YELLOWSTONE CUTTHROAT TROUT CONSERVATION STRATEGY FOR MONTANA

© Joseph Tomelleri

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List of Abbreviations

Agreement	Memorandum of understanding and conservation agreement
BIA	Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
CNF	Custer National Forest
DEQ	Montana Department of Environmental Quality
DNRC	Montana Department of Natural Resources and Conservation
EBES	Extrapolated, based on extensive surveys
EBS	Extrapolated, based on surveys
EFSSO	Extrapolated from a single survey or observation
FWP	Montana Fish, Wildlife & Parks
GIS	Geographical information system
GNF	Gallatin National Forest
HUC	Hydrologic unit code
MCTSC	Montana Cutthroat Trout Steering Committee
MFISH	Montana Fisheries Information System
N/A	Not applicable
NPSJ	No survey, professional judgment
NRCS	Natural Resources and Conservation Service
RBT	Rainbow trout
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Service
WCT	Westslope cutthroat trout
YCT	Yellowstone cutthroat trout
YNP	Yellowstone National Park

Executive Summary

This document presents a strategy for securing, restoring, and maintaining Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*) in its native range in Montana. Development of a conservation strategy is a requirement of an agreement developed by the Montana Cutthroat Trout Steering Committee (MCTSC 2007). Threats to the persistence of this native fish are considerable, and without intervention, further losses are inevitable. This strategy provides a framework for conserving Yellowstone cutthroat trout following the goals and objectives established in the agreement developed by the MCTSC. The spatial scope of this document is the historic range of Yellowstone cutthroat trout in Montana, which encompasses most of the waters in the larger Yellowstone River watershed. Exempted from this strategy is the portion of the Shields River upstream of the Chadbourne diversion, which is addressed in a separate document (FWP et al. 2012).

Potential conservation actions will be tailored on a site-specific basis; however, several categories encompass most of the potential actions. Continued survey and assessment is a considerable need that will identify secure populations and areas where intervention is required to meet conservation goals. Restoration of habitat is a broadly applicable category of intervention that will increase the likelihood that habitat can support this native species. Actions that fall under the category of restoration include improving riparian and in-stream habitat and water quality, removing barriers that restrict movement of Yellowstone cutthroat trout, and maintaining in-stream flows at levels to support various life history stages. As nonnative species present a major threat to remaining populations of Yellowstone cutthroat trout, removal of these may be an appropriate action in some cases. Construction of barriers to prevent reinvasion of nonnative fishes may also be appropriate to ensure long-term persistence of Yellowstone cutthroat trout populations.

This strategy includes a review of waters within the historic range of the Yellowstone cutthroat trout. The purpose of these reviews is to provide an initial screen to determine the extent of the available information and currently identifiable conservation opportunities. Implementation of specific projects will entail additional review and analysis under the Montana Environmental Policy Act (MEPA), the National Environmental Policy Act (NEPA), or both.

This document is the first iteration of what will be continuing efforts to restore, protect, and enhance Yellowstone cutthroat trout within their native range in Montana. Subsequent documents will provide updates on implementation of projects aimed at meeting conservation goals, will include results of field investigations evaluating trends in Yellowstone cutthroat trout distribution and genetic status, and will identify emerging threats to individual populations, such as invasions by nonnative salmonids. Succeeding iterations will occur at 5-year intervals.

1.0 Introduction

The Yellowstone cutthroat trout is native to Montana and is a species of special concern. Historically, Yellowstone cutthroat trout occupied waters in Montana, Wyoming, Idaho, Nevada, and Utah[3]; however, a host of factors has resulted in a reduced and fragmented distribution (Figure 1-1). In response to this decline, state and federal agencies, and tribes, have conferred special status designations on Yellowstone cutthroat trout and begun associated conservation planning efforts to promote recovery of the species.

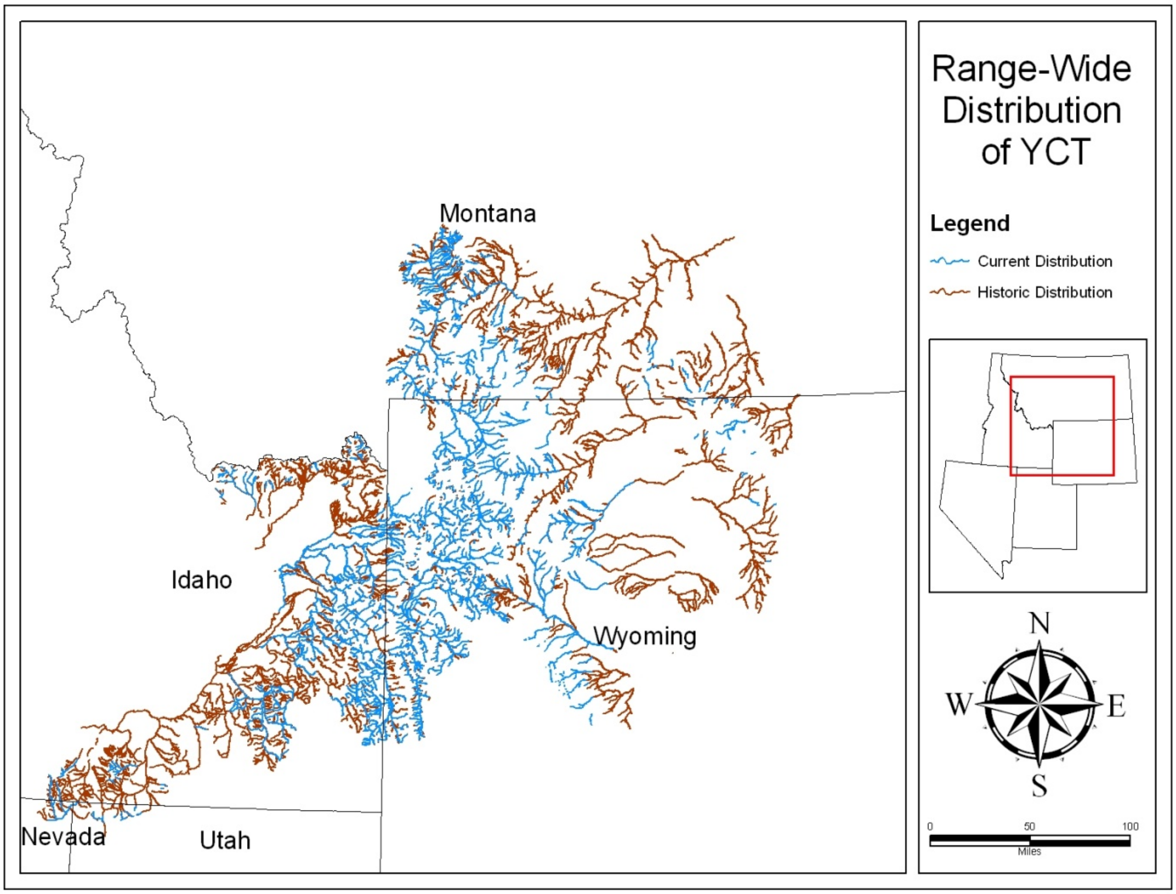

Figure 1-1: Historic and current (2009) distribution of Yellowstone cutthroat trout throughout its range (FWP geographical information system [GIS] database).

In 2007, the MCTSC completed a memorandum of understanding and conservation agreement (the Agreement) to expedite implementation of conservation measures for Yellowstone cutthroat trout and westslope cutthroat trout (*O. clarkii lewisii*) in Montana (MCTSC 2007). The MCTSC includes representatives from resource agencies, conservation groups, tribes, industry, and resource users (Table 1-1). The Agreement documents Montana's efforts as part of coordinated

[3] The period of European "discovery" of the West (around 1800) is the reference period used in this and other cutthroat trout status assessments in defining historic distribution (May et al. 2007).

multistate, range-wide efforts to conserve cutthroat trout. Signatories consent to accept the goals and objectives presented in the Agreement, will incorporate them into their planning processes, and will strive to accomplish the goals and objectives within the identified timeframes.

Table 1-1: Participants in the MCTSC and signatories to Montana's cutthroat trout agreement.

Category	*Entity*	*MCTSC Participants*	*Agreement Signatories*
Conservation and Resource Users	American Wildlands	✓	✓
	Federation of Fly Fishers	✓	✓
	Greater Yellowstone Coalition	✓	✓
	Montana Chapter of the American Fisheries Society (MCAFS)	✓	✓
	Montana Trout Unlimited	✓	✓
	Montana Wildlife Federation	✓	✓
Industry	Montana Farm Bureau	✓	✓
	Montana Stockgrowers Association	✓	✓
	Plum Creek	✓	✓
Resource Agencies (federal)	Bureau of Land Management (BLM)	✓	✓
	Glacier National Park	✓	✓
	Natural Resources and Conservation Service (NRCS)	✓	✓
	U.S. Fish and Wildlife Service (USFWS)		✓
	U.S. Forest Service (USFS)	✓	✓
	Yellowstone National Park (YNP)	✓	✓
Resource Agencies (state)	Department of Environmental Quality (DEQ)		✓
	Department of Natural Resources and Conservation (DNRC)	✓	✓
	Montana Fish, Wildlife & Parks (FWP)	✓	✓
Tribes	Blackfeet Tribe	✓	✓
	Confederated Salish and Kootenai Tribes	✓	✓
	Crow Tribe	✓	✓

The management goals and objectives described in the Agreement provide an integrative strategy to reduce threats leading to decline of cutthroat trout. The goals are as follows:

- Ensure the long-term, self-sustaining persistence of each subspecies distributed across their historical ranges as identified in recent status reviews (Shepard et al. 2003; May et al. 2007);
- Maintain the genetic integrity and diversity of non-introgressed populations, as well as the diversity of life histories represented by remaining cutthroat trout populations; and
- Protect the ecological, recreational, and economic values associated with each subspecies.

The Agreement lists five objectives that will lead to attainment of management goals for cutthroat trout in Montana, which are as follows:

- Maintain, secure, and/or enhance all cutthroat trout populations designated as conservation populations, especially the nonhybridized components;
- Continue to survey waters to locate additional cutthroat trout populations and determine their distribution, abundance, and genetic status;
- Seek collaborative opportunities to restore and/or expand populations of each cutthroat trout subspecies into selected suitable habitats within their respective historic ranges;
- Continue to monitor cutthroat trout distributions, genetic status, and abundance using a robust, range-wide, statistically sound monitoring design;
- Provide public outreach, technical information, interagency coordination, administrative assistance, and financial resources to meet the listed objectives and encourage conservation of cutthroat trout.

The Agreement for cutthroat trout conservation relegated specifics on achieving these goals to conservation documents detailing strategies to be implemented on a regional or watershed levels. This document presents the conservation strategy for Yellowstone cutthroat trout throughout its historic distribution in Montana, with the exception of the Shields River watershed above the Chadbourne diversion, which is addressed separately (FWP et al. 2012).

2.0 Watershed Characterization

In Montana, Yellowstone cutthroat trout are native to streams and lakes in the Yellowstone River watershed and historically occupied waters with suitable habitat and thermal regime, from the headwaters near Cooke City, Montana, to the Tongue River watershed (Figure 2-1)**.** The headwaters of the Yellowstone River originate in Yellowstone National Park, and include the area contributing to Yellowstone Lake. The Yellowstone River enters Montana near Gardiner, Montana, and flows north through Paradise Valley, with the Gallatin Range forming the western boundary, and the Absaroka Mountains the eastern. Mountain ranges on the north side of the Yellowstone River include the Bridger, Bangtail, and Crazy mountain ranges. On the south side of the Yellowstone River, the Beartooth and Pryor mountain ranges provided suitable lake and stream habitat for Yellowstone cutthroat trout.

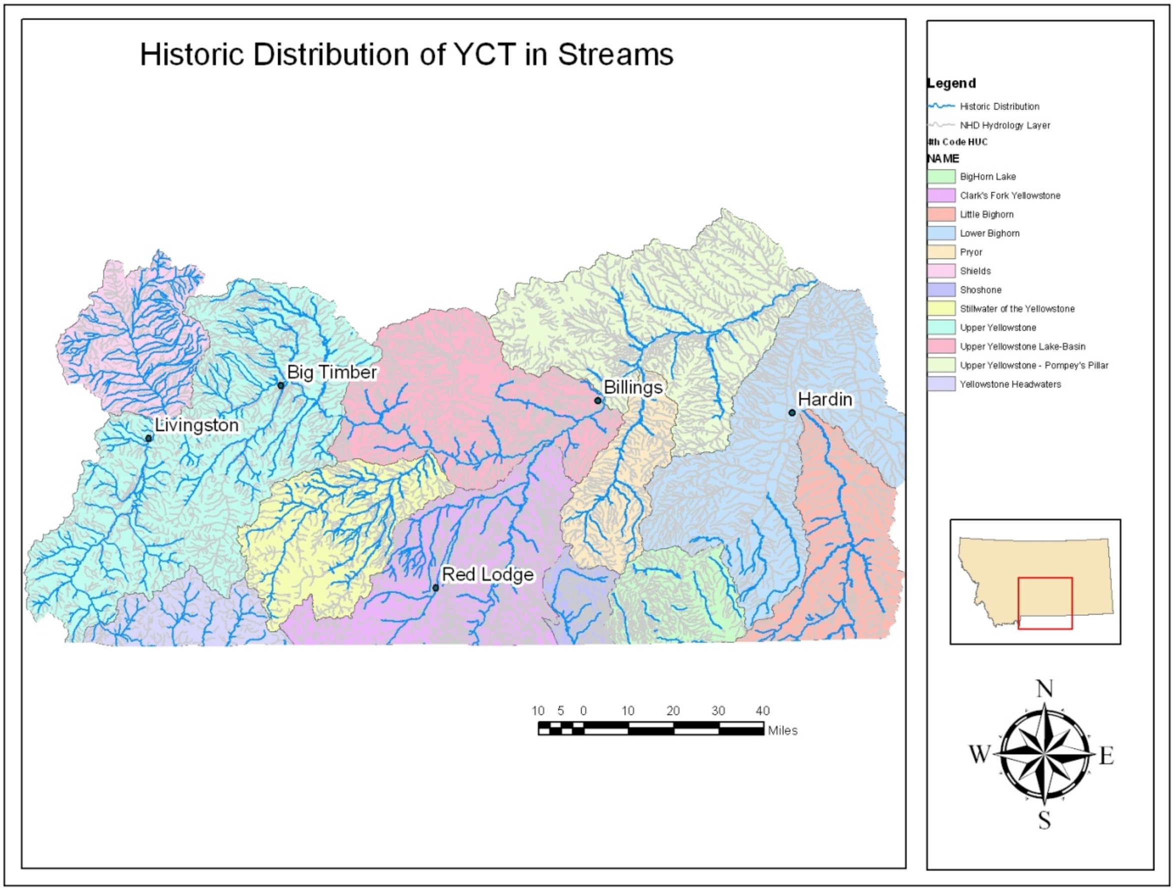

Figure 2-1: Historic range of Yellowstone cutthroat trout in Montana streams (FWP GIS database).

Habitats unsuitable for Yellowstone cutthroat trout include the main stems of several major tributaries of the Yellowstone River; for example, the lower reaches of rivers such as the Tongue River, which are more suitable for warm-water fisheries that are adapted to higher levels of suspended sediment. Although the lower reaches are unsuitable for Yellowstone cutthroat trout, the headwaters of these streams supported this species historically, and some streams still provide habitat for isolated populations.

A variety of lake types currently provide habitat to Yellowstone cutthroat trout in Montana. High elevation lakes, primarily cirques formed by alpine glaciers, are a common lentic habitat within the Yellowstone cutthroat trout's historic range. Many of these lakes were historically fishless; however, widespread introductions of Yellowstone cutthroat trout and other sport fishes have provided recreational fisheries in these lakes. Human-made impoundments, intended to store water for irrigation and recreation, are relatively recent additions to the available habitats. Private recreational ponds are increasingly common in the area. FWP's regulations require stocking permits for private ponds to ensure unwanted fish species do not adversely affect public waters, so for many ponds, Yellowstone cutthroat trout is the only species permitted.

Climatic patterns are variable across the Yellowstone cutthroat trout's historic range. Climate data managed by the Western Regional Climate Center from representative climate stations demonstrate this variability, which relates primarily to elevation. For example, the average maximum daily temperature for July at Cooke City, located about 7,500 feet above mean sea level, is 74 °F (Table 2-1). The average total snowfall is 209 inches, and the average annual precipitation is about 26 inches. In contrast, at Big Timber the average maximum temperature in July is 87 ° (Table 2-2). At this elevation, about 4,100 feet, average total snowfall amounts to only 46 inches, and the mean annual precipitation is 15 inches.

Table 2-1: Climate summary data for climate station 241995, Cooke City, elevation ≈ 7,500 feet above sea level, for the period of record 11/01/1967 to08/31/2012 (Western Regional Climate Center 2012).

Parameter	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***	***Annual***
Average Max. Temperature (°F)	24	30	37	44	54	65	74	72	62	49	32	24	47
Average Min. Temperature (°F)	4	6	12	19	28	34	39	37	30	23	12	5	21
Average Total Precipitation (in.)	2	2	2	2	3	3	2	2	2	2	2	2	26
Average Total Snow Fall (in.)	41	29	27	19	9	2	0	0	2	11	30	39	209
Average Snow Depth (in.)	30	36	37	27	6	0	0	0	0	1	8	19	14

Table 2-2: Climate summary data for climate station 240780, Big Timber, elevation ≈ 4,100 feet above sea level, for the period of record 4/01/1894 to 7/13/2012 (Western Regional Climate Center).

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
Average Max. Temperature (F)	37	41	48	59	68	77	87	86	74	62	47	39	60
Average Min. Temperature (F)	17	19	23	32	40	47	53	51	42	35	26	19	34
Average Total Precipitation (in.)	1	0	1	2	3	3	1	1	1	1	1	1	15
Average Total Snow-fall (in.)	9	6	8	5	1	0	0	0	0	4	7	7	46
Average Snow Depth (in.)	2	1	1	0	0	0	0	0	0	0	1	1	0

Stream flows in the area are characteristic of snowmelt driven systems, and flow data from the Yellowstone River near Livingston illustrate the typical hydrograph (Figure 2-2). The spring rise begins in April, with peak flows occurring from late May through June. Precipitation tends to be greater during these months (Table 2-1 and Table 2-2), which also augments stream flows. Although snowmelt is a primary influence on flow, in many streams, irrigation withdrawals often have a dramatic effect by causing a more abrupt drop of the declining limb and lower stream flows through the irrigation season, which can extend to October in some locations. Thunderstorms during summer months result in localized increases in stream flow in smaller streams, which can sometimes be substantial and result in localized flooding.

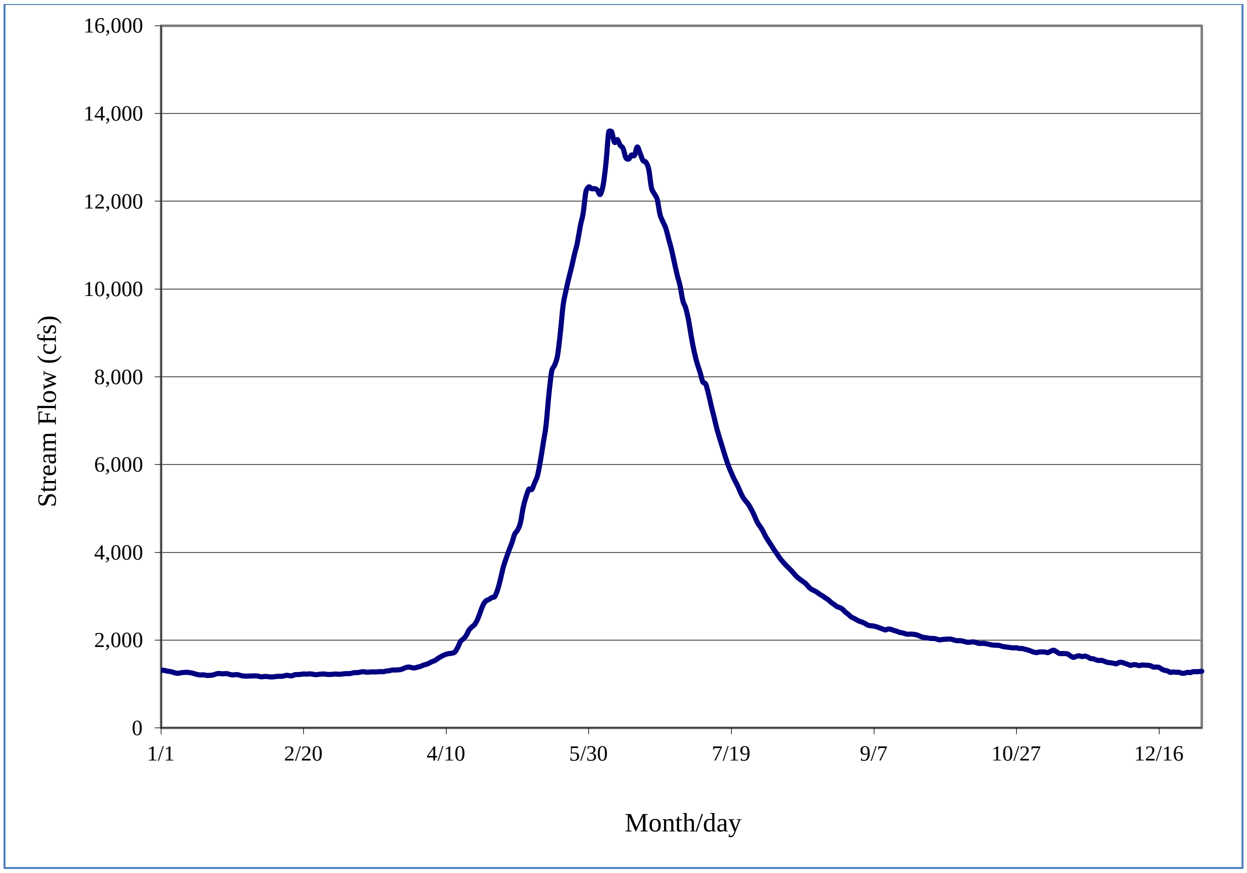

Figure 2-2: Average daily stream flow for the past 30 years (May 5, 1978 through May 5, 2008) at the Livingston gage on the Yellowstone River (U.S. Geological Survey [USGS] station 6192500).

Spring creeks also provide habitat for Yellowstone cutthroat trout, and these differ from other streams in terms of flow and temperature regimes and productivity. Spring creeks tend to have relatively stable flows year round, unless irrigation withdrawals are substantial. Likewise, as groundwater is the primary source of flow, spring creeks maintain cooler temperatures in the summer, and warmer winter temperatures. Furthermore, these streams often emerge from limestone formations and the calcium carbonate rich waters support productive ecosystems, which often maintain high densities of fish. Many are renowned for producing large trout. Spring creeks are among the high quality spawning streams for fluvial Yellowstone cutthroat trout in the Yellowstone River (Clancy 1988).

Current landownership within the fish's native range in Montana is a mix of private, public, and tribal lands (May et al. 2007). The majority of habitat falls on private lands, and the USFS holds the second greatest amount of Yellowstone cutthroat trout habitat (Figure 2-3). Other federal lands include Yellowstone National Park, which accounts for 3%, and BLM, which possesses less than 1%. About 3% of the current range lies on the Crow Indian Reservation.

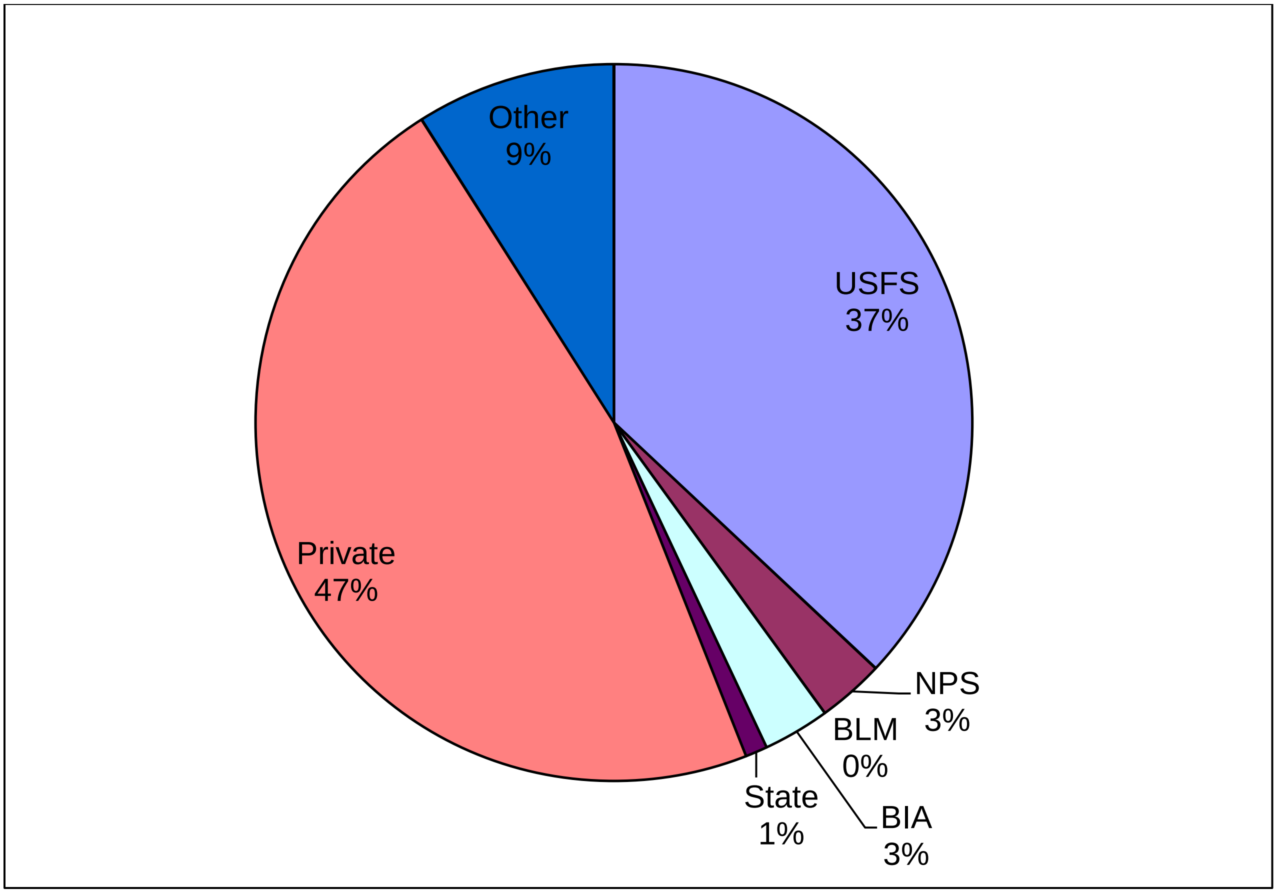

Figure 2-3: Landownership within the historic range of Yellowstone cutthroat trout in Montana (May et al. 2007).

Land uses within the Yellowstone cutthroat trout's historic range are typical of largely rural watersheds in the Intermountain West. Forested headwaters support timber harvest, recreation, and livestock grazing. Mineral development occurs at discrete locations, usually at higher elevations. Valley portions of watersheds are principally agricultural, with livestock, forage crops, small grains, and sugar beets being typical agricultural products. Urban development is limited, with Billings, near the downstream extent of the historic range, being the largest city with a population of nearly 104,000, according to the 2010 U.S. census data. Livingston is the second largest city with about 7,000 people in 2010. According to the U.S. Census, the other towns within the historic range have fewer than 2,000 people. Outside of the relatively few towns, most area residents live on widely spaced ranches, although rural subdivisions are increasing.

Energy development is an emerging land use within the native range of the Yellowstone cutthroat trout in Montana. Energy development that is underway or pending includes traditional oil and gas, coal bed methane, and wind energy. Hydraulic fracturing, a means to free gas or oil from deep shale formations by pumping water, proppants, and chemicals at high pressure, is an expanding type of energy development that may occur within the historic range of the Yellowstone cutthroat trout. Areas with considerable potential for exploration and development of oil or gas include the Shields River watershed and the southern and eastern flanks of the Crazy Mountains. Energy development in the Yellowstone River corridor is likely, as DNRC has leased mineral rights underlying the riverbed.

Currently, the Yellowstone River watershed within the Yellowstone cutthroat trout's native range supports 34 species of fish representing 11 families (Table 2-3). Twenty of these species are native to these waters. Yellowstone cutthroat trout and mountain whitefish are the only native members of the Salmonidae, the family encompassing trout, grayling, whitefish, and salmon. Introduced salmonids include rainbow trout, brown trout, and brook trout, all of which have wide distribution within the Yellowstone cutthroat trout's native range. Golden trout and Arctic grayling are present in some high elevation lakes, and an illegal introduction of lake trout into Yellowstone Lake presents a substantial threat to Yellowstone cutthroat trout in the lake.

Table 2-3: Fishes occupying the historic range of the Yellowstone cutthroat trout.

Family	*Common Name*	*Scientific Name*	*Origin*
Hiodontidae (Mooneye Family)	Goldeye	*Hiodon alosoides*	Native
Catostomidae (Sucker Family)	Shorthead redhorse	*Moxostoma macrolepidotum*	Native
	River carpsucker	*Carpiodes carpio*	Native
	White sucker	*Catostomus commersoni*	Native
	Longnose sucker	*C. catostomus*	Native
	Mountain sucker	*C. platyrhhynchus*	Native
Cyprinidae (Minnow Family)	Lake chub	*Cousieus plumbeus*	Native
	Flathead chub	*Platygobio gracilis*	Native
	Longnose dace	*Rhinichthys cataractae*	Native
	Western silvery minnow	*Hypognathus argyritis*	Native
	Fathead minnow	*Pimephales promelas*	Native
	Emerald shiner	*Notropis atherinoides*	Native
	Common carp	*Cyprinus carpio*	Introduced
Salmonidae (trout, grayling, whitefish, and salmon)	Rainbow trout	*Oncorhynchus mykiss*	Introduced
	Yellowstone cutthroat trout	*O. clarkii bouvieri*	Native
	Golden trout	*O. aguabonita*	Introduced
	Brown trout	*Salmo trutta*	Introduced
	Brook trout	*Salvelinus fontinalis*	Introduced
	Lake trout	*S. namaycush*	Introduced
	Mountain whitefish	*Prosopium williamsoni*	Native
	Arctic grayling	*Thymallus arcticus*	Introduced
Ictaluridae (Bullhead Catfish Family)	Channel catfish	*Ictaluris punctatus*	Native
	Black bullhead	*Ameirus melas*	Introduced
	Stonecat	*Noturus flavus*	Native
Gadidae (Codfish Family)	Burbot	*Lota lota*	Native
Gasterosteidae (Stickleback Family)	Brook stickleback	*Culaea inconstans*	Introduced
Centrarchidae	Smallmouth bass	*Micropterus dolomieu*	Introduced
	Largemouth bass	*M. salmoides*	Introduced
	Bluegill	*Lepomis macrochirus*	Introduced
Sciaenidae	Freshwater drum	*Aplodinotus grunniens*	Native
Cottidae	Mottled sculpin	*Cottus bairdi*	Native
Percidae	Yellow perch	*Perca flavescens*	Introduced
	Sauger	*Sander canadensis*	Native
	Walleye	*S. vitreus*	Introduced

The Yellowstone River supports the greatest number of species, with several of these barely overlapping with historically held Yellowstone cutthroat trout habitat. Warm-water fishes, such as several of the cyprinids (minnow family members), channel catfish, freshwater drum, shorthead redhorse, and river carpsucker, encroach into Yellowstone cutthroat trout range in the Yellowstone River seasonally, and at relatively low densities. Burbot have broad distribution in warm-water and cold-water habitats in Montana, but are rare in the Yellowstone River drainage upstream of its confluence with the Shields River.

Introductions account for occurrence of several nonnative species within high elevation lakes. Golden trout and Arctic grayling have been introduced into mountain lakes in the Beartooth and Absaroka mountains. Likewise, largemouth bass, bluegill, and yellow perch have been stocked in lakes in the area. Many of these lakes may have previously been fishless, although some may have supported adfluvial Yellowstone cutthroat trout populations.

3.0 Status and Ecology of Yellowstone Cutthroat Trout

Information on distribution and status of Yellowstone cutthroat trout across its historic range comes from a 2006 status review (May et al. 2007). This document is the second iteration in evaluating the range-wide status of Yellowstone cutthroat trout, and it updates and refines the previous status review (May et al. 2003). Both reviews employed a replicable, quantitative approach within a project geographical information system (GIS). The 2006 effort expanded the protocol to include additional attribute information in four categories: 1) presence of nonnative fishes; 2) evaluation of habitat quality; 3) incorporation of stocking records at the stream or segment level; and 4) description of life history behaviors for each population (May and Shepard 2007). This chapter examines results from the twelve fourth level HUCs in the Montana portion of the range (6.0 Subbasin Assessments and Conservation Opportunities).

3.1 Genetic Considerations

The 2006 status review (May et al. 2007) identified seven categories of genetic status for Yellowstone cutthroat trout populations in its historic range (Table 3-1). These categories included classes for populations subjected to genetic testing, and those not yet tested. Other criteria for class designation involved extent of genetic alteration within a population, which was either presumed or tested.

Table 3-1: Genetic considerations used for assessing genetic status of Yellowstone cutthroat trout in the 2006 status assessment (May et al. 2007).

Code	*Genetic Status*
1	Genetically unaltered (<1% introgression detected) as a result of introduced species interactions (tested using electrophoresis or DNA)
2	≥1% to ≤10 introgression (hybridized) with introduced species (tested using allozyme of DNA, and introgression indicated to be from a hybrid swarm
3	>10% to ≤25% introgression (hybridized) with introduced species (tested using allozyme or DNA, and introgression indicated to be from a hybrid swarm)
4	>25% introgression (hybridized) with introduced species (tested using using allozyme or DNA, and introgression indicated to be from a hybrid swarm)
5	Not genetically tested, suspected unaltered with no record of stocking or contaminated species being stocked or occurring in stream
6	Not genetically tested, potentially hybridized with records of introduced hybridizing species being stocked or occurring in stream
7	Hybridized and nonhybridized populations co-exist (sympatric mixed stock) in stream (use only if there is evidence of reproductive isolation, non-random mating, and genetic testing has been completed)

During the assessments, biologists further classified each cutthroat trout population as: 1) core conservation populations, which are genetically unaltered (>99%); 2) conservation populations that may be either genetically unaltered or slightly introgressed, but have attributes worthy of conservation (>90%); and 3) sport fish populations that are managed primarily for their recreational fishery value (May et al. 2003). Core populations have important genetic value and could serve as donor sources for developing either captive brood or for refounding additional populations. Management will emphasize conservation, including potential expansion, of both core and conservation populations.

3.2 Distribution

The Yellowstone cutthroat trout is native to waters in the upper portions of the Yellowstone River drainage in Montana and Wyoming, and the upper Snake River watershed in Idaho, Wyoming, Nevada, and Utah; however, distribution and abundance has changed markedly from the historic condition (Figure 2-1; May et al. 2007). The 2006 status review estimated Yellowstone cutthroat trout occupied over 17,700 miles range-wide, with about 43% still occupied by core, conservation, and sport fishing populations (May et al. 2007). Although distribution in streams has decreased, Yellowstone cutthroat trout have increased substantially in the number of lakes occupied, owing to introductions into previously fishless lakes. An estimated 205 lakes currently support Yellowstone cutthroat trout populations, compared to 61 historically occupied lakes.

In Montana, Yellowstone cutthroat trout historically occurred in nearly 4,300 miles of stream, which accounted for 24% of the fish’s total historic distribution (May et al. 2007). Currently, core, conservation, and sport populations occupy 31% of their historic stream miles in Montana (Figure 3-1). The western parts of its historic range, particularly in the upper Yellowstone River and Shields hydrologic units, support the greatest extent of the remaining Yellowstone cutthroat trout populations. Proceeding east in the watershed, fewer Yellowstone cutthroat trout populations are found, and these remaining populations are rarely connected with others.

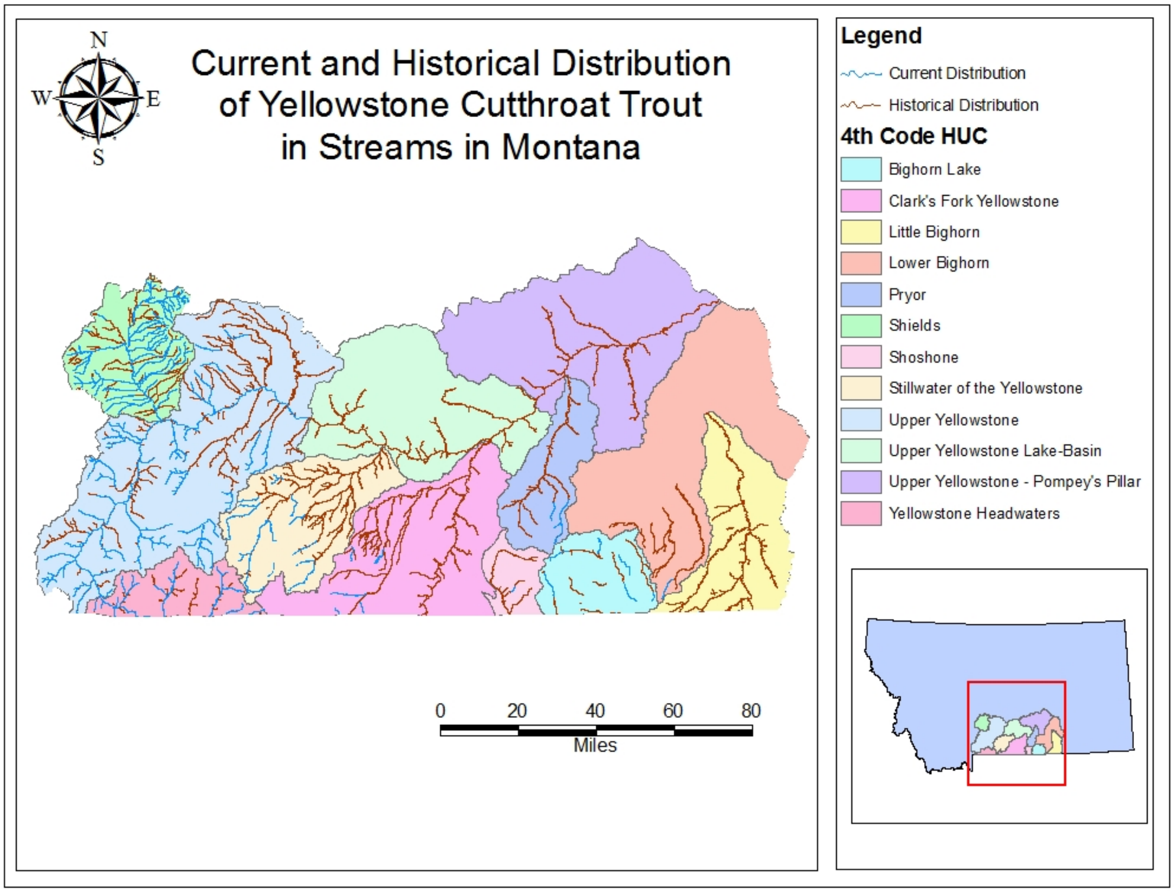

Figure 3-1: Current and historic distribution of Yellowstone cutthroat trout in Montana (FWP GIS database).

Examination of the percent of historically occupied stream miles still supporting Yellowstone cutthroat trout further demonstrates the trend for greater fragmentation and reduced distribution in the eastern extent of its range (Table 3-2). The Yellowstone Headwaters Subbasin, which lies mostly in Wyoming, supports a nearly intact distribution of Yellowstone cutthroat trout, with 96% of historically occupied waters still containing this fish. The Shields and Upper Yellowstone subbasins rank second and third respectively, in terms amount of historically occupied habitat still supporting Yellowstone cutthroat trout. In other HUCs, Yellowstone cutthroat trout still reside in as little as 2% of their historic habitat, or are no longer present.

Table 3-2: Comparison of historically and currently occupied stream miles for 4th code HUCs with water in Montana (from May et al. 2007).

Name	*HUC*	*Historically Occupied Miles*	*Currently Occupied Miles*	*Percent of Historical Habitat Still Occupied*
Yellowstone Headwaters	10070001	952	915	96
Upper Yellowstone	10070002	1116	560	50
Shields	10070003	682	453	66
Upper Yellowstone-Lake Basin	10070004	288		00
Stillwater	10070005	416	103	25
Clarks Fork Yellowstone	10070006	525	81	15
Upper Yellowstone-Pompey's Pillar	10070007	273		0
Pryor	10070008	226	27	12
Bighorn Lake	10080010	278	65	23
Shoshone	10080014	0172	4	2
Lower Bighorn	10080015	422	7	2
Little Bighorn	10080016	224	20	9

According to May et al. (2007), widespread stocking of Yellowstone cutthroat trout has greatly expanded the number of lakes occupied by Yellowstone cutthroat trout, especially in Wyoming and Montana. The extent of this expansion in Montana is currently unclear, as errors in the data entry process resulted in the inadvertent omission of several lakes believed to support Yellowstone cutthroat trout historically. The next iteration of the Yellowstone cutthroat trout status review will include these refined determinations of origin of lake dwelling populations, either aboriginal or anthropogenic.

3.3 Life History Strategies

Yellowstone cutthroat trout exhibit three primary life history strategies (Gresswell 1995). Fluvial fish reside principally in larger streams and rivers, and migrate to tributaries to spawn. Juvenile fish vary in the length of their residency in natal streams. Fluvial fry drift to the Yellowstone River soon after emergence (Byorth 1990). Resident fish live their entire lives within tributary watersheds, although these fish may also have migratory tendencies, using different parts of the watershed for spawning, rearing, and overwintering. Adfluvial fish reside in lakes, but return to streams for spawning. Maintenance and restoration of this diversity of life history strategies are conservation goals under the Yellowstone cutthroat trout Agreement, and are therefore a substantial concern in this restoration strategy.

3.4 Causes of Decline and Threats

The diminished and fragmented distribution of Yellowstone cutthroat trout is the result of a variety of disturbances across the landscape. Introduction of nonnative salmonids (rainbow trout, brown trout, and brook trout) has been especially deleterious (Gresswell 1995, Kruse et al. 2000). Hybridization with rainbow trout is a major concern, as the resulting fertile offspring form hybrid swarms (Allendorf and Leary 1988) and the effects of hybridization are irreversible. Likewise, brown trout and brook trout tend to displace native cutthroat trout through competition and predation (Behnke 1992). The rate at which brook trout are accelerating invasion and displacement of Yellowstone cutthroat trout in many headwaters streams is alarming and requires action to reverse this trend. Lake trout present a substantial threat to Yellowstone cutthroat trout in Yellowstone Lake. Discovered in 1994 (Kaeding et al. 1995), this illegal introduction is the subject of considerable effort to remove the highly piscivorous lake trout.

Habitat alterations in the form of dewatering and passage barriers have also contributed to the decline. Dewatering in tributaries of the Yellowstone River presents a major constraint to fluvial fish, as incubation, emergence, and drift coincide with peak demands for irrigation water (Clancy 1988, Byorth 1990). Conversely, irrigation does benefit some streams by contributing cooler groundwater from irrigation return flows later in the season. Barriers formed by impassable road crossings or irrigation diversion structures fragment the habitat and select against complex life history strategies (Rieman and Dunham 2000). In addition, the resulting isolation can contribute to extirpation of populations relegated to headwaters (Dunham et al. 1997).

Yellowstone cutthroat trout inhabit cold, clear waters, and streamside activities that disrupt riparian health and function and change channel morphology, can have adverse effects on this species. Unless properly managed, livestock grazing, residential development, and other activities along streams have potential to increase delivery of sediment and otherwise degrade habitat quality, which is detrimental to Yellowstone cutthroat trout, and may provide an advantage to the more tolerant introduced species. Likewise, reductions in shade afforded by riparian vegetation increases temperature loading to streams, which may favor introduced fishes, as these likely have broader thermal tolerances than cutthroat trout.

Whirling disease presents another threat to Yellowstone cutthroat trout populations in Montana. *Myxobolus cerebralis*, a European protozoan, is the parasite that causes whirling disease, and this organism has been found in several important Yellowstone cutthroat trout spawning streams in Montana. Investigations in Pelican Creek, a tributary of Yellowstone Lake, have confirmed susceptibility of Yellowstone cutthroat trout to whirling disease, and documented dramatic declines in the spawning run relating to whirling disease (Koel et al. 2007). Moreover, whirling disease is present in spawning tributaries to the Yellowstone River. Yellowstone cutthroat trout are extremely susceptible, and a high rate of infection is present in these tributaries (R. Vincent, FWP retired, personal communication). FWP personnel have deployed sentinel fish deployed in Upper Yellowstone River Basin in the 1990s and 2000s; however, those data have not yet been compiled and interpreted. The extent to which whirling disease may be having population level effects on Yellowstone cutthroat trout in the Montana portion of its range is a topic in need of further study.

Spring creeks are especially vulnerable to whirling disease infection, as the winter warm/summer cool temperatures and moderate flows provide ideal habitat for *Tubifex tubifex*, the intermediate worm host for *Myxobolus cerebralis*. Several spring creeks are among the high quality spawning streams for Yellowstone cutthroat trout (Clancy 1988). Although spring creeks may have high levels of infection, the timing of release of *Myxobolus cerebralis* does not necessarily coincide with presence of vulnerable young-of-the year cutthroat trout (Neudecker 2012), so more investigation is needed for Yellowstone cutthroat trout spawning streams. Whirling disease is present in the Upper Yellowstone River Subbasin, and fish entering spring creeks can bring the parasite with them. Anglers are the other potential source of transfer. Educational efforts aimed at ensuring anglers clean their waders and other fishing gear is an essential component of reducing the spread of whirling disease.

Climate change presents a current and looming threat with projected effects on water temperature and quantity. Recent warming has already driven significant changes in the hydroclimate, with a shift towards more rainfall and less snow in the western U.S. (Knowles et al. 2006). Likewise, the peak of spring snowmelt is two weeks earlier in recent years, and this trend is anticipated to continue (Stewart et al. 2004). Probable effects of climate change in the western U.S. will be increased water shortages and warmer water temperatures, especially during late summer, which will complicate cutthroat trout restoration efforts. In addition, changes in timing of spring runoff may alter spawning cues that have maintained temporal segregation of rainbow trout and Yellowstone cutthroat trout spawning runs, which may increase hybridization in the Yellowstone River.

4.0 Conservation Actions

A variety of actions will be necessary to secure and restore Yellowstone cutthroat trout within its historic range in Montana. This chapter details the general approaches available to address factors contributing to decline of Yellowstone cutthroat trout. Stream-specific conservation actions will follow field investigations and review of the available data.

4.1 Survey and Monitoring

A considerable number of streams have never been sampled, or the sampling information is old and may no longer reflect species composition or genetic status. Discovering additional populations and determining the status of existing populations of Yellowstone cutthroat trout will require continued field monitoring and genetic testing. These actions are critical for developing an informed conservation strategy and monitoring the success of conservation efforts.

4.2 Habitat Stewardship

High quality fish habitat requires sufficient water quantity and quality flowing through functional, dynamic stream channels that transport sediments efficiently, lined by healthy riparian wetlands that provide cover and nutrients and stabilize stream banks. The USFS, BLM, and Crow Tribe are responsible for habitat management on their lands. Landowners manage streamside activities on private lands. A variety of state and federal agencies share administrative jurisdiction to protect aquatic habitats in streams and wetlands on private and public lands. The Natural Streambed and Land Preservation Act (310 permit), the Stream Protection Act (124 permit), and private pond laws are examples of state laws that require permitting and inspection of proposed projects that may affect stream habitats. Federal laws also play a role in habitat protection, such as the Clean Water Act's Section 404, which regulates the placement of fill in wetlands, or the Forest Planning Act. Floodplain permits, issued by counties or cities, are often necessary if projects occur in designated floodplain. Agency cooperators will continue to work with landowners through the permitting processes to ensure that high quality habitats can be maintained.

4.3 Habitat Restoration

A host of land and water management practices has affected many streams in the Yellowstone River basin by altering stream function and degrading fish habitat. Many opportunities exist to restore high quality habitats to benefit Yellowstone cutthroat trout. Actions such as implementation of livestock best management practices (BMPs), restoration of healthy riparian corridors, and other innovative projects that enhance or improve stream function and water quality are among the available tools. Positive, cooperative working relationships with landowners, local watershed groups, and cooperating agencies are essential in implementation of habitat restoration projects. In 2003, FWP established a position for a Yellowstone cutthroat trout restoration biologist, whose primary responsibility is working towards Yellowstone cutthroat trout conservation, with an emphasis on providing technical and financial assistance to private landowners. FWP also administers the Future Fisheries Improvement Program, which provides grants to landowners to restore habitats on their lands. Watershed groups and conservation districts provide local leadership and mechanisms to interact with private landowners. Many other state, federal, and non-governmental organizations have grant programs targeted towards restoring stream habitats.

4.4 Connectivity

Fragmentation of habitats presents a significant threat to the persistence of isolated populations of Yellowstone cutthroat trout. These populations are at risk from genetic isolation and catastrophic disturbances, such as landslides, wild fires, disease, or extreme drought. Features that limit connectivity include impassable culverts at road crossings and irrigation diversions. Eliminating these fish passage barriers, where warranted, will be an important component of Yellowstone cutthroat trout conservation in the planning area.

Connecting or isolating populations of Yellowstone cutthroat trout will need to be considered on a case-by-case basis because these strategies bring benefits and risks. Often, short-term conservation will require isolation to protect a particular Yellowstone cutthroat trout population from introgression; however, long-term conservation may require connection to allow for natural population processes (dispersal, colonization, etc.) to operate over large spatial scales.

Although passage barriers have contributed to the decline of Yellowstone cutthroat trout across its range, not all barriers are undesirable. In many cases, fish barriers protect upstream populations of nonhybridized Yellowstone cutthroat trout from encroaching nonnative salmonids. These nonnative salmonids may pose hybridization, competition, or predation risks to extant populations of Yellowstone cutthroat trout. Investigations on fish distributions and connectivity will need to be conducted over relatively large scales to determine where existing fish barriers should remain or where additional fish barriers should be considered to protect existing populations of Yellowstone cutthroat trout. Conversely, removal of existing fish barriers may be appropriate to provide connectivity among cutthroat trout populations or to allow for expression of a more migratory life history if little to no risk from nonnative introgression or competition exists.

FWP maintains a database of natural and human-made features that likely block fish movements in streams. Numerous unknown barriers likely exist across the landscape. Additional survey will be required to identify potential barriers, and develop a strategy to remove or alter those limiting Yellowstone cutthroat trout from potential habitat.

Options available to promote connectivity vary with the nature of the barrier. In some cases, modifying the channel downstream of the structure with a series of step pools or fish ladder will provide access to and through a culvert or diversion. At some road crossings, replacing impassable culverts with bridges or bottomless arch culverts may be the preferred options. Fish ladders installed on irrigation diversions, or within culverts, allow fish to move past these features.

Collaborators in this process include a variety of entities. Parties responsible for road management include the state, county, USFS, and private landowners. Modifications to irrigation diversions will require the collaboration of ditch companies and individual irrigators. FWP will work with these groups to promote fish passage throughout the basin, as appropriate.

4.5 Entrainment

Entrainment into irrigation diversions results in loss of both adult and juvenile cutthroat trout. Several options exist to reduce or eliminate fish loss to irrigation ditches. Ditch management recommendations developed by FWP (http://fwp.mt.gov/habitat/diversions.asp) provide one tool in reducing entrainment. Essentially, these guidelines call for a staggered shut down of irrigation operations that will prompt fish to return to the stream. Ditch maintenance resulting in a uniform canal, without cover or refuge for fish, further reduces fish losses, as fish are more likely to return to the stream as flows attenuate.

Installation of fish screens that prevent fish from entering irrigation systems is another approach to reduce fish loss to irrigation ditches. Several types of screen are available such as rotating drum, Coanda, farmer, and turbulent fountain screens. As screens are relatively expensive and require regular maintenance, prioritization of diversions will follow observed rates of entrainment and risks to Yellowstone cutthroat trout populations.

As the vast majority of irrigation diversions deliver water to private landowners, partnerships among FWP, watershed groups, conservation districts, and individual landowners will be required to identify problematic diversions and develop solutions. Entrainment investigations can be tied with barrier inventories to promote fish passage (where desirable) and reduce entrainment at a given structure through installation of screens and fish ladders.

4.6 Constructed Fish Barriers

Although promotion of fish movement and gene flow is often desirable, protection of remaining nonhybridized populations from invasion of brook trout, brown trout, and rainbow trout is often necessary. Installation of a fish barrier is the typical approach to protecting headwater populations from the threats of hybridization, competition, and predation. A variety of types of intentional fish barriers exist, including impassable culverts, concrete structures, and created waterfalls in bedrock. Fish from downstream cannot ascend the barrier, although fish can move downstream over the barrier.

A number of geologic, logistic, and biological considerations relate to barrier site selection. The primary geologic consideration is presence of bedrock wall confinement at a potential barrier site, which will prevent the stream from cutting around the barrier during high flows. Logistic considerations address the ability to transport and mobilize heavy equipment and materials. Isolated sites lacking road access may be infeasible, given the complications in getting equipment, personnel, and materials to the site in a cost-effective manner.

The biological considerations involve the ability of a barrier to protect a sufficient amount of habitat. Population size is a primary determinant of long-term persistence of fis,h and the length of stream often correlates to the number of fish occupying a stream (Hilderbrand and Kershner 2000). In other words, the larger the population is, and the more miles of habitat it occupies, the less likely it will go extinct over time. Smaller populations are more vulnerable to inbreeding and extirpation from random events, such as fire, drought, and disease. Furthermore, migration barriers may also isolate important habitats, such as spawning areas, from fish that are downstream of the barrier.

The possibility of excluding fish from important habitat is reduced by maximizing the amount of habitat located upstream of the barrier. Guidelines developed by Hilderbrand and Kershner (2000), and a model developed to predict extinction risks associated with habitat size and other features (Peterson et al. 2008), will guide barrier site selection. For extant Yellowstone cutthroat trout that occupy relatively short segments of headwater stream habitats, replicating these populations into another stream habitat, and constructing barriers to isolate the two populations may be necessary. If monitoring determines that one of these isolated populations either goes extinct or reaches critically low levels, the replicate population will provide the source for reestablishing the extirpated population, making humans the dispersal vector.

4.7 Reintroduction into Reclaimed Streams or Lakes

Removal of nonnative fishes, followed by reintroduction of native cutthroat trout, has been a vital tool in cutthroat trout conservation, and will be used to restore Yellowstone cutthroat trout populations in Montana. Removal typically involves the use of a piscicide, such as rotenone, which kills all fish in a stream or lake, although mechanical removal can be feasible in a few situations (Shepard and Nelson 2004). In lakes, piscicide is often the best option; however, extended gillnetting and genetic swamping may also be successful in some situations. Once the nonnative species have been removed from the stream or lake, nonhybridized Yellowstone cutthroat trout would be reintroduced. In some cases, the given lake may have been historically fishless, and introduction of Yellowstone cutthroat trout would represent a range expansion. Often, these opportunities occur in high elevation lakes within designated wilderness. The USFS has authority over acceptable activities within wilderness areas and would need to approve introductions within previously fishless waters.

4.8 Water Quantity

Dewatering related to withdrawals for irrigation or other uses is a significant constraint on fisheries in Montana. Dewatering reduces the amount of suitable habitat for all life history stages, and results in warmer water temperatures, which can result in sublethal to lethal stress to Yellowstone cutthroat trout. In addition, water withdrawals for irrigation have the potential to reduce recruitment when the irrigation season coincides with incubation, emergence, and drift of Yellowstone cutthroat trout fry. Dewatering puts redds at risk of desiccation and can result in stranding of fry.

Solutions to address the effect of dewatering on Yellowstone cutthroat trout involve a voluntary, integrative approach that decreases demand for water by increasing irrigation and conveyance efficiency, and potentially compensates irrigators for maintaining in-stream flows through water leases. Several signatories of the Agreement have been involved, and will continue to be involved, in these efforts. The NRCS provides financial and technical assistance to agricultural producers in upgrading irrigation systems to improve efficiency. Likewise, FWP provides grant writing assistance to private landowners to procure NRCS funds. FWP and nonprofit groups can purchase water leases that maintain in-stream flows during critical summer months.

4.9 Water Quality

Although habitat restoration described above will benefit water quality through reduced loading of sediment, nutrients, and temperature, the total maximum daily load (TMDL) process is the primary mechanism available to improve water quality. These plans allocate an acceptable level of a pollutant a body of water can assimilate before the pollutant prevents the full support of beneficial uses. The beneficial uses of concern for this plan are growth and propagation of cold-water fishes. Primary pollutants within the area covered by this strategy are sediment, thermal alterations, and nutrients, although metals contamination is present in several streams. To date, approved TMDLs exist for the Shields River watershed, the Cooke City TMDL planning area, Big Creek, and the Boulder River watershed.

Upon completion of a TMDL plan, local watershed groups, conservation districts, or other entities work with DEQ on development of a watershed restoration plan. These plans prioritize streams or subbasins based on factors such as landowner consent, degree of pollutant loading, and presence of species of concern. A list of potential projects may be part of the watershed restoration plan. Streams listed in a watershed restoration plan have priority for receiving 319 funding, which is money the EPA provides to states to fund abatement nonpoint source pollution under Section 319 of the Clean Water Act.

5.0 Conservation Schedule and Milestones

The Agreement includes explicit goals and milestones for conserving and restoring Yellowstone cutthroat trout within its current range (MCTCS 2007). The purpose of establishing these milestones is to evaluate progress towards meeting conservation goals. The milestones applicable to Yellowstone cutthroat trout are as follows:

1. Draft a statewide Yellowstone cutthroat trout conservation plan by December 31, 2007.
2. Complete watershed or regional plans for at least two designated Yellowstone cutthroat trout conservation areas by January 1, 2008.
3. Work on 10 conservation projects for Yellowstone cutthroat trout per year.
4. Update statewide distribution and genetic status information annually by January 1 each year.
5. Compare the genetic risk and demographic risk ratings assigned by these more recent assessments to ratings assigned during earlier assessments to determine trends in these risks over time for each subspecies.
6. Maintain the number and miles of conservation populations, including those conservation populations that are nonhybridized, at levels at least as high as identified for Yellowstone cutthroat trout in 2000.
7. Work annually to reduce genetic and demographic risks to conservation populations, as measured by the overall mean genetic and demographic risk scores across all conservation populations by implementation of conservation projects.

This document and the *Yellowstone Cutthroat Trout Conservation Strategy for the Shields River Watershed above the Chadbourne Diversion* (FWP et al. 2012) meet the requirements for the first two milestones; however, the dates of completion were well beyond the dates in the Agreement. The scope and breadth of the documents, along with the need to incorporate the local expertise of state, federal, and tribal biologists, made the one-to-two year deadlines unachievable. As prepared, these documents provide conservation planners with thorough references to evaluate status of Yellowstone cutthroat trout populations, potential conservation needs, the age and quality of available data, and data collection needs at relatively fine spatial resolution.

The third milestone addresses the agreement to work on 10 Yellowstone cutthroat trout conservation projects per year. Most projects take more than one year to accomplish given the steps required from initial identification of a potential project to its completion. Typically, a restoration project involves evaluation of feasibility and often requires gaining landowner support. Other components of conservation projects include preliminary design, cost estimation, procurement of grant funds, contractor selection, final design and cost estimation, permitting, and public involvement as required by MEPA or NEPA. The MEPA/NEPA process can require considerable effort, especially for larger and potentially controversial projects. Despite the complexity of project planning through implementation, state and federal agencies and tribes have been exceeding this milestone since inception of the Agreement in 2007. An inventory of work per year towards Yellowstone cutthroat trout conservation shows that Yellowstone cutthroat trout conservation partners work on an average of 16 projects per year since the Agreement went into effect in 2007 (Table 5-1). Undoubtedly, private landowners implementing voluntary BMPs increase the number of projects benefitting Yellowstone cutthroat trout throughout its historic range. Moreover, this list does not include conservation actions in the Shields River watershed upstream of the Chadbourne diversion, where an active watershed group has been working towards conservation of Yellowstone cutthroat trout since the 1990s.

Table 5-1: Yellowstone cutthroat trout (YCT) conservation projects worked on from 2007 through 2012.

Year(s)	***Stream***	***Work Performed***	***Project type***
2007-2012	Soda Butte Creek	Brook trout suppression	Protect conservation population of YCT
2008	Willow Creek	Project assessment & fundraising	Stream restoration
2010	Willow Creek	Fundraising	Stream restoration
2011	Willow Creek	Permitting	Stream restoration
2012	Willow Creek	Construction	Stream restoration
2007-2012	Cedar Creek	Water lease	In-stream flow
2007-2012	Mulherin Creek	Water lease	In-stream flow
2009	Rock Creek	Preliminary design	Fish passage
2010	Rock Creek	Final design, fundraising, permitting & MEPA	Fish passage
2011	Rock Creek	Railroad culvert removal and step-pool construction	Fish passage
2007-2012	Big Creek	Water lease	In-stream flow
2007	Big Creek	Engineering & design	Fish screen
2008	Big Creek	Fish screen installation	Fish screen
2007	SF Fridley Creek	Engineering & design	Fish ladder
2007-2012	Mulherin Creek	Engineering & design	Fish screen
2008	Fleshman Creek	Fundraising	Stream restoration
2009	Fleshman Creek	Permitting & construction	Stream restoration
2007	Duck Creek	Initial project assessment	Protect core population of YCT
2008-2012	Tom Miner, upper Shields	Survey waters using robust, statistically designed approach	Inventory
2009-2010	Duck Creek	Establish replicate population above a barrier falls	Protect core population of YCT
2011	Upper Boulder River	Preparation of Environmental Assessment	Establishment of a conservation population
2012	Upper Boulder River	Gillnetting and piscicide application	Establishment of a conservation population

Year(s)	***Stream***	***Work Performed***	***Project type***
Table 5-1 continued			
2009	Upper Deer Creek	Brook and brown trout suppression	Protect nonhybridized population of YCT
2008	Lower Deer Creek	Initial planning and barrier site selection	Protect nonhybridized population of YCT
2009	Lower Deer Creek	Preliminary design and cost estimation	Protect nonhybridized population of YCT
2008	Lower Deer Creek	Fundraising	Protect nonhybridized population of YCT
2009	Lower Deer Creek	Fundraising & MEPA	Protect nonhybridized population of YCT
2010	Lower Deer Creek	Barrier construction	Protect nonhybridized population of YCT
2011	Lower Deer Creek	Removal of nonnatives	Protect nonhybridized population of YCT
2010	Shields River	Fundraising	Restore and retrofit Chadbourne diversion
2011	Shields River	Stability investigation	Restore and retrofit Chadbourne diversion
2012	Shields River	Design and permitting	Restore and retrofit Chadbourne diversion
2009	Shields River and headwater tributaries	Survey and brook trout suppression	Protect nonhybridized population of YCT
2009	South Fork Horse Creek	Project assessment	Stream restoration
2010	South Fork Horse Creek	Fundraising	Stream restoration
2011	South Fork Horse Creek	Permitting & construction	Stream restoration
2009	Middle Fork Horse Creek	Project assessment	Stream restoration
2010	Middle Fork Horse Creek	Fundraising	Stream restoration
2011	Middle Fork Horse Creek	Permitting & construction	Stream restoration
2008	Bangtail Creek	Willow plantings	Stream restoration
2011-2012	Shields River and headwater tributaries	PIT tag research	Life history, movement, & ecological investigation
2007-2009	Goose Creek and Goose Lake	Removal of nonnatives	Protect core population of YCT, expand habitat, create broodstock
2007	Crooked Creek	Barrier construction	Protect and expand core population of YCT
2007-2009	Crooked Creek	Mechanical removal of nonnatives	Protect and expand core population of YCT
2007	Crooked Creek	Preparation of Environmental Assessment addendum	Protect and expand core population of YCT
2008	Crooked Creek	Chemical removal of nonnatives	Protect and expand core population of YCT
2010-2011	Sage Creek	Chemical removal of nonnatives	Restore a core population of YCT
2012	Sage Creek	Follow-up monitoring to evaluate effectiveness of chemical removal	Inventory
2009	Piney Creek	Grant applications	Protect nonhybridized population of YCT
2010	Piney Creek	Construct fish screen	Protect nonhybridized population of YCT
2011	Piney Creek	Install riparian fencing	Protect nonhybridized population of YCT
2011	Piney Creek	Install habitat improvements	Protect nonhybridized population of YCT

The fourth milestone addresses data management of recent fisheries surveys and results of genetic analyses. Updating the database entails several mechanisms. FWP biologists enter their data into the data management system soon after they are collected. Likewise, the genetic analyses are entered into the database and department library as soon as they are received from the laboratory. Other agencies or entities require permits to sample fish in Montana, and they must submit their data by the end of the year. Finally, a data management specialist meets with biologists of all agencies on a yearly basis to ensure data addressing fish populations, genetic status, risks to persistence, and barriers are entered into FWP's database.

