
027-2015	Devil's Dip Spring Creek channel restoration	Completed	$8,500.00							$8,500.00
031-2015	Moose Creek riparian fencing	Completed					$3,000.00			$3,000.00
033-2015	Poindexter Slough channel restoration	Completed				$75,000.00				$75,000.00
034-2015	Rattlesnake Creek fish screen	Completed	$11,865.00							$11,865.00
038-2015	Stonewall Creek fish screen	Completed	$13,300.00							$13,300.00
039-2015	Trail Creek fish screen	Completed	$21,175.00							$21,175.00
040-2015	Upper Lolo Creek sediment reduction	Completed			$38,000.00					$38,000.00
041-2015	Van Houten Lake fish barrier and spawning channel	Completed	$9,899.75							$9,899.75
005-2016	French Creek riparian fencing	Ongoing		$128.00	$61.00					$189.00
012-2016	Sucker Creek fish passage	Completed			$16,500.00					$16,500.00
014-2016	Vermillion River Miners Gulch restoration	Ongoing			$44,485.00					$44,485.00
SUB-TOTALS			$668,680.22	$146,522.09	$99,046.00	$248,696.73	$34,498.55	$150,000.00	$38,464.40	$1,385,907.99
73643	OPERATION EXPENSES	N/A	$21,748.71							$21,748.71
GRAND TOTALS			$690,428.93	$146,522.09	$99,046.00	$248,696.73	$34,498.55	$150,000.00	$38,464.40	$1,407,656.70

Fund 02022	$935,997.02
Fund 02149	$471,659.68

* *ongoing maintenance*

** *negative balance due to the transfer of funds between Browns gulch projects*

RECENTLY COMPLETED PROJECTS (IMPLEMENTATION)

The FFIPO or FWP staff inspected 44 recently completed projects since the last biennial report. All of these projects were completed (and funds expended) in Regions 2, 3, 4, and 5. Implementation monitoring by the FFIPO facilitated discussions about technique successes and failures with applicants and landowners. Table 6 lists the recently completed projects. Photographs and a description of most projects are either described in the PROGRAM PROJECTS, FUNDED section starting on page 12 (denoted with an asterisk *) or if the projects were funded before the 2015/2016 biennium, they are found in the following section (denoted in bold, Table 6).

TABLE 6. COMPLETED PROJECTS, MONITORED FOR IMPLEMENTATION IN 2015 AND 2016. MANY PROJECTS ARE DETAILED IN THE PROJECTS FUNDED SECTION (*; ABOVE) AND OTHERS ARE DESCRIBED BELOW (BOLD).

FFIP#	ENDYEAR	PROJECT NAME
040-2010	2015	Poindexter Slough restoration* (along with 033-2015)
006-2012	**2015**	**Little Otter Creek corral relocation**
007-2012	**2015**	**Racetrack Creek riparian fencing and fish passage**
008-2012	**2015**	**Ruby River channel stabilization**
020-2012	2015	Smith River riparian fencing
021-2012	**2014**	**Swamp Creek siphon**
002-2013	2015	Dry Fork Belt Creek fish barrier* (along with 001-2015)
004-2013	2016	Kennedy Creek mine reclamation
007-2013	**2015**	**Lost Horse Creek siphon**
011-2013	2015	Poindexter Slough channel restoration (along with 033-2015)
012-2013	**2015**	**Sawpit Creek mine reclamation**
016-2013	**2015**	**South Fork Sixteenmile Creek fish barrier**
002-2014	**2015**	**Cabin Creek fish barrier**
004-2014	**2014**	**Gleason Creek culvert replacement**
006-2014	**2014**	**Keep Cool Creek culvert fish passage**
011-2014	2015	Bean Creek Channel Restoration
012-2014	**2015**	**Deadmans Basin Diversion Dam Fishway**
013-2014	**2015**	**East Gallatin Restoration at Story Mill**
014-2014	**2014**	**Keep Cool Creek Fish Passage Improvement**
016-2014	**2015**	**Liverpool Creek Fish Passage/Entrainment/Flow**
020-2014	**2015**	**Prickly Pear Spring Creek Bank Stabilization**
021-2014	2015	Sauerkraut Creek Phase 2 Channel Restoration
001-2015	2016	Barker-Hughesville fish barrier* (along with 002-2013)
002-2015	2015	Bitterroot River riparian fencing
004-2015	2015	Deep Creek riparian habitat and streamflow improvement*
010-2015	2015	Moore's Creek Grazing and Water Quality Enhancement*
013-2015	2015	Ruby Creek Channel Relocation*
014-2015	2015	Shanley Creek Restoration*
018-2015	2015	Theodore Creek Fish Passage Improvement*
019-2015	2016	Upper Lolo Creek Sediment Reduction (along with 040-2015)
020-2015	2016	Upper Sleeping Child / Rye Creek Sediment Reduction
021-2015	2015	West Fork Jacobsen Spring Creek Restoration*
022-2015	2015	Yukon Creek Fish Passage Improvement*
023-2015	2016	Big Otter Creek fencing and stock tank*

TABLE 6. CONTINUED.

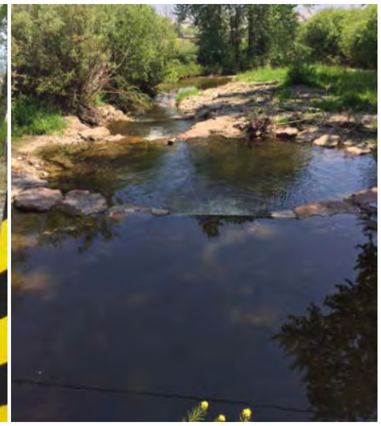
FFIP#	ENDYEAR	PROJECT NAME
025-2015	2016	Cherry Creek fish passage*
026-2015	2016	Deep Creek streamflow improvement*
027-2015	2016	Devil's Dip Spring Creek channel restoration
031-2015	2016	Moose Creek riparian fencing*
033-2015	2016	Poindexter Slough Channel Restoration* (along with 040-2010, 011-2013)
034-2015	2015	Rattlesnake Creek fish screen*
038-2015	2015	Stonewall Creek fish screen*
039-2015	2015	Trail Creek fish screen*
040-2015	2016	Upper Lolo Creek sediment reduction (along with 019-2015)
041-2015	2015	Van Houten Lake fish barrier and spawning channel*
012-2016	2016	Sucker Creek fish passage*

LITTLE OTTER CREEK CORRAL RELOCATION (006-2012)

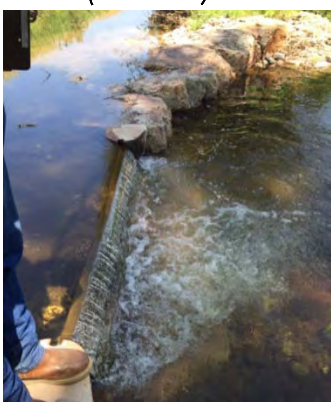
After (water tank) *(corral)*

This project moved a corral system from the stream corridor to an upland area and revegetated and fenced the disturbed area. The intent was to reduce sedimentation and improve water quality. The project area included 100 to 300 yards of riparian corridor. Future Fisheries contributed $6,622, including a 10% overrun (total cost $37,236). *Photos by FWP.*

RACETRACK CREEK RIPARIAN FENCING AND FISH PASSAGE (007-2012)



Before (diversion) *After*



After (diversion) *After (stock tank)*

This project replaced and relocated a riparian fence that had been damaged by past flooding. Additional riparian fence was installed, an offsite well and two winterized stock tanks were built, and an irrigation diversion was upgraded to provide fish passage. The intent was to create fish passage and to keep livestock off the stream and riparian corridor. Future Fisheries contributed $14,735.73 to the project, which came in under budget due to a change in the fish passage structure and a reduction in the scope of the riparian fencing (the furthest downstream landowner dropped out). The total cost was $25,320. *Photos by the Clark Fork Coalition and FWP.*

RUBY RIVER CHANNEL STABILIZATION (008-2012)

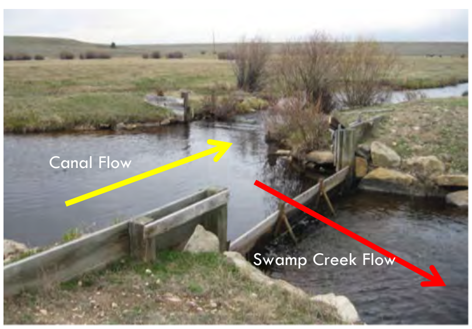
Before *During* *After*

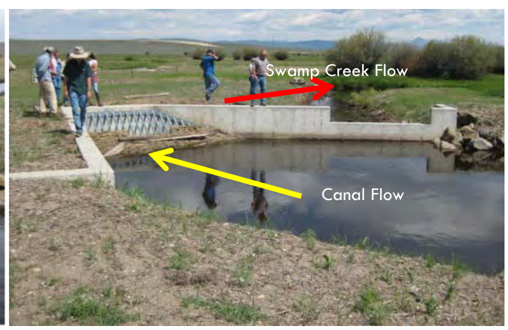
Before During After

Before During After

This project took a straightened channel and reconstructed it; sinuosity and stream length were increased, returning this portion of the Ruby River to its natural state. A feedlot was also moved away from the channel, 7,000 feet of riparian fencing were installed, and a bridge was constructed. FFIP contributed $40,661 to the project, which had a total cost of $698,411. *Photos by the Ruby Valley Conservation District.*

SWAMP CREEK SIPHON (021-2012)





Before After

This project installed a siphon at the crossing of an irrigation canal and Swamp Creek. The intent was to separate canal water from Swamp Creek, increasing stream flow and creating fish passage for an additional 12 miles of stream. A new diversion, watering device, and fish ladder were installed into Swamp Creek at another location. FFIP contributed $30,000 to the project and the total cost was $385,556. *Photos by the U.S. Fish and Wildlife Service and FWP.*

LOST HORSE CREEK SIPHON (007-2013)

Before (looking downstream) *Before (looking across stream)*

During (siphon pipe) *After (looking across stream)*

This project installed a siphon underneath Lost Horse Creek, to convey water diverted from the Bitterroot River down the Ward Canal. The siphon eliminates the need for constructing a seasonal in-channel dam on Lost Horse Creek, which removes a seasonal migration barrier, and reduces a source of fish entrainment. A minimum flow agreement was also made with the irrigation district. FFIP contributed $98,350 (including 10% overrun) and the total cost was $487,006, due to an increase in costs. *Photos by the Clark Fork Coalition and FWP.*

SAWPIT CREEK MINE RECLAMATION (012-2013)

Before *After*

In the Sawpit Creek vicinity, past mining activity led mining deposits in the riparian area (with no vegetation), a dredge pond, and a gully. The project involved excavation of approximately 10,000 cubic yards of mine tailings, re-grading, and creation of a functional floodplain. Approximately 1,000 feet of disturbed channel was reconstructed with rock and log step-pool structures for habitat and grade control. Stream banks were formed and vegetated with soil lifts, willow cuttings, and containerized woody shrubs. The intent was to restore stream and riparian function and to increase available habitat for westslope cutthroat trout. FFIP contributed $28,200 to the project, which had a total cost of $156,290. *Photos by Trout Unlimited and FWP.*

SOUTH FORK SIXTEENMILE CREEK FISH BARRIER (016-2013)

Before *During* *After*

This project installed a fish migration barrier, intending to protect a native westslope cutthroat trout habitat. A second phase of the project involves removing non-native fishes using a piscicides, and a third phase will restock the stream with genetically pure westslope cutthroat trout. FFIP contributed $61,681.36 to the project, coming in $18,070.64 under budget. The total cost was $174,991.36. *Photos by the U.S. Forest Service.*

CABIN CREEK FISH BARRIER (002-2014)

Before *After*

This project installed a permanent fish migration barrier to preserve genetic purity in a relatively large population of westslope cutthroat trout. A scarp, created from the 1959 Quake Lake earthquake, has slowly eroded and allowed a few rainbow trout to enter the drainage. This barrier will keep rainbow trout separated from westslope cutthroat trout. FFIP contributed $64,372.65, as the project was completed under budget. The total project cost was $334,372.65, approximately $100,000 less than estimated. *Photos by the U.S. Forest Service and FWP.*

GLEASON CREEK CULVERT REPLACEMENT (004-2014)


Before *After*

This project replaced an undersized culvert, which acted as a partial fish barrier, with a larger steel pipe that accommodates larger flows and allows year-round fish passage. Rock weirs were added downstream for grade control. FFIP contributed $10,000 to the project, which had a total cost of $48,650. *Photos by Big Blackfoot Chapter of Trout Unlimited and FWP.*

KEEP COOL CREEK CULVERT FISH PASSAGE (006-2014)



Before *After* *After*

This project replaced two undersized culverts that acted as partial fish passage barriers, with a hardened ford and a steel arch pipe. The intent was to improve stream and floodplain function and to provide fish passage. FFIP contributed $6,000 to this $16,052 project. *Photos by Big Blackfoot Chapter of Trout Unlimited and FWP.*

DEADMANS DIVERSION DAM FISHWAY (012-2014)


Before *After*

Deadmans diversion dam was deteriorating, and was not built to allow for fish passage. This project ensured fish passage was a component of the diversion repair. Rock was used to create step-pools and create fish passage, potentially connecting fish habitat 52 miles upstream and 39 miles downstream. FFIP contributed $82,400 to this $96,400 project. *Photos by FWP and Deadmans Basin Water Users Association.*

EAST GALLATIN RESTORATION AT STORY MILL (013-2014)



Before *After* *After*

This project restored a riparian-wetland complex within Bozeman, intending to improve water quality and provide additional fishing opportunities to the East Gallatin River. Man-made materials were removed, streambanks were revegetated, backwater areas were restored, and floodplain connectivity was improved. This project encompassed 0.5 miles of river. FFIP contributed $51,953 to the project, and the total cost was $172,294. *Photos by Respec.*

KEEP COOL CREEK FISH PASSAGE IMPROVEMENT (014-2014)


Before *After*

This project replaced an undersized stream crossing with a timber bridge. The intent was to improve natural channel condition, floodplain function, and fish passage. FFIP contributed $8,500 to the project, which had a total cost of $28,222. *Photos by Big Blackfoot Chapter of Trout Unlimited.*

LIVERPOOL CREEK FISH PASSAGE/ENTRAINMENT/FLOW (016-2014)




Before *After (coanda)* *After (coanda)* *After (bridge; no before)*

This project replaced an undersized stream crossing with a bridge, eliminated an upper diversion, and replaced the lower diversion with a coanda fish screen. A long-term instream flow lease will be pursued in the future. FFIP contributed $11,255 to the project, which had a total cost of $44,442. *Photos by Big Blackfoot Chapter of Trout Unlimited and FWP.*

PRICKLY PEAR CREEK BANK STABILIZATION (020-2014)



Before (spring creek channel) *After (spring creek channel)* *After (bridge)*

This project improved pool and riffle habitat in selected meander bends of the spring creek that feeds into Prickly Pear Creek, replaced an undersized culvert with a bridge, and reconnected the spring creek with the original confluence with Prickly Pear Creek. Realignment, revetments, and debris cleanup were components of the adjacent project on Prickly Pear Creek. FFIP contributed $6,323 to the project and the total cost was $77,886.55 (including the Prickly Pear Creek component). *Photos by FWP.*

LONG-TERM MONITORING PLANS

In the next biennium, 2017-2018, there will be a continued emphasis on monitoring. Inspecting between 50 and 100 sites per year is a priority, which will bring the program close to having current monitoring records for all active projects. Currently, more than half of all the completed projects have recent monitoring information.

ANTICIPATED EXPENSES FOR ENSUING 10 YEARS

Since inception of the FFIP (enacted in 1995), the Commission has committed an average of approximately $710,682 per year to habitat enhancement projects (combined FFIP and NSEP funding sources). Combined Program expenditures for the last three report periods have totaled between approximately $916,406 and $1.40 million while appropriations have totaled between $790,000 and $1.27 million (Table 7).

TABLE 7. APPROPRIATIONS AND EXPENDITURES FROM THE PREVIOUS THREE BIENNIA.

	November 1, 2010 – October 31, 2012	November 1, 2012 – October 31, 2014	November 1, 2014 – October 31, 2016
Expenditures	$1.72 million	$916,406	$1.40 million
Appropriations	$1.24 million	$790,000	$1.27 million

The amount appropriated has been less than the amount expended for at least the last three biennia, made possible only as a result of unexpended carry-over from past appropriations (prior to 2007). Expenditure reporting typically reflects funds allocated in the previous biennia, as projects are usually completed between 1 and 3 years after the grant is awarded.

Assuming appropriations to the two funding sources (FFIP and NSEP) remain at similar levels as in the past three biennia ($0.79 to $1.27 million per biennia), we would anticipate expending the total amount appropriated, resulting in an overall expenditure of between $3.95 and $6.35 million in the next 10 years. These anticipated future expenses, however, are directly tied to future appropriations, which are unknown. The estimated range of expenditures is lower than the last decade, potentially resulting in fewer completed projects. The program receives more funding requests than the appropriations can accommodate, and funding proposals are prioritized to best utilize limited dollars.

LONG-TERM PHOTO MONITORING (2015-2016)

With 570 completed projects and over 50 ongoing, a significant and worthwhile investment has been made in the lake and stream habitat of Montana. Since implementation of the FFIP 1996, the Commission has approved $14,738,701 for restoration projects which generated approximately $47,087,533 in available matching funds. Overall, nearly $62,410,000 of habitat restoration work has been undertaken in Montana since 1996 as a result of the FFIP. Such a large investment requires monitoring, not only to ensure that projects are being maintained, but also to determine if projects are effective and represent the type of projects that should be funded in the future. Long-term monitoring is also called effectiveness monitoring, and determines if the project continues to meet objectives. It includes questions of compliance with the project agreement.

To meet long-term monitoring goals, photo-point procedures and comprehensive monitoring forms were developed. The use of photo points to monitor projects is an invaluable method to document compliance and investigate changes over time in areas such as riparian conditions and maintenance of channel function, for example. Visual references, combined with written notes of long-term project effectiveness, land management changes, and compliance are necessary to provide critical, unbiased project records. This information, combined with landowner considerations, can be used to gain additional understanding of what makes a successful habitat project. Determination of project components or methods that worked well can help improve future project quality and success rate.

Long-term photo-monitoring goals call for re-visiting sites every five to ten years to take follow-up photographs and record land-use data. The duration between monitoring visits depends on whether the project is highly sensitive to land management changes (e.g. involves riparian grazing) or does not typically show physical changes in the short-term (e.g. fish barrier). As new projects are completed, they are added to the monitoring rotation. Projects that have reached the end of their contractual life are removed from long-term monitoring. However, many completed projects are continued by the landowners or projects sponsors after the contract has expired.

To be most efficient, most monitoring is done in clusters. Consultants or FWP staff visited many projects in a specific watershed to make best use of their time. Therefore, individual efforts can look specific, but overall monitoring is balanced. The goal of long-term monitoring is to track all projects statewide. TerraGraphics Environmental Engineering, Inc. (TEEI) was hired in 2015 as a consultant to monitor several projects in western Montana. Projects were also monitored by the FFIPO, time permitting, and the projects were typically chosen to coincide with travel for other work-related activities. In 2016, an intern (Shannon Bockman) was hired by Carol Endicott, Yellowstone Cutthroat Trout Biologist, to monitor projects in eastern Montana. Shannon and Carol monitored 21 projects in the Yellowstone river drainage.

In the sections below, monitoring results are summarized by individual monitoring contracts or efforts. They have been separated by effort for clarity in reporting; together, they represent comprehensive, statewide monitoring efforts.

TERRAGRAPHICS ENVIRONMENTAL ENGINEERING, INC.

In 2015, TerraGraphics Environmental Engineering, Inc. (TEEI) accepted a contract to perform long-term monitoring in western Montana (Table 8). Monitoring sites were chosen based on need and proximity; projects that were over 5 years old were considered priority, and the distance between projects was also considered for efficiency. Twelve sites were successfully monitored.

TABLE 8. PROJECTS MONITORED BY TERRAGRAPHICS ENVIRONMENTAL ENGINEERING INC. IN 2015 FOR THE FUTURE FISHERIES IMPROVEMENT PROGRAM (FFIP).

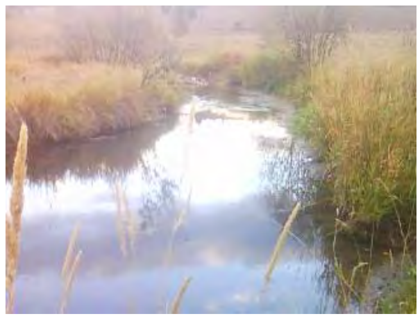
FFIP #	Region	Project
013-1996	1	Little Beaver Creek riparian fence
004-1997	2	Middle Fork Rock Creek riparian enclosure
050-1999	2	Ninemile Creek restoration and fencing
027-1999	2	Lower Willow Creek
013-2000	1	East Fork Bull River
005-2001	2	Dunkelberg Creek restoration
031-2001	2	Antelope Creek
028-2002	2	Ninemile Creek riparian fencing
012-2002	2	Harvey Creek
028-2003	1	Thompson River
018-2008	1	Thompson River riparian enhancement
015-2009	1	Marten Creek bank stabilization

LITTLE BEAVER CREEK RIPARIAN FENCE (013-1996)

2009

2009

2015



2015

2015

This project involved fencing the riparian area along one mile of stream. In 2009, fencing was listed as broken but project was still effective. In 2015, TEEI noted an exclosure and functional fence but also reported grazing. It is unclear what grazing has occurred and how (no notes). There were observed areas where wildlife was breaking/jumping fencing and accessing the creek. Ultimately, stream benefits were from removing beaver dams more so than fencing. Completed in 1996.

MIDDLE FORK ROCK CREEK RIPARIAN ENCLOSURE (004-1997)

2002

2015

This project involved riparian fencing to exclude livestock from streamside areas and off-stream water development to provide alterative watering. Three miles of stream were treated. The site was visited by TEEI in 2015. Fencing was no longer functional and grazing was occurring that has resulted in moderate browsing. Cattle guards had been removed. According to past monitoring information, the exclosure ended around 2003/2004. Long term compliance is questionable and requires follow up with the U.S. Forest Service. Completed in 1997.

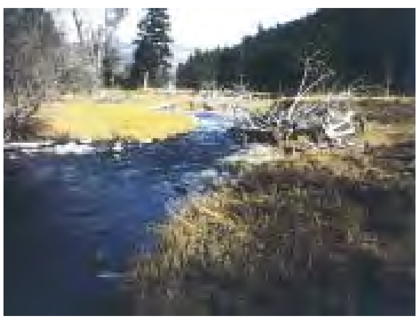
NINEMILE CREEK RESTORATION AND FENCING (050-1999)




2002 *2002* *2015* *2015*

This project involved riparian livestock to exclude livestock from 1.75 miles of stream and treated eroding banks using natural materials. The landowner reported that Missoula county floodplain administrator has prevented her from addressing bank stabilization issues since time of original work and reported that the plantings have washed away. The fencing was not evaluated and needs follow-up. The project was beneficial to the landowner and improved stream/riparian conditions. It is unclear if fencing/eroded structures are causing problems. Failure of wood structures was obvious. Completed in 1999.

LOWER WILLOW CREEK (027-1999)



1999 (pre-project) *2015* *2015*

This project involved installation of 4.6 miles of fencing, development of a grazing management plan to protect the stream, and willow planting. In 2015, riparian growth was abundant and there were no signs of grazing. Riparian fencing was in great condition and despite wildlife browsing the riparian area appeared to be in good condition. TEEI listed the stream as aggrading/narrow and deep with no other information; photos do not illustrate this condition. Overall, the project was considered successful with beneficial impacts to stream function, fishery, and landowner. Completed in 1999.