The fifth milestone occurs on 5-year intervals using data collected annually through regular reporting requirements. The result is a status report that identifies demographic and genetic risks. May et al. (2003) and May et al. (2007) are the first two iterations of this milestone. The next version will provide updates on these factors.

The conservation projects described under the third milestone provide the mechanism to meet the sixth and seventh milestones. Examples of conserving the number and miles of conservation populations include the Lower Deer Creek and Crooked Creek barrier and piscicide projects, the Piney Creek fish screen and habitat enhancement. Each of these projects conserved a core Yellowstone cutthroat trout population at risk of extirpation from sympatry with nonnative species or entrainment into an irrigation canal. Moreover, the conservation partners have restored Yellowstone cutthroat trout to 24 miles in the Sage Creek watershed in the Pryor Mountains. Reclamation of Sage Creek removed the threats posed by nonnative brook trout and rainbow trout. All of the projects worked on annually (Table 5-1) lead towards meeting the sixth and seventh conservation objectives.

6.0 Subbasin Assessments and Conservation Opportunities

This chapter describes the status of Yellowstone cutthroat trout and potential conservation opportunities for individual streams and watersheds. A note on hydrologic nomenclature may be useful in reading this document. The NRCS classification system designates hydrologic units hierarchically, according to a numeric coding system that assigns a hydrologic unit code (HUC) and an associated term[4]. For example, the area draining into the Shields River until its confluence with the Yellowstone River comprises a 4th code HUC, and under this system its narrative descriptor is "subbasin"; therefore, the Shields River 4th code HUC is technically referred to as the Shields River Subbasin. The next smaller hydrologic division is a 5th code HUC, which this system denotes as a watershed. Mill Creek and its tributaries are a designated 5th code HUC, and the technical name for this hydrological unit is the Mill Creek Watershed. In common use, the terms watershed, basin, and drainage are used interchangeably and typically without regard to the size of the drainage under consideration. This document uses the NRCS

[4] http://www.nrcs.usda.gov/programs/rwa/Watershed_HU_HUC_WatershedApproach_defined_6-18-07.pdf

nomenclature when specifically referring to designated HUCs. Otherwise, terms like watershed and drainage will be used generically and may reflect colloquial uses of these terms.

6.1 Yellowstone Headwaters Subbasin (HUC 10070001)

The Yellowstone Headwaters Subbasin originates in Wyoming and Montana, encompassing the area contributing to Yellowstone Lake, and extending to downstream of (Figure 6-1). The majority of this HUC is within Yellowstone National Park and, although national forest and some private lands occur in the northern portion of the watershed. Most of the national forest lands in Montana are also within the Absaroka-Beartooth Wilderness.

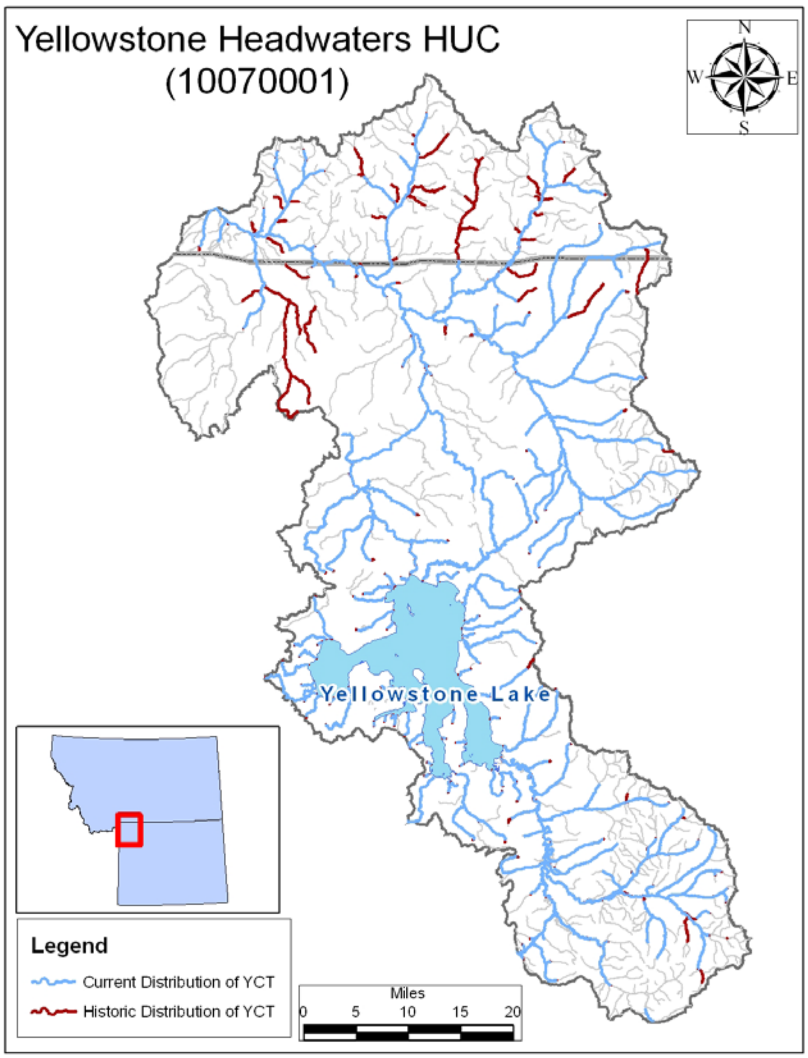

Figure 6-1: Historic and current distribution of Yellowstone cutthroat trout in the Yellowstone Headwaters Subbasin (FWP GIS database).

The Yellowstone Headwaters Subbasin supports the most extensive remaining distribution of Yellowstone cutthroat trout in the Yellowstone River watershed, with 96% of historically occupied stream habitat still supporting the fish (May et al. 2007). Nonetheless, several threats exist. Notably, an illegal introduction of lake trout into Yellowstone Lake was discovered in 1994, and this nonnative species poses a dire threat to Yellowstone cutthroat trout in the system (Kaeding et al. 1995). In addition, whirling disease is limiting recruitment of Yellowstone cutthroat trout to the lake system (Koel et al. 2007). Elsewhere, nonnative brown, brook, and rainbow trout put Yellowstone cutthroat trout at risk from competition, predation, and hybridization.

As a considerable amount of this hydrologic unit lies within national park or designated wilderness, recreation is the primary land use. Park and forest infrastructure such as roads and trails encroach on streams, but agricultural uses are negligible. Wildlife are the primary browsers and grazers in the subbasin, although recreational use of horses is considerable. Historic mining has occurred in the headwaters of some streams, and acid mine drainage and metals loading results in degraded water quality locally.

Genetic testing has occurred on numerous streams within the Montana portions of this watershed (Table 6-1). Genetic status is variable, with nonhybridized, slightly introgressed, and substantially introgressed populations being present. Continued invasion of rainbow trout is a concern for several tributaries in this watershed.

Table 6-1: Summary of genetic analyses conducted in the Montana portion of the Yellowstone Headwaters Subbasin (MFISH database). .

Stream	*Sample No.*	*Sample Size*	*Target Species*	*Percent of Genes*	*Count*	*Collection Date*
Bear Creek	183	10	YCT	83.5	0	10/01/1986
Bear Creek	183	10	RBT	16.5	0	10/01/1986
Bear Creek	11	1	YCT	100	0	08/20/1981
Darroch Creek	1322	10	YCT	100	0	08/04/1998
Darroch Creek	502	3	YCT	100	0	08/01/1991
Eagle Creek	185	25	YCT	93	0	10/01/1986
Eagle Creek	185	25	RBT	7	0	10/01/1986
Lake Abundance Creek	3550	33	YCT	99.8	0	08/13/2007
Lake Abundance Creek	3550	33	RBT	0.2	0	08/13/2007
North Fork Bear Creek	184	10	YCT	62.6	0	10/01/1986
North Fork Bear Creek	184	10	RBT	37.4	0	10/01/1986
Pebble Creek	822	25	YCT	100	0	08/24/1993
Reese Creek	401	25	YCT	96.2	0	07/26/1990
Reese Creek	401	25	RBT	3.8	0	07/26/1990
Slough Creek	3553	36	YCT	0	36	08/14/2007
Slough Creek	971	25	YCT	100	0	08/01/1994
Soda Butte Creek	2957	22	YCT	98.7	0	09/009/2004
Soda Butte Creek	2957	22	RBT	0.7	0	09/009/2004
Soda Butte Creek	2957	22	WCT	0.6	0	09/009/2004
Soda Butte Creek	346	25	YCT	88	0	09/06/1989
Soda Butte Creek	346	25	WCT	12	0	09/06/1989

6.1.1 Soda Butte Creek

Soda Butte Creek (Figure 6-2) and its headwater tributaries originate east of Yellowstone National Park in the Gallatin National Forest (GNF) in Montana, and in the Shoshone National Forest in Wyoming. Although most of the land is in public ownership, small parcels of privately owned lands occur along much of Soda Butte Creek, and include the towns of Silver Gate and Cooke City. The creek flows west into Yellowstone National Park, where it eventually joins the Lamar River. Recreation is the dominant land use in the area, although historic mining has had substantial influence on stream habitat and water quality in portions of this watershed.

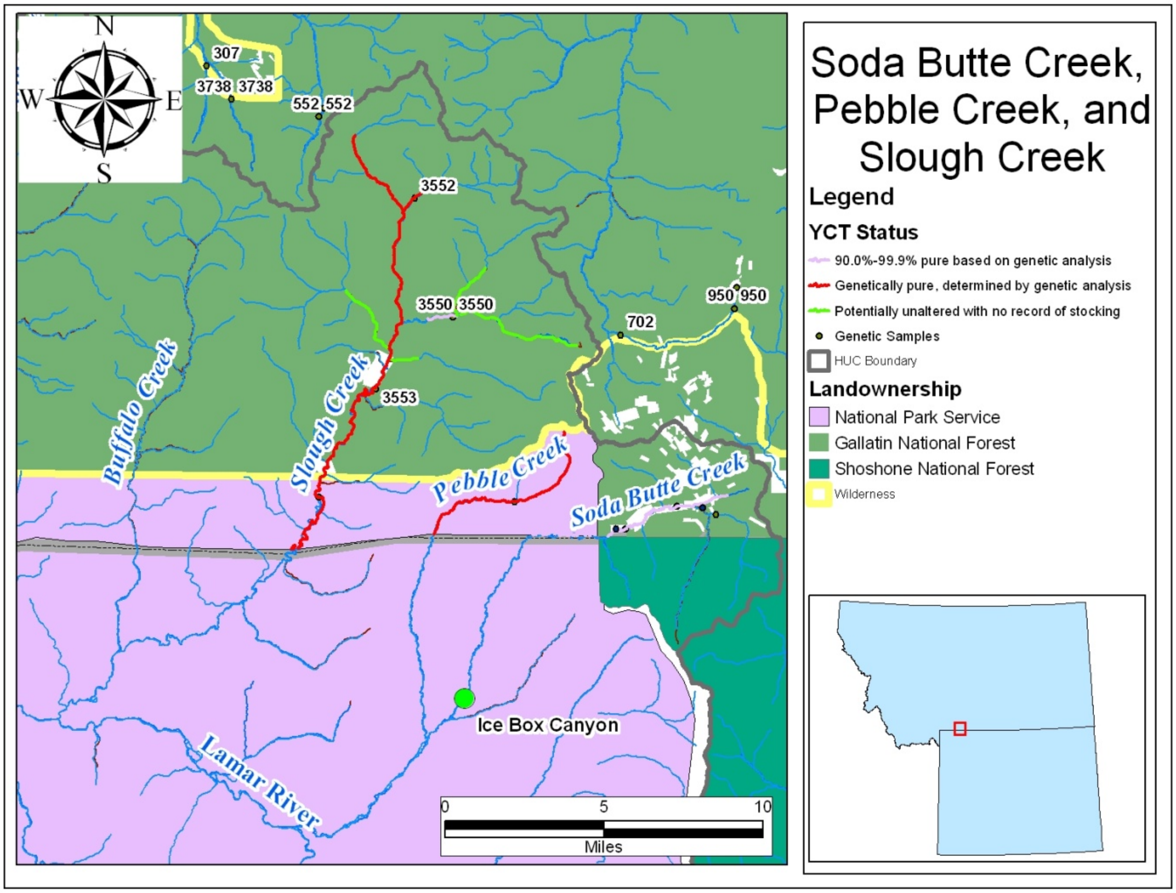

Figure 6-2: Distribution of Yellowstone cutthroat trout in Soda Butte Creek, Pebble Creek, and Slough Creek (FWP GIS database).

Soda Butte Creek supports a slightly introgressed population of Yellowstone cutthroat (Table 6-1). Genetic sampling in 2004 indicated Soda Butte Creek is a conservation population with 98.7% of alleles being of Yellowstone cutthroat trout origin, and 0.7% and 0.6% coming from rainbow trout and westslope cutthroat trout respectively (Wright 2005).

Sympatry with brook trout presents a threat to Soda Butte Creek's cutthroat population. These fish were originally present in a tributary stream, but metals contamination from historic mining formed a chemical barrier that prevented further invasion. Reclamation of mine wastes allowed brook trout to invade Soda Butte Creek and its tributaries. In 2005, FWP removed brook trout from an unnamed tributary using piscicide; however, brook trout managed to invade other waters. An ongoing mechanical removal effort has suppressed brook trout numbers; however, this multi-year, interagency collaboration has not succeeded at removing all the brook trout.

Rainbow trout invasion is another concern for Soda Butte Creek's Yellowstone cutthroat trout. Steep gradient and cascades through Ice Box Canyon have slowed invasion of rainbow trout from the Lamar River, although the occasional rainbow trout is captured during brook trout removal efforts. Installation of a barrier within this canyon is a planned future action to protect this conservation population.

Downstream of Ice Box Canyon, Soda Butte Creek is open to the influence of rainbow trout in the Lamar River. The fishery likely supports nonhybridized Yellowstone cutthroat trout, extensively hybridized Yellowstone cutthroat trout, and rainbow trout.

The limited success of the brook trout removal, combined with the degree of hybridization (> 1%), has resulted in reconsideration of the conservation approach for Soda Butte Creek. Future planning will evaluate the costs and benefits of two options. The first option would entail continued mechanical removal of brook trout, rainbow trout, and obvious hybrids. The alternative would be chemical removal of the existing fishery, followed by reintroduction of nonhybridized Yellowstone cutthroat trout.

Historic mining has had a pronounced negative effect on water quality and fisheries in Soda Butte Creek. The McLaren mine tailings, located upstream of Cooke City, are a major source of metals and acid mine drainage. Montana Department of Environmental Quality has embarked on reclamation of these tailings with the goal of removing this source of pollutants to Soda Butte Creek.[5] The multi-year project will extend from 2010 through 2015.

Degradation of spawning habitat in an unmapped spring creek following the fires of 1988 likely contributed to a significant loss of recruitment of Yellowstone cutthroat trout to Soda Butte Creek. Long time landowners recalled spawning runs numbering more than 200 fish. Residents of Silver Gate cherished this run, comparing it to Alaskan salmon runs, stating the fish were so numerous “that you could probably walk across their backs”. Recently, local residents sought assistance from FWP to restore habitat so that this run would return.

A combination of natural disturbance and human activities has reduced the quality and quantity of habitat in this once heavily used tributary (Endicott 2009). Notably, hillslope erosion following the 1988 fires contributed considerable amounts of fine, organic sediment in excess of the stream’s ability to transport these fines. A series of undersized, improperly placed culverts further limited the stream’s ability to transport fines. McNeil cores collected in areas where Yellowstone cutthroat trout had been observed spawning found these isolated patches of gravel were in a thin layer over black, anaerobic muck (C.L. Endicott, FWP, personal communication). Despite the absence of gravel through the profile of the streambed, and the preponderance of cohesive, organic material, a few Yellowstone cutthroat trout still spawn in this stream and observations of a several fry in October 2012 indicated limited reproduction occurs.

Restoration of this stream occurred in fall of 2012. The goal was to provide high quality spawning habitat by increasing the stream’s ability to transport sediment and providing clean

[5] See DEQ’s website for more information on reclamation of the McLaren tailings (http://www.deq.mt.gov/abandonedmines/mclaren.mcpx).

gravel to a depth of 1 foot. Installation of biologs, which are rolls of enmeshed coconut fibers, narrowed the channel and increased sinuosity. Within this narrowed channel, the organic, fine-grained substrate was excavated into a sequence of pools and riffles to a depth 1foot lower than the ultimate bed elevation. High quality spawning gravel was placed within the new bed profile. The result is a deeper, narrower, and more sinuous channel with a streambed composed of gravel suitable for spawning trout.

In summary, conservation of Soda Butte Creek's Yellowstone cutthroat trout population will address its various threats: nonnative species, heavy metals, acid mine drainage, and habitat degradation. Construction of a barrier in Ice Box Canyon to prevent further invasion of rainbow trout is a proposed future action. Continued monitoring will allow evaluation of the effectiveness of brook trout removals on managing threats to Yellowstone cutthroat trout. Reclamation using piscicide may be an option if mechanical removal does not provide sufficient protection of Yellowstone cutthroat trout over the long-term. Remediation of the McLaren mine tailings will improve water quality, and will increase the amount of habitat available to support Yellowstone cutthroat trout. Finally, restoration of the small, unmapped tributary flowing through Silver Gate will increase recruitment of Yellowstone cutthroat trout to Soda Butte Creek.

6.1.2 Pebble Creek

Pebble Creek, (Figure 6-2) a tributary of Soda Butte Creek, lies entirely within Yellowstone National Park. Its headwaters are in Montana, but it crosses into Wyoming before its confluence with Soda Butte Creek. As the stream is entirely within the national park, fisheries management falls exclusively to the National Park Service.

Genetic analyses occurred upstream of a canyon reach located immediately upstream of the Pebble Creek campground in 1993 and 2005 (Table 6-1). Neither analysis detected hybridization. A series of small waterfalls within the canyon may be preventing invasion of nonnative species. In contrast, the reach of Pebble Creek downstream of the canyon is open to the influence from fish in Soda Butte Creek, and hybridized Yellowstone cutthroat trout are likely present.

The portion of Pebble Creek upstream of the canyon is one of Yellowstone National Park's remaining strongholds for nonhybridized Yellowstone cutthroat trout, and protecting this population is a conservation priority. Downstream of the canyon, the likely presence of hybrids and risk of brook trout invasion makes the strategy in Pebble Creek the same as Soda Butte Creek. Potential actions include suppression or removal of brook trout or hybrids. Connectivity with the Lamar River, which has experienced an invasion of rainbow trout over the past decade, presents a challenge in securing a Yellowstone cutthroat trout population in lower Pebble Creek.

6.1.3 Slough Creek

Slough Creek (Figure 6-2) originates in the Absaroka-Beartooth Wilderness in Montana, and flows to the south into Yellowstone National Park. Over half of its length is in Montana. Slough Creek enters Wyoming, where it eventually joins the Lamar River in Yellowstone National Park.

Slough Creek was historically home to Yellowstone cutthroat trout from its headwaters to its confluence with the Lamar River. Rainbow trout invaded the lower reaches of Slough Creek following stocking in the 1930s; however, hybridization had not spread to the upper reaches until relatively recently. A canyon reach was thought to be a barrier to upstream fish movement, although rainbow trout apparently can pass this feature during low water years. Anglers reported rainbow trout upstream of the canyon in the late 1990s, and genetic testing confirmed the presence of hybrids in 2002.

Buffalo Creek is a tributary that joins Slough Creek downstream of the canyon. This stream is open to lower Slough Creek, resulting in presence of Yellowstone cutthroat trout, rainbow trout, and hybrids. A barrier exists on Buffalo Creek close to the park boundary. No current fish survey or genetic testing data are available for this stream, and filling this gap is a conservation need.

Given the recent invasion of rainbow trout into upper Slough Creek, the highest conservation priority is to halt the invasion through construction of a fish barrier in Slough Creek Canyon. Additional actions under consideration include selective removal of rainbow trout and hybrids using electrofishing, and changing angling regulations to increase harvest of rainbow trout. Other conservation needs include fish surveys on all tributaries of Slough Creek and Buffalo Creek.

6.1.4 Hellroaring Creek

Hellroaring Creek (Figure 6-3) originates in the Absaroka-Beartooth Wilderness in Montana, and flows south into Yellowstone National Park. Its lowest three miles flow through the park in Wyoming and joins the Yellowstone River.

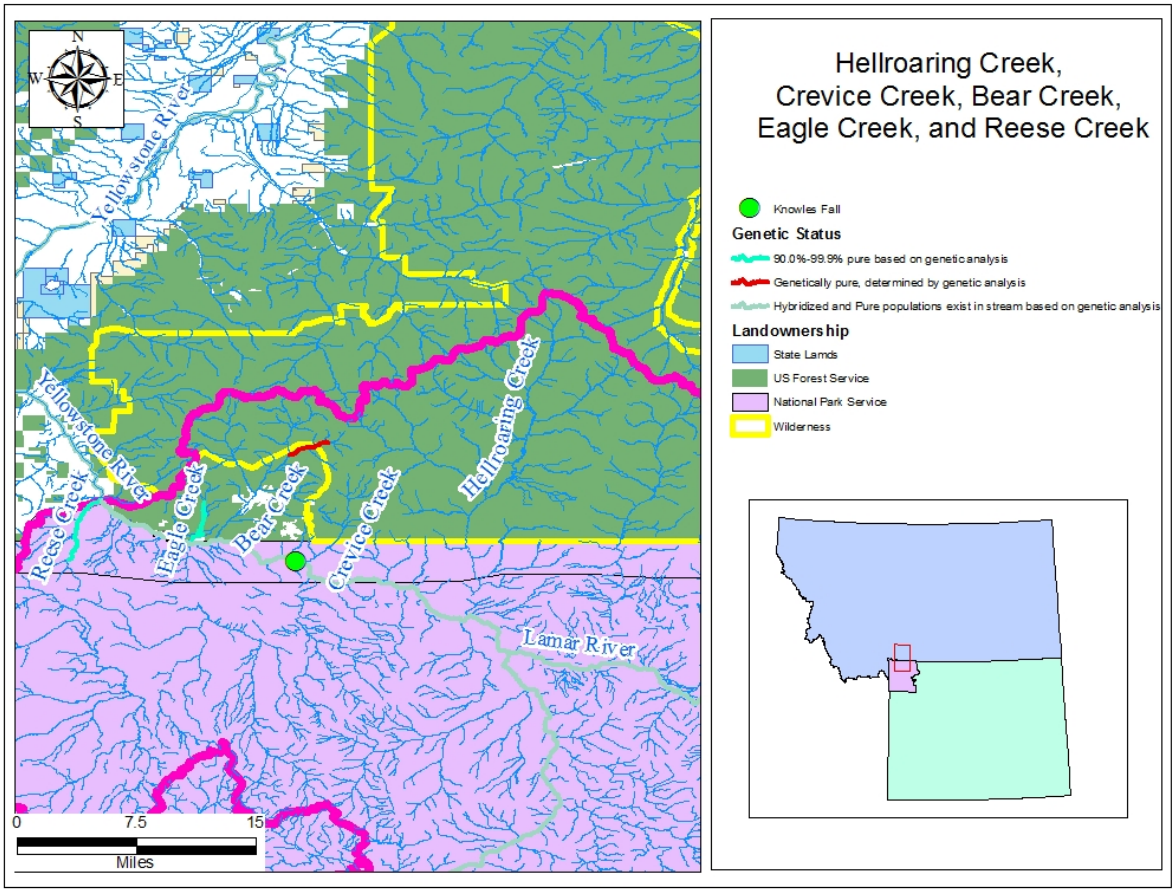

Figure 6-3: Distribution of Yellowstone cutthroat trout in Hellroaring Creek, Crevice Creek, Bear Creek, Eagle Creek, and Reese Creek in the Yellowstone Headwaters Subbasin (FWP GIS database).

Fisheries information is limited for Hellroaring Creek and its tributaries. Yellowstone cutthroat trout occur throughout the watershed and appear to be nonhybridized; however, no genetic analyses are available to verify conservation status. The two lakes in the basin, Carpenter and Charlie White lakes, have self-sustaining populations of Yellowstone cutthroat trout, although their genetic status is unknown. The creek's connectivity to the Yellowstone River and proximity to the Lamar River suggest rainbow trout and other nonnatives have access to Hellroaring Creek, which presents a threat to the basin's Yellowstone cutthroat trout.

The conservation priority for Hellroaring Creek is to conduct baseline investigations on fish community composition, distribution, and genetic status of Yellowstone cutthroat trout. These data will inform development of a specific conservation approach to secure or restore Yellowstone cutthroat trout in the sub-watershed.

6.1.5 Crevice Creek

Crevice Creek (Figure 6-3) is the next major drainage downstream from Hellroaring Creek. This stream and its tributaries lie nearly entirely within Yellowstone National Park or the Absaroka-

Beartooth Wilderness, so human-caused disturbance is unlikely. With a drainage area of over 31,000 acres and 6.6 miles of main stem, this stream has considerable potential to support a population of Yellowstone cutthroat trout if nonnative species have not gained access. The primary conservation need for Crevice Creek is survey to determine species composition, abundance, and genetic status of Yellowstone cutthroat trout if present.

6.1.6 Bear Creek

Bear Creek (Figure 6-3) and its tributaries originate in the Absaroka-Beartooth Wilderness and flow south through the GNF. Bear Creek enters the Yellowstone River at the Yellowstone National Park boundary. Small parcels of privately owned land are also present within the watershed.

Historically, Bear Creek supported Yellowstone cutthroat trout. In the 1980s, heavily hybridized Yellowstone cutthroat trout occupied Bear Creek and nonhybridized Yellowstone cutthroat trout were in North Fork Bear Creek (Table 6-1). Hybridization may be the result of stocking 2,000 catchable rainbow trout into Bear Creek in 1958. Brook trout are also present in the drainage, which presents another threat to the remaining Yellowstone cutthroat trout (S.W. Shuler, GNF, personal communication).

Fluvial Yellowstone cutthroat trout spawn in Bear Creek (Oswald 1984; DeRito 2004) and spawners include nonhybridized Yellowstone cutthroat trout (DeRito 1984). The potential for Bear Creek to recruit Yellowstone cutthroat trout into the Yellowstone River is substantial, and may rival Cedar Creek (see 6.2.6 Cedar Creek), which is the largest known contributor of fluvial fry. In the 1980s, Bear Creek supported the second largest spawning run of streams sampled (Oswald 1984). Investigation of the extent and quality of suitable spawning habitat available is a conservation need.

Darroch Creek, a three-mile-long tributary, may provide an opportunity to expand stream miles occupied by Yellowstone cutthroat trout. Yellowstone cutthroat trout are present downstream, but not upstream, of a natural barrier a short distance from its mouth (C. M. Sestrich, GNF, personal communication). Several investigations would be useful in determining the conservation potential for Darroch Creek. Evaluation of the genetic status of Yellowstone cutthroat trout below the barrier, and determination of the effectiveness of the barrier, are primary conservation needs. Depending on the results, Darroch Creek may be a candidate for expanding Yellowstone cutthroat trout within its native range.

Given the age of the available genetics information, verification of the genetic status of Yellowstone cutthroat trout in Bear Creek and North Fork Bear Creek is a conservation priority. Should nonhybridized or slightly hybridized fish still exist in the drainage, future planning should include development of a strategy to protect these fish. Brook trout removal is among the potential options, given the tendency of this nonnative species to displace Yellowstone cutthroat trout, especially in small headwater streams. Likewise, barrier construction may be warranted to prevent reinvasion by brook trout or rainbow trout.

If no core or conservation populations of Yellowstone cutthroat trout remain in the Bear Creek watershed, reclamation using piscicide or mechanical removal, followed by reintroduction of nonhybridized Yellowstone cutthroat trout, are potential activities. Again, barrier construction may be a necessary component of this approach in order to prevent reinvasion of nonnatives. Factors to consider in developing a specific approach include the extent of the available habitat for Yellowstone cutthroat trout with construction of a barrier. Bear Creek is about 10 miles long, and has several tributaries with the potential to support fish. Therefore, this stream may provide sufficient habitat to support a population of Yellowstone cutthroat trout over the long-term, even though barrier construction may be a necessary component of Yellowstone cutthroat trout conservation in Bear Creek.

Bear Creek formerly supported a small hydropower facility and a preliminary permit to resume hydropower on Bear Creek expired in 2010. Should interest in power production in Bear Creek resume, agencies will need to work with power producers to minimize the effect of the facility on fish. The potential for this development to occur is unknown.

Gold mining has occurred at several locations within the Bear Creek watershed and physical reclamation has been completed at the Mineral Hill Mine (M. Marks, GNF, personal communication). Drainage from the tailings facility is contained on-site. The operator has a Montana Discharge Elimination System allowing discharge of water to Bear Creek, although no discharge has occurred yet. Macroinvertebrate monitoring has not indicated impairment from metals; however, the invertebrate populations have suggested sediment loading at the sampling station downstream of the mine.

DEQ lists Bear Creek as impaired for low flow alterations and temperature. Opportunities to increase in-stream flows may exist for Bear Creek. Currently, FWP has 2 in-stream flow reservations on Bear Creek. A 22 cfs (cubic feet per second) water right for mining related activities also exists on Bear Creek (S.T. Opitz, FWP, personal communication). FWP will work with the water rights holder to evaluate the potential to convert that water to improve the fishery. Maintaining in-stream flows would be beneficial to the resident and fluvial fisheries.

6.1.7 Eagle Creek

Eagle Creek (Figure 6-3) is a tributary of the Yellowstone River that enters near Gardiner, Montana This 3-mile-long stream originates in the GNF and enters private land near its mouth. In 1986, Eagle Creek supported a conservation population of Yellowstone cutthroat trout, with 7% of alleles being of rainbow trout origin (Table 6-1). Fisheries investigations in the 1990s and 2009 found Yellowstone cutthroat trout hybrids and brook trout (S.W. Shuler, GNF, personal communication).

Three culverts present fish passage barriers in the Eagle Creek watershed (C. M. Sestrich, GNF, personal communication). One culvert is near the mouth and may be a beneficial barrier by keeping nonnatives from accessing Eagle Creek. Two other culverts are on tributary streams and prevent fish movement into these tributaries.

Conservation planning for Eagle Creek should address several issues. First, genetic status of this population may have changed in the 25 years since the last genetic testing, especially if rainbow trout from the Yellowstone River have free access to Eagle Creek. If a conservation population still exists, protecting it would be a priority. Potential actions may include removal of nonnatives and maintaining the lowest culvert as a fish passage barrier. The size of the watershed is a consideration in prioritizing Eagle Creek for such activities. Other culverts on tributaries to Eagle Creek are impassable and could be replaced with arched culverts if Yellowstone cutthroat trout conservation is a priority in the watershed. At only 3 miles in length, Eagle Creek would not have the capacity for long-term support of a Yellowstone cutthroat trout population that a stream affording more habitat could provide.

6.1.8 Reese Creek

Reese Creek (Figure 6-3) originates in Yellowstone National Park and flows to the north for 5 miles, until its confluence with the Yellowstone River, downstream of Gardiner. Reese Creek supports a slightly hybridized population of Yellowstone cutthroat trout, with 3.8% of alleles being of rainbow trout origin (Table 6-1). Nonnative fishes reside in Reese Creek up to a restrictive irrigation diversion and include rainbow trout, brook trout, and hybrids.

Reese Creek supports a spawning run of fluvial Yellowstone cutthroat trout and 44% of captured spawners were nonhybridized (M. Ruhl, YNP, personal communication). Dewatering was once a constraint on the fluvial and resident fish; however, YNP negotiated an agreement for water use that maintains a minimum of 1.6 cfs in Reese Creek. Water rights held by the GNF present a potential for further maintaining in-stream flows in Reese Creek if the USFS is willing to convert this right to in-stream flows. This action would be consistent with YNP's conservation objectives for Reese Creek.

6.1.9 Yellowstone River

The portion of the Yellowstone River (Figure 6-3) within the Montana part of the Yellowstone Headwaters Subbasin begins where the Yellowstone River crosses the border into Montana downstream of the confluence with Hellroaring Creek in Yellowstone National Park, and extends to several miles downstream of Gardner, Montana.

The reach of the Yellowstone River within Yellowstone National Park and Montana is home to a fish assemblage identical to that in the river downstream. Species present include Yellowstone cutthroat trout, mountain whitefish, and nonnative brown and rainbow trout (Table 6-2). Although not listed in the MFISH database)., native suckers and mottled sculpin are also likely present in this portion of the river.

Table 6-2: Distribution and abundance of fishes in the Yellowstone River within the Yellowstone Headwaters HUC (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Genetic Status*	*Data Rating*
554	559	Mottled sculpin	Unknown	Not applicable (N/A)	EBS[16]
519	559	Rainbow trout	Common	Tested conservation	EBS
548	559	Yellowstone cutthroat trout	Common	Nonhybridized	EBS
379	559	Mountain whitefish	Abundant	N/A	EBS
375	559	Brown trout	Common	N/A	EBS
454	559	Brook trout	Rare	N/A	EBS

Knowles Falls (Figure 6-3) restricts the distribution of several fish species within the Montana portion of the Yellowstone River. Mountain whitefish do not extend past these falls. Brown trout occur up to the falls, and have been reported, but not documented in the Yellowstone River upstream of Knowles Falls. Rainbow trout are present in the Lamar River, and have potential to disperse into the Yellowstone River and its adjacent tributaries.

Collection of current information on species presence, distribution, abundance, and genetic status of Yellowstone cutthroat trout is a conservation need for the portion of the Yellowstone River within Yellowstone National Park. As riverine Yellowstone cutthroat trout tend to spawn in tributaries, identifying spawning areas and ensuring access to these would also be beneficial. Brown trout and rainbow trout in the Yellowstone River upstream of Knowles Falls are threats to Yellowstone cutthroat trout throughout a large portion of the Yellowstone River basin within the national park. Determining their distribution and abundance would inform development of specific strategies to protect and secure Yellowstone cutthroat trout populations.

6.2 Upper Yellowstone River Subbasin (HUC 10070002)

The Upper Yellowstone River Subbasin (Figure 6-4) lies entirely within Montana, originating at the confluence of the Yellowstone River downstream of Gardiner, Montana, and extending to the confluence of Bridger Creek. The watershed contributing to Paradise Valley comprises a substantial portion of the hydrologic unit. Major subdrainages downstream of Paradise Valley include the Boulder River, Big Timber Creek, Sweet Grass Creek, and Otter Creek.

[6] EBS = extrapolated, based on surveys

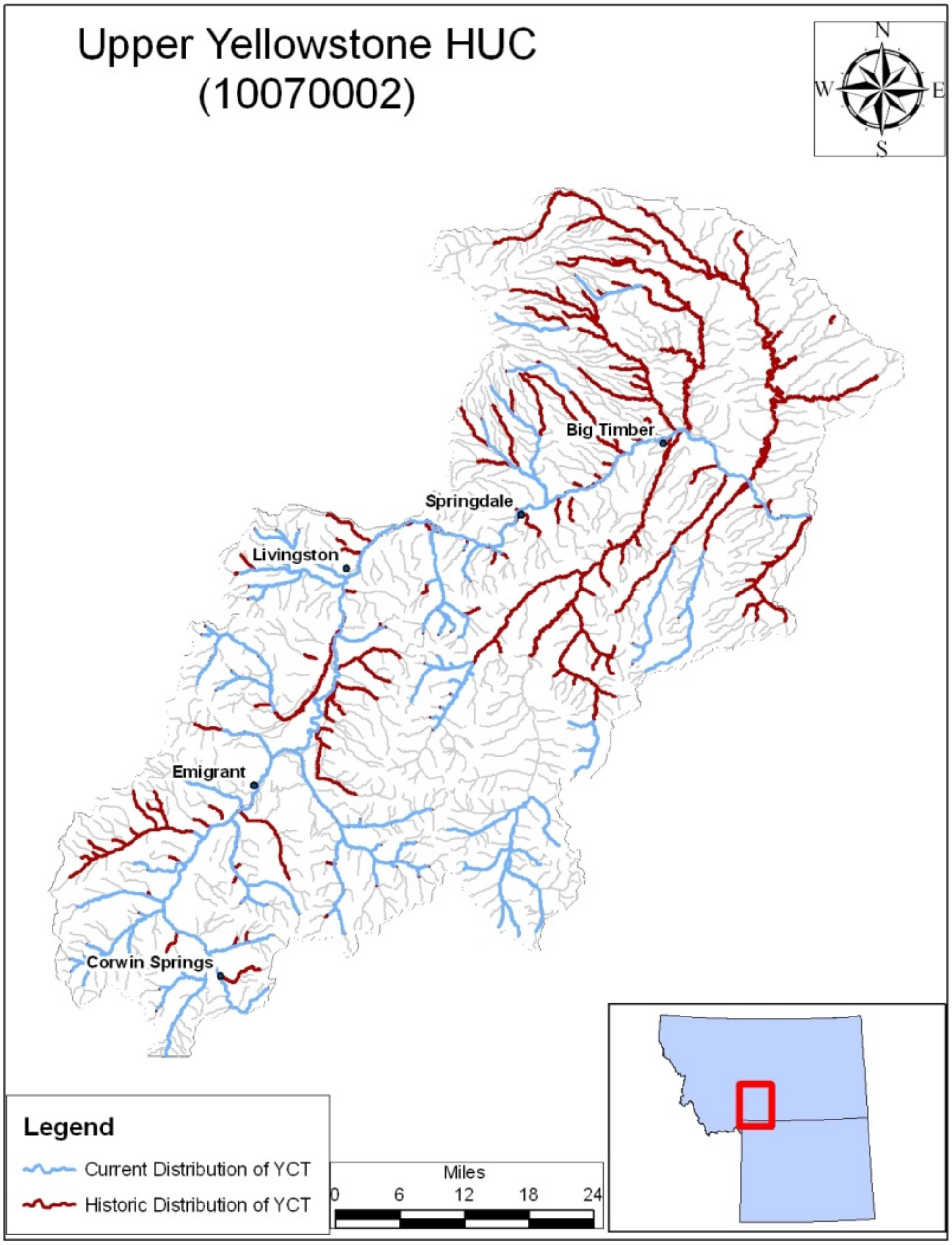

Figure 6-4: Current and historic distribution of Yellowstone cutthroat trout in the Upper Yellowstone River Subbasin (FWP GIS database).

This subbasin provides substantial habitat to core and conservation populations of Yellowstone cutthroat trout, and according to the 2006 status review (May et al. 2007), 50% of its historically occupied stream miles still support conservation populations. Streams draining to Paradise Valley have relatively intact distribution; however, Yellowstone cutthroat trout populations become increasingly fragmented in streams in the eastern portion of the subbasin. A similar pattern exists for the fluvial population of Yellowstone cutthroat trout in the Yellowstone River. Highest densities occur in the upstream portions of the river, near Corwin Springs. Yellowstone cutthroat trout become progressively rare proceeding downstream. Scarcity of Yellowstone cutthroat trout near Springdale is a relatively recent phenomenon, with dramatic reductions in abundance in the 2000s compared to the 1980s and 1990s (Opitz 2004).

Fisheries investigations have occurred on a substantial number of the subbasin's streams, although significant gaps in genetic testing and fish distribution exist. Moreover, some of the surveys may be outdated, and may no longer reflect current conditions. For example, fisheries investigations on East Fork Duck Creek in the 1980s found Yellowstone cutthroat trout substantially outnumbered brown trout (White 1984). In 2007, the reverse scenario was present, with brown trout dominating the fishery by a considerable margin (FWP, unpublished data). Fisheries biologists from FWP and the USFS have been working to fill these data gaps through a prioritized approach to survey and genetic testing.

Nonnative salmonids have wide distribution in the upper Yellowstone HUC, and pose a continuing threat to remaining populations of Yellowstone cutthroat trout. Rainbow trout are abundant in the Yellowstone River and many of its tributaries. Although temporal asynchrony in the spawning times has prevented wholesale hybridization and resulting loss of the nonhybridized fluvial Yellowstone cutthroat trout population (DeRito 2004), climate change may bring moderation in the physical cues that maintain this separation. Similarly, brown trout and brook trout occur sympatrically with Yellowstone cutthroat trout in numerous streams, or have displaced Yellowstone cutthroat trout altogether.

Dewatering during the irrigation season presents another constraint to fluvial and resident populations. FWP has identified several streams as being chronically or periodically dewatered (Table 6-3). Most of these are the lower ends of Yellowstone River tributaries, which limits the potential of these streams to support recruitment of Yellowstone cutthroat trout fry to the Yellowstone River. Water leases protect in-stream flows in several of these streams, including Cedar Creek, Mulherin Creek, Big Creek, and Locke Creek.

Table 6-3: FWP's dewatered stream list for the Upper Yellowstone River Subbasin (MFISH database).

Stream Name	***Tributary To***	***Begin River Mile***	***End River Mile***	***Dewatering Class***
Big Creek	Yellowstone River	0	2	Chronic
Big Timber Creek	Yellowstone River	0	5	Chronic
Boulder River	Yellowstone River	0	5	Chronic
Bridger Creek	Yellowstone River	0	3	Chronic
Cedar Creek	Yellowstone River	0	1	Periodic
Deep Creek	Yellowstone River	0	3	Chronic
East Fork Boulder River	Boulder River	0	7	Chronic
Eightmile Creek	Yellowstone River	0	2	Chronic
Elbow Creek	Yellowstone River	1	2	Chronic
Elk Creek	East Boulder River	0	2	Chronic
Emigrant Creek	Yellowstone River	0	2	Chronic
Fleshman Creek	Yellowstone River	0	10	Periodic
Fridley Creek	Yellowstone River	0	0.1	Chronic
Locke Creek	Yellowstone River	0	0.1	Periodic
Lower Deer Creek	Yellowstone River	0	4	Chronic
Mill Creek	Yellowstone River	0	1	Chronic
Mill Creek	Yellowstone River	1	5	Periodic
Mission Creek	Yellowstone River	0	1	Chronic
Mulherin Creek	Yellowstone River	0	1	Periodic
Pine Creek	Yellowstone River	0	2	Chronic
Sixmile Creek	Yellowstone River	0	3	Chronic
Strawberry Creek	Yellowstone River	0	1	Chronic
Suce Creek	Yellowstone River	0	2	Chronic
Suce Creek	Yellowstone River	2	3	Periodic
Sweet Grass Creek	Yellowstone River	0	2	Periodic
Trail Creek	Yellowstone River	8	13	Chronic
Trail Creek	Yellowstone River	18	31	Periodic
Upper Deer Creek	Yellowstone River	10	13	Chronic
Yellowstone River	Out-of-State	294	474	Periodic

Whirling disease presents a potential threat to the fluvial Yellowstone cutthroat trout population in the upper Yellowstone River HUC. Several tributaries tested positive for *Myxobolus cerebralis* and Yellowstone cutthroat trout are especially susceptible to infection (R. Vincent, FWP retired, personal communication). Educating anglers on the importance of cleaning gear between stream visits is among the tools available to prevent further spread of this disease. Managing streamside activities to reduce loading of fine sediment and nutrients is an important conservation objective. These pollutants favor a high abundance of the aquatic worm *Tubifex tubifex*, *Myxobolus cerebralis*'s intermediate host. Additional study on the influence of whirling disease on Yellowstone cutthroat trout is a research need. The findings will foster an adaptive approach to conserving Yellowstone cutthroat trout with respect to this growing concern.

Streams in the Upper Yellowstone River Subbasin have been the focus of substantial conservation efforts involving collaboration among FWP, private landowners, and the USFS. Specific conservation measures have included water leases, which have mostly been successful in maintaining in-stream flows and increasing reproductive success of fluvial Yellowstone cutthroat trout. The Upper Yellowstone River Subbasin presents several opportunities to secure genetically unaltered populations of Yellowstone cutthroat trout. The Yellowstone River is the largest stream supporting nonhybridized Yellowstone cutthroat trout, although hybridized fish also exist. The primary approach to securing this population will be to promote in-stream flows in the lower reaches of tributaries, combined with improving habitat, to promote recruitment of Yellowstone cutthroat trout fry.

As cues maintaining segregation of the rainbow trout and Yellowstone cutthroat trout may be moderating with climate change, continued monitoring of the genetic status is required to inform future management options. For example, if the spawning runs begin to show a greater degree of overlap, fisheries managers might resort to structures that facilitate selective passage of Yellowstone cutthroat trout, while preventing entrance of rainbow trout to tributaries.

Securing other core and conservation populations within the subbasin will require a combination of barrier installation and removal of nonnative species. Likely candidates for these activities include the Upper Deer Creek watersheds, Little Timber Creek, and streams in the Duck Creek watersheds. A massive Yellowstone cutthroat trout conservation project has been ongoing in streams in the upper Boulder River watershed, above Hell’s Canyon. Opportunities to restore Yellowstone cutthroat trout into streams where they have been extirpated also exist. Most of the potential sites are likely to occur in upper reaches of watersheds, which are mostly under USFS management. FWP and the USFS will identify streams with suitable characteristics, such as sufficient habitat and presence of a feasible barrier site.

In summary, the upper Yellowstone HUC supports relatively intact populations of Yellowstone cutthroat trout; however, an aggressive approach to securing existing and restoring extirpated populations is required to ensure persistence over the long-term. Protecting nonhybridized fluvial and resident populations is the highest priority, requiring an integrative approach that addresses dewatering, hybridization, competition, and disease. Continued survey of the basin’s streams, combined with genetic testing, is another critical component of the conservation approach, and will inform future actions. Finally, reintroduction of Yellowstone cutthroat trout into reclaimed streams will increase the fish’s distribution in its historic range.

6.2.1 Yellowstone River

The Yellowstone River (Figure 6-4) flows for about 120 miles through the Upper Yellowstone River Subbasin. Most of the land in the valley bottom is in private ownership, although some publically owned land is present along the river’s course. FWP has several long-term monitoring sections on the Yellowstone River, and annual fisheries investigations provide information on relative abundance of Yellowstone cutthroat trout and other fishes. In addition, an investigation of movements and spawning of Yellowstone cutthroat trout, rainbow trout, and hybrids provides substantial information on the river's cutthroat trout population (DeRito 2004).

Several factors limit the river's Yellowstone cutthroat trout population. As Yellowstone cutthroat trout tend to be tributary spawners, flow in tributary streams and access to spawning areas are perhaps the greatest influences on the riverine population (Berg 1975; Clancy 1984). Harvest was a constraint until the implementation of catch-and- release regulations for Yellowstone cutthroat began in the 1980s (Clancy 1987). In recent years, whirling disease has emerged as a potential threat, with Yellowstone cutthroat trout showing infection, primarily in the form of cranial deformities.

Corwin Springs Monitoring Section

The Corwin Springs monitoring section begins upstream of the Corwin Springs bridge and extends downstream for just over 5 miles. Trout present in this section include Yellowstone cutthroat trout, rainbow trout, and brown trout. Comparisons of population estimates indicate rainbow trout are often the most abundant species, although Yellowstone cutthroat trout were the most abundant in several years (Figure 6-5). Brown trout and Yellowstone cutthroat trout tend to be present in similar numbers. This upper sampling reach generally has the greatest number of Yellowstone cutthroat trout compared to downstream reaches. Although no confidence intervals or other measures of variance were reported with these data, these results indicate Yellowstone cutthroat trout are relatively abundant in this part of the Yellowstone River compared to brown trout and rainbow trout.

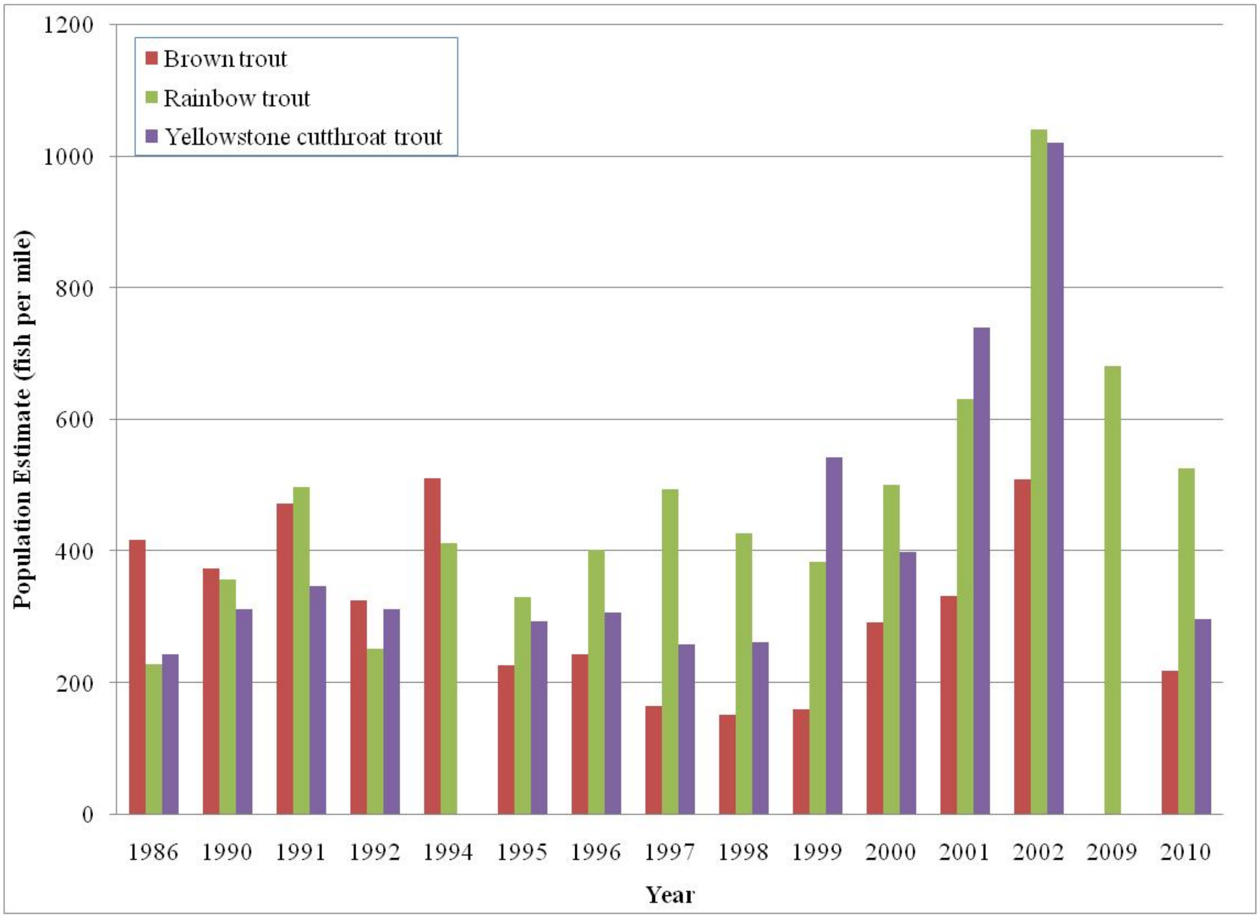

Figure 6-5: Population estimates for brown trout, rainbow trout, and Yellowstone cutthroat trout captured in the Corwin Springs section (MFISH database).

The increases in Yellowstone cutthroat trout abundance in the late 1990s through the early 2000s follow water leases in neighboring streams including Cedar Creek, Mulherin Creek, and Big Creek, which began in the late 1990s. Such positive responses following implementation of water leases underscore the value of conservation.

Nonhybridized and hybridized individuals are present in this part of the river. A sample of 30 fish captured in 1998 tested as being a mixture of nonhybridized Yellowstone cutthroat trout and hybridized individuals (Thelen 1999). The average contribution of Yellowstone cutthroat trout alleles for this sample was 96.7%, and rainbow trout alleles comprised 3.3%. DeRito (2004) reported radio-tagging 27 nonhybridized Yellowstone cutthroat trout from this section during 2001 and 2002, along with 7 hybrids. More recently, analyses of 43 putative Yellowstone cutthroat trout collected from this section yielded a mixture of nonhybridized and hybridized fish (S.T. Opitz, FWP, personal communication).

The presence of substantial numbers of Yellowstone cutthroat trout in this portion of the river relates largely to the proximity of several high quality tributaries including Cedar Creek, Mulherin Creek, Big Creek, and Tom Miner Creek. Maintaining habitat, water quality, and stream flows within these tributaries are important conservation objectives for the river's Yellowstone cutthroat trout population. Likewise, identifying potential projects to increase the number of suitable spawning tributaries would be beneficial.

Whirling disease is among the threats to Yellowstone cutthroat trout in this portion of the Yellowstone River. Cranial deformities typical of whirling disease are present in Yellowstone cutthroat trout and rainbow trout captured in this portion of the river (S.T. Opitz, FWP, personal communication). Identifying spawning streams testing positive for the *Myxobolus cerebralis* would be useful in devising strategies to reduce or mitigate infection.

This portion of the Yellowstone River has outstanding conservation value for Yellowstone cutthroat trout. This value relates in part to the relatively high abundance of Yellowstone cutthroat trout remaining in this part of the river. Moreover, this population retains the fluvial life-history strategy that has been eliminated in a large extent of the Yellowstone cutthroat trout's historic range. Preserving the diversity of life-history strategies is a priority under the cutthroat trout conservation agreement (MCTSC 2007). Threats to this population include reduced recruitment relating to dewatering in tributary streams, and continued hybridization with sympatric rainbow trout. Conservation actions will include promoting in-stream flows in spawning tributaries and installation of screens on irrigation diversions to reduce loss. Continued monitoring will evaluate the population level risks from hybridization with rainbow trout.

Mill Creek Bridge Monitoring Section

Proceeding downstream, the next long-term monitoring section is the Mill Creek bridge monitoring reach. This section begins at the bridge, and extends 4.4 miles downstream. This section supports Yellowstone cutthroat trout, rainbow trout, and brown trout. Mountain whitefish are also abundant in this portion of the river. Data from several years indicate nonhybridized and hybridized Yellowstone cutthroat trout have been captured in this monitoring section (MFISH database).

Relative abundance of the three species of trout has varied over the years (Figure 6-6). Throughout the 1990s, brown trout were the most abundant species; however, in the 2000s, rainbow trout became numerically dominant. Yellowstone cutthroat trout were typically less abundant than the nonnative trout, but still comprised a substantial proportion of the assemblage. Yellowstone cutthroat trout were the most abundant trout species in 1999. This strong showing was potentially related to a strong year class produced in Mill Creek in 1997. The combination of a water lease to maintain in-stream flows and a good water year resulted in the greatest number of fry produced in Mill Creek during six years of monitoring (Roulson 2002).

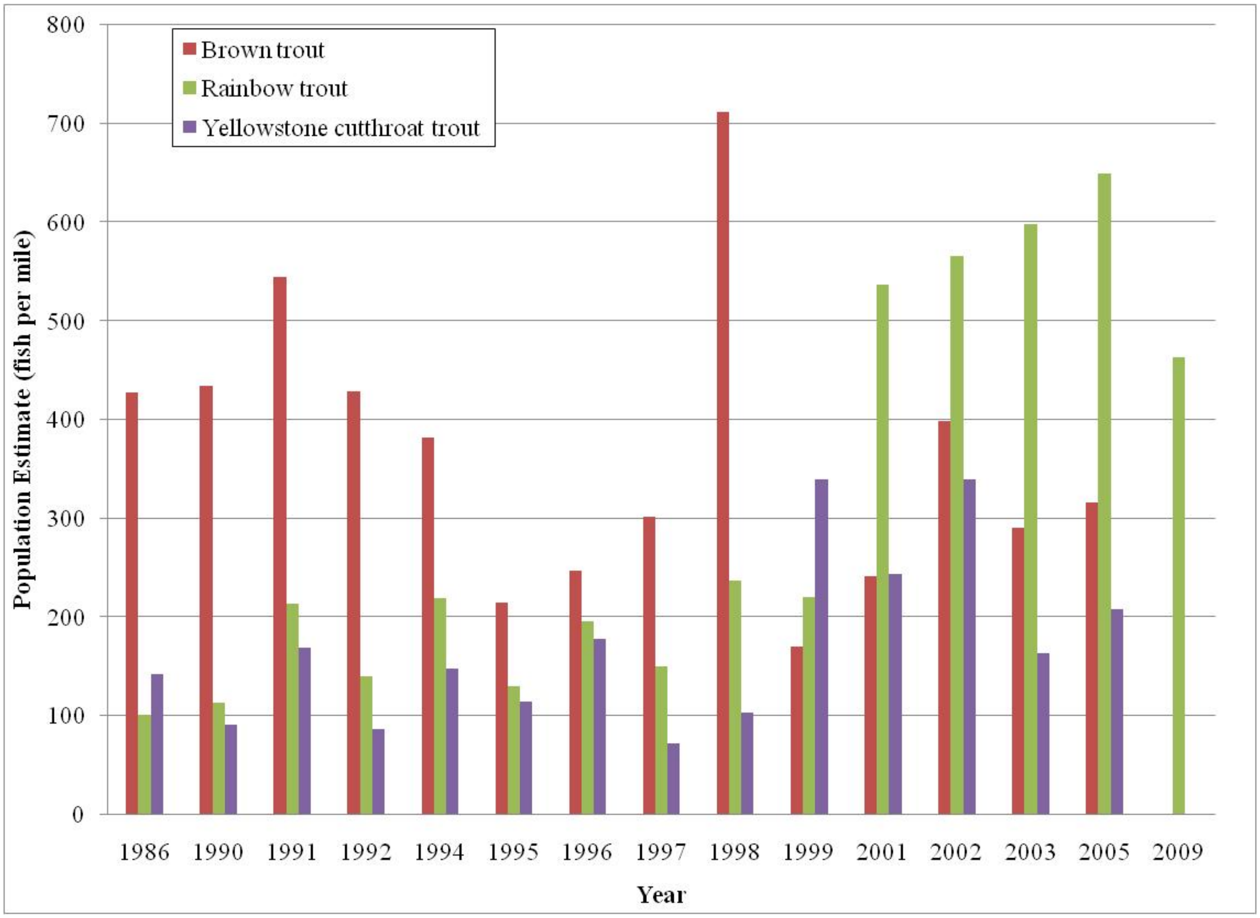

Figure 6-6: Population estimates for brown trout, rainbow trout, and Yellowstone cutthroat trout captured in the Mill Creek bridge section (MFISH database).

Whirling disease presents a threat to Yellowstone cutthroat trout in this portion of the Yellowstone River. The characteristic cranial deformities are present in Yellowstone cutthroat trout and rainbow trout captured in the Mill Creek bridge monitoring reach (S.T. Opitz, FWP, personal communication). Additional investigation is needed to evaluate hotspots for whirling disease infection.

Increasing recruitment from tributaries would benefit the Yellowstone cutthroat trout in this portion of the Yellowstone River. Potential actions include finding solutions to maintain in-stream flow, and ensuring access to potential spawning habitat. In 2008, installation of a fish ladder on an irrigation diversion on South Fork Fridley Creek opened up several miles of potential spawning habitat. Apparent Yellowstone cutthroat trout were observed spawning upstream of this structure in 2009 (C.L. Endicott, FWP, personal communication).

Other conservation actions for this portion of the river relate to continued monitoring. Evaluations of abundance of Yellowstone cutthroat trout, evidence of whirling disease, and genetic status are the primary monitoring objectives.

Ninth Street Bridge Monitoring Section

The upstream extent of this monitoring section has changed over the years, originally starting at the Ninth Street Bridge, but then moving downstream to Mayor's Landing. The downstream end is at the Highway 89 bridge. Trout species include rainbow trout, brown trout, and Yellowstone cutthroat trout, with rainbow trout outnumbering the others by a substantial margin (Figure 6-7). Yellowstone cutthroat trout are typically the least abundant trout in this reach of the Yellowstone River.

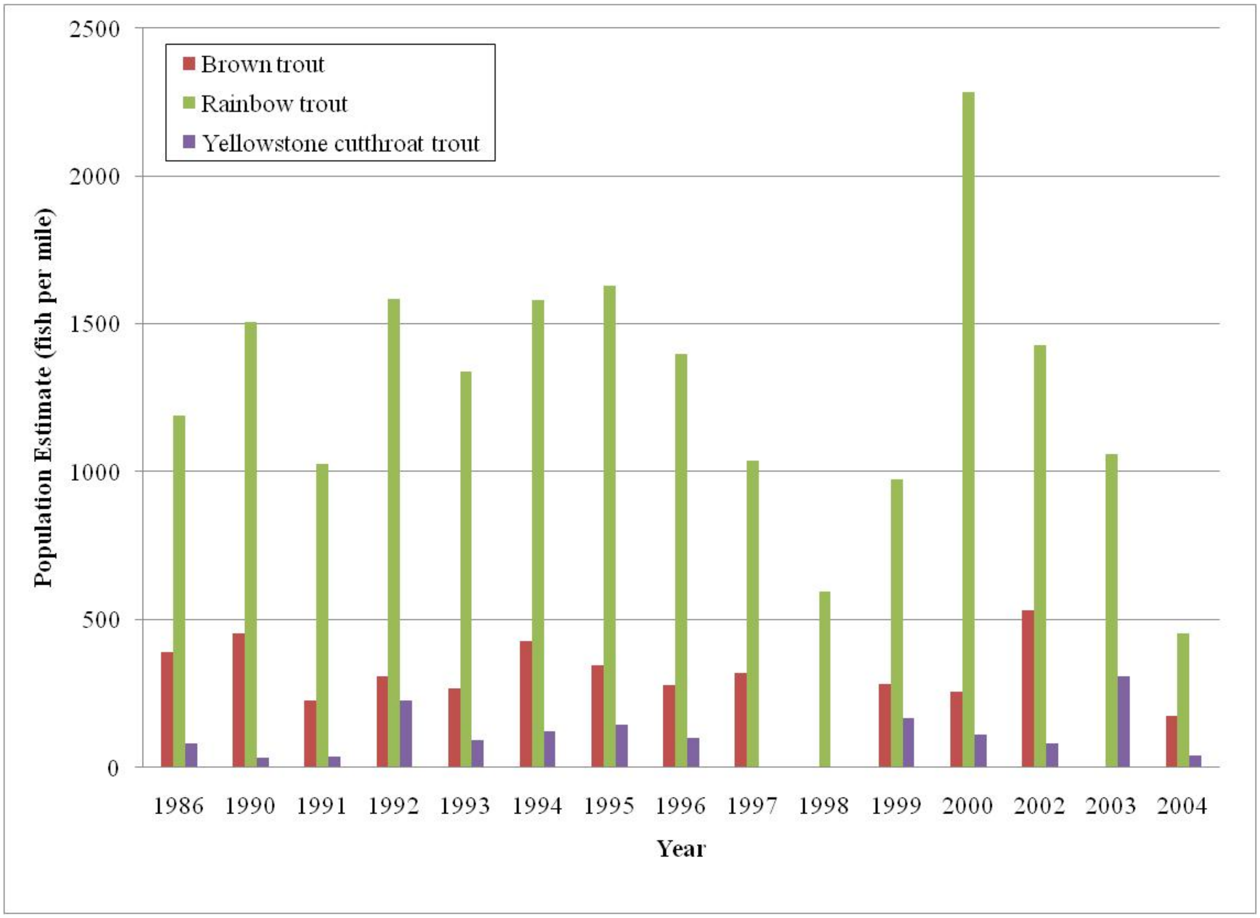

Figure 6-7: Population estimates for brown trout, rainbow trout, and Yellowstone cutthroat trout captured in the Ninth Street bridge section of the Yellowstone River (MFISH database).

A lack of tributary spawning habitat is among the constraints on the Yellowstone cutthroat trout population in this portion of the river. Completed and proposed habitat improvements in Fleshman Creek may be beneficial to Yellowstone cutthroat trout. Currently, brown trout and rainbow trout spawn in Fleshman Creek; however, high levels of fine sediment likely limit survival to emergence of embryos (C.L. Endicott, FWP, personal communication). An effort in the 1990s to imprint Yellowstone cutthroat trout fry on Fleshman Creek resulted in production of about 14,500 Yellowstone cutthroat trout fry (Tohtz 1996); however, this did not result in the establishment of a fluvial run into Fleshman Creek. Yellowstone cutthroat trout were documented among lost in a fish kill in 2007, but at low numbers. Following restoration of Fleshman Creek, a potential option would be to try again with imprinting using fertilized eggs collected from known fluvial fish.

Springdale Monitoring Section

The Springdale monitoring section encompasses about five river miles, extending upstream from the fishing access site at Springdale. Rainbow trout tend to be the numerically dominant trout in this part of the river, followed by brown trout (Figure 6-8). Until recently, the Springdale monitoring section had some of the higher concentrations of Yellowstone cutthroat trout, and these were often similar to, or greater than, brown trout. The past decade has seen a substantial decline in Yellowstone cutthroat trout numbers, with too few fish captured to calculate a population estimate.

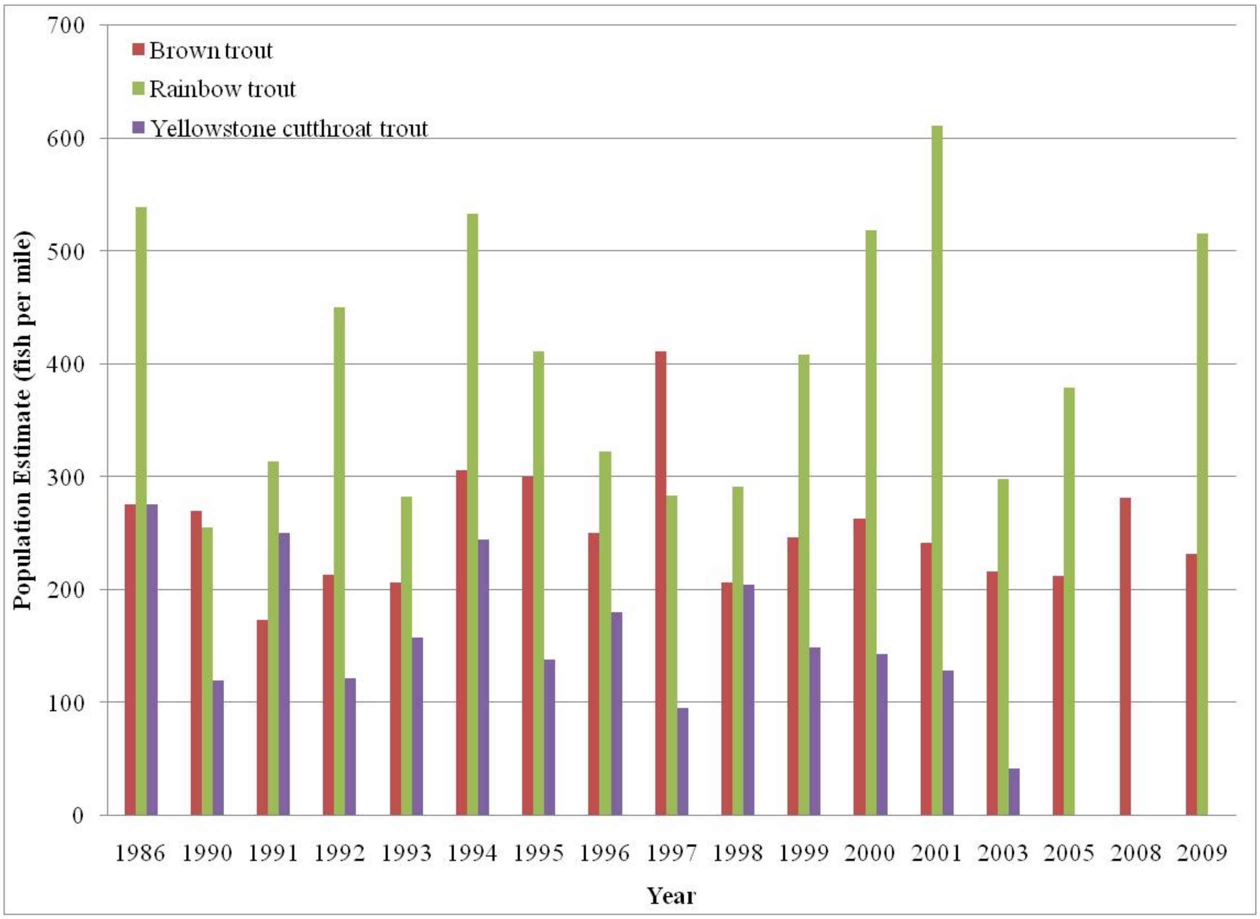

Figure 6-8: Population estimates for brown trout, rainbow trout, and Yellowstone cutthroat trout captured in the Springdale section of the Yellowstone River (MFISH database).

The causes of decline likely relate in part to extended drought that put greater demands on available water in tributaries and side channels, and increased water temperatures in tributaries and the main stem. The loss of a spawning run in Locke Creek is another potential factor. Locke Creek was once among the high quality spawning streams for Yellowstone cutthroat trout

(Clancy 1988). With changes in the course of the Yellowstone River following the 1997 flood, a perched railroad culvert became more of a barrier to spawning Yellowstone cutthroat trout. Trapping over the past few years has not documented any Yellowstone cutthroat trout accessing this formerly productive spawning area (S.T. Opitz, FWP, personal communication). Whirling disease is another potential factor, as cranial deformities in rainbow trout and Yellowstone cutthroat trout are present in this part of the river (S.T. Opitz, FWP, personal communication) and these streams tested positive for whirling disease in 2007 (R. Vincent, FWP retired, personal communication).

A substantial conservation need for this part of the river is to increase recruitment in tributaries. Restoring access through the culvert in Locke Creek was a potential project; however, liability associated with modifications near a railroad culvert is considerable. Likewise, restoring access may be detrimental to the nonhybridized Yellowstone cutthroat trout higher in the Locke Creek watershed. In other neighboring tributaries, irrigation withdrawals and habitat degradation may be factors in limiting the potential of these streams to support a fluvial spawning run. Finding opportunities to work with private landowners on conservation projects to improve flow and habitat quality would be beneficial to fluvial Yellowstone cutthroat trout.

Big Timber Monitoring Section

The Big Timber monitoring section begins at the Otter Creek fishing access site downstream of Big Timber, and extends upstream for six miles. Monitoring in this reach has occurred sporadically beginning in the 1980s. Among year comparisons of fish numbers are difficult given the variability in how results were reported. In several years, a population estimate yielded numbers of fish per mile. In other years, results were reported as catch per unit effort or total number of fish captured. Because of the disparity in methodologies, Figure 6-9 displays the percentage of the total number of trout comprised by the three species.

Similar to the Springdale and Ninth Street Bridge monitoring sections, rainbow trout are the most abundant species of trout in the Big Timber monitoring section. Brown trout are the next most abundant species. Yellowstone cutthroat trout are relatively rare, and comprise considerably less than 10% of trout in most years.

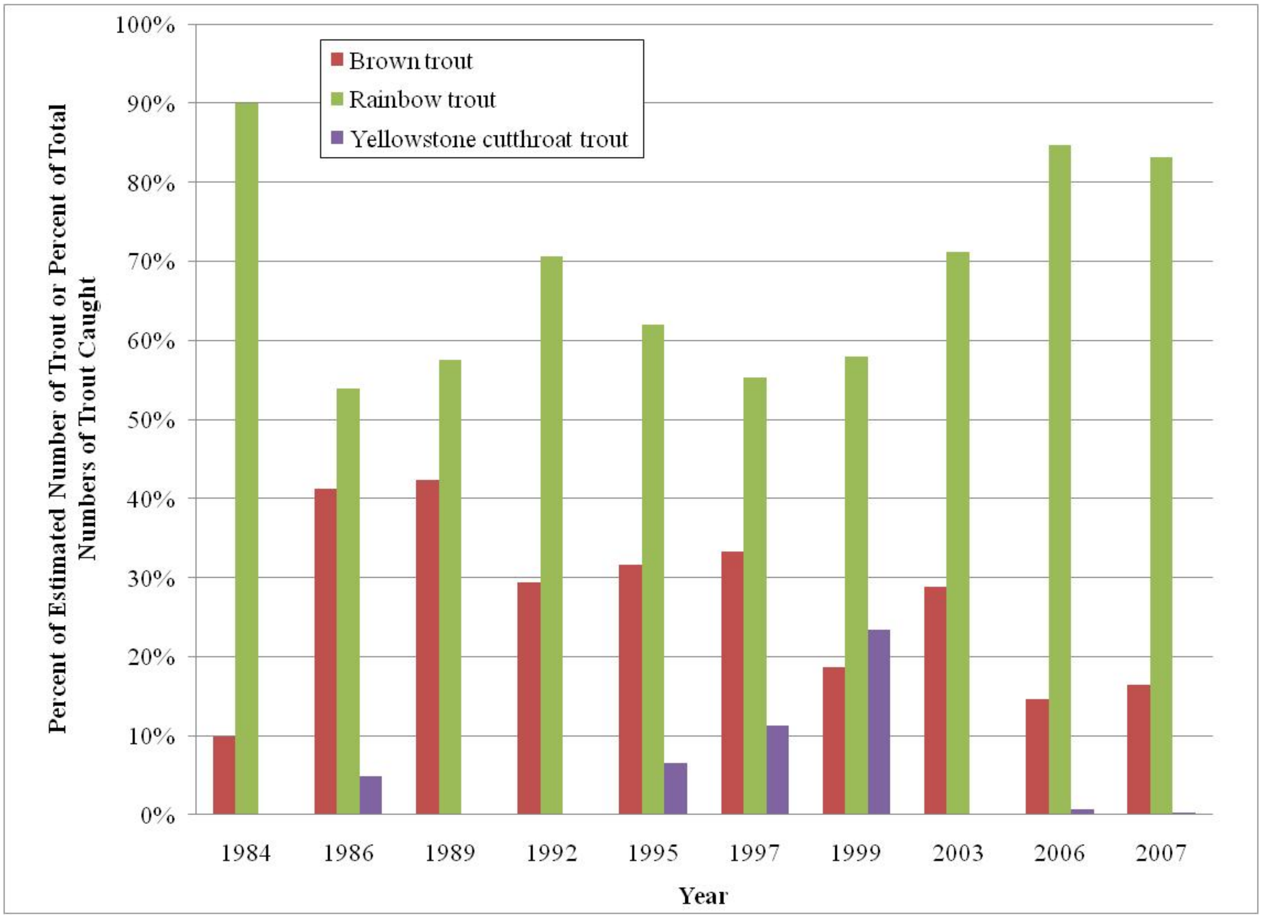

Figure 6-9: Comparisons of percentages of total estimated trout numbers or total trout caught comprised by brown trout, rainbow trout, and Yellowstone cutthroat trout in the Big Timber monitoring section (MFISH database).

Similar to the Springdale and Ninth Street Bridge monitoring sections, rainbow trout are the most abundant species of trout in the Big Timber monitoring section (Figure 6-9). Brown trout are the next most abundant species. Yellowstone cutthroat trout are relatively rare, and comprise considerably less than 10% of trout in most years.

A lack of spawning habitat is among the factors likely to be constraining Yellowstone cutthroat trout in this part of the river. Several projects have attempted to provide spawning habitat in unmapped spring creeks, but none have been successful as of yet (see 6.2.45 Unmapped Spring Creeks). Future attempts should consider using gametes collected from fluvial strains of Yellowstone cutthroat trout.

6.2.2 Beattie Gulch

Beattie Gulch (Figure 6-10) is a small stream located near the upstream boundary of the upper Yellowstone River HUC. This stream flows mostly within the GNF, with less than two-tenths of its 2.6 miles crossing private land near its mouth. No fisheries data are available for this stream.

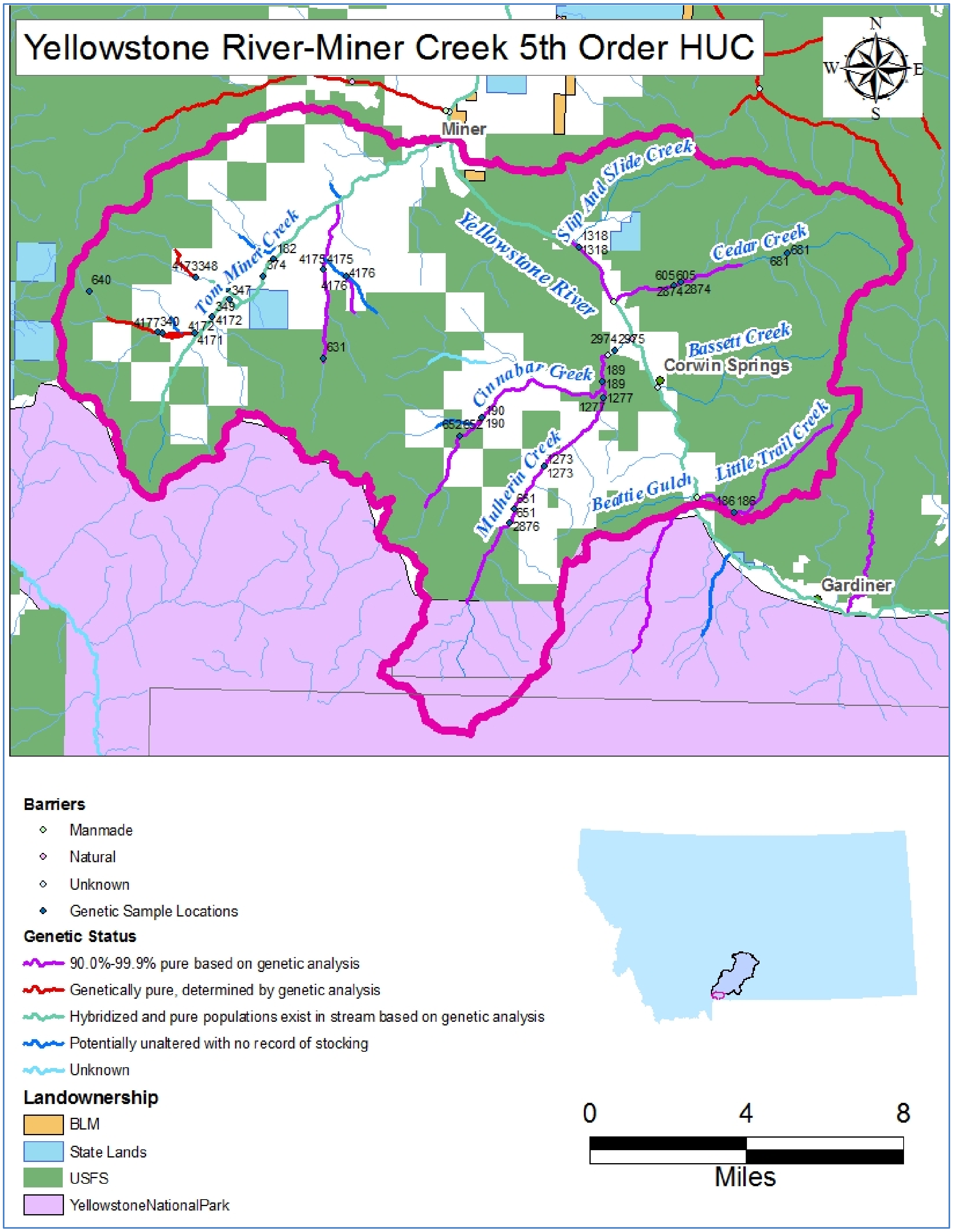

Figure 6-10: Distribution of Yellowstone cutthroat trout in the Yellowstone-Miner Creek Watershed (FWP GIS database).

Aerial imagery suggests Beattie Gulch currently has low potential to support a spawning run of fluvial Yellowstone cutthroat trout; however, its upper reaches may contain a resident population. Factors apparently limiting the ability of this stream to provide spawning habitat to fluvial cutthroat include low water supply and marginal habitat. A lack of water in this stream is inferable from aerial photos, which show an irrigation ditch intercepting the stream about 0.5 miles from its mouth. In addition to potential flow alterations from the irrigation canal, this small watershed may not supply enough water to ensure reliable flows through incubation and emergence periods. Downstream of the irrigation canal, the stream appears to lose channel definition, which may be related to a lack of stream power due to low water supply, combined with its occupancy of an alluvial fan. Alluvial fans tend to be highly permeable, and flows may naturally go subsurface through this reach. A combination of the limited natural potential to provide sufficient water and suitable habitat, and apparent flow alterations for irrigation, make Beattie Gulch a marginal to poor candidate for establishing or enhancing a fluvial spawning run.

A conservation priority for Beattie Gulch is assessment of fish populations to determine if this stream supports a nonhybridized or conservation population of Yellowstone cutthroat trout. The apparently dewatered reach, combined with the lack of channel definition and an intercepting irrigation ditch, may present a barrier to nonnatives, which would protect Yellowstone cutthroat trout in the forested portions of the stream. Should a nonhybridized or conservation population exist in upper Beattie Gulch, the small amount of habitat available would put the population at risk of extirpation because of small population size and the resulting risks of inbreeding, and vulnerability to disturbance. Intervention may include supplementing the existing population to increase genetic diversity. Should Beattie Gulch not support a nonhybridized or conservation population of Yellowstone cutthroat trout, this stream would be a low priority for reestablishment of a nonhybridized population given the low probability that a population would be able to self-maintain over the long-term in the small amount of available habitat.

6.2.3 Little Trail Creek

Little Trail Creek is (Figure 6-10) on the east side of the Yellowstone River, and flows mostly through the GNF. Of its nearly 6-mile length, only about one-third of a mile flows across private lands. Fisheries information for Little Trail Creek includes genetic samples from the 1980s (Leary et al. 1989), and documentation that a culvert close to the mouth of Little Trail Creek presents a barrier to upstream movement. Species assumed present include Yellowstone cutthroat trout and mottled sculpin (Table 6-4). Electrofishing surveys in the early 1990s found no other species to be present (S.W. Shuler, GNF, personal communication.). Recent survey data are not available to rule out the presence of competing species.

Table 6-4: Distribution and species composition for Little Trail Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	6	Mottled sculpin	Rare	Year-round resident	N/A	N/A	NSPJ[7]
0	5	Yellowstone cutthroat trout	Common	Unknown	Unknown	Tested conservation	EBS

In 1986, Little Trail Creek supported a conservation population of Yellowstone cutthroat trout; however, the small sample size (N=4) limits the certainty of these results (Leary et al. 1989). Additional sampling using a minimum sample size of 25 fish is warranted to evaluate the status of the Yellowstone cutthroat trout population in Little Trail Creek.

Investigations of streams used by fluvial Yellowstone cutthroat trout (Berg 1975; Clancy 1988) did not examine Little Trail Creek, and DeRito (2004) did not document any of the 44 radio-tagged Yellowstone cutthroat trout entering this stream during the spawning period. Steep gradients, such as Maiden Falls, in the lowest reach of Little Trail Creek may be natural impediments to a spawning run, as fluvial spawners may not be able to ascend the stream. Field verification of accessibility would determine the potential for fish to access Little Trail Creek.

Although Little Trail Creek is not on the list of dewatered streams, no information is available to evaluate the sufficiency of flows through the irrigation season to support a spawning run of fluvial Yellowstone cutthroat trout. Aerial imagery shows an apparent diversion about 0.4 miles from the mouth, indicating some decrease in stream flow likely occurs. Future conservation planning for Little Trail Creek should include evaluation of the stream flow through critical periods, and the potential for developing voluntary measures to promote sufficient flows during summer months.

Restoring or enhancing a fluvial spawning run is one category of conservation action possible for Little Trail Creek, although additional investigation is necessary to determine limiting factors, feasibility, relative benefits, and to develop a specific approach if warranted. A primary factor affecting feasibility is the steepness of the channel immediately upstream of the confluence with the Yellowstone River. In the event that gradient does not present a barrier, potential opportunities include restoring passage under the Highway 89 crossing and improving in-stream flow through voluntary increases in water use efficiency, water leases, or both, if water supply is limited. Installation of fish screens would be a potential future action, with establishment of a spawning run and evidence that entrainment limits recruitment or captures adult fish. Factors that may relegate these actions to a lower priority include costs associated with these actions, and the potential benefit based on the amount and quality of spawning habitat made available.

[7] NSPJ = no survey, professional judgment

Securing or restoring Little Trail Creek's resident Yellowstone cutthroat trout is the second potential category of conservation action for Little Trail Creek. Given the age of the available data, and the small sample size of genetic samples (N=4), field sampling is the first need in developing a specific conservation approach. Specific actions to conserve the resident population would follow the findings of the field surveys.

Determination of the specific actions to conserve Yellowstone cutthroat trout in Little Trail Creek must acknowledge the potential conflicts in promoting access for fluvial spawners and maintaining the genetics and lack of competing species for the resident population. Reopening access for fluvial spawners may also allow invasion of nonnative brown trout and rainbow trout, which would place the resident population at risk. As securing the remaining conservation populations is the highest priority, restoring or enhancing the fluvial run would occur only if it would not jeopardize the resident Yellowstone cutthroat trout.

6.2.4 Bassett Creek

Bassett Creek (Figure 6-10) originates in the Absaroka Mountains and flows to the west until its confluence with the Yellowstone River near Corwin Springs. Most of Bassett Creek's five-mile length is on the GNF, with only its lowest ¼ mile flowing through private lands. Bassett Creek is among streams considered to support a Yellowstone cutthroat trout population historically (May et al. 2007).

In the early 1990s, mottled sculpin and brook trout were the only species found within the Absaroka-Beartooth Wilderness (S .W. Shuler, GNF, personal communication). Habitat in the headwaters is suitable for supporting a resident fishery, making Bassett Creek a potential candidate for reintroduction of Yellowstone cutthroat trout following removal of brook trout. A perched culvert located upstream of Highway 89 is a definite fish barrier, which would protect a restored population from reinvasion by nonnative species, although construction of a barrier may be advisable to ensure protection of a reestablished population.

Bassett Creek has potential to support a spawning run of fluvial Yellowstone cutthroat trout from the Yellowstone River in some years. Bassett Creek's confluence with the Yellowstone River is perched above river elevation during most flows, and spawning Yellowstone cutthroat trout do not always have access to the stream. Nonetheless, in higher water years, river flows are sufficiently high to allow fish passage into Bassett Creek, and GNF personnel have documented spawning in the lower reaches during these events.

The extent of available spawning habitat for fluvial Yellowstone cutthroat trout is likely limited, as the Highway 89 culvert is a possible barrier to upstream movement, leaving about 1/10 mile of stream reliably available to spawning Yellowstone cutthroat trout. Moreover, a perched culvert located approximately 300 yards upstream of the Highway 89 crossing is impassible. Upstream of this culvert, Bassett Creek flows through a steep, confined canyon reach, with gradients approaching 15%. This section is unlikely to provide a significant amount of potential spawning habitat, so opening access to passage for fluvial spawners through the perched culvert would not bring substantial conservation benefit.

In 2006, a proposal to develop a hydroelectric facility would have used an existing water right claim of 12.5 cfs. This amount typically exceeds the available water in Bassett Creek and diversion of flow for power generation could dewater the channel. The special use permit process allows the USFS to retain sufficient water in Bassett Creek to protect water dependent resources. Initial review suggested about 1 cfs is the minimum flow needed below the pipeline diversion to submerge the active channel and maintain aquatic habitat and riparian vegetation. Should this project proceed, monitoring may be a conservation action needed to ensure sufficient flow.

Conservation opportunities in Bassett Creek include reestablishment of a resident population of Yellowstone cutthroat trout, and increasing the amount of habitat available to fluvial spawners. Habitat upstream of the canyon reach is of suitable quality to support Yellowstone cutthroat trout (S.W. Shuler, GNF, personal communication). In addition, the amount of available habitat in Bassett Creek and in lower reaches of its tributaries is approximately 5 miles, which is the minimum recommended length of stream to maintain a viable fishery over the long-term (Hilderbrand and Kershner 2000). Although streams providing a greater extent of available habitat would be higher priorities for reestablishment of a Yellowstone cutthroat trout population, Bassett Creek is a suitable candidate for this activity.

Increasing the available spawning habitat for fluvial spawners is an option for Bassett Creek; however, more investigation is required to determine the potential benefits and landowner interest. Specifically, determination of the river flow required to make Bassett Creek accessible to fluvial Yellowstone cutthroat trout would aid in decision-making. If the recurrence interval for the necessary flow is long, other projects may be higher priorities.

6.2.5 Mulherin Creek

Mulherin Creek, known locally as Mol Heron Creek, (Figure 6-10) arises in Yellowstone National Park, and flows through a patchwork of private and public lands until its confluence with the Yellowstone River. A number of tributary streams feed Mulherin Creek, with Cinnabar Creek being the largest. Mulherin Creek has been the subject of considerable study to evaluate its use by fluvial Yellowstone cutthroat trout. These studies have resulted in implementation of conservation actions aimed at increasing reproductive success in this important stream, and provided documentation of the effects on Yellowstone cutthroat trout production. The resident fishery has received less study. Nonnative salmonids presumed present in Mulherin Creek and its tributaries include brook trout and rainbow trout (Table 6-5).

Table 6-5: Distribution and abundance of fishes in Mulherin Creek (MFISH database).

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Genetic Status	Data Rating
0	1	Brown trout	Rare	Year-round resident	N/A	N/A	EBS[8]
0	1	Longnose sucker	Rare	Year-round resident	N/A	N/A	EBS
0	1	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
5	9	Mottled sculpin	Rare	Year-round resident	N/A	N/A	EBS
0	1	Mountain whitefish	Rare	Year-round resident	N/A	N/A	EBS
1	2	Mountain whitefish	Rare	Year-round resident	Adfluvial	N/A	EBS
0	1	Rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
2	5	Rainbow trout	Common	Year-round resident	N/A	N/A	EBS
5	9	Rainbow trout	Common	Year-round resident	N/A	Tested conservation	EBES
0	1	Westslope cutthroat trout	Unknown	Unknown	Unknown	Unknown	EBS
0	1	Yellowstone cutthroat trout	Rare	Unknown	Resident	Potentially hybridized	EBS
1	9	Yellowstone cutthroat trout	Abundant	Unknown	Resident	Tested conservation	EBES[9]

The importance of Mulherin Creek as a spawning tributary has been recognized since the early 1970s (Berg 1975), and subsequent investigations found Mulherin Creek to be among the most heavily used tributaries in the upper Yellowstone River hydrologic unit (Clancy 1988, DeRito 2004). In addition, Mulherin Creek is one of the major contributors of Yellowstone cutthroat trout fry to the Yellowstone River (Roulson 2002). These factors make Mulherin Creek a highly valuable stream in Yellowstone cutthroat trout conservation.

Genetic investigations in the Mulherin Creek drainage have addressed fluvial and resident Yellowstone cutthroat trout (Table 6-6). Timing of sampling allows inference on life history strategy evaluated, with spring samples targeting fluvial spawners. Consistent with findings on temporal segregation of rainbow trout and Yellowstone cutthroat trout spawning runs (DeRito 2004), Wright (2005) reported two genetically different groups of trout ascending this stream to spawn. The earlier run consisted of hybridized fish possessing a dominance of rainbow trout genes, on average 77%, with Yellowstone cutthroat trout genes accounting for 11% of the loci examined. Slightly hybridized Yellowstone cutthroat trout comprised the second run. These fish were on average 98.4% Yellowstone cutthroat trout, with small proportions of rainbow trout and

[9] EBES = Extrapolated, based on extensive survey.

westslope cutthroat trout genes being present. DeRito (2004) documented three nonhybridized Yellowstone cutthroat trout occupying Mulherin Creek during the spawning period.

Table 6-6: Summary of genetic analyses conducted in the Mulherin Creek watershed (MFISH database).

Stream	***Sample No.***	***Sample Size***	***Target Species***	***Percent of Genes***	***Count***	***Collection Date***
Mulherin	2974	47	WCT×YCT×RBT	10		06/16/2004
Creek	2975	05	WCT×YCT×RBT	10		05/20/2004
	0189	29	RBT	31		10/03/1986
	0189	29	YCT	69		10/03/1986
	1277	6	YCT	78.2		04/01/1997
	1277	6	RBT	21.8		04/01/1997
	1273	16	YCT	96.7		05/21/1997
	1273	16	RBT	03.3		05/21/1997
	0651	20	YCT	70		07/28/1992
	0651	20	RBT	30		07/28/1992
	2876	20	YCT	100	19	07/15/2003
	2876	20	YCT × WCT		1	07/15/2003
Cinnabar	190	15	YCT	98.7		10/03/1986
Creek	190	15	RBT	1.3		10/03/1986
Mill	652	15	YCT	098.7		07/28/1992
Creek	652	15	RBT	1.3		07/28/1992

Variable degrees of hybridization occur in the Yellowstone cutthroat trout in Mulherin Creek, Cinnabar Creek, and Mill Creek, a tributary of Cinnabar Creek (Table 6-6). Fish sampled in fall of 1986 in Mulherin Creek, below the confluence Cinnabar Creek, were heavily hybridized, with an average of 69% Yellowstone cutthroat trout genes and 31% rainbow trout genes (Leary et al. 1987). Fish sampled above the confluence with Cinnabar Creek had a variable degree of hybridization among sampling efforts, with the proportion of Yellowstone cutthroat trout alleles comprising from 70 to 100%. Alleles typical of westslope cutthroat trout occurred in one fish collected in 2003.

Cinnabar and Mill creeks support conservation populations of Yellowstone cutthroat trout (Table 6-6). Samples from both streams indicated Yellowstone cutthroat trout were over 98% nonhybridized, with rainbow trout alleles accounting for 1.3% of the loci examined. Conserving the genetic integrity of these fish, and evaluating risks from introduced salmonids are significant needs for these streams.

Because of its importance as a natal stream for fluvial Yellowstone cutthroat trout, Mulherin Creek has been the subject of a variety of conservation efforts. A water lease has been in effect since 1998, with the objective of increasing recruitment of Yellowstone cutthroat trout from Mulherin Creek into the Yellowstone River. An early attempt to prevent entrainment of Yellowstone cutthroat trout into an irrigation ditch involved installation of an infiltration gallery. This approach failed, as deposition of fine sediment clogged the gallery, limiting water delivered to irrigators. FWP is working towards installation of an alternative approach to reduce losses of fluvial adults and fry to irrigation ditches.

Identified barriers to fish movement in the Mulherin Creek watershed include a velocity barrier at its mouth, and an impassable culvert on Cinnabar Creek, near its confluence with Mulherin Creek. Spring runoff apparently obscures the velocity barrier at the mouth, as fluvial Yellowstone cutthroat trout regularly ascend Mulherin Creek. The impassable culvert is likely beneficial in preventing further hybridization to the conservation populations in Cinnabar Creek and its tributaries.

Significant data gaps for the Mulherin Creek watershed include a lack of information on species composition, distribution, and genetic status of Yellowstone cutthroat trout in headwater reaches in the basin. Aside from the impassible culvert on Cinnabar Creek, no other barriers are known to protect the headwaters of Mulherin Creek from invasion by nonnatives. Sportsman Lake in Yellowstone National Park supports nonhybridized Yellowstone cutthroat trout and likely contributes nonhybridized fish to headwater streams. Field surveys and genetic testing are priority actions for headwater reaches the Mulherin Creek watershed.

Aldridge Lake is a 24-acre lake that inundates portions of Aldridge Creek, which is a tributary of Mulherin Creek. Stocking of Yellowstone cutthroat trout into Aldridge Lake occurred 27 times, beginning in 1928 and ending in 1993. Limited public access provided the justification to cease stocking efforts. The ability of Aldridge Creek to continue to support a population of Yellowstone cutthroat trout is unknown. With a maximum depth of 20 feet, winterkill may limit the ability of the lake to sustain a self-sustaining population of Yellowstone cutthroat trout. Likewise, spawning habitat may be limited.

Given the limited information on the status of Aldridge Lake and Aldridge Creek, several surveys are warranted. Determination of fish species composition, distribution, genetic status, and abundance are primary data needs. Similarly, evaluation of the potential for winterkill and the availability of suitable spawning habitat would allow assessment of the lake’s ability to support a wild fishery. Finally, the presence of a barrier may have kept some of Aldridge Creek and all of the lake free of nonnative species. Conducting a barrier search would be valuable and would guide a management approach for the lake and creek should one be present.

A lack of information on habitat condition and fish distribution also exists for privately owned portions of the watershed. Much of the lower Cinnabar Creek basin is under private ownership, with livestock grazing and forage production being primary land uses. Opportunities may exist for implementation of conservation actions to promote fish habitat and water quality, while maintaining the agricultural productivity of these lands.

Conservation of Yellowstone cutthroat trout in Mulherin Creek will involve actions to preserve the fluvial spawning run and protect the integrity of resident populations of Yellowstone cutthroat trout. FWP will continue to work with private landowners and irrigators in the basin to maintain minimum in-stream flows, and reduce entrainment of adults and fry into irrigation systems. In addition, as a significant portion of the Cinnabar Creek sub-watershed flows through range and hay meadows, opportunities may exist to work with private landowners on implementing grazing and forage production practices to improve riparian function and habitat condition, while maintaining agricultural productivity. Fisheries investigations refining the understanding of distribution and status of nonnative salmonids will allow development of more specific strategies to conserve the headwaters population of Yellowstone cutthroat trout in the basin.

6.2.6 Cedar Creek

Cedar Creek (Figure 6-10) originates in the Absaroka-Beartooth Wilderness, and flows to the west until its confluence with the Yellowstone River downstream of Corwin Springs. Cedar Creek lies nearly entirely on the GNF, with less than 0.5 miles of its 8-mile length flowing through private lands. Fisheries investigations have focused primarily on its role as a spawning tributary for fluvial Yellowstone cutthroat trout, with considerably less emphasis addressing the resident fishery. A population survey in 1990 found an estimated 13 brook trout per 1000 feet, but did not report other species being present (FWP unpublished data). Fish surveys conducted by GNF personnel found brook trout to be the most abundant species downstream of the wilderness boundary (S.W. Shuler, GNF, personal communication)

Cedar Creek is an important spawning tributary for fluvial Yellowstone cutthroat trout and had the largest confirmed run of all streams evaluated (Berg 1975). Cedar Creek is among the “high quality” spawning tributaries (Clancy 1988) and has had substantially greater number of adults ascending the stream and correspondingly greater numbers of redds than neighboring Tom Miner or Big creeks (Byorth 1990). This heavy use by fluvial Yellowstone cutthroat trout has resulted in Cedar Creek being the greatest known contributor of fry to the Yellowstone River in the upper Yellowstone River HUC, with fry production substantially exceeding neighboring Mulherin, Big, and Mill creeks (Roulson 2002).

Genetic analyses have examined fluvial spawners, out-migrating fry, and resident fish (Table 6-7). In 1991, of the 13 fry tested, at least 2 individuals were of hybrid origin (Leary 1992). Analyses of tissue collected from 24 fluvial Yellowstone cutthroat trout in 2003 found 23 nonhybridized Yellowstone cutthroat trout, and one Yellowstone cutthroat trout × westslope cutthroat trout hybrid (Martin 2004). A radio-tag study also confirmed nonhybridized Yellowstone cutthroat trout use Cedar Creek, with one of the 44 tagged, nonhybridized Yellowstone cutthroat trout using Cedar Creek (DeRito 2004). In contrast, none of the radio-tagged rainbow trout nor hybrids used Cedar Creek during this study.

Table 6-7: Summary of genetic analyses conducted in the Cedar Creek watershed (MFISH database).

Sample No.	*Sample Size*	*Target Species*	*Percent of Genes*	*Count*	*Collection Date*
2874	24	YCT		23	07/15/2003
2874	24	YCT×WCT		1	07/15/2003
0681	20	YCT	41.2		08/13/1992
681	20	WCT	58.8		08/13/1992
605	13	RBT	3.8		08/19/1991
605	13	YCT	96.2		08/19/1991

A dominance of westslope cutthroat trout genes was present in the resident cutthroat trout near the wilderness boundary (Table 6-7). The occurrence of westslope cutthroat trout genes at such high proportions, nearly 60%, likely relates to fish plants in the early 1930s, when about 44,000 "cutthroat trout" were released in Cedar Creek (FWP fish plants database). Distinctions between subspecies of cutthroat trout were considered irrelevant in those years, and some of these fish may have been westslope cutthroat trout, although additional plants in the 1940s were listed as being Yellowstone cutthroat trout.

Several barriers to fish movement are present in Cedar Creek. Installation of a fish ladder in the culverts under the Highway 89 bridge has allowed spawning Yellowstone cutthroat trout into Cedar Creek since the 1980s (Clancy and Reichmuth 1990). This road crossing is slated to be replaced by the Montana Department of Transportation in the near future, and the new crossing will provide fish passage. The next fish barrier is an irrigation diversion located about 0.5 miles from the mouth. This partial barrier may limit the habitat available to fluvial Yellowstone cutthroat trout to spawning. A natural barrier lies about 0.5 miles above this irrigation diversion.

As the greatest producer of Yellowstone cutthroat trout fry to the Yellowstone River, Cedar Creek has substantial conservation value, and several existing and future projects will preserve this important run. Entrainment of Yellowstone cutthroat trout fry into irrigation canals is minimal, eliminating the stream from the list of streams where a fish screen would be beneficial (P. Byorth, Trout Unlimited, personal communication). FWP has water leases with several irrigators to maintain minimum flows, as well as owning a water right. The USFS holds a water right of 10.02 cfs from 6 water rights that are under a lease agreement with FWP and this water prevents dewatering of prime habitat for fluvial Yellowstone cutthroat trout in the lower 2,700 feet of channel. The lease will expire in September 2015, but will be eligible for renewal as early as 2014. In the interest of securing permanent in-stream flow rights for fish and wildlife habitat, the USFS could convert all owned rights to in-stream flow through DNRC's change of water use application. This action would have substantial conservation benefits and FWP will work with USFS to explore this opportunity.

Reestablishment of a nonhybridized, resident population of Yellowstone cutthroat trout is a possible, future action that would require removing the existing Yellowstone cutthroat trout × westslope cutthroat trout hybrids, and reintroduction of nonhybridized Yellowstone cutthroat trout. The existing, natural barrier about one mile from the mouth may be sufficient to prevent upstream movement of nonnative salmonids. Alternatively, construction of a barrier may be necessary to protect the reestablished population. Future planning for Cedar Creek will evaluate the feasibility of these options.

6.2.7 Slip and Slide Creek

Slip and Slide Creek (Figure 6-10) originates in the Absaroka Mountains and flows west for just over 4 miles before its confluence with the Yellowstone River. Two unnamed forks of substantial length feed Slip and Slide Creek, and an on-stream impoundment is a significant feature. Approximately 1.8 miles of stream flow through private lands, with the bulk of the remaining stream occurring within the GNF.

Available fisheries information comes from surveys conducted by the GNF in the early 1990s (S.W. Shuler, GNF, personal communication) and again in the 2010s (S.T. Opitz, FWP, personal communication). Slip and Slide Creek does not support a resident fishery, presumably due to low or intermittent stream flow, or lack of connectivity to a population source. Likewise, intermittency in drought years limits this stream’s ability to support a fluvial run of Yellowstone cutthroat trout. Nonetheless, recent reconnaissance from the mouth to the Highway 89 crossing found sufficient flow and no obstructions that would impede fluvial fish. The highway crossing is a concrete box culvert installed to grade, with no drop at the outlet, and gravels and cobbles on its bed, which are features conducive to fish passage.

Three impoundments are on privately owned portions of lower Slip and Slide Creek. One private pond was historically licensed for rainbow trout and this species is likely still present (S.T. Opitz, FWP, personal communication). The USFS is currently examining the land and water rights under the Shooting Star Land Exchange. If the USFS acquires the property, an evaluation of the fish assemblage within the ponds, stability of their outlets, and degree of connectivity to the stream would be follow. Establishment of Yellowstone cutthroat trout populations in these ponds would be a possibility, and would meet the conservation objectives of decreasing risk of hybridization, replicating local populations, and providing a recreational fishery. Likewise, establishing a resident population of Yellowstone cutthroat trout in the stream above the ponds may be possible. Another potential opportunity with this land exchange would be conversion of water rights for in-stream flow. This action could benefit fluvial Yellowstone cutthroat trout in the lower reach of Slip and Slide Creek and increase recruitment of fry to the Yellowstone River.

6.2.8 Tom Miner Creek

The headwaters of Tom Miner Creek (Figure 6-10) begin in the Gallatin Range, and it flows through primarily private lands until its confluence with the Yellowstone River. Tributaries include Horse, Skully, Sunlight, Trail, Soldier, Sheep, Ferrell, Wigwam, and Pine creeks. Fisheries investigations on Tom Miner Creek have examined the fluvial Yellowstone cutthroat trout spawning run, and genetic status of resident fish. Yellowstone cutthroat trout are present, along with other members of the native fish assemblage, and introduced rainbow, brook, and brown trout.

Tom Miner Creek is among the major spawning tributaries for the neighboring reach of the Yellowstone River, and most investigations have focused on fluvial fish. The presence of a run in Tom Miner Creek was confirmed in the early 1970s (Berg 1975), and this run is among the strongest in the area (Clancy 1987; Clancy 1988; Byorth 1990). In the early 2000s, nonhybridized Yellowstone cutthroat trout used Tom Miner Creek during the spawning period (DeRito 2004). Unlike other local streams, dewatering for irrigation was not a factor limiting fry production; however, naturally low flows during drought did reduce fry production (Byorth 1990).

Genetic analyses in the 1980s and 1990s focused on resident fish in the upper half of the watershed. Only nonhybridized Yellowstone cutthroat trout had been detected in the Tom Miner Creek drainage in these efforts (Table 6-8). This apparent lack of hybridization suggests a barrier, either natural or human-made, is preventing invasion of rainbow trout from the Yellowstone River. In 2009, FWP biologists documented a long reach of cascades that may be a partial or total barrier to upstream movement (C.L. Endicott, FWP, personal communication).

Table 6-8: Summary of genetic analyses conducted in the Tom Miner Creek watershed (MFISH database).

Stream	*Sample No.*	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
Tom Miner Creek	374	25	YCT	100	09/30/1989
	347	25	YCT	100	09/07/1989
	349	17	YCT	100	9/07/1989
	182	25	YCT	100	09/30/1986
Horse Creek	949	7	YCT	100	07/10/1992
Skully Creek	324	25	YCT	100	09/07/1989
Trail Creek	554	25	YCT	100	08/30/1989
Dry Creek	640	5	YCT	100	07/23/1992

In summer of 2010, FWP and the GNF collaborated on an extensive fish survey in the Tom Miner Basin, which is the area encompassing the headwaters to the confined canyon reach (Opitz 2011). The sampling design called for electrofishing Tom Miner Creek and its tributaries at 0.5-mile intervals. Of the 11 tributaries sampled, the fish-bearing reaches yielded only Yellowstone cutthroat trout. Electrofishing efforts on Tom Miner Creek found brown trout, Yellowstone cutthroat trout, one rainbow trout, and an apparent rainbow trout × Yellowstone cutthroat trout hybrid.

A mixture of nonhybridized and slightly hybridized Yellowstone cutthroat trout occur throughout the upper basin (Leary 2011). Analyses of 7 fish from Skully Creek found all but 6 of the fish were nonhybridized Yellowstone cutthroat trout. The presence of a hybrid was an unwelcome find, especially as a sample of 25 fish in 1989 yielded no hybrids. In contrast, an 8 fish sample from Sunlight Creek indicated that all fish were nonhybridized. Of the 29 fish analyzed in the main stem of upper Tom Miner Creek, all but one were nonhybridized. The 4 fish from Twin Peaks Creek tested as nonhybridized. A hybrid swarm was present in Horse Creek (N=17) and a tributary (N=6), although the majority of the tested alleles were Yellowstone cutthroat trout in origin. A sample of 13 fish from Trail Creek yielded only nonhybridized fish.

The distribution of nonhybridized Yellowstone cutthroat trout and the absence of brook trout were encouraging results (Opitz 2010). Rainbow trout present a threat to the basin's Yellowstone cutthroat trout. Rainbow trout were not found in any tributaries, but as indicated by genetic results, they have been able to hybridize with Yellowstone cutthroat trout. Ongoing assessments have included Soldier, Divide, and Middle creeks, although genetic results are pending. Reed, Pine, and Walsh creeks were fishless.

Future research will be needed to determine the degree of movement of fish from Tom Miner Creek into the tributaries. Protecting this apparent core population of Yellowstone cutthroat trout is a high priority. Actions to prevent spread of rainbow trout or hybrids may include removal or construction of small barriers.

As the majority of the Tom Miner Creek watershed is in private ownership, FWP and its conservation partners should identify opportunities to evaluate stream health and habitat condition. The lower reaches of Tom Miner Creek were subdivided in recent years, and residential development has potential to negatively affect water quantity and quality, as well as fish habitat. Likewise, agricultural uses can have an adverse effect on fish, if not managed in a way compatible with stream health. Development of a collaborative effort with local landowners to evaluate stream condition, and develop solutions as warranted, is therefore a component of the strategy for the Tom Miner Creek basin.

6.2.9 Rock Creek

Rock Creek (Figure 6-11), the next drainage to the north of Tom Miner Creek, flows through the GNF and private lands across its 12.4 miles of length. In the 1980s and early 1990s (Table 6-9), nonhybridized Yellowstone cutthroat trout was the most abundant species upstream of a railroad crossing, with only one brown trout captured in this stream (MFISH database). In 2008, a mixture of brown trout, rainbow trout, Yellowstone cutthroat trout, and apparent hybrids were present upstream of the railroad culvert. A series of cascades followed by a 10-foot-high-waterfall are probable barriers to upstream fish movement, as no hybrids or other species were present upstream of either feature (C.L. Endicott, FWP, personal communication). A landowner reports that a 40-ft waterfall occurs upstream of the 10-foot high waterfall. Although its presence has not been verified, a waterfall of this height would be a certain fish barrier.

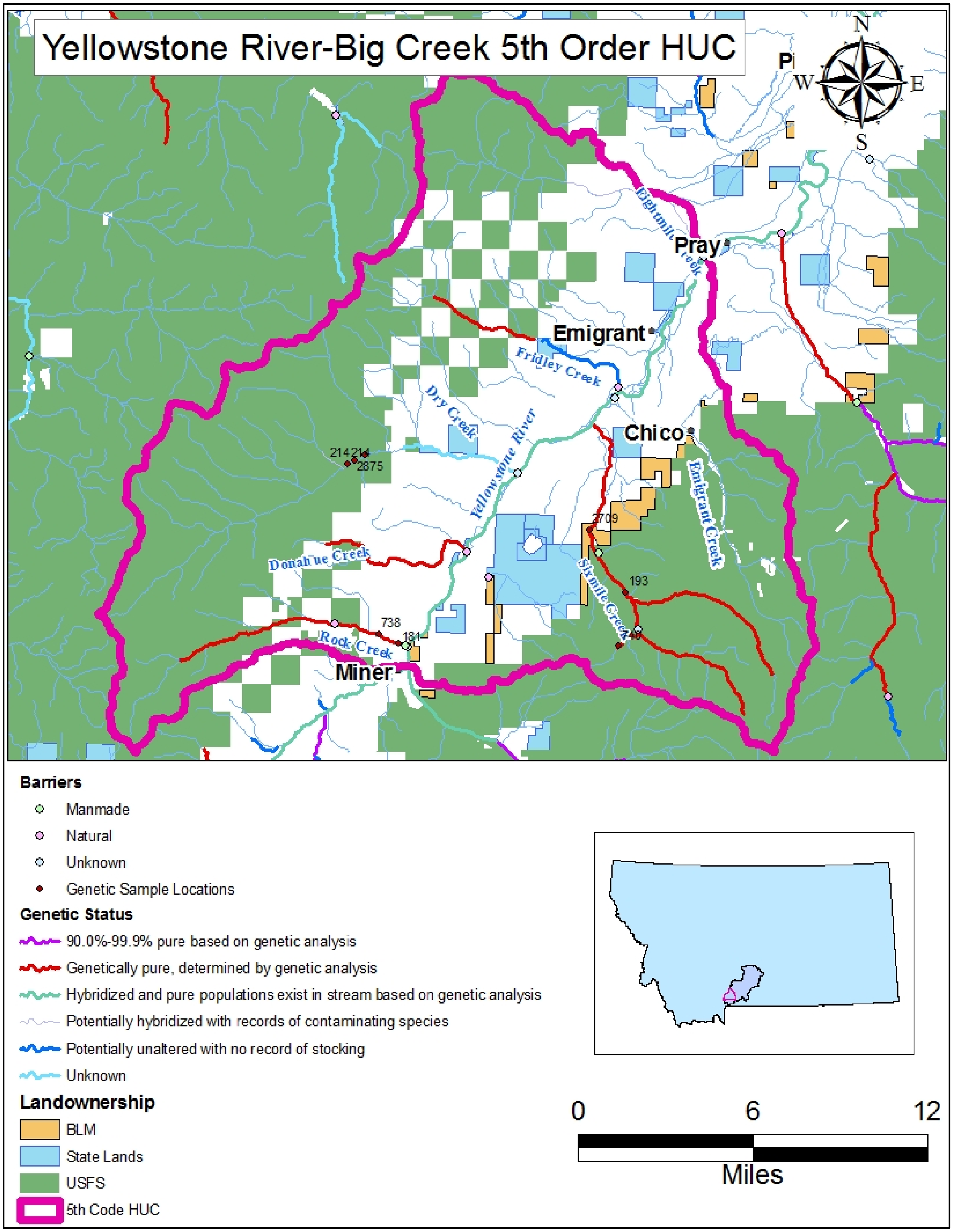

Figure 6-11: Distribution of Yellowstone cutthroat trout in the Yellowstone-Big Creek Watershed (FWP GIS database).

Table 6-9: Summary of genetic analyses conducted in the Rock Creek watershed (MFISH database).

Sample No.	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
738	5	YCT	100	7/28/1992
181	25	YCT	100	9/30/1986

Previous efforts to increase access for fluvial Yellowstone cutthroat trout had mixed results. A fish ladder installed in the late 1980s provided access for fluvial Yellowstone cutthroat trout, and presumably nonnative salmonids, which now occupy Rock Creek upstream of the culvert. When the fish ladder was in operation, Rock Creek produced relatively large numbers of Yellowstone cutthroat trout fry (Shepard 1992); however, the ladder failed soon afterward. In 2008, no Yellowstone cutthroat trout were found upstream of the culvert and a few fry were present downstream of the culvert. These results suggest the ladder did increase recruitment of Yellowstone cutthroat trout to the Yellowstone River over the short term, but the price was loss of a nonhybridized Yellowstone cutthroat trout population in lower Rock Creek.

Rock Creek presented considerable opportunity to increase recruitment of Yellowstone cutthroat trout fry to the Yellowstone River, while preserving a nonhybridized population in its upper reaches. Irrigation demands on Rock Creek are relatively light, and this stream maintains adequate flow through the incubation and emergence periods, making it an ideal candidate for reestablishing a spawning run. The natural barriers prevent nonnative fishes already present above the railroad culvert from invading the upper watershed. Likewise, these barriers will exclude nonnatives that gain access with elimination of the passage barrier near the mouth.

In 2011, removal of the impassable railroad culvert, and subsequent construction of a series of step pools has opened Rock Creek to fluvial Yellowstone cutthroat trout. Monitoring to evaluate the effect of this project has included implantation of passive inductive transponder or PIT tags in Yellowstone cutthroat trout and rainbow trout in the Yellowstone River. Antennae installed on the nearby county bridge recorded several Yellowstone cutthroat trout ascending the stream in the first and second year following the project. The presence of fry during the Yellowstone cutthroat trout emergence period was another promising observation. FWP will continue to monitor use by fluvial Yellowstone cutthroat trout and fry production in Rock Creek. This project met the conservation objective of conserving Yellowstone cutthroat trout populations and life histories.

6.2.10 Donahue Creek

Donahue Creek (Figure 6-11) originates in the Gallatin Range, and flows through federal and private lands before its confluence with the Yellowstone River. Limited fisheries information (Table 6-10) is available for this stream and the available information is nearly 20 years old. Yellowstone cutthroat trout is the only species identified as present in Donahue Creek and a fish survey conducted near the mouth in 1991 found an estimated nine Yellowstone cutthroat trout per mile. Genetic sampling in 1989 found only nonhybridized Yellowstone cutthroat trout (N = 26; MFISH database).

Table 6-10: Distribution and abundance of fishes in Donahue Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	7	Yellowstone cutthroat trout	Common	Unknown	Resident	Nonhybridized	EBS

Conservation priorities for Donahue Creek include updating information on fish distribution and genetic status. In addition, the presence of only Yellowstone cutthroat trout so low in the watershed suggests a barrier close to the mouth may be preventing encroachment of nonnatives. Severe dewatering may be the barrier. Identifying and protecting any barrier would be vital in protecting the nonhybridized Yellowstone cutthroat trout population, should it still exist. FWP seeks opportunities to work with private landowners in the basin to evaluate stream health, and develop a restoration or stream management strategy as warranted. Private landowners have already contributed to Yellowstone cutthroat trout conservation in Donahue Creek by retrofitting an irrigation diversion to prevent entrainment of Yellowstone cutthroat trout (S.W. Shuler, GNF, personal communication).

6.2.11 Big Creek

The Big Creek watershed (Figure 6-11) is the second largest in the Paradise Valley. Much of this stream, and many of its tributaries, flow through the GNF. Its lowermost 5 miles flow through private lands.

Big Creek has been the focus of fisheries investigations beginning in the 1970s, with an emphasis on evaluating its role in recruiting Yellowstone cutthroat trout fry to the Yellowstone River. Several investigations confirmed that Big Creek supported a small run, with dewatering being the factor limiting the fluvial run (Berg 1975; Clancy 1985; Byorth 1990). Fluvial spawners using Big Creek have tested as being nonhybridized Yellowstone cutthroat trout (Martin 2004).

Beginning in 1999, FWP secured a water lease to maintain in-stream flows in Big Creek through the summer months. The lease calls for a minimum of 11 cfs in Big Creek during incubation, emergence, and out-migration periods. Monitoring use of Big Creek by fluvial spawners and production of fry allowed evaluation of the effect of water leases on fry production. These investigations confirmed the efficacy of water leasing in improving the spawning run into Big Creek. Big Creek went from having a small spawning run, with unreliable recruitment (Byorth 1990), to being the second largest producer of Yellowstone cutthroat trout fry in the upper Yellowstone River HUC (Roulson 2002).

Entrainment of fluvial spawners and fry presents a constraint on reproduction in Big Creek (DeRito 2004; FWP Livingston fisheries files). In 2007, installation of a rotating drum screen on the Mutual Ditch. Internal baffles power the rotation. The baffles and other elements of the screen have broken on several occasions necessitating repairs and retrofits. Although self-powered drum screens may be successful in some situations, other types of screens are available, and may be more appropriate for a given site. Furthermore, tapping into an external power source such as power lines or solar panels may be possible if a drum screen an appropriate option.

Sampling in the Big Creek occurred in the 1980s and 2012. The efforts in the 1980s were not spatially expansive, but provided information on species composition and genetic status. Species presumed present include brook trout, brown trout, mottled sculpin, rainbow trout, and mountain whitefish (Table 6-11). Yellowstone cutthroat trout × rainbow trout hybrids also reside in Big Creek. Genetic investigations in the 1980s found variability among sampling locations in terms of proportions of rainbow trout genes present (Table 6-16). These data suggest presence of nonhybridized Yellowstone cutthroat trout higher in the watershed, with an area of mixing near the downstream boundary of USFS lands (Leary 1987).

Table 6-11: Distribution and abundance of fishes in Big Creek (MFISH database).

Begin Mile	***End Mile***	***Species***	***Abundance***	***Use Type***	***Life History***	***Genetic Status***	***Data Rating***
0	4	Brook trout	Unknown	Unknown	N/A	N/A	NSPJ
0	4	Brown trout	Common	Year-round resident	N/A	N/A	NSPJ
4	8	Brown trout	Rare	Year-round resident	N/A	N/A	NSPJ
0	4	Mottled sculpin	Unknown	Year-round resident	N/A	N/A	NSPJ
0	4	Mountain whitefish	Common	Year-round resident	N/A	N/A	NSPJ
0	4	Rainbow trout	Common	Both resident and fluvial/adfluvial populations	N/A	N/A	EBS
5	8	Rainbow trout	Common	Both resident and fluvial/adfluvial populations	N/A	N/A	EBS
5	6	Rainbow × cutthroat trout	Unknown	Unknown	Unknown	Unknown	EBS
3	4	Westslope cutthroat trout	Unknown	Unknown	Unknown	Unknown	EBS
5	8	Yellowstone cutthroat trout × rainbow	Unknown	Year-round resident	N/A	N/A	EBS

Table 6-12: Summary of genetic analyses conducted in the Big Creek watershed (MFISH database)

Sample No.	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
215	11	YCT	10.5	7/02/1987
215	11	RBT	89.5	7/02/1987
2875	18	YCT (fluvial)	100	7/15/2003
214	14	YCT	57.1	7/02/1987
214	14	RBT	42.9	7/02/1987

The fish survey conducted in 2012 followed a systematic approach, with100 meters of stream sampled at 0.5-mile intervals. Similar to the 1980s effort, a mixed fishery of Yellowstone cutthroat trout, rainbow trout, and hybrids were present up to a waterfall located about 9 river miles from the confluence with the Yellowstone River. Upstream of the 20-ft falls, apparently nonhybridized Yellowstone cutthroat trout were present, although genetic analyses to confirm this assumption are pending. Conservation actions for resident Yellowstone cutthroat trout populations include protecting core or conservation populations and evaluation of opportunities to expand distribution of nonhybridized fish.

The conservation strategy for Big Creek includes measures to protect the fluvial spawning run, and to identify and protect any remaining conservation populations of Yellowstone cutthroat trout higher in the drainage. The water leases in Big Creek have been phenomenally successful in increasing recruitment of fry to the Yellowstone River, and these should be continued. Similarly, preventing entrainment of fry at the Mutual Ditch, and potentially other diversions, would protect spawners and increase recruitment of fry to the Yellowstone River.

Improving spawning habitat in lower Big Creek is a potential activity, although the strength of the spawning run suggests habitat alterations may be unwarranted. Much of lower Big Creek has been channelized, and consists of an entrenched channel with limited gravel available for spawning (Byorth 1990, Endicott 2007a). Adding structure to this uniform and entrenched channel would promote deposition of gravel. Nonetheless, any habitat project occurring in Big Creek should be undertaken with caution to not jeopardize the existing, strong run of Yellowstone cutthroat trout.

6.2.12 Dry Creek

Dry Creek (Figure 6-11) lies to the north of Big Creek, and flows through mostly private lands over its seven-mile length. Little fisheries information is available for Dry Creek, and no survey data are available for its resident fishery. Presumably, Dry Creek has a naturally low potential to support a Yellowstone cutthroat trout spawning run. As its name implies, a lack of water availability may limit its potential as a spawning stream, although a Yellowstone cutthroat trout × rainbow trout hybrid has been documented ascending Dry Creek during the spring (DeRito 2004).

Although its potential to support resident or fluvial Yellowstone cutthroat trout populations may be limited, local landowners have inquired about potential projects to promote a spawning run by using water savings from a proposed pipeline conveying irrigation water in the Mutual Ditch, which is fed by Big Creek (Endicott 2007a). Over 0.5- miles of habitat is available before the Mutual Ditch intercepts Dry Creek, and if sufficient flow could be maintained during the summer months, Dry Creek has potential to provide some recruitment of Yellowstone cutthroat trout to the Yellowstone River. Evaluation of the feasibility of siphoning the ditch under the stream is among the informational needs for Dry Creek.

In summary, Dry Creek has some potential to support a resident cutthroat trout fishery, and a spawning run of fluvial fish. Fisheries surveys to determine the status of its resident fishery would guide development of a specific conservation strategy for Dry Creek. In addition, working collaboratively with landowners and irrigators, FWP should evaluate the feasibility of increasing stream flow in Dry Creek during summer months to support a Yellowstone cutthroat trout spawning run.

6.2.13 Sixmile Creek

Sixmile Creek (Figure 6-11) originates in the Absaroka-Beartooth Wilderness on the east side of the Paradise Valley, and flows through the GNF, before entering private land four miles from its mouth. Major tributaries include the North Fork Sixmile Creek and Big Pine Creek. The Sixmile Creek watershed supports nonhybridized Yellowstone cutthroat trout, mottled sculpin, and nonnative brown trout and rainbow trout (Table 6-13).

Table 6-13 : Distribution and abundance of fishes in Sixmile Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	5	Brown trout	Rare	Year-round resident	N/A	N/A	EBS
5	7	Brown trout	Common	Year-round resident	N/A	N/A	EBS
7	14	Brown trout	Rare	Year-round resident	N/A	N/A	EBS
0	5	Mottled sculpin	Rare	Year-round resident	N/A	N/A	EBS
5	7	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
7	14	Mottled sculpin	Rare	Year-round resident	N/A	N/A	EBS
4	5	Rainbow trout	Rare	Unknown	N/A	Nonhybridized	EBS
0	11	Yellowstone cutthroat trout	Common	Unknown	Resident	Nonhybridized	EBES

Table 6-14: Summary of genetic analyses conducted in the Sixmile Creek watershed (MFISH database).

Stream	*Sample No.*	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
Sixmile Creek	2709	1	RBT	100	09/19/1999
	193	25	YCT	100	10/10/1986
Big Pine Creek	740	5	YCT	100	08/14/1992

The presence of sympatric brown trout, and confirmation of rainbow trout occurring in Sixmile Creek, presents concerns for the persistence of the nonhybridized Yellowstone cutthroat trout residing in this stream. Moreover, electrofishing surveys suggest brown trout densities have increased in Sixmile Creek and its north fork over the past 15 years (S.W. Shuler, GNF, personal communication). Potential options include mechanical suppression of nonnatives, or chemical removal, with Yellowstone cutthroat trout being reintroduced. Construction of a barrier to prevent reinvasion by nonnatives would be a potential action, if chemical removal is the preferred option.

Sixmile Creek is a dewatered stream, with water diverted to Dailey Lake and downstream water uses. Determination of the sufficiency of flows in lower Sixmile Creek during the irrigation season is warranted to evaluate the potential for this stream to support a run of fluvial Yellowstone cutthroat trout. Partnerships with irrigators and adjacent landowners would be valuable in promoting greater in-stream flow and habitat improvements, as feasible.