EAST FORK BULL RIVER (013-2000)


2015 *2015*

The project restored approximately 1,200 feet of stream by returning a braided channel to a single thread channel capable of transporting sediment and conveying bankfull flows. Treatments included rootwad and log revetments, large woody debris weirs, and riparian revegetation. In 2015, TEEI indicated that stable, functional structures remained in place. The landowner reported that the project was beneficial with the only concern being invasion of canarygrass. No before photos available. Completed in 2000.

DUNKELBERG CREEK RESTORATION (005-2001)


2001 (after)


2001 (after)


2015


2015

Dunkelberg Creek had a healthy riparian area but poor instream habitat. The project added woody debris to the stream channel to improve habitat complexity. Approximately 1,500 feet of channel was treated. In 2015, there were no signs of cattle grazing or livestock use. Project reach is primarily within a recreational/residential property. Woody material was highly weathered, yet mostly intact and partially buried in sections of the stream channel. Completed in 2001.

ANTELOPE CREEK (031-2001)


2001 (pre-project)


2001 (pre-project)


2015


2015

Antelope and Woods Creeks had been impacted by grazing. This project installed 4.8 miles of riparian fencing, water gaps, and livestock crossings. The site was also revegetated. In 2015, the streambank at the site was considered stable or degrading and the channel had very low or no water flowing. Weeds were abundant, and the riparian fencing was in good condition. Light grazing is allowed but TEEI monitoring reported no or unknown increase in riparian condition since last visit; the level of project improvement is unclear. The landowner reported a beneficial project with improved stream and riparian conditions. Completed in 2001.

NINEMILE CREEK RIPARIAN FENCING (028-2002)



2003 *2004* *2015*

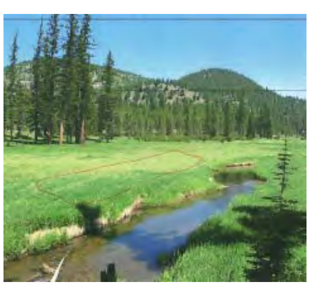
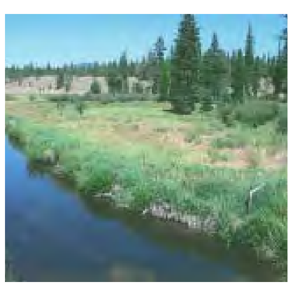
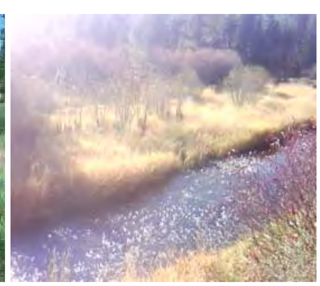
This project addressed portions of the stream degraded due to grazing. It involved installation of 1,150 feet of riparian fencing and management as a grazing exclosure. In 2015, exclusion fence appeared to be in good working order. The landowner had installed additional fencing to prevent further grazing along the creek through the property and reported an improvement in riparian condition and an overall benefit as a result of the project. Completed in 2002.

HARVEY CREEK (012-2002)


2009 *2016*

This project reconstructed the stream channel, revegetated riparian areas, installed riparian fencing on both sides of the stream, and installed a fish screen on the diversion. In 2015, TEEI observed a stable streambed with abundant gravel and no improvement in riparian condition since 2009. Beaver were observed in the area. The landowner reported no improvement in stream/riparian conditions and no overall impact. Previous monitoring noted a dam on lower end of project site that could be affecting the population. Completed in 2002.

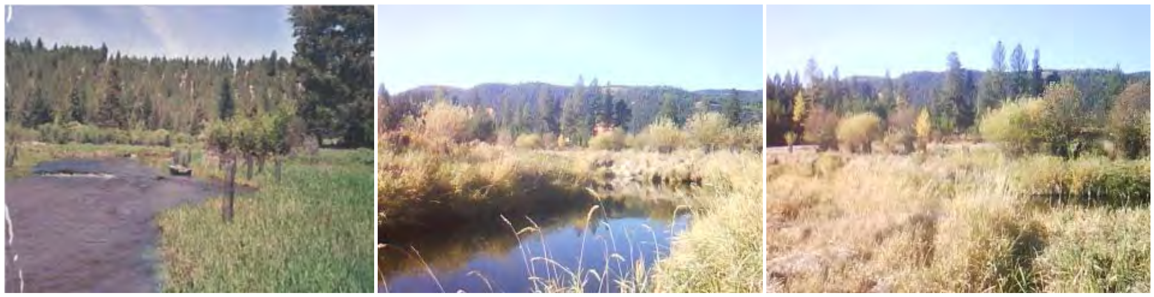
THOMPSON RIVER (028-2003)


2003 (pre-project) *2003 (pre-project)* *2015* *2015*

This project was completed to increase riparian vegetation that had been cleared for agriculture and riparian logging. Willow, dogwood, snowberry, and Engelmann spruce was planted in the riparian area and reed canary grass was controlled on 2.6 miles of stream. In 2015, the consultant observed reed canarygrass. Planted willows were thriving and outgrowing protective enclosures. Additional willow was growing. The landowner reported improvement in riparian condition, no known change in fishery, and would like to see additional browse protection. Black matting had been pulled, and reed canarygrass control was ineffective. Completed in 2003.

THOMPSON RIVER RIPARIAN ENHANCEMENT (018-2008)



2009 *2015* *2015*

In response to an invasion of reed canarygrass that negatively impacted the riparian areas and suppressed native vegetation, this project built upon a previous project that was successful in establishing native shrubs through the use of browse protectors. This project installed 500 browse protectors around shrubs to protect them. In 2015, the willows were thriving and the landowner reported riparian improvement. Of the three projects on the property, this was the most successful. Canarygrass was still present, but the relative amount was not recorded. Completed in 2008.

MARTEN CREEK BANK STABILIZATION (015-2009)

2009 (after construction) 2009 (after construction) 2015 *2015*

Before this project, high spring runoff resulted in channel degradation through accelerated bank erosion, downstream channel braiding, and loss of fish habitat complexity. The project restored 1,500 feet of stream channel by reconstructing the floodplain and installing grade control/energy reducing structures. In 2015, the consultant noted that riparian enclosures around willows were removed. The overall project appeared successful in stabilizing stream banks and reducing erosion/sedimentation. The structures were in place and the project appeared successful. Completed in 2009.

FUTURE FISHERIES IMPROVEMENT PROGRAM OFFICER MONITORING

In 2015 and 2016, 44 projects were monitored by the FFIPO (Table 9). Of these projects, all were compliant but had varying degrees of success. Many of these projects involved riparian fencing and were identified as a monitoring priority because of land-use activities. Other project components included installing restoring stream channels, enhancing fish passage, improving instream flow, and barriers. The sites that were monitored were chosen based on need and were often combined with the FFIPO's existing work-related travel plans.

TABLE 9. PROJECTS MONITORED BY THE FUTURE FISHERIES IMPROVEMENT OFFICER (FFIPO) BETWEEN NOVEMBER 1, 2014 AND OCTOBER 31, 2016.

FFIP #	Region	Project
010-1997	2	O'Brien Creek
003-1998	3	Beaverhead River fencing
010-1998	3	Deep Creek
056-1998	3	Staubach Creek fish barrier
033-1999	4	Big Coulee
051-1999	2	O'Brien Creek
057-1999	1	Spring Creek
009-2001	2	Mill Creek culvert replacement
013-2001	2	Rattlesnake Creek
037-2001	3	Boulder River fish ladder
002-2002	4	Beaver Creek diversion repair
003-2002	2	Beaver Creek
014-2002	3	Jefferson River fish entrainment
016-2002	3	Mathew Bird Creek
022-2002	2	Rattlesnake Creek fish screen
030-2002	3	Creeklyn Ditch and Jefferson Canal
040-2002	2	German Gulch
013-2003	2	Marshall Creek
017-2003	2	Mill Creek
029-2003	2	Upper Willow Creek
036-2003	2	Clark Fork River
037-2003	3	Deep Creek
043-2003	2	Marshall Creek
020-2004	2	Mill Creek
024-2004	2	Pattee Creek
026-2004	3	Steel Creek
031-2004	2	Uncle George Creek
034-2004	3	Willow Springs Creek
041-2004	2	Dry Creek
047-2004	2	Tyler Creek
013-2005	3	Parson's Slough channel restoration
004-2007	3	Blacktail Deer Creek flood mitigation
042-2007	3	Whites Gulch fish barrier replacement
015-2008	2	Morrell Creek fish passage and fish screens
020-2008	6	Beaver Creek culvert to bridge conversion
022-2008	3	Fish Creek (Hanson) channel restoration
029-2008	3	Whites Gulch fish barrier supplement
012-2009	3	Leverich Creek native fish protection (barrier)
020-2009	2	Skalkaho Creek bank stabilization
004-2010	2	Dry Cottonwood Creek riparian fencing
023-2010	2	Skalkaho creek channel stabilization
031-2010	6	Cow Creek Reservoir Rehab and instream flow protection
038-2010	2	Nevada Creek channel restoration
011-2011	3	McVey Creek fish barrier

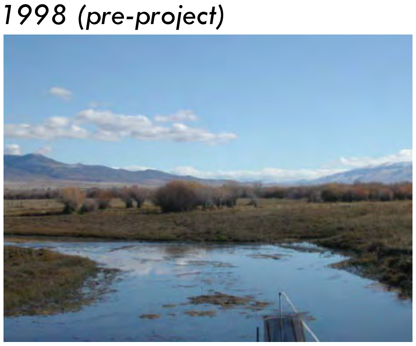
OBRIEN CREEK (010-1997 & 051-1999)


2000 (after construction) *2015*

This project restored pools and riparian areas in O'Brien Creek, near Missoula. Habitat structures remain in place and functional and the riparian area has grown in since project. Some erosion is present, but the overall project is functional. Completed in 2000.

BEAVERHEAD RIVER FENCING (003-1998)


1998 (pre-project) *2015*



1998 (pre-project) *2015*

This project fenced three miles of the Beaverhead River on both sides and installed water gaps to protect the riparian area from cattle. Limited grazing was allowed, as long as it was consistent with riparian protection. Past monitoring identified a poor riparian condition. In 2016, the landowner reported short duration fall grazing, which helps with weeds. Conditions appear to be improved compared to pre-project conditions, but sections of eroding bank persist. Fencing was in place and most riparian areas were moderately vegetated. Sheep have been allowed to graze the entire property and probably affected the success of the project. Completed in 1998.

DEEP CREEK (010-1998 & 037-2003)


2001 *2015*

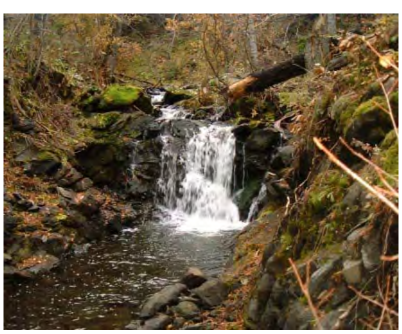
This project used bioengineering techniques, revegetation, and riparian fencing to stabilize banks, and insert a gravel plug to reestablish a stream meander (completed in 1998). Additional riparian fencing and off-channel water were added in 2006. Project now appears natural and fully functional.

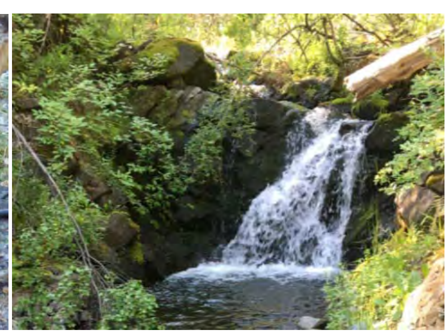
STAUBACH CREEK FISH BARRIER (056-1998)


2011 *2016*

This project installed fish barriers in the form of perched culverts at county road crossings. In 2016, the barrier continued to keep brook trout below the barrier and westslope cutthroat trout isolated above the barrier. Completed in 2000.

BIG COULEE (033-1999)





2000 (pre-project) *2002 (after construction)* *2015*

This project created a migration barrier to protect the genetic integrity of westslope cutthroat trout and prevent invasion by non-native brook trout. The waterfall barrier was enhanced in 2004. In 2015, brook trout were discovered above the barrier. In the next few years, planned activities include genetic evaluation to determine genetic purity and extensive suppression to remove brook trout above the barrier. The structure will also be modified to reduce the head of the pool at the base of the barrier. Completed in 2002.

SPRING CREEK (057-1999)


2015 *2015*

This project restored an untreated reach of stream that was degraded by land use activities. The channel was narrowed, deepened, and returned to a single channel. In 2015, the channel appeared overwide and shallow with very little deeply rooted vegetation. Some erosion/slumping is occurring. The fish biologist believes project is performing decently well; there are no pre-project or other monitoring photos. Completed in 2000.

MILL CREEK CULVERT REPLACEMENT (009-2001 & 020-2004)


2004 *2015*

This project replaced an undersized culvert with two embedded arch culverts. It was scaled back, not installed well, and has experienced stream function problems. However, it continues to provide fish passage. Completed in 2004.

RATTLESNAKE CREEK (013-2001)



2001 (during construction) *2009* *2015*

This project reconnected a side channel on Rattlesnake Creek and reconstructed the main channel, improving spawning habitat, fish habitat, and riparian condition. The project is in good condition. Banks and stream are stable and well vegetated. Rock vanes have been retained and show limited movement. Completed in 2002.

BOULDER RIVER FISH LADDER (037-2001)


2002 (during installation) *2015*

This project installed a denil fish ladder to provide fish passage around a diversion dam on the Boulder River. The ladder has been effective at providing fish passage, but is difficult to maintain. In 2015, the biologist agreed to fix the structure, which was damaged with recent flooding. Completed in 2003.

BEAVER CREEK DIVERSION REPAIR (002-2002)


2004 *2015*

This project reconnected the bottom end of an irrigation diversion with Beaver Creek, allowing return flows to re-water the stream and prevent fish loss. The diversion remains connected to the creek and the project is in good condition. Completed in 2003.

BEAVER CREEK (003-2002)

2003 (after construction) *2016*

2003 (after construction) *2016*

This project intended to restore an area that had been overgrazed. It was significantly reduced in scope and ultimately involved a headgate installation due to difficulties with landowner cooperation. Water was to be managed so that the user maintains their water right and the creek gets the remainder. The goal was to connect Beaver Creek with Upper Willow Creek. In 2016, the headgate appeared to be in excellent condition. Year round fish passage is unlikely, as the headgate was only cracked open. The majority of the streamflow was going down the ditch, which passes through two shallow ponds and Bear Creek before connecting with Upper Willow Creek. Completed in 2003.

JEFFERSON RIVER FISH ENTRAINMENT (014-2002)


Pre-project *2015*

This project installed a velocity barrier that would exclude fish from the Kurnow overflow and prevent fish from being lost down Parrot Ditch (when running). In 2015, the project was intact and assumed to be functional. It had not been monitored for fishery impacts. Completed in 2004.

MATTHEW BIRD CREEK (016-2002)


Pre-project *2016*

This project addressed vertically eroding banks, and restored approximately 300 feet of stream using back sloping, erosion control fabric, and revegetation. In 2016, vegetation was abundant and the stream was stable. The project looks natural and is considered a success. Completed in 2003.

RATTLESNAKE CREEK FISH SCREEN (022-2002)


Pre-project *2015*

This project constructed screens on two of the four unscreened diversions on Rattlesnake Creek and made improvements to an existing screened diversion (above). The screens were not functional 5/2015 (during runoff), but get cleaner post-runoff. The screens currently function as barriers and need to be updated in the future. Completed in 2002. One screen update was funded in 2016.

CREEKLYN DITCH AND JEFFERSON CANAL (030-2002)

2015

This project involved the sealing of two major diversion canals with polyacrylamide. Preliminary results indicated that water savings were realized. However, in 2015 the biologist noted that the sealant had a two year lifespan and would have worked better with sand substrate (gravel was present in the project area and sealant could not fill the interstitial spaces). No historical photos were available. Completed in 2002.

GERMAN GULCH (040-2002)

2009 *2016 (meander abandoned)* *2016*

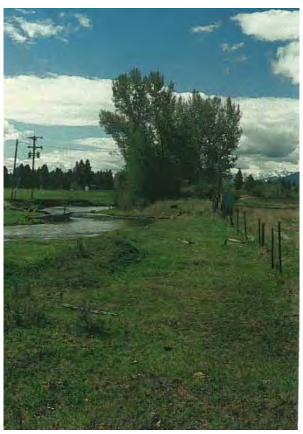
This project intended to improve a stream impacted by logging, grazing, and historic placer mining. The stream was improved by adding woody debris and boulders, excavating pools, widening the floodplain, and adding vegetation to the riparian areas. It was reduced in scale and used as a demonstration project. Past monitoring indicated a relatively healthy riparian area with minimal riparian shrub establishment, stream channel widening, and loss of small woody debris. In 2016, the riparian area was inundated with weeds. Some of the wood was at the margins of the stream or abandoned and vegetation establishment was considered fair. The channel has adjusted to a less sinuous configuration. The actual demonstration value is unknown. Completed in 2007.

MARSHALL CREEK (013-2003)


2005 *2015*

This project upgraded a culvert, which was a barrier to fish passage. A pool-and-weir fish ladder was installed and baffles were added to the inside of the culvert to provide fish passage. It is functioning as intended. Completed in 2005.

MILL CREEK (017-2003)




Pre-project *2004 (after construction)*


2014 *2016*

This project reconstructed and restored approximately 7,500 feet of channel with channel shaping, riparian revegetation, and riparian fencing. Since project construction, erosion has been reduced and the riparian area was improved. The channel is stable and the wood has remained in place. The limiting factor is water quantity and streamflow, particularly in the fall. Because of this, the impact to the fishery is probably negligible. Completed in 2004.

UPPER WILLOW CREEK (029-2003)

Pre-project

2005

2016

This project restored about 6,500 feet of stream that had been degraded by agricultural practices. The channel was reconstructed, habitat features were installed, stream crossings and irrigation structures were rebuilt, and the riparian area was revegetated. Past monitoring indicated that riparian condition was fair but improved. Grazing compliance was high. In 2016, the condition of the project was improved relative to pre-project conditions, but the riparian area was dominated by reed canarygrass and willow establishment was minimally successful (project applicant noted installation of willow was not ideal). The channel has adjusted and has some erosion and incision. Completed in 2005.

CLARK FORK RIVER (036-2003)

2013

2015

This project installed riparian fencing on the river and property boundary. Monitoring completed in 2013 indicated a violation, as horse grazing was seen on the riverbank. A follow-up site visit in 2015 found that the fences were mended and the issue was resolved. The riparian area was in good condition. No historical photos were available. Completed in 2004.

MARSHALL CREEK (043-2003)

Pre-project *2015*

This project constructed approximately 2,500 feet of streamside fencing to improve riparian management and facilitate woody vegetation recovery. In 2015, the fencing was in good condition and the local biologist reported that the project was a success. The exclosure could have been bigger but the landowner wanted to maximize pasture area. The area is a stronghold for westslope cutthroat trout. Completed in 2003.

PATTEE CREEK (024-2004)

2005 *2015* *2015*

This project, within the town of Missoula, involved channel reconstruction in Elms and Lester Parks. The stream was originally channelized, and is now meandering and vegetated. However, the stream above and below the project remains channelized. The project appears to be in good condition, but presents a good opportunity to consider the role of FFIP in these types of projects—including the utility as fish habitat or demonstration project. Completed in 2005.

STEEL CREEK (026-2004)

2004 (after construction) *2015*

This project installed riparian fence, willow transplants, and seedlings. The project was considered successful because modifications were made to the fence. The original application fenced the riparian corridor and excluded cattle for 5 years. The pasture wasn't working for the landowner and the fence was moved, with FFIP approval. A project partner indicated that jackleg fence is needed in wet, marshy areas. A lesson learned was to make sure the initial pasture configuration will work long-term. Stream and riparian condition appears to be in decent condition, but willow expansion could be greater. Completed in 2004.

UNCLE GEORGE CREEK (031-2004)


2015


2015

This project installed riparian fencing along ¼ mile of stream and developed off-site water on Uncle George Creek, a site that had been degraded by livestock. In 2016, the site was functioning well. Riparian fence was intact and the off-stream water was operational. The project location is the headwaters of Uncle George Creek and the fishery impact is unknown. Downstream of the project site, heavy grazing by cattle is apparent (no historical photos available). Completed in 2004.

WILLOW SPRINGS CREEK (034-2004)


Pre-project


2005 (after construction)


2015

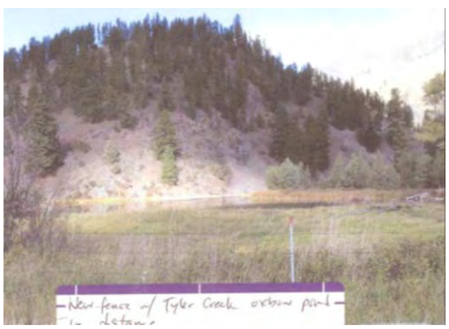
This project involved channel improvements, riparian fencing, and the addition of spawning gravel. The intention was to improve spawning sites for trout. In 2015, the project remained in good condition. Some algae have affected the spawning gravel, particularly in the fall, but this project has contributed to an increase in spawning sites, recruitment, and Jefferson River fish populations. Completed in 2005.

DRY CREEK (041-2004)


Pre-project *2015*

This project replaced a wood crib diversion with a series of rock weirs to allow fish passage. The project required maintenance in 2010, but is in good condition and is most likely performing as intended. The impact to the fishery was unknown. Completed in 2004.

TYLER CREEK (047-2004)




Pre-project *2009* *2016*

This project fenced approximately 1,720 feet of riparian area to protect existing wetlands and an oxbow area. Since project completion, the fencing has remained intact and the riparian areas appear to be healthy. However, the project scope did not protect Tyler Creek itself from grazing and it is unlikely that the project has benefited the fishery in Tyler Creek. Although the project was compliant, the impact has been minimal at best. Completed in 2004.

PARSON'S SLOUGH CHANNEL RESTORATION (013-2005)



Project construction (2006) *2015* *2015*

This project constructed a 2,000-foot spawning channel that receives irrigation return flows from Parson's Slough during the spawning and incubation season for brown trout. In 2015, gravel had been retained in the stream and the channel maintained its structure. However, because of the absence of flushing flows and the release of sediment upstream, watercress had established. Rainbow trout (spring spawners) were less impacted than brown trout (fall spawners). Thirty-five years of red data accompany this project. Completed in 2007.

EUSTACHE CREEK CHANNEL RESTORATION (003-2006)



Pre-project *2007 (after construction)* *2015*

This project involved channel and floodplain construction, revegetation, woody debris, and culvert replacement. Approximately 1.3 miles of stream was treated. The structures appear to be in retained; however, flow was intermittent. The impact on the fishery is unknown, as stream flow did not appear to support fish populations in August 2015. The latest fish sampling was done in 2006. Seasonal benefit is likely; however, condition encourages thought regarding funding of intermittent/low flow streams. Completed in 2007.

COTTONWOOD CREEK CULVERT REPLACEMENT (002-2006)



Pre-project *2007 (after construction)* *2015*

This project replaced a perched culvert with a bridge, thereby allowing fish passage. In 2015, the bridge was functional and the rock weirs were still in place. This section of Cottonwood Creek was still having fishery benefit, although portions of the stream are intermittent at certain times of the year. Completed in 2007.

BLACKTAIL DEER CREEK FLOOD MITIGATION (004-2007)


2010 (after construction) *2010 (after construction)*


2016 *2016*

This project intended to increase flood capacity on 2,200 feet of Blacktail Deer Creek within the city of Dillon. Two undersized culverts were replaced with free span bridges, stream gradient was re-established, channel constriction problems were eliminated, and fish habitat structures were added. In 2016, flood capacity was not determined, and fish habitat structures were not observed. Riparian condition is improved and stream appears stable. Completed in 2010.

WHITES GULCH FISH BARRIER REPLACEMENT (042-2007 & 029-2008)


2009 (after construction) *2015*

This barrier protects a genetically pure population of westslope cutthroat trout. The project upgraded wooden barrier to a concrete structure. It is still functioning as a complete barrier. Some erosion has occurred around the downstream side of structure since its installation. Completed in 2009.

MORRELL CREEK FISH PASSAGE AND FISH SCREENS (015-2008)


2011 *2015*

This project replaced two wooden irrigation diversions with rock weirs, new headgates with fish screens, and water measuring devices. The project continues to function as intended, but fishery response is unknown. Completed in 2009.

BEAVER CREEK CULVERT TO BRIDGE CONVERSION (020-2008)



2011 (after construction) *2013 flood* *2015 culvert damage*

This project replaced and undersized culvert. A full-span bridge was planned, but an arched culvert was installed due to the cost of a bridge. Severe flooding in 2013 damaged the structure. The contractor and landowner planned to repair the culvert, but follow-up is needed. Completed in 2011.

FISH CREEK (HANSON) CHANNEL RESTORATION (022-2008)



2009 (after construction) *2015* *2015*

This project removed sediment, narrowed and deepened the channel, installed a bridge, reconstructed water gaps for cattle, improved an irrigation diversion, and installed riparian fencing. In 2015, the channel looked more like a ditch, and it is believed that winter grazing occurs. The inspection was similar to 2011, when riparian condition was considered fair and grazing compliance was medium. Completed in 2009.

LEVERICH CREEK NATIVE FISH PROTECTION (BARRIER) (012-2009)


2011 (after construction) *2016*

This project constructed an upstream fish passage barrier at an existing road crossing to prevent further invasion by nonnative fish. In 2016, the barrier was intact and continues to isolate and protect westslope cutthroat trout. Completed in 2011.

SKALKAHO CREEK BANK STABILIZATION (020-2009)



Pre-project *2009 (after construction)* *2016*

This project addressed some accelerated bank erosion on the Chester and Sheahan properties along Skalkaho Creek. Approximately 150 feet of bank was stabilized using a bankfull bench and four logjams. In 2016, the project had established vegetation and the bank was generally holding together. A small amount of slumping was observed due to an eroding toe, and the landowner planned to have the area assessed. Completed in 2009.

SKALKAHO CREEK CHANNEL STABILIZATION (023-2010)

2012 (after construction)

2016

This project installed a series of three log weirs on Skalkaho Creek and planted willows on the stream banks. The goal was to reduce erosion along a property and improve stream function. In 2016, the structures remained in place. However, the benefit to the fishery is unknown and unlikely to be quantified. Completed in 2012 (dashed lines indicate the location of one log weir).

COW CREEK RESERVOIR REHAB & INSTREAM FLOW PROTECTION (031-2010)

Pre-project

2012 (during construction)

2015

This project rehabilitated the face of the dam at Cow Creek Reservoir to facilitate the return to full pool and reduce the potential for a breach. In return, Sand Creek Ranch entered into a water management and fishing access agreement with FWP and agreed not to divert water from Cow Creek Reservoir for 10 years. In 2015, the project was in good condition. Completed in 2012.

NEVADA CREEK CHANNEL RESTORATION (038-2010)

Pre-project

2011 (after construction)

2015

This project involved channel reconstruction, toe wood and log vanes installation, shrub transplants, and riparian fencing. An existing diversion was reconstructed. The project remains intact with only a small amount of erosion occurring. The landowner considers project to be successful and the fishery response has been positive. Completed in 2011.

MCVEY CREEK FISH BARRIER (011-2011)

2011 (after construction) *2015*

This project installed a barrier at the Highway 43 culvert to protect a non-hybridized population of westslope cutthroat trout. In 2015, the barrier was working well. Some modifications were made after construction to improve the function. Completed in 2011.

FWP INTERN MONITORING

In 2016, an intern was hired by FWP Yellowstone cutthroat trout biologist Carol Endicott to perform monitoring on FFIP projects in the Yellowstone River drainage. Shannon Bockman completed monitoring for 21 projects.

The goal of this effort was to document the condition of projects in the Yellowstone River watershed that received funding from the FFIP (Figure 3). When available, background information was compiled for each project. Sources included FWP's database and the local biologists' internal files. Information obtained included pre-project photos, fish survey data, and project designs. This information often provided a baseline of pre-project conditions that allowed evaluation of the success of the specific project.

One or more field observers visited each site, and filled out an assessment form that included descriptions of fields of conditions at the project site, and whether the project met the terms of the agreement. Photos provided additional documentation of site conditions, and the coordinates of the locations of the photos were obtained with a handheld GPS unit.

Following field data collection, the field observer prepared a narrative that described the project area, and compared baseline conditions to current conditions. Other components of the narrative were compliance with the terms in the agreement, an assessment of whether the project was successful in meeting project goals, and recommendations for improvements. Mapping locations of photo points on an aerial photos linked field conditions to a recent aerial view of the project area.

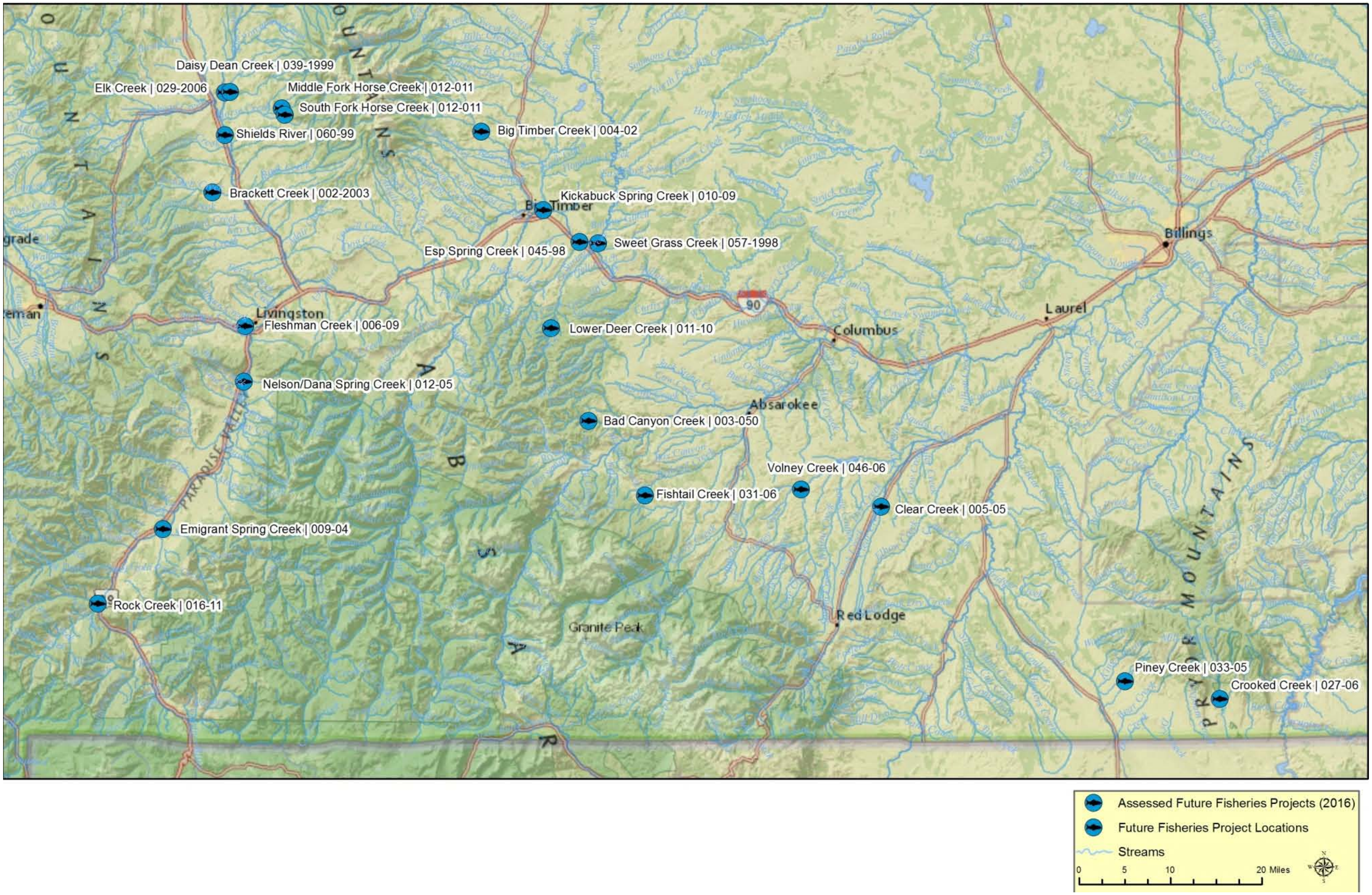


FIGURE 3. MAP OF ASSESSED PROJECTS.

Synthesis of pre-project information and field observations allowed determination of the success of the project. Evaluation of projects also documented shortcomings and failures, and provided recommendations for improvements or future study.

A number of native fishes benefit from FFIP projects in the Yellowstone River watershed. Yellowstone cutthroat trout, a species of concern, is the driving force behind many of the projects described here. Of course, other native species benefit from improvements in habitat and water quality, and these include mountain whitefish, sculpin, and several species in the sucker and minnow families. Nonnative, but economically and recreationally important species including brown trout, rainbow trout, and brook trout also benefit. These popular game fishes attract anglers world-wide, and investments in improving habitat for these species brings considerable benefit to local communities.

BAD CANYON CREEK BARRIER REPAIR (003-2005)

Background

Bad Canyon Creek is a tributary of the Stillwater River, located 5 miles north of Nye. Bad Canyon Creek supported populations of nonhybridized Yellowstone cutthroat trout and brown trout, with Yellowstone cutthroat trout increasing in abundance in the upstream reaches of the creek. FWP, the Custer Gallatin National Forest (CGNF) and the Bureau of Land Management (BLM) began collaborating on Yellowstone cutthroat trout conservation in 1996. Initially, a partial barrier was enhanced to prevent upstream movement of brown trout, with the intent of protecting about 7 miles of stream for Yellowstone cutthroat trout (Figure 4). Subsequent mechanical removal of brown trout was ineffective, and the barrier waterfall began to erode, which threatened to allow more brown trout to invade the protected reach. In addition, Yellowstone cutthroat trout numbers were on the decline, prompting the need for action.

Protecting this nonhybridized population of Yellowstone cutthroat trout entailed several components. A temporary repair of the barrier prevented upstream passage of fish, until a permanent barrier could be installed. Afterwards, Yellowstone cutthroat trout were salvaged from Bad Canyon Creek, and held outside of the project area, while the stream was treated with rotenone to remove the remaining fish. Brown trout were eradicated with a single rotenone treatment, and salvaged Yellowstone cutthroat trout were returned to Bad Canyon Creek. To augment population size and genetic diversity, nonhybridized LeHardy Rapids strain Yellowstone cutthroat trout were also introduced to Bad Canyon Creek.

FWP secured this FFIP grant to contribute to the establishment a permanent barrier to upstream movement of fish. The approach was to secure the existing barrier of large boulders by sealing the loose material around and upstream of the barrier falls, with a combination of grout and a fabric liner (Figure 5 and Figure 6). Low flow and high flow channels were constructed to focus flows over the center boulder that formed the waterfall. Grout was applied to spaces between large boulders that formed the falls to fortify the feature. Additional rock was obtained by blasting portions of the adjacent cliff face.

FIGURE 4. UNALTERED NATURAL BARRIER ON BAD CANYON CREEK.

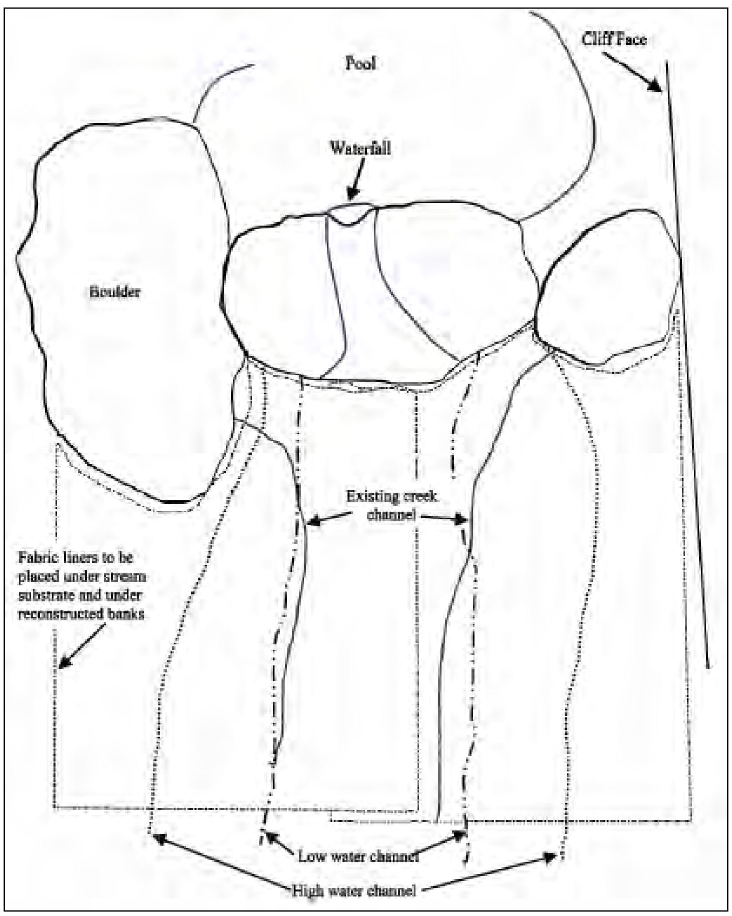


FIGURE 5. PLAN VIEW OF NATURAL BARRIER STABILIZATION.

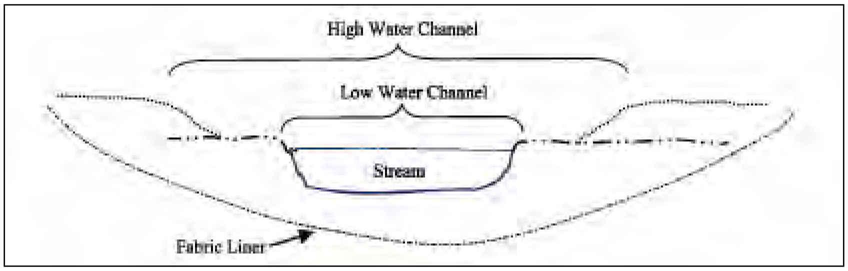


FIGURE 6. CROSS-SECTIONAL VIEW OF NATURAL BARRIER STABILIZATION.

Fish surveys conducted after barrier construction and rotenone treatment indicate this project was successful. Sampling in 2006, the year following piscicide treatment, found no brown trout. Yellowstone cutthroat trout were present at relatively low numbers, which was expected for a population recently restored with salvaged and stocked fish. In contrast, sampling in 2013 found Yellowstone cutthroat trout to be 10 times more abundant than before piscicide treatment, and average lengths had also increased. No brown trout have been captured upstream of the barrier since the single rotenone treatment.

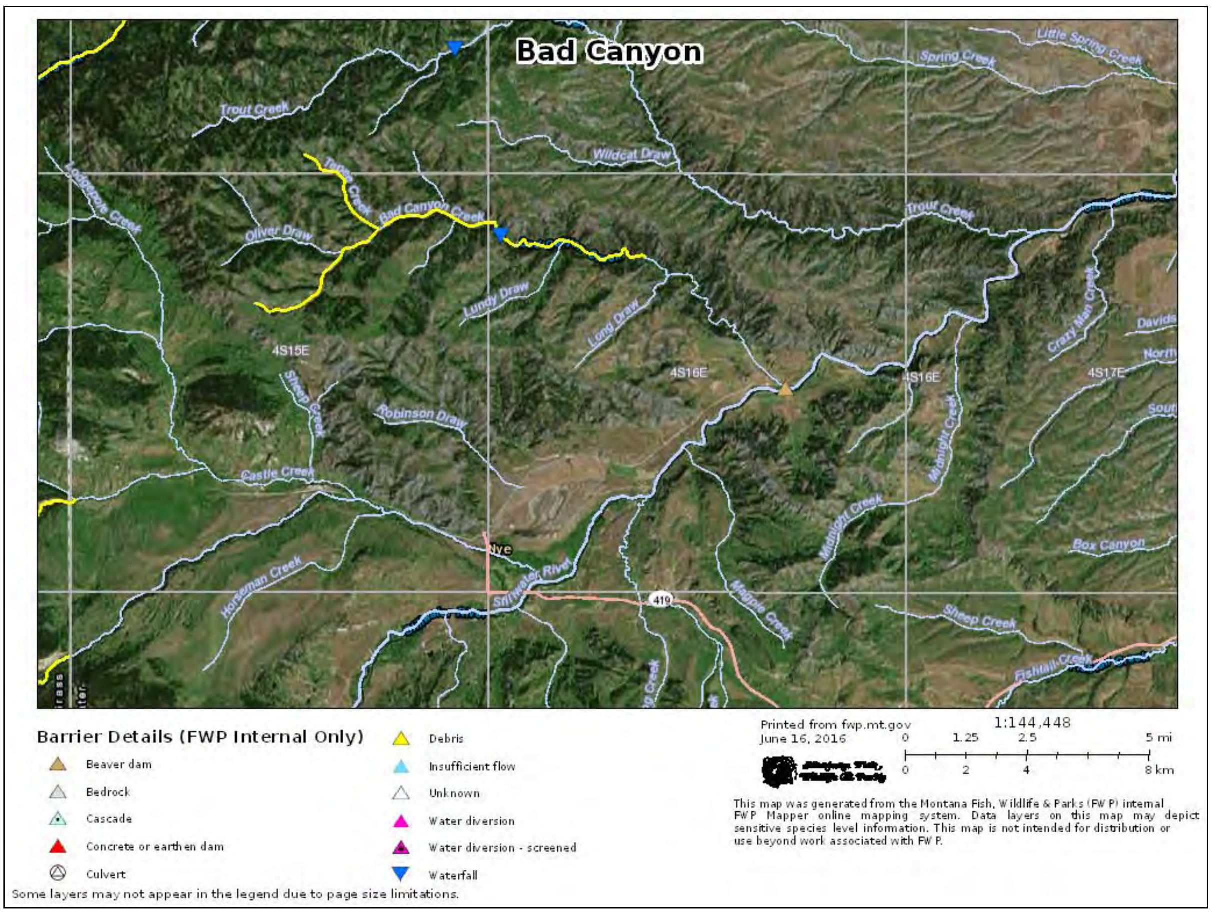


FIGURE 7. DISTRIBUTION OF YELLOWSTONE CUTTHROAT TROUT IN BAD CANYON CREEK, AND LOCATION OF THE FORTIFIED NATURAL BARRIER. YELLOWSTONE CUTTHROAT TROUT DISTRIBUTION IS SHOWN IN YELLOW.

Field Assessment 2013/Maintenance & Repair 2014

Jason Rhoten, a fisheries biologist with FWP, visited the Bad Canyon Creek barrier in July 2013, and found maintenance and repair was warranted. A log jam had formed approximately 20 yards downstream of the barrier, and had the potential to backwater flows leading up to the barrier, which could allow brown trout to leap over. In addition, water was flowing under the barrier near the left bank. This flow could jeopardize the integrity of the barrier, by eroding under and around the boulders and rock walls.

Actions to protect the barrier's ability to block fish began in 2013, with removal of the debris jam. In 2014, several repairs were made to the barrier. Installation of large rock and concrete blocked the flows through the boulders, and prevented potential failure of the barrier. Combined, these actions preserved the structural integrity of the barrier, and eliminated the potential for backwatered flows to decrease the leap height over the barrier, which could otherwise allow brown trout to reinvade Bad Canyon Creek.

FIGURE 8. BAD CANYON BARRIER AFTER REPAIR AND MAINTENANCE.

Conclusions

The Bad Canyon Creek fish barrier project has met its goals of removing brown trout, preventing their reinvasion, and providing a secure haven for Yellowstone cutthroat trout. The accumulation of debris, and water flow through the barrier, underscore the need for periodic maintenance of barriers. This population of nonhybridized Yellowstone cutthroat trout has considerable conservation value, so ensuring the barrier remains impassible over the long-term warrants regular site visits, particularly after large flow events.

BIG TIMBER CREEK (004-2002)

Background

Big Timber Creek is a tributary of the Yellowstone River, and its confluence with the Yellowstone River is near Boulder. The fish community within the project area includes brown trout, mountain whitefish, mottled sculpin, and common carp. The South Fork Big Timber Creek joins Big Timber Creek about 1 mile upstream of the property. This tributary supports nonhybridized Yellowstone cutthroat trout in its headwaters, and may contribute Yellowstone cutthroat trout to waters downstream.

The reach of Big Timber Creek flowing through the Cloud Ranch experienced substantial mechanical disturbance in years before the project. Following a fall flood, the previous landowner bulldozed 0.5 miles of channel in a misguided attempt to mitigate for future flood disturbance. These modifications straightened and widened the channel, and bed material was used to create dikes along much of the left bank. Combined, these alterations divorced the stream from its floodplain, resulting in degradation of riparian and wetland areas and a braided channel. In addition, these modifications simplified habitat, and eliminated pools and other important habitat features for fish.

Restoration of the disturbed reach occurred in 2002. A nearby reference reach provided the parameters to develop design specifications for the altered reach. The design objective was to return the existing braided channel (Rosgen D3 classification), to a single thread C3 channel, with riffle/pool morphology. Design specifications followed the channel geometry and plan view of the reference reach.

FIGURE 9. CHANNELIZED REACH OF BIG TIMBER CREEK.

Field Assessments 2016

On July 6, 2016, Shannon Bockmon visited the project area, accompanied by Tom Coleman, the consultant who designed and provided oversight during the restoration. The channel was dramatically different than the pre-construction condition. Instead of the overly wide, braided, straight channel, the stream had meanders, greatly enhanced pool habitat, and recruitment of shrubs on point bars (Figure 10). This project was successful in restoring natural morphology to the stream, and improving fish habitat.


FIGURE 10. VIEW OF RESTORED REACH OF BIG TIMBER CREEK, 2016.

Conclusions

This project greatly improved the quality habitat for fish and water quality. The narrower, deeper channel had a natural plan form that provided pool habitat on outer meander bends, which may have resulted in greater density of brown trout. The decrease in surface area exposed to sunlight will contribute to cooler water temperatures. Recruitment of willows on point bars is another indicator of recovery.

BRACKETT CREEK (002-2003)

Background

Brackett Creek is a tributary of the Shields River, and joins the river near Clyde Park. Brackett Creek supports nonhybridized and hybridized Yellowstone cutthroat trout, although at relatively low densities within the project area. Brown trout, mountain whitefish, rainbow trout, sculpin, longnose dace, and lake chub are abundant in this reach. Brown trout and mountain whitefish from the Shields River likely migrate into Brackett Creek for spawning, and brown trout redds are commonly observed in fall.

This project addressed 2 alterations that had negative effects on stream morphology and fish passage. At some point after 1954, the stream was diverted from the floodplain, and pushed against the south valley wall (Figure 11). This channelization resulted in considerable loss of stream length, and loss of the natural pool/riffle sequence that was present before channelization.