6.2.14 Emigrant Spring Creek

Emigrant Spring Creek is a small, unmapped spring creek originating in the floodplain of the Yellowstone River downstream of Sixmile Creek. This stream supports a resident fishery composed of native and nonnative species (Table 6-15). In 2004, Emigrant Spring Creek was the subject of a restoration project aimed at restoring habitat and increasing in-stream flows. The goal of these efforts was to establish a Yellowstone cutthroat trout spawning run into Emigrant Spring Creek. Whirling disease was detected in 2007, and monitoring the effect of this infestation on recruitment and infection would be informative.

Table 6-15: Distribution and abundance of fishes in Emigrant Spring Creek (MFISH database).

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Genetic Status	Data Rating
0	0.4	Brook trout	Rare	Year-round resident	N/A	N/A	EBS
0	0.4	Brown trout	Abundant	Both resident and fluvial/adfluvial populations	N/A	N/A	EBS
0	0.4	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
0	0.4	Mountain whitefish	Rare	Year-round resident	N/A	N/A	EBS
0	0.4	Rainbow trout	Common	Both resident and fluvial/adfluvial populations	N/A	N/A	NSPJ
0	0.4	Yellowstone cutthroat trout	Common	Unknown	Resident	Nonhybridized	EBS

Redd counts conducted in 2007 confirmed use by fluvial spawners (Endicott 2007b). Nine redds were observed, and several of these were of sufficient size to suggest they consisted of several, superimposed redds. This level of use, so soon after completion of habitat restoration, is promising, and confirms the value of habitat restoration in conserving native fish.FWP will continue monitoring to evaluate species composition of spawners and fry production.

6.2.15 Fridley Creek

Fridley Creek (Figure 6-11) originates in the Gallatin Range on the west side of Paradise Valley. It flows through a patchwork of federal, private, and state lands before entering the valley, where landownership is solely private. About 3 miles from its mouth, Fridley Creek separates into two forks. The North Fork of Fridley Creek was disconnected from the Yellowstone River in the 1930s with construction of the Park Branch Canal. A project reconnecting the north fork to the Yellowstone River occurred in 2003. On the south fork, replacement of an existing irrigation diversion with a structure outfitted with a fish ladder has restored connectivity. The goal of this project was to establish a fluvial Yellowstone cutthroat trout spawning run. The previous pin-and-plank structure blocked upstream movement when the diversion was in use, which coincided with the Yellowstone cutthroat trout spawning run.

Fisheries data include several surveys over the past few decades. MFISH indicates this stream supports members of the native fish assemblage including nonhybridized Yellowstone cutthroat trout (Leary 1992) and introduced brook trout and rainbow trout (Table 6-16), although electrofishing surveys in the mid-1990s found only Yellowstone cutthroat trout, with no nonnative species (S.W. Shuler, GNF, personal communication). A waterfall presumably presents a barrier to upstream movement into the forested portion of the watershed. In 2012, Yellowstone, rainbow, brown and brook trout were present throughout Fridley Creek.

Table 6-16: Distribution and abundance of fishes in Fridley Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	9.1	Brook trout	Common	Year-round resident	N/A	N/A	EBS
0	9.1	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
0	9.1	Mountain whitefish	Common	Year-round resident	N/A	N/A	EBS
0	9.1	Rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
0	9.1	Yellowstone cutthroat trout	Abundant	Unknown	Resident	Nonhybridized	EBES

The survey in 2012 will fill several data gaps; however, these data were not available in time for this report. The survey employed the statistically sound sampling design required by the agreement and will provide information on longitudinal species composition and abundance. Genetic samples will update information on genetic status along Fridley Creek.

Conservation priorities for Fridley Creek include protecting remaining nonhybridized fish, and reestablishing a fluvial run into the lower reaches of both forks.FWP will seek partnerships with private landowners to implement conservation practices to ensure the agricultural and residential uses are compatible with native fish. Major landowners in the basin have already been valuable partners in Yellowstone cutthroat trout conservation efforts, and these relationships will facilitate continued work towards conservation goals.

6.2.16 Emigrant Creek

Emigrant Creek (Figure 6-11) arises in the Absaroka- Beartooth Wilderness on the east side of Paradise Valley. About five of the nine stream miles within the montane reaches of the stream are within private ownership. The valley portion flows entirely through private lands. The lowest two miles of Emigrant Creek are listed as chronically dewatered. A diversion on Emigrant Creek intercepts a substantial amount of stream flow and conveys it into the Mill Creek watershed.

Little fisheries information is available for Emigrant Creek. A survey in 1986 reported brook trout in the lower 0.2 miles (MFISH database). Fish surveys in 1996 found only brook trout present in headwater reaches upstream of the Huckleberry Gulch confluence (S.W. Shuler, GNF, personal communication). This same effort found no fish in East Fork Emigrant Creek, presumably due to poor water quality from acid mine discharge. Species presumed present lower in the drainage include brook trout, mottled sculpin, rainbow trout, and Yellowstone cutthroat trout (Table 6-17). No genetics data are available to evaluate the genetic status of any cutthroat trout occupying Emigrant Creek.

Table 6-17: Distribution and abundance of fishes in Emigrant Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	2	Brook trout	Rare	Year-round resident	N/A	N/A	EBS
0	2	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
0	2	Rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
0	2	Yellowstone cutthroat trout	Rare	Unknown	Resident	Potentially hybridized	EBS
7	17	Brook trout	Rare	Year-round resident	N/A	N/A	EBS
7	17	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
7	17	rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
7	17	Yellowstone cutthroat trout	Rare	Unknown	Resident	Potentially hybridized	EBS

As the lower 2 miles of Emigrant Creek is regularly dewatered, flow may be no longer sufficient to support a spawning run, and none of the studies of Yellowstone cutthroat trout spawning has reported Yellowstone cutthroat trout using Emigrant Creek. The feasibility of restoring connectivity would be contingent on voluntary participation of water rights holders. Review of aerial photos indicate the canal transferring water from Emigrant Creek travels nearly 4 miles before connecting with the irrigation system off of Mill Creek. Seepage and evaporation losses are unknown; however, some opportunity may be available to increase conveyance efficiency. Conversely, much of the area along the ditch is subdivided. Substantial demands on water and the large number of landowners may make Emigrant Creek a lower priority in reestablishment of a fluvial run of Yellowstone cutthroat trout.

Heavy metals and acid mine drainage have apparently extirpated Yellowstone cutthroat trout from the upper reaches of Emigrant Creek. Reclamation would be a significant and expensive undertaking and would not open up much habitat given channel steepness and the velocity and volume of spring runoff. Although mine reclamation would be desirable for human health and wildlife, it rates low as an opportunity to reintroduce Yellowstone cutthroat trout.

6.2.17 Eightmile Creek

Eightmile Creek (Figure 6-11) lies on the west side of the Paradise Valley, and originates in the Gallatin Range. Eightmile Creek begins at the confluence of its north and south forks, and flows for nearly 3 miles through the GNF, before entering private lands. Rangeland is the dominant land use in the valley portion of this stream, although the lowest mile has been subdivided into residential development.

Limited fisheries information is available for Eightmile Creek. A survey conducted in 1987 found brook trout and cutthroat trout (MFISH database). Subsequent surveys near the National Forest boundary in the late 1990s found low densities of brook trout and Yellowstone cutthroat trout (S.W. Shuler, GNF, personal communication). No fish were found in the South Fork of Eightmile, presumably due to low stream flows and high gradients. Species presumed present throughout lower reaches include brook trout, mountain whitefish, rainbow trout, and Yellowstone cutthroat trout (Table 6-18). The record of westslope cutthroat trout is likely an error.

Table 6-18: Distribution and abundance of fishes in Eightmile Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	9	Brook trout	Rare	Year-round resident	N/A	N/A	EBS
0	9	Mountain whitefish	Abundant	Year-round resident	N/A	N/A	EBS
0	9	Rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
4	5	Westslope cutthroat trout	Unknown	Unknown	Unknown	Unknown	EBS
0	9	Yellowstone cutthroat trout	Rare	Unknown	Resident	Potentially hybridized	EBS

Eightmile Creek has potential to support a fluvial spawning run, and nonhybridized Yellowstone cutthroat trout have been documented ascending this stream during the spawning period (DeRito 2004). Dewatering is a likely constraint on potential recruitment, as the lower 2 miles are chronically dewatered during the irrigation season. FWP will explore opportunities to work with irrigators on increasing water use efficiency, which could allow water savings to be left in the stream. Likewise, working with private landowners to manage streamside activities in ways compatible with fish habitat may also be beneficial.

A priority for Eightmile Creek is to collect information on fish composition, distribution, and genetic status of any Yellowstone cutthroat trout present. An apparent absence of natural or human-made barriers within and downstream of the forest boundary (S.W. Shuler, GNF, personal communication) means nonnative fishes have access to invade the headwaters of Eightmile Creek. Moreover, two private ponds downstream of the GNF boundary were formerly on-stream, and were potentially a source of nonnatives. Determining fish composition and genetic status of Eightmile Creek’s resident fishery would guide development of specific restoration activities to secure or reestablish a Yellowstone cutthroat trout population.

6.2.18 Mill Creek

Mill Creek (Figure 6-12) is the largest sub-watershed in the upper Yellowstone HUC, encompassing over 160 square miles. Its headwaters originate in the Absaroka-Beartooth Wilderness on the east side of the Paradise Valley. The majority of the watershed lies within the GNF. The valley portions are under private ownership.

Mill Creek supports native and introduced fishes, including Yellowstone cutthroat trout, and nonnative brook, rainbow, and brown trout (Table 6-19). Nonhybridized Yellowstone cutthroat trout dominate in the watershed within the GNF, as a barrier was constructed to protect this population in the mid-1990s, although hybrids have been found upstream of the barrier. Their presence is a significant concern for the genetic integrity of this resident population. Nonhybridized and slightly hybridized Yellowstone cutthroat trout have been found in lower Mill Creek (Table 6-20).

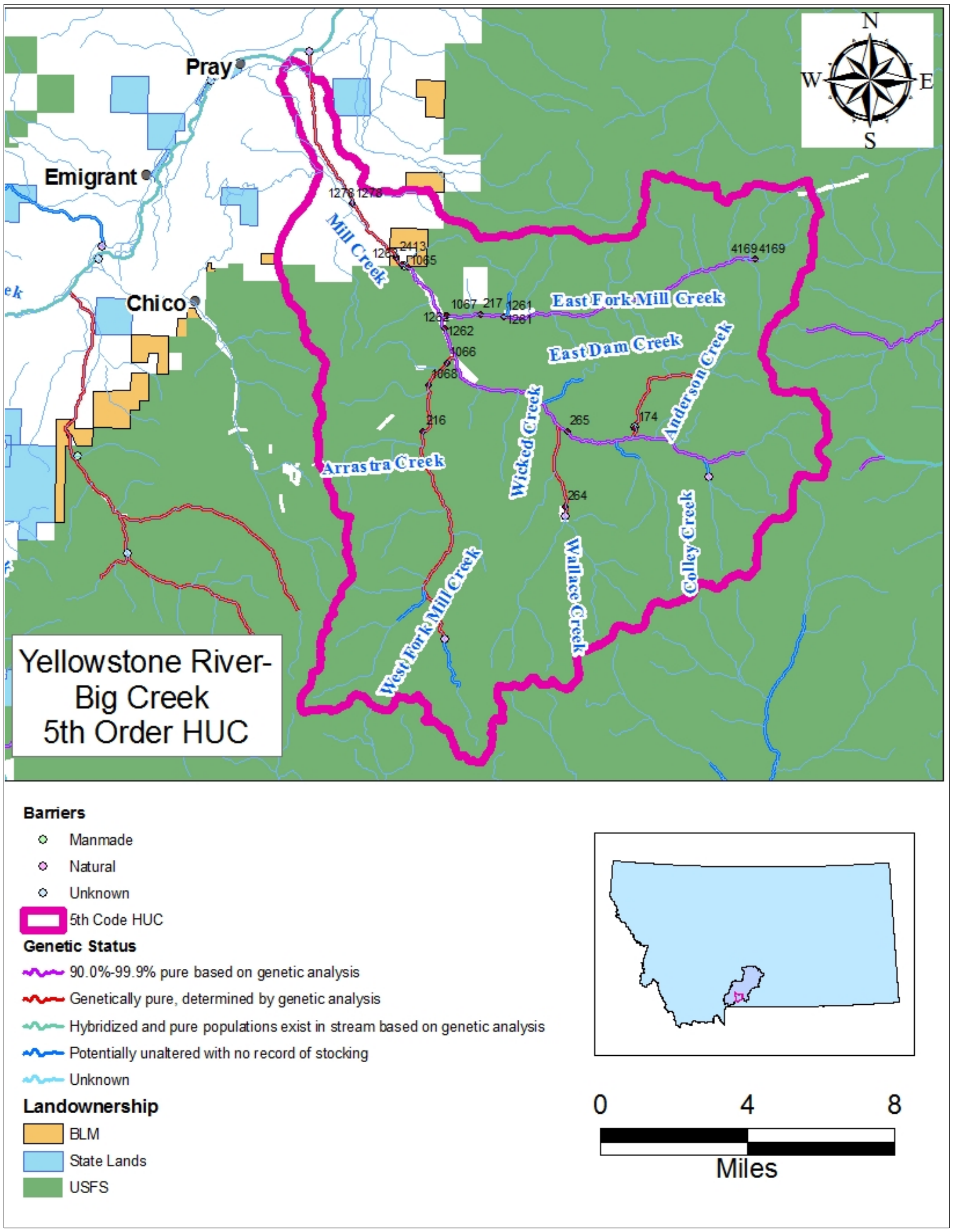

Figure 6-12: Distribution of Yellowstone cutthroat trout in the Mill Creek Watershed (FWP GIS database).

Table 6-19: Distribution and abundance of fishes in Mill Creek (MFISH database).

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Genetic Status	Data Rating
7	10	Brook trout	Unknown	Unknown	Unknown	Unknown	EBS
8	10	Brown trout	Unknown	Unknown	Unknown	Unknown	EBS
0	22	Mottled sculpin	Rare	Year-round resident	N/A	N/A	EBS
9	22	Mountain whitefish	Rare	Year-round resident	N/A	N/A	EBS
0	9	Rainbow trout	Rare	Year-round resident	N/A	Tested conservation	EBES
7	10	Rainbow × cutthroat trout	Unknown	Unknown	Unknown	Unknown	EBS
0	7	Yellowstone cutthroat trout	Rare	Unknown	Resident	Nonhybridized	EBES
7	20	Yellowstone cutthroat trout	Abundant	Unknown	Resident	Tested conservation	EBES

Table 6-20: Summary of genetic analyses conducted in the Mill Creek watershed (MFISH database).

Stream	*Sample No.*	*Sample Size*	*Target Species*	*Percent of Genes*	*Count*	*Collection Date*
Mill Creek (below barrier)	2711	1	YCT	100		03/18/1999
	2712	32	YCT × RBT		1	04/20/1999
	2712	32	RBT		31	04/20/1999
	1278	9	YCT	96.80		04/02/1997
	1278	9	RBT	3.2		04/02/1997
	2413	29	YCT	100		07/29/2002
	1263	2	YCT	100		09/25/1997
Mill Creek (above barrier)	1065	11	YCT	100		04/24/1995
	1262	10	RBT	02		11/06/1997
	1262	10	YCT	98		11/06/1997
	265	23	YCT	100		09/29/1988
East Fork Mill Creek	1067	05	YCT	100		04/24/1995
	217	20	YCT	100		07/22/1987
	1261	19	YCT	94		11/06/1997
	1261	19		0.70		11/06/1997
West Fork Mill Creek	1066	10	YCT	100		04/24/1995
	1068	16	YCT	100		04/24/1995
Anderson Creek	74	25	YCT	100		08/01/1986

Mill Creek has been the subject of considerable study, with most focusing on its role as a spawning tributary for fluvial Yellowstone cutthroat trout, and on evaluation of the effect of leasing water rights on improving fry survival and recruitment. Numerous investigators have documented fluvial Yellowstone cutthroat trout using Mill Creek to spawn (Berg 1975; Clancy 1984; FWP unpublished data; and DeRito 2004). Water leases intended to maintain minimum in-stream flows, and a flushing flow to transport fry, were unsuccessful in contributing fry to the

Yellowstone River in most years (Roulson 2002), and were not renewed. In some years, dewatering is severe enough to result in dessication of redds or stranding of fry and adult fish. Likewise, entrainment of fry into irrigation diversions presents another loss of potential recruitment (FWP, unpublished data). Brook trout were found concentrated in a spring-fed, unnamed tributary to Mill Creek in a meadow within private land just above the Forest Service boundary. In 1997, 560 brook trout were removed from this spring creek by electrofishing (FWP, Livingston, Montana, unpublished data).

Until recently, less effort has been focused on tributaries upstream of the constructed barrier, although East Fork Mill Creek has received some attention. Hybridized and nonhybridized fish have been sympatric in East Fork Mill Creek for at least 13 years. This mixture of hybridized and nonhybridized fish was first documented in 1997 (FWP unpublished data). In 2010, analysis of 15 fish found a similar mixture of nonhybridized and hybridized fish, indicating these sympatric fish have not formed a hybrid swarm over the intervening years (Leary 2011). These results suggest some factor is segregating their spawning in East Mill Creek.

In 2012, an extensive sampling effort focused on tributary streams in the Mill Creek watershed. Streams sampled included Lambert Creek, Anderson Creek, Mill Creek near its headwaters, Colley Creek, Passage Creek, and East Dam Creek. Putative Yellowstone cutthroat trout were present and sometimes abundant in all streams except East Dam Creek, which was apparently fishless. East Dam Creek has a culvert barrier preventing connection at its confluence with Mill Creek. Genetic analyses are pending for these streams.

The Mill Creek watershed has experienced wildfire over the past decade. Wildfire is a natural and necessary component of the ecosystem; however, streams may suffer adverse effects over the short-term. Sediment loading, debris jams, and channel alterations often reduce the quality of the in-stream habitat. Although wildfire can eliminate a population, if a local source of fish is nearby, these fish will eventually recolonize disturbed streams. The Yellowstone cutthroat trout population in Anderson Creek is of particular concern relating to these fires. Anderson Creek supports a nonhybridized population of Yellowstone cutthroat trout upstream of a barrier falls. The GNF will monitor fish populations in Anderson Creek and other streams affected by fire in the Mill Creek watershed.

Conservation priorities for the Mill Creek watershed include maintaining the fluvial run, and protecting the genetic integrity of fish upstream of the USFS boundary. Recently, landowners and irrigators have organized to explore means to maintain in-stream flows, while protecting agricultural values. FWP will provide technical assistance and aid in procurement of grant funds to promote the success of these efforts.

Protecting the genetic integrity of the resident fish population is challenging, as the source of the hybrids is unknown. FWP has tagged rainbow trout downstream of the constructed barrier, and none have been captured above. Alternatively, some fish may be escaping from private fishponds. FWP will not issue fishpond permits for species other than Yellowstone cutthroat trout in this drainage. Identifying any remaining ponds with rainbow trout, and educating the public about the consequences of illegal introductions, are among the actions needed to address threats to Yellowstone cutthroat trout in the upper drainage.

6.2.19 Elbow Creek

Elbow Creek (Figure 6-13) is the next drainage to the north of Mill Creek. No recent fish data exist for Elbow Creek, although a fish survey in 1984 found brown trout, rainbow trout, and mountain whitefish (Table 6-21). Yellowstone cutthroat trout may be present; however, occurrence of nonnatives is a constraint to persistence of Yellowstone cutthroat trout. Fish surveys to update information on species composition and distribution are warranted. Genetic testing of trout species in Elbow Lake is also a conservation need. Elbow Lake was stocked with Yellowstone cutthroat trout and “cutthroat trout” (subspecies unknown) in the 1930s and 1940s.

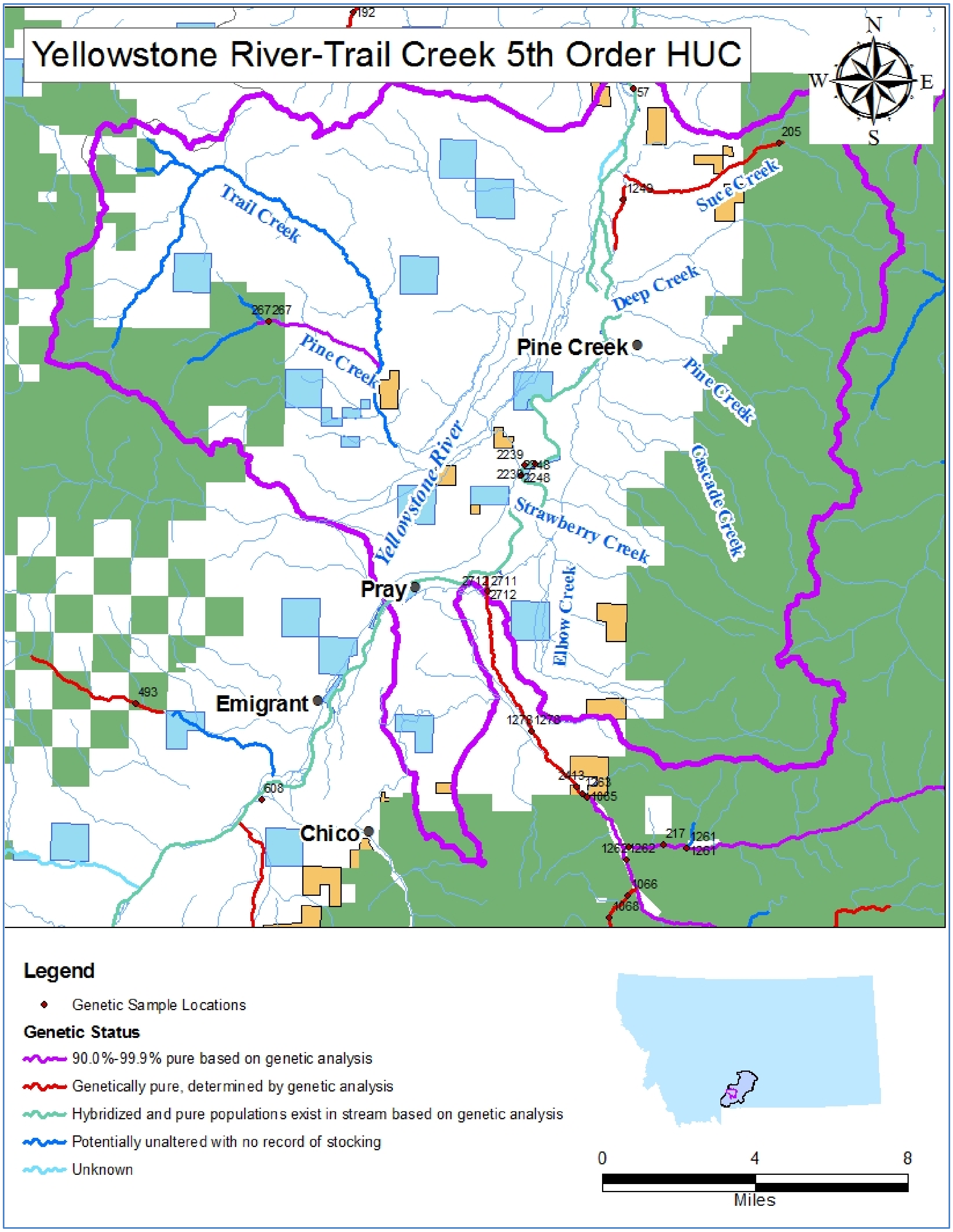

Figure 6-13: Distribution of Yellowstone cutthroat trout in the Yellowstone River – Trail Creek Watershed (FWP GIS database).

Table 6-21: Distribution and abundance of fishes in Elbow Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
1	11	Brown trout	Rare	Year-round resident	N/A	N/A	EBS
1	11	Mountain whitefish	Unknown	Year-round resident	N/A	N/A	EBS
1	11	Rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
0	6	Yellowstone cutthroat trout	Unknown	Unknown	Resident	Potentially hybridized	NSPJ

Although Elbow Creek is a chronically dewatered stream, nonhybridized Yellowstone cutthroat trout have been documented ascending this stream during the spawning period (DeRito 2004). Working with irrigators on voluntary measures to increase irrigation efficiency and maintain in-stream flows is a potential conservation option for Elbow Creek. Likewise, implementing grazing management strategies compatible with riparian health and function may also be beneficial.

6.2.20 Strawberry Creek

Strawberry Creek (Figure 6-13) originates in the Absaroka Mountain range and flows for about four miles through the GNF before entering private lands in the Paradise Valley. No recent fisheries data are available for Strawberry Creek. Species presumed present include mottled sculpin and mountain whitefish (Table 6-22).

Table 6-22: Distribution and abundance of fishes in Strawberry Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	6	Mottled sculpin	Rare	Year-round resident	N/A	N/A	EBS
0	6	Mountain whitefish	Rare	Year-round resident	N/A	N/A	EBS

Conservation priorities for Strawberry Creek include collection of fisheries information on species composition and distribution. Consistent with the second conservation priority of the Agreement, fish surveys, especially in the stream's montane reaches, may identify a remaining conservation population of Yellowstone cutthroat trout.

The lower mile of Strawberry Creek rates as a chronically dewatered stream, suggesting it provides little to no recruitment of Yellowstone cutthroat trout to the Yellowstone River. Moreover, no radio-tagged cutthroat trout, rainbow trout, or hybrids have been documented ascending Strawberry Creek during the spawning period (DeRito 2004). Nonetheless, opportunities to work with irrigators on increasing water use efficiency, and maintaining in-stream flows may arise, which could benefit the Yellowstone River fishery.

6.2.21 Cascade Creek

The Cascade Creek watershed (Figure 6-13) is the next drainage to the north from Strawberry Creek. Major tributaries include McDonald Creek and Barney Creek. Fisheries information is limited for streams in this watershed. A fish survey in McDonald Creek, conducted in 1984, yielded an estimated 92 brown trout per 1,000 feet of stream. Other species presumed present include mottled sculpin, mountain whitefish, rainbow trout, and Yellowstone cutthroat trout (Table 6-23). As with other streams lacking current fish surveys, a conservation objective for the Cascade Creek watershed is determining species composition, distribution, and genetic status of any Yellowstone cutthroat trout present.

Table 6-23: Distribution and abundance of fishes in Cascade Creek (MFISH database).

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Genetic Status	Data Rating
0	1	Brown trout	Abundant	Both resident and fluvial/adfluvial populations	N/A	N/A	EBS
0	1	Mottled sculpin	Abundant	Year-round resident	N/A	N/A	EBS
0	1	Mountain Whitefish	Rare	Year-round resident	N/A	N/A	EBS
0	1	Rainbow trout	Common	Both resident and fluvial/adfluvial populations	N/A	N/A	EBS
0	1	Yellowstone cutthroat trout	Common	Unknown	Resident	Potentially hybridized	EBS

Although Cascade Creek and its tributaries are not listed as dewatered streams, the amount of neighboring irrigated agriculture evident in aerial photos suggests irrigation withdrawals are substantial. FWP will seek opportunities to work with irrigators on voluntary measures to increase water use efficiency, and maintain in-stream flow.

6.2.22 Trail Creek

Trail Creek (Figure 6-13) originates in the Gallatin Range, and flows through private lands for most of its 30-mile length. Pine Creek is a major tributary of Trail Creek, and a considerable portion of its length flows through the GNF. An irrigation system intercepts Trail Creek as it flows into Paradise Valley, and the stream no longer has connectivity to the Yellowstone River.

A number of disturbances have had pronounced influence on stream morphology and habitat quality in the upper portions of the Trail Creek watershed. Timber harvest in the 1980s included several large clear cuts, which likely increased water yield and sediment loading over the short term. In 2000, the Fridley fire burned the entire Pine Creek drainage, which has resulted in increased water yield, sediment loading, and flooding. In addition, failure of a large earthen dam in 1997 had pronounced effect on Trail Creek. The dam impounded a 12-acre pond, and the resulting flood exerted tremendous erosive force on the channel downstream of the dam. The landowners have restored this section of stream; otherwise, disturbance of this magnitude would have taken decades to recovery naturally.

Limited fisheries data are available for the Trail Creek watershed. MFISH lists Yellowstone cutthroat trout, mottled sculpin, brown trout, and rainbow trout as likely being present (Table 6-24). In 2008, FWP sampled Trail Creek in the area of the failed dam and found Yellowstone cutthroat trout, brown trout, and apparent hybrids. In the 1990s, surveys in Pine Creek found nonhybridized Yellowstone cutthroat trout above a culvert and hybrids downstream of the culvert (S.W. Shuler, GNF, personal communication). Fish surveys following the Fridley fire revealed a complete fish kill on the National Forest, and by 2007, fish had not yet refounded upper reaches of Pine Creek. This event underscores the vulnerability of small isolated populations of Yellowstone cutthroat trout to natural disturbance. The culvert that had protected the now extirpated population of Yellowstone cutthroat trout was removed and replaced with a larger culvert that allows for fish passage.

Table 6-24: Distribution and abundance of fishes in Trail Creek (MFISH database).

Begin Mile	***End Mile***	***Species***	***Abundance***	***Use Type***	***Life History***	***Genetic Status***	***Data Rating***
13	29	Brown trout	Rare	Year-round resident	N/A	N/A	EBS
12	21	Cutthroat trout	Unknown	Unknown	Unknown	Unknown	EBS
0	13	Mottled sculpin	Rare	Year-round resident	N/A	N/A	NSPJ
13	18	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
0	13	Rainbow trout	Rare	Year-round resident	N/A	N/A	NSPJ
14	28	Yellowstone cutthroat trout	Common	Unknown	Resident	Potentially hybridized	EBS

The limited amount of data available on fish distribution in the Trail Creek watershed indicates further inventory is a conservation need. Determining species distribution and genetic status of any remaining Yellowstone cutthroat trout would allow development of a specific conservation strategy. If nonhybridized or slightly hybridized Yellowstone cutthroat trout remain in the basin, protecting these fish would be the highest priority. If conservation populations of Yellowstone cutthroat trout are no longer present in the Trail Creek drainage, this watershed may be a candidate for reestablishment of native fish.

The extent of habitat alteration from dam failure and wildfire was considerable, and several private landowners have completed habitat restoration projects. These projects include restoring reaches of channel altered by dam failure and replacing culverts on tributaries affected by the Fridley fire. Additional efforts may be beneficial, especially if conservation populations of Yellowstone cutthroat trout are involved. Likewise, review of aerial photographs indicates areas exist with apparently reduced riparian health and function. Opportunities to work with landowners on restoring these reaches may exist, and these would benefit fisheries and water quality.

6.2.23 Pine Creek

Pine Creek (Figure 6-13) arises in the Absaroka Range on the east side of the Paradise Valley. It flows through the GNF, with a substantial proportion of the watershed occurring within the Absaroka-Beartooth Wilderness. South Fork Pine Creek is a major tributary, and contributes a substantial amount of habitat for fish within the GNF. Pine Creek enters private lands about three river miles from its confluence with the Yellowstone River. Much of this watershed burned in a severe wildfire in 2012. Increased sediment loading, water yield, and woody debris recruitment are likely consequences of this event.

Natural and human-made barriers are significant features on Pine Creek that influence distribution of fishes. Two diversion structures within private lands are likely barriers that prevent invasion by brown trout and rainbow trout into the upper watershed (Endicott 2008c). A large waterfall presents a total barrier to upstream movement. Historically, this portion of Pine Creek, and the lakes in its headwaters, were likely fishless; however, FWP regularly stocks Pine Creek Lake with Yellowstone cutthroat trout to provide a recreational fishery. These stocked fish likely occupy Pine Creek upstream of the waterfall, and may occasionally disperse downstream.

Brook trout are likely the most abundant and widely distributed fish species in Pine Creek, and a fish survey in 1983 found only brook trout in a sampling reach near the USFS boundary (MFISH database). Other species presumed present in the lower reach, downstream of barriers, include mottled sculpin and rainbow trout (Table 6-25). Occupancy of fish in the lowest 1 to 2 miles of channel is seasonal, as irrigation withdrawals divert most to all flows in most years.

Table 6-25: Fish distribution in Pine Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	4.5	Brook trout	Abundant	Year-round resident	N/A	N/A	EBS
0	4.5	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
0	4.5	Rainbow trout	Rare	Fluvial/adfluvial population, spawning elsewhere	N/A	N/A	EBS
0	3.7	Yellowstone cutthroat trout	Unknown	Unknown	Resident	Potentially hybridized	NSPJ

The Pine Creek watershed is a potential candidate for reestablishment of a nonhybridized Yellowstone cutthroat trout population, following removal of nonnative brook trout. The existing irrigation diversions may prevent reinvasion by nonnatives and eliminate the need to construct a fish barrier. More evaluation of these barriers is needed to determine if they are passable. The amount of habitat upstream of the upper diversion structure, approximately 10 miles, is sufficient to support a population over the long-term (Hilderbrand and Kershner 2000)

Chronic dewatering limits Pine Creek's ability to support a fluvial run of Yellowstone cutthroat trout in the lower 2 miles of stream. Nonetheless, opportunities to promote water use efficiency and maintain in-stream flow through voluntary measures may exist. FWP will explore these options with willing landowners and irrigators.

6.2.24 Deep Creek

Deep Creek (Figure 6-13) is the next major drainage to the north from Pine Creek. Its north and south forks originate in the Absaroka-Beartooth Wilderness before entering private lands in Paradise Valley. The confluence of these forks marks the upstream extent of Deep Creek, about 2.5 miles from its mouth. The Deep Creek drainage burned in a major wildfire in 2012 and will experience increased water yield, sediment loading, and debris recruitment until the watershed recovers.

Little fisheries information is available for the Deep Creek watershed. In 2011, a fish survey in South Fork Deep Creek yielded no fish, presumably, because its high gradient may not be suitable to support fish. Otherwise, no formal survey data are available to verify species composition and distribution; although, brook trout and Yellowstone cutthroat trout are presumed to be present (Table 6-26). As the lower two miles of channel are chronically dewatered during summer months, Deep Creek is unlikely to support much of a fluvial spawning run, and no fluvial Yellowstone cutthroat trout have been documented in Deep Creek in spawning investigations (Berg 1975, DeRito 2004)

Table 6-26: Distribution and abundance of fishes in Deep Creek (MFISH database).

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Genetic Status	Data Rating
0	2.4	Brook trout	Rare	Year-round resident	N/A	N/A	EBS
0	2.4	Yellowstone cutthroat trout	Unknown	Unknown	Resident	Potentially hybridized	NSPJ

The first priority for the Deep Creek watershed is to conduct fisheries investigations to determine species composition in the main stem and its north fork. The resulting information would guide development of a conservation strategy. For example, if Yellowstone cutthroat trout still occur in the upper watershed, protection of remaining fish would be the course of action. Alternatively, the south and north forks of Deep Creek may be candidates for reclamation and reestablishment of Yellowstone cutthroat trout. Should appropriate barrier sites be present, these streams have sufficient stream miles to support Yellowstone cutthroat trout over the long-term.

Similar to other dewatered streams, opportunities may exist to increase in-stream flow during summer months. FWP will work to identify irrigators willing to increase water use efficiency, and lease water savings for in-stream flow. These efforts may result in reestablishment of a spawning run of fluvial Yellowstone cutthroat trout in Deep Creek.

6.2.25 Nelson Spring Creek

Nelson Spring Creek is among several spring creeks arising in the floodplain of the Yellowstone River at the north end of the Paradise Valley. As with the next few spring creeks, their locations and names are not clear in the available GIS streams layer. This stream flows entirely through private land. Like many spring creeks, this stream is highly productive, and its summer cool/winter warm water temperatures attract large numbers of fish. Species composition reflects its proximity to the Yellowstone River, with introduced and native species being present (Table 6-27). This spring creek is an important contributor to the main stem populations of the Yellowstone River, and is among streams supporting a run of fluvial Yellowstone cutthroat trout (Berg 1975; Clancy 1984; DeRito 2004; Roberts 1988).

Table 6-27: Distribution and abundance of fishes in Nelson Spring Creek (MFISH database).

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Genetic Status	Data Rating
0	2.5	Brown trout	Abundant	Both resident and fluvial/adfluvial populations	N/A	N/A	EBS
0.7	2.5	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
0.7	2.5	Mountain whitefish	Rare	Year-round resident	N/A	N/A	EBS
0	2.5	Rainbow trout	Abundant	Both resident and fluvial/adfluvial populations	N/A	N/A	EBS
0	0.70	Yellowstone cutthroat trout	Common	Unknown	Resident	Potentially hybridized	EBS
0.7	2.5	Yellowstone cutthroat trout	Common	Unknown	Resident	Potentially hybridized	EBS

Whirling disease is a potential constraint on the ability of spring creeks to produce trout fry. Spring creeks have high susceptibility to be a source of whirling disease as the summer-cool and winter-warm water temperatures, and moderate flows, provide habitat favorable to *Tubifex tubifex*, the intermediate worm host to the whirling disease organism (*Myxobolus cerebralis*). The commercial hatchery fed by this spring is tested regularly, and remains free from infection. Future investigations into the role of whirling disease in shaping fluvial Yellowstone cutthroat trout populations are possible.

The landowners have a continued commitment to improving fish habitat, with an emphasis on providing high quality spawning habitat and holding habitat for adult fish. The goals for these landowner driven projects were to reduce width-to-depth ratios in overly wide and shallow portions of the stream, provide depth and cover for fish, and provide clean gravel substrate for spawning. Other actions have included riparian fencing to exclude livestock from the stream, and native plantings to restore the health and function of the riparian zone.

6.2.26 DePuy's Spring Creek

DePuy's Spring Creek is a 3.5-mile long spring creek that parallels and eventually joins the Yellowstone River near the northern end of the Paradise Valley. Like many spring creeks, this stream is highly productive, and its cool water attracts large numbers of fish. Similar to Nelson Spring Creek, public access is limited to reduce damage to cutthroat trout embryos and fry from wading. Yellowstone cutthroat trout occupy DePuy's Spring Creek during the spawning period (DeRito 2004).

Little fisheries information is available for DePuy's Spring Creek. A fish survey in 1988 found exceptionally high densities of fish, and rainbow trout were the most abundant of the trout species (Decker-Hess 1989). Habitat improvements in the 1980s were predicted to improve habitat for resident fish and increase recruitment of trout to the Yellowstone River (Decker-Hess 1989). Genetic analyses of trout captured in DePuy's Spring Creek found nonhybridized Yellowstone cutthroat trout in sympatry with rainbow trout (Leary 1997).

As is true of many spring creeks, whirling disease is a potential constraint on the stream's ability to produce Yellowstone cutthroat trout fry. In general, more research is needed to evaluate the relative susceptibility of Yellowstone cutthroat trout to whirling disease, and its potential to have population level effects. Until more is known, educating anglers on the importance of cleaning gear is among the options to conserving Yellowstone cutthroat trout in these streams.

6.2.27 Armstrong Spring Creek

Armstrong Spring Creek flows for over a mile in the north end of the Paradise Valley before entering the Yellowstone River south of Livingston. This spring creek supports a renowned fee fishery for brown trout, rainbow trout, and Yellowstone cutthroat trout. Fish surveys in the 1970s found high densities of game species in Armstrong Spring Creek with species composition reflecting proximity to the Yellowstone River (Berg 1975; Stevenson 1980).

This spring creek is an important contributor to main stem populations of Yellowstone River fish. Moreover, it is one of the few tributaries in the area available to fluvial fish and provides ideal spawning and rearing habitat. Similar to DePuy's Spring Creek, the cool water and productivity attracts large numbers of fish. As a spring creek, it has potential to be a source of whirling disease underscoring the need to educate anglers on cleaning fishing gear before moving to a different stream to fish.

6.2.28 Yellowstone Cutthroat Trout Conservation Potential in Upper Yellowstone River Subbasin Spring Creeks

The spring creeks at the mouth of the Paradise Valley provide important, high-quality habitat that supports main stem fish populations and high-quality resident fisheries. The conservation opportunities beyond the existing recruitment of Yellowstone cutthroat trout are limited. Rainbow trout and brown trout will continue to be important components of the fisheries of these streams. Landowners have invested considerably in habitat protection and quality. This stewardship will likely continue so to maintain the health and abundance of fish in these streams.

6.2.29 Suce Creek

Suce Creek (Figure 6-13) is the next drainage to the north of Deep Creek, originating in the GNF on the east side of Paradise Valley. Limited fisheries information is available for this stream. Species presumed present include brown trout, mottled sculpin, and rainbow trout (Table 6-28). In 1987, a sample of 16 Yellowstone cutthroat trout collected in the headwaters tested as nonhybridized (Leary 1987). A sampling effort in 2011 yielded no fish (MFISH database). Chronic dewatering limits Suce Creek's ability to support a fluvial spawning run.

Table 6-28: Distribution and abundance of fishes in Suce Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	7.4	Brown trout	Rare	Year-round resident	N/A	N/A	EBS
0	7.4	Mottled sculpin	Rare	Year-round resident	N/A	N/A	EBS
0	7.4	rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
0	7.4	Yellowstone cutthroat trout	Rare	Unknown	Resident	Nonhybridized	EBS

Conservation priorities for Suce Creek include conducting fisheries investigations to update information on species composition and distribution, and genetic status of Yellowstone cutthroat trout. The results would guide development of a specific conservation approach. Likewise, reestablishment of a fluvial Yellowstone cutthroat trout population may be possible, if irrigators agree to voluntary water conservation measures and leasing water rights for in-stream flow. FWP will work towards identifying interested landowners.

6.2.30 Billman Creek

The Billman Creek (Figure 6-14) watershed originates in the north slope of the Wineglass Mountains, which form the northern boundary of Paradise Valley. Nearly the entire watershed lies on private lands. Major tributaries include Miner and Area creeks. (Locals refer to Area Creek as O'Rea Creek.)

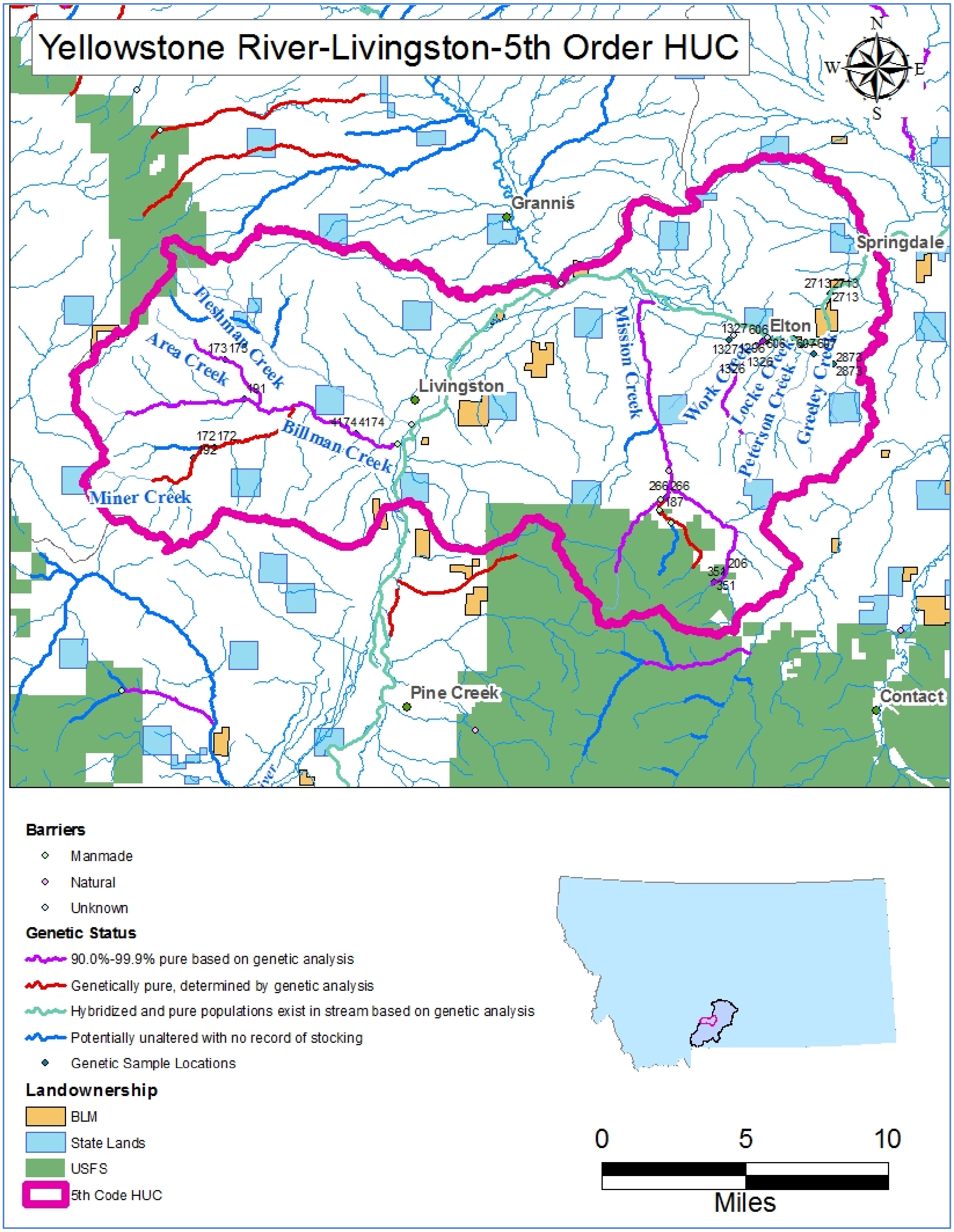

Figure 6-14: Distribution of Yellowstone cutthroat trout in the Yellowstone River-Livingston Watershed (FWP GIS database)

Fisheries information is limited for the Billman Creek watershed, and age of the available data restricts the ability to make inference on current conditions. Species presumed to be present include Yellowstone cutthroat trout, brook trout, brown trout, rainbow trout, mountain whitefish, and several nongame species (Table 6-29). In the mid-1980s, genetic analyses of Yellowstone cutthroat trout found nonhybridized and slightly hybridized fish in Billman Creek and its tributaries (Table 6-30).

Table 6-29: Distribution and abundance of fishes in Billman Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	12	Brook trout	Rare	Year-round resident	N/A	N/A	EBS
0	12	Brown trout	Rare	Year-round resident	N/A	N/A	EBS
0	12	Longnose sucker	Rare	Year-round resident	N/A	N/A	EBS
0	12	Mottled sculpin	Rare	Year-round resident	N/A	N/A	EBS
0	12	Mountain whitefish	Rare	Year-round resident	N/A	N/A	EBS
0	12	Rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
0.1	12	Yellowstone cutthroat trout	Common	Unknown	Resident	Nonhybridized	EBS

Table 6-30: Summary of genetic analyses conducted in the Billman Creek watershed (MFISH database).

Stream	*Sample No.*	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
Billman	191	19	YCT	100	10/09/1986
Miner	192	28	YCT	100	10/09/1986
	172	25	YCT	94	07/31/1986
Area	173	25	YCT	99.6	08/01/1986
	173	25	RBT	0.04	08/01/1986

Fisheries investigations in 2009 confirmed the presence of Yellowstone cutthroat trout in Miner and Area creeks, both are relatively large tributaries (C.L. Endicott, FWP, personal communication). Captured fish showed no obvious signs of hybridization; however, genetic analysis of tissue samples is pending. Additional sampling in Billman Creek tributaries is warranted to determine species composition and update genetic status of Yellowstone cutthroat trout.

In 2010, FWP sampled Billman Creek near the west interchange of Interstate 90. Yellowstone cutthroat trout, brown trout, and brook trout were present (MFISH database). Genetic analyses found that the 19 fish evaluated contained a hybrid swarm with predominantly Yellowstone cutthroat trout and a small component of hybrids with a greater degree of admixture (Leary 2011).

The presence of private ponds has the potential to be a source of rainbow genes in the Billman Creek watershed. These ponds lie in the headwaters and were likely stocked with rainbow trout. Stocking no longer occurs, but species composition has not been confirmed.

A potential barrier at the mouth of Billman Creek may limit this stream's accessibility to fluvial Yellowstone cutthroat trout. A culvert approximately 600 feet long conveys water to its confluence with the Yellowstone River. Given its length, the pipe may not be passable. This pipe is an ideal candidate to apply the Fish Xing model.

Land use activities adjacent to Billman Creek and its tributaries include livestock grazing, forage crop production, and urbanization. These uses have potential to negatively affect stream habitat and water quality, if not managed in a compatible manner. The Montana Department of Environmental Quality lists Billman Creek as a water quality impaired stream, with nutrients and sediment being probable causes of impairment, and agriculture and habitat modification being probable sources of impairment. Associated water quality planning efforts will be useful in identifying potential habitat restoration projects, and opportunities to work with private landowners on implementing fisheries-compatible streamside management.

Conservation priorities for Billman Creek include collecting updated information of species composition, distribution, and genetic status. In addition, the culvert at the lumberyard should be evaluated for its potential to block upstream movement of fish. These data will guide development of more specific plans to secure or reestablish resident Yellowstone cutthroat. Reestablishment of connectivity with the Yellowstone River would likely be incompatible with securing or reestablishing the resident fishery.

6.2.31 Fleshman Creek

Fleshman Creek (Figure 6-14) is the next drainage to the north of Billman Creek, and its watershed is nearly entirely in private ownership. Rangeland and irrigated crop production dominate the upper reaches. The lower two miles flow through Livingston. The Sacajawea Park Lagoon is an on-stream impoundment.

Fisheries investigations have focused mostly on the portion of stream flowing through Livingston, and species composition reflects the neighboring Yellowstone River (Table 6-31). In the 1970s, FWP sampled Fleshman Creek just upstream of the City of Livingston, and found brook trout were the most abundant species, with a few Yellowstone cutthroat trout present (FWP, unpublished data). Investigations following a fish kill in 2007 indicated the presence of brown trout, rainbow trout, and Yellowstone cutthroat trout (FWP data files).

Table 6-31: Distribution and abundance of fishes in Fleshman Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	12	Brook trout	Common	Year-round resident	N/A	N/A	EBS
0	6	Brown trout	Rare	Year-round resident	N/A	N/A	EBS
0	6	Lake chub	Common	Year-round resident	N/A	N/A	EBS
0	12	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
0	6.44	Rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
0.1	7.1	Yellowstone cutthroat trout	Common	Unknown	Resident	Potentially hybridized	EBS

In 2009, FWP sampled fish at two locations on Fleshman Creek (C.L. Endicott, FWP, personal communication). The lower reach was just above town, and the upper reach was close to the headwaters. Fishes captured in the lower reach included lake chub, longnose dace, white sucker, rainbow trout, and brown trout. One apparent Yellowstone cutthroat trout × rainbow trout hybrid was also present. Yellowstone cutthroat trout was the only species found at the upper sampling reach. These fish showed no apparent signs of hybridization. Genetic analysis of this population is a conservation need.

The apparent absence of nonnative fishes from the upper reach of Fleshman Creek suggests a passage barrier exists somewhere along the stream. Potential barriers include several large beaver dams or road crossings. Identifying and securing any existing barrier protecting the upper reaches from invasion is a conservation priority for Fleshman Creek.

Fleshman Creek is the subject of a series of conservation actions that target fish habitat and flood and sediment conveyance through Livingston. The first phase, which was constructed in 2010, restored habitat on a ranch upstream of Livingston. This effort involved channel restoration and installation of suite of ranch infrastructure improvements such as riparian fencing and development of off-channel water for livestock. The next phase will involve restoration of a two-mile reach flowing through Livingston. Partners in this phase include Park County, the Army Corps of Engineers, the Federal Emergency Management Agency (FEMA), FWP, the Joe Brooks Chapter of Trout Unlimited, and private landowners along the creek. The goals of this project include mitigation of flood risks, restoration of in-stream and riparian habitat, water quality improvement, and improved recreation and aesthetics.

6.2.32 Mission Creek

Mission Creek (Figure 6-14) originates on the north slope of the Absaroka Range, and flows for over 13 miles, mostly through private lands, before its confluence with the Yellowstone River. Major tributaries include Little Mission Creek and Mill Fork. Fishes present in Mission Creek include Yellowstone cutthroat trout, mountain whitefish, and two suckers (Table 6-32).

Table 6-32: Distribution and abundance of fishes in Mission Creek (MFISH database).

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Genetic Status	Data Rating
0	8	Brown trout	Common	Year-round resident	N/A	N/A	EBS
0	8	Longnose sucker	Rare	Year-round resident	N/A	N/A	EBS
0	8	Mottled sculpin	Common	Year-round resident	N/A	N/A	EBS
0	8	Mountain whitefish	Rare	Year-round resident	N/A	N/A	EBS
0	8	Rainbow trout	Rare	Year-round resident	N/A	N/A	EBS
0	8	White sucker	Rare	Year-round resident	N/A	N/A	EBS
0	9	Yellowstone cutthroat trout	Common	Unknown	Resident	Tested conservation	EBS
8	14	Yellowstone cutthroat trout	Abundant	Unknown	Resident	Tested conservation	EBS
9	12	Yellowstone cutthroat trout	Common	Unknown	Resident	Tested conservation	NSPJ

Nonhybridized and slightly hybridized Yellowstone cutthroat trout reside in the basin's streams (Table 6-33). Chronic dewatering in the lowest portion of Mission Creek is a likely constraint to the potential for a fluvial Yellowstone cutthroat trout run, and DeRito (2004) did not document any radio-tagged fish ascending Mission Creek.

Table 6-33: Summary of genetic analyses conducted in the Mission Creek watershed (MFISH database).

Stream	*Sample No.*	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
Mission Creek	452	12	YCT	98.3	09/29/1988
	452	12	RBT	1.7	09/29/1988
Mill Fork Creek	187	21	YCT	100	10/01/1986
Little Mission Creek	206	21	YCT	100	06/12/1987
	351	25	YCT	092.6	09/11/1989
	351	25	RBT	7.4	09/11/1989

Several culverts present potential passage barriers in Mission Creek (Figure 6-14). These culverts may be beneficial in preventing invasion of nonnative fishes. In 1993, the USFS retrofitted a culvert on Tie Creek, a tributary of Mission Creek to prevent upstream movement of rainbow trout and hybrids Alternatively, impassable culverts may restrict movement, and gene flow, through the subbasin. Evaluating the costs and benefits of these features is a conservation priority for the Mission Creek watershed.

The age of the available data presents a concern in the management of Mission Creek's Yellowstone cutthroat trout. Reevaluation of species composition and genetic status are considerable data needs. Updating information on Mission Creek would assist in developing a specific strategy doe conserving the watershed's Yellowstone cutthroat trout.

6.2.33 Work Creek

Work Creek (Figure 6-14) is a small stream originating in the foothills to the east of Mission Creek. Its headwaters originate in state-owned, school trust land. The rest flows through private property before its confluence with the Yellowstone River.

A combination of small drainage area and moderate elevation of its headwaters suggests Work Creek does not have sufficient water supply to support a strong, resident fishery. Investigations near the mouth in 1998 found several fluvial spawners in Work Creek. These included several nonhybridized Yellowstone cutthroat trout, and some hybrids (Kanda 1998). The sufficiency of flows to support a fluvial run in Work Creek is unknown. The conservation priority for the creek is to fill data gaps that will allow determination of the its potential and specific conservation opportunities.

6.2.34 Locke Creek

Locke Creek (Figure 6-14) is a small stream with substantial importance for Yellowstone cutthroat trout. Its headwaters originate in the foothills of the Absaroka Mountains, although most of its six miles flow through private lands. Locke Creek joins the Yellowstone River between Livingston and Springdale; it is one of the few documented spawning tributaries downstream of Paradise Valley.

Fisheries investigations on Locke Creek have focused on its role as a spawning stream for fluvial Yellowstone cutthroat trout. Locke Creek was among the high-quality spawning tributaries, owing to the number of Yellowstone cutthroat trout ascending this stream during the spawning period (Clancy 1985). Redd counts in 1991 found 13 redds from the stream's mouth to the culvert under Interstate 90 (Shepard 1992). Fry recruitment was considerable that year, with nearly 1,000 Yellowstone cutthroat trout fry captured in one fry trap during six nights of trapping (Shepard 1992). Fry trapping in 1996 and 1997 yielded fewer fry, and maintaining minimum in-stream flows was recommended to increase fry production (Hennessey 1998).

Genetic investigations have focused on fluvial spawners and out-migrating fry (Table 6-34). Nonhybridized Yellowstone cutthroat trout and slightly hybridized fish use Locke Creek during the spawning period. Fry tested as 97.9% nonhybridized. These results indicated Locke Creek supports a conservation population of fluvial spawners.

Table 6-34: Summary of genetic samples collected in Locke Creek (MFISH database).

Sample No.	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
1326	15	YCT	95.8	06/02/1998
1326	15	RBT	4.2	06/02/1998
1296	4	YCT	100.0	06/02/1998
606	24	YCT	97.9	07/23/1991
606	24	RBT	2.1	07/23/1991

A water lease has been in place in Locke Creek since 2001; however, channel alterations in the Yellowstone River have blocked Yellowstone cutthroat trout attempting to access the stream. The floods of 1997 shifted the main flow of the Yellowstone River to the north, away from Locke Creek. Before this shift, the Yellowstone River backwatered the lower portion of the creek during high flows, which allowed Yellowstone cutthroat trout access to it through a railroad culvert. A combination of diminished peak flows, and the lack of backwatering now makes this culvert impassable in some years. The reduced access may be in part responsible for dramatic declines in Yellowstone cutthroat trout in the Springdale sampling reach (Opitz 2004).

Less work has been focused on Locke Creek's resident fishery. An irrigation diversion upstream of the reach used by fluvial spawners is an apparent fish barrier. Spot sampling upstream of this structure captured 26 resident Yellowstone cutthroat trout (B.B. Shepard, FWP retired, personal communication). These fish tested as being hybrids, with 4.2% of alleles being characteristic of rainbow trout (Table 6-34). Sampling upstream of the diversion in 2012 found only putative Yellowstone cutthroat trout. Results of genetics sampling are pending. Additional survey to determine distribution and health of the Locke Creek Yellowstone cutthroat trout population would be useful.

Conservation priorities for Locke Creek include protecting its fluvial run of nonhybridized and hybridized fish. Restoring the accessibility of Locke Creek by modifying the stream downstream of the railroad culvert is a potential future action. Likewise, continued maintenance of minimum in-stream flows is warranted. Fisheries investigations aimed at determining status and distribution of resident Yellowstone cutthroat trout would assist in development of conservation actions for the rest of Locke Creek and its tributaries.

6.2.35 Greeley/Peterson Creek

This watershed (Figure 6-14) originates in foothills south of the Yellowstone River and flows entirely through private lands across its 5 ½ mile length. Stream name designations are unclear for Greeley and Peterson Creek. USGS maps label both Greeley and Peterson, but do not designate the name of the stream below the confluence of these streams. The national hydrologic layer used in GIS designates Greeley Creek as the main stem. Locals know the stream as Peterson Creek. Fisheries investigators have been variable in what they consider Greeley or Peterson Creek.

Fisheries investigations in the Peterson/Greeley Creek watershed have focused on its use by fluvial Yellowstone cutthroat trout. Peterson Creek was among the high-quality spawning tributaries identified by Clancy (1985), and nonhybridized, radio-tagged Yellowstone cutthroat trout were observed in Greeley Creek during the early 2000s (DeRito 2004). Genetic investigations have found nonhybridized and slightly hybridized spawners ascending the stream (Table 6-35). Genetic analyses of out-migrating fry in 1991 found these to be Yellowstone cutthroat trout × rainbow trout hybrids.

Table 6-35: Summary of genetic analyses conducted in the Peterson/Greeley Creek watershed (MFISH database).

Sample No.	*Sample Size*	*Target Species*	*Percent of Genes*	*Count*	*Collection Date*
3711	50	YCT	99.7		05/02/2007
3711	50	RBT	0.3		05/02/2007
2873	16	YCT		15	06/15/2003
2873	1	YCT×WCT		1	06/15/2003
607	10	YCT	76.8		07/24/1991
607	10	RBT	23.2		07/24/1991

Little information is available on the species composition and distribution of the resident fishery. The lowest half-mile of stream may support hybridized Yellowstone cutthroat trout. Peterson Creek and Greeley creeks may support hybridized Yellowstone cutthroat trout, along with nonnative rainbow trout and brown trout (Table 6-36 and Table 6-37). These species pose a threat to persistence of resident Yellowstone cutthroat trout in the Peterson/Greeley Creek watershed.

Table 6-36: Distribution and abundance of fishes in Greeley Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	0.53	Yellowstone cutthroat trout	Abundant	Unknown	Resident	Tested conservation	EBS

Table 6-37: Distribution and abundance of fishes in Peterson Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	3	Brown trout	Abundant	Resident	N/A	N/A	EBS
0	3	Mottled sculpin	Common	Resident	N/A	N/A	EBS
0	3	Mountain Whitefish	Common	Resident	Adfluvial	N/A	EBS
0	3	Rainbow trout	Common	Resident	N/A	N/A	EBS
0	0.69	Yellowstone cutthroat trout	Abundant	Unknown	Resident	Tested conservation	EBS

Peterson/Greeley Creek experienced a substantial flood event in spring of 2011that resulted in considerable channel alterations, especially near the mouth, where Interstate 90 and a frontage road cross the creek. The stream made large vertical adjustments, making large head cuts, which also contributed to the already sizeable load of sediment coming through the stream. This event resulted in enough sediment to fill the interstate and railroad crossings. MDT is proceeding with channel rehabilitation and replacing the two culverts under the west-bound portion of the interstate with a bridge.

Despite the degree of disturbance with this flood event, Yellowstone cutthroat trout had a strong spawning run the following spring. Trapping of fluvial spawners yielded 52 Yellowstone cutthroat trout. Fry traps deployed in August captured over 30 Yellowstone cutthroat trout fry, which is a promising given the amount of sediment still in the lower gradient reaches of the stream.

Conservation planning for this watershed should include a strategy to protect and enhance its use by nonhybridized fluvial Yellowstone cutthroat trout. Additionally, investigations into the species composition, distribution, and genetic status of resident fishes would guide development of an approach to protect or restore resident Yellowstone cutthroat trout where feasible.

6.2.36 Duck Creek

Duck Creek (Figure 6-15) originates along the south slope of the Crazy Mountains, and flows south before its confluence with the Yellowstone River near Springdale, Montana. Most of the watershed is in private ownership, although streams do flow through several sections of GNF, and some state owned lands.