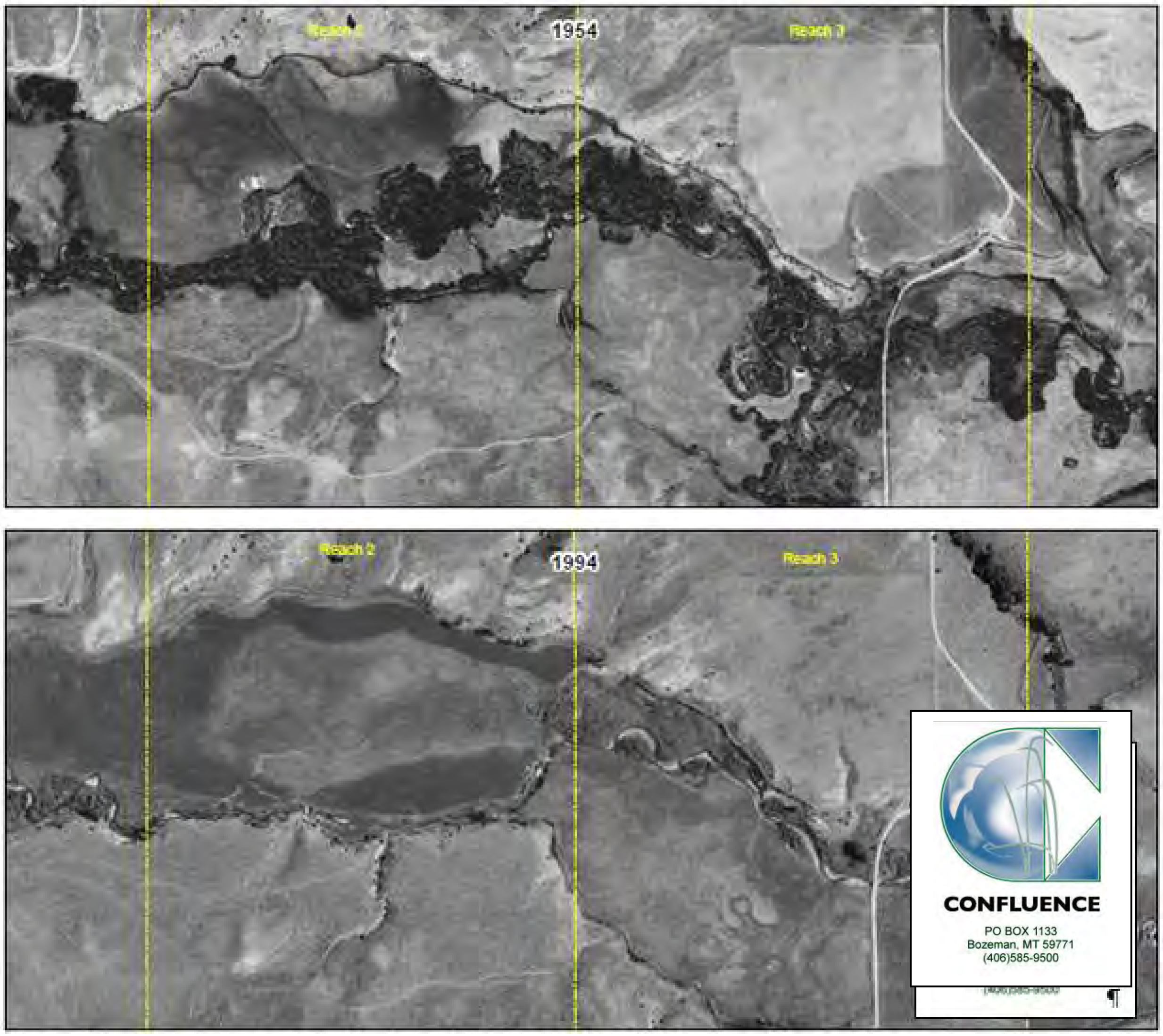


FIGURE 11. HISTORICAL AND RECENT AERIAL PHOTOS OF BRACKETT CREEK THROUGH THE PROJECT AREA.

The goals were to restore Brackett Creek to the location it occupied before channelization, and to create high quality habitat for fish. A sinuous channel with a longitudinal profile that created riffles and pools was constructed within the meander scars of the historical channel. Banks were sloped at an approximately 30% grade, and were revegetated with sod harvested during channel excavation (Figure 12). Willows were harvested locally, and transplanted along the newly constructed banks.

FIGURE 12. BRACKETT CREEK RE-NATURALIZATION IMMEDIATELY POST-CONSTRUCTION.

The second alteration was abandonment of an irrigation diversion that was at least a partial barrier to the upstream movement of fish (Figure 13). In the early 2000s, opening passage to allow Yellowstone cutthroat trout to move freely throughout the watershed was a management priority, so rerouting the stream away from the diversion was desirable. Since then, the presence of rainbow trout in the adjacent Shields River and Brackett Creek has changed the conservation strategy for Yellowstone cutthroat trout, with protecting the genetic integrity of Yellowstone cutthroat trout being the highest priority. Nevertheless, the project followed the management objectives of the time, and the channel was moved away from the diversion structure.

FIGURE 13. IRRIGATION DIVERSION BLOCKING FISH PASSAGE ON BRACKETT CREEK (2003).

Weather and flow are important considerations in evaluating the success of this project. Soon after construction was completed, Brackett Creek experienced a flood that inundated the entire floodplain, and was an 80-year recurrence interval event (Matt Klara, Herrera Environmental Consultants, personal communication). This flood put considerable erosive pressure on newly constructed banks. In addition, restoration and willow transplanting occurred during an especially hot summer, with temperatures frequently exceeding 100 °F, which resulted in harsh conditions for transplanted willows.

In 2007, FWP conducted a field evaluation of the project. The assessment concluded that the new channel was a striking improvement over its former, channelized position, although 2 problems were obvious. Notably, the large flood that occurred soon after construction exerted considerable shear stress on outer meander bends, resulting in extensive areas of bank erosion. Nonetheless, plan form remained intact, and lateral adjustments were relatively minor. The longitudinal profile of the streambed was indistinguishable from a natural channel, and had high quality pools and extended gravel dominated pool tails and riffles. The channel was vertically stable, with no down-cutting. The stream could readily access its floodplain during high flows.

The second short-coming was failure of willows to become reestablished along the stream channel. Finding willows was challenging, as they were widely scattered. Most willows present were short, solitary shrubs that were stunted by browsing. Livestock had not grazed this pasture following restoration, although elk were often present along the stream; therefore, browsing by wildlife was the factor most likely limiting recovery of riparian shrubs.

Field Assessment 2016

On June 16, 2016, FWP field observers Shannon Bockmon and Carol Endicott visited Brackett Creek. The ranch manager accompanied the observers and provided background on current livestock use, management objectives, and trends.

The site visit began where the plug of dense willows was placed to divert the water away from the old, straightened into the re-naturalized channel (Figure 14). Dense shrubs obscured the upstream end of the channelized reach, and provided an impenetrable barrier against the stream returning to its former location, and abandoning the reconstructed channel.

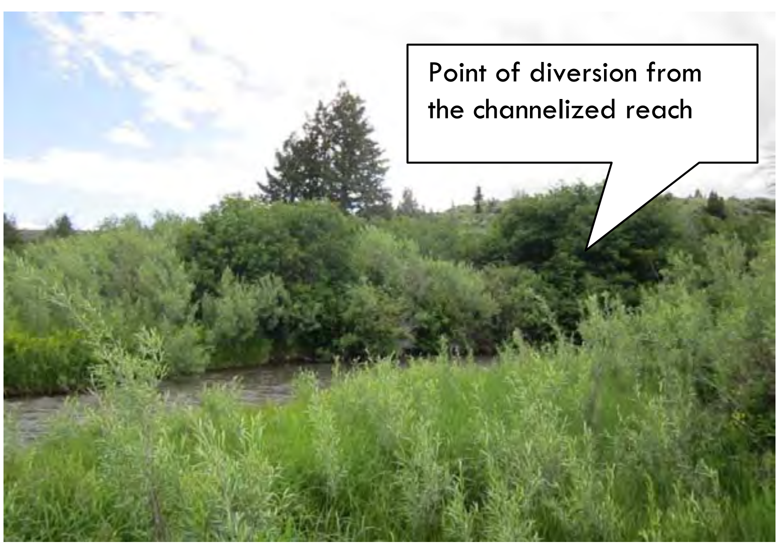


FIGURE 14. LOCATION OF PLUG THAT DIVERTED WATER AWAY FROM THE OLD CHANNEL INTO THE RE- NATURALIZED CHANNEL.

Thick, high, nonnative grasses, such as Timothy and smooth brome occupied the entire floodplain. According to the ranch manager, he grazes about 300 head of cattle in that pasture for 1 month. The great abundance of grass keeps the cows off the stream banks. We noted only 1small, isolated spot where livestock accessed the stream, and hoof shear was otherwise absent from stream banks. Livestock grazing under this strategy has no harmful effect on riparian health and function, bank stability, or stream morphology. Grazing strategies that are compatible with riparian health and function without the use of fencing are especially attractive. The landowner does not have to maintain the fencing, and wildlife movements are unrestricted near the stream.

Recruitment of riparian shrubs had improved since 2007; however, most of the stream remained devoid of woody vegetation (Figure 15). Individual willows were sparsely distributed along much of the channel, with isolated willows showed heavy browse. Nonetheless, several stands of sandbar willow had become established since 2007 (Figure 16). Despite continued heavy browse pressure, willows were beginning to gain more of a foothold along the stream channel.

FIGURE 15. AERIAL IMAGERY OF RE-NATURALIZED STREAM (2015) SHOWING INTACT PLAN FORM, LIMITED RECOVERY OF SHRUBS.

FIGURE 16. BRACKETT CREEK SHOWING WILLOW RECRUITMENT ON LEFT BANK. NOTE BANK STABILITY WHERE SEDGES OCCUPY THE CHANNEL MARGIN.

As observed in the 2007 assessment, the 80-year flood that occurred soon after channel re-naturalization resulted in considerable erosive pressure on outer meander bends, causing numerous reaches of eroding bank (Figure 17). Shallow-rooted grasses, such as smooth brome and Timothy, occupied the tops of banks, and these species do not contribute to recovery of banks, except in cases where clods of vegetated dirt calve into the stream. These vegetated clumps have potential to trap sediments, and build a new bank adjacent to the existing eroding bank; however, these features are vulnerable during floods. The ranch manager expressed concern over losing land from bank erosion. Other reaches of Brackett Creek have much higher bank retreat rates; however, the loss of land, delivery of fine sediment, channel widening, and loss of high quality bank line habitat for fish are legitimate concerns for fish and agriculture.

FIGURE 17. EXAMPLE OF ERODING OUTER MEANDER BEND ON THE RE-NATURALIZED REACH ON BRACKETT CREEK.

Stream flow was relatively high and turbid during the field visit; however, stream bed material was visible at most places. Brackett Creek has sorted its gravel so that spawning size gravel was present in the pool tails. Fine sediment filled spaces within the gravel substrate. The fines could be coming from nearby eroding banks or from erosion of banks and terraces upstream of the project area. The watershed restoration plan for the Shields River watershed identifies lower Brackett Creek as being among the 10 greatest contributors of fine sediment from bank erosion, so deposition of fine sediment was not unexpected.

Although bank erosion was a significant feature along the re-naturalized reach, substantial portions of stream were stable, with dense sedges providing protection from elevated flows (Figure 18). These reaches were narrower and deeper than areas with eroding banks, and were consistent with the channel morphology designed for this re-naturalization project.

FIGURE 18. REACH OF RE-NATURALIZED CHANNEL SHOWING BANKS STABILIZED WITH SEDGES, AND NARROWER CHANNEL.

Noxious weeds, specifically leafy spurge and Canada thistle, have been a long-term problem on this property. The current ranch manager has an aggressive weed control program, and weeds, especially leafy spurge, appeared to have decreased substantially since 2007.

Conclusions

The re-naturalized reach of Brackett Creek is a marked improvement from the straightened alignment, as it considerably increased channel length and habitat complexity. In addition, the re-naturalized channel has retained its sinuous plan form, and the alternating pools and riffles that are typical of streams occupying floodplain valleys. The sorting of gravel in pool tails has substantially increased the amount of spawning habitat.

Although the re-naturalized stream is preferable to the previous, channelized condition, several problems remain. Flooding eroded considerable stretches of bank, and these have not healed. The shallow roots of nonnative grasses do not provide protection from the erosive power of high flows, and these grasses are highly competitive, so riparian species are unable colonize these areas. The grass-lined, eroding banks are laterally mobile, and the channel is overly-wide in these locations. The associated erosion contributes fine sediment, which diminishes the quality of habitat for aquatic invertebrates, and clogs spawning gravels.

The relatively wide and shallow channel, and lack of a riparian overstory, limits the quality of habitat for fish, and contributes to warmer water temperatures. Brackett Creek ranks as a periodically dewatered stream, which further increases the tendency for warmer stream temperatures.

Although noxious weeds are a longstanding problem on this property, an aggressive weed management program is underway. The weed management strategy employs herbicides and introduction of insects evolved to consume specific weeds. The multiple lines of defense will likely continue to diminish noxious weeds on the property.

Although flooding likely contributed to the failure of willow transplants to thrive, seasonality also was a factor. Willow transplants occurred during an exceptionally hot summer, and plants were not dormant. Dormant plants are resilient to the disturbance associated with planting, and are more likely to become established after they break dormancy.

Finding a solution to restore eroding banks with limited ability to heal on their own is a primary recommendation. Restoring stability to these banks would benefit water quality, fish, and protect valuable agricultural land from erosion. As a priority watershed for sediment reduction, grant funds could be available to address the erosion, subsequent sediment loading, and impairment of fish habitat.

Potential actions that would stabilize the eroding banks vary in expense and potential for failure. One approach would be to slope the banks to the angle of repose, then place wetland sod mats and sprig willows on the banks. This approach would be relatively expensive, as it would require heavy equipment to slope banks, and harvest sod mats. These banks would be vulnerable to erosion if high flows occur before the sedge mats establish the deep, dense root mass that helps maintain bank stability. The original restoration followed this approach, and would likely have been successful if not followed by a substantial flood.

Sprigging willow stems into the existing eroding banks may also assist in the stabilization of these banks. Pounded deep into the water table, at a 45° angle, the willows may provide sufficient roughness for trapping of sediments, and ultimate repair of eroding banks. Although comparatively inexpensive, this method has a high risk of failure if the stream floods before the willows become established.

An alternative is to plant willow sprigs away from the channel margin using a Waterjet Stinger™, which uses a high-pressure pump to drill narrow holes through soil into the alluvial gravels and water table (http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcarwproj17.pdf). Willows do not thrive in good soil, but do well when their roots reach saturated gravel. Willow sprigs planted in these holes would establish a thick stand of riparian shrubs that would guard against bank erosion when the soil between the stream bank and new willow stand eroded. Under the existing grazing management strategy, the channel will naturally narrow and deepen, and provide high quality habitat for fish. Protective sheaths and wildlife repellent spray are recommended to discourage elk and deer from browsing willow stems.

Bank retreat rates are an important consideration in determining placement of willows transplanted with a Waterjet Stinger. Review of several vintages of aerial photos to evaluate bank retreat rates, and calculation of flood recurrence intervals, would allow for informed decision making on how far banks may move during floods of different magnitudes. Although laterally mobile, banks on this reach of Brackett Creek do not experience drastic retreats during floods, and transplanted willows would have better probability of becoming established and functional, if placed at a sufficient distance from the existing channel.

CLEAR CREEK (005-2004 & 005-2005)

Background

Clear Creek is a tributary of Rock Creek, and the confluence of these streams is near the town of Roberts. Groundwater from natural springs and irrigation return flows maintain adequate water during peak demands for water. Neighboring Rock Creek experiences chronic dewatering, and Clear

Creek had potential to provide temperature refugia and spawning habitat for fish in Rock Creek, if fish could access the stream. A perched box culvert blocked fish from accessing this high quality habitat.

The objective of this project was to provide fish passage by constructing a series of step-pools that would allow fish to swim up to and through the culvert. Clear Creek had the potential to provide spawning habitat for brown and rainbow trout. Moreover, native fishes such as mountain sucker, longnose sucker, mountain whitefish, and sculpin would also benefit from improved access to high quality habitat in Clear Creek. The resident fishery in Clear Creek and migratory fish in Rock Creek were the populations targeted to benefit from this project.

Pre-project photos illustrate the features that limited the ability to swim through the structure (Figure 19). An abrupt drop downstream of the outlet of the concrete box culvert was likely a leap barrier. In addition, rapid laminar flow and shallow water depths potentially presented a velocity barrier to the fish that were capable of leaping into the culvert.

FIGURE 19. IMPASSIBLE CULVERT ON CLEAR CREEK.

Providing passage to and through the culvert entailed narrowing the channel, and constructing a series of step-pools. Construction occurred in the fall of 2005. The step-pools provided a series of smaller leaps that provided lower velocity resting areas upstream of the leap (Figure 20). The bed elevation immediately downstream of the outlet of the culvert was raised above the existing elevation, so that fish would not have to leap to get to the culvert, and flows through the culvert were backwatered, which increased the depth, and decreased the velocity through the culvert.

FIGURE 20. POST-CONSTRUCTION PHOTO OF STEP-POOL SEQUENCE PROVIDING PASSAGE UP TO, AND THROUGH, THE

Field Assessment 2016

On July 24, 2016, Shannon Bockmon visited the Clear Creek fish passage project. Dense riparian vegetation obscured much of the stream; however, the step-pools were visible, and rocks armoring the stream banks remained in place (Figure 21). Although some of the rocks forming the step-pools had moved, the channel modifications were still functioning to provide fish passage. The stream has not re-scoured a plunge pool at the outlet of the box culvert, and the streambed is at the same grade as the floor of the culvert (Figure 22).

FIGURE 21. VIEW OF STEP-POOL SEQUENCE PROVIDING PASSAGE ON CLEAR CREEK.


FIGURE 22. OUTLET OF BOX CULVERT ON CLEAR CREEK

Conclusions

Based on visual inspection, the modifications to the banks and bed of the stream downstream of the box culvert continued to provide fish passage since the project was constructed over 10 years ago. The movement of some of the rock forming pools indicates periodic inspection and maintenance should be ongoing.

Several fish surveys have been conducted before and after construction of the step-pools; however, differences in seasonality and methodology do not allow for inference on the effect of this project on fish populations in Clear Creek or Rock Creek. If resources allow, installation of trap upstream of the culvert during periods of low flow would determine if fish were capable of moving through the culvert, and evaluate if fish were moving into Clear Creek from Rock Creek when water temperatures were stressful. Likewise, redd counts or fry trapping would provide information on the importance of Clear Creek as a spawning stream.

CROOKED CREEK FISH BARRIER (027-2006)

Background

Crooked Creek originates in the Pryor Mountains, and flows south into Wyoming. Crooked Creek supports an aboriginal population of Yellowstone cutthroat trout in its headwaters. Natural barriers had prevented the invasion of nonnative fishes into waters occupied by Yellowstone cutthroat trout; however, 2 invasions placed brook trout, then brown trout, just downstream of cutthroat trout bearing waters. Wildfires resulted in debris flows that eliminated brook trout; however, the extent of the disturbance resulted in concern over the permanence of the natural barriers. A temporary barrier was installed to prevent reinvasion of these waters, until a permanent barrier could be constructed. Brown trout breached the temporary barrier, which again placed the resident Yellowstone cutthroat trout at risk. Numerous attempts at mechanical removal were ineffective in removing or depleting brown trout, so construction of a permanent barrier, along with removal of brown trout using piscicide, were the actions selected to protect the headwaters population of Yellowstone cutthroat trout.

The FFIP contributed funds towards construction of the barrier within the Crooked Creek canyon (Figure 23). The barrier was a weir with a v-notch on a flat front. The apron was angled towards the center, and wing walls were constructed to prevent scour around the barrier. Public comment on the barrier included concerns over aesthetics, so the concreted was tinted and textured to match the surrounding red sandstone canyon walls.

FIGURE 23. NEWLY CONSTRUCTED BARRIER ON CROOKED CREEK, 2008.

Application of rotenone followed in October of 2009. A detoxification station established at the barrier limited toxic concentrations of rotenone to the distance stream flow could travel in 30 minutes. Follow up monitoring over the course of several years has found no brown trout, indicating 1 application of piscicide was effective in removing brown trout.

Field Assessment 2016

On July 27, 2016, Shannon Bockmon visited the Crooked Creek barrier with the area biologist Mike Ruggles. Specific concerns relating to barrier projects include the structural stability of the weir, the creation of conditions that would allow fish the ability to breach the barrier, and the ability of the structure to transport bed load and woody debris.

The Crooked Creek barrier showed slight signs of wear, but no structural instability. No scouring of the concrete of the apron, or splash pad, was evident (Figure 24). In the first decade after construction, bed load had been relatively slow to fill in behind the front wall of the weir, with fine sediment being the dominant particle size, and water remaining deep behind the wall for several years. By 2016, larger material had accumulated within the impounded portion of the stream, and it is now possible to walk across the accumulated cobble and gravel (Figure 25).


FIGURE 24. SPLASH PAD OF THE CROOKED CREEK BARRIER.


FIGURE 25. VIEW UPSTREAM OF THE FACE OF THE WEIR SHOWING ACCUMULATION OF COHESIVE BED LOAD.

Formation of a plunge pool at the downstream end of the apron was a concern, as the turbulence could allow fish a vantage to leap over the weir. The streambed on the downstream end of the apron remained well armored with large boulders (Figure 26). The combination of the lack of pool habitat, and shallow, high velocity flows on the apron is desirable in preventing fish from being able to pass over the barrier.

FIGURE 26. DOWNSTREAM END OF APRON SHOWING LACK OF A PLUNGE POOL.

In addition to inspection of the structure, the site visit included electrofishing upstream of the barrier to determine if Yellowstone cutthroat trout from the headwaters had recolonized the stream in its lower reaches, to determine if the barrier was passable, and reevaluate if the piscicide treatment had been successful. Yellowstone cutthroat trout had not yet recolonized the lower reaches since the piscicide application in 2008. Nevertheless, spawning gravels have sorted in pool tails since catastrophic debris flows, and blow-out of natural barriers, so the habitat will be suitable for propagation of Yellowstone cutthroat trout, when they disperse downstream. No nonnative trout were found upstream of the barrier. The lag in recolonization of Yellowstone cutthroat trout is unsurprising given the cold, nutrient-limited nature of Crooked Creek.

Conclusions

Crooked Creek has been the subject of several actions to conserve the isolated, nonhybridized Yellowstone cutthroat trout in its headwaters. The barrier is 10 years old, and shows slight wear but no structural instability. The single application of piscicide was effective in removing nonnative brown trout. Although Yellowstone cutthroat trout have yet to recolonize the available habitat in substantial numbers, they remain protected, and will likely expand in distribution and numbers over time. This project has been successful securing a population of nonhybridized Yellowstone cutthroat trout from nonnatives, which is Montana's high priority in cutthroat trout conservation.

DAISY DEAN CREEK OFF STREAM WATERING AND FENCING (039-1999)

Background

Daisy Dean Creek is a small tributary of the Shields River that supports nonhybridized Yellowstone cutthroat trout. The goal of this project was to preserve, protect, and enhance fluvial geomorphic processes, biological resources, and property values, while accommodating agricultural land uses. Specific actions included development of off-stream stock water, development of a grazing management strategy, and installation of riparian fencing. The pre-project photo showed concentration of cattle on a severely impaired stream, and sparse herbaceous and woody vegetation (Figure 27).

FIGURE 27. PRE-PROJECT PHOTO OF DAISY DEAN CREEK.

Field Assessment 2016

On June 14, 2016, Shannon Bockmon visited the project site to evaluate if project goals had been met, and if the conditions of the agreement were met. The landowner had installed 3 off-channel watering devices (Figure 28). Fencing excluded livestock from the stream channel, and thick stands of willows or sedges covered the stream banks (Figure 29). The channel was a narrow and deep, which are features that promote transport of sediment. The streambed is mostly fine sediment; however, this is likely the result of a limited supply for gravel recruitment, and not necessarily related to sediment inputs from upstream.