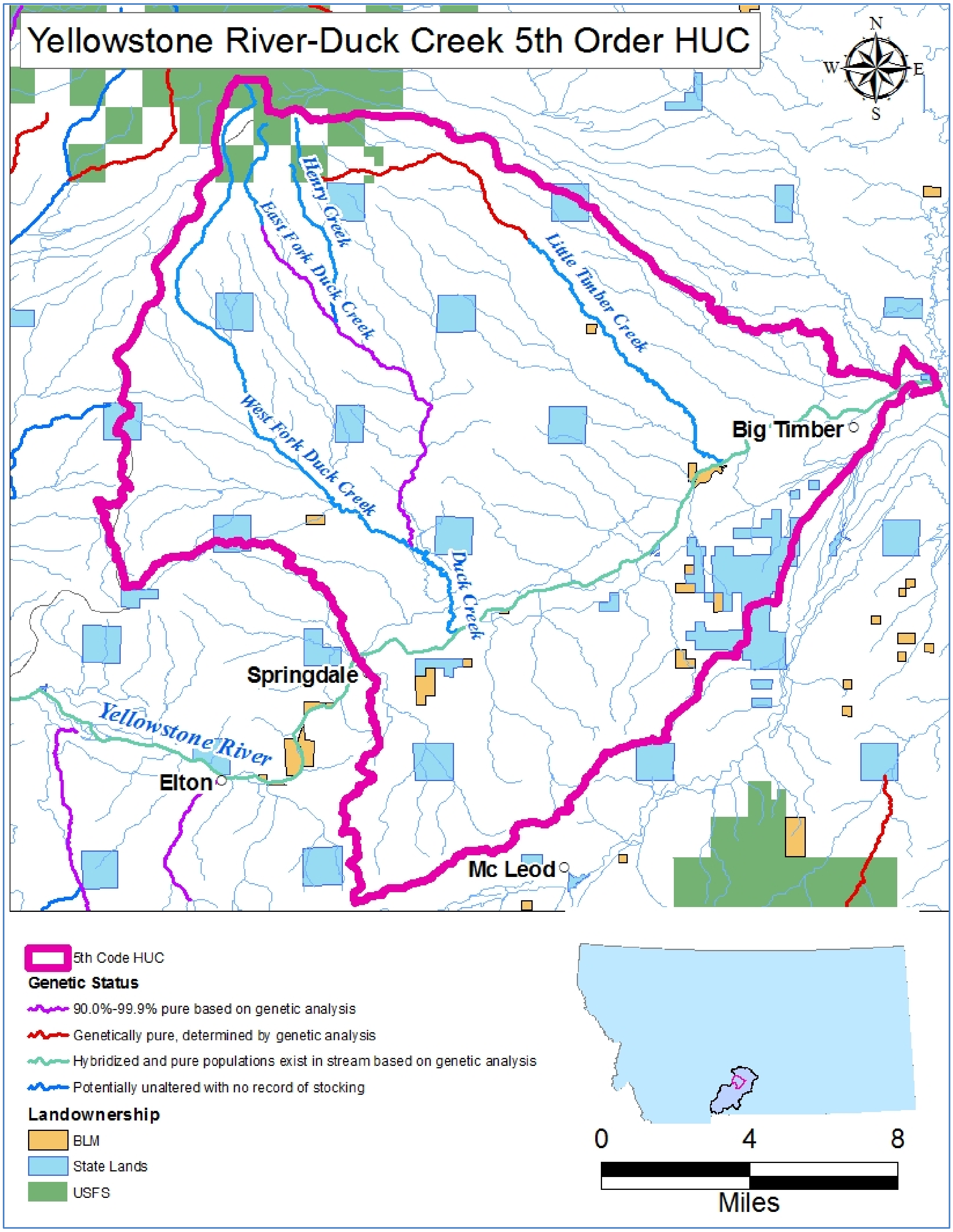

Figure 6-15: Distribution of Yellowstone cutthroat trout in the Yellowstone River-Duck Creek Watershed (FWP GIS database).

Fisheries information is limited for the Duck Creek watershed. No fish surveys have been conducted in West Fork Duck Creek or the main stem, and information on species composition is conjectural (Table 6-38). In 1984, a fisheries investigation in East Fork Duck Creek found Yellowstone cutthroat trout to outnumber brown by a substantial margin (White 1984). Alarmingly, FWP found a reversal in species dominance in 2007, with brown trout being considerably more abundant than Yellowstone cutthroat trout. Genetic analysis of Yellowstone cutthroat trout captured in this effort found less than 1% introgression by rainbow trout genes, which makes this a core population of Yellowstone cutthroat trout (Leary 2007).

Table 6-38: Distribution and abundance of fishes in the Duck Creek watershed (MFISH database).

Begin Mile	***End Mile***	***Species***	***Abundance***	***Use Type***	***Life History***	***Genetic Status***	***Data Rating***
Duck Creek							
0	4	Brown trout	Common	Year-round resident	N/A	N/A	NSPJ
0	4	rainbow trout	Common	Year-round resident	N/A	N/A	NSPJ
0	4	Yellowstone cutthroat trout	Rare	Unknown	Resident	Potentially hybridized	NSPJ
East Fork Duck Creek							
0	16	Brown trout	Common	Year-round resident	N/A	N/A	NSPJ
0	12	Yellowstone cutthroat trout	Unknown	Resident and fluvial/adfluvial populations	Combination	Tested conservation	NSPJ
West Fork Duck Creek							
3	18	Brook trout	Rare	Year-round resident	N/A	N/A	NSPJ
0	3	Brown trout	Common	Year-round resident	N/A	N/A	NSPJ
3	18	Brown trout	Rare	Year-round resident	N/A	N/A	NSPJ
0	3	Longnose Dace	Common	Year-round resident	N/A	N/A	NSPJ
0	3	Mountain Whitefish	Common	Year-round resident	N/A	N/A	NSPJ
0	3	Rainbow trout	Common	Year-round resident	N/A	N/A	NSPJ
3	18	Rainbow trout	Rare	Year-round resident	N/A	N/A	NSPJ
0	9	Yellowstone cutthroat trout	Rare	Both resident and Fluvial/Adfluvial populations	Combination	Potentially hybridized	NSPJ

Conservation actions are underway in the Duck Creek watershed. In 2009, FWP transferred fertilized Yellowstone cutthroat trout eggs above a waterfall on Henry Creek, a tributary of the

East Fork Duck Creek. The objectives of this effort are to expand the miles of stream occupied, and establish a secure subpopulation that can be used as brood stock in the future.

Securing the watershed's Yellowstone cutthroat trout population is a conservation priority. Sympatry with brown trout presents a significant threat to the persistence of Yellowstone cutthroat trout in the basin. Removal or suppression of brown trout are among the tools likely to be applied. Protecting the basin from invasion of nonnatives is another concern. An irrigation diversion about 1 mile from the mouth of Duck Creek is a barrier to upstream movement; however, the irrigation canal may carry fish from neighboring streams.

Other conservation opportunities include restoring riparian function and fish habitat. A considerable portion of the basin's streams is in excellent condition; however, some reaches show impairment relating to grazing practices that disrupted riparian health and function (C.L. Endicott, FWP, personal communication). FWP will work with interested landowners on implementing projects to benefit streams that are also compatible with agricultural uses.

6.2.37 Little Timber Creek

The Little Timber Creek (Figure 6-15) watershed is the drainage to the east of Duck Creek. Its waters originate in the south side of the Crazy Mountains, and flows mostly through rangeland until they merge with the Yellowstone River. Most of the watershed is under private ownership, with the exception of short reaches flowing through GNF in the headwaters.

Limited fisheries information is available for streams in this drainage; however, the stream presumably supports a mixture of native and nonnative species (Table 6-39). Surveys in 1993 found nonhybridized Yellowstone cutthroat trout in the upper reaches of Little Timber Creek (Leary 1995). In 2008, the U.S. Geological Survey sampled fish about 1 mile from the mouth of Little Timber Creek and found longnose dace, brown trout, mountain sucker, and longnose sucker (Cleasby 2008).

Table 6-39: Distribution and abundance of fishes in Little Timber Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Data Quality*	*Genetic Status*	*Life History*
0	19	Brook trout	Abundant	NSPJ	Not Applicable	N/A
0	19	Brown trout	Abundant	EFSSO[10]	Not Applicable	N/A
1.5	2.5	Longnose Dace	Abundant	EFSSO	Not Applicable	N/A
1.5	2.5	Longnose Sucker	Rare	EFSSO	Not Applicable	N/A
1.5	2.5	Mountain Sucker	Common	EFSSO	Not Applicable	N/A
10	17.3	Yellowstone cutthroat trout	Common	NSPJ	Nonhybridized	Resident

[10] EFSSO = Extrapolated from a single survey or observation

Securing the existing Yellowstone cutthroat trout population in Little Timber Creek is a conservation priority. Fish surveys to determine the distribution of brown trout and Yellowstone cutthroat trout are necessary to guide development of a specific conservation approach. Depending on findings, potential actions include nonnative removal or suppression and construction of a barrier to protect the headwaters Yellowstone cutthroat trout population.

The potential for Little Timber Creek to provide spawning habitat for fluvial Yellowstone cutthroat trout is unknown. Determining the sufficiency of flow and habitat condition in the lower end of Little Timber Creek would aid in determining the suitability of the stream to support a spawning run. FWP will seek opportunities to work with private landowners on water use efficiency and habitat management should these be identified as useful in promoting a spawning run in Little Timber Creek.

6.2.38 Big Timber Creek

Big Timber Creek (Figure 6-16) has its headwaters in the GNF, on the east flank of the Crazy Mountains. It flows for about 35 miles before it joins the Yellowstone River near the town of Big Timber. Valley portions of the watershed are mostly under private ownership, although several state-owned parcels are present.

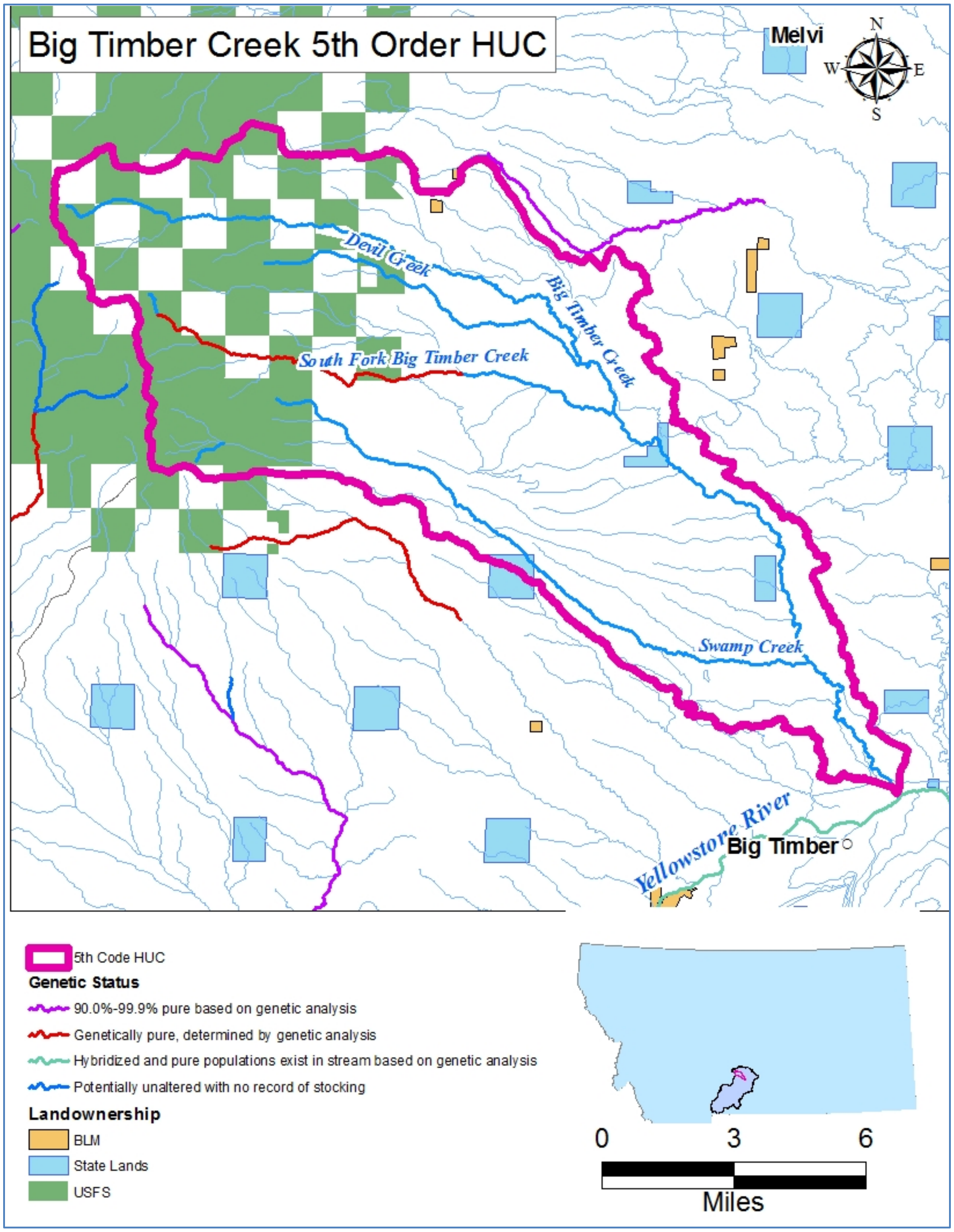

Figure 6-16: Distribution of Yellowstone cutthroat trout in the Big Timber Watershed (FWP GIS database).

Fishes present in the Big Timber Creek watershed include nonnative brook, brown, and rainbow trout (Table 6-40). Historically, Yellowstone cutthroat trout resided throughout the Big Timber Creek watershed. Currently, these nonhybridized Yellowstone cutthroat trout are restricted to the South Fork Big Timber Creek. This population may be a remnant, or the result of stocking Yellowstone cutthroat trout in Crazy Lake. Fish surveys in Devil Creek and the Middle Fork of

Big Timber Creek in late 1990s found both streams inhabited by brook trout with no other species present.

Table 6-40: Distribution and abundance of fishes in Big Timber Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Life History*	*Genetic Status*	*Data Rating*
15	31	Brook trout	Abundant	N/A	N/A	NSPJ
0	26	Brown trout	Common	N/A	N/A	NSPJ
0	15	Common carp	Common	Adfluvial	N/A	NSPJ
0	15	Mountain sucker	Abundant	N/A	N/A	NSPJ
0	226	Mountain whitefish	Common	N/A	N/A	NSPJ
15	31	Rainbow trout	Rare	N/A	N/A	NSPJ
0	15	White sucker	Common	N/A	N/A	NSPJ

Conservation priorities relevant to the Big Timber Creek watershed include protecting the nonhybridized population of Yellowstone cutthroat trout in the South Fork Big Timber Creek. Given the age of the available data for South Fork Big Timber Creek (1993), and the small sample size used in evaluating genetic composition (N=6), reevaluating the status of its Yellowstone cutthroat trout is a priority. Additionally, opportunities to return Yellowstone cutthroat trout to historically occupied streams should be explored. Removals of nonnatives, along with construction of barriers to protect waters from reinvasion are among the potential conservation actions.

6.2.39 Otter Creek

The Otter Creek watershed (Figure 6-17) drains the east side of the Crazy Mountains, and joins the Yellowstone River near Big Timber. Most land in the basin is in private ownership, although some state and BLM lands occur throughout the watershed

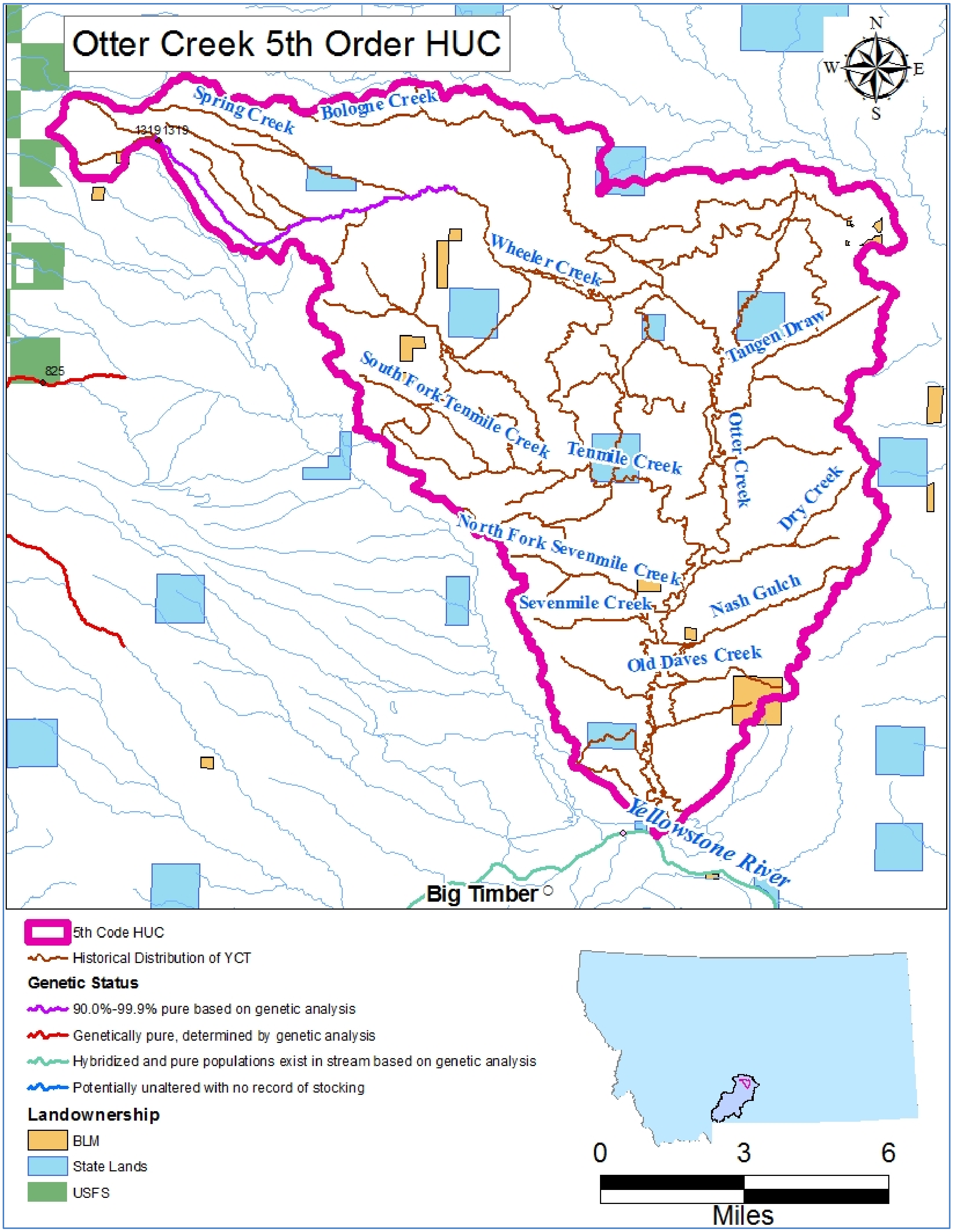

Figure 6-17: Distribution of Yellowstone cutthroat trout in the Otter Creek Watershed (FWP GIS database).

Fisheries information for the Otter Creek watershed includes fish surveys on the main stem, and genetic analysis of Yellowstone cutthroat trout in Wheeler Creek. Genetic testing found these to be hybrids, with 93.4% of alleles being Yellowstone cutthroat trout in origin, making this a conservation population In 2004, seining in the lower portion of Otter Creek yielded only suckers and members of the minnow family (Table 6-41). A record of westslope cutthroat trout is probably an error. Securing the remaining Yellowstone cutthroat trout population in Wheeler Creek is a conservation priority. FWP will investigate potential projects, such as removal of nonnatives, and construction of a barrier to prevent further invasion.

As a chronically dewatered stream, Otter Creek probably has limited potential to support a spawning run of Yellowstone cutthroat trout from the Yellowstone River. Nonetheless, opportunities may exist to work with water users to improve efficiency and promote in-stream flow. FWP will seek to identify willing partners in implementing associated conservation actions.

Table 6-41: Distribution and abundance of fishes in Otter Creek (MFISH database).

Begin Mile	***End Mile***	***Species***	***Abundance***	***Data Quality***	***Life History***	***Genetic Status***
0	1	Fathead minnow	Unknown	EFSSO	Unknown	N/A
0	1	Lake chub	Rare	EFSSO	Unknown	N/A
0	1	Longnose dace	Rare	EFSSO	Unknown	N/A
0	1	Mountain sucker	Unknown	EFSSO	Unknown	N/A
0	17	Rainbow trout	Unknown	NSPJ	Year-round resident	Tested conservation
14	15	Westslope cutthroat trout	Common	EFSSO	Unknown	Unknown
0	1	White sucker	Unknown	EFSSO	Unknown	N/A
7	15	Yellowstone cutthroat trout	Common	EFSSO	Year-round resident	Tested conservation

6.2.40 Sweet Grass Creek

Sweet Grass Creek (Figure 6-18) originates in the Crazy Mountains, and flows for 75 miles before its confluence with the Yellowstone River. Its headwaters are in the GNF. The valley portions of the watershed are mostly under private ownership, although state and BLM lands occur throughout the watershed.

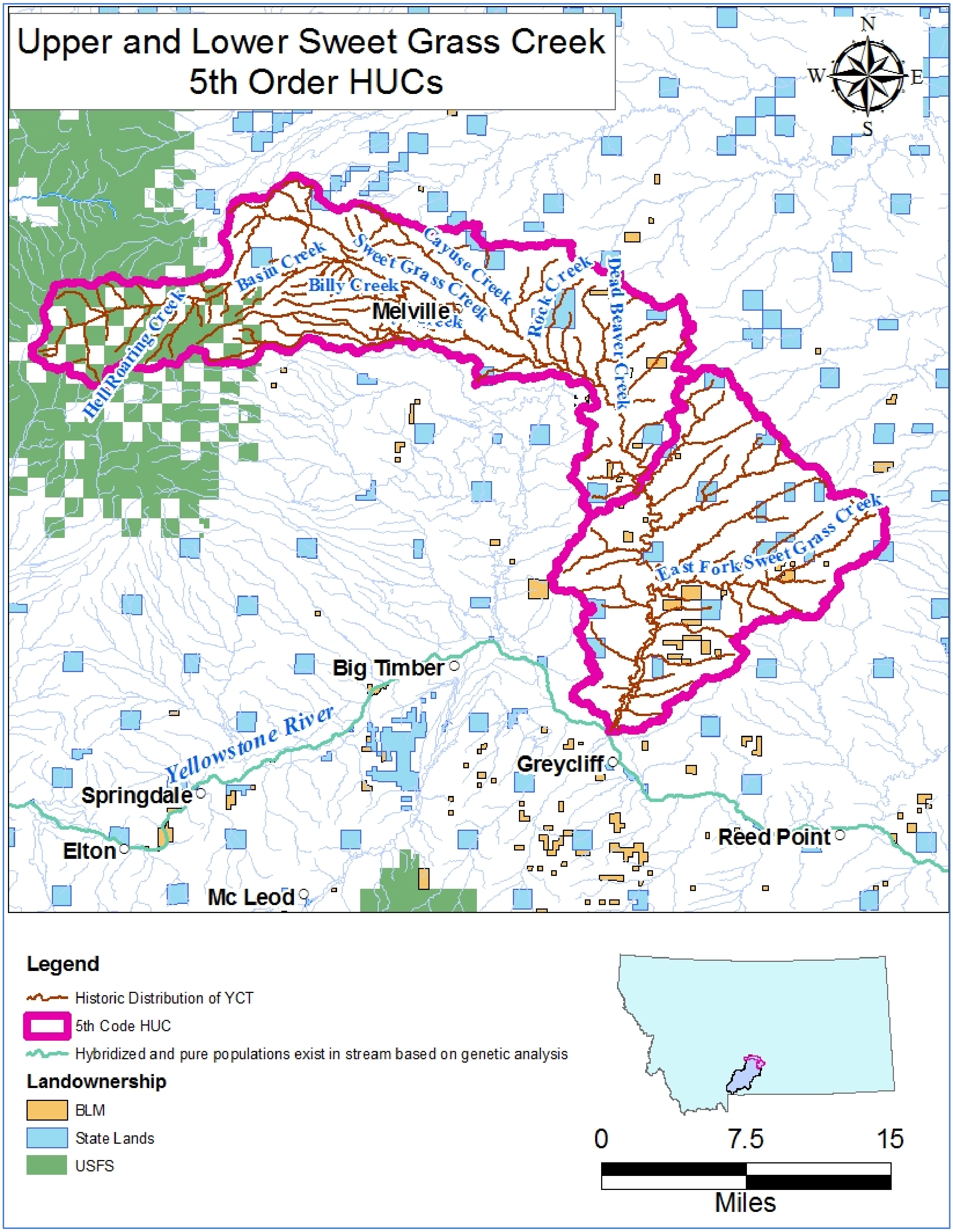

Figure 6-18: Historic distribution of Yellowstone cutthroat trout in the upper and lower Sweet Grass Creek watersheds (FWP GIS database).

Fish community composition is variable along the length of Sweet Grass Creek (Table 6-42). The upper portions support a cold-water fishery, with nonnative salmonids such as brook trout, rainbow trout, and brown trout ranking as common. Presence of emerald shiners, shorthead redhorse, stonecat, and fathead minnows in the lower reaches indicate a transition to a warm-water fishery occurs in the lower reaches.

Table 6-42: Distribution and abundance of fishes in Sweet Grass Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Life History*	*Genetic Status*	*Data Rating*
0	10	Brook stickleback	Unknown	N/A	N/A	EFMSO
41	51	Brook trout	Rare	N/A	N/A	EFMSO
51	67	Brook trout	Common	N/A	N/A	EFMSO
0	60	Brown trout	Common	N/A	N/A	EFMSO
0	01	Emerald shiner	Unknown	Unknown	N/A	EFSSO
0	25	Fathead minnow	Unknown	N/A	N/A	EFMSO
0	25	Lake chub	Unknown	N/A	N/A	EFMSO
0	25	Longnose dace	Common	N/A	N/A	EFMSO
41	75	Longnose dace	Rare	N/A	N/A	EFMSO
13	14	Longnose sucker	Unknown	N/A	N/A	EFMSO
41	75	Longnose sucker	Rare	N/A	N/A	EFMSO
0	1	Mottled sculpin	Unknown	N/A	N/A	EFMSO
0	25	Mountain sucker	Common	N/A	N/A	EFMSO
41	75	Mountain sucker	Rare	N/A	N/A	EFMSO
0	25	Mountain whitefish	Rare	N/A	N/A	EFMSO
0	41	Rainbow trout	Rare	N/A	N/A	NSPJ
41	75	Rainbow trout	Common	N/A	N/A	NSPJ
0	5	Shorthead redhorse	Rare	N/A	N/A	EFMSO
0	25	Stonecat	Rare	N/A	N/A	EFMSO
0	25	White sucker	Common	N/A	N/A	EFMSO
41	75	White sucker	Rare	N/A	N/A	EFMSO

Historically, Yellowstone cutthroat trout occurred throughout the Sweet Grass Creek watershed, although the montane and foothill portions likely had the most suitable habitat. Yellowstone cutthroat trout have been extirpated, making reintroduction into reclaimed waters a potential conservation action for the watershed. Given the wide distribution of nonnatives, reintroduction would need to be associated with nonnative removal and barrier construction to protect restored Yellowstone cutthroat trout populations.

Establishment of a spawning run from the Yellowstone River is another potential conservation priority for Sweet Grass Creek, although the suitability of the habitat for spawning is unknown. Sweet Grass Creek may have prairie stream affinities, such as warmer water temperatures and finer substrate near its confluence with the Yellowstone River. Dewatering presents another constraint to support of a spawning run. If the habitat is otherwise suitable for Yellowstone cutthroat trout spawning, FWP will seek opportunities to work with landowners on practices that will maintain in-stream flow.

6.2.41 Boulder River

The Boulder River (Figure 6-19) originates in the Absaroka and Beartooth mountain ranges in south central Montana and flows north-northeast approximately 60 miles before joining the Yellowstone River in the town of Big Timber. The Boulder River has two major tributaries, the West Boulder River and the East Boulder River, as well as a large number of small tributaries and numerous lakes. The majority of the land on the main Boulder downstream of Natural Bridge Falls is under private ownership. Upstream of the falls, most of the land is within the GNF, with the exception of a number of small in-holdings containing private camps and residences. A large proportion of the GNF is also within the Absaroka-Beartooth Wilderness.

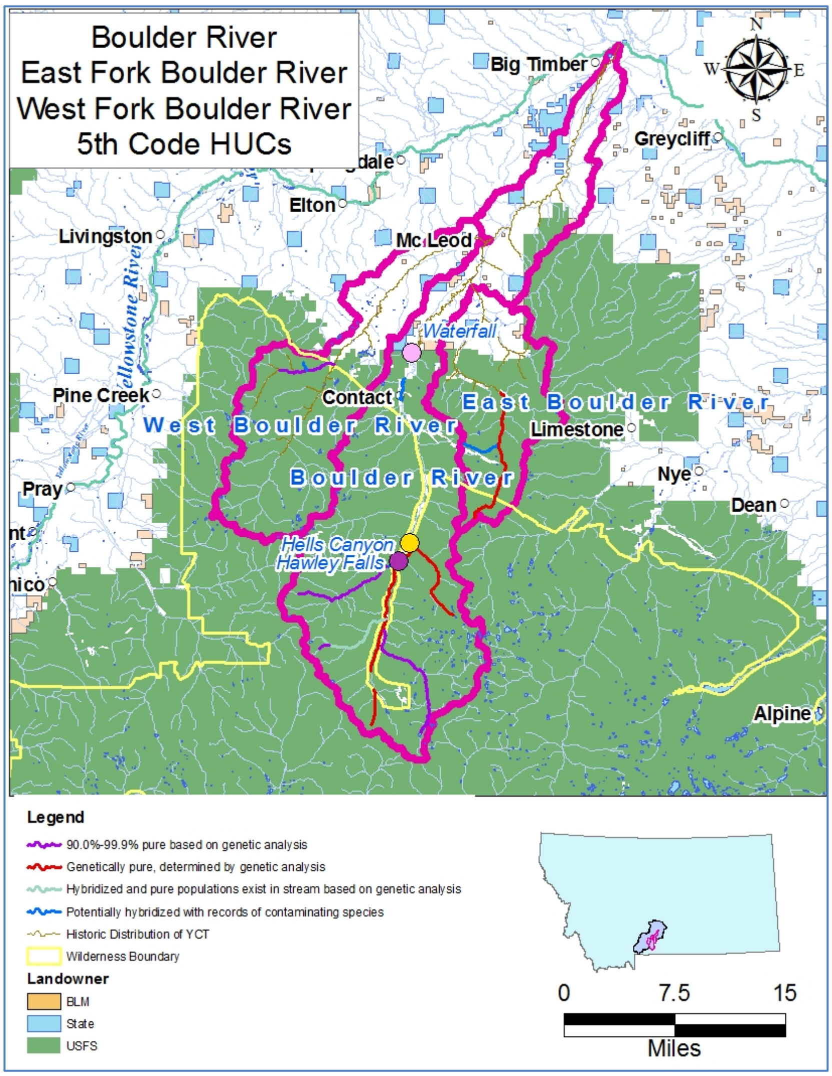

Figure 6-19: Distribution of Yellowstone cutthroat trout in the Boulder River watershed (FWP GIS database).

The Boulder River supports nine species of fish, including nonnative brook trout, rainbow trout, and brown trout (Table 6-43). Fluvial and resident populations of rainbow trout and brown trout use the Boulder River. Brook trout have relatively restricted distribution in the main stem, and are present in about 10 river miles beginning about 37 miles from the mouth. Yellowstone cutthroat trout are limited to the upper reaches of the Boulder River. Other native species include longnose and mountain sucker, longnose dace, mountain whitefish, and mottled sculpin.

Table 6-43: Distribution and abundance of fishes in the Boulder River (MFISH database).

Begin Mile	***End Mile***	***Species***	***Abundance***	***Use Type***	***Genetic Status***	***Data Rating***
37	42	Brook trout	Abundant	Year-round resident	N/A	EFSSO
42	48	Brook trout	Rare	Year-round resident	N/A	EFSSO
0	37	Brown trout	Abundant	Both resident and fluvial populations	N/A	EFMSO
0	23	Longnose dace	Common	Year-round resident	N/A	NSPJ
0	37	Longnose sucker	Abundant	Year-round resident	N/A	NSPJ
0	23	Mottled sculpin	Common	Year-round resident	N/A	NSPJ
0	23	Mountain sucker	Common	Year-round resident	N/A	NSPJ
0	37	Mountain whitefish	Abundant	Year-round resident	N/A	EFMSO
0	50	Rainbow trout	Common	Year-round resident	N/A	EFMSO
52	56	Rainbow trout	Common	Year-round resident	N/A	EFSSO
50	60	Yellowstone cutthroat trout	Rare	Unknown	Nonhybridized	NSPJ
60	65	Yellowstone cutthroat trout	Rare	Unknown	Tested conservation	NSPJ

The historic and current distribution of fish in the Boulder River watershed relates largely to the presence of two waterfalls and introductions of native and nonnative salmonids. From its headwaters downstream to Natural Bridge Falls (Figure 6-19), the Boulder River was historically fishless, as these falls blocked upstream movement of fish. From the falls downstream to the Yellowstone River, the Boulder river historically contained a population of Yellowstone cutthroat trout that moved freely among the Yellowstone, Boulder, East Boulder, and West Boulder rivers. The introduction of nonnative brown, rainbow, and brook trout in this river system has resulted in the extirpation of Yellowstone cutthroat trout in all but a few places in the

East Boulder and West Boulder rivers. Because the lower Boulder River is such a large and interconnected stream system with a popular rainbow and brown trout fishery, few options exist to restore a Yellowstone cutthroat trout population in the main stem of the river below Natural Bridge Falls.

Above Natural Bridge Falls, the Boulder River fishery is a reflection of fish stocking in lakes and streams, with a second waterfall also influencing fish distribution. The presence of brook trout downstream of Hells Canyon, and their absence above the canyon, had led to inference that a passage barrier within the canyon prevented invasion of brook trout. In 2010, biologists confirmed the presence a 12-foot-high waterfall upstream of Hells Canyon between the confluences of Hawley Creek and Fourmile Creek, and referred to it as Hawley Falls (J.R. Wood, FWP, personal communication; Figure 6-20).

Figure 6-20: Hawley Falls on the upper Boulder River.

The area above this waterfall likely presents the best opportunity to establish secure populations of Yellowstone cutthroat trout in the drainage. Currently, populations of nonhybridized Yellowstone cutthroat trout, rainbow trout, and various degrees of hybrid fish exist in this portion of the watershed. In the extreme headwaters, the population of Yellowstone cutthroat trout is approximately 99% nonhybridized, with progressively increasing rainbow trout hybridization transitioning downstream to Hawley Falls. Between Hawley Falls and Natural Bridge Falls, rainbow trout, brook trout, and hybrids comprise the community, with a few nonhybridized Yellowstone cutthroat trout trickling down from areas upstream. Brown trout are not present upstream of Natural Bridge Falls. Brook trout are in the Boulder River up to Hawley Falls, but none have been found upstream of this barrier (J.R. Wood, FWP, personal communication).

Much of the genetic makeup of the fish in the upper Boulder is likely the result of downstream movement of fish from headwater lakes. Of the 103 lakes occurring in the Boulder River drainage, approximately 36 contain fish. Most of these lakes contain nonhybridized Yellowstone cutthroat trout, with a handful containing rainbow trout and golden trout.

Above Hawley Falls, FWP is collaborating with the GNF forest with the goal of achieving a conservation population of Yellowstone cutthroat trout, with a target of 90% or better genetic status. Actions to achieve this goal include selective removal of rainbow trout from a number of headwater lakes and tributaries that are likely sources of rainbow trout. These efforts began in 2009 and continued through 2012. By combining progressive Yellowstone cutthroat trout restoration projects with natural processes that are contributing to species presence, it may be possible to foster the development of a healthy conservation population of Yellowstone cutthroat trout.

An alternative to mechanical removal and reliance on natural processes to achieve a conservation population would be chemical removal of fish, followed by introduction of nonhybridized Yellowstone cutthroat trout. Several factors limit the feasibility of this alternative. Notably, the scale of this effort would be prohibitive given the amount of stream habitat and number of lakes. Moreover, piscicide projects of this scale require considerable use of motorized equipment to transport material into rugged backcountry, and to mix piscicide into lakes. As all but the Boulder River corridor is within wilderness, obtaining permission to use motorized equipment and piscicide on this scale may be difficult. Moreover, as this portion of the watershed was historically fishless, justification to use motors and piscicide within the wilderness would be less than if the project aimed to protect existing or restore an extirpated population of Yellowstone cutthroat trout.

Extending the conservation area to Natural Bridge Falls may be an option over the long-term; however, several factors present challenges and affect feasibility. The presence of brook trout in the system downstream of Hawley Falls would necessitate the use of chemical removal in establishment of a Yellowstone cutthroat trout conservation area. The extent of stream miles within this portion of the watershed means chemical removal would require considerable effort and expense. Additionally, this portion of the Boulder River supports a popular recreational fishery, and reclamation would temporarily disrupt angling opportunities. Furthermore, all but the Boulder River corridor is within wilderness, which brings wilderness rules into consideration.

The final factor relates to conservation objectives under the Agreement (1.0 Introduction). As this portion of the Boulder River was historically fishless, establishing a Yellowstone cutthroat trout population would relate to the third ranking conservation priority, which entails establishing a population in previously fishless waters. Given the time and expense required to establish a Yellowstone cutthroat trout population in this location, and its lower priority as a previously fishless area, such an effort would rank lower compared to projects securing existing nonhybridized populations or reestablishing populations to where they have been extirpated.

A large number of tributaries contribute to the Boulder River, particularly in its upper reaches. Below are descriptions of the fish populations in streams upstream of the Natural Bridge Falls. Many of the tributaries in the upper part of the drainage are steep and small, and only contain fish near their confluence with the Boulder. Others are much larger, lower gradient streams that contain healthy fish populations. Introduced fish populations in many headwater lakes influence species composition of the tributaries. Mechanical removal of nonnative rainbow trout from these lakes and their tributaries, and restocking with Yellowstone cutthroat trout, would remove the source of rainbow trout alleles.

Boulder River

The portion of the Boulder River (Figure 6-21) with the greatest potential for Yellowstone cutthroat trout conservation is the reach upstream of Hawley Falls. Genetic analyses in 1989 found no evidence of hybridization in the Yellowstone cutthroat trout present in this portion of the Boulder River; however, in 2008, the population was a hybrid swarm with 88.7% of alleles being characteristic of Yellowstone cutthroat trout (Table 6-44). This level of introgression makes this population a sport population. Mechanical removal of rainbow trout and hybrids from lakes, tributaries, and the main stem may result in reduction of the proportion of rainbow trout alleles present in the population, and establishment of a conservation population of Yellowstone cutthroat trout.

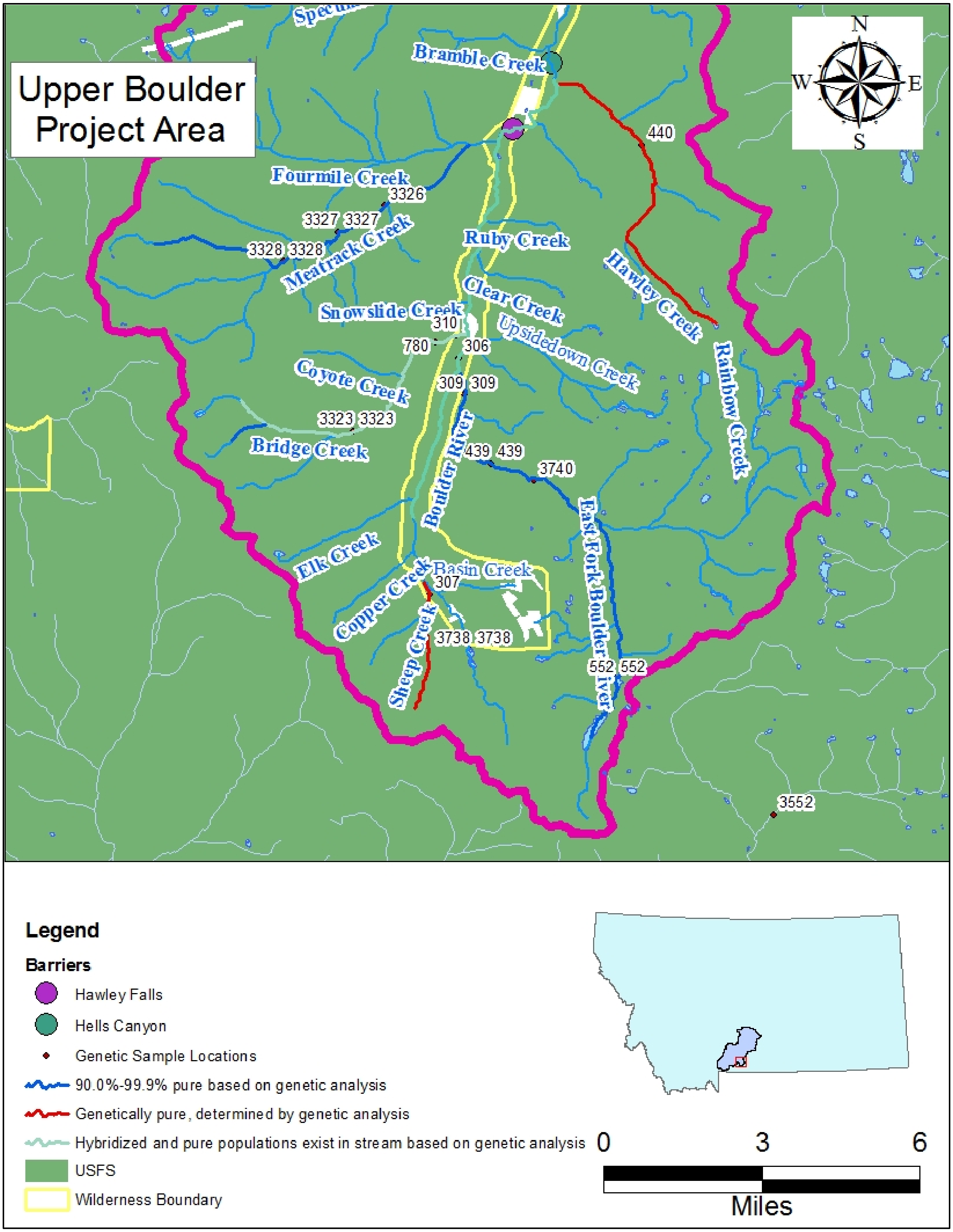

Figure 6-21: Upper Boulder River project area.

Table 6-44: Summary of genetic analyses conducted in the Boulder River watershed (MFISH database).

Stream	*Sample No.*	*Collection Date*	*Sample Size*	*Species Name*	*Percent*	*Count*
Boulder River	306	08/01/1989	24	YCT	100	
Boulder River	3738	07/15/2008	17	YCT	88.7	
Boulder River	3738	07/15/2008	17	RBT	11.3	
Bridge Creek	3323	07/15/2006	20	YCT		19
Bridge Creek	3323	07/15/2006	20	YCT×RBT		1
Bridge Creek	7080	08/01/1993	2	YCT	100.0	
Bridge Creek	310	08/02/1989	25	YCT	98	
Bridge Creek	310	08/02/1989	25	RBT	2	
Davis Creek	3551	07/11/2007	26	YCT	100	
Davis Creek	357	09/26/1989	25	YCT	96.6	
Davis Creek	357	09/26/1989	25	RBT	3.4	
East Boulder River	815	08/19/1993	29	YCT	100	
East Boulder River	430	08/17/1990	26	YCT	100	
East Boulder River	333	08/22/1989	29	YCT	100	
East Fork Boulder River	3739	07/15/2008	32	YCT	99	
East Fork Boulder River	3739	07/15/2008	32	RBT	1	
East Fork Boulder River	3740	07/15/2008	12	YCT×RBT		12
East Fork Boulder River	552	09/11/1991	27	YCT	98.9	
East Fork Boulder River	552	09/11/1991	27	RBT	1.1	
East Fork Boulder River	439	09/06/1990	23	YCT	92.4	
East Fork Boulder River	439	09/06/1990	23	RBT	7.6	
East Fork Boulder River	309	08/02/1989	26	YCT	95.9	
East Fork Boulder River	309	08/02/1989	26	WCT	4.1	
Hawley Creek	440	09/06/1990	2	YCT	100	
Meatrack Creek	3326	07/24/2006	29	YCT	100	
Meatrack Creek	3327	07/24/2006	30	YCT		29
Meatrack Creek	3327	07/24/2006	30	YCT×RBT		1
Meatrack Creek	3328	07/24/2006	30	YCT		26
Meatrack Creek	3328	07/24/2006	30	YCT×RBT		4
Meatrack Creek	3085	08/12/2003	30	YCT	99	
Meatrack Creek	3085	08/12/2003	30	RBT	1	
Sheep Creek	307	08/01/1989	7	YCT	100	
West Boulder River	356	09/21/1989	25	YCT	79.3	
West Boulder River	356	09/21/1989	25	WCT	17.2	
West Boulder River	356	09/21/1989	25	RBT	3	

Basin Creek

Basin Creek (Figure 6-21) is in the extreme headwaters of the Boulder River and enters the Boulder River near the mining ghost town of Independence. Substantial mining activity has taken place in the creek’s headwaters. Much of Basin Creek is likely fishless. Because of its small size, short length (around 1.5 miles) and extremely steep gradient, Basin Creek is not a suitable candidate for Yellowstone cutthroat trout introduction.

Sheep Creek

Sheep Creek (Figure 6-21) enters the Boulder River immediately downstream of Basin Creek. The creek contains two forks: main Sheep Creek and the South Fork, which join about 0.75 miles upstream from the Boulder River. The steep stream gradient near the wilderness boundary limits the potential to support fish. Sampling in 1989 revealed the presence of nonhybridized Yellowstone cutthroat trout, although the small sample size (N=7) limits certainty on the genetic status of this population (Table 6-44). The extent of fish distribution in the drainage is uncertain, but Yellowstone cutthroat trout probably do not extend upstream of the forks. Further investigation will be necessary to describe the extent of fish distribution in the creek and identify potential suitable fish habitat further upstream.

Copper Creek
Copper Creek (Figure 6-21) flows to the northeast until its confluence with the Boulder River, and is the next drainage to the north of Sheep Creek. Fisheries data are lacking for Copper Creek. The creek likely contains Yellowstone cutthroat trout near its mouth, but because of the steep gradient and small drainage area of this 2.5-mile creek, fish probably do not extend far beyond the mouth. Nonetheless, future sampling is warranted to determine fish species composition and fisheries potential.

Elk Creek
Elk Creek (Figure 6-21) originates at Elk Lake and flows about 3.25 miles to where it joins the Boulder River downstream of Copper Creek. Stocking of Elk Lake began in 1936 with introduction of rainbow trout. Because suitable spawning habitat does not exist in Elk Lake, rainbow trout probably did not reproduce there; however, some fish may have moved downstream and populated portions of the Boulder River watershed. A Yellowstone cutthroat trout stocking program began in 1977, and stocking reoccurs on a six-year rotation. Today, Yellowstone cutthroat trout may move downstream from Elk Lake and populate Elk Creek and the Boulder. Although no sampling data are available, fish population densities in Elk Creek are likely low due to the extremely steep gradient, particularly near the wilderness boundary. Further sampling would provide a better characterization of the fishery in Elk Creek.

East Fork Boulder River
The East Fork Boulder River (Figure 6-21) flows for more than 11 miles, much of it through low gradient, high quality habitat before it joins the Boulder River, below the Box Canyon trailhead. Over 20 lakes are present in the East Fork drainage, and 13 of these contain fish. The Yellowstone cutthroat trout population in the East Fork Boulder River is likely a result of fish that were stocked in these headwater lakes. The upper 4 to 6 miles of the East Fork contain Yellowstone cutthroat trout that are greater than 99% nonhybridized (Table 6-44). This population is probably a result of historic downstream movement of fish from Blue Lake, which has been stocked with Yellowstone cutthroat trout on a regular basis since 1965. Several fishless lakes draining into the East Fork have potential to support Yellowstone cutthroat trout if introduced, and include Lamb, Wool, Mutton, Kathleen, and Raymond lakes.

Rainbow Lakes and Mirror Lake

Rainbow Lakes and Mirror Lake are within the Yellowstone cutthroat trout conservation area above Hawley Falls and support nonnative fishes or highly introgressed Yellowstone cutthroat trout. These lakes are a source of rainbow trout and contribute to hybridization in the Boulder River watershed upstream of Hawley Falls. A Yellowstone cutthroat trout conservation effort has been underway since 2011 and will continue through 2013 to achieve core or conservation populations in the lakes and the streams they feed.

The strategy for replacing rainbow trout and hybrid populations in these lakes entails selective removal of rainbow trout through gillnetting and genetic swamping with Yellowstone cutthroat trout. The gillnetting component began in 2011 and continued in 2012. Gillnets were set within these lakes for 1 to 2 weeks, and adult rainbow trout captured in these nets were sunk to keep nutrient cycling within the lakes.

Genetic swamping entails stocking high densities of juvenile Yellowstone cutthroat trout in lakes that contain rainbow trout or hybrids. These young fish will not be susceptible to gillnetting, a least for the first few years. Genetic swamping achieves success through two potential mechanisms. First, the stocked Yellowstone cutthroat trout interbreed with rainbow trout, but through several generations, genetic composition tends toward Yellowstone cutthroat trout as the stocking overwhelms the rainbow trout populations reduced by gillnetting. Alternatively, stocked Yellowstone cutthroat trout may outcompete rainbow trout of the same year class to the extent that Yellowstone cutthroat trout replace an entire year class of rainbow trout.

Stocking Yellowstone cutthroat trout on top of an existing rainbow trout population may appear counterintuitive, especially in light of the role rainbow trout have had in the decline of Yellowstone cutthroat trout, a factor repeated throughout this document. Nonetheless, this method has been successful in Montana and has resulted in elimination or substantial reduction of rainbow trout genes from some lakes. The first mechanism, which entails continued genetic swamping, results in a trend towards more Yellowstone cutthroat trout genes, but may take several decades to be successful. With the second method, intensive gillnetting removes 50 to 75% of the adult rainbow trout in 1 to 2 years, while stocking Yellowstone cutthroat trout at high rates for several years. This section option has been successful in converting a rainbow trout fishery to predominantly Yellowstone cutthroat trout in as little as 4 years (M. Boyer, FWP, personal communication).

Rainbow Creek

Rainbow Creek (Figure 6-21) is a tributary of the East Fork Boulder River, and joins this stream near its midpoint. Rainbow Creek begins in a chain of lakes, and these were the first mountain lakes in Montana to be stocked by airplane, with introduction of rainbow trout in 1932. Currently, all seven of the Rainbow Lakes contain self-sustaining populations of rainbow trout. Nearby Mirror Lake is the only other lake in the drainage that contains rainbow trout. Fish, Chickadee and Burnt Gulch lakes support self-sustaining Yellowstone cutthroat trout populations. A number of fishless lakes in the drainage have unknown potential to support Yellowstone cutthroat trout if introduced.

Although no official survey data exist for Rainbow Creek, the creek likely supports a population of rainbow trout with some intermixing of Yellowstone cutthroat trout and hybrids. Below the mouth of Rainbow Creek, fish sampled for genetics analysis in the East Fork of the Boulder show much higher levels of hybridization than those upstream of Rainbow Creek (Table 6-44). This finding indicates that Rainbow Creek and Rainbow Lakes are a source of rainbow trout genetics contributing to hybridization further down the drainage. Rainbow Creek is part of the Yellowstone cutthroat trout conservation project that includes gillnetting and genetic swamping in Rainbow Lakes. Chemical removal of the existing fishery will occur by 2013, and Yellowstone cutthroat trout from Rainbow Lakes will populate this stream from the connected lake system.

Upsidedown Creek

Upsidedown Creek (Figure 6-21) is a 5-mile-long tributary to the Boulder River downstream of Rainbow Creek. Horseshoe Lake, near the creek's headwaters, was stocked with Yellowstone cutthroat trout in 1970 and now supports a self-sustaining population. Other lakes in the drainage (Diamond, Upper Hicks, Lower Hicks, and several unnamed lakes) are likely fishless. Diamond Lake was stocked with Yellowstone cutthroat trout in 1970, although no data are available to determine if it supports a self-sustaining population. Sampling near the mouth of Upsidedown Creek in 2003 resulted in the capture of 21 Yellowstone cutthroat trout and one rainbow trout. A potential barrier to upstream fish passage was identified approximately 1/3 mile upstream from the mouth. No fish were captured in a short distance sampled above this barrier. While little is known about the fish population between Horseshoe Lake and the Boulder River, Yellowstone cutthroat trout presumably can move freely downstream from the lake and contribute to the fish population in the Boulder. The creek is likely too steep to support a significant fish population.

Bridge Creek

The 6.5-mile long Bridge Creek (Figure 6-21) begins at Bridge Lake and flows into the Boulder River opposite Upsidedown Creek. Bridge Lake contains a stocked population of Yellowstone cutthroat trout that was originally introduced in 1970 and is supplemented every six years. The creek contains several small tributaries (South Fork, Coyote Creek, Tuscarora Creek, and two unnamed creeks). All but the South Fork Bridge Creek are likely fishless. Several sampling events in the lower reaches of Bridge Creek have identified both nonhybridized and slightly hybridized populations of Yellowstone cutthroat trout. A barrier to upstream fish passage likely keeps rainbow trout from inhabiting the upper reaches of Bridge Creek, but hybridization from rainbow trout is probable in the lower reaches. A population of Yellowstone cutthroat trout is present throughout the creek between Bridge Lake and the Boulder River.

Snowslide Creek

Snowslide Creek (Figure 6-21) is a small stream that joins the Boulder River downstream of Upsidedown Creek. Because of its small size and steep gradient, Snowslide Creek is unlikely to support much of a fishery. No data are available to confirm the status of this stream's fish population.

Clear Creek

This short, steep tributary to the Boulder River (Figure 6-21) likely only contains a few fish near its mouth. Electrofishing surveys in 2003 upstream and downstream of the culvert crossing on the Boulder Road resulted in the capture of only one fish, which appeared to be a Yellowstone cutthroat trout × rainbow trout hybrid (Olsen 2003). Emerald Lake, in the headwaters of Clear Creek, is fishless. Most of the creek is likely too small and steep to support a fish population.

Ruby Creek

Ruby Creek (Figure 6-21) is another short (<1.5 miles), steep tributary to the Boulder River downstream of Clear Creek. Electrofishing surveys in 2003 near the Boulder Road culvert crossing resulted in the capture of three Yellowstone cutthroat trout × rainbow trout hybrids (Olsen 2003). Further upstream, Ruby Creek is likely too small and steep to support a fish population.

Trout Lake

Trout Lake (Figure 6-21) is a 0.9-acre lake near the Boulder River just upstream from the mouth of Fourmile Creek. The lake supports a popular fishery for hatchery-reared catchable Yellowstone cutthroat trout. This recreational fishery for nonhybridized Yellowstone cutthroat trout will be maintained.

Fourmile and Meatrack Creeks

Fourmile Creek (Figure 6-21) is a 7.5-mile-long tributary to the Boulder River. In the upper portion of the basin, the creek originates from three lakes: Silver, Prospect and Patient. Two of these lakes support introduced fish populations. Stocking in Silver Lake began in 1931 with plants of cutthroat trout, followed by stocking of rainbow trout beginning in 1939. Stocking of rainbow trout into Prospect Lake began in 1980. Until recently, both Silver and Prospect supported self-sustaining populations of rainbow trout. A number of small tributaries flow off steep mountain faces and enter Fourmile Creek throughout its length. Except for Trail Creek, none of these streams support significant numbers of fish. Further investigation of Trail Creek is a conservation need that will determine the extent of fish distribution here.

The main stem of Fourmile Creek supports a healthy population of rainbow trout and rainbow × Yellowstone cutthroat trout hybrids throughout most of its length. Electrofishing surveys in 2003 revealed relatively high fish densities in the creek (Olsen 2003). This population likely originated as a result of fish stocking in Silver and Prospect lakes and fish plants in Fourmile Creek from

1932-1944. Upstream movement of fish from the Boulder River is another potential avenue of dispersal; however, a large cascade may be a barrier to upstream invasion by fish.

Meatrack Creek joins Fourmile Creek just upstream of the confluence with the Boulder River. Meatrack Creek supports a healthy fish population, primarily of Yellowstone cutthroat trout, throughout over 8 miles of stream. Meatrack Creek fish are mainly nonhybridized Yellowstone cutthroat trout, but some level of Yellowstone cutthroat trout × rainbow trout hybridization does exist (Table 6-44). This hybridization may be a result of a 1952 stocking of rainbow trout following the 1950 introduction of Yellowstone cutthroat trout.

Downstream of where Fourmile and Meatrack creeks join, but upstream of the Boulder River, a large cascade may prevent upstream movement of fish from the Boulder River. Evaluation to determine whether the cascade is a barrier to fish passage has proven difficult. Several options for Yellowstone cutthroat trout restoration in the upper Boulder drainage revolve around this potential barrier. One option would entail building a permanent structure to ensure that upstream fish passage were completely prevented in the drainage, and subsequently replacing the fish populations from Fourmile and Meatrack creeks with nonhybridized Yellowstone cutthroat trout. This option would ensure additional protected populations of nonhybridized Yellowstone cutthroat trout, but would likely be costly. Another option for Yellowstone cutthroat trout conservation in the drainage would be to replace rainbow trout with Yellowstone cutthroat trout from Fourmile Creek, Silver Lake and Prospect Lake, and assume that upstream movement of rainbow trout and hybrids over the cascade would be minimal, allowing the Yellowstone cutthroat trout population above the cascade to remain a >90% nonhybridized conservation population.

The option that does not entail construction of a barrier is likely the most feasible. Notably, this cascade likely prevents the passage of most fish during most times of the year. Moreover, downstream movement of fish from Fourmile and Meatrack creeks is much more prevalent than upstream movement of fish from the Boulder River. Subsequently, these creeks would be a source of Yellowstone cutthroat trout genetics for the Boulder River, with more Yellowstone cutthroat trout moving downstream and breeding with rainbow trout and hybrids in the main Boulder River. Combined with the removal of rainbow trout from Rainbow Lakes and Rainbow Creek, this action could be the most significant action in increasing the prevalence of Yellowstone cutthroat trout in the upper Boulder River drainage.

Efforts to secure the Fourmile Creek drainage for Yellowstone cutthroat trout began in 2007, and more actions are likely in the next few years. The initial step was mechanical removal of rainbow trout from headwater lakes using intense gillnetting. Gillnetting efforts ceased in 2009, and planting of nonhybridized Yellowstone cutthroat trout followed the next year. Stocking will continue until Yellowstone cutthroat trout establish a self-sustaining population. A waterfall barrier at the outlet of Silver Lake prevents rainbow trout in the creek from colonizing the lake, which protects this investment in fish conservation over the short term. In 2012, Fourmile Creek and lower Meatrack Creek were treated with piscicide to remove rainbow trout; restocking with nonhybridized Yellowstone cutthroat trout will follow in 2013.

Hawley Creek

Hawley Creek (Figure 6-21) is a 6.5-mile long tributary that enters the Boulder River upstream of Hells Canyon, but downstream of Hawley Falls. The creek is exceptionally steep in its lower reaches, which likely limits its ability to provide fish habitat, and prevents upstream fish passage. The only fisheries data for Hawley Creek is a genetic investigation in 1990 that identified two nonhybridized Yellowstone cutthroat trout (Table 6-44). Two lakes stocked with Yellowstone cutthroat trout, Squeeze and Narrow Escape, are the likely source of Yellowstone cutthroat trout in the creek. No survey data are available to characterize the abundance and distribution of this population, but it likely serves as a source of Yellowstone cutthroat trout moving downstream into the Boulder River. Two other lakes in the drainage, Hawley Lake and Helicopter Lake, are fishless but may be capable of supporting Yellowstone cutthroat trout.

Bramble Creek

Bramble Creek (Figure 6-21) is a steep, 3-mile-long tributary to the Boulder below Hells Canyon. Three lakes in the headwaters of the creek support introduced Yellowstone cutthroat trout populations. The creek is almost certainly too small and steep to support a Yellowstone cutthroat trout population. No fish were captured during electrofishing sampling near the mouth of the creek in 2003 (Olsen 2003).

Speculator Creek

The 8-mile long Speculator Creek (Figure 6-22) begins at Speculator Lake and enters the Boulder River just downstream of a private camp. The creek is steep near its mouth, and upstream fish movement is not possible beyond a short distance from the Boulder River. The creek was stocked with rainbow trout in 1943, and cutthroat trout in 1950. Both times, fish were planted near the confluence with the Boulder River. Several rainbow trout were caught during electrofishing sampling near the mouth of the creek in 2003 (Olsen 2003). Speculator Lake was stocked with Yellowstone cutthroat trout beginning in 1976. As is common in these systems, Yellowstone cutthroat trout have likely moved downstream out of the lake and colonized the creek. Due to its size and relatively low gradient, Speculator Creek likely supports a Yellowstone cutthroat trout population throughout much of its length. Collection of fish survey data is a conservation priority for Speculator Creek. The results will inform development of a specific strategy for Yellowstone cutthroat trout conservation as warranted.

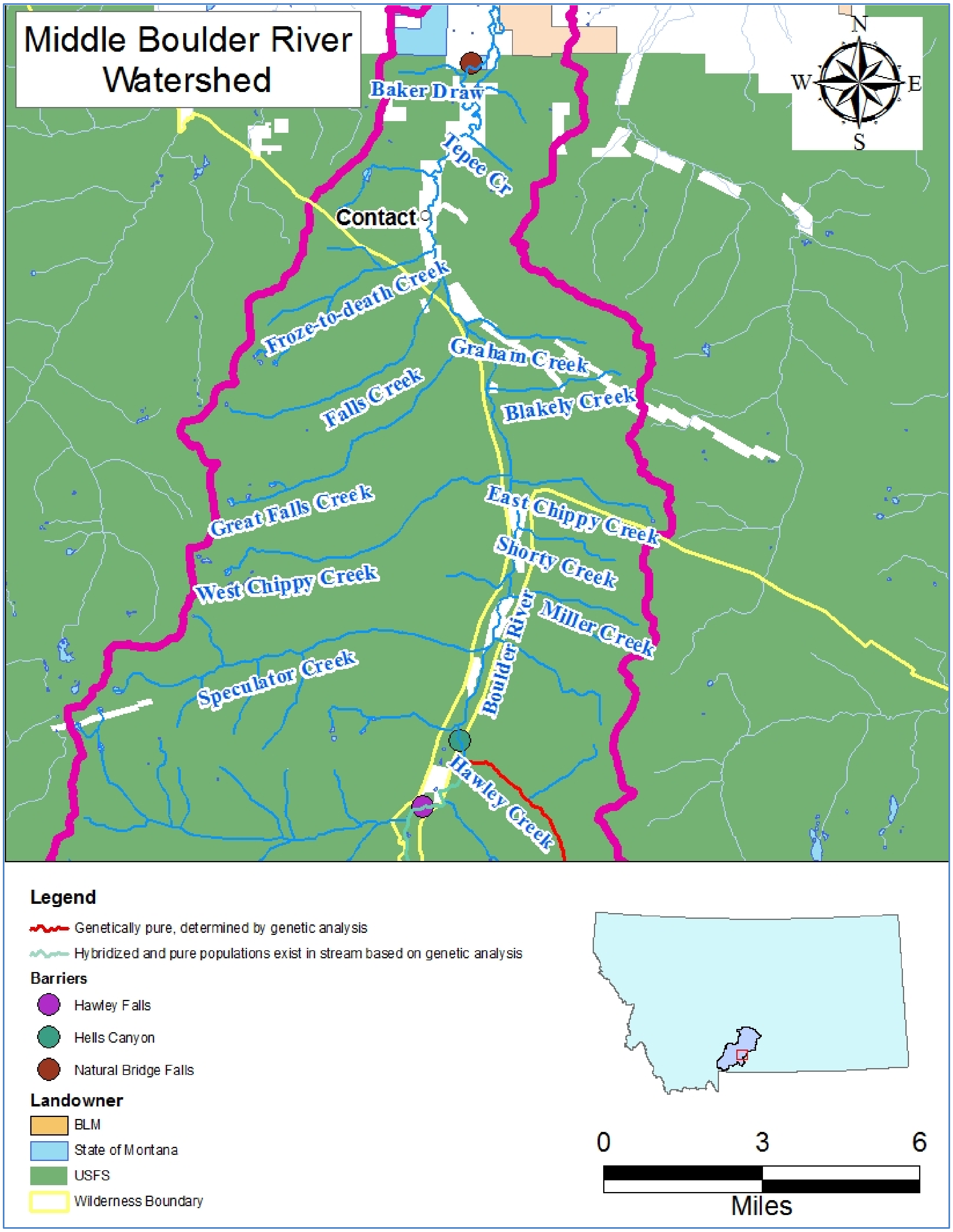

Figure 6-22: Boulder River watershed between Hawley Falls and Natural Bridge Falls

West Chippy (Weasel) Creek

West Chippy Creek (Figure 6-22), also known as Weasel Creek, flows about 6.5 miles through very steep terrain from its headwaters to the Boulder River. Of the eight lakes in the drainage, two support Yellowstone cutthroat trout, owing to fish stocking beginning in 1979. The extent of the Yellowstone cutthroat trout population in the creek is unknown, but is likely limited due to the stream's small size and steep gradient. Further investigation is necessary to characterize this population. Electrofishing sampling near the mouth of the creek in 2009 resulted in the capture of numerous rainbow trout and brook trout and a few Yellowstone cutthroat trout (J.R. Wood, FWP, personal communication). The rainbow and brook trout had likely moved upstream from the Boulder River, while the Yellowstone cutthroat trout may have moved downstream from areas of the creek inaccessible from below.