FIGURE 28. EXAMPLE OF OFF-STREAM STOCK WATER.


FIGURE 29. RECOVERED RIPARIAN AREA AND STREAM CHANNEL ON DAISY DEAN CREEK.

Conclusions

The Daisy Dean stock water and riparian protection project has been successful in meeting project goals. Sources of fine sediment, nutrients, and thermal loading have been drastically reduced. The stream channel is narrow and deep, and has considerable lengths of undercut banks. Despite its small size, Daisy Dean Creek has high conservation value for Yellowstone cutthroat trout. Significantly, the landowner is pleased with the outcome

ELK CREEK CHANNEL STABILIZATION (029-2006)

Background

Elk and Daisy Dean creeks are small streams that flow west out of the Crazy Mountains, until their confluences with the Shields River near Wilsall. Fisheries data are limited for Elk Creek. Sampling near the mouth in the 1970s found Yellowstone cutthroat trout, brown trout, longnose sucker, and white sucker. Genetic analysis of a single trout from a tributary indicated it was a hybrid. Daisy Dean Creek has been documented to support nonhybridized Yellowstone cutthroat trout.

A landowner applied for FFIP funding to reduce sediment loading, and improve riparian health and function, reaches of Elk and Daisy Dean creeks that had experienced considerable channel down-cutting, and degradation of the riparian area (Figure 30). Specific actions included installation of riparian fencing and off-channel stock water, and sloping vertical banks caused by down-cutting, and installing sod mats to stabilize the altered banks (Figure 31).

FIGURE 30. EXAMPLE OF CHANNEL DOWN-CUTTING, AND A VERTICAL BANK SLATED FOR SLOPING.

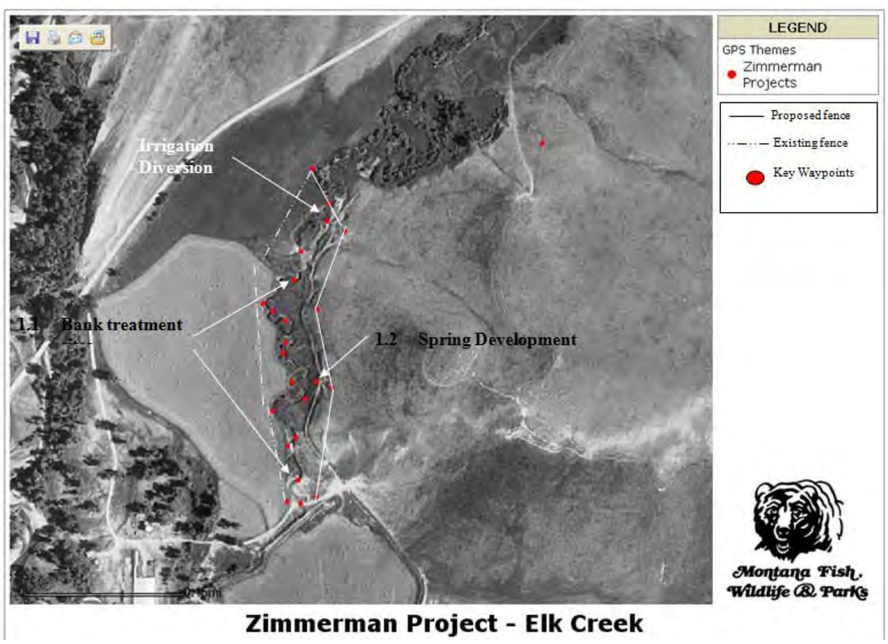


FIGURE 31. PLAN VIEW OF ACTIONS IMPLEMENTED IN ELK CREEK.

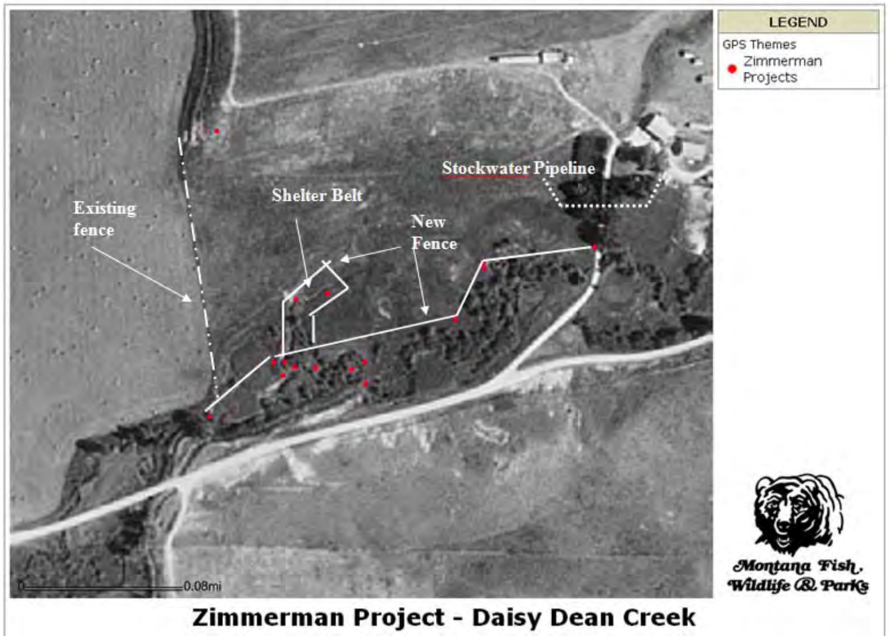


FIGURE 32. PLAN VIEW OF ACTIONS IMPLEMENTED IN DAISY DEAN CREEK.

On January 23, 2007, Carol Endicott visited the project sites, accompanied by the landowner. Most of the restoration actions had been implemented at this time; however, snow and ice obscured much of the bank restoration and sod mats. This site visit was too soon after project implementation to evaluate recovery of vegetation. Moreover, winter field conditions do not reflect the health and function of a riparian area during the peak of the growing season, which also confounded evaluation of recovery. Nonetheless, the fencing, bank sloping, and off-channel water components of project were in place. A concern that emerged during this site visit was for the stability of the head-gate, which was perched at the head of the down-cut reach

FIGURE 33. PERCHED HEAD-GATE ON ELK CREEK.

On 6/20/2007, another site visit allowed evaluation of the state of the projects with more time for the vegetation to recover. The bank sloping eliminated the bare, vertical walls and vegetation was becoming established on the sloped banks and within the riparian area (Figure 34). As expected for a recently disturbed site, weeds had colonized the sloped banks; however, these plants were holding soil much better than the pre-restoration condition.

FIGURE 34. RIPARIAN FENCING, SLOPED BANKS, AND EARLY STAGE RECOVERY OF RIPARIAN VEGETATION ON ELK CREEK IN JUNE 2007.

Field Assessment 2016

On August 9, 2016, Shannon Bockmon visited the project site with the landowner. All components had been implemented at this time. The riparian area has made a strong recovery in both streams (Figure 35), and grazing is limited to light grazing during the non-growing season. Remaining banks that had not been sloped have not migrated, and are minor features, especially compared to pre-restoration conditions.

FIGURE 35. EXAMPLE OF REDUCED EROSION AND RECOVERY OF RIPARIAN VEGETATION ALONG A MECHANICALLY SLOPED BANK.

The landowner identified 2 concerns for these project areas. The irrigation diversion on Daisy Dean Creek has begun to undercut, and he will seek a 310 permit to armor the structure. In addition, the off-channel stock water freezes in early winter, and requires frequent chipping to remove ice to supply water to cattle.

Conclusions

The FFIP investment on Elk and Daisy Dean creeks has provided benefits to fish and water quality, with improved riparian health and function, and greatly reduced sediment loading to streams. Armoring the head-gate is desirable from the landowner's perspective, and will also prevent its failure, which would have negative consequences on fish habitat and water quality. Replacing the existing off-channel water with heated livestock waterers would maintain a constant source of fresh water throughout the winter months, and eliminate the need for ice removal.

EMIGRANT SPRING CREEK (009-2004)

Background

Emigrant Spring Creek is an unmapped stream that joins the Yellowstone River between Emigrant and Corwin Springs. Before restoration, livestock had considerable negative effect on riparian health and function, substrate composition, stream morphology, and habitat for fish (Figure 36). Field surveys found low numbers of Yellowstone cutthroat trout and rainbow trout spawning in Emigrant Spring Creek, but neither species appeared to spawn in the stream yearly. Because it maintains adequate flow throughout the summer, this stream had potential to support a spawning run of Yellowstone cutthroat trout and rainbow trout.

FIGURE 36. EMIGRANT SPRING CREEK BEFORE RESTORATION.

Restoration of Emigrant Spring Creek included several components. Improvements in irrigation efficiency decreased the water used, while maintaining crop production. The savings in water augmented water flowing through the stream. Because livestock were the primary disturbance, fencing the riparian corridor allowed for management of livestock's access to the stream. A water gap provided water to the cattle in the neighboring pasture. Grazing pressure was substantially reduced within the stream corridor, with a dramatic decrease in stocking rates and duration of use. All improvements were completed by 2003.

Channel restoration entailed deepening and narrowing the channel with an excavator, and removing a considerable volume of nutrient rich muck. Spawning gravel was imported to the site. New banks were constructed using stacked sod mats, with wetland sod being harvested on site.

In 2007, FWP counted redds and made observations on the health and function of the riparian area, channel stability, and streambed material. Yellowstone cutthroat trout and rainbow trout were likely using Emigrant Spring Creek, and the great size of some of the redds suggested superimposition of several redds (Figure 37). Most of the redds were downstream of the restored reach, although "test redds" or digs, were found throughout the restored reach (Figure 38). For much of the stream, bed material was suitable for spawning, the riparian area was functioning, and the channel was stable. The light grazing pressure did not have an appreciable effect on stream conditions.

FIGURE 37. EXAMPLE OF NEWLY CONSTRUCTED REDD IN EMIGRANT SPRING CREEK IN 2007.

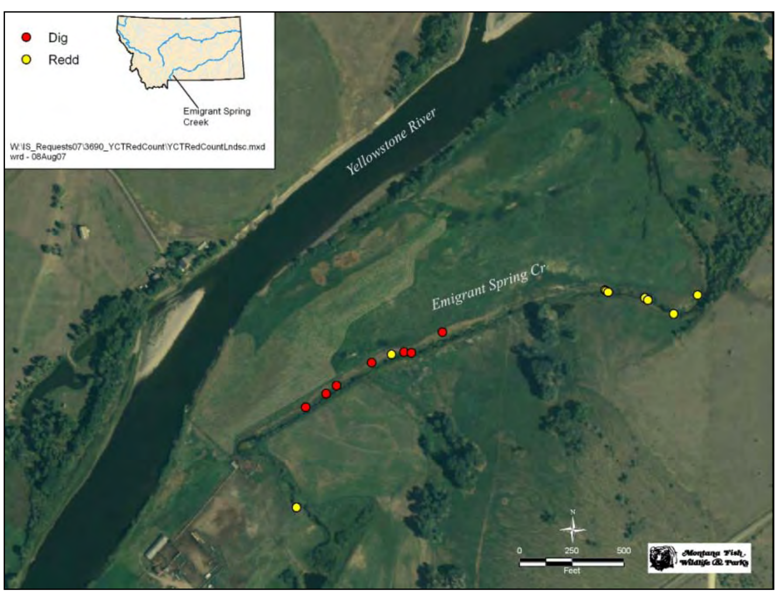


FIGURE 38. MAP OF REDDS AND DIGS ("TEST REDDS") ON EMIGRANT SPRING CREEK, JUNE 2007.

Field Assessment 2016

On May 26, 2016, FWP field observers Shannon Bockmon and Carol Endicott walked the length of the riparian exclosure and restored reach. Riparian vegetation, primarily sedges, which are typical of spring creeks with saturated soils, remained dense, and effective at protecting stream banks from erosion (Figure 39). The grazing management plan allowed for grazing within the riparian exclosure. Manure within the exclosure indicated cattle grazing occurred within the riparian exclosure; however, grazing pressure was light, and there was no evidence of hoof shear, or other disturbance to stream banks. Sandhill cranes had a nest adjacent to the stream, within the dense sedges.

FIGURE 39. EXAMPLE OF RESTORED REACH SHOWING THE NARROW AND DEEP CHANNEL, AND DENSE SEDGES STABILIZING BANKS.

A substantial change in bed material occurred since the 2007 assessment. In 2007, clean spawning gravel was present along most of the restored reach, and in relatively high gradient reaches downstream of the restored reach. By 2006, the gravel bed in the restored reach had been buried under 4 to 6 inches of muck, which rendered this reach unsuitable for spawning (Figure 40). Suitable spawning gravel remains in the higher gradient reach downstream of the restored reach (Figure 41).


FIGURE 40. EXAMPLE OF EXTREME SILTATION OF STREAMBED IN RESTORED REACH.


FIGURE 41. GRAVEL SUITABLE FOR SPAWNING DOWNSTREAM OF THE RESTORED REACH.

A component of the grazing management plan was installation of a water gap to allow cattle limited access to the stream (Figure 42). The water gap is effective at controlling livestock, while providing stock water. The water gap restricts cattle to about 20 feet of stream in order to access water.


FIGURE 42. WATER GAP ALLOWING CATTLE ACCESS TO WATER.

In mid-May, FWP installed a fish trap at the downstream end of the riparian exclosure. Typically, when trout are ascending a tributary to spawn, they stage in deeper water; however, no staging fish were observed during the near daily check of the fish trap. In addition, no fish were captured in the fish trap between its installation in mid-May and removal in mid-July. During the field assessment, a single rainbow trout that had likely ascended Emigrant Spring Creek to spawn was present. No redds were observed in the stream.

On July 14, 2016, FWP electrofished 1000 ft of Emigrant Spring Creek, beginning at the fish trap. Brown trout were the most abundant species, with nearly 60 fish captured. These fish ranged in size from 2.5 to 12 inches, with only 12 fish exceeding 4.5 inches. The presence of 4 rainbow trout less than 2 inches suggested some successful spawning by rainbow trout, although no redds were observed. In its current condition, Emigrant Spring Creek provides substantial rearing habitat for brown trout.

On July 27, 2016, Carol Endicott, Michelle McGree (the FFIP officer), and Jonathan Ferree (FWP's fluvial geomorphologist) revisited Emigrant Spring Creek to delve further into the apparent lack of spawning, deep accumulation of fine sediment on the streambed, and channel widening. Width-to-depth ratios were greater than the design specifications, and the existing channel was unable to transport fines. The pliable nature of sedge-lined bank margins may allow water pressure to push banks laterally at higher flows, thereby increasing channel width, and decreasing sediment transport.

Conclusions

Initially, the Emigrant Spring Creek restoration project showed promise, with an assessment in 2007 finding numerous large redds and exposed gravel along most of the stream. By 2016, several inches of muck had covered the gravel streambed along most of its restored length, with the wider channel geometry being unable to transport the fines. The remaining exposed gravel was outside of the restored reach of channel. No fluvial fish were captured during the approximately 3 months a trap was deployed.

Multiple sources may be contributing to accumulation of fine sediment within the restored reach. Given enough time, atmospheric deposition of fines may be sufficient to create the current conditions, and as a spring creek, the stream does not experience flushing flows to transport fines out of the stream. Alternatively, the fines could be sourced from the channel margin as the higher flows widened the channel. Loading from the nearby corrals is likely negligible, as a substantial herbaceous buffer lies between the corrals and the stream.

The restored reach no longer provides suitable spawning habitat. Nevertheless, the higher gradient reach downstream that had numerous redds in 2007 also lacked any evidence of spawning. Whirling disease is a potential causal factor, and the cool temperatures and deep mud provide ideal habitat for *Tubifex tubifex*, the worm host for infective parasite.

Although the project has not met its conservation goal of providing spawning habitat over the longer-term, the project has been beneficial in terms of water quality, and habitat for wildlife. The amount of sediment and nutrients has been reduced with riparian fencing. Suspended sediment has been greatly reduced. In addition, the thick sedges provide high quality nesting habitat for ducks and sandhill cranes. Maintaining in-stream flow has also been advantageous in supporting habitat for resident fish and rearing brown trout, which is consistent with FFIP goals.

ESP/CHAMBERS SPRING CREEK (045-1998 & 011-2002)

Background

Esp Spring Creek (sometimes called Chambers Spring Creek) is a small spring-fed tributary to the Yellowstone River that joins the Yellowstone River about 10 miles downstream of Big Timber, MT. Yellowstone cutthroat trout, brown trout, rainbow trout, sculpin, longnose dace, brook stickleback, white sucker, and mountain sucker occupy its 0.3 mile length.

The goal of this project was to provide fish passage and spawning habitat for fluvial Yellowstone cutthroat trout. Barriers near the mouth of the stream prevented upstream migration of Yellowstone cutthroat trout. Furthermore, the habitat in Esp Spring Creek was degraded to the point that mechanical channel restoration was warranted. No pre-project photos were available; however, design drawings detail the existing conditions, and restoration design (Figure 43). Restoration included providing passage through construction of step-pools, constructing a deeper, more sinuous channel, creating spawning habitat, and restoring riparian vegetation health and function by controlling livestock adjacent to the stream.

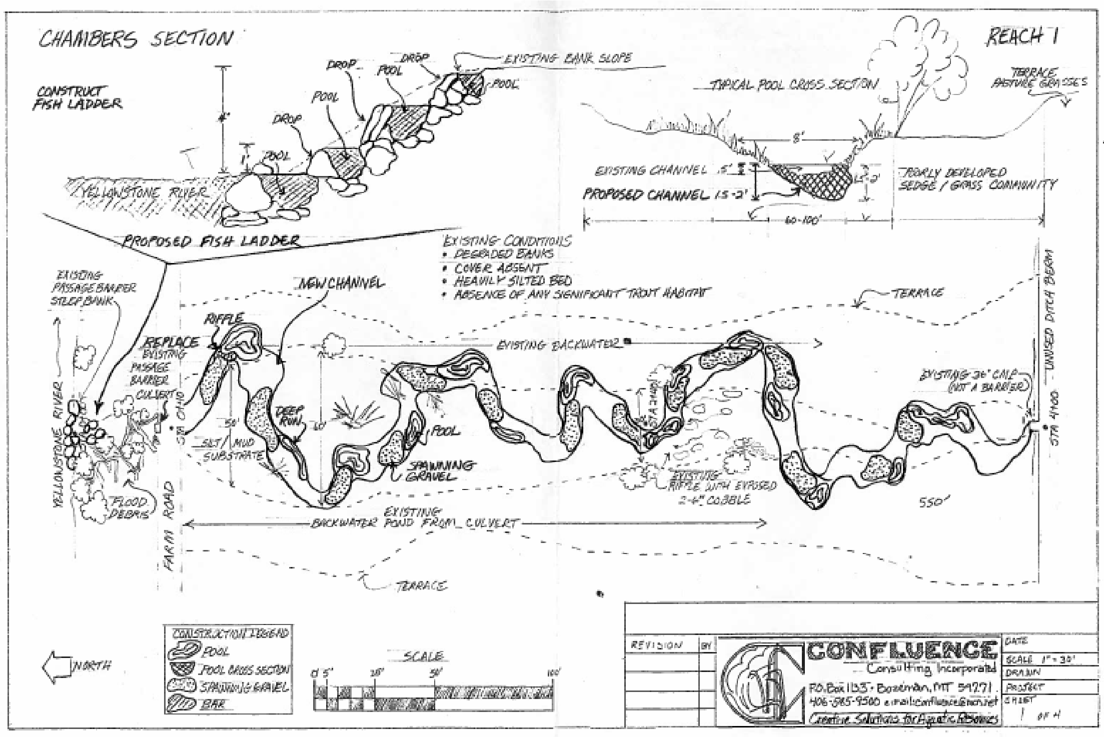


FIGURE 43. EXAMPLE OF DESIGNS FOR FISH PASSAGE AND CHANNEL RESTORATION IN ESP SPRING CREEK.

Field Assessment 2016

On August 10, 2015, Shannon Bockmon, and Charles Roloff, District Conservationist with the NRCS, visited the Esp Spring Creek project. Mr. Roloff collaborated with FWP on this project, and provided valuable historical perspective.

The step-pool feature constructed at the mouth of Esp Creek had largely been washed away, likely from the force of ice jams and flood flows (Figure 44). Passage is likely possible at this location; however, elimination of the step-pools has decreased the ability of fish to access Esp Spring Creek.

FIGURE 44. CONFLUENCE OF ESP SPRING CREEK WITH THE YELLOWSTONE RIVER, SHOWING ABSENCE OF CONSTRUCTED STEP-POOLS.

Channel reconfiguration, riparian area recovery, and availability of spawning habitat continued to meet the goals for high quality habitat. Dense willows occupied the riparian area and substantially exceeded what was present pre-project (Figure 46). Fencing livestock off the channel, except for at a water gap (Figure 45), promoted riparian health and vigor. Hardening with addition of gravel would decrease sediment loading from this discrete location. Likewise, the channel retained the constructed plan form and width-to-depth ratios. The stream supported numerous areas with high quality spawning gravel (Figure 47). Macrophytes occupied much of the stream; however, stream flow is sufficient to limit growth of aquatic plants, and flush sediment through the stream.

FIGURE 45. WATER GAP ON ESP SPRING CREEK.

FIGURE 46. RESTORED AND FENCED REACH OF ESP SPRING CREEK.

FIGURE 47. PATCH OF SPAWNING GRAVEL

Conclusions

The goal of the Esp Spring Creek restoration project was to provide spawning habitat for Yellowstone cutthroat trout. Yellowstone cutthroat trout have become relatively rare in that reach of the river and too few fish may be present to support a run. On the other hand, channel restoration and grazing management have greatly improved stream health and fish habitat from the pre-project state. These improvements benefit the resident fishery, and fish from the Yellowstone River may still be able to access the stream. Trapping spawners or fry, or conducting redd counts would be useful in evaluating the extent to which fish are spawning in Esp Spring Creek. Note that this project is now 20 years old and many of the restoration goals are still being met.

FISHTAIL CREEK CORRAL RELOCATION (031-2006)

Background

Fishtail Creek is a tributary of West Rosebud Creek, which is in the Stillwater River watershed. Fishtail Creek joins West Rosebud Creek near Fishtail. Brown trout are abundant, and rainbow trout, suckers, and longnose dace are also present. As it retains adequate flows through the summer months, Fishtail Creek supports a recreational fishery of substantial value.

The goal was to improve water quality, by decreasing nutrient, sediment, and thermal loading to Fishtail Creek. This project entailed moving a corral off-stream, and providing stock water at the new location. The corral experienced heavy use by livestock, and had considerable accumulation of manure, and negligible vegetation to trap sediment or nutrients before entering the stream (Figure 48). Runoff from the new corrals would be diverted away from the stream. Other components included installation of watering devices within the new, off-channel corrals.

FIGURE 48. VIEW OF THE CORRAL THAT WAS ON FISHTAIL CREEK.

Field Assessment 2016

On August 11, 2016, Shannon Bockmon, accompanied by the landowner, evaluated the Fishtail Creek corral relocation project. The corral had been moved, and the berm that redirected runoff away from the stream had been constructed, and remained functional. The riparian area had improved substantially since project implementation, and aspens were beginning to recruit (Figure 48). Weeds remained a problem within the footprint of the former corral, although efforts to control weeds are ongoing. The landowner found the off-channel watering devices to be superior to watering stock from the stream. With the exception of last winter, the holding tank has not frozen. Determination of whether the watering device has a heated element to keep stock water from freezing would be useful. These features are optional in commercially available livestock waterers.

FIGURE 49. FORMER LOCATION OF CORRALS ON FISHTAIL CREEK.

FIGURE 50. OFF-STREAM LIVESTOCK WATERING DEVICE IN THE CORRAL ADJACENT TO FISHTAIL CREEK.

Conclusions

The Fishtail Creek corral relocation was successful and appropriate use of FFIP funds. By moving an area of concentrated animal use off-stream, and diverting run-off away from the stream, the project resulted in considerable reduction in sediment and nutrient loading to the creek. In addition, the riparian area has been healing, and regaining its health and function. The off-channel watering devices are an effective means to provide stock water yearlong, and ensure livestock get sufficient water, while limiting their access to riparian areas and stream banks.

FLESHMAN CREEK CHANNEL AND RIPARIAN RESTORATION (006-2009)

Background

Fleshman Creek is a tributary of the Yellowstone River, and originates in the Bangtail Mountains, west of Livingston. In its upper reaches, Fleshman Creek flows through agricultural and rangelands, and supports apparently nonhybridized Yellowstone cutthroat trout in its headwaters. Its last 2 miles flow through the City of Livingston. Fleshman Creek has been the subject of several restoration actions, with most focusing on the reach through Livingston. This project area was in the lowermost agricultural reach on Fleshman Creek, and was just upstream of where Fleshman Creek entered residential neighborhoods. Combined, these projects have the goal of improving water quality, flood conveyance, fish habitat, and increase the use of Fleshman Creek for spawning by fluvial fish from the Yellowstone River, including Yellowstone cutthroat trout. Other species include rainbow trout, brown trout, rainbow × Yellowstone cutthroat trout hybrids, and native suckers and minnows.

Livestock use in the project area had been heavy for decades, resulting in severe degradation of riparian health and function, extreme siltation, and a lack of channel definition for much of its length (Figure 51). The deep accumulation of mud within the existing channel made electrofishing challenging, as fieldworkers wading the stream would get bogged in the mud. In addition, actively eroding terraces were contributing large quantities of fine sediment (Figure 52). Decades of accumulation of manure adjacent to the stream was a source of nutrients, which further contributed to degraded water quality.

FIGURE 51. PRE-RESTORATION VIEW OF FLESHMAN CREEK.

FIGURE 52. EXAMPLE OF AN ERODING TERRACE ON FLESHMAN CREEK WITHIN THE PROJECT AREA.

Actions to restore Fleshman Creek included installing riparian fencing, fenced stream crossings, and off-stream stock water, which allowed control of livestock in and around the stream. Given the extent of the channel degradation, a lack of locally available wetland sod, and absence of a gravel substrate, the channel restoration component required construction of a new channel, and importation of materials from off-site.

In constructing a new channel, the old channel was mostly abandoned, with spoils from the newly excavated channel used in filling the old channel. A narrower, deeper channel was constructed, and gravel was trucked in, and installed in the new channel. Stream banks were constructed of coir fabric encapsulated soil lifts (Figure 53). The fenced stream crossings were constructed using a bottomless arch culvert, along with 2 overflow pipes set at the bank full elevation. Bottomless arch culverts are desirable for aquatic organism passage, as they have the same substrate as the neighboring streambed, and have a ledge of rock constructed at the bank full elevation.

FIGURE 53. EXAMPLE OF NEWLY CONSTRUCTED CHANNEL ON FLESHMAN CREEK AND STREAM CROSSING WITH BOTTOMLESS ARCH CULVERT AND OVERFLOW PIPES.

The revegetation component entailed collaboration among the NRCS, FWP, and Park High School. These parties collected willow stems from the Yellowstone River, while in fall dormancy. The NRCS soaked the willow stems over winter, and the same collaborators installed the dormant willow sprigs into the bank full margins of the newly constructed channel the following spring. As the entire pasture was denuded of vegetation, or had considerable infestations of weeds, the area was seeded with a native seed mix.

Field Assessment 2016

On June 2, 2016, Shannon Bockmon and Carol Endicott visited the Fleshman Creek restoration project, and documented remarkable improvement from pre-project conditions, and evidence that the restoration efforts were effective in restoring Fleshman Creek. The riparian fencing was in place (Figure 54), as were the off-channel water sources.

FIGURE 54. RIPARIAN FENCING INSTALLED TO CONTROL LIVESTOCK AROUND FLESHMAN CREEK.

The channel was relatively narrow and deep, and other than the formation of desirable, undercut banks, minimal lateral movement had occurred since the channel was constructed in 2009 (Figure 55). Willow survival and recruitment was impressive, with well established stands of willows exceeding 9 feet occurring along most of the stream. In the few locations where willows had not become established, the coir fabric and seeding was effective in creating a stream bank that was indistinguishable from a natural bank (Figure 56).


FIGURE 55. EXAMPLE OF CONSTRUCTED RIFFLE, ESTABLISHED WILLOWS, AND UNDERCUT BANKS ON FLESHMAN CREEK.


FIGURE 56. OUTER MEANDER BEND SHOWING STABLE BANK CONSTRUCTED WITH COIR FABRIC ENCAPSULATED SOIL LIFTS. (NOTE THAT PHOTO WAS TAKEN IN EARLY JUNE, AND GROUND COVER WAS BEGINNING TO GROW FOR THE SEASON.)

Although the current condition was a marked improvement from pre-project conditions, livestock were having a small, but noticeable effect on stream banks. Localized areas of bank trampling and stock trails were present at several locations. Consultation with NRCS on the grazing management strategy developed for this site, and evaluation of modifications to limit trailing are warranted to protect the investment.

FIGURE 57. BANK TRAMPLING AND STOCK TRAILS ON FLESHMAN CREEK.

Conclusions

The Fleshman Creek restoration project resulted in tremendous improvements in a reach of stream that had been highly degraded. The constructed channel had maintained its plan form and longitudinal profile, despite being subjected to a substantial flood in 2011. Riparian health and function had been restored from bare soil, manure, and weeds, to relatively dense stands of maturing and recruiting willows. The seeding had been successful in establishing sedges and grasses along the banks and elsewhere within the pasture.

Fencing has been largely effective in controlling livestock around the stream; however, limited grazing within the fenced riparian pasture is part of the grazing management strategy. Further investigation into the sufficiency of the strategy to protect the stream is warranted.

The road crossings were effective in allowing the producer to move cattle, while protecting the riparian zone and stream channel. The bottomless arch culverts were effective in providing stream habitat under the crossing, fish passage, and debris conveyance. Yearly inspection of the overflow pipes in spring, before runoff, is recommended, as plant growth can obscure the pipes, and limit their ability to convey high flows.

An ancillary component of this project relates to the educational opportunities it provides students at Park High School. In addition to being involved in restoration, high school students are monitoring water quality, and other measures of stream health in the restored reach of Fleshman Creek. Combining restoration with educational opportunities fosters scientific knowledge and an understanding of the importance of conservation in the next generation.

KICKABUCK SPRING CREEK SPAWNING HABITAT ENHANCEMENT (010-2009)

Background

Kickabuck Spring Creek is a small unmapped spring creek that joins the Yellowstone River downstream of Big Timber. The goal of the project was to provide spawning habitat for Yellowstone cutthroat trout in the Yellowstone River downstream of its confluence with the Shields River. This reach of river maintained relatively high numbers of Yellowstone cutthroat trout through the late 1990s, but the population had diminished considerably since. Kickabuck Spring Creek had poor quality habitat for spawning; however, flow appeared sufficient during the Yellowstone cutthroat trout spawning, incubation, and outmigration periods to support a run. Moreover, as a spring creek, water temperatures would be within the optimal range for growth of cutthroat trout. The landowners were highly supportive of an enhancement project to provide suitable spawning habitat.

Before project implementation, channel morphology and gradient varied along the length of Kickabuck Spring Creek. In its upper half, the stream had low gradient, a relatively wide and shallow channel, and a mud streambed (Figure 58). In the lower half of the stream, the channel became deeper and narrower (Figure 59). The higher gradient exposed gravel suitable for spawning (Figure 60).

FIGURE 58. TYPICAL CHANNEL MORPHOLOGY IN THE UPPER HALF OF KICKABUCK SPRING CREEK BEFORE ENHANCEMENT.

FIGURE 59. TYPICAL CHANNEL MORPHOLOGY IN LOWER HALF OF KICKABUCK SPRING CREEK.

FIGURE 60. STREAMBED IN THE LOWER HALF OF KICKABUCK SPRING CREEK.

The stream has an atypical flow pattern. The channel conveys little water from late winter through early spring. The initial rise in stream flow and groundwater follow spring runoff in the Boulder and Yellowstone rivers, with water quantity increasing as these rivers saturated their alluvial aquifers. Irrigation return flows from the Boulder River likely keep flows elevated into winter.

Kickabuck Spring Creek has been visited several times since construction. For several years, the channel cross-sectional dimensions (Figure 61) and plan form (Figure 62) remained unchanged, and spawning gravel was exposed and clean. In late fall of 2009, the stream teemed with juvenile mountain whitefish, which was atypical, as whitefish typical seek larger water to overwinter. Subsequent visits during the Yellowstone cutthroat trout spawning season did not yield observations of fluvial fish or redds.

FIGURE 61. RECONSTRUCTED CHANNEL AND IMPORTED SPAWNING GRAVEL.

FIGURE 62. VIEW OF THE RECONSTRUCTED PLAN FORM ON KICKABUCK SPRING CREEK.

Field Assessment 2016

On June 1, 2016, Shannon Bockmon and Carol Endicott visited the Kickabuck Spring Creek enhancement project. Channel geometry had changed significantly, with the channel being considerably wider, and aquatic and terrestrial plants were growing within the channel during this period of low stream flow. In many places the accumulation of fine sediment was greater than 6 inches deep. Despite poor habitat and low flow, small fish, which were potentially brown trout fry, were exceptionally abundant. Two weeks later, we deployed minnow traps baited with Balls O'Fire™ fish bait; however, the fry were no longer present. The traps captured sculpin and a longnose dace.

On July 27, 2016, Carol Endicott, Michelle McGree, and Jonathan Ferree, all from FWP, visited Kickabuck Spring Creek to evaluate the cause of channel widening and extreme sedimentation. Among the observations was that the Kickabuck Spring Creek, and its wet meadow, is perched above the level of the Yellowstone River, resulting in a lush area with floating sedge meadows. Stream flows increase considerably through late summer and fall, and appear to exert lateral force on the soft, yielding sedge banks. As a result, the channel has become wider and shallower than what was constructed.

Conclusions

Kickabuck Spring Creek has not been successful in meeting its original goal of establishing a spawning area for fluvial Yellowstone cutthroat trout. Factors affecting this outcome include a decrease in fluvial Yellowstone cutthroat trout in neighboring Yellowstone River, the entombment of spawning gravels under several inches of muck, along with the widening of the constructed channel. The potential for spawning by brown trout needs more investigation. No redds have been seen during fall months; however, the abundant small fish present in June suggests brown trout spawn in the stream. Additional attempts at redd counts in fall, and trapping fry in spring are warranted to evaluate Kickabuck Spring Creek's potential to contribute to brown trout recruitment.

LOWER DEER CREEK FISH BARRIER (011-2010)

Background

Lower Deer Creek is a tributary of the Yellowstone River that joins the Yellowstone about 8 miles downstream of Big Timber. Yellowstone cutthroat trout and brown trout reside in Lower Deer Creek, with brown trout outnumbering Yellowstone cutthroat trout, although Yellowstone cutthroat trout increased in relative abundance in the headwaters. Genetic analyses found only nonhybridized Yellowstone cutthroat trout until 2005, when 8 hybridized fish were found on private lands about 3 miles downstream from the Custer Gallatin National Forest boundary. As protection of nonhybridized populations of Yellowstone cutthroat trout is the highest conservation priority, the presence of hybrids resulted in an urgent need to intervene. In 2010, FWP constructed a barrier on state land, and the FFIP contributed towards the cost of design and construction. The barrier location provided over 11 miles of protected habitat, which would allow for a relatively large population size, with the ability to persist over the long-term, in absence of nonnative species.

FIGURE 63. NEWLY CONSTRUCTED BARRIER ON LOWER DEER CREEK.

A second element of protecting this isolated population of Yellowstone cutthroat trout was removal of brown trout. Yellowstone cutthroat trout had persisted alongside brown trout for 60 years in Lower Deer Creek; however, their relative abundance was decreasing. A marked reversal in the relative abundances of Yellowstone cutthroat trout and brown trout in other streams suggested long-term persistence of Yellowstone cutthroat trout was at risk due to the presence of brown trout. Constructing a barrier and removing brown trout provided the nonhybridized Yellowstone cutthroat trout in Lower Deer Creek the best chance at long-term persistence.

The barrier was constructed in November 2010. In spring of 2011, high snowpack and spring rains resulted in peak flows approaching a 500 year flood. Examination of the barrier after this event found the pool upstream of the barrier had filled in entirely with cobbles, which was desirable, as flow and debris will not exert pressure on the wall in future floods. Conversely, cobbles had accumulated on the downstream apron, which caused concerns for backwatering or providing roughness that would allow nonnatives to breach the barrier. An old wheelbarrow became jammed against the upstream wall of the barrier, and bed load transported over the wheelbarrow scoured a hole in the concrete of the apron. This scour hole was repaired the following summer.

Rotenone treatment occurred in late August 2010. Electrofishing crews salvaged as many Yellowstone cutthroat trout as possible over 4 days. The rotenone treatment lasted 4 days, and the Yellowstone cutthroat trout were returned to Lower Deer Creek as soon as treatment stopped.

Field Assessment 2014

In 2014, Jason Rhoten the area fisheries biologist with FWP visited the barrier location. His objectives were to evaluate 2 aspects of the project: was the barrier structural stable, and was it functioning to prevent invasion of nonnative species. The structure remained structurally sound and functionally operational as a fish barrier. Periodic inspection, especially following large flow events, is warranted to inspect for damage, clear debris, and conduct repairs as warranted.

In addition to barrier construction, Mr. Rhoten and his field crew electrofished several miles of Lower Deer Creek and Placer Gulch, a known spawning tributary. Yellowstone cutthroat trout were abundant, an array of year classes were present, and size and fitness of fish suggested a plentiful forage base. Age-1 fish were super-abundant in Placer Gulch, indicating this stream remained an important, productive spawning area and nursery for Yellowstone cutthroat trout. No brown trout were found, nor have anglers reported catching brown trout; therefore, the single rotenone treatment was likely successful in removing this nonnative species. Overall, indicators of the health of this fishery were consistent with a thriving population of Yellowstone cutthroat trout that was free from threats of nonnative species.

Conclusions

The Lower Deer Creek project has been successful in securing a substantial amount of stream habitat for nonhybridized Yellowstone cutthroat trout, without pressure from nonnative species. The lack of brown trout in the 2014 sampling event indicates the single rotenone treatment was successful in removing this nonnative species. The barrier has prevented upstream movement of nonnatives since its construction. The explosive growth of the Yellowstone cutthroat trout population is typical of populations that are freed from competition with nonnative species. As securing nonhybridized populations of cutthroat trout is the highest priority for cutthroat conservation in Montana, this project is an important conservation success.

In terms of barrier management, the tendency for cobbles to accumulate on the apron of the barrier underscores the need for periodic maintenance of barriers, especially after high flows. In addition, future barrier design should consider steeper aprons that would have more energy to transport bed load.

NELSON/ DANA SPRING CREEK CHANNEL RESTORATION (012-2005)

Background

Nelson/Dana Spring Creek (also known as Nelson Ditch) is a small stream that joins the Yellowstone River just south of Livingston, MT. Several springs feed this stream, and historically, the entire site likely was a patchwork of emergent wetlands within ancient river meanders. The flows had been routed through several channels that had been substantially altered from their historical condition, and did not provide suitable habitat for fish (Figure 64). Presumably, the ditches were excavated to capture and route groundwater, which would lower the water table, and replace wetland with pastureland. The channels were overly wide, and had a mud substrate. Riparian vegetation was limited to sedges growing in a swampy, channel-adjacent strip. The channels converged for the last 500 feet of channel before entering the Yellowstone River.

FIGURE 64. PRE-PROJECT PHOTO OF AN EXCAVATED CHANNEL FEEDING THE NELSON/DANA SPRING CREEK.

The landowners were interested in enhancing the fish and wildlife resource values of this aquatic feature, with emphasis on creating spawning habitat for Yellowstone River resident fish. Specific actions varied among the 7 reaches delineated within the project area (Figure 65). Typical treatments included narrowing and deepening channels, excavating pools, providing woody debris, construction of new banks with sod mats, construction of reaches of channel, and willow plantings.

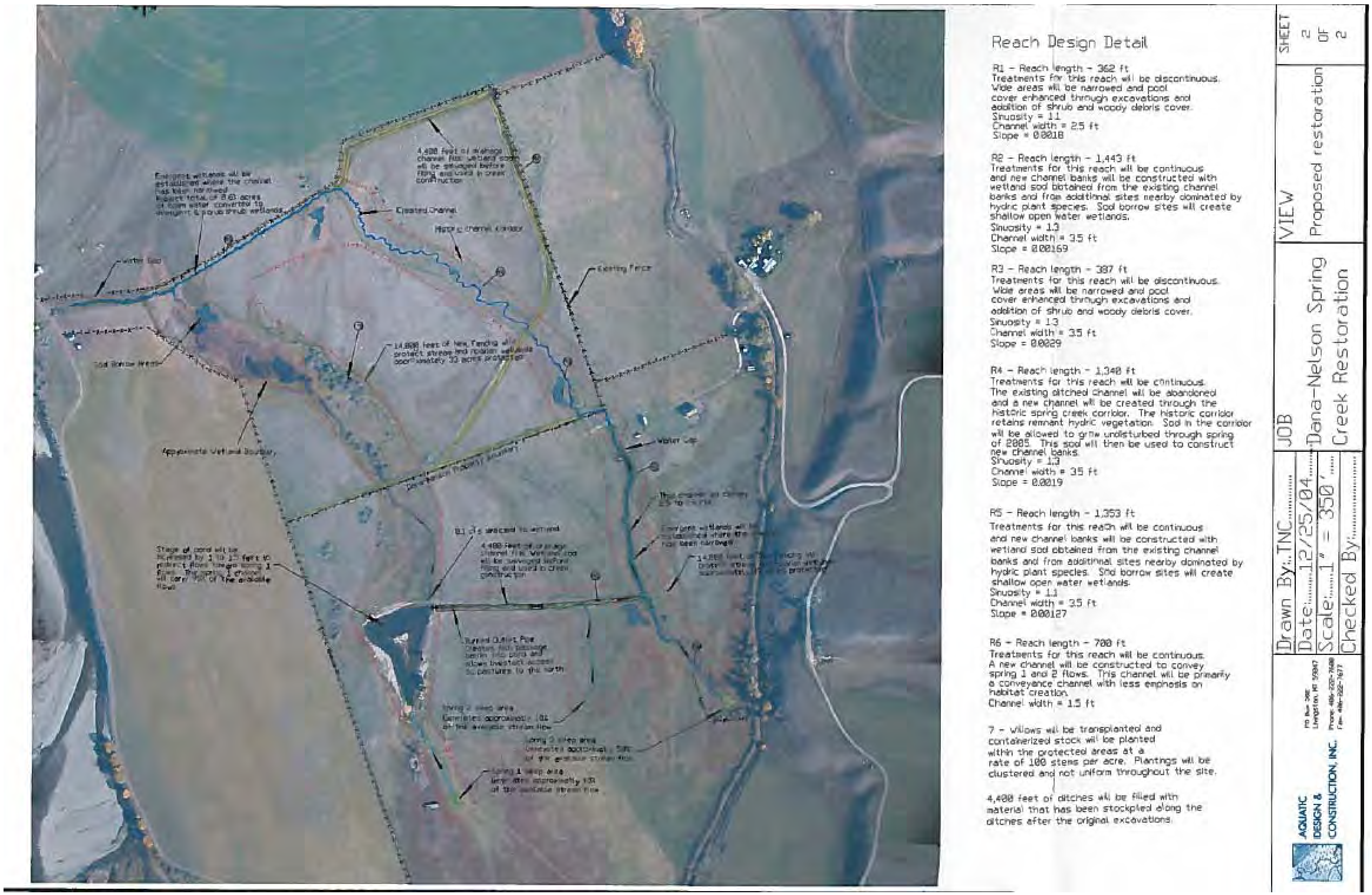


FIGURE 65. DESIGNS FOR THE NELSON/DANA SPRING CREEK RESTORATION.

Field Assessment 2016

On July 5, 2016, Shannon Bockmon visited the Nelson/Dana Spring Creek project, accompanied by the landowner. A beaver dam near the mouth was the first feature noted (Figure 66). According to the landowner, high flows in the Yellowstone River remove beaver dams near the mouth in most years; however, low peak flows did not flush out the dam. He also reported seeing Yellowstone cutthroat trout ascending the spring creek in most years.

FIGURE 66. BEAVER DAM ON NELSON/DANA SPRING CREEK.

Installation of a hardened water gap was a component of the project that allowed livestock access to water, while protecting the riparian area and stream banks (Figure 67). Outside this small area of livestock access, the riparian area was thriving. A mature, thick stand of willows provided considerable benefit to the stream and fisheries by shading the stream, providing overhead cover, and maintaining channel stability.

FIGURE 67. WATER GAP FOR WATERING LIVESTOCK ON NELSON/DANA SPRING CREEK.

The constructed and enhanced stream channel had maintained its narrow and deep cross-sectional morphology for the stream's entire length (Figure 68). The sedge banks provided considerable undercut bank habitat. Aquatic macrophytes, which are typical of spring creeks, were dense in places; however, sufficient flow existed to limit their cover, and areas of spawning gravel remained exposed.

FIGURE 68. TYPICAL VIEW OF THE CONSTRUCTED AND ENHANCED CHANNEL ON NELSON/DANA SPRING CREEK.

FIGURE 69. SPAWNING GRAVEL IN NELSON/DANA SPRING CREEK.

Conclusions

The Nelson/Dana Spring Creek restoration and enhancement project has been successful in terms of providing high quality, small stream habitat. The landowner reported regular spawning runs of Yellowstone cutthroat trout; however, no data have been collected to document the size of the run, and relative numbers of fry recruited. Moreover, this stream supports a resident fishery, and no data are available on the resident fish population. Trapping adult spawners, fry trapping, and electrofishing would be useful in evaluating use by fluvial fish, fry production, and the health of the resident fishery.

PINEY CREEK POOL AND HABITAT ENHANCEMENT (033-2005 & 034-2009)

Background

Piney Creek is a small spring creek that emerges in juniper scrubland on the west side of the Pryor Mountains, south of Billings. The stream flows for about ¾ miles before being diverted into several irrigation canals (Figure 70). Piney Creek supports population of nonhybridized Yellowstone cutthroat trout. Piney Creek is the only stream in Shoshone River 4th code HUC (Figure 71), an area that encompasses the main stem of the Shoshone River watershed and minor tributaries, that supports an aboriginal population of Yellowstone cutthroat trout. Piney Creek comprises 1% of the historically occupied habitat in this HUC. As a nonhybridized population of Yellowstone cutthroat trout, securing this population is the highest priority under Montana's conservation strategy for cutthroat trout.