Great Falls Creek

Three lakes form the headwaters of Great Falls Creek (Figure 6-22), which flows about 6 miles before entering the Boulder River. The lowermost lake, Great Falls Creek Lake #55, has been stocked with Yellowstone cutthroat trout since 2007 in an effort to replace a small rainbow trout population through genetic swamping. A combination of rainbow trout, Yellowstone cutthroat trout and hybrid fish may occur in the creek, but future survey work would be necessary to determine their extent. Great Falls Creek Lake # 53 and 54 are likely fishless, and their ability to support fish is unknown.

Falls Creek

Falls Creek (Figure 6-22) flows for about 5 miles before its confluence with the Boulder River. Falls Creek is likely too small and steep to support a fish population throughout most of its length. In 2003, electrofishing near the mouth of the Boulder River yielded only rainbow trout (Olsen 2003).

Froze-to-Death Creek

Froze-to-Death Creek (Figure 6-22) is a small tributary to the north of Falls Creek. Froze-to-Death Creek is likely too small and steep to support a fish population throughout most of its length. Rainbow trout were the only species captured in the creek near the mouth of the Boulder during electrofishing sampling in 2003 (Olsen 2003).

West Boulder River

The West Boulder River (Figure 6-23) flows approximately 30 miles and joins the Boulder River in the town of McLeod, MT. In its lower reaches, brown trout dominate the fish community, and rainbow trout and mountain whitefish are present in low densities. Further upstream, rainbow trout, Yellowstone cutthroat trout, and rainbow × Yellowstone cutthroat trout hybrids become more common. Fish are present from the mouth of the West Boulder River upstream to what is likely a fish passage barrier just upstream from the mouth of Falls Creek. Above this probable barrier, an estimated minimum of 4 to 6 miles of suitable, high-quality habitat exists, but this reach is likely fishless. If introduced to the creek, a new Yellowstone cutthroat trout population would likely thrive, particularly in the slow-moving meadow reaches. An obstacle to introducing Yellowstone cutthroat trout introduction into the upper West Boulder River is the potential conflict with wilderness values. Future work on the main stem of the West Boulder River should focus on identifying the distribution of Yellowstone cutthroat trout, assessing their genetic purity, and determining the effectiveness of the probable barrier in blocking upstream movement of fish.

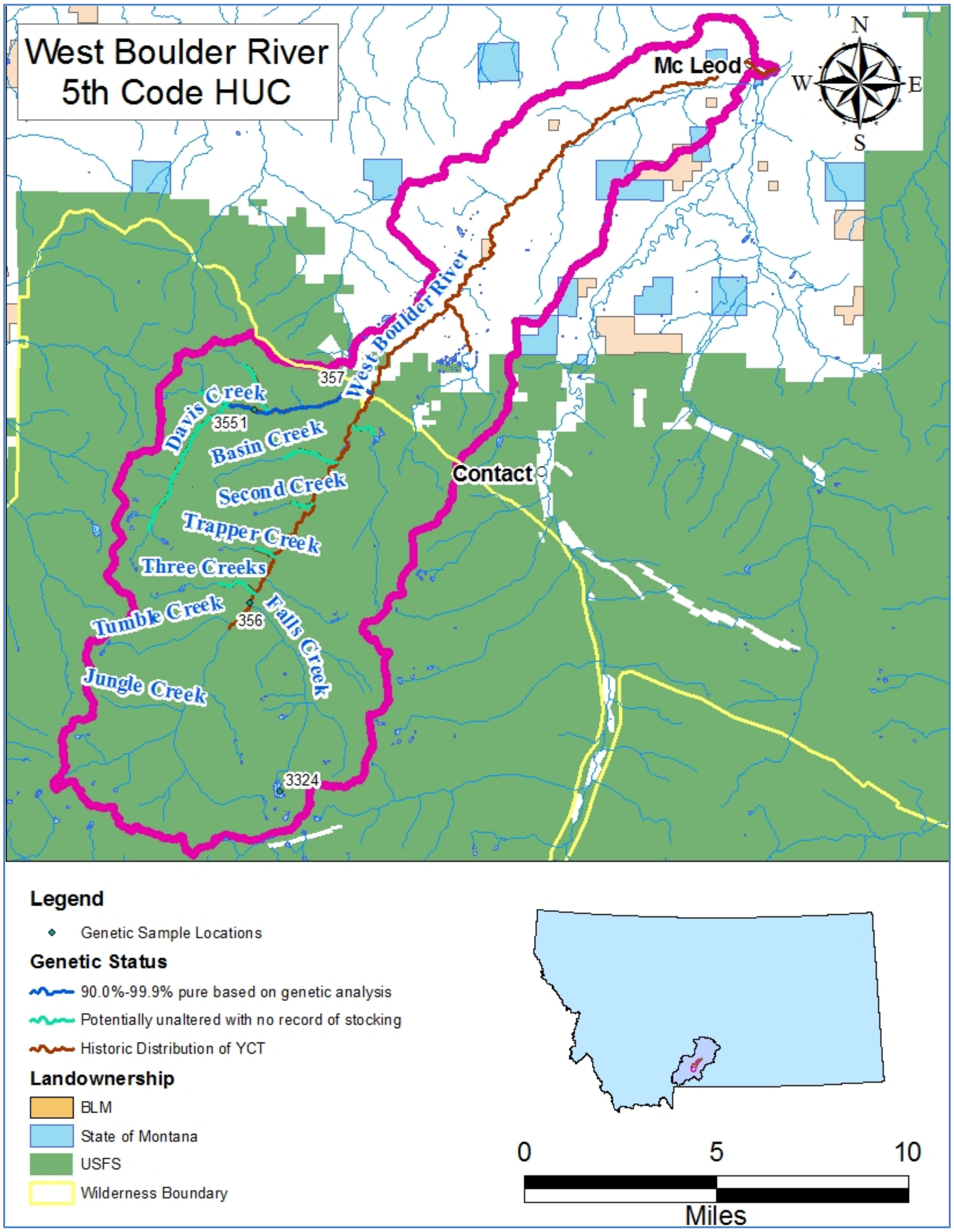

Figure 6-23: Distribution of Yellowstone cutthroat trout in the West Boulder Watershed (FWP GIS database).

Four fish-bearing lakes drain into the main West Boulder River. Kaufman and West Boulder lakes are at the head of Falls Creek, which flows 6 miles before reaching the West Boulder River. West Boulder Lake is the uppermost lake and contains a stocked population of Yellowstone cutthroat trout. Golden trout were stocked here in 1958, but recent genetics results show that the fish currently residing in the lake are nonhybridized Yellowstone cutthroat trout. Just down from West Boulder, Kaufman Lake contains a self-sustaining population of Yellowstone cutthroat trout. Kaufman was stocked with golden trout in 1958 as well, but similar to West Boulder Lake, genetic analyses indicate this lake supports nonhybridized Yellowstone cutthroat trout. Yellowstone cutthroat trout may move downstream and reside in Falls Creek, but its steep nature likely prevents them from thriving here. Future survey work may better evaluate the presence and abundance of Yellowstone cutthroat trout in Falls Creek.

Alpine Lake contains a stocked population of Yellowstone cutthroat trout and drains into the Three Creeks then the West Boulder River, just downstream of Falls Creek. Below Three Creeks, the outlet of Icicle Lake drains into the West Boulder. Icicle Lake contains a self-sustaining population of rainbow trout whose origin is unknown (no stocking history is available). Restoration of a Yellowstone cutthroat trout population in the West Boulder River near Icicle Lake would require removal of these fish, as they likely contribute to downstream movement of rainbow trout into the West Boulder River.

Davis Creek

The largest tributary to the West Boulder River is Davis Creek (Figure 6-23), flowing about 9.5 miles and entering the West Boulder just below the wilderness boundary. In the lower 2 to 3 miles of the creek, a barrier to upstream fish passage apparently keeps fish downstream from colonizing most of Davis Creek. Upstream from this barrier, a nonhybridized population of Yellowstone cutthroat trout exists in the creek. This population is likely present because of past stocking of lakes in the drainage.

The Davis Creek drainage contains four fish-bearing lakes. Davis Lake, at the head of the drainage, was stocked with Yellowstone cutthroat trout in 1934, which is likely the origin of the Yellowstone cutthroat trout population in Davis Creek. The lake now contains a self-sustaining population of Yellowstone cutthroat trout. Lower in the drainage, Blacktail Lake was stocked with Yellowstone cutthroat trout beginning in 1945, and stocking continues periodically. Near Davis Lake, McKnight and Upper McKnight lakes contain a stocked population of golden trout, most recently stocked in 2005. Although the outlet of these lakes would certainly discourage downstream movement of golden trout, there is potential for golden trout to move downstream and hybridize with Yellowstone cutthroat trout in Davis Creek, thus compromising this nonhybridized population. Therefore, plans call for discontinuing golden trout stocking in the McKnight lakes.

East Boulder River

The East Boulder River (Figure 6-24) flows over 20 miles from its headwaters to the confluence with the Boulder River. The lower ¼ of the watershed is in private ownership. The remaining is in the GNF, with a small portion of the extreme headwaters being within the Absaroka-Beartooth Wilderness.

For planning purposes, the East Boulder River can be broken into two segments. The lower segment begins at the mouth of the river and extends upstream to about the mouth of Brownlee Creek. This portion of river is large with relatively low gradient, and provides high quality fish habitat. Brown trout, rainbow trout, and brook trout are common, with an occasional Yellowstone cutthroat trout dropping down from upstream. The stream is chronically dewatered during most years. The only major tributary that enters the East Boulder in this area is Elk Creek, a small stream that flows for several miles and contains brown, rainbow and brook trout. Dry Fork Creek and Burnt Gulch are likely too small to support fish populations, although fish surveys are needed to verify their status. Canyon Creek is very small and steep, but may contain some Yellowstone cutthroat trout that drop down from Camp Lake. Camp Lake is the only fish-bearing lake in the East Boulder drainage. The origin of the fish in Camp Lake is unknown, but the lake contains a self-sustaining population of Yellowstone cutthroat trout.

Yellowstone cutthroat trout are the only fish occupying the upper segment of the East Boulder, extending from the mouth of Brownlee Creek to the headwaters. Near the mouth of Brownlee Creek, a large series of cascade waterfalls prevents upstream passage of fish. The East Boulder River upstream of here was historically fishless until being stocked with Yellowstone cutthroat trout from 1970 to 1972. The area, which is also known locally as Placer Basin, now contains a healthy, self-sustaining population of Yellowstone cutthroat trout that is not threatened by nonnative fish species. Forge Creek, a tributary to East Boulder Creek in Placer Basin, also contains Yellowstone cutthroat trout in its lower reaches.

The Stillwater Mine is within the East Boulder Creek watershed and mining activities have the potential to affect water quality and fish habitat. A monitoring program that evaluates fish, macroinvertebrates, and water quality is in place. Likewise, a mitigation plan has been developed to address any adverse effects of the mining operation on fish, water quality, and in-stream habitat.

Because of connectivity with the main stem of the Boulder River and the abundance of nonnative trout, opportunities to restore Yellowstone cutthroat trout in this reach are limited. The upper segment, which supports nonhybridized Yellowstone cutthroat trout, does have potential for maintenance of a core population of Yellowstone cutthroat trout. Continued monitoring of this population is the primary relevant conservation action.

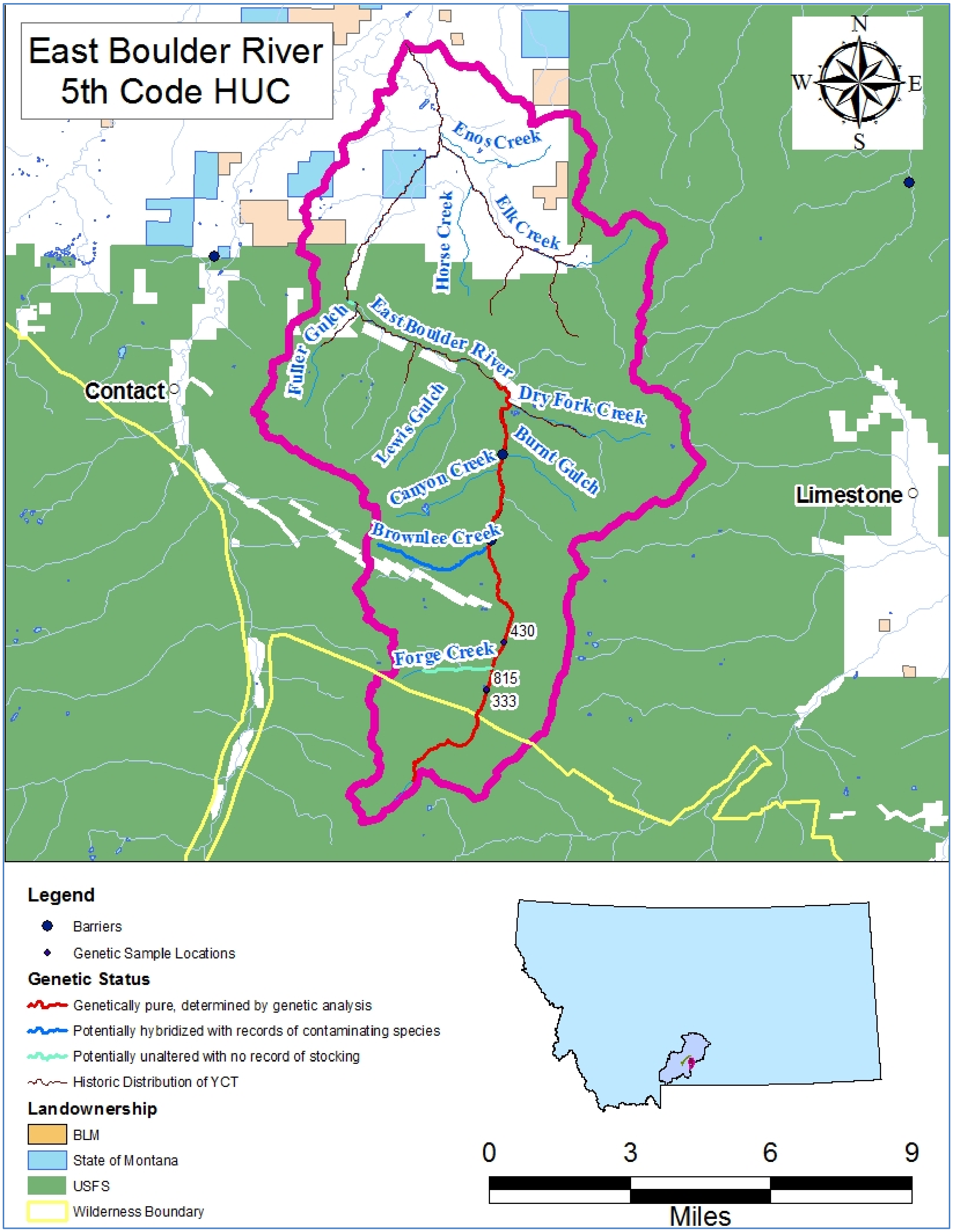

Figure 6-24 East Boulder River 5th order HUC.

6.2.42 Upper Deer Creek

Upper Deer Creek (Figure 6-25) is the next drainage to the east of the Boulder River, and joins the Yellowstone River about one mile upstream of Greycliff, Montana. Upper Deer Creek has three major tributaries, the West, East, and Middle forks. The upper 1/3 of the watershed is within the GNF. Downstream of the forest boundary, ownership is primarily private, although the stream does flow through some state-owned lands and public lands managed by the BLM.

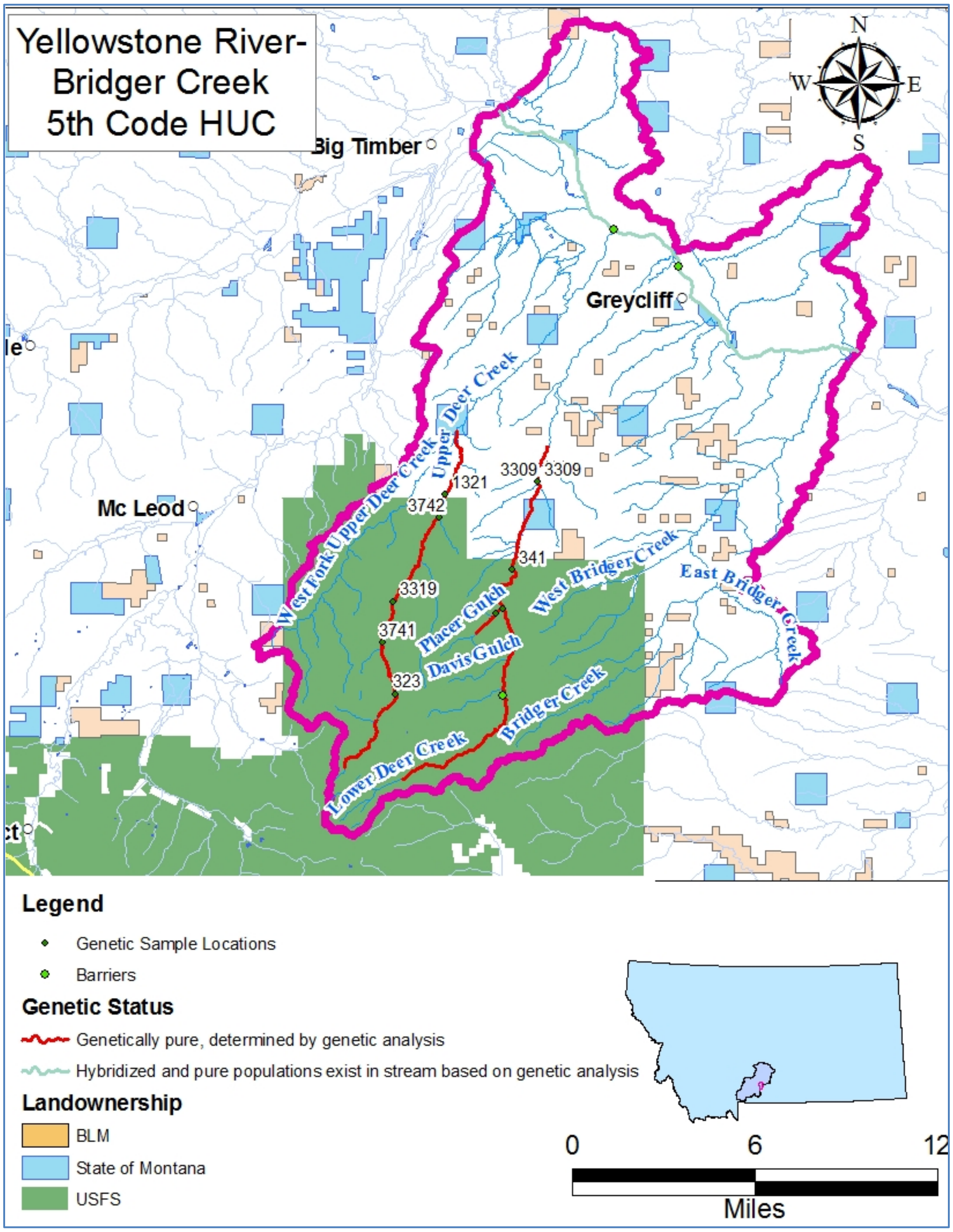

Figure 6-25: Yellowstone River-Bridger Creek 5th order HUC.

Species composition and relative abundance of fishes vary along the length of Upper Deer Creek (Table 6-45). The lower half of the watershed supports nonnative brook trout, brown trout, and rainbow trout, and native mountain whitefish. Yellowstone cutthroat trout are present in the upper half of the main stem of Upper Deer Creek, although brook trout and brown trout outnumber Yellowstone cutthroat trout in most of this reach. All Yellowstone cutthroat trout tested in the upper reaches have been nonhybridized (Table 6-46), making this a core population.

Table 6-45: Distribution and abundance of fishes in Upper Deer Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	21	Brook trout	Common	Year-round resident	N/A	N/A	NSPJ
0	11	Brown trout	Common	Year-round resident	N/A	N/A	EFSSO
0	10	Mountain whitefish	Rare	Year-round resident	N/A	N/A	NSPJ
0	10	Rainbow trout	Unknown	Year-round resident	N/A	N/A	EFSSO
9.7	21	Yellowstone cutthroat trout	Rare	Unknown	Resident	Nonhybridized	NSPJ

Table 6-46: Summary of genetic analyses conducted in Upper Deer Creek (MFISH database). .

Sample No.	*Sample Size*	*Percent*	*Collection Date*	*Target Species*
3741	19	100	07/10/2008	YCT
3742	9	100	07/10/2008	YCT
3319	9	100	10/02/2006	YCT
1321	10	100	08/12/1998	YCT
323	26	100	08/15/1989	YCT

Dominance of nonnative salmonids presents a threat to the persistence of Yellowstone cutthroat trout in the Upper Deer Creek drainage. As a nonhybridized population, securing these fish is consistent with the highest priority for Yellowstone cutthroat trout in Montana (MCTSC 2007). Conservation planning to protect the remaining Yellowstone cutthroat trout in Upper Deer Creek has begun, and implementation of some actions is underway. Suppression of brown trout and brook trout began in 2009, with the goal of reducing pressure on Yellowstone cutthroat trout in the upper watershed.

Construction of a barrier to prevent upstream movement of nonnative fishes is a possible future action. Several potential sites for barrier construction are in the running. A site downstream of the GNF boundary has the advantage of providing many miles of habitat for Yellowstone cutthroat trout; however, the expense of spanning the wide floodplain may be cost prohibitive. One or more sites upstream provide the lateral wall confinement that increases the suitability for barrier construction, although barriers at these locations would provide considerably less habitat for Yellowstone cutthroat trout. Future planning will include cost and benefit analyses of barrier construction at various sites.

Chemical removal of nonnatives would be the next possible step, and resident Yellowstone cutthroat trout would be salvaged before treatment. The combination of barrier construction and removal of nonnatives, with reintroduction of salvaged Yellowstone cutthroat trout, would result in secured habitat for a locally adapted, nonhybridized population of Yellowstone cutthroat trout.

Historically, Upper Deer Creek potentially supported a spawning run of fluvial Yellowstone cutthroat trout from the Yellowstone River; however, no significant run has been documented in recent times. Chronic dewatering in the lower reaches is likely a limiting factor. Low flows during the summer months relate to irrigation demands, although natural dewatering through subsurface losses is also likely. The rarity of Yellowstone cutthroat trout in the neighboring portions of the Yellowstone River relates in part to a lack of suitable tributary spawning habitat, so finding opportunities to promote in-stream flows would have considerable conservation value. The potential for maintaining flow through the summer months is unknown. FWP will seek opportunities to work with water rights holders in promoting voluntary practices that increase water use efficiency, and allow savings to be left in Upper Deer Creek.

6.2.43 Lower Deer Creek

Lower Deer Creek (Figure 6-25) flows for approximately 25 miles and enters the Yellowstone River near Greycliff, MT. About half of Lower Deer Creek's length is in the GNF. The remainder flows through private lands and one state-owned section.

Fish species present in Lower Deer Creek include brown trout and Yellowstone cutthroat trout (Table 6-47). The MFISH database lists brook trout as potentially being present in the lower portions of stream; however, no survey data are available to confirm this. Although not currently included in MFISH, mottled sculpin are also present, and extend into reaches within the GNF at low numbers.

Table 6-47: Distribution and abundance of fishes in Lower Deer Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	19	Brook trout	Common	Year-round resident	N/A	N/A	NSPJ
0	19	Brown trout	Common	Year-round resident	N/A	N/A	NSPJ
9	24	Yellowstone cutthroat trout	Common	Unknown	Resident	Nonhybridized	EFSSO

Lower Deer Creek is intermittent for several miles before its confluence with the Yellowstone River. Irrigation withdrawals and the presence of a losing reach in the lower miles contribute to a lack of flow during much of the summer. This intermittency presents a partial barrier to fish movement and limits the potential for a fluvial run of Yellowstone cutthroat trout into Lower Deer Creek. Brown trout dominate the lower reaches and, until recently, brown and Yellowstone cutthroat trout occupied areas from immediately below the GNF boundary extending upstream to a natural barrier waterfall several miles within National Forest. Three fish-bearing tributaries, Placer Gulch, Davis Gulch, and West Fork Lower Deer Creek, are within the National Forest. The lower reaches of these streams are important spawning and rearing areas for Yellowstone cutthroat trout (J.R. Wood, FWP, personal communication).

Lower Deer Creek has been the subject of an extensive Yellowstone cutthroat trout conservation effort that included establishment of replicated populations, barrier construction, Yellowstone cutthroat trout salvage, establishment of replicate populations and piscicide treatment. These actions were the result of discovery of hybrids several miles downstream of the GNF boundary in 2005. These fish were first generation backcrosses (Leary 2006), meaning their grandparents were a nonhybridized Yellowstone cutthroat trout and a rainbow trout. This crossing is typical of early stage of invasion, which spurred FWP and the GNF to action, consistent with the conservation objective of securing nonhybridized populations. Subsequent sampling found rapid upstream invasion of hybridized fish, with hybrids found close to Placer Gulch by 2010 (J.R. Wood, FWP, personal communication).

6.2.44 Bridger Creek

Bridger Creek (Figure 6-25) marks the downstream extent of the upper Yellowstone HUC. Its waters originate on the north flank of the Beartooth Mountains, within the GNF. Most of its length is within private land, although state-owned sections and BLM lands are interspersed throughout the valley portions.

Little information is available on fish species composition and distribution in Bridger Creek. Species presumed present include brook trout, brown trout, and rainbow trout, although no data are available to verify this presumption (Table 6-48). Filling these data gaps is the conservation priority for Bridger Creek. The findings will guide development of conservation plans to restore or secure Yellowstone cutthroat trout in the watershed.

Table 6-48: Distribution and abundance of fishes in Bridger Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	13	Brook trout	Common	Year-round resident	N/A	N/A	NSPJ
13	22	Brook trout	Abundant	Year-round resident	N/A	N/A	NSPJ
0	13	Brown trout	Rare	Year-round resident	N/A	N/A	NSPJ
0	12	Rainbow trout	Rare	Year-round resident	N/A	N/A	NSPJ

Dewatering presents a probable constraint on the fishery in the lower portion of Bridger Creek, and may limit the occurrence of a spawning run of Yellowstone cutthroat trout into this stream. Low flows likely relate to irrigation demands and the losing nature of the stream when it encounters the Yellowstone River alluvium. The feasibility of increasing in-stream flow through implementation of voluntary practices that improve water use efficiency is unknown. FWP will work with interested water rights holders to explore potential projects.

6.2.45 Unmapped Spring Creeks

Near Big Timber, several unmapped spring creeks have potential to provide spawning habitat for fluvial Yellowstone cutthroat trout. These include Esp Spring Creek, Kickabuck Spring Creek, and Milligan Slough. As they maintain adequate flow of cool water throughout the summer months, these streams have potential to provide spawning habitat for fluvial Yellowstone cutthroat trout, and augment fish numbers in this portion of the Yellowstone River. Additional investigation may uncover more streams presenting conservation potential.

Esp Spring Creek was the subject of a restoration project in 1999. Conservation actions included replacement of a perched culvert, installation of riparian fencing and off-channel water, movement of a corral away from the stream, and restoration of 1,000 feet of channel. Yellowstone cutthroat trout fry were imprinted on the stream to establish a spawning run. This imprinting was unsuccessful, as no spawners returned to Esp Spring Creek.

Several factors may have contributed to the failure of Yellowstone cutthroat trout to establish a spawning run in Esp Spring Creek. First, the stream may not have been accessible during the cutthroat trout spawning period. Esp Spring Creek enters the Yellowstone River from a terrace, and drought in subsequent years may have not provided a spring peak of sufficient magnitude to allow fish access to the stream. The available brood stock may also be related to the failure of Yellowstone cutthroat trout to return to Esp Spring Creek. The fry imprinted on the stream were not of a fluvial strain, and may have lacked the genetic predisposition to home to their natal stream. Likewise, conditions in the Yellowstone River may have been unsuitable for fry to survive to reproductive age. Warm water temperatures during continued drought, combined with predation pressure, may have resulted in the demise of imprinted fish.

Potential conservation actions for Esp Spring Creek include investigations into accessibility of this stream during the Yellowstone cutthroat trout spawning period. If Esp Spring Creek is accessible, re-imprinting Yellowstone cutthroat trout from a fluvial strain may be an option to establish a spawning run.

In 2009, another spring creek enhancement project created about 1,400 feet of high quality spawning habitat on Kickabuck Spring Creek, known locally as Thompson Spring Creek. This stream consisted of a relatively straight channel lacking pools and substrate suitable for spawning. Enhancement involved construction of a new channel, which nearly doubled stream length, and importation of spawning gravel to line the new bed. Imprinting of fry obtained from fluvial brood stock is a potential, future conservation action for Kickabuck Spring Creek.

Milligan Slough is a third spring creek with potential to provide spawning habitat. Currently, much of Milligan Slough is overly wide, and fine sediment dominates the streambed (Endicott 2007). Conservation actions appropriate for this stream would include channel restoration, grazing management, and riparian plantings. FWP will seek opportunities to work with landowners on implementation of conservation activities along Milligan Slough.

6.3 Shields River (HUC 10070003)

The Shields River (Figure 6-26) watershed encompasses approximately 289,000 acres and flows into the Yellowstone River, east of Livingston, Montana. The Shields River valley is primarily agricultural, with irrigated crops, pasture, and rangeland being major land uses. Forest occupies the higher elevations, with timber harvest, livestock grazing, and recreation being common in these areas.

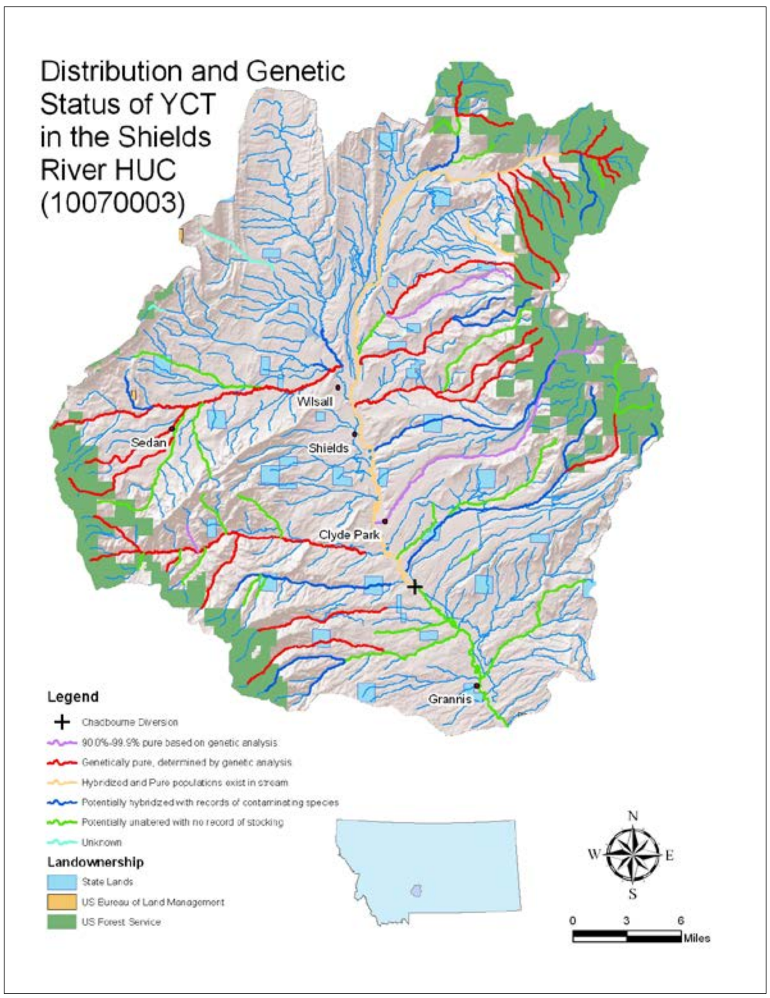

Figure 6-26: Shields River Subbasin (HUC 10020003).

The Shields River watershed (Figure 6-27) provides substantial habitat for Yellowstone cutthroat trout, and this species is still widely distributed throughout the basin's waters. Most of the subpopulations show a high degree of genetic integrity, with nonhybridized populations still occupying a substantial number of stream miles, and hybridized subpopulations having less than 10% rainbow trout alleles.

The spatial focus of this strategy is the Shields River watershed downstream of the Chadbourne diversion (Figure 6-27). The Chadbourne diversion was built in 1908, and was likely an impediment to fish passage historically, although it may not be a complete barrier currently (OASIS 2006). The Chadbourne diversion makes a logical management divider because it has functionally isolated the Yellowstone cutthroat trout upstream from potential genetic introgression with rainbow trout. FWP and its partners have addressed the watershed above this feature in a separate conservation strategy (FWP et al. 2012).

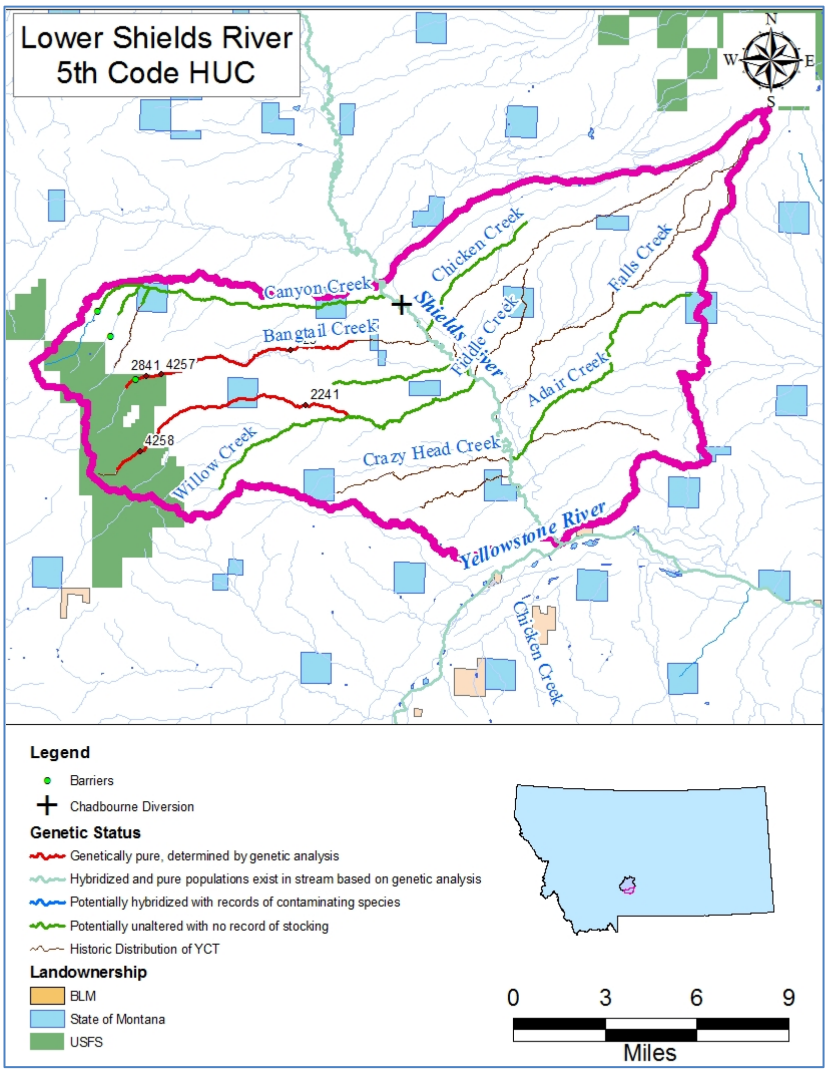

Figure 6-27: Lower Shields River 5th order HUC.

Although Yellowstone cutthroat trout still occupy a considerable portion of their historic range in the Shields River watershed, numerous threats to their persistence still exist. Brook trout are invading new streams and in places are rapidly displacing Yellowstone cutthroat trout. Brown trout are also present in many streams and have potential to eliminate Yellowstone cutthroat trout through competition and predation. Brown trout pose less of a risk to Yellowstone cutthroat trout than rainbow trout and brook trout, although brown trout tend to displace native fish in lower elevation streams (Behnke 1992; de la Hoz Franco and Budy 2005; Wood and Budy 2009) ,and this tendency appears to hold true for brown trout and Yellowstone cutthroat trout in the Shields River. In the portion of the watershed downstream of the Chadbourne Diversion, few barriers prevent invasion of rainbow trout, making loss of remaining nonhybridized populations and continued genetic contamination of slightly hybridized populations a significant threat.

Reduced stream flow from irrigation diversion is among the factors limiting suitability of streams to support Yellowstone cutthroat trout in the planning area. Within this planning area, FWP lists three streams as dewatered (Table 6-49). FWP has in-stream flow reservations only for the Shields River. These reservations were based on the percent exceedance approach, which has been replaced by the wetted perimeter approach (Leathe and Nelson 1989). Two key components to the strategy for addressing the effects of dewatering in the basin’s streams will be to determine minimum recommended flows, and identify opportunities to improve water-use efficiency though voluntary implementation of conservation measures.

Table 6-49: FWP’s dewatered stream list for the lower Shields River watershed (MFISH database).

Stream Name	***Tributary To***	***Begin River Mile***	***End River Mile***	***Dewatering Class***
Bangtail Creek	Shields River	0	5	Chronic Dewatering
Shields River	Yellowstone River	0	65	Periodic Dewatering
Willow Creek	Shields River	0	12	Chronic Dewatering

Locally led conservation has been substantial in the Shields River watershed, with the Shields Valley Watershed Group, private landowners, and agencies collaborating on a numerous projects on the main stem and in tributaries. The progenitor of the current watershed group originally organized to address Yellowstone cutthroat trout conservation, as well as other concerns in agricultural watersheds, such as weed control. The group has completed planning efforts that will benefit Yellowstone cutthroat trout, including development of a watershed restoration plan to reduce loading of nonpoint-source sediment from roads, hillslopes, and bank erosion. This sediment reduction plan is part of the total maximum daily load (TMDL) plan developed through the Montana Department of Environmental Quality (DEQ 2009), a requirement of the Clean Water Act.

6.3.1 Shields River

Approximately 16 miles of the Shields River (Figure 6-27) is within the area covered by this conservation strategy. Landownership is almost entirely private, with the exception of small parcels of state-owned land, including a fishing access site. Agriculture, including livestock grazing and production of small grains and forage crops, is the primary land use, although residential development is considerable and is likely to expand.

Fish community composition reflects its connectivity with the Yellowstone River, and includes nonnative brown trout and rainbow trout, in addition to members of the native fish assemblage (Table 6-50). Yellowstone cutthroat trout are rare in this part of the river, and rainbow trout × Yellowstone cutthroat trout hybrids are likely present.

Table 6-50: Distribution and abundance of fishes in the Shields River (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	33	Brown trout	Common	Year-round resident	N/A	N/A	EFMSO
0	21	Longnose dace	Common	Year-round resident	N/A	N/A	NSPJ
0	33	Longnose sucker	Abundant	Year-round resident	N/A	N/A	EFSSO
0	63	Mottled sculpin	Common	Year-round resident	N/A	N/A	EFSSO
0	33	Mountain sucker	Common	Year-round resident	N/A	N/A	NSPJ
0	33	Mountain whitefish	Abundant	Year-round resident	N/A	N/A	EFMSO
0	33	Rainbow trout	Rare	Year-round resident	N/A	N/A	EFMSO
0	2	Rainbow × cutthroat trout	Unknown	Unknown	Unknown	N/A	EFSSO
0	33	White sucker	Common	Year-round resident	N/A	N/A	NSPJ
0	13	Yellowstone Cutthroat Trout	Rare	Unknown	Resident	Potentially unaltered with no record of stocking	EFSSO
0	13	Yellowstone cutthroat trout × rainbow	Rare	Year-round resident	Resident	N/A	NSPJ

FWP regularly monitors fish populations in three sections of the Shields River, and the Convict Grade monitoring reach is within the area covered by this strategy. Yellowstone cutthroat trout have not been especially abundant in the Convict Grade section in the recent past, and their numbers are in decline (Figure 6-28). Yellowstone cutthroat trout were most abundant during sampling efforts in the 1970s through the mid-1980s. During the remainder of the 1980s, Yellowstone cutthroat trout were exceptionally rare to absent. Their numbers have fluctuated since the early 1990s, but have not returned to levels seen in the 1970s and 1980s.

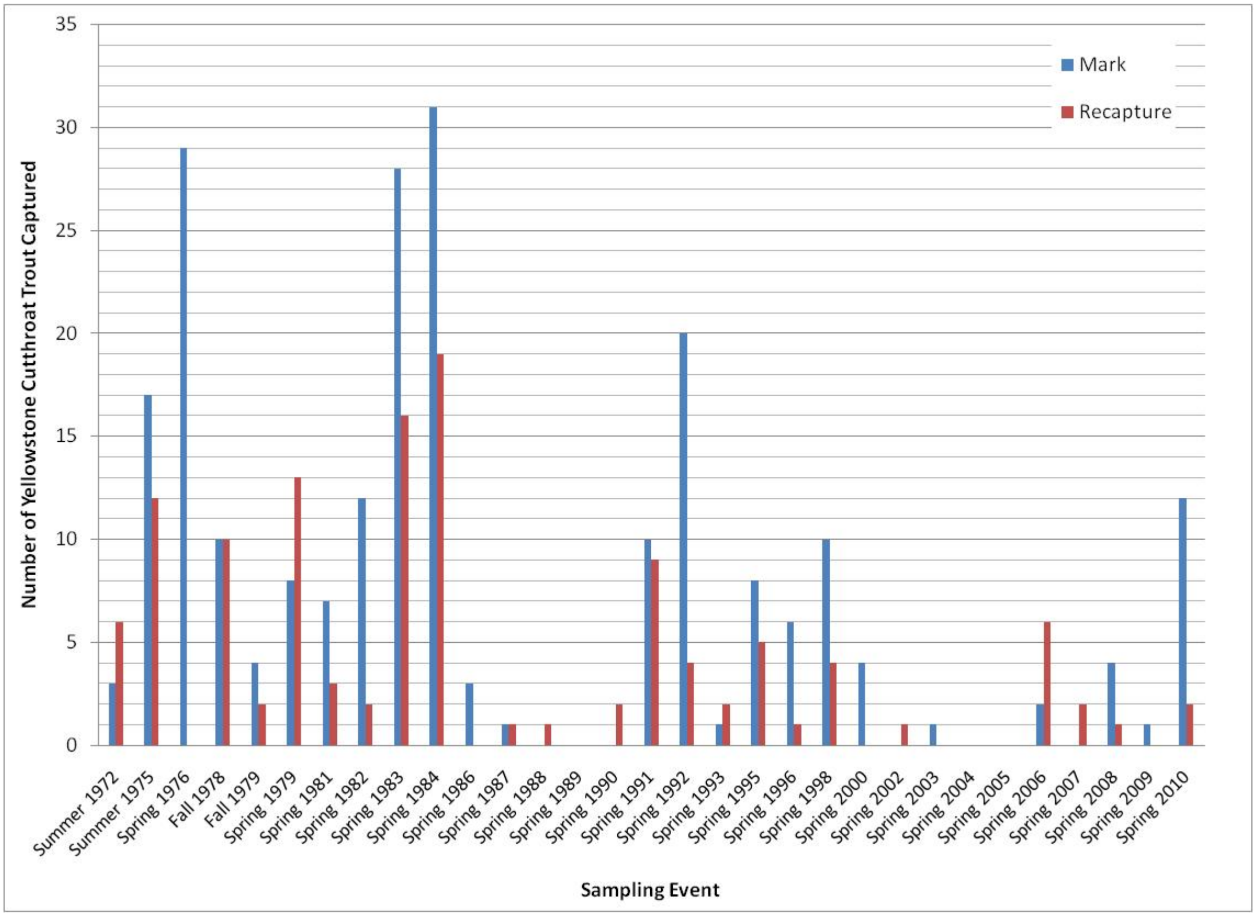

Figure 6-28: Number of Yellowstone cutthroat trout captured during mark-recapture sampling events in the Convict Grade monitoring section, Shields River (data from FWP, Livingston Fisheries Office files).

Comparison of abundance of Yellowstone cutthroat trout in the Convict Grade section to other games species underscores their rarity in the lower Shields River (Figure 6-29). Population estimates reported in MFISH indicates mountain whitefish is the numerically dominant species, with a median population estimate of about 2,650 fish per mile for the 3 years with a reported population estimate. Brown trout ranged from an estimated 164 to 875 fish per mile, and averaged nearly 360 fish per mile over 13 years. Rainbow trout population estimates were similar to those for brown trout, averaging about 420, and ranging from 127 to 852 fish per mile for the 8 years with reported population estimates. Low numbers of Yellowstone cutthroat trout precluded calculation of a population estimate in most years. In 1984, sufficient Yellowstone cutthroat trout were captured to allow calculation of a population estimate, which yielded an estimate of fewer than 70 fish per mile.

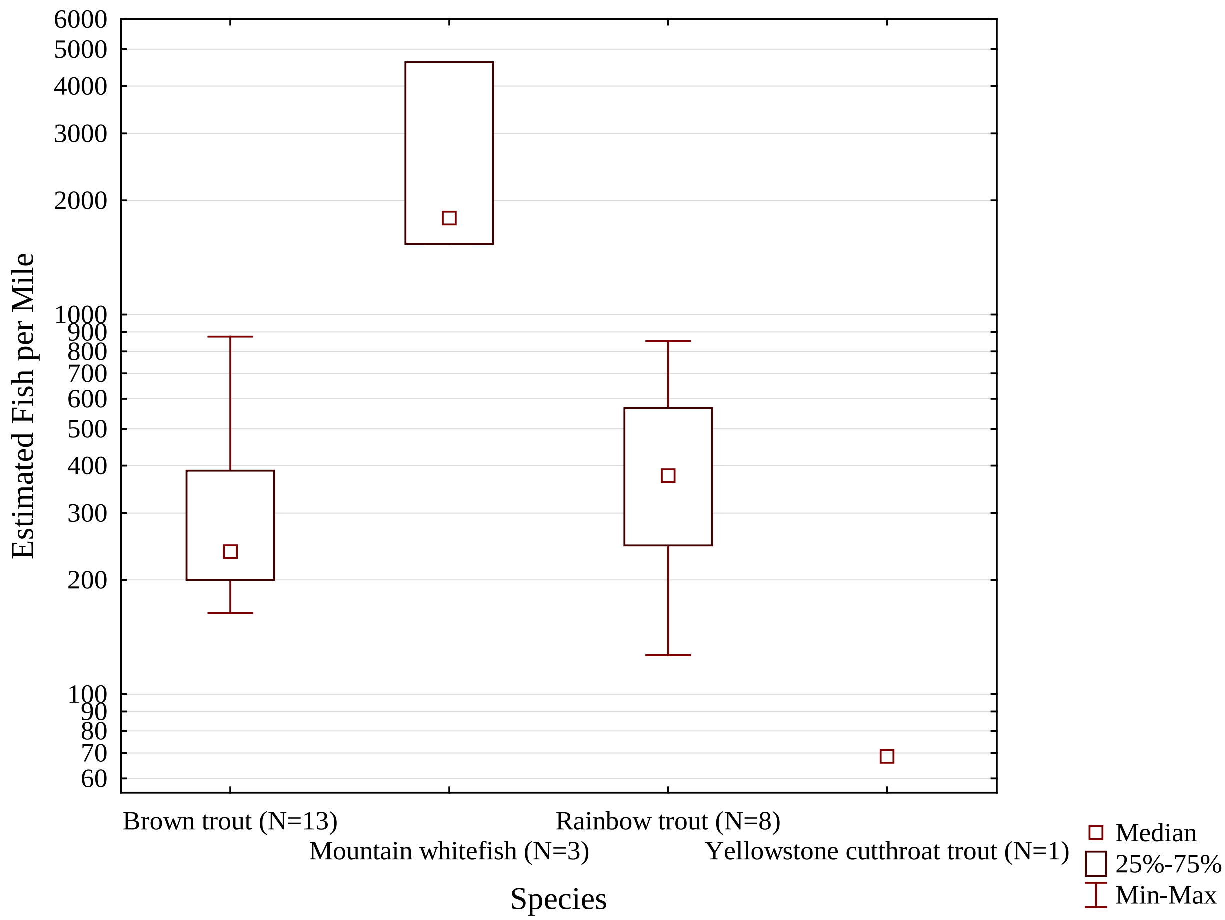

Figure 6-29: Comparisons of estimated fish per mile for salmonids captured in the Convict Grade monitoring section (MFISH database).

Probable causes for the low numbers of Yellowstone cutthroat trout in the lower Shields River include presence of nonnatives and potentially a lack of suitable spawning habitat in the adjacent tributaries. Low stream flows through the summer months likely have negative effects on habitat availability and water temperature, although irrigation return flows may mitigate thermal loading associated with dewatering.

Temperature data from the USGS provide a means to evaluate thermal regime in this reach of the Shields River. The USGS has been monitoring daily temperatures at their gage station since the late 1990s. This gage is about 1 mile from the mouth of the Shields River, within the area covered in this conservation strategy.

Ideally, interpretation of temperature data uses thermal tolerances and optima developed for the target species. These values have not yet been determined for Yellowstone cutthroat; however, a thermal study on the closely related westslope cutthroat trout provides a surrogate in evaluating potential thermal stress to Yellowstone cutthroat trout (Bear et al. 2007). This study identified 19.6 °C (67 °F) as the upper incipient lethal temperature (UILT) for westslope cutthroat trout, which is the temperature at which 50% of a test population survives for 60 days of exposure. Optimum temperatures were those where peak growth occurred and were between 13 and 15 °C (55 and 59 °F). Although a number of factors limit the certainty in applying the optima and UILT to Yellowstone cutthroat trout, this study is the best information we have currently to evaluate habitat suitability relating to temperature and the potential for thermal stress.

One consideration in the use of this research for Yellowstone cutthroat trout is that incidental observations suggest Yellowstone cutthroat trout may be less sensitive to thermal loading than westslope cutthroat trout (B.B. Shepard, Wildlife Conservation Society, personal communication). Furthermore, this investigation examined one life history stage (age-0 fish), and older fish may vary in their thermal optima or tolerance. Nevertheless, application of westslope cutthroat trout values to Yellowstone cutthroat trout provides a conservative approach to conserving Yellowstone cutthroat trout in face of uncertainty over thermal tolerances and optima for the subspecies. Conclusions drawn from the available data will acknowledge the considerable uncertainty.

Another important consideration in interpreting thermal optima is that this is the range where fish experience peak growth in the laboratory, but does not suggest that Yellowstone cutthroat trout cannot thrive in waters where the mean or maximum daily temperatures exceed this range. In nature, optimal conditions of various types may occur during relatively brief windows for many species. Moreover, these laboratory studies hold temperatures steady with no daily variation, whereas stream temperatures show diel fluctuations following air temperatures and insolation of stream surfaces. Inclusion of the optimal ranges on the following figures is meant to be an informative comparison to measured optima, but does not imply that streams with mean or maximum temperatures that frequently exceed the thermal optima cannot support thriving populations of Yellowstone cutthroat trout.

The use of UILT as a measure of thermal stress brings similar limitations. In the laboratory, temperatures remain constant over the 60 days of exposure, and fish do not experience the natural, daily temperature fluctuations that would provide respite from warm daytime temperatures. Moreover, this study design does not account for inter-day variability, where some days will be cooler and others warmer. As the controlled laboratory study did not account for natural variation within and among days, interpretation of recorded temperatures should acknowledge the considerable uncertainty in applying these values to field conditions. Evaluation of the frequency of occurrences over optima and the UILT, and the degree to which temperatures exceed these levels, allows inference on the role of thermal regime in shaping

Yellowstone cutthroat trout distribution in the watershed and the potential for fish to experience thermal stress.

Another uncertainty associated with applying laboratory studies to field conditions is that it ignores fish behavior and movement relating to temperature. Fish are adept at finding upwellings of cooler groundwater within an otherwise warm stream. Alternatively, adult fish can move to other streams providing thermal refugia. Current research in the headwaters of the Shields River watershed is evaluating the role of temperature in shaping growth, brook trout invasion, and fish movement. Research of this type will provide a refined approach to evaluating how temperature shapes abundance, persistence, movement, and growth of Yellowstone cutthroat trout. Future iterations of this strategy will incorporate new research as a means to conserve Yellowstone cutthroat trout in the Shields River watershed, and elsewhere within their historic range.

Application of criteria prescribed in FWP's drought management policy for fishing closures provides another approach to evaluating suitability of temperature to support cold-water fisheries (FWP 2007). According to the policy, daily maximum water temperature thresholds reaching or exceeding 73 °F (23 °C) during three consecutive days triggers a fishing closure. This analysis examined the number of periods meeting fishing closure thresholds, and the maximum number of consecutive days equaling or exceeding 73 °F.

Evaluation of daily maximum temperatures (Figure 6-30) at the USGS gage station record suggests the lower main stem has a thermal regime potentially unfavorable to the of Yellowstone cutthroat trout in most summers. From 2000 to 2008, maximum daily temperatures occurring from July through August equaled or exceeded the UILT for westslope cutthroat trout on a majority of days, which suggests some thermal stress to Yellowstone cutthroat trout. The frequency of days in which temperatures exceeded the UILT was often substantial, with maximum daily temperatures greater than 70 °F on most of days in some years. Data were not available for 2007; however, during this exceptionally dry and warm year, water temperatures were likely less suitable for support of cold-water fisheries, especially sensitive Yellowstone cutthroat trout. The thermal regime was slightly less stressful to Yellowstone cutthroat trout in 2009 and 2010, with just under half of days reaching temperatures greater than the UILT for westslope cutthroat trout. In 2011, snowpack was at, or near, record levels, and maximum water temperatures rarely exceeded the UILT; however, data were available for July only, so late summer water temperatures are unknown.

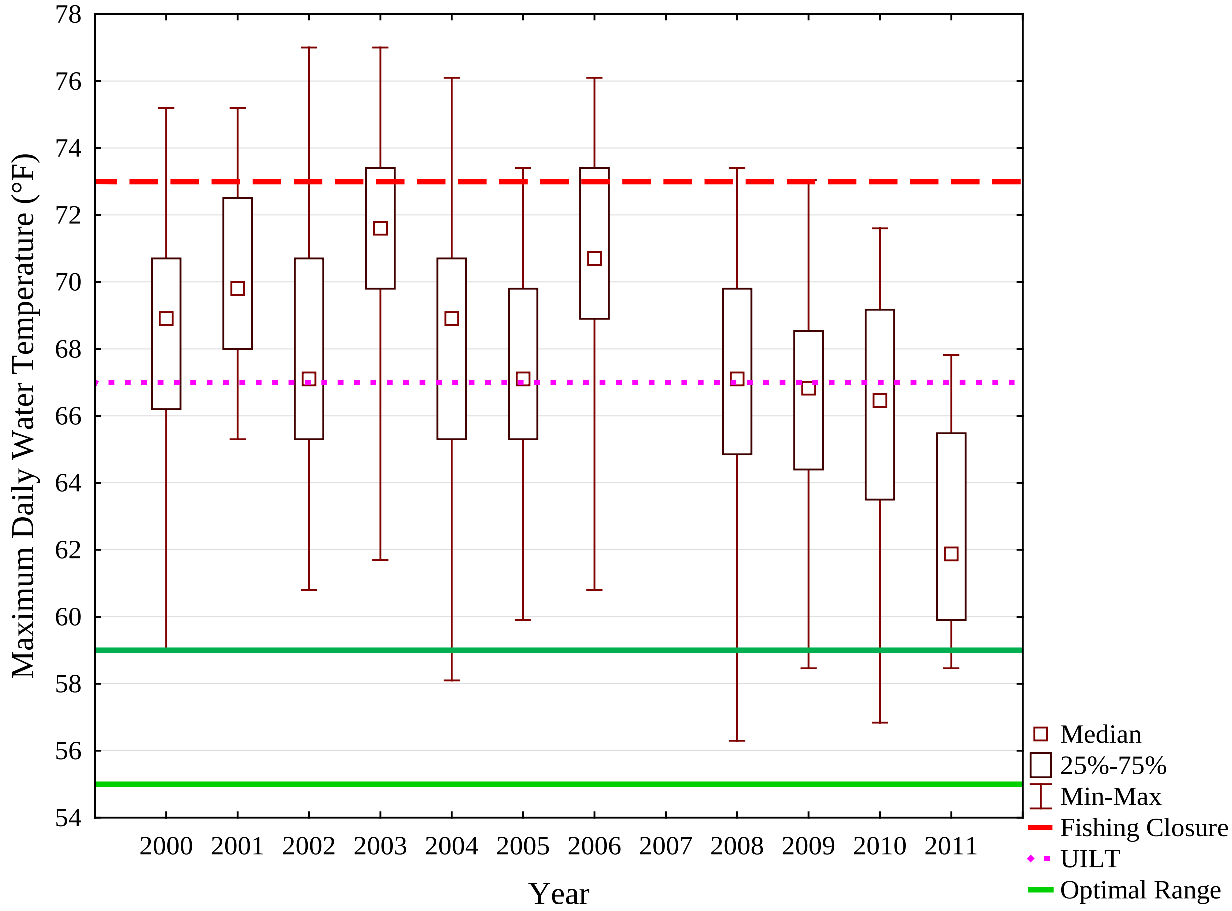

Figure 6-30: Distributional statistics for maximum daily water temperatures measured at USGS gage station 6195600 during July and August for the period of record, and comparison to thermal optimum (55 °F to 59 °F) and UILT (67 °F) of westslope cutthroat trout and drought closure criteria (> 3 days at 73 °F).

Mean daily temperatures (Figure 6-31) reflect maximum temperatures and cooling in the evening and nighttime hours. In most years, mean daily temperatures typically exceeded the optimal range and even the UILT on several occasions. The exception was 2011, when on the majority of days the mean daily temperature was within the optimal range. These data cover only July temperatures, so no inference is possible for temperatures during August. Overall, these results indicate that in most years, warm water temperatures were possibly a limiting factor for Yellowstone cutthroat trout, and negatively affected the suitability of this habitat for Yellowstone cutthroat trout during the summer months. As noted above, these values of thermal optima and UILT do not reflect field conditions, diel fluctuations in stream temperature, and were not developed specifically for Yellowstone cutthroat trout.

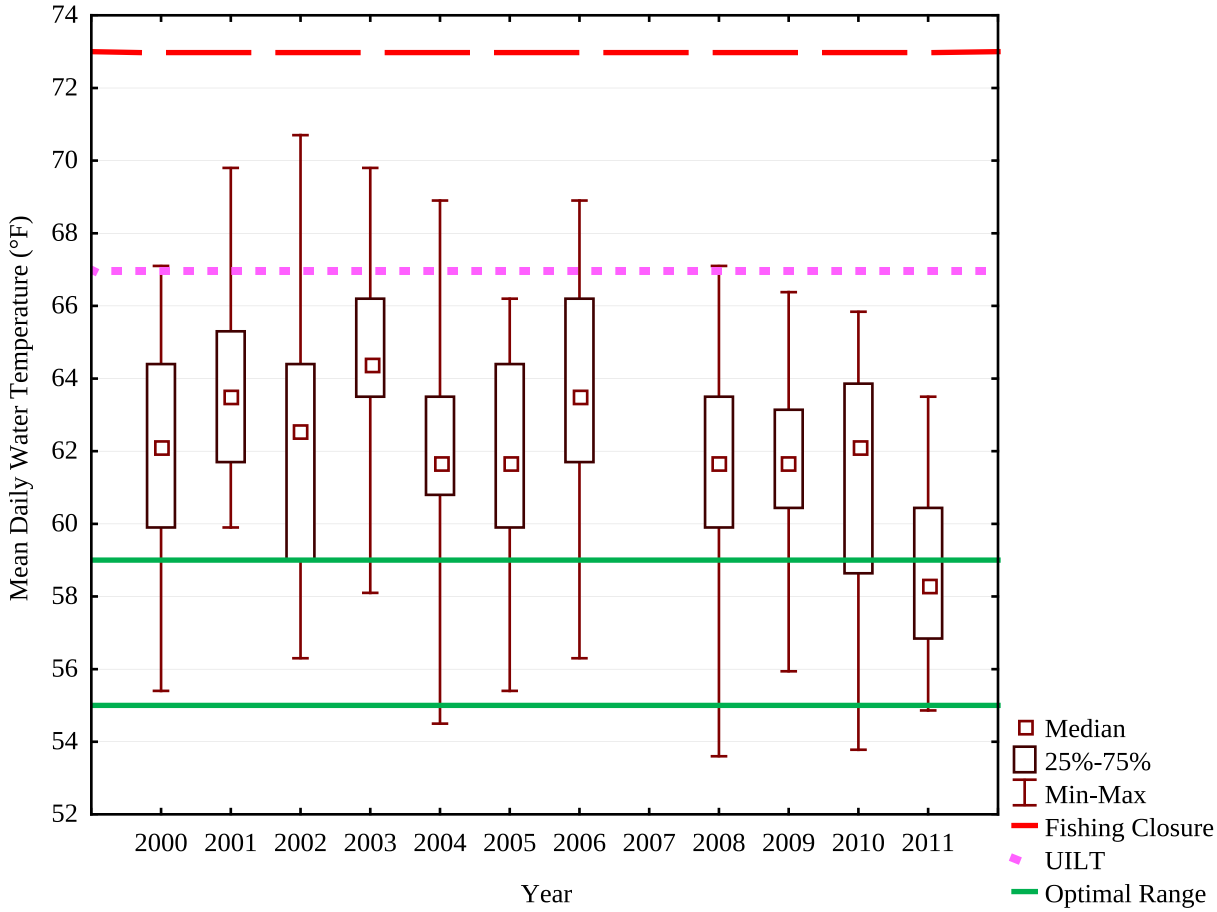

Figure 6-31: Distributional statistics for mean daily water temperatures measured at USGS gage station 6195600 during July and August, from 2000 through 2011, and comparison to thermal optimum and tolerances of westslope cutthroat trout.

Comparisons of average and maximum daily temperatures (Figure 6-32) at the gage station near the mouth of the Shields River indicate they were highly correlated, with a correlation coefficient of 0.93. Although a substantial number of maximum daily temperatures fell above the fishing closure threshold of 73 ^{o}F, cooler temperatures during evening through morning resulted in average temperatures that were less than the UILT, suggesting fish get respite from peak water temperatures. Evaluation of the number of hours a fish can survive temperatures 73 ^{o}F or greater, while controlling for cooler parts of the day, would be informative in setting goals for water temperature that provide for support of Yellowstone cutthroat trout as a beneficial use.