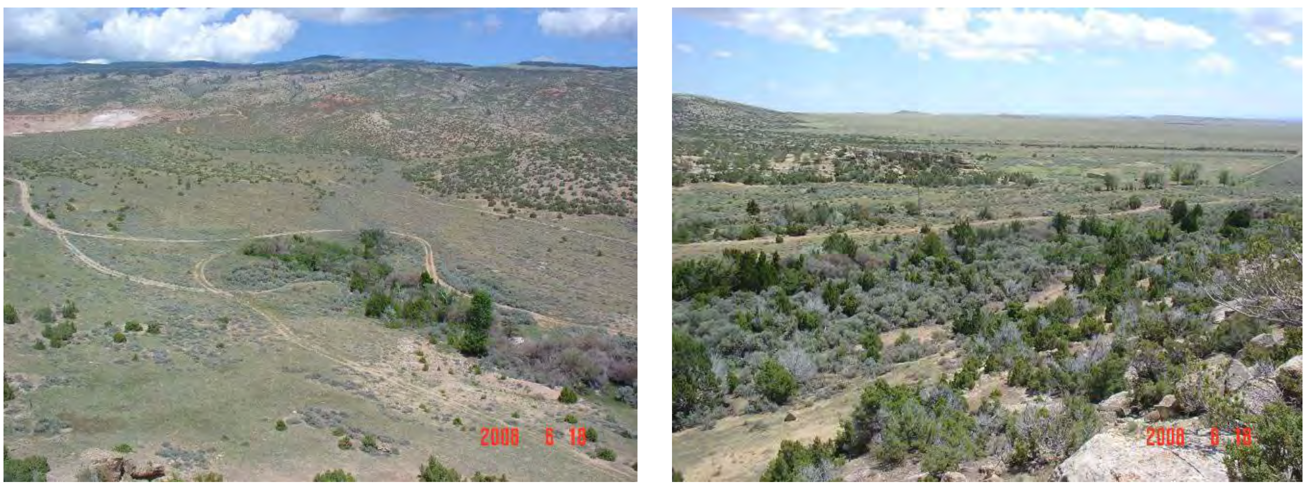


FIGURE 70. HEAD OF PINEY CREEK AND ITS VALLEY.

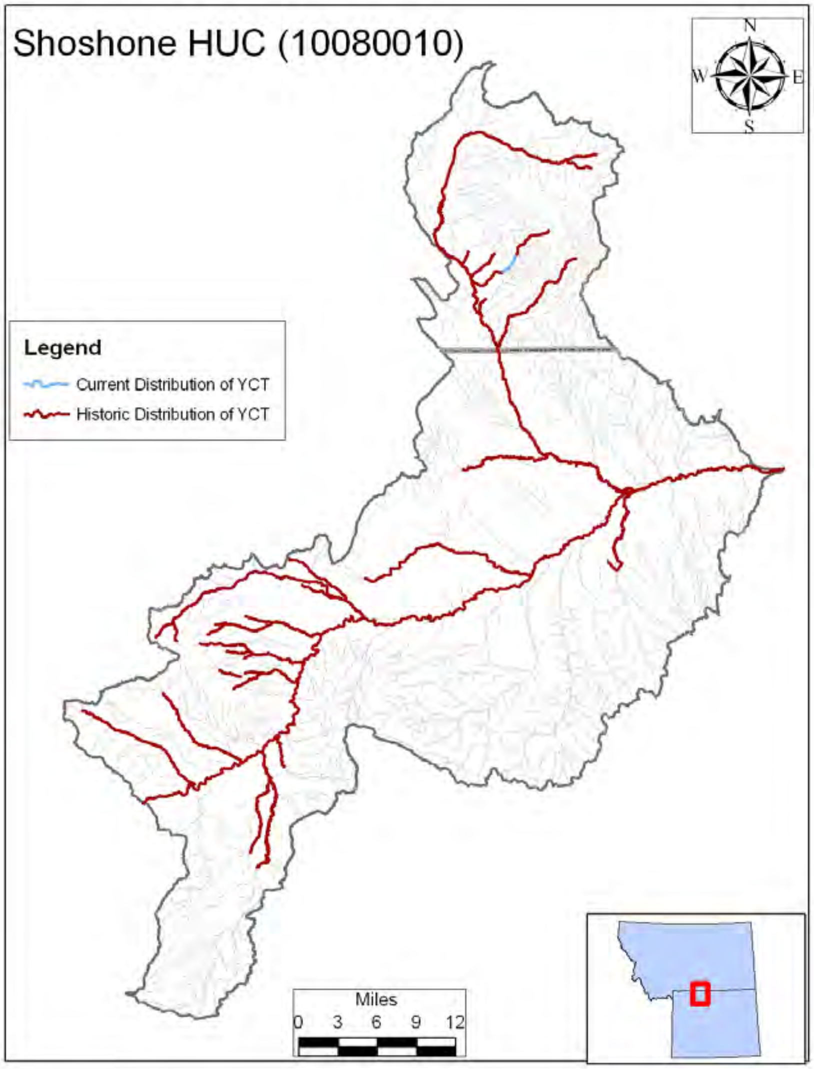


FIGURE 71. HISTORICAL AND CURRENT DISTRIBUTION OF ABORIGINAL YELLOWSTONE CUTTHROAT TROUT IN THE SHOSHONE RIVER HUC.

The extreme isolation, small population size, comprised habitat and documented loss to the irrigation ditches put Yellowstone cutthroat trout in Piney Creek at extreme risk for extirpation. The short extent of occupiable stream has the potential to support a tiny population, which could lead to problems associated with inbreeding. Likewise, no neighboring populations have access to Piney Creek in the event that a catastrophic event or the results of inbreeding were to eliminate the population. Comparison of electrofishing data from the 1990s and 2000s caused concern that drought had severely depressed Piney Creek's Yellowstone cutthroat trout population. The dense, low riparian canopy makes sampling Piney Creek difficult, as only a handful of discrete locations can be accessed, so fish density within areas of heavy riparian cover is indeterminable. However, markedly fewer fish were captured in the 2000s, compared to the mid-1990s, and extended drought was a probable stressor on the fish population. The BLM captured only 4 Yellowstone cutthroat trout in 2004.

A lack of high quality habitat presented another limitation on Piney Creek's Yellowstone cutthroat trout population. Pools were rare and present in a few locations where large rock or other structure allowed for scouring of the streambed. In addition, livestock grazing along portions of the stream impaired the health and function of riparian vegetation, and degraded habitat.

Along its short length, Piney Creek flows through national forest, BLM lands, and private property. The private landowners, FWP, CGNF, and BLM collaborated on efforts to improve habitat and prevent loss of fish to irrigation diversions. FFIP provided funds for prevention of entrainment and pool creation. The CGNF and BLM worked on grazing management, which included riparian fencing. In addition, the BLM added woody debris to promote scour of pool habitat.

In 2005, FFIP provided funds for the excavation of pools, to reverse the extreme shortage of this important habitat feature within Piney Creek. Given the small size of the stream, hand excavation using shovels was the chosen method. Unfortunately, the streambed was well armored, and shovels could not penetrate it in order to excavate pools. As a result, this project did not meet the objective of increasing pool habitat in Piney Creek.

Prevention of entrainment entailed construction of a berm to reactivate a pond in an existing depression, and installing standpipes that delivered water to the irrigation canals (Figure 72 and Figure 73). Waterman gates controlled inflows to the pipes. Fry and juvenile fish would be unlikely to be in the water column, near the top of the standpipe, and would not risk entrainment. Likewise, adult fish would be less likely to enter the standpipes, compared to the irrigation ditches, which were indistinguishable from natural streams. The creation of a large pool stored water for irrigation, but also increased overwintering habitat, and provided standing water habitat that was not present previously.

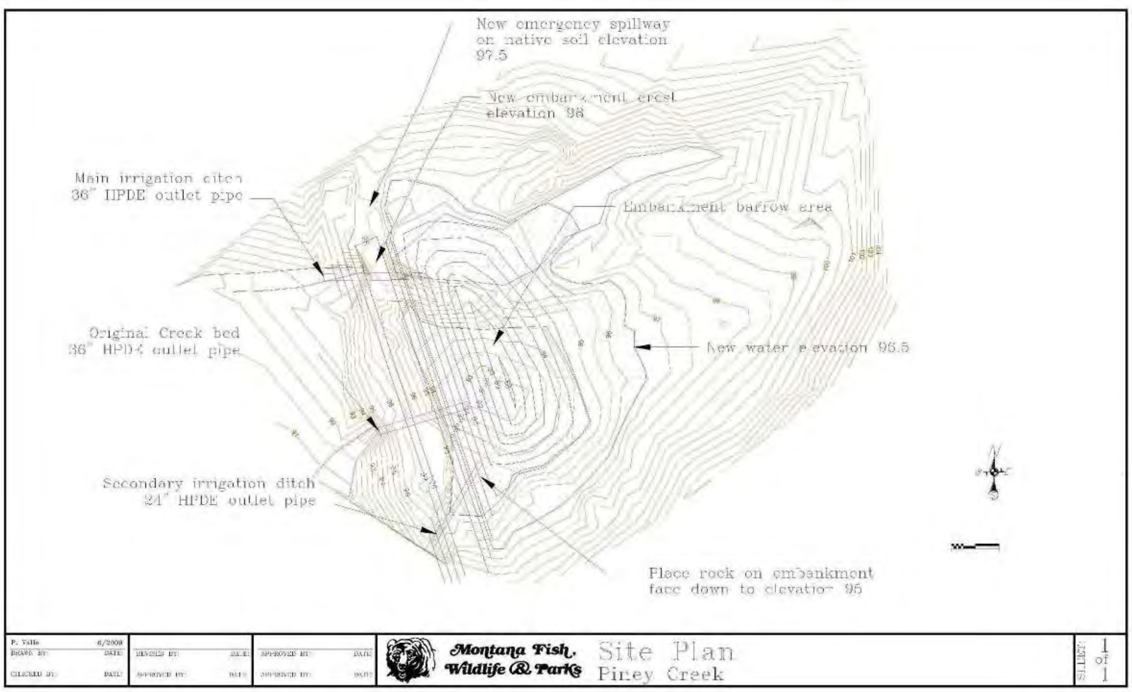


FIGURE 72. DESIGN FOR FISH ENTRAINMENT PREVENTION ON PINEY CREEK.

FIGURE 73. STORAGE POND AND GATED STAND PIPES SOON AFTER CONSTRUCTION.

Field Assessment 2016

On July 21, 2016, Shannon Bockmon and Mike Ruggles, FWP's area fisheries biologist evaluated entrainment prevention and habitat improvements on Piney Creek. In addition, they spot electrofished where possible, to evaluate Yellowstone cutthroat trout numbers in the stream. They collected fin clips from 50 Yellowstone cutthroat trout to evaluate the genetic status of this population.

The pond was full and delivering water to the canal through the gated standpipes (Figure 74). Numerous, relatively large Yellowstone cutthroat trout were visible in the pond. Willows had colonized the perimeter of the pond. This type of aquatic feature is rare to absent in this arid landscape, and provides a patch of habitat diversity.

FIGURE 74. STAND PIPE DIVERSION, AND INLET OF PINEY CREEK INTO THE STORAGE POND.

Given the density of the riparian vegetation, electrofishing was confined to discrete spots; however, over 50 fish were captured, which is a marked increase from the 4 that were captured in 2004. An apparently substantial increase in the number of fish in the stream, and the additional fish-bearing habitat in the pond indicates this project has been successful in increasing population size, which increases its resilience to disturbance and inbreeding.

The woody debris installed in Piney Creek had been effective in scouring new pools into the stream bed. Increased number and depth of pools improved the quality of habitat, and likely increased the carrying capacity, or number of fish the stream could support.

Conclusions

The Piney Creek habitat enhancement and entrainment prevention projects met the goals of increasing fish numbers in Piney Creek, and preventing loss of fish to irrigation and stock water systems. Although isolation and small population size remain as threats to the long-term persistence of this population, these actions have substantially increased the ability of the population to withstand environmental stressors. Continued evaluation of the genetic diversity of the population is warranted, with augmentation with nonhybridized brood stock occurring as deemed necessary by FWP's fish geneticist.

ROCK CREEK CULVERT FISH PASSAGE (016-2011)

Background

Rock Creek is a tributary of the Yellowstone River, and is located downstream of Corwin Springs, in upper Paradise Valley. In the early 1900s, the Northern Pacific Railroad Company constructed a concrete culvert that funneled Rock Creek under the rail line that ran from Livingston to Gardiner. This culvert was 70 feet long and had a slope of 7.5%. The combined length and velocity of water flowing through this structure made it a barrier to upstream movement, and fluvial Yellowstone cutthroat trout were excluded from spawning in Rock Creek. In the late 1970s, a fish ladder was installed, and connectivity was restored for several years, and substantial numbers of Yellowstone cutthroat trout fry were documented outmigrating from Rock Creek. This ladder failed in the early 1980s. As the culvert floor scoured, and debris clogged the culvert, some Yellowstone cutthroat trout were likely able to swim through the culvert, owing to the increased complexity and roughness. Nevertheless, these would need to be especially strong swimmers. Fry monitoring in 2009 found no fry upstream of the culvert.

FIGURE 75. RAILROAD CULVERT ON ROCK CREEK.

Protecting migratory life-history strategies is a high conservation priority under Montana's agreement for cutthroat trout conservation. The population in the upper Yellowstone River has substantial conservation value, as nonhybridized fish remain, despite presence of rainbow trout. The genetic status of these fish elevates the population to the highest conservation priority in securing cutthroat trout. Therefore, this project brings substantial conservation benefit. Moreover, Yellowstone cutthroat trout are common in the neighboring reach of the Yellowstone River, and provide a valued recreational fishery for anglers. Being able to catch large, native cutthroat trout, in a spectacular setting is a rare and special opportunity.

The solution to provide passage into Rock Creek was to remove the culvert, and construct a series of step-pools through the former footprint of the steep culvert (Figure 76). Design considerations included ensuring rock was large enough to remain in place, and placed so that current refugia existed at the channel margins at high flows.

FIGURE 76. NEWLY CONSTRUCTED STEP-POOL SEQUENCE.

To evaluate how early a spawning run of Yellowstone cutthroat trout would be established in Rock Creek, FWP implanted PIT tags in Yellowstone cutthroat trout, rainbow trout, and their hybrids caught in the Yellowstone River near Rock Creek. PIT tags use technology similar to microchips in pets. Two antennae installed under the county road bridge would register when a fish swam over the antennae, and identify the specific fish. The 2 antennae allowed for determination of direction.

The culvert removal and step-pool construction occurred in 2011, and in the following spawning season, PIT tag antennae registered 6 individual Yellowstone cutthroat trout, 2 rainbow trout, and 1 hybrid. The number of specifically identifiable fish increased in 2013, with 22 individual Yellowstone cutthroat trout passing under the bridge, and 7 rainbow trout. As fish in this reach of river have the choice of several tributaries, recolonization of Rock Creek the next 2 springs was sign of success. The progeny of these spawners will home to Rock Creek, and the run should grow within a few years.

In 2014, Michelle McGree, Jim Darling, and Carol Endicott evaluated the step-pool and the recovery of vegetation planted on the surrounding railroad berm. The boulders remained in place, and the feature appeared passable. Willows were beginning to recruit along the stream margin, and upland plantings on the re-sloped sides of the berm were doing well.

FIGURE 77. STEP-POOL SEQUENCE CONSTRUCTED TO PROVIDE FISH PASSAGE INTO ROCK CREEK.

Field Assessment 2016

As the step-pool structure had remained unchanged since the last assessment, monitoring in 2016 focused on fry recruitment. From August 3, 2016 through August 12, 2016, a fry trap was deployed upstream of the county road bridge (Figure 78). Fry traps consist of a rectangular frame, with a funnel net that leads to PVC pipes that in turn empty into a perforated, plastic box (Figure 79). The frame is set where it can capture the bulk of the stream flow.

FIGURE 78. LOCATION OF FRY TRAP ON ROCK CREEK, UPSTREAM OF CONSTRUCTED STEP-POOLS. SHANNON BOCKMON IS READY TO PROCESS TRAPPED FRY.

FIGURE 79. EXAMPLE OF A FRY TRAP.

Although fry outmigration usually occurs later in August, warm temperatures pushed many ecological phases earlier. On the first night of fry trapping, over 300 fry were captured in the fry trap (Figure 80). Numbers decreased for 2 days, and then rose again to almost 300. The outmigration was over by August 12, 2016. Tissue samples were collected from a number of mortalities to verify species, although the timing suggests Yellowstone cutthroat trout, and obviously rainbow trout fry were considerably larger.

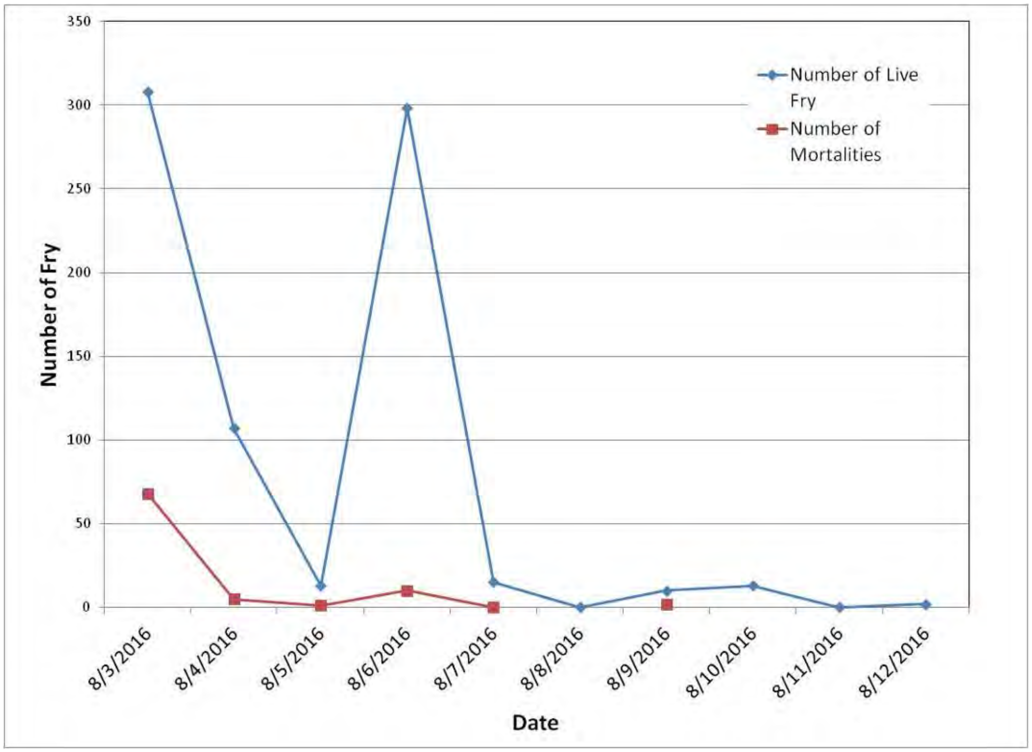


FIGURE 80. NUMBER OF FRY CAPTURED IN THE FRY TRAP DEPLOYED IN ROCK CREEK.

Conclusions

The Rock Creek fish passage project has shown tremendous success to date, with the step-pool structure remaining passable, Yellowstone cutthroat trout ascending the feature, and substantial numbers of fry outmigrating to the Yellowstone River. Although results that will verify genetic composition of outmigrating fry are pending, this project has potential to meet the highest conservation priorities for cutthroat trout conservation in Montana, namely, securing migratory life histories and nonhybridized populations. Such success decreases justification to protect Yellowstone cutthroat trout under the Endangered Species Act, and provides excellent angling opportunities in the Yellowstone River.

SHIELDS RIVER (060-1999)

Background

The Shields River is a major tributary of the Yellowstone River, and its confluence with the Yellowstone River is downstream of Livingston. The Shields River watershed has considerable conservation value for Yellowstone cutthroat trout, as nonhybridized Yellowstone cutthroat trout remain widespread in its streams, although some hybridization is present. Other conservation concerns include bank erosion, which contributes considerable amounts of fine sediment to the river, and the Shields River corridor is a high priority for projects to decrease sediment loading.

The first attempt at bank restoration was in 1999. The goal of this project was to stabilize approximately 600 feet of stream bank. Actions included installation of riparian fencing, root wads, and tree revetments along the eroding banks. In addition, development of a spring, and piping water to a stock tank located outside of the fenced riparian provided an alternative source of stock water away from the river.

Evaluation of aerial photos upstream of the project area, and within the project area, provides insight into the cause of the lateral movements of stream banks. Approximately 1/3 of a mile of stream channel was likely straightened in the relatively distant past (Figure 81). Closer view of the channelized reach shows old meander scars, which support the assumption that the stream occupied more of its floodplain, and humans had altered the channel (Figure 82).

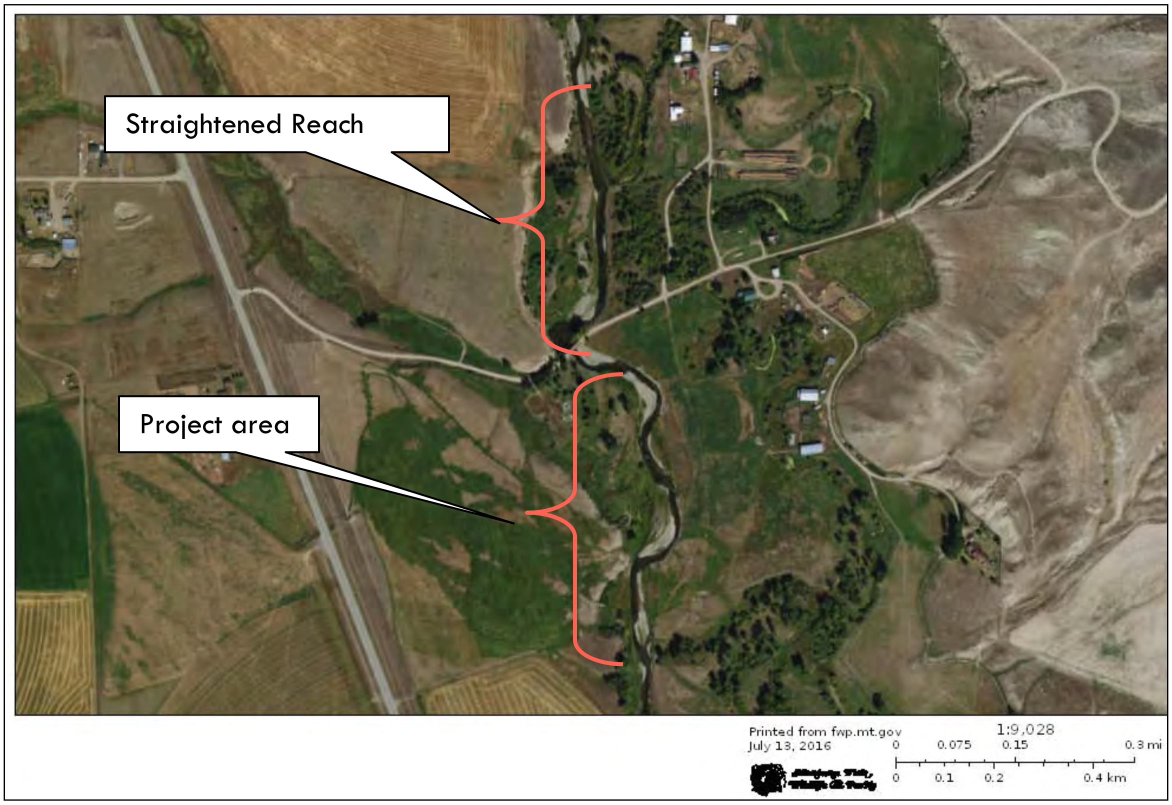


FIGURE 81. AERIAL PHOTO OF PROJECT AREA AND THE STRAIGHTENED REACH LOCATED UPSTREAM.

FIGURE 82. CLOSE-UP OF CHANNELIZED REACH UPSTREAM OF THE PROJECT AREA.

Straight channels have greater stream power during high flows, as they lack meanders to dissipate flow velocities. As a result, bed load movement of gravel and cobbles is substantial, and these particles do not accumulate on point bars within the straightened channel. When the flows hit the more sinuous reach, the water slows down, and the gravel and cobble settle out to form large point bars. (Figure 81). These point bars divert high flows into the opposite bank, which results in greater erosive pressure than the banks can handle.

Follow-up monitoring in 1999 found the root wads and revetments were not successful in maintaining bank stability, and many of these installed features washed out. The assessment concluded that stabilization efforts on rivers with high bed load and frequent flooding, like the Shields River, is challenging. The project did not meet the bank stabilization goals; however, livestock management efforts were successful in improving riparian health and function.

Field Assessment 2016

On July 12, 2016, Shannon Bockmon and Carol Endicott revisited the site, along with the landowner. After failure of the root wads and revetments, the landowner obtained permits to apply relatively large rock along the toe eroding banks (Figure 83). Sod mats place along re-sloped banks provided protection above the bank full margin. This work was done at his own expense.

FIGURE 83. EXAMPLE OF BANK STABILIZATION ON THE SHIELDS RIVER AFTER FAILURE OF THE ROOT WADS AND TREE REVETMENTS.

Within the restored reach, point bar development indicated an imbalance in transport and deposition of bed load (Figure 84 and Figure 81), and growth of point bars put more pressure on the opposing banks, which were the subject of restoration efforts. Bank armoring, although not desirable from fisheries or river form and function perspectives, was successful in protecting land. Nonetheless armoring did extend the area of disturbance by exerting pressure on banks downstream of the project area, contributing to a small area of bank erosion.

FIGURE 84. EXAMPLE OF LARGE POINT BAR WITHIN PROJECT AREA.

With the exception of the large point bars, the livestock grazing management component of the project continued to be successful in promoting a healthy, functional riparian area, with recruitment of woody vegetation. In contrast, the amount of bed load deposited on the large point bars, and their elevation above the water table makes recruitment of woody vegetation difficult. Young willows and cottonwoods are buried by deposited rock. In addition, as seedlings, these species need to keep their taproots in contact with groundwater as the flows subside in the summer. Water levels drop relatively quickly in these elevated and porous point bars, and the young plants die of desiccation, despite being within the active channel.

Conclusions

This project did not meet the project goal of using supposedly "softer" approaches to restore bank stability, reduce sediment loading, or improve fish habitat. The revetments and root wads failed to achieve the desired stream bank conditions, and in hindsight, their use on a stream as flashy as the Shields River was inappropriate. The subsequent use of relatively large rock was successful in protecting land, although this approach runs the risk of increasing erosive forces downstream. The fencing was successful in promoting recruitment of shrubs, and willows were contributing to stabilizing banks within the project area.

This project provides an example of the benefit of looking beyond the area of concern, to determine if upstream geomorphic changes are contributing to degradation within a project area. Viewing projects from the perspective of river form and function on a larger scale is essential in restoring reaches within the project area. In this case, channelization upstream had increased the force and delivery of bed load to the project area. An alternative or adjunct to bank restoration in the project area would be to return the straightened channel upstream to its former, sinuous channel, which would dissipate flow velocities, and avoid downstream development of large point bars that divert stream flows into the opposite bank.

Several considerations affect the feasibility of taking this larger view of river restoration. Often, the land upstream may be under different ownership, and that landowner may not be interested in channel alterations on his or her property. Cost is another consideration. Restoring the channel to its former configuration would require considerable design, the use of heavy equipment within the project area, and an aggressive re-vegetation plan. Conversely, armoring banks with large rock is also expensive, as the rock must often be purchased, moved to the site, and installed using heavy equipment.

From the perspective of the Future Fisheries Improvement Program goals, channel re-naturalization would bring fisheries benefits. The channelized reach is unlikely to provide pools, and other habitat features that are important to fish. Returning sinuosity to the channel would result in lateral scour pools, and sorting of gravels to provide spawning habitat. Likewise, the formation of large point bars downstream does not allow riparian vegetation opportunity establish near the stream. Therefore, functional attributes such as shading, woody debris recruitment, and formation of undercut banks are unlikely to occur.

SOUTH FORK & MIDDLE FORKS HORSE CREEK CHANNEL STABILIZATION (012-2011)

Background

Horse Creek is a tributary of the Shields River that joins the Shields River downstream of Wilsall, MT. Horse Creek has 3 major tributaries that originate in the Crazy Mountains, and converge in the valley. The goals of this project were to reverse impaired riparian health and function, improve degraded fish habitat, and eliminate several significant sources of fine sediment on the south and middle forks of Horse Creek.

Both forks of Horse Creek support nonhybridized Yellowstone cutthroat trout, which makes habitat restoration and protection a priority. Yellowstone cutthroat trout live in sympatry with brook trout in the south fork, and brook trout can easily displace Yellowstone cutthroat trout. Decreasing sedimentation may give Yellowstone cutthroat trout a little more resilience in the face of competition with brook trout.

The Middle Fork Horse Creek project addressed sediment delivered from where the stream abutted a vertical, eroding terrace, and a lack of willows within the project area (Figure 85). This pasture was likely used during calving by previous owners, and cattle had removed much of the riparian vegetation. The landowners at the time did not plan to use this pasture for grazing, so it had several years of rest. Nonetheless, willows had not recovered, and weeds infested most of the floodplain.

FIGURE 85. MIDDLE FORK HORSE CREEK PROJECT AREA BEFORE PROJECT IMPLEMENTATION.

Similar to Middle Fork Horse Creek, South Fork Horse had several reaches where the stream exerted considerable force on vertical, eroding terraces (Figure 86). In addition, current grazing practices were damaging stream banks, and impairing the health and function of the riparian area. Cattle accessed the stream at numerous locations, resulting in hoof shear, and exposed dirt (Figure 87). Riparian shrubs were absent from a considerable portion of the stream, and many banks were actively eroding (Figure 88). The suspended sediment load was substantial, as the stream was turbid, even during low flows.

FIGURE 86. EXAMPLE OF STREAM ABUTTING AN ERODING TERRACE ON SOUTH FORK HORSE CREEK.

FIGURE 87. EXAMPLE OF CATTLE ACCESS POINT.

FIGURE 88. EXAMPLE OF LACK OF RIPARIAN SHRUBS AND ERODING BANKS ON SOUTH FORK HORSE CREEK.

On both streams, the strategy to reduce erosion from high vertical terraces entailed construction of a floodplain bench between the stream and the terrace (Figure 89). The benches removed the shear stress at the toe of the terrace, and provided a floodplain with roughness that dissipates the erosive force of flood flows. The banks were built from wetland sod mats that were harvested from within the project area.

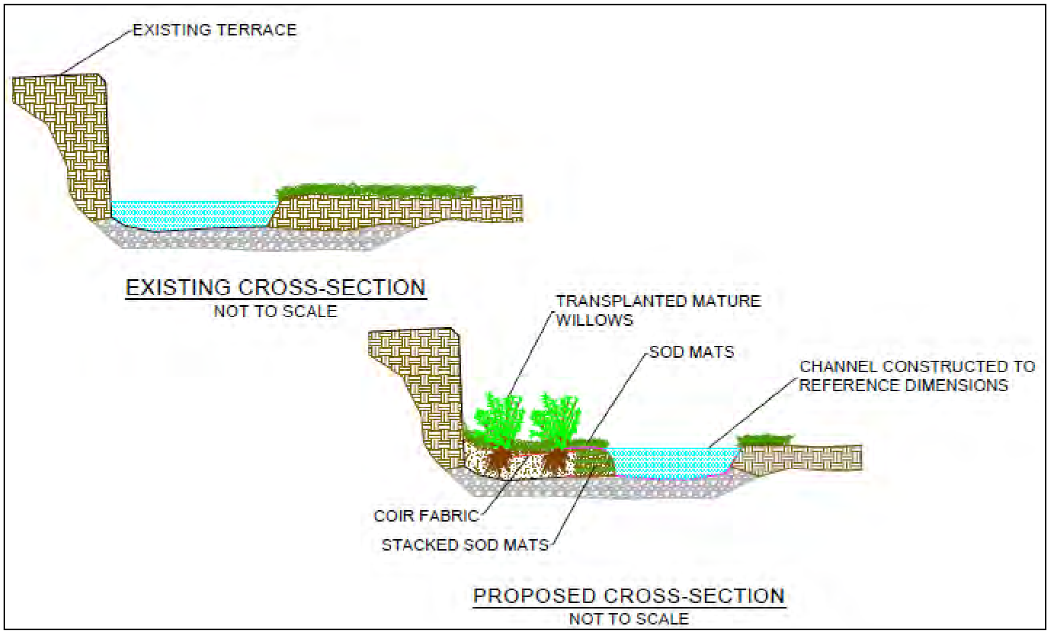


FIGURE 89. CONCEPTUAL PLAN FOR CONSTRUCTION OF FLOODPLAIN BENCH.

Deposition of fine sediment occurred along most of the channel (Figure 90). This siltation reduces the suitability of the gravel for spawning, and limits invertebrate production, as the spaces among gravel particles are clogged with sediment. Even relatively high gradient, narrow and deep portions of channel had substantial amounts of fine sediment.

FIGURE 90. SEDIMENTATION OF STREAMBED IN A RELATIVELY HIGH GRADIENT PORTION OF SOUTH FORK HORSE CREEK.

A separate component of this project addressed livestock management on the ranch. The landowner chose to exclude cattle in the project area of the Middle Fork Horse Creek, so livestock would not alter riparian vegetation, or access the stream banks. Actions on South Fork Horse Creek included installation of a fence to control the ability of cattle to access the riparian area and stream, development of a ranch-wide grazing management plan, and installation of off-stream stock water. The landowner worked with the Natural Resources and Conservation Service (NRCS) on these activities.

Disturbance is common in streams, and the South Fork Horse Creek flooded the spring after construction (Figure 91), resulting in considerable shear stress on the newly constructed benches. These flows also resulted in abandonment of existing channels, formation of multiple channels, and a substantial head cut, where the streambed made a dramatic drop in elevation (Figure 92).

FIGURE 91. DECLINING LIMB OF FLOOD, SPRING 2012.

FIGURE 92. HEAD CUT ON SOUTH FORK HORSE CREEK CAUSED BY FLOOD.

Field Assessment

On June 7, 2016, Shannon Bockmon and Carol Endicott visited the restoration projects on the middle and south forks of Horse Creek. Overall, these projects have made profound improvements in the quality of fish habitat, and have dramatically decreased sediment loading.

The Middle Fork Horse Creek floodplain bench is serving its purpose of reducing sediment delivery to streams, and the adjacent channel is considerably more narrow and deeper than the pre-project channel (Figure 93). Keeping erosive forces off the toe of the vertical terrace has allowed the upper portion of the terrace to settle into an angle of repose. Furthermore, this formerly vertical wall is growing vegetation, albeit weeds, but the plants will continue to stabilize the bare soil. Willows are recruiting on the bench, and the transplanted sedge mats are indistinguishable from a natural bank.

FIGURE 93. FLOODPLAIN BENCH 5 YEARS AFTER CONSTRUCTION.

Marked improvements were also present on the South Fork Horse Creek. Similar to the middle fork, construction of floodplain benches had eliminated the erosive force on the toes of the eroding terrace, and these benches are vegetated with sedges and willows (Figure 94). Moreover, the vertical walls were settling, and becoming vegetated.

FIGURE 94. CONSTRUCTED FLOODPLAIN BENCH ON SOUTH FORK HORSE CREEK.

Resting this reach of stream from livestock grazing has resulted in profound improvements in riparian health and function (Figure 95). A decrease in deposition of fine sediment was also striking condition, compared to pre-project sedimentation (Figure 96). Cleaner substrate should increase spawning success and the forage base for fish.

FIGURE 95. HEALTHY RIPARIAN VEGETATION AND RECOLONIZATION ON GRAVEL BARS.

FIGURE 96. EXAMPLE OF STREAMBED 5 YEARS AFTER PROJECT IMPLEMENTATION SHOWING MARKED DECREASE IN FINE SEDIMENT (COMPARE TO FIGURE 90).

Conclusions

This project has resulted in profound improvements in several measures of stream health. Rest from grazing has resulted in recovery of riparian vegetation, which allowed substantial lengths of eroding stream bank to heal naturally. Construction of the floodplain benches was also beneficial, and has greatly decreased sediment loading to these streams. The floodplain benches have also allowed the vertical, eroding terraces to settle to a lower angle, and vegetation is colonizing areas where the steepness and constant sloughing had prevented establishment of vegetation before restoration. The decrease in sediment loading appears to have resulted in a cleaner streambed, which is more suitable for spawning, and production of aquatic invertebrates. Overall, this project has been a huge success, and a well spent use of FFIP funds.

SWEET GRASS CREEK FENCING (057-1998)

Background

Sweet Grass Creek is a tributary of the Yellowstone River that joins the river about 9 miles downstream of Big Timber. The project area lies about ½ miles from the confluence of the Yellowstone River. This portion of Sweet Grass Creek is transitional between a warm-water and cold-water fishery, and supports a diversity of fishes including brown trout several species of the minnow family, mountain white fish, shorthead redhorse, mountain sucker, sculpin and stonecat.

The goal of the project was to improve habitat for fish and wildlife. Cattle exerted considerable pressure on banks and riparian vegetation. In addition, flooding had removed riparian fencing. Specific actions included fencing the riparian area, and installing water gaps to allow access for stock water.

The project was implemented in 1998, and within 4 years, the riparian area and stream channel recovered markedly (Figure 97 and Figure 98). In its pre-project condition, the banks mostly were exposed cobble, and the channel was overly wide and inefficient in transporting bed load or sediment. With rest from livestock grazing, plants become established on the bare banks. These plants created roughness that trapped sediment during high flows, which is the mechanism through which stream banks are built. With deposition of soil building banks, the channel became narrower. Narrower channels have greater capacity to transport sediment, and the stream carved a deeper channel within the new bank full margin. The consequences of the narrower, deeper channel are improved habitat for fish, and likely slowed warming of water temperatures, with a decrease in the stream's surface water exposed to sunlight. The rate at which the stream recovered is typical of how quickly streams repair themselves when released from continued disturbance.

FIGURE 97. PRE-PROJECT PHOTO OF THE SWEET GRASS CREEK PROJECT AREA (1998).


FIGURE 98. POST-PROJECT PHOTO OF THE SWEET GRASS CREEK PROJECT AREA (2002)

Field Assessment 2016

On July 2, 2016, Shannon Bockmon and the landowner evaluated the status of the project. Fencing to control cattle access to the stream was still in place (Figure 99), and the landowner reported grazing occurred within the riparian exclosure for short duration each year. An overview of the stream channel from the uplands indicated livestock management continued to maintain stream channel morphology and riparian vegetation (Figure 99), and recovery was continuing. Evidence of livestock near the stream was minimal, with isolated hoof shear near banks.


FIGURE 99. RIPARIAN FENCING ON SWEET GRASS CREEK.

FIGURE 100. OVERVIEW OF THE MIDDLE PORTION OF THE PROJECT.

A substantial area of bank erosion was present associated with cultivation of irrigated hay adjacent to the channel (Figure 101); however, the landowner was unconcerned with the amount of bank erosion. Should erosion along this bank accelerate, construction of a floodplain bank adjacent to the eroding bank may be appropriate to take pressure off the eroding bank, and provide more floodplain area for dissipation of the erosive force of floods.

FIGURE 101. AREA OF BANK EROSION ADJACENT TO HAY PASTURE.

VOLNEY CREEK CORRAL RELOCATION (046-2006)

Background

Volney Creek is a small tributary of Red Lodge Creek, which ultimately feeds Cooney Reservoir. Volney Creek flows through rangeland, and is too warm to support a thriving cold-water fishery. Native minnows and suckers, and the occasional brook or brown trout are present in Volney Creek.

The project entailed moving corrals off Volney Creek, and developing wells to replace Volney Creek as a source of stock water. The goal of this project included improving water quality and fisheries values in Volney Creek, but the expected outcomes extended into Red Lodge Creek and Cooney Reservoir. Red Lodge Creek supports an important brown trout fishery. Cooney Reservoir supports a popular recreational fishery for trout and pan fish, such as black crappie. Nutrient loading into Cooney Reservoir results in periodic algal blooms, which can impair fishing and aesthetics, or result in periods of low dissolved oxygen when the algae decompose. Concentrating cattle within the corrals had resulted in a severely degraded riparian area, and an overly wide channel that did not provide habitat suitable for a healthy fishery. The corrals were a source of nutrients, and eliminating these inputs would have far-reaching advantages, extending from the project site into Cooney Reservoir.

FIGURE 102. ON-STREAM CORRALS ON VOLNEY CREEK.

Field Assessment 2016

On July 11, 2016, Shannon Bockmon evaluated conditions within the Volney Creek corral relocation project area. All components of the project had been implemented. In the 10 years since project implementation, a narrowing and deepening of the channel was the most apparent sign of recovery (Figure 103). Recovery of the shrub community has lagged, although a source for seeds or eventual vegetative recruitment is nearby. As is common in areas with long-term disturbance, noxious weeds continue to infest the project area. The landowner sprays herbicide where she can, and hand pulls weeds close to the stream.

FIGURE 103. NARROW CHANNEL AND VEGETATED BANKS WITHIN THE FORMER CORRALS ON VOLNEY CREEK.

Conclusions

The Volney Creek corral relocation project has been successful in eliminating a point source of nutrients to Volney Creek, and eventually Red Lodge Creek and Cooney Reservoir. In addition, fish habitat has improved markedly within the project area, with substantial narrowing and deepening of the channel. Under the current management, riparian shrubs will likely recruit over time. In addition, continuing weed management will be beneficial to range health within the project area, and reduce spread of noxious weeds.

FWP INTERN MONITORING CONCLUSIONS

Evaluation of the 21 projects provides insight into the benefits of specific projects, and allows for evaluation of specific approaches to restoration. Identification of approaches with limited success fosters an adaptive approach to stream restoration, in which lessons learned on a given project inform stream practitioners and landowners on practices that are likely to be successful, or actions that may not be appropriate for a given site. Conversely, successful projects provide a model for future efforts, and a showcase for the benefits of fish conservation.

Across all projects involving livestock grazing, controlling animals' access to the stream was an effective component of restoring health and function to riparian areas, improving water quality, and habitat for fish. Numerous options are available, and the selected options should be site specific, and incorporate the producer's resources and goals. Riparian fencing is a commonly employed method, and is highly effective; however, the same results can be attained through grazing management strategies that manage timing, duration, and intensity of grazing within stream adjacent pastures. Fencing has disadvantages in terms of maintenance needs, and blocking wildlife movements, although wildlife friendly fencing can mitigate for the effects of fencing. The NRCS's technical assistance in developing grazing management strategies can be invaluable in promoting stream health, while incorporating the health and vigor of uplands, and the nutritional needs of livestock.

Providing stock water, while limiting access to streams is another universally effective approach. Off-stream stock watering devices and water gaps are effective measures. Constructing water gaps that are sufficiently hardened, while being easy for cattle or horses to walk on, will ensure they are used, and will reduce sediment loading from an area of heavy use.

Restoration, enhancement, or creation of stream habitat in spring creeks had variable results. Esp Spring Creek and Nelson/Dana Spring Creek retained the constructed channel morphology in the years since construction, and provided high quality habitat for resident fish, if not fluvial spawners. In contrast, Kickabuck Spring Creek and Emigrant Spring Creek experienced considerable lateral bank movement, and the resulting overly wide channels were unable to transport fine sediment, resulting in deep accumulations of muck. The pliability of the stream banks appears to be an important factor in the ability of these streams to maintain their channel geometry. Because of their cool summer temperatures, spring creek restoration can bring numerous benefits to all life history stages; however, restoration design should consider the factors allowing banks to be deformable, but not overly mobile.

FFIP frequently provides funding for bank and stream restoration projects entailing mechanical alteration of banks, reconfiguration of stream channels, and riparian plantings on streams with a flashy hydrograph. Among the goals of these projects is to make these streams more resilient to disturbance; however, snow melt and rainfall events result in expected, but unpredictable floods that can undo channel and bank modifications if they occur before riparian vegetation has recovered its function. Designs need to consider geomorphic processes, such as the need for deformable banks, yet acknowledge and plan for the potential for a post-project flood. Brackett Creek provides an example of a project that has been overall beneficial, although a large flood that occurred soon after restoration resulted in considerable bank erosion that has not healed in the decade since the flood, even though Brackett Creek had easy access to its floodplain. The middle and south forks of Horse Creek also experienced a substantial flood in the spring following restoration; however, the damage was relatively limited, and all the constructed floodplain benches remain functional.

Prescribing specific approaches is beyond the scope of this document; however, post-project monitoring identified several points to be considered. A crucial yet complicated consideration is determining how laterally immobile a newly constructed channel or stream bank should be. Armoring the toe of a newly constructed bank with rock that would be movable at a flood of a selected recurrence interval is an option; however, determining the dimension of that flood entails judgment, and an agreed on level of acceptable risk. Likewise, encasing sod mats in coir fabric may provide additional security to the newly constructed banks, yet coir fabric may not be appropriate in all locations, and some restoration designers are decreasing their use of this material. Evaluation of the success or failure of restoration projects elsewhere in the state should inform design parameters. In addition, restoration designers, landowners, fluvial geomorphologists, and stream permitting personnel need to be in collaboration, and determining an acceptable level of risk early in the design process.

The initial failure of the “soft” restoration approach on the Shields River is largely an artifact of limiting the view of the project to the immediate area. By not considering upstream channel alterations, the factors contributing to bank erosion were not fully understood. Livestock grazing practices may have contributed to bank instability; however, an over-abundance of bed load transported at high velocity into the project area was probably more influential.

Another consideration that is difficult to evaluate in retrospect is whether the use of root wads and revetments was appropriate for this site. These bank treatments were commonly used in the 1990s; however, additional methods have been developed in the intervening years, and some of these may have more effective on a flashy river with potential to scour around structures. In general, bank restoration on highly active channels, such as those present on larger, bed load rich rivers, bring challenges and increased risk of failure.

Installation or fortification of fish barriers, combined with treatment with piscicide as warranted, is an effective means to provide secure habitat for native Yellowstone cutthroat trout. Periodic evaluation and maintenance of the structural stability of the barriers, and removal of debris captured on barriers or accumulating downstream, are essential to the long-term success of these projects, and these actions have protected the considerable investment in constructing barriers, and removing nonnatives. Lower Deer Creek, Crooked Creek, and Bad Canyon Creek are examples where these actions have been successful in providing substantial habitat for native cutthroat, and nonnatives have not been able to reinvade in the years since barrier installation and piscicide treatment. In each case, these projects protected an aboriginal population of nonhybridized Yellowstone cutthroat trout. From a cutthroat trout conservation perspective, these were critically important projects. Range-wide and statewide conservation planning places protection of nonhybridized cutthroat populations as the most important conservation objective. These projects help meet requirements to conserve cutthroat trout under state and federal law, and reduce the justification for including Yellowstone cutthroat trout for protection under the Endangered Species Act.

Providing fish passage through construction of step-pools had variable success. At the mouth of Esp Spring Creek, ice jams or high flows removed the large rock. Despite the failure of the installed steps, the stream may still be accessible during the spring spawning period. On Clear Creek, the large rocks in the step-pools have shifted, but appear to remain functional, and flows through the culvert remain backwatered, and therefore are likely deep and slow enough to allow fish to swim through.

So far, the Rock Creek fish passage project has been highly successful at providing passage. PIT tag monitoring indicated nonhybridized Yellowstone cutthroat trout, rainbow trout, and hybrids ascended this feature in the first spawning period after they were installed. Fry trapping in 2016 captured 766 fry over 10 nights of trapping, and as the greatest number was trapped on the first night, considerably more fry likely outmigrated to the Yellowstone River this year. Periodic monitoring of fry outmigration is warranted to evaluate the establishment of a spawning run into Rock Creek.