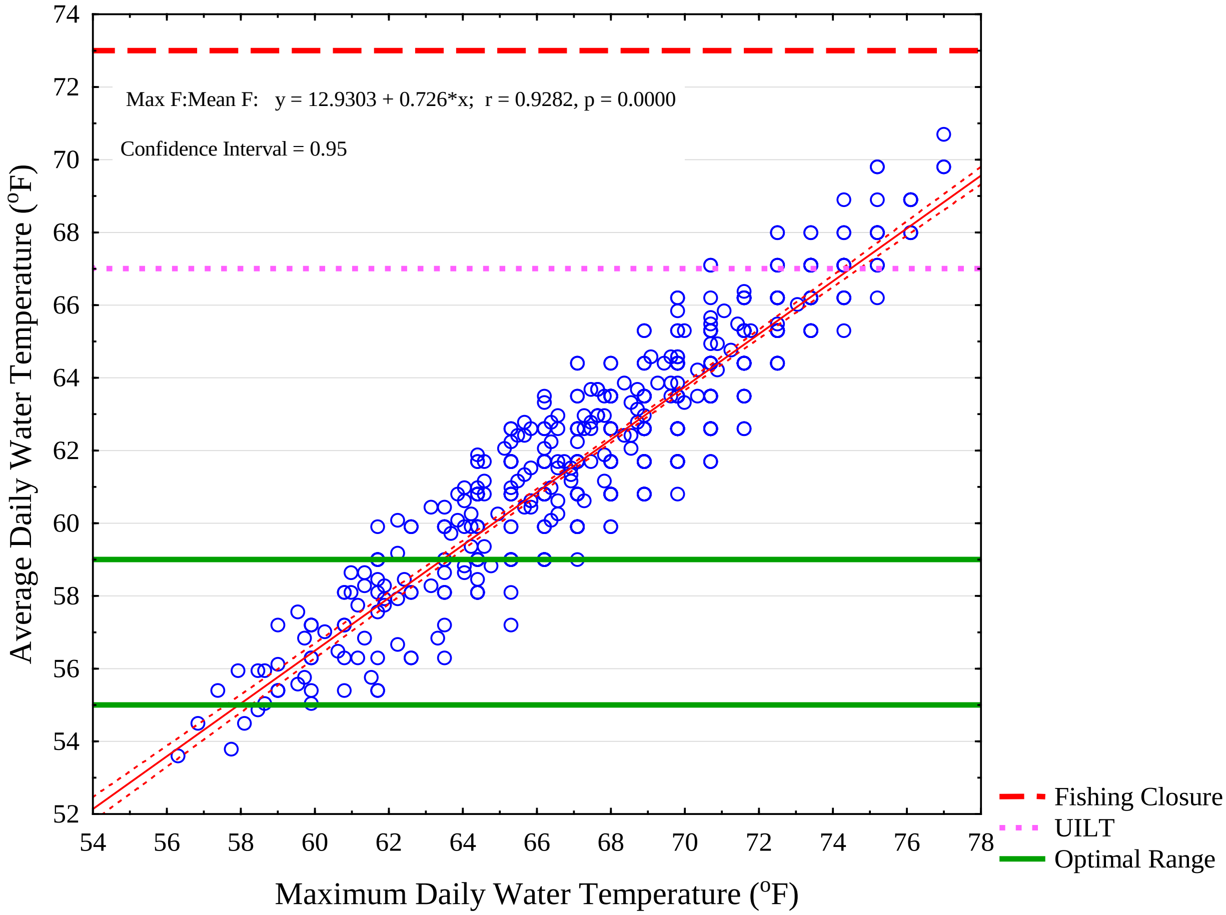

Figure 6-32: Comparison of average and maximum daily temperatures from USGS gage station 6195600.

Application of FWP fishing-closure-policy triggers to monitoring data at the USGS gage station indicates at least one fishing closure was warranted in five of eight years (Table 6-51). The number of periods with temperatures exceeding the threshold was variable, from 1 to 4. In some years, maximum daily temperatures exceeded 73 °F for extended periods. For example, maximum daily temperatures exceeded 73 °F for 13 consecutive days in 2003, and 10 days in 2006.

Table 6-51: Number of qualifying occasions triggering a fishing closure (maximum daily temperature ≥ 73 ° for 3+ consecutive days), and maximum number of consecutive days ≥ 73 °F for water temperatures measured at USGS gage station 6193500.

Year	*Number of Occasions Triggering Fishing Closure*	*Maximum Number of Consecutive Days exceeding 73 °F*
2000	0	2
2001	4	4
2002	1	4
2003	2	13
2004	1	4
2005	0	1
2006	2	10
2008	0	1
2009	0	1
2010	0	0
2011	0	0

Water demands for irrigation and other agricultural uses in the Shields River are considerable, and water reservations to support fisheries are typically junior rights. Nonetheless, opportunities may exist to increase in-stream flows through implementation of voluntary improvements in water-use efficiency and potentially compensating water rights holders for contributing to in-stream flows.

One of the goals of Yellowstone cutthroat trout conservation agreement (MCTSC 2007) includes maintaining the diversity of life histories represented by remaining cutthroat trout populations. Although information on habitat use and movements of Yellowstone cutthroat trout occupying the lower Shields River is lacking, these fish are likely fluvial migrants that move between the Shields and Yellowstone rivers (S.T. Opitz, FWP, personal communication). Fluvial migrants are especially vulnerable to dewatering in tributary streams, and efforts that maintain in-stream flows through the incubation and drift periods provide enormous benefit. Efforts to conserve this life history strategy should be similar to actions for the Yellowstone River, with an emphasis on identifying potential spawning streams, and working towards solutions that are compatible with agricultural production while increasing the efficiency of water use.

6.3.2 Bangtail Creek

Bangtail Creek (Figure 6-27) is the only named stream in the Bangtail Creek drainage, and joins the Shields River downstream of the Chadbourne diversion. Bangtail Creek originates in the GNF, but most of its length flows through privately owned lands.

Bangtail Creek supports native Yellowstone cutthroat trout and mottled sculpin, and nonnative brook trout (Table 6-52). Brook trout have been present in the creek for decades. According to fish stocking records maintained by FWP, over 15,000 brook trout fry have been stocked in Bangtail Creek, beginning in the 1920s and extending through the 1960s. Efforts to establish a brown trout population involved stocking of 39,000 fry. Despite this level of stocking, brown trout did not become established in Bangtail Creek.

Table 6-52: Distribution and abundance of fishes in Bangtail Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	13	Brook trout	Common	Year-round resident	N/A	N/A	EFMSO
0	13	Mottled Sculpin	Common	Year-round resident	N/A	N/A	NSPJ
3	12	Yellowstone cutthroat trout	Common	Unknown	Resident	Nonhybridized	EFMSO

A fisheries investigation conducted in 2001 (Shepard 2004) provides information on species composition and abundance at regular intervals along the length of Bangtail Creek (Figure 6-33). Brook trout were present at each sampling station. Yellowstone cutthroat trout were not captured in the lower 3 miles of Bangtail Creek, but were present at the next six sampling reaches. Brook trout outnumbered Yellowstone cutthroat trout at each location where they were sympatric, although some of these differences may not be statistically significant. GNF biologists sampled near river mile 8 in 2006 and river mile 10 in 2010, and found Yellowstone cutthroat trout were more abundant than brook trout (MFISH database).

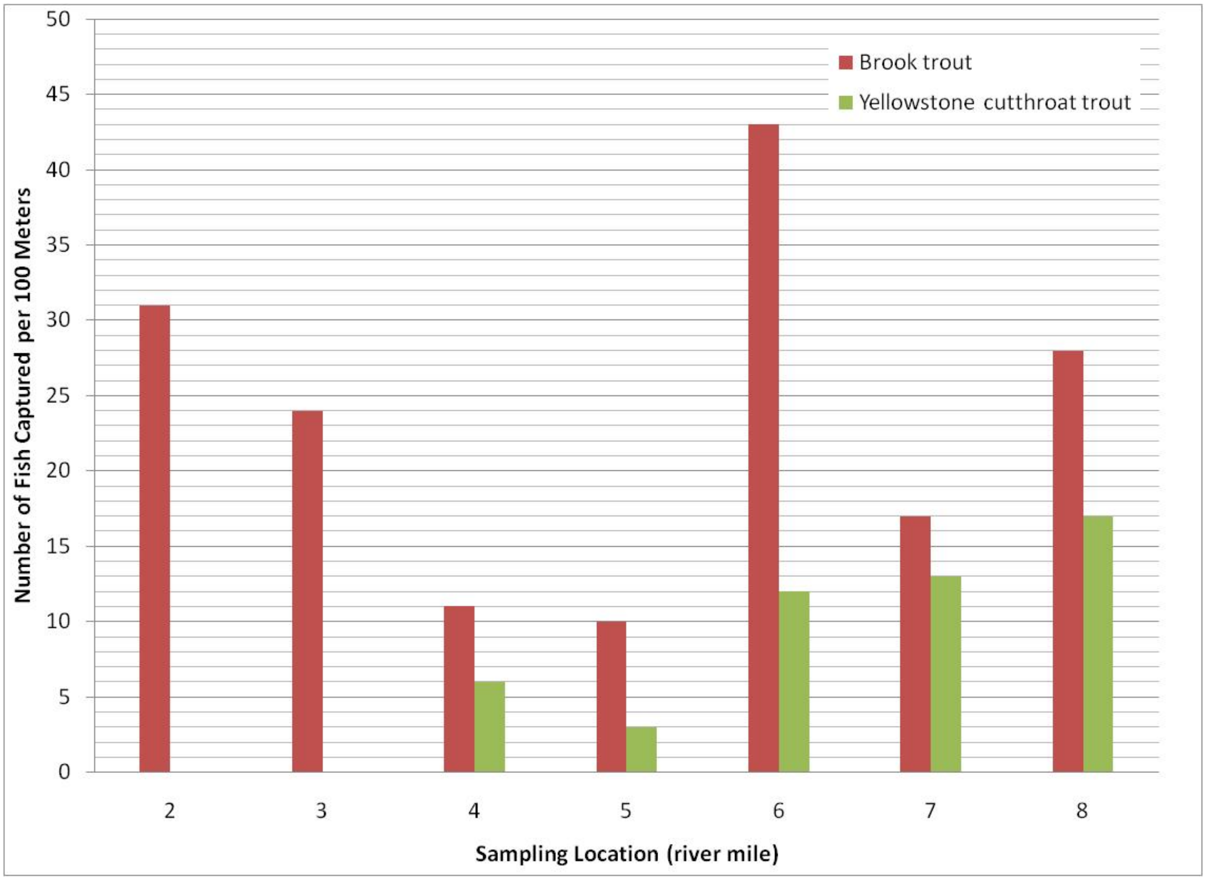

Figure 6-33: Population estimates for Yellowstone cutthroat trout and brook trout for sampling stations on Bangtail Creek (MFISH database).

Fish sampling near river mile 5 has occurred several times, beginning in the 1970s (MFISH database). Methods varied among these events, making comparisons of population estimates problematic. The proportion of the catch comprised by each species does allow inference on temporal trends. In 1974, Yellowstone cutthroat trout were the most abundant, and accounted for nearly 70% of trout captured (Figure 6-34: Percent of catch comprised by Yellowstone cutthroat trout and brook trout in fisheries investigations near river mile 5 on Bangtail Creek.

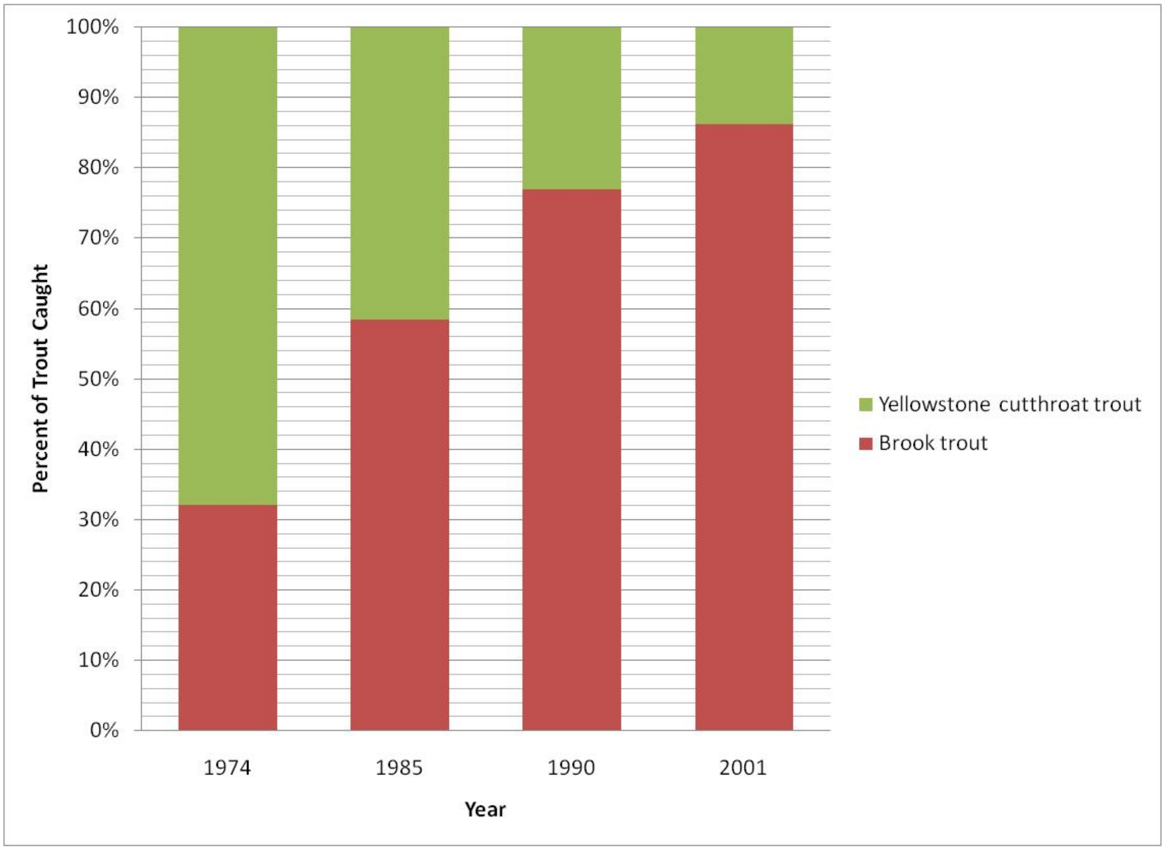

Figure 6-34: Percent of catch comprised by Yellowstone cutthroat trout and brook trout in fisheries investigations near river mile 5 on Bangtail Creek.

Genetic sampling of Bangtail Creek's Yellowstone cutthroat trout (Table 6-53) suggests slight hybridization, which may be of relatively recent origin. Samples collected in 1990 and 1999 showed no evidence of hybridization. In 2001, tissue from fish captured from several locations along Bangtail Creek tested as slightly hybridized, with 97.6% of alleles being Yellowstone cutthroat trout in origin. These samples also indicated first generation hybridization with rainbow trout was likely occurring at that time. Additional longitudinal genetic sampling throughout the stream would be useful to determine if hybridization is continuing and to document the distribution of hybridization along the stream. Depending on the results from the longitudinal genetic sampling, installation of a barrier to prevent spread of hybridization may be advisable.

Table 6-53: Summary of genetic analyses collected in Bangtail Creek (MFISH database).

Sample No.	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
2841	22	YCT	100	7/07/1999
423	12	YCT	100	8/07/1990
	24	YCT	97.6	7/16/2001

An on-stream reservoir presents the likely feature protecting Bangtail Creek's Yellowstone cutthroat trout population from a greater degree of hybridization. The dam is about 3 miles from the confluence with the Shields River, and sampling in 2001 found no Yellowstone cutthroat trout downstream of the barrier. Maintaining the structural integrity of this feature is a conservation priority for Bangtail Creek. Its failure or removal would allow the abundant rainbow trout in the lower Shield Rivers access to this refuge for native fish.

Fisheries investigations in 2001 (Shepard 2004) included observations of habitat quality, and factors that may limit fish populations. In the privately owned portions of Bangtail Creek, willows and grasses dominated the riparian vegetation, although some disturbance associated with livestock management were apparent. Fine sediment may be limiting fish recruitment in portions of the creek.

Temperature monitoring suggests relatively warm summer temperatures for a small stream (Shepard 2004). Average daily temperatures near river mile 5 were above the optimal range for westslope cutthroat trout (see Bear et al. 2007), and maximum daily temperatures often exceeded 68 °F, which may result in sublethal to lethal stress to cutthroat trout. As the lower five miles of Bangtail Creek experience chronic dewatering, low stream flows may be contributing to these relatively warm temperatures. Restoring riparian shrub canopy and increasing water use efficiency may be among the potential actions employed to improve this component of water quality.

The presence of nonhybridized and slightly hybridized Yellowstone cutthroat trout gives Bangtail Creek considerable conservation value, and protecting this population ranks as a high priority. Hybridization presents an immediate threat to the population, and additional investigation should guide development of specific actions to secure the nonhybridized fish. Brook trout present another threat to Yellowstone cutthroat trout, although cutthroats have been able to persist for several decades in sympatry with brook trout. Nonetheless, the available data suggest brook trout are displacing native cutthroat, indicating a need to intervene. Other potential actions to conserve Bangtail Creek's Yellowstone cutthroat trout relate to promoting compatibility of agricultural production with fisheries needs. FWP will seek opportunities to work with agricultural producers on voluntary practices that maintain economic viability while supporting these native fish.

6.3.3 Chicken Creek

Chicken Creek (Figure 6-27) originates in the Shields River valley near the foothills of the Crazy Mountains. Chicken Creek has no named tributaries, and flows for about eight miles before its confluence with the Shields River. Adjacent land uses include irrigated crop production and livestock grazing.

Fisheries information for Chicken Creek is limited to a single survey in 2002 (Shepard 2004). Low numbers of Yellowstone cutthroat trout were present in a reach about four miles from the mouth. No genetic data are available for this stream.

Habitat observations made during the fisheries investigation indicated relatively poor condition relating to extremely high levels of fine sediment covering the streambed, and little riparian cover. Factors contributing to degraded habitat include naturally erosive soils and incompatible livestock management. Aerial imagery for Chicken Creek indicates reduced riparian cover occurs along considerable portions of the creek. Implementation of grazing BMPs, along with development of off-channel sources of stock water, would likely be beneficial for much of Chicken Creek.

Chicken Creek has been the subject of several projects aimed at improving fish habitat and water quality. Two projects addressed corrals where heavy livestock use had greatly reduced riparian cover and the quality of in-stream habitat. These projects moved corrals off Chicken Creek, and provided alternative sources of stock water to reduce pressure on the stream, while providing essential water for livestock. Within a year after installation of fences and off-channel water, these reaches had recovered remarkably from the pre-project condition.

A third project involved elimination of a passage barrier that blocked upstream movement of fish from the Shields River into Chicken Creek. The effectiveness of this project has not been evaluated. Note that strategies to conserve Yellowstone cutthroat trout in tributaries have changed from the early 2000s, when opening passage was the emphasis. Growing concerns regarding hybridization and invasion of brook trout now make opening passage a viable option only when it does not jeopardize existing populations of Yellowstone cutthroat trout.

6.3.4 Willow Creek

Willow Creek (Figure 6-27) originates in the Bangtail Range, and flows east for twelve miles until its confluence with the Shields River. Its extreme headwaters are in the GNF, and the remainder flows through private lands. Willow Creek has three headwater forks, and a lack of agreement exists among maps for names of streams in this watershed. The USGS 1:100,000 maps and the NHD hydrology coverage designate Willow Creek as extending upstream past its confluence with Middle Fork Willow Creek. Other maps consider this reach South Fork Willow Creek, and fisheries investigations followed this convention (Shepard 2004).

Fishes present in the Willow Creek drainage include Yellowstone cutthroat trout and nonnative brown trout, in addition to other members of the native fish assemblage (Table 6-54). Below the confluence of the middle fork, fish surveys yielded only brown trout and suckers; however, sampling was inefficient because of beaver dams. Upstream of the confluence of Middle Fork Willow Creek, Willow Creek (designated South Fork Willow Creek in Shepard 2004), supported low numbers of Yellowstone cutthroat trout and mottled sculpin (Shepard 2004). Genetic testing of three of these fish found no evidence of hybridization (Shepard 2004).

Table 6-54: Distribution and abundance of fishes in Willow Creek (from MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Life History*	*Genetic Status*	*Data Rating*
0	5	Brown trout	Common	Year-round resident	N/A	N/A	EFSSO
0	8	Longnose sucker	Rare	Year-round resident	N/A	N/A	EFSSO
0	8	Mottled sculpin	Rare	Year-round resident	N/A	N/A	NSPJ
0	8	Mountain sucker	Rare	Year-round resident	N/A	N/A	NSPJ
6	10	Surveyed; no fish captured	Unknown	Unknown	Unknown	N/A	EFMSO
0	5	White sucker	Rare	Year-round resident	N/A	N/A	EFSSO
0	5	Yellowstone cutthroat trout	Common	Unknown	Resident	Potentially unaltered with no record of stocking	EFMSO
5	8	Yellowstone cutthroat trout	Rare	Unknown	Resident	Potentially unaltered with no record of stocking	EFMSO
8	11	Yellowstone cutthroat trout	Unknown	Unknown	Resident	Potentially hybridized	EFMSO

The North Fork Willow Creek has been the subject of several investigations that document Yellowstone cutthroat trout as being present in this stream. In 1995, GNF biologists found only Yellowstone cutthroat trout in surveyed sections within the national forest (MFISH database). Likewise, Shepard (2004) sampled fish at seven locations, and captured Yellowstone cutthroat trout in all reaches except the uppermost, which was fishless. In 2008, GNF biologists sampled another reach within the forest boundary and found healthy numbers of Yellowstone cutthroat trout. Genetic analyses of fish in the North Fork Willow Creek found no evidence of hybridization in two sampling events (Table 6-55). Given the apparent lack of introgression, this population is a core population, and has substantial conservation value.

Table 6-55: Summary of genetic analyses conducted in North Fork Willow Creek (MFISH database). .

Sample No.	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
2241	19	YCT	100	1/01/2002
771	17	YCT	100	7/23/1993

Fisheries investigations in the Middle Fork Willow Creek suggest this stream has reduced potential to support a fishery. Sampling in two reaches found no fish of any species (Shepard 2004). Additional surveys upstream of sampled reaches would be useful in confirming the status of this stream.

Information on habitat quality includes qualitative observations and habitat surveys on the north fork. Shepard (2004) notes Willow Creek is aptly named given the dense stand of willows that occupies much of the riparian zone. Nonetheless, changes in grazing management would be beneficial in some areas to restore and maintain shrub cover and its function. The GNF has made such changes in its grazing permit in the upper drainage. An on-stream impoundment in lower Willow Creek is another feature with potential to affect fisheries. Investigation into its potential to block upstream movement of nonnative salmonids would be informative.

Two habitat surveys conducted on the North Fork Willow Creek (Shepard 2004) found fine sediment was a constraint to the quality and quantity of spawning habitat available in both reaches. Spawning habitat was extremely limited in the lower habitat section and moderately low in the upper section. Spawning gravels in both sections contained lots of silt that reduced its quality. Domestic livestock accounted for most of the riparian use in the lower section, while logging-related use in the upper basin appeared to cause channel alterations at the upper habitat site.

Dewatering is among the potential constraints on the resident fishery, and may limit Willow Creek's ability to support a spawning run of fluvial Yellowstone cutthroat trout from the Shields River. FWP will work with interested water rights holders on identifying potential projects to increase water use efficiency and increase in-stream flows.

As the Willow Creek drainage supports an apparently nonhybridized population of Yellowstone cutthroat trout, conservation priorities include securing the population. Projects to restore and maintain habitat quality are among potential actions. Likewise, preventing encroachment of brown trout into the upper watershed is an important goal. Their absence in the upper basin suggests a passage barrier, and identification of this barrier is a conservation priority.

6.3.5 Fiddle Creek

Fiddle Creek (Figure 6-27) is a small stream that emerges within the Shields River valley. No fisheries data are available for this stream. Baseline investigations on its potential to support fish and factors affecting this potential are conservation needs.

6.3.6 Falls Creek

Falls Creek (Figure 6-27) originates in the foothills of the Crazy Mountains, and flows for eight miles until its confluence with the Shields River. In 2002, FWP biologists surveyed three reaches, none of which yielded fish. Although these results suggest a low potential to support a fishery, further investigation should evaluate limiting factors and the potential for a passage barrier to preclude fish from Falls Creek.

6.3.7 Adair Creek

Adair Creek (Figure 6-27) originates in the foothills of the Crazy Mountains, and flows through private lands until its confluence with the Shields River. The only fisheries data available for this stream is a survey in 1975 that reported capture of seven cutthroat trout in a 250-ft-long section of stream (Berg 1975).

Baseline investigations to determine species composition and distribution of fish are the primary conservation need for Adair Creek. This information would provide the basis for developing specific recommendations for cutthroat trout conservation.

6.3.8 Crazy Head Creek

Crazy Head Creek (Figure 6-27) originates on the west side of the Shields River valley, and flows for about 7 miles before its confluence with the Shields River. The only available fisheries data comes from a survey in the 1970s that found lake chub (Berg 1975). As Crazy Head Creek flows entirely through rangeland and lacks headwaters in a montane environment, it may not have habitat or thermal regime suitable for support of a cold-water fishery. Determining Crazy Head Creek's potential to support salmonids is a conservation need.

6.4 Upper Yellowstone-Lake Subbasin (HUC 10070004)

The Upper Yellowstone-Lake Subbasin begins downstream of Bridger Creek, and extends past Billings, Montana. The majority of the basin is in private ownership, although numerous state-owned sections are present. This watershed lies within the Northwestern Great Plains Ecoregion, and has the characteristically gentle topography and low elevations typical of Montana prairies.

This historic distribution of Yellowstone cutthroat trout in this HUC was likely limited, as most streams possessed prairie stream affinities such as warmer water temperatures, fine streambed materials, and relatively high dissolved solids. The Yellowstone River and several of its tributaries are the only streams predicted to have supported Yellowstone cutthroat trout historically (Figure 6-35).

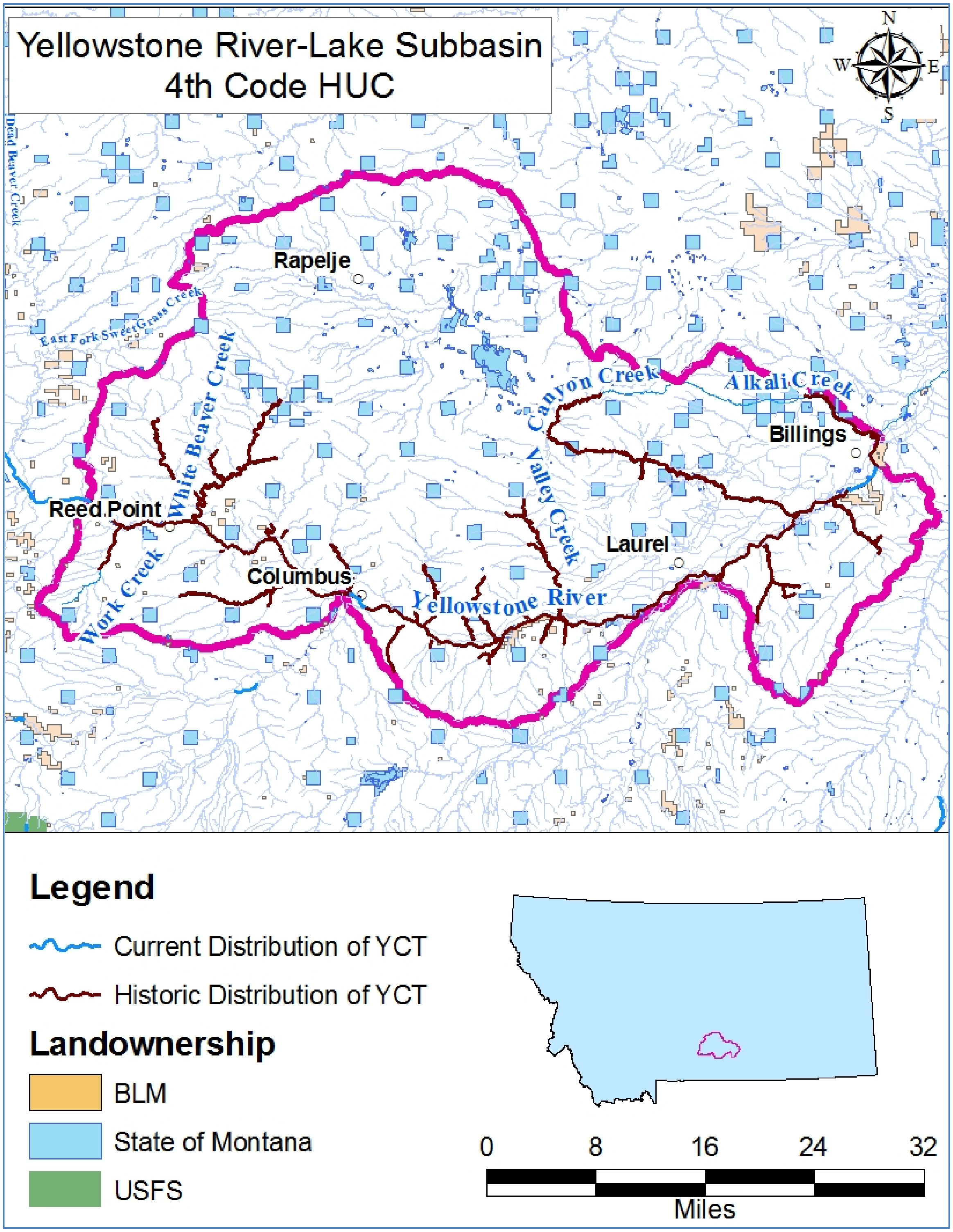

Figure 6-35: Upper Yellowstone River – Lake Basin Subbasin (HUC 10070004)/

Yellowstone cutthroat trout were historically present in this subbasin; however, recent assessments consider them to be extirpated. Factors likely contributing to their absence in the Yellowstone River and tributaries include thermal regime, lack of suitable spawning habitat, and introductions of nonnative brown trout and rainbow trout. Although some of these factors relate to human activities, the natural potential for Yellowstone cutthroat trout in this HUC is marginal.

Currently, fish community composition varies along this portion of the Yellowstone River, and this variation reflects its transition from a cold-water fishery towards a warm-water fishery. Cold-water species including mountain whitefish, brown trout, and rainbow trout occur throughout this portion of the Yellowstone River, but become rarer near Billings (MFISH database). Warm-water species such as channel catfish, goldeye, flathead chub, and river carpsucker begin to comprise a portion of the fish assemblage in the downstream portions of the Yellowstone River (MFISH database).

Given the natural limitations for Yellowstone cutthroat trout in the Upper Yellowstone – Lake Subbasin, this area is a low priority for implementation of specific conservation actions. Projects that promote recovery of fluvial Yellowstone cutthroat trout upstream of this HUC may increase the representation of Yellowstone cutthroat trout in this part of its range. A greater abundance of Yellowstone cutthroat trout upstream may result in fluvial fish moving into these lower reaches, especially during seasons when water temperatures are favorable for this sensitive species.

6.5 Stillwater River of the Yellowstone Subbasin (HUC 10070005)

The Stillwater River (Figure 6-36) begins in the Beartooth Mountains near Cooke City and flows north and east approximately 70 miles before entering the Yellowstone River in the town of Columbus. Several major tributaries feed the Stillwater River. The West Fork Stillwater River flows about 25 miles and joins the Stillwater near the town of Nye. East Rosebud and West Rosebud creeks measure about 40 miles each and form Rosebud Creek, which flows a short distance before joining the Stillwater River near the town of Absarokee.

Land uses are typical of the region. The forested higher elevations support timber harvest, livestock grazing, and recreation. Agriculture is the primary land use in the valley portions of the watershed, and includes livestock production and irrigated crops. Water demands for irrigation result in periodic dewatering in portions of the Stillwater River and two of its tributaries (Table 6-56).

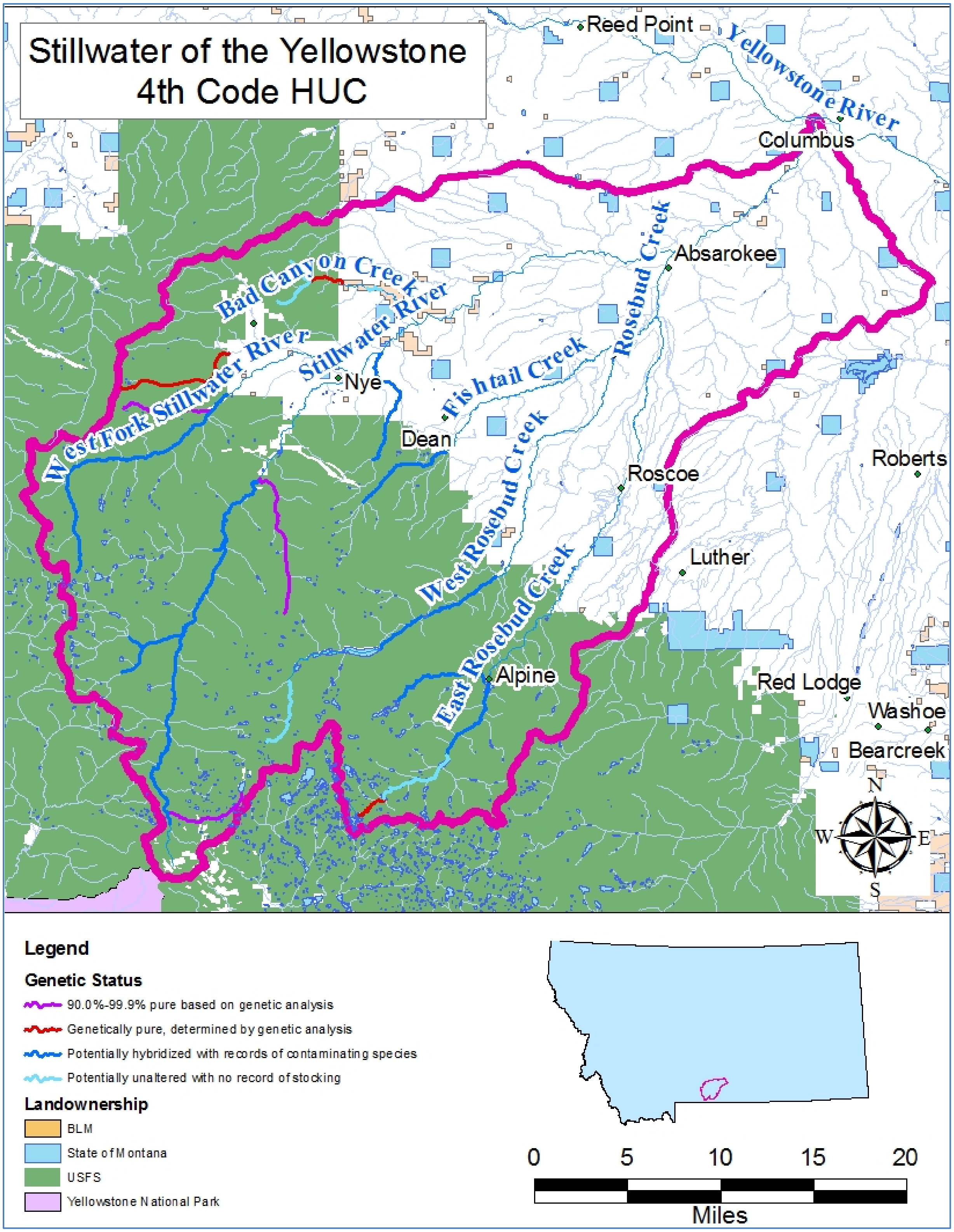

Figure 6-36: Stillwater of the Yellowstone River Subbasin (10070005).

Table 6-56: Dewatered streams in the Stillwater River watershed (MFISH database).

Stream	*Tributary To*	*Begin Mile*	*End Mile*	*Dewater*
Bad Canyon Creek	Stillwater River	0	1	Periodic Dewatering
Fishtail Creek	West Rosebud Creek	0	2	Periodic Dewatering
Stillwater River	Yellowstone River	12	24	Periodic Dewatering

Historically, the Stillwater drainage supported a healthy population of Yellowstone cutthroat trout through most of its length. Today, Yellowstone cutthroat trout are only present in small remnant populations in tributaries to the Stillwater and in headwater lakes that were previously fishless. Brook trout, brown trout, and rainbow trout rate as common to abundant through much of the main stem (Table 6-57). Given the connectivity with the Yellowstone River, the majority of the Stillwater drainage has little to no potential for restoration of secure Yellowstone cutthroat trout populations. Several tributaries have features that make them suitable candidates for reestablishment or protection of core populations of Yellowstone cutthroat trout. Genetic analyses in the Stillwater River watershed indicate the populations present are core or conservation populations (Table 6-58).

Table 6-57: Distribution and abundance of trout species in the Stillwater River (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Data Rating*
30	40	Brook trout	Rare	Year-round resident	EFMSO
40	42	Brook trout	Common	Year-round resident	EFMSO
44	70	Brook trout	Common	Year-round resident	EFMSO
0	26	Brown trout	Abundant	Primarily rearing and migration	EFMSO
26	36	Brown trout	Abundant	Both resident and fluvial/adfluvial populations	EFMSO
36	40	Brown trout	Common	Both resident and fluvial/adfluvial populations	EFMSO
40	42	Brown trout	Rare	Both resident and fluvial/adfluvial populations	EFMSO
0	20	Rainbow trout	Abundant	Primarily rearing and migration	EFMSO
20	44	Rainbow trout	Common	Both resident and fluvial/adfluvial populations	EFMSO
44	60	Rainbow trout	Rare	Year-round resident	EFSSO
11	13	Yellowstone cutthroat trout	Not Applicable	Unknown	EFSSO
44	67	Yellowstone cutthroat trout	Abundant	Unknown	NSPJ

Table 6-58: Summary of genetic analyses for streams and lakes in the Stillwater River watershed (MFISH database).

Body of Water	*Sample. No.*	*Sample Size*	*Target Species*	*Percent of Genes*	*Count*	*Collection Date*
Bad Canyon Creek	525	4	YCT	100	0	8/28/1991
East Rosebud Creek	3556	13	YCT	0	13	7/25/2007
Goose Creek	950	11	YCT	97.7	0	7/20/1994
Goose Creek	950	11	RBT	2.3	0	7/20/1994
Goose Creek	702	4	YCT	100	0	9/01/1992
Goose Lake	2840	50	YCT	100	0	7/22/2003
Iron Creek	816	15	YCT	93	0	8/19/1993
Iron Creek	816	15	RBT	7	0	8/19/1993
Picket Pin Creek	1027	6	YCT	100	0	9/21/1994
Woodbine Creek	3554	30	YCT	99.7	0	7/27/2007
Woodbine Creek	3554	30	WCT	0.2	0	7/27/2007
Woodbine Creek	3554	30	RBT	0.1	0	7/27/2007

Numerous mountain lakes in the Stillwater River drainage support populations of Yellowstone cutthroat trout, and 22 are likely to be nonhybridized. These lakes are: Sundown, Jordan, Martes, Jay, Chrome, Wood, Wilderness, Cataract, Wrong, Courthouse, Beauty, Anvil, Goose, Little Goose, Huckleberry, Mutt, Jeff, Lake of the Woods, Aufwuch, Mouse, Pentad, and Favonius. Most notably, the population in Goose Lake is the current brood source for the Yellowstone cutthroat trout hatchery program in Montana. Reportedly, a prospector living at the lake transported these fish from the Clarks Fork of the Yellowstone River around 1906. Huckleberry, Mutt, and Jeff lakes have been the subject of conservation actions to remove brook trout and establish a population of Yellowstone cutthroat trout. This project began in 2007 and was completed in 2009.

6.5.1 Goose Creek

The 6-mile long Goose Creek (Figure 6-37) is a tributary to the Stillwater near its headwaters, just north of Cooke City. Goose and Little Goose lakes harbor self-sustaining populations of Yellowstone cutthroat trout. Below a small cascade, brook trout were present throughout Goose Creek, the result of historic brook trout stocking in Huckleberry Lake. From 2007 through 2009, a piscicide project resulted in the successful removal of brook trout from Huckleberry, Mutt and Jeff lakes, as well as about five miles of Goose Creek. Yellowstone cutthroat trout are being reintroduced to the lakes and creek, and the goal of creating a self-sustaining Yellowstone cutthroat trout population throughout 3 lakes and 5-6 miles of creek will be accomplished soon.

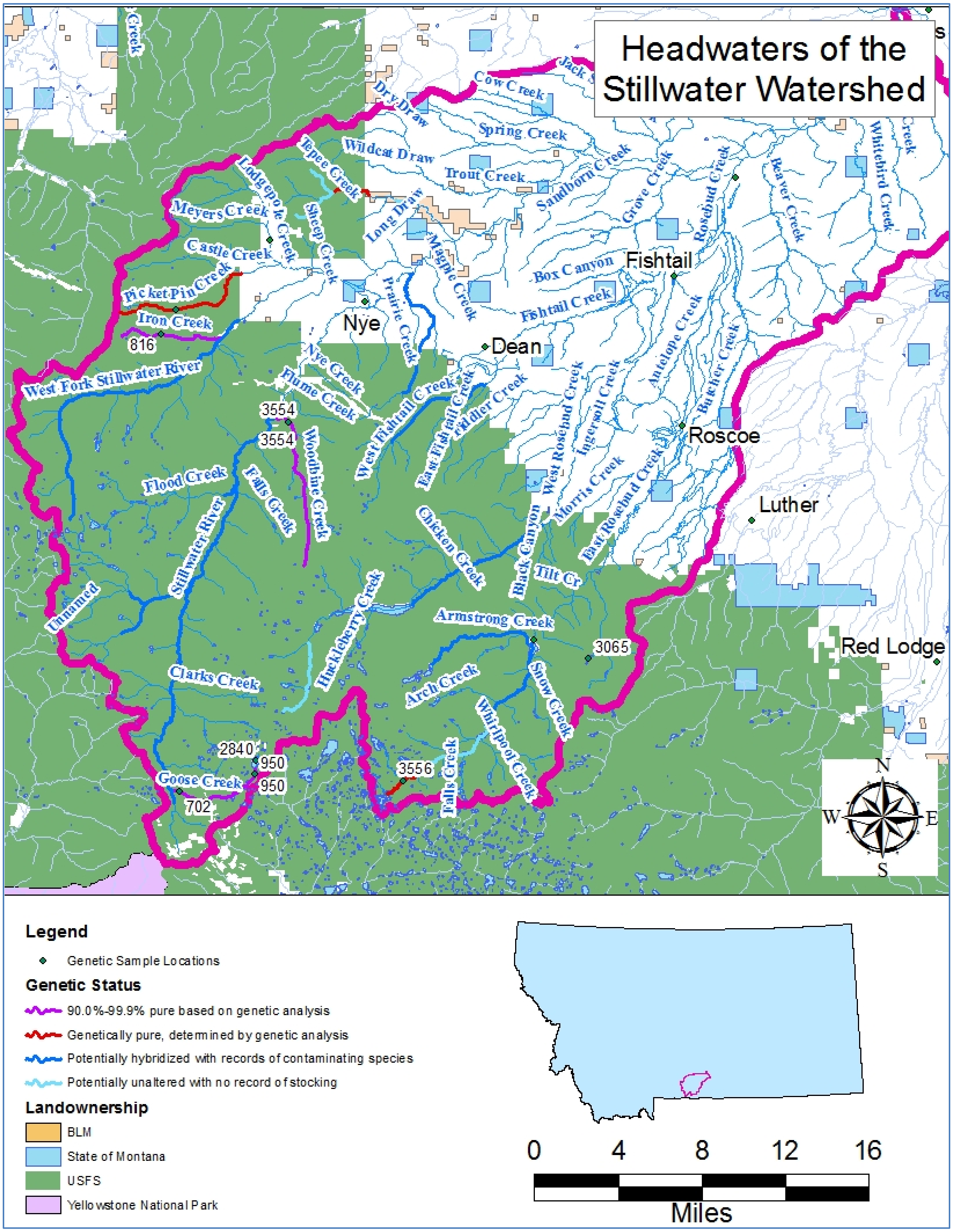

Figure 6-37: Upper Stillwater River watershed.

6.5.2 Woodbine Creek

Woodbine Creek (Figure 6-37), a tributary of the Stillwater River, enters the Stillwater near the boundary of the Absaroka-Beartooth Wilderness. Woodbine Creek supports a population of slightly introgressed Yellowstone cutthroat trout (Table 6-58). A waterfall near its mouth has likely been the feature that has allowed persistence of Yellowstone cutthroat trout in this part of the watershed. As a core population with less than 1% hybridization, protecting this population is a conservation priority. Additional investigation of abundance and distribution will guide development of a specific conservation approach.

6.5.3 Little Rocky Creek

Little Rocky Creek (Figure 6-37) flows about 10 miles from the Benbow Mine area down to the Stillwater River just southwest of Beehive. Despite its length, the creek is relatively small and steep, and fish densities are low. Rainbow and brown trout are present in the lower reaches of the creek, and brook trout and Yellowstone cutthroat trout are present upstream of the GNF boundary. A nonhybridized population of Yellowstone cutthroat trout may be present in Little Rocky Creek, but too few fish have been captured to obtain a reliable genetic sample. Access to most of the creek is difficult. Chrome Lake, near the headwaters of Little Rocky, was historically stocked with brook trout, and now contains stocked populations of Yellowstone cutthroat trout and Arctic grayling. Some potential exists to build a barrier to upstream fish passage in lower Little Rocky Creek, perhaps at the Forest Service road crossing, or further downstream at the Highway 419 crossing, and remove brook, brown, and rainbow trout from above the barrier. The suitability of the available habitat to support Yellowstone cutthroat trout is unknown, and should be the subject of future survey work.

6.5.4 Bad Canyon Creek

Bad Canyon (Figure 6-37) is a 10-mile long creek that flows through National Forest, BLM and private lands before joining the Stillwater River. Near its confluence with the Stillwater River, Bad Canyon has low flow for most of the year. Brown trout dominate the lower six miles of creek, where water is in sufficient supply. About 6 miles upstream from the mouth, a Yellowstone cutthroat trout population that is thriving throughout four miles of creek, and a barrier prevents invasion of brown trout into this area.

The current fish distribution is a result of a past Yellowstone cutthroat trout restoration project that involved the improvement of a fish barrier to ensure its effectiveness, and treatment of the creek above the barrier with a piscicide. The piscicide treatment occurred in 2002. Yellowstone cutthroat trout salvaged before piscicide application were returned to the stream after detoxification. Surveys in 2005 and 2008 revealed a healthy Yellowstone cutthroat trout population in the creek above the barrier. Below the barrier, brown trout continue to be present in high densities. Expanding the Yellowstone cutthroat trout population downstream is a potential conservation action. Achieving expansion would require the construction of a fish passage barrier on BLM land and another piscicide project. The relatively complex landownership along

Bad Canyon Creek means collaboration among agencies and private landowners would be necessary for implementation of conservation actions.

6.5.5 Trout Creek

Trout Creek (Figure 6-37) enters the Stillwater River several miles downstream from Bad Canyon Creek, and bears similarities to Bad Canyon Creek in terms of size and nature of the habitat. The fish population in Trout Creek is a mix of brown and brook trout, with brown trout more common in the lower reaches and brook trout more common near the headwaters. Livestock grazing practices are compatible with fisheries, as the stream retains high quality habitat and abundant fish. Near the headwaters of Trout Creek, a waterfall keeps fish from moving further upstream. Some suitable fish habitat exists above the barrier, and may support a small Yellowstone cutthroat trout population if introduced. Further downstream, building a fish passage barrier, and reclaiming the stream to reestablish Yellowstone cutthroat trout population, may be feasible. These actions would require significant cooperation and support from the private landowners on Trout Creek.

6.5.6 West Fork Stillwater River

The West Fork Stillwater River drainage (Figure 6-37) supports a diverse fishery, including rainbow, brown, brook, golden and cutthroat trout, as well as Arctic grayling. The abundance of nonnative fishes, combined with connectivity with the main stem Stillwater River, means little potential exists for Yellowstone cutthroat trout restoration in this stream. Moreover, much of the drainage is within the Absaroka-Beartooth Wilderness, which limits options for use of motorized equipment to implement fish conservation actions in this sizeable watershed.

Potential conservation actions for the West Fork Stillwater include basic inventories: of species distribution, presence of fish passage barriers, and the potential for available habitat to support Yellowstone cutthroat trout. Nonetheless, its steep gradient, difficult accessibility, and wilderness designation may preclude Yellowstone cutthroat trout introduction. Four lakes, (Jasper, Little Jasper, North Picket Pin and South Picket Pin) and two creeks (Iron Creek and Picket Pin Creek) support nonhybridized Yellowstone cutthroat trout populations in the West Fork drainage. Additionally, Castle, Meyers and Lodgepole creeks should be evaluated for potential Yellowstone cutthroat trout restoration projects.

6.5.7 Iron Creek

Upstream of the confluence West Fork of the Stillwater, t5.5 mile long Iron Creek (Figure 6-37contains a self-sustaining population of nonhybridized Yellowstone cutthroat trout. No other fish species are present here, potentially due to a fish passage barrier located somewhere near the mouth of the creek. The origin of this Yellowstone cutthroat trout population is likely a result of stocking events in 1943 and 1971. Because the creek is steep throughout much of its length, the spatial extent of the Yellowstone cutthroat trout population is probably limited. Investigation of the density and distribution of Yellowstone cutthroat trout would be useful in determining the status and security of this population.

6.5.8 Picket Pin Creek

Picket Pin (Figure 6-37) is a headwater tributary in the West Stillwater Creek drainage. Plants of Yellowstone cutthroat trout into the North and South Picket Pin lakes began in 1969. Sampling in 1994, 2004 and 2008 confirmed that a self-sustaining population of Yellowstone cutthroat trout exists in the creek on the Custer National Forest (CNF), upstream from an apparent natural barrier to fish passage that precludes brown and rainbow trout invasion (J.R. Wood, FWP, personal communication). The effectiveness of this barrier is uncertain, but no nonnative fish species have been found above it in recent years. Future sampling should confirm whether the barrier is functioning to keep invasive fish species out of the creek and obtain information about the distribution and density of the Yellowstone cutthroat trout population in Picket Pin Creek.

6.5.9 Castle, Meyers and Lodgepole Creeks

These three streams (Figure 6-37are tributaries to Limestone Creek, which is a tributary of the West Fork Stillwater River. All three flow through private and CNF land and may have some potential to support Yellowstone cutthroat trout populations. Data needs include determination of the current upstream extent of fish distribution and identification of barriers, if present. These streams have an unknown potential for restoring a Yellowstone cutthroat trout population, but possible actions include stocking into fishless waters, constructing fish passage barriers, and reclaiming Yellowstone cutthroat trout populations. As landownership is a mixture of public and private, collaboration with private landowners would be essential to Yellowstone cutthroat trout restoration in these drainages.

6.5.10 East Rosebud Creek

East Rosebud Creek (Figure 6-37) originates high in the Beartooth Mountains where it forms the drainage for 76 mountain lakes, 30 of which contain fish populations. Such a wide variety of nonnative trout species and hybrid trout occur in these lakes that Yellowstone cutthroat trout restoration is not feasible throughout most of the drainage. Some nonhybridized Yellowstone cutthroat trout are present in the creek near its headwaters, but the stream gradient is steep, and the creek only flows a short distance between lakes.

The creek flows into East Rosebud Lake at the wilderness boundary and flows mostly through private land until it joins the West Rosebud to form Rosebud Creek near the town of Absarokee. Brown trout dominate the fish population in this reach of East Rosebud Creek, although rainbow trout are also present. Significant water withdrawal and interbasin transfer of water through irrigation ditches, combined with naturally poor habitat conditions, would make Yellowstone cutthroat trout restoration infeasible in the few tributaries to East Rosebud Creek (Morris Creek, Antelope Creek, Butcher creeks).

6.5.11 West Rosebud Creek

Similar to East Rosebud, West Rosebud Creek (Figure 6-37) originates high in the Beartooth Mountains and drains 84 mountain lakes, the majority of which are naturally fishless. Twelve lakes in the drainage currently contain populations of Yellowstone cutthroat trout, five of which are self-sustaining. These are Frenco, Princess, Beckwourth, Arrapooash and Ram lakes.

Potential to stock Yellowstone cutthroat trout in stream and lake habitat exists in the headwaters of West Rosebud Creek; however, because this part of the watershed is within designated wilderness, stocking Yellowstone cutthroat trout in fishless waters has been a priority. Downstream of the wilderness boundary, the West Rosebud Creek, brown trout are the most numerous fish, although rainbow trout and brook trout are also present. The presence of these species results in little potential for Yellowstone cutthroat trout restoration in the main stem of the creek. Only two major tributaries, Fishtail Creek and Fiddler Creek, enter the West Rosebud in this reach.

6.5.12 Fiddler Creek

Fiddler Creek (Figure 6-37) is a 7.5-mile long stream that originates on the north face of the Beartooth Mountains and enters West Rosebud Creek south of the town of Fishtail. Numerous small tributaries contribute to Fiddler Creek, the two largest being the Middle Fork and the East Fork. Brook trout dominate the fish population throughout these streams. Brown trout are present, but are confined to the lower reaches. Though small, the fish habitat throughout much of Fiddler Creek is complex, with beaver dams contributing to the diversity of habitats.
Early attempts to establish populations of Yellowstone cutthroat trout and rainbow trout in Fiddler Creek were unsuccessful. These plants occurred from 1928 to 1934. Although anglers have reported catching Yellowstone cutthroat trout in the headwaters of the East Fork Fiddler Creek, extensive sampling yielded only brook trout (J.R. Wood, FWP, personal communication).

Although Fiddler Creek has some potential for establishment of a Yellowstone cutthroat trout population, several factors present significant challenges. Notably, brook trout are abundant throughout the creek, and the presence of numerous beaver dams would complicate reclamation efforts, as achieving total removal is difficult in complex habitat. Removal of rainbow trout from Crater Lake would also be required, although this would be considerably easier than treating the stream.

6.5.13 Fishtail Creek

Fishtail Creek (Figure 6-37) begins at the junction of East and West Fishtail creeks and flows about 14 miles before joining West Rosebud Creek in the town of Fishtail. Brown trout are the most common salmonid in Fishtail Creek. Rainbow trout are also present throughout the creek’s length, and some brook trout are present in the upper reaches. Most of the creek provides good trout habitat, some of which has been degraded by significant sediment loading and agricultural-related runoff. The potential for Yellowstone cutthroat trout restoration in Fishtail Creek, while minimal, is dependent upon restoration potential in its tributaries, East and West Fishtail creeks.

6.5.14 East Fishtail Creek

East Fishtail Creek joins West Fishtail Creek to form Fishtail Creek just downstream of the CNF boundary (Figure 6-37). The creek flows approximately 6 miles through steep terrain, primarily on national forest. No lakes are present in the creek’s headwaters. Brown trout, brook trout, and rainbow trout are likely present in the creek, but fish survey data are not available. Access to the creek by a trail has become difficult due to recent blow-down events and lack of trail maintenance. Future survey work will be necessary to determine the spatial distribution of fish in East Fishtail Creek, and to determine the potential for securing an existing population or restoring Yellowstone cutthroat trout to these waters. Depending on findings of baseline investigations, possible actions may include barrier construction and removal of nonnative fishes.

6.5.15 West Fishtail Creek

West Fishtail Creek flows (Figure 6-37) approximately 10 steep stream miles along the Beartooth Mountain face before joining East Fishtail Creek just below the forest boundary. No survey data are available for West Fishtail Creek, but species potentially present include brown trout, rainbow trout, and Yellowstone cutthroat trout (MFISH database). Beginning in the early 1980s, golden trout have been stocked into a series of lakes at the headwaters of West Fishtail Creek, and some of these lakes support self-sustaining populations of golden trout. The presence of golden trout makes the possibility for Yellowstone cutthroat trout restoration in West Fishtail Creek unlikely to be successful over the long term. Golden trout have potential to move downstream and interbreed with Yellowstone cutthroat trout. Data requirements for this drainage include determination of species composition and distribution, and determination of the potential for downstream movement of golden trout from lakes. Without this information, drainage-wide Yellowstone cutthroat trout restoration potential remains unknown.

6.5.16 Island Lake Project

In the lower reaches of West Fishtail Creek, about a mile upstream from the forest boundary, two irrigation ditches take water from the creek and run it into adjacent drainages. The lowermost ditch runs for approximately 1 mile, entering and exiting several small lakes before providing irrigation water for the 4-K Guest Ranch. Of these bodies of water, Island Lake, located on CNF land is the largest at approximately 4.5 surface acres. Water exits Twin Lakes through a small headgate, runs through a flume for several hundred yards, drops into Island Lake, exits through another headgate and drops almost vertically before reaching irrigated pasture land. Water level fluctuates substantially in the lake, dropping approximately 6-8 vertical feet from full elevation when irrigation season ends.

Because of the irrigation-caused flow fluctuations and the limited amount of spawning habitat available, brown and brook trout that drop into the lake from the ditch cannot spawn successfully. This limitation has resulted in a small group of medium to large sized fish, primarily brown trout, which grow well but are unable to reproduce. The water-level regime appears to be ideal for a spring-summer spawning fish like Yellowstone cutthroat trout, whose spawning and egg incubation period would take place while the lake is full, unlike fall-spawned brown and brook trout eggs that dry up when the lake level drops.

Beginning in 2009, FWP, the 4-K Ranch, and the CNF implemented a spawning habitat improvement and Yellowstone cutthroat trout introduction project in Island Lake. The spawning habitat component involved placement of spawning gravels in the lake outlet. In summer 2009, approximately 1,000 2-inch long Yellowstone cutthroat trout and 100 14-inch-long Yellowstone cutthroat trout were stocked into the lake. Stocking will occur for several years with the objective of establishing a self-sustaining Yellowstone cutthroat trout population. Survival, growth and spawning/reproduction of these fish will continue to be monitored in the future.

6.6 Clarks Fork of the Yellowstone Subbasin (HUC 10070006)

The Clarks Fork of the Yellowstone River Subbasin (Figure 6-38) begins in the high mountain lakes of the Absaroka-Beartooth Wilderness Area near Cooke City, Montana. The Clarks Fork drainage has more mountain lakes (424) than any other drainage in the Beartooth Mountains, and these lakes support a wide variety of trout species, including brook trout, rainbow trout, Yellowstone cutthroat trout, golden trout, lake trout and various hybrid trout. Although this large variety offers significant angling opportunity, it makes Yellowstone cutthroat trout restoration a difficult, if not impossible task in much of the drainage. No significant headwater areas in the Clarks Fork drainage present great Yellowstone cutthroat trout restoration opportunity due to large numbers of nonnative trout that would have to be removed in headwater lakes and streams. Fisher Creek, near Cooke City, has adequate water and no headwater lakes, but does not support fish due to heavy metal contamination. Restoration work here may improve water quality, but it is more likely that background metal levels would be too high to support fish even with remediation of mining-related sources.

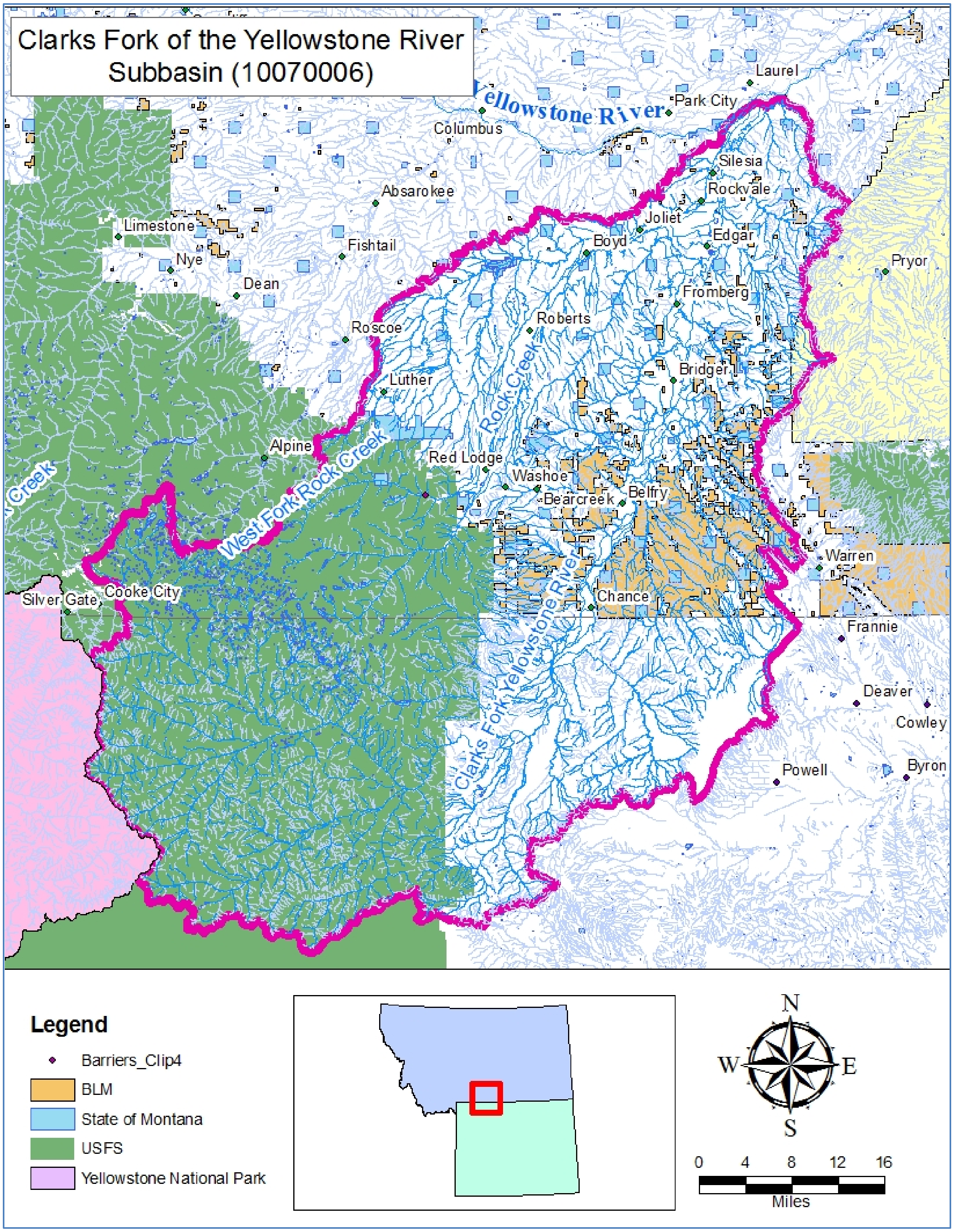

Figure 6-38: Clarks Fork of the Yellowstone River Subbasin

Downstream from the headwaters, the Clarks Fork exits Montana at an elevation of 7,600 feet and flows through the state of Wyoming. After many miles of steep water and deep canyons, the river reenters Montana in desert country at just under 4,000 feet elevation. From where it reenters Montana to its confluence with the Yellowstone River, the Clarks Fork flows mainly through agricultural land and transitions from a cold-water rainbow and brown trout fishery (from the Wyoming border downstream to the town of Bridger) to a warm-water river (downstream from Bridger). This portion of river experiences substantial dewatering during the summer irrigation season. Yellowstone cutthroat trout restoration potential is largely nonexistent in the main stem of the Clarks Fork, and because it flows mainly through high desert country throughout much of its length, few tributaries with adequate water to support trout enter the river. Nonetheless, several tributaries offer some potential or possibility for Yellowstone cutthroat trout work. These include Line Creek, Bluewater Creek, and several tributaries to Rock Creek.

6.6.1 Line Creek

Line Creek (Figure 6-39) enters the Clarks Fork in Wyoming, but about 5 miles of the creek and its tributaries are in Montana. The North Fork of the creek begins at Line Lake, located just within Montana near the Wyoming border. An intermittent stream flows out of the lake to form the headwaters. The South Fork (or main fork) of Line Creek begins approximately 2 miles south of Line Lake, in Wyoming. The confluence of the two tributaries is in Montana, 4 miles east of Line Lake, and just north of the Montana-Wyoming border. Brook trout are present in the lower reaches of the creek in Wyoming, and Yellowstone cutthroat trout were stocked in Wyoming in 2009. Portions of Line Creek in Montana were surveyed in 2002, and no fish were found. Stream habitat surveys identified high quality fish habitat that would likely support a healthy Yellowstone cutthroat trout population in the creek. An apparent barrier to the upstream movement of fish between the Wyoming and Montana reaches of Line Creek exists, keeping fish from colonizing the headwaters.

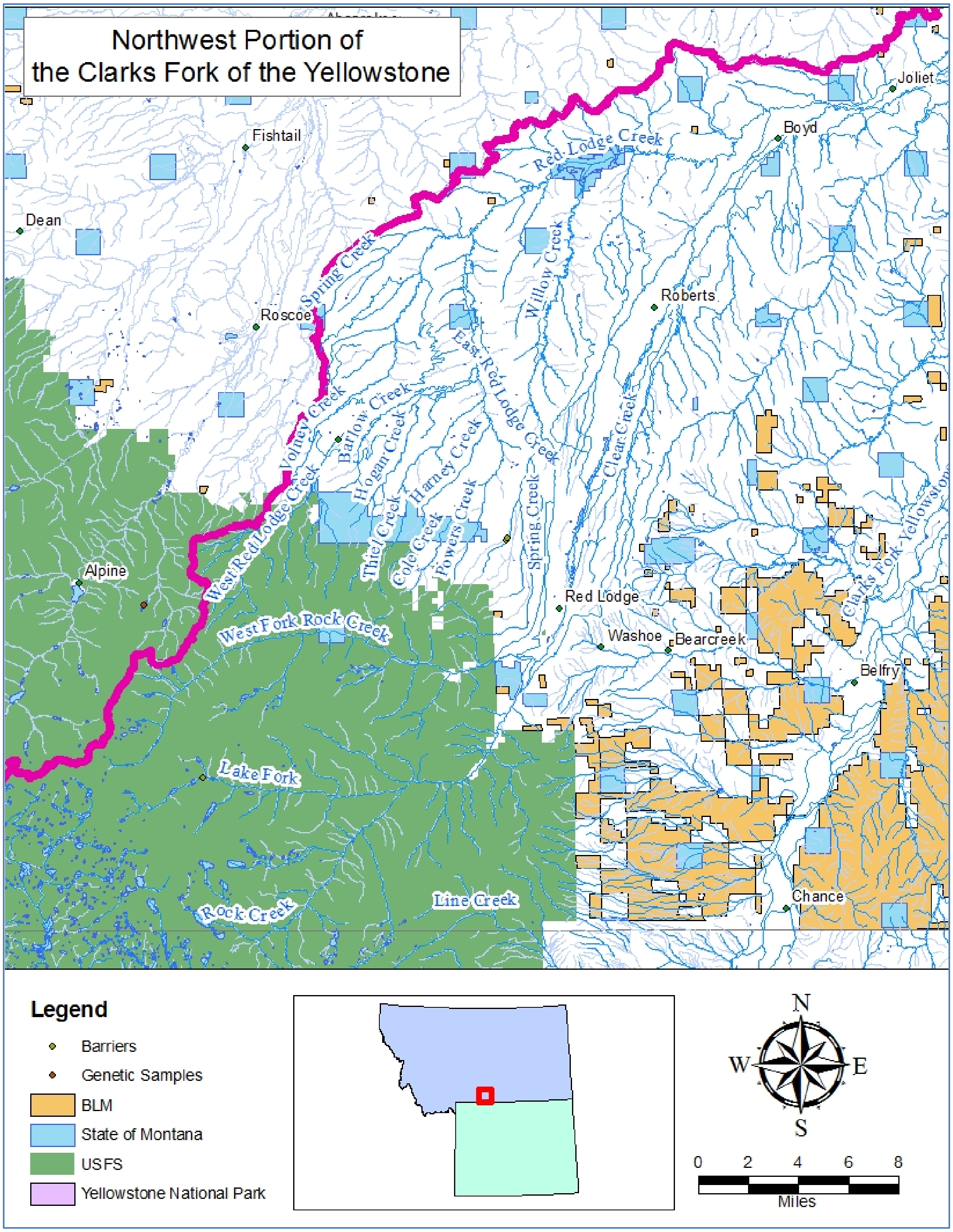

Figure 6-39: Northwest portion of the Clarks Fork of the Yellowstone Subbasin with potential for Yellowstone cutthroat trout conservation.

The Lake Fork of Rock Creek (Figure 6-39) flows over 12 miles and joins Rock Creek southwest of Red Lodge. The drainage contains brook trout, rainbow trout, and nonhybridized Yellowstone cutthroat trout. Numerous lakes in the drainage provide the source for the fish present in the creek. As Lake Fork of Rock Creek supports a nonhybridized population of Yellowstone cutthroat trout, securing these fish is a conservation priority.

6.6.2 Red Lodge Creek

Red Lodge Creek (Figure 6-39) begins where numerous tributaries draining the north face of the Beartooth Mountains join in the open meadow country between Red Lodge and Absarokee. The relatively slow, meandering creek flows into Cooney Reservoir, an irrigation reservoir that also serves as a popular rainbow trout and walleye fishery. Cooney Reservoir delivers water to irrigators in Red Lodge Creek and these augmented flows benefit the fishery. Brown trout and rainbow trout dominate the fish population in lower Red Lodge Creek, and restoration of Yellowstone cutthroat trout is likely infeasible. Tributaries to the 30-mile-long Red Lodge Creek, which joins Rock Creek north of Boyd, likely have the greatest potential for Yellowstone cutthroat trout restoration in the Clarks Fork drainage.

6.6.3 West Fork Rock Creek

The West Fork of Rock Creek (Figure 6-39) flows over 20 miles and joins Rock Creek just west of Red Lodge. Numerous lakes in the West Fork drainage contain Yellowstone cutthroat trout, but many contain brook trout as well, reducing the possibility for Yellowstone cutthroat trout restoration in the drainage. The upper reaches of the West Fork would likely provide quality Yellowstone cutthroat trout habitat if brook trout were removed from all of the headwater lakes and the creek.

In 2003, FWP prepared an environmental assessment to evaluate the potential consequences of stocking Yellowstone cutthroat trout in the fishless waters of Line Creek with the intent to establish a self-sustaining population. The drainage is in a Research Natural Area administered by the CNF, and the CNF opposed the project because it conflicted with the goals and objectives of the Research Natural Area. The project did not proceed. Some potential exists to revisit the discussion of Yellowstone cutthroat trout introduction with the CNF. In addition, Yellowstone cutthroat trout have possibly moved downstream into the creek from Line Lake, which has supported a stocked population of Yellowstone cutthroat trout since 1958. The outlet of the lake and creek should be surveyed more intensively to determine whether Yellowstone cutthroat trout are present here.

6.6.4 East Red Lodge Creek

East Red Lodge Creek (Figure 6-39) begins at the junction of Cole and Powers creeks, and flows exclusively through private land. Species presumed present include brook, brown, and rainbow trout. Because of its position in the drainage, Yellowstone cutthroat trout restoration and nonnative fish removal would have to be completed in all of its tributaries in order to successfully reestablish Yellowstone cutthroat trout into East Red Lodge Creek.

6.6.5 Clear Creek

Clear Creek (Figure 6-39) is a 15-mile long tributary that enters Rock Creek just north of Roberts. The headwaters of the creek appear to be a series of springs that emerge from the bench above Red Lodge. Brook, brown and rainbow trout are present in this spring-fed creek. Some opportunity to restore Yellowstone cutthroat trout may exist here, but the interbasin transfer of irrigation water that brings water from Rock Creek to Clear Creek diminishes this potential. In addition, this transfer of water likely brings fish with it. Opportunities for Yellowstone cutthroat trout restoration in the headwaters of Clear Creek upstream from any source of Rock Creek water should be investigated.

6.6.6 Spring Creek

Spring Creek (Figure 6-39) is a small tributary to Willow Creek that flows through agricultural land just west of Red Lodge. No survey data are available for Spring Creek, but brook trout and brown trout are likely present (MFISH database). The creek begins in a series of ditches and interacts extensively with an irrigation system along its length. Connectivity with this complex system of irrigation ditches provides considerable opportunity for transfer of fish from other streams, and limits the potential for establishing a secure population of Yellowstone cutthroat trout.

6.6.7 Cole and Powers Creeks

Cole Creek and Powers Creek (Figure 6-39) originate on the Beartooth Mountain face and join together just below their crossings of Montana Highway 78. Both are small tributaries that contain populations of brook trout. Landowner cooperation and further sampling are necessary to determine the potential for Yellowstone cutthroat trout restoration. A potentially feasible restoration strategy may be to build a fish passage barrier downstream of where these two creeks join, on East Red Lodge Creek, chemically treat the brook trout populations, and reestablish Yellowstone cutthroat trout.

6.6.8 Harney Creek

Harney Creek (Figure 6-39) is a small tributary that enters East Red Lodge Creek just upstream of Thiel Creek. Harney supports brook trout, and this small stream may have the potential to support Yellowstone cutthroat trout. A future large-scale project involving the reclamation of the East Red Lodge Creek drainage, including Thiel, Cole, Powers and Harney creeks would be much more likely of successfully establishing a healthy Yellowstone cutthroat trout population than establishing a population in Harney Creek alone.

6.6.9 Thiel Creek

Thiel Creek (Figure 6-39) enters East Red Lodge Creek a couple of miles upstream of its confluence with West Red Lodge Creek. Thiel Creek has adequate flow to support fish throughout much of its length, and currently supports brook trout.

Thiel Creek was the subject of an attempt to replicate a population of Yellowstone cutthroat trout from Lower Deer Creek (see 6.2.43 Lower Deer Creek). Wildfire and recent hybridization posed immediate threats to the Yellowstone cutthroat trout population in Lower Deer Creek. These efforts sought to establish a brood stock of Lower Deer Creek fish in the event that catastrophic flows or continued hybridization eliminated this nonhybridized population. In 2006, Yellowstone cutthroat trout from Lower Deer Creek were transplanted into Thiel Creek. To prepare the stream for this transfer, FWP installed a fish passage barrier to prevent upstream movement of brook trout, and mechanically removed brook trout from above the barrier. These efforts were unsuccessful. The complexity of the habitat made mechanical removal of brook trout inefficient, and they quickly rebounded. In addition, most of the Yellowstone cutthroat trout, especially the adults, appeared to have left the creek. Although some of the fish stocked as juveniles tended to stay, their long-term survival in Thiel Creek is unlikely in the presence of brook trout.

The fish passage barrier still exists in Thiel Creek, supporting the opportunity to remove brook trout and establish a Yellowstone cutthroat trout population. Because of the complex habitat and many spring-like areas, removal of brook trout would require the use of piscicide. Future work should establish the upstream extent of fish distribution in Thiel Creek and quantify all spring seeps, irrigation water transfers and other features that would affect the feasibility of restoring Yellowstone cutthroat trout to Thiel Creek. As this stream flows through private lands, landowner involvement and collaboration would be essential in any future efforts. Landowners along Thiel Creek were supportive of the past efforts to restore Yellowstone cutthroat trout to this stream.

6.6.10 Hogan Creek

Hogan Creek (Figure 6-39) is another small tributary that enters West Red Lodge Creek just downstream of Barlow Creek. Hogan Creek contains a population of brook trout. This stream has an unknown potential to support Yellowstone cutthroat trout conservation efforts. As it flows entirely through privately owned lands, baseline investigations and eventual implementation of conservation project would require collaboration with landowners.

6.6.11 Barlow Creek

Barlow Creek (Figure 6-39) enters West Red Lodge Creek in the foothills below the town of Luther. Although believed to be fishless, this stream appears to have adequate water to support fish. Access to survey and evaluate the potential for Yellowstone cutthroat trout restoration in Barlow Creek would require cooperation of private landowners.

6.6.12 West Red Lodge Creek

West Red Lodge Creek (Figure 6-39) begins on the face of the Beartooth Mountains and flows over 18 miles to where it joins Red Lodge Creek in the foothills. The West Red Lodge Creek drainage contains one of the few remaining populations of indigenous Yellowstone cutthroat trout in the Clarks Fork Yellowstone River system.

In the main stem of West Red Lodge Creek, brown trout and brook trout are present in the upper reaches and brown trout dominate the lower reaches. As of the most recent sampling, no Yellowstone cutthroat trout have been found here. Upstream from the wilderness boundary, this stream may not support fish.

West Red Lodge Creek contains two major tributaries, the East Fork of West Red Lodge Creek and the Burnt Fork, a tributary to the East Fork. The 4.5 mile long East Fork, which joins the West Fork just below the CNF boundary, contains a population of Yellowstone cutthroat trout and brook trout. These Yellowstone cutthroat trout are likely to be indigenous and nonhybridized. The Burnt Fork contains a population of brook trout. Further evaluation of the West Red Lodge Creek drainage is necessary to determine Yellowstone cutthroat trout restoration opportunities and the steps necessary to recover the Yellowstone cutthroat trout population here.

6.6.13 Volney Creek

Volney Creek (Figure 6-39) originates in the foothills of the Beartooth Mountains just downstream of the CNF boundary. This relatively small creek flows 16.5 miles before entering Red Lodge Creek. The one major tributary to Volney Creek is West Fork Volney Creek, a small 5 mile long stream. Its relatively low elevation headwater area and corresponding warm water results in dominance of native prairie fishes, although the occasional brown trout and brook trout are also present. Although Volney Creek likely has limited potential to support Yellowstone cutthroat trout, future survey efforts should evaluate this assumption.

6.6.14 Willow Creek

Willow Creek (Figure 6-39) is a 32-mile-long tributary to Cooney Reservoir in the Red Lodge Creek drainage. Brown trout and native prairie fishes occur in its lower reaches, and brook trout are present in the headwaters. The fish-bearing tributaries to Willow Creek are concentrated near the headwaters and include Spring Creek, Brushy Fork, and several unnamed tributaries.

Some potential for Yellowstone cutthroat trout restoration exists in the headwaters of Willow Creek but the opportunities are limited. Where it descends the Beartooth Mountain face on CNF land, the creek is small and steep. A population of brook trout exists here, but is present in low densities. Proceeding downstream, extensive subdivision and complex habitat would make nonnative fish removal and Yellowstone cutthroat trout restoration here a challenge. As the current fish and habitat information available from Willow Creek is limited, further research should seek to identify Yellowstone cutthroat trout restoration potential.

6.6.15 Brush Fork Willow Creek

The Brush Fork of Willow Creek (unmapped) contains one of the few remaining indigenous Yellowstone cutthroat trout populations in the Clarks Fork of the Yellowstone River drainage. This population is sympatric with brook trout, which puts it at high risk for extirpation. An effort began in 2005 to remove brook trout from the creek using electrofishing in order to provide some relief to the Yellowstone cutthroat trout population. Yellowstone cutthroat trout have rebounded, and in several years, the majority of the fish in the reach being electrofished were Yellowstone cutthroat trout. Unless complete removal of brook trout takes place, however, Yellowstone cutthroat trout will continue to be threatened and will decline as brook trout numbers increase in the absence of these removal efforts. Chemical treatment may not be successful in the Brushy Fork drainage because of the extensive beaver activity and spring-like areas. The goal is to continue the brook trout removal effort until a suitable site in the Willow Creek or Red Lodge Creek drainage can be prepared to transfer these fish into and establish a population that does not face the threat to extinction posed by brook trout.

6.6.16 Rock Creek

Rock Creek (Figure 6-39) flows over 60 miles, beginning high in the Beartooth Mountains, and entering the Clarks Fork of the Yellowstone between the towns of Edgar and Silesia. In contrast to the Clarks Fork valley, which is one of the drier areas in the state, the Rock Creek drainage receives substantially more precipitation and has many small trout-bearing tributaries. The main stem of Rock Creek contains a fish population dominated by brown trout and mountain whitefish in its lower reaches, and rainbow and brook trout in its headwaters. During the summer irrigation season, dewatering can be severe in the stream below the CNF boundary. Cooney Reservoir mitigates some of this dewatering by delivering irrigation water to lower Rock Creek through Red Lodge Creek.

The Rock Creek drainage contains 91 mountain lakes (26 are in Wyoming), 47 of which contain fish. Fish species in the Rock Creek mountain lakes include brook trout (29 lakes), Yellowstone cutthroat trout (25 lakes) and rainbow trout (2 lakes). The presence of brook trout in so many of these lakes greatly diminishes the potential for Yellowstone cutthroat trout restoration projects, which would have to include removal of brook trout from any source water that could repopulate the reclaimed area.

The strong presence of nonnative trout species in the main Rock Creek drainage reduces the potential for Yellowstone cutthroat trout restoration. Nonetheless, some potential for reestablishment exists in some of the tributaries to Rock Creek. The major fish-bearing tributaries to Rock Creek are Lake Fork Rock Creek, West Fork Rock Creek, Clear Creek, and Red Lodge Creek

Red Lodge Creek (Figure 6-39) begins where numerous tributaries draining the north face of the Beartooth Mountains join in the open meadow country between Red Lodge and Absarokee. The relatively slow, meandering creek flows into Cooney Reservoir, an irrigation reservoir that also serves as a popular rainbow trout and walleye fishery. Cooney Reservoir delivers water to irrigators in Red Lodge Creek and these augmented flows benefit the fishery. Brown trout and rainbow trout dominate the fish population in lower Red Lodge Creek, and restoration of Yellowstone cutthroat trout is likely not feasible. Tributaries to the 30-mile-long Red Lodge

Creek, which joins Rock Creek north of Boyd, likely have the greatest potential for Yellowstone cutthroat trout restoration in the Clarks Fork drainage.

6.6.17 Bluewater Creek

Bluewater Creek (Figure 6-39) enters the Clarks Fork of the Yellowstone near the town of Fromberg. The creek originates as a series of large springs, and provides cool, clear, oxygenated water in the middle of a desert area. FWP operates the Bluewater Springs Trout Hatchery, which is located on the creek about 10 stream miles upstream from the mouth of the creek. Bluewater Creek contains a healthy population of brown trout, and some rainbow trout. The hatchery primarily raises rainbow trout. Upstream from the hatchery, there may be some potential for Yellowstone cutthroat trout restoration. Future work should investigate the potential to establish a Yellowstone cutthroat trout population here.

6.7 Upper Yellowstone-Pompey’s Pillar Subbasin (HUC 10070007)

The Upper Yellowstone-Pompey’s Pillar Subbasin (Figure 6-40) encompasses the portion of the Yellowstone River drainage downstream of Billings to downstream of Custer. Landownership is mostly private, with state lands and BLM lands interspersed throughout the drainage. Land uses are agricultural, and include livestock production and irrigated crops.

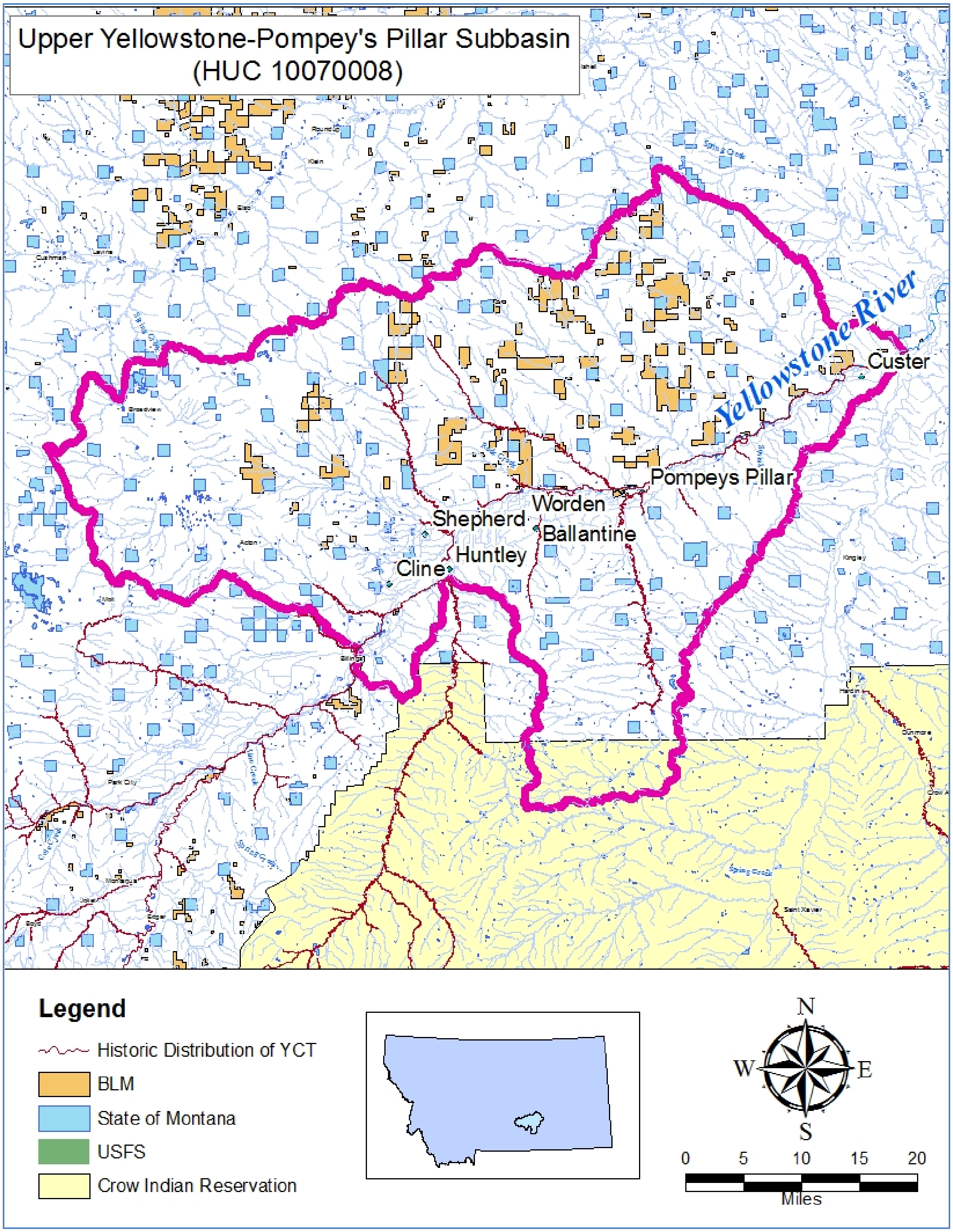

Figure 6-40: Upper Yellowstone-Pompey's Pillar HUC.

The presumed historic distribution of Yellowstone cutthroat trout in the basin includes the main stem of the Yellowstone River and several unnamed tributaries (Figure 6-40). This portion of the historic range was likely marginal habitat for Yellowstone cutthroat trout, as the river and its tributaries are transitional between cold-water and warm-water systems in this subbasin. The distribution of representative cold-water and warm-water fishes illustrates this transitional character. Rainbow trout are the only cold-water species rating as common in this portion of the Yellowstone River (MFISH database). Brown trout and mountain whitefish are rare, and Yellowstone cutthroat trout are not present. In contrast, warm-water fishes, such as channel catfish, goldeye, flathead chub, and river carpsucker are common to abundant within the subbasin (MFISH database).

As this portion of the Yellowstone cutthroat trout's historic range is marginal for cold-water fisheries, restoring Yellowstone cutthroat trout to this area faces natural impediments. Improvements in the reaches upstream may result in increased representation of Yellowstone cutthroat trout in this reach, especially during colder seasons. Specific actions to restore Yellowstone cutthroat trout to the Upper Yellowstone-Pompey's Pillar HUC would be low priority compared to portions of its historic range.

6.8 Pryor Creek Subbasin (HUC 10070008)

The Pryor Creek hydrological unit (Figure 6-41) lies to the east of Billings, and is mostly within the Crow Reservation. Originating in the Pryor Mountains, Pryor Creek flows north for over 100 miles until its confluence with the Yellowstone River near Huntley. Most of the basin's streams flow through prairie, and only the extreme headwaters are within montane or foothills environments.

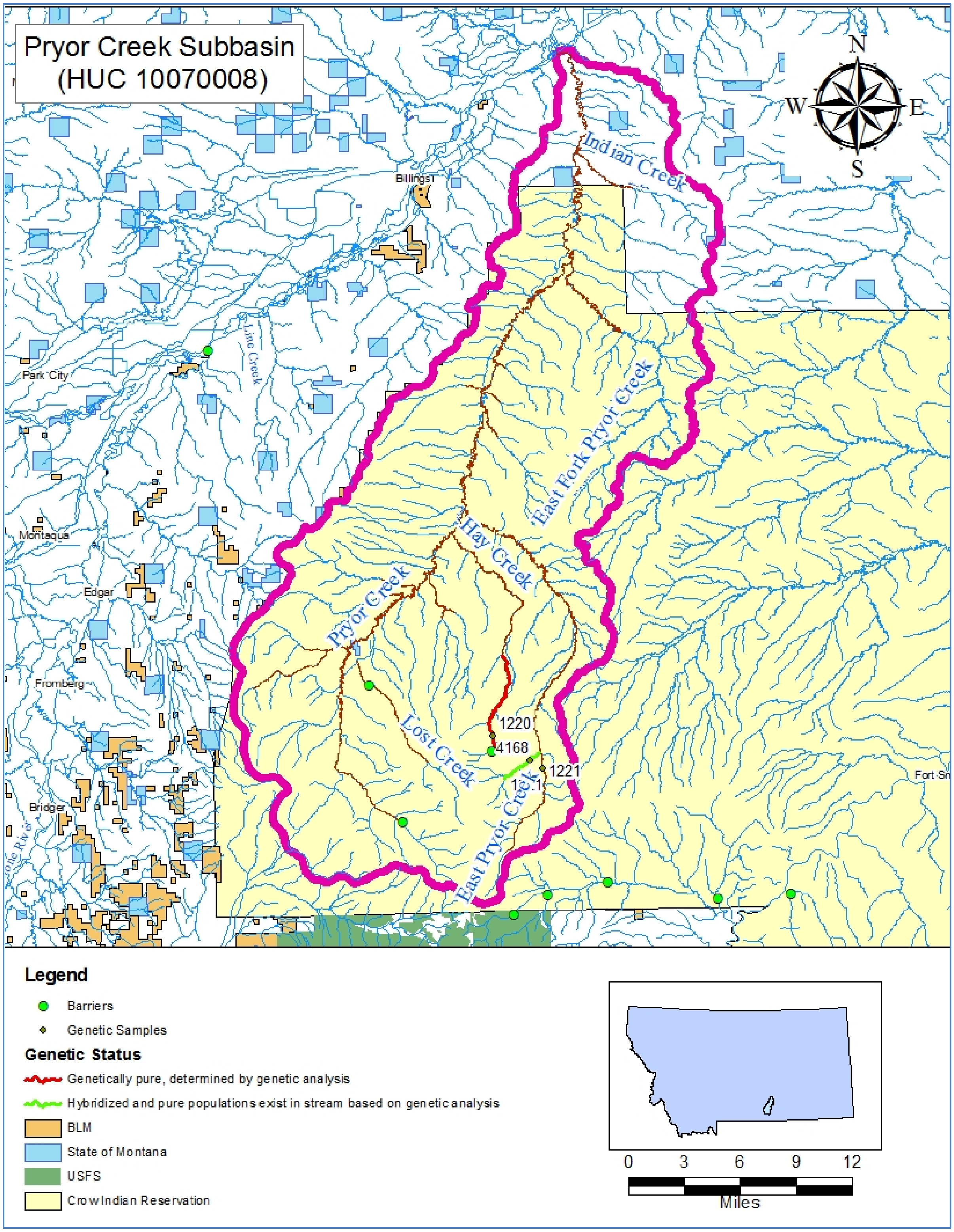

Figure 6-41: Pryor Creek Subbasin (HUC 10070008).

Land uses in the basin are typical of the region. The upper, montane portions support timber harvest and livestock grazing. Agriculture is the primary activity in the lower elevations, and includes livestock grazing and irrigated crop production. Irrigation withdrawals have a substantial influence on stream flow. FWP includes the lower 21 miles of Pryor Creek on its lists of dewatered streams.

Fisheries potential varies along a longitudinal gradient. The lower 60 miles of Pryor Creek supports a warm-water fishery with native prairie species such as minnows and suckers being the most abundant taxa (Table 6-59). The fishery transitions to cold-water species higher in the watershed, and includes nonnative brook trout, rainbow trout, and Yellowstone cutthroat trout.

Table 6-59: Distribution and abundance of fishes in Pryor Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Data rating*
13	15	Black bullhead	Unknown	Unknown	EFSSO
15	16	Black bullhead	Unknown	Unknown	EFSSO
78	81	Brook trout	Rare	Year-round resident	NSPJ
81	101	Brook trout	Common	Year-round resident	NSPJ
0	27	Channel catfish	Rare	Year-round resident	EFMSO
0	02	Common carp	Rare	Year-round resident	EFSSO
13	14	Common carp	Unknown	Year-round resident	EFMSO
0	016	Fathead minnow	Rare	Year-round resident	EFMSO
0	026	Flathead chub	Common	Year-round resident	EFMSO
26	62	Flathead chub	Abundant	Year-round resident	EFMSO
0	62	Longnose dace	Rare	Year-round resident	EFMSO
62	81	Longnose dace	Rare	Year-round resident	EFMSO
13	16	Longnose sucker	Unknown	Year-round resident	EFMSO
0	13	Mountain sucker	Abundant	Year-round resident	EFMSO
13	16	Mountain sucker	Common	Year-round resident	EFMSO
62	78	Mountain sucker	Common	Year-round resident	EFMSO
62	101	Rainbow trout	Rare	Year-round resident	NSPJ
0	2	Sand shiner	Unknown	Unknown	EFMSO
13	15	Sand shiner	Unknown	Unknown	EFMSO
0	13	Shorthead redhorse	Abundant	Year-round resident	EFMSO
13	62	Shorthead redhorse	Rare	Year-round resident	EFMSO
0	26	Stonecat	Rare	Year-round resident	EFMSO
0	14	Western silvery minnow	Common	Year-round resident	EFMSO
0	26	Western silvery/plains minnow	Rare	Year-round resident	NSPJ
26	27	Western silvery/plains minnow	Common	Year-round resident	NSPJ
27	62	Western silvery/plains minnow	Rare	Year-round resident	NSPJ
0	27	White sucker	Abundant	Year-round resident	EFMSO
27	62	White sucker	Common	Year-round resident	EFMSO
62	78	White sucker	Common	Year-round resident	EFMSO

Historically, Yellowstone cutthroat trout occurred throughout the Pryor Creek drainage with the possible exclusion of a few streams. Indian Creek and East Fork Pryor Creek provide habitat suitable for warm-water species, so occupancy by Yellowstone cutthroat trout may have been incidental. A natural barrier on Lock Creek likely blocked upstream movement of Yellowstone cutthroat trout.

Currently, Yellowstone cutthroat trout are restricted to Hay and Shively creeks. In the mid-1990s, nonhybridized Yellowstone cutthroat trout in were present in Hay Creek, and both nonhybridized and introgressed Yellowstone cutthroat in Shively Creek (Table 6-60). Updating information on the genetic status of these populations is a data need. Currently Hay Creek is the only conservation population in the Pryor Creek drainage.

Table 6-60: Summary of genetic analyses conducted for streams in the Pryor Creek watershed (MFISH database). .

Stream	*Sample No.*	*Sample Size*	*Target Species*	*Percent of YCT Genes*	*Number of Fish*	*Collection Date*
Hay Creek	1220	12	YCT	100		7/10/1996
East Pryor Creek	1221		YCT	76.3		7/10/1996
Shively Creek	4168	12	YCT×RBT×WCT		10	7/11/1996
Shively Creek	4168	12	YCT×RBT		2	7/11/1996

As the habitat suitable for support of cold-water fisheries is within the Crow Reservation, the Crow Tribe would be the principal partner in restoration efforts. State and federal agencies, along with nonprofit groups, would be probable collaborators should Yellowstone cutthroat trout conservation projects proceed. Future actions should include additional survey to determine the distribution and abundance of trout and identification of potential sites to construct barriers to protect existing or restored Yellowstone cutthroat trout populations.

6.8.1 Pryor Creek

Pryor Creek (Figure 6-41) originates from numerous springs on the north and east slopes of the Pryor Mountains of the Crow Reservation and flows for just over 100 miles before its confluence with the Yellowstone River at Huntley. Landownership is a mixture of tribal, allotted and private lands. Pryor Creek's tributaries include Indian Creek, East Fork Pryor Creek, East Pryor Creek, Hay Creek and Lost Creek. Chronic dewatering relating to agricultural practices occurs in the lowest portions of Pryor Creek and to a lesser extent in lower Lost Creek, while natural flow regimes provide seasonal connections between Pryor Creek and the tributaries Hay and East Pryor creeks.

Habitat suitable for support of cold-water fisheries is limited to the upper watershed. Currently, the main stem supports brook trout and rainbow trout, and restoration of Yellowstone cutthroat trout in this portion of Pryor Creek would require removal of the nonnatives.

Several factors need consideration in determining the feasibility of reclaiming upper Pryor Creek for native cutthroat trout. Preventing reinvasion of rainbow trout is a concern. Currently, an irrigation diversion near the mouth of Pryor Creek blocks upstream movement of fish; however, providing passage for warm-water species is a potential future project that may allow rainbow trout access to Pryor Creek. Nonetheless, the long expanse of warm-water, prairie stream habitat may be a natural barrier to upstream movement of rainbow trout, although rainbow trout may eventually invade the upper reaches. Construction of a barrier is an option to protect the trout-bearing portions of Pryor Creek, and field surveys of potential barrier sites are needed.

The extreme headwaters of Pryor Creek originate in limestone caves, which pose difficulties in applying piscicide to reclaim the stream for native trout. The extent of trout-bearing water within these caves is unknown. Investigation into the potential for the caves to provide refuge to nonnative fishes, and development of an approach to treat these waters is a subject requiring additional investigation.

6.8.2 East Fork Pryor Creek

East Fork Pryor Creek (Figure 6-41) is a major tributary that joins Pryor Creek about 27 miles from its confluence with the Yellowstone River. The lower portions of East Fork Pryor Creek may have supported Yellowstone cutthroat trout historically, although they are unlikely to be present currently. Fisheries data are lacking for East Fork Pryor Creek. Conservation actions should include surveys to determine species composition and potential for this stream to support Yellowstone cutthroat trout.

6.8.3 East Pryor Creek

East Pryor Creek (Figure 6-41) originates on the northeast face of the Pryor Mountains and flows northwesterly for nearly 40 miles across a mixture of tribal, allotted and private lands before entering Pryor Creek. Trout are limited to about 7 miles of East Pryor Creek in its upper reaches. These trout are an introgressed mixture of Yellowstone cutthroat, westslope cutthroat and rainbow trout; the westslope cutthroat trout resulting from a 1917 fish-car stocking originating from Somers Fish Hatchery on Flathead Lake.

Restoration of a core population of Yellowstone cutthroat trout would require removal of the existing introgressed fishery. As with Pryor Creek, consideration of the potential for reinvasion is necessary in determining a specific approach. The warm-water reaches dominated by native prairie fish species may not provide a suitable migration corridor for rainbow trout in the Yellowstone River, and may prevent reinvasion. Nonetheless, rainbow trout may eventually move through this unsuitable habitat; therefore, construction of a barrier may be the preferred option in securing a restored population.

6.8.4 Shively Creek

Shively Creek (Figure 6-41) is a tributary to East Pryor Creek that originates on the northeast face of the Pryor Mountains and flows easterly across tribal and private lands for 4.5 miles to its confluence with East Pryor Creek. A mixture of nonhybridized and introgressed Yellowstone cutthroat and rainbow trout inhabit most of this short stream, except for the uppermost mile.

The presence of rainbow trout and hybrids presents a substantial threat to the Yellowstone cutthroat trout in Shively Creek. Potential actions include reclaiming the stream for Yellowstone cutthroat trout, and installation of barrier to prevent reinvasion of nonnative species. Future conservation planning for Shively Creek should consider the potential to expand the extent of habitat occupied by Yellowstone cutthroat trout into East Pryor Creek.

6.8.5 Hay Creek

Hay Creek (Figure 6-41) originates on the northeast face of the Pryor Mountains and flows entirely within the Crow Reservation for nearly 20 miles before entering Pryor Creek. Much of Hay Creek has prairie stream affinities, and does not provide habitat suitable for Yellowstone cutthroat trout. The trout-bearing portion of Hay Creek is the seven miles upstream of the Pryor - St. Xavier BIA road. This reach supports nonhybridized Yellowstone cutthroat and brook trout.

Brook trout are a substantial threat to persistence of the Yellowstone cutthroat trout in Hay Creek. Options to protect this core population include removal of brook trout and installing a barrier. Brook trout suppression may be an appropriate interim tool in reducing interspecific competition, and would allow Yellowstone cutthroat trout to increase in abundance.

6.8.6 Lost Creek

Lost Creek (Figure 6-41) originates on the northern face of the Pryor Mountains and flows northerly through Lost Creek Canyon on tribal lands for approximately seven miles before flowing sub-surface into a large alluvial outwash at the mouth of the canyon. From this outwash, Lost Creek extends five more miles to Pryor Creek just upstream from the town of Pryor. An irrigation diversion captures the entire flow of Lost Creek at the mouth of the canyon and conveys it westerly approximately 3.5 miles to the Pryor Creek Ditch.

Historically, Lost Creek was barren of fish; however, the canal has provided a conduit for invading brook trout and consequently Lost Creek now supports a robust population of brook trout. A natural waterfall barrier (6 feet high) exists approximately 1.5 miles upstream from the diversion, which confines brook trout below the barrier and protects the upper fishless portion of the stream.

The Lost Creek ditch screening project began in 2010 as a conservation effort to eliminate brook trout and introduce Yellowstone cutthroat trout to this previously unoccupied habitat within the Pryor Creek watershed. This project will establish Yellowstone cutthroat trout throughout the Lost Creek drainage, while eliminating the threat of upstream reinvasion of brook trout.

6.9 Bighorn Lake Subbasin (HUC 10080010)

The Bighorn Lake hydrologic unit (Figure 6-42) straddles the Montana/Wyoming border, with about three quarters of the watershed being in Wyoming. The presumed historic distribution of Yellowstone cutthroat trout in this hydrologic unit encompassed 278 miles of stream, but Yellowstone cutthroat trout are now present in 64 miles stream habitat (May et al. 2007).

Remaining populations are isolated and occupy short reaches of streams. These factors put the remaining populations at high risk of extirpation.

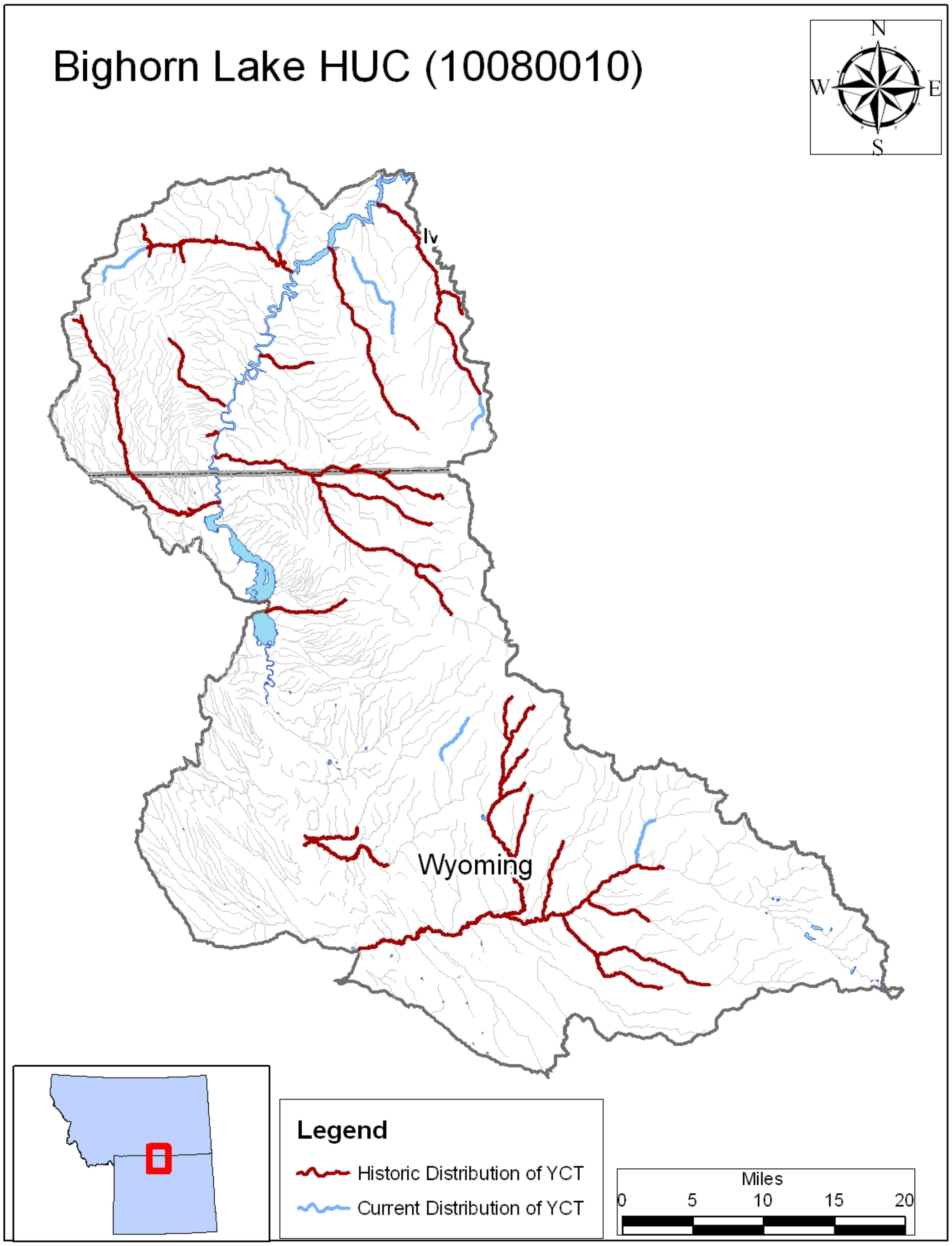

Figure 6-42: Bighorn Lake Subbasin (HUC 10080010).

Yellowtail Dam is at the downstream extent of this hydrologic unit, and this structure impounds the Bighorn River to form Bighorn Lake, which is the largest body of water in the watershed. This reservoir supports a popular recreational fishery that includes a diverse assemblage of native and nonnative species (Table 6-61). The Bighorn River was unlikely to provide significant habitat to Yellowstone cutthroat trout historically (May et al. 2007), and warm water temperatures likely make the reservoir unsuitable for establishment of a Yellowstone cutthroat trout population. Brown trout in Bighorn Lake have access to the adjacent tributarie and present a threat to remaining populations of Yellowstone cutthroat trout in these streams.

Table 6-61: Fishes rating as common and abundant in Bighorn Lake (MFISH database).

Common Name	***Scientific Name***	***Origin***	***Abundance***	***Data Rating***
Black crappie	*Pomoxis nigromaculatus*	Nonnative	Common	EFMSO
Brown trout	*Salmo trutta*	Nonnative	Common	EFMSO
Burbot	*Lota lota*	Native	Common	EFMSO
Channel catfish	*Ictalurus punctatus*	Native	Common	EFMSO
Common carp	*Cyprinus carpio*	Nonnative	Common	EFMSO
Emerald shiner	*Notropis athernoides*	Native	Abundant	EFMSO
Longnose sucker	*Catostomus catostomus*	Native	Common	EFMSO
River carpsucker	*Carpoides carpio*	Native	Common	EFMSO
Sauger	*Sander canadensis*	Native	Common	EFMSO
Shorthead redhorse	*Moxostoma macrolepidotum*	Native	Common	EFMSO
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	Native	Common	NSPJ
Smallmouth bass	*Micropterus dolomieu*	Nonnative	Abundant	EFMSO
Walleye	*Sander vitreus*	Nonnative	Abundant	EFMSO
White sucker	*Catostomus commersoni*	Native	Common	EFMSO
Yellow perch	*Perca flavescens*	Nonnative	Common	EFMSO

Within the Montana portions of the Bighorn Lake HUC, several streams supported Yellowstone cutthroat trout historically. Remaining populations are restricted to headwater portions of streams, and are isolated from other populations. This isolation, combined with small extent of occupied habitat, puts these populations at risk of extirpation. To date, genetic testing has found only nonhybridized Yellowstone cutthroat trout in the watershed (Table 6-62). These nonhybridized populations on the fringe of the remaining range have considerable conservation value, and securing these populations is consistent with the highest priority under the cutthroat trout Agreement (MCTSC 2007).

Table 6-62: Summary of genetic analyses for streams sampled in the Bighorn Lake HUC (MFISH database).

Stream	*Sample No.*	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
Big Bull Elk Creek	1323	18	YCT	100	10/27/1998
Big Bull Elk Creek	1222	7	YCT	100	08/07/1996
Big Bull Elk Creek	810	5	YCT	100	08/18/1993
Crooked Creek	3321	20	YCT	100	08/01/2006
Crooked Creek	147	24	YCT	100	09/11/1985
Dry Head Creek	761	4	YCT	100	07/13/1993

6.9.1 Dry Head Creek

Dry Head Creek (Figure 6-43) originates from numerous springs on the east slopes of the Pryor Mountains, and flows through the CNF and then the Crow Reservation until its confluence with the Bighorn River. The creation of Bighorn Lake resulted in the inundation of the lowest portion of the creek,with two miles of former channel being under water when the reservoir is at full pool. The upper two miles of the creek flows subsurface and the stream reemerges as a large spring upwelling about 13 miles upstream from the mouth.

Dry Head Creek supports a population of nonhybridized Yellowstone cutthroat trout, although invasion of brown trout puts this population at risk. Drought extending from 1999 to 2001 apparently wiped out Dry Head Creek's Yellowstone cutthroat trout. The current population is the result of reintroduction into the reaches within the CNF in 2001 through 2003. Livestock grazing practices present another threat to Yellowstone cutthroat trout, and development of grazing strategies that are compatible with fisheries and stream health is a conservation need.

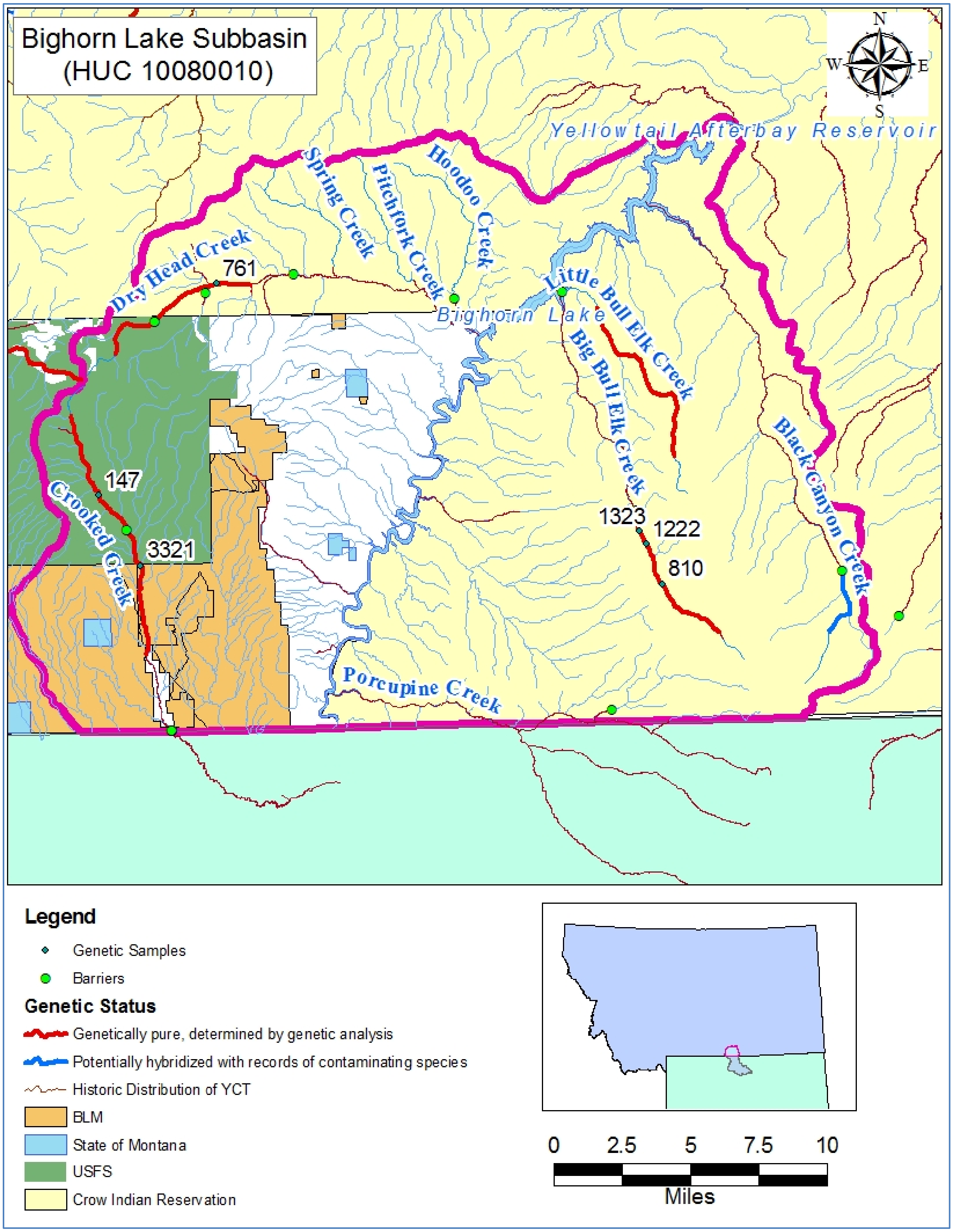

Figure 6-43: Montana portions of the Bighorn Lake HUC.

Additional fish surveys would be beneficial in developing specific strategies to protect Dry Head Creek's Yellowstone cutthroat trout population. Most sampling has occurred within the CNF. Expanding fish surveys into the Crow Reservation would be useful in determining the extent of Yellowstone cutthroat trout distribution in the drainage.

Sympatry with brown trout presents a long-term threat to the remaining Yellowstone cutthroat trout in Dry Head Creek. Potential activities include suppression or removal of brown trout. Field surveys for suitable barrier sites are also needed.

6.9.2 Hoodoo Creek

Hoodoo Creek (Figure 6-43) originates on the east face of the Pryor Mountains, and flows to the south until its confluence with Bighorn Lake. Before the reservoir inundated its lower reaches, Hoodoo Creek was a tributary of Dry Head Creek. Landownership is nearly entirely within the Crow Reservation, with the exception of its lowest reach, which in under private ownership.

Historically, Hoodoo Creek supported Yellowstone cutthroat trout; however, brown trout now occupy its lower reaches. Upstream of a barrier located about 1 mile from its confluence with Bighorn Lake, a natural barrier prevents upstream movement of fish, and this reach is barren of fish.

Current livestock grazing practices limit Hoodoo Creek's suitability for restoration of a Yellowstone cutthroat trout population. Implementing best management practices that allow the channel and riparian area to recover, while maintaining agricultural productivity, would need to be the first step. Should improvements in stream habitat and riparian condition occur, the barrier on Hoodoo Creek may provide secure habitat for establishment of a core population of Yellowstone cutthroat trout.

6.9.3 Pitchfork Creek

Pitchfork Creek (Figure 6-43) is a tributary of Dry Head Creek; it flows through a mixture of tribal and private lands before joining Dry Head Creek. Pitchfork Creek likely supported Yellowstone cutthroat trout historically; however, no information is available on its current fish assemblage. Livestock grazing practices along Pitchfork Creek are incompatible with fisheries needs, and limit the stream's potential to support a healthy fishery. Conservation planning for Pitchfork Creek should focus on the potential to improve stream health through implementation of agricultural BMPs, and conducting surveys to determine status and potential of the stream's fishery.

6.9.4 Spring Creek

Spring Creek is another tributary of Dry Head Creek and flows entirely within the Crow Reservation (Figure 6-43). Yellowstone cutthroat trout were likely present in Spring Creek historically; however, brown trout now occupy its entire length. Livestock grazing practices are currently incompatible with fisheries needs, and restoring health and function to the stream corridor would need to be a first step in reestablishing a Yellowstone cutthroat trout population.

6.9.5 Black Canyon Creek

Black Canyon Creek (Figure 6-43) and its tributaries originate from numerous springs along the western terminus of the Bighorn Mountains in the Crow Reservation. The stream flows to the north through a deeply incised canyon for about 22 miles until its confluence with Bighorn Lake. Bighorn Lake inundates the lowest three miles of Black Canyon Creek when at full pool.

Historically, Yellowstone cutthroat trout occupied the lower 17 miles of Black Canyon Creek. Following construction of a tribal youth camp and access road in 1959, the USFWS introduced rainbow trout, brown trout, and brook trout into Black Canyon Creek. Despite these successful introductions, a small number of Yellowstone cutthroat trout persist today, although the genetic status of these fish is unknown.

Black Canyon Creek has several opportunities for reintroduction or range expansion of Yellowstone cutthroat trout. Although nonnative fish thrive in the main stem, several tributaries contain adequate stream habitat with natural fish barriers or potential barrier construction sites. Data needs include surveys of habitat and potential barrier sites in Black Canyon and its unnamed tributaries.

6.9.6 Big Bull Elk Creek

Big Bull Elk Creek (Figure 6-43) originates from numerous springs on the west side of the Bighorn Mountains on the Crow Reservation, and flows for 16 miles before its confluence with Bighorn Lake. The stream and its tributaries occupy deeply incised canyons for their entire lengths.

Historically, Yellowstone cutthroat trout occupied the entire drainage downstream from a barrier falls in the headwaters, and nonhybridized Yellowstone cutthroat trout continue to occupy the upper five miles of stream. Presumably, a barrier exists downstream of this Yellowstone cutthroat trout stronghold, and brown trout and a few Yellowstone cutthroat trout occupy the rest of Big Bull Elk Creek.

The conservation priority for Big Bull Elk Creek is to preserve the remaining Yellowstone cutthroat trout in the drainage. Opportunities to increase the amount of habitat occupied by Yellowstone cutthroat trout without brown trout may also be present. The lateral confinement provided by the canyon walls likely provides suitable locations for construction of a barrier. Barrier construction combined with removal of nonnative brown trout could provide substantially more secured habitat for Yellowstone cutthroat trout.

6.9.7 Little Bull Elk Creek

Little Bull Elk Creek (Figure 6-43) is a former tributary of Big Bull Elk Creek and bears several similarities to this stream. Springs feed the headwaters of Little Bull Elk, and the stream flows through a deeply incised canyon. Creation of Bighorn Lake has inundated the lower portions of Little Bull Elk Creek and Big Bull Elk Creek, and Little Bull Elk Creek now drains directly to the reservoir.

A series of waterfalls near the mouth of Little Bull Elk Creek prevented expansion of Yellowstone cutthroat trout, or subsequently introduced species into Little Bull Elk Creek. In 1999, the U.S. Fish and Wildlife Service transferred 83 adult Yellowstone cutthroat trout from Big Bull Elk Creek into Little Bull Elk Creek in an effort to expand their range. This effort was apparently successful, as monitoring in 2001 documented two years of reproduction. Future conservation actions may include continued introduction efforts and documentation of downstream population expansion into Little Bull Elk Creek.

6.9.8 Porcupine Creek

Porcupine Creek (Figure 6-43) and its tributaries originate in the Bighorn Mountains of northern Wyoming and flow through Big Horn National Forest, tribal lands, and private lands for about 30 miles. The majority of the Porcupine Creek watershed is in Wyoming, and only a portion of the main stem and a few tributaries are in Montana.

Historically, Yellowstone cutthroat trout likely existed throughout much of the Porcupine Creek drainage. They currently occupy a few headwater streams in Wyoming. Little is known about the Montana portions, which lie entirely within the Crow Reservation. Surveys for the Montana portion are a high priority. Specific conservation actions will follow determination of species composition and related physical factors affecting distribution and potential.

6.9.9 Crooked Creek

Crooked Creek (Figure 6-43) originates in the south end of the Pryor Mountains, and flows south into Wyoming, eventually joining Bighorn Lake. In Montana, most of Crooked Creek flows through the CNF and BLM lands, although the lower four miles flow through private property. Crooked Creek has been the subject of considerable effort to secure the remaining Yellowstone cutthroat trout present in this stream.

Crooked Creek supports a population of nonhybridized Yellowstone cutthroat trout, which was sympatric with brook trout in its upper reaches. A couple of natural barriers exist in Crooked Creek, and the uppermost barrier provides a small refuge of stream habitat for Yellowstone cutthroat trout that was free of nonnative brook trout. Catastrophic flooding and debris flows following a wildfire resulted in extirpation of brook trout from reaches of Crooked Creek within the CNF and BLM lands. Biologists from FWP, BLM, and the CNF mobilized to install a barrier to prevent reinvasion of nonnative trout from downstream reaches. Unfortunately, brown trout gained access over a temporary gabion barrier and spawned, resulting in a newly established population of brown trout within this reach.

Mechanical fish removals ensued over the next few years, while agency biologists raised grant funds for construction of a permanent concrete barrier. Electrofishing proved an ineffective means to achieve total elimination of brown trout. Each removal event yielded similar numbers of brown trout, indicating these efforts were not depleting the brown trout population. Following construction of the concrete barrier in 2007, fisheries managers decided that piscicide was the only viable option to secure the native Yellowstone cutthroat trout population, and provide them with sufficient habitat to ensure the population's long-term survival.

Piscicide application occurred in 2008, and subsequent monitoring found this effort was successful in removal of nonnative brown trout. Remaining conservation actions for Crooked Creek will include monitoring to document downstream movement of Yellowstone cutthroat trout into the reclaimed stream, and evaluation of the efficacy of the barrier in preventing reinvasion of nonnative fishes. In addition, genetic monitoring is a potential activity that will determine if low population size and inbreeding depression present threats to Crooked Creek's native Yellowstone cutthroat trout population.

6.10 Shoshone River Subbasin (HUC 10080014)

The Shoshone River HUC (Figure 6-44) lies mostly in Wyoming, with a small portion extending north into Montana. Historically, Yellowstone cutthroat trout occurred throughout the Shoshone River main stem and many of its tributaries. Until recently, Yellowstone cutthroat trout were restricted to a short expanse of Piney Creek, a small spring creek on the west side of the Pryor Mountains in Montana. In 2010, a conservation effort to restore Yellowstone cutthroat trout into the creek resulted in release of Yellowstone cutthroat trout into the creek following an initial piscicide project aimed at removing nonnative brook trout and rainbow trout.

The Sage Creek watershed encompasses the majority of the Montana portion of the Shoshone HUC (Figure 6-44). Streams in the Sage Creek watershed originate in the Pryor Mountains, and landownership includes CNF, the Crow Reservation, and BLM lands. The valley portions of the Sage Creek watershed flow through arid scrubland. Currently, the suitable potential habitats for Yellowstone cutthroat trout are restricted to headwaters portion of the basin within the Pryor Mountains.

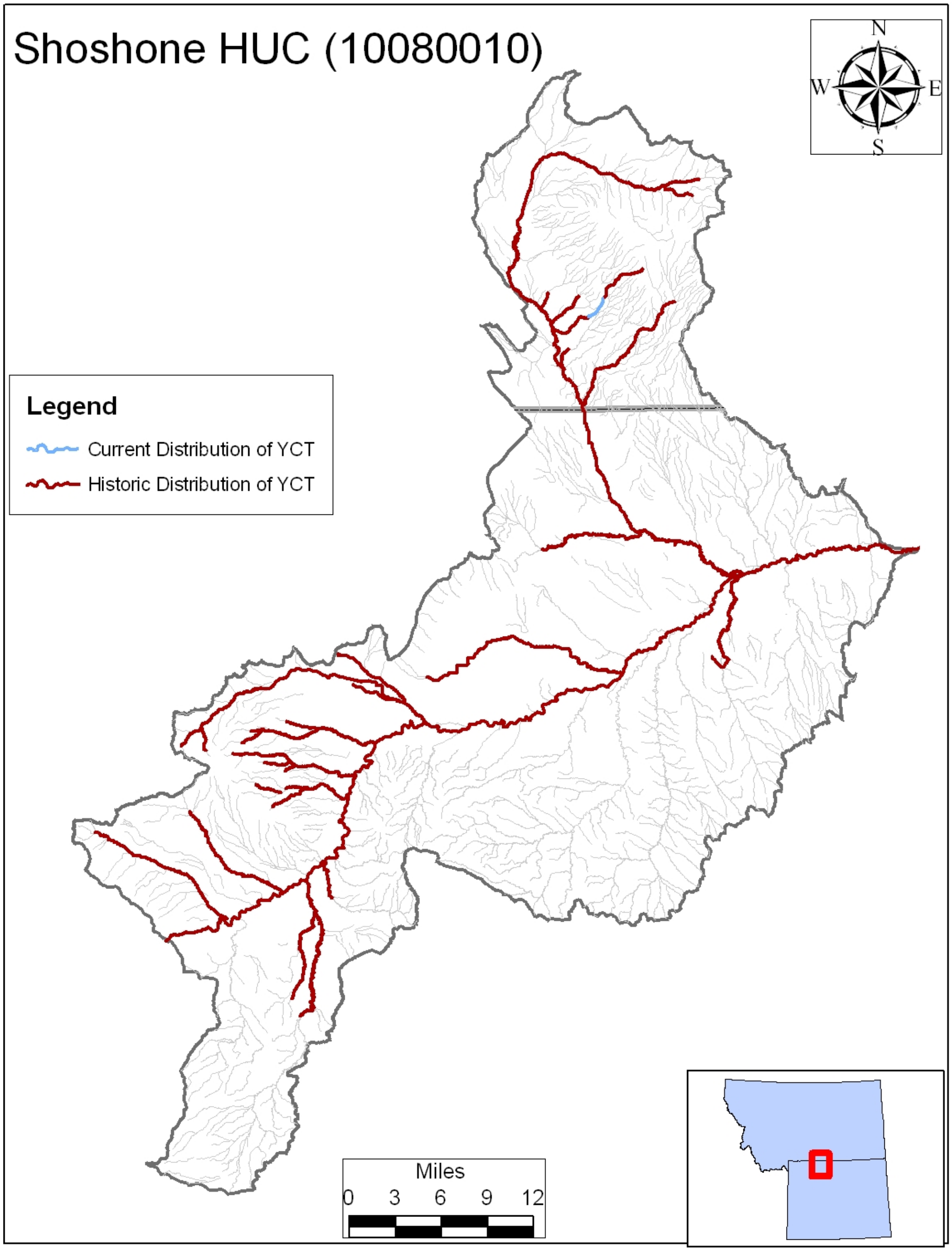

Figure 6-44: Shoshone River Subbasin (HUC 10080014)

6.10.1 Sage Creek

Sage Creek (Figure 6-45) originates in the northern terminus of the Pryor Mountain and flows west then south to the Wyoming border. Sage Creek and its tributaries flow through a mixture of national forest and private lands before entering the Crow Reservation. Habitat suitable for cold-water fisheries extends from its headwaters to Bowler Flats, an area of irrigated crop production located about 3 river miles downstream of the Crow Reservation boundary. Downstream of Bowlers Flats, Sage Creek is largely intermittent and provides habitat more suitable for warm-water, prairie fish species.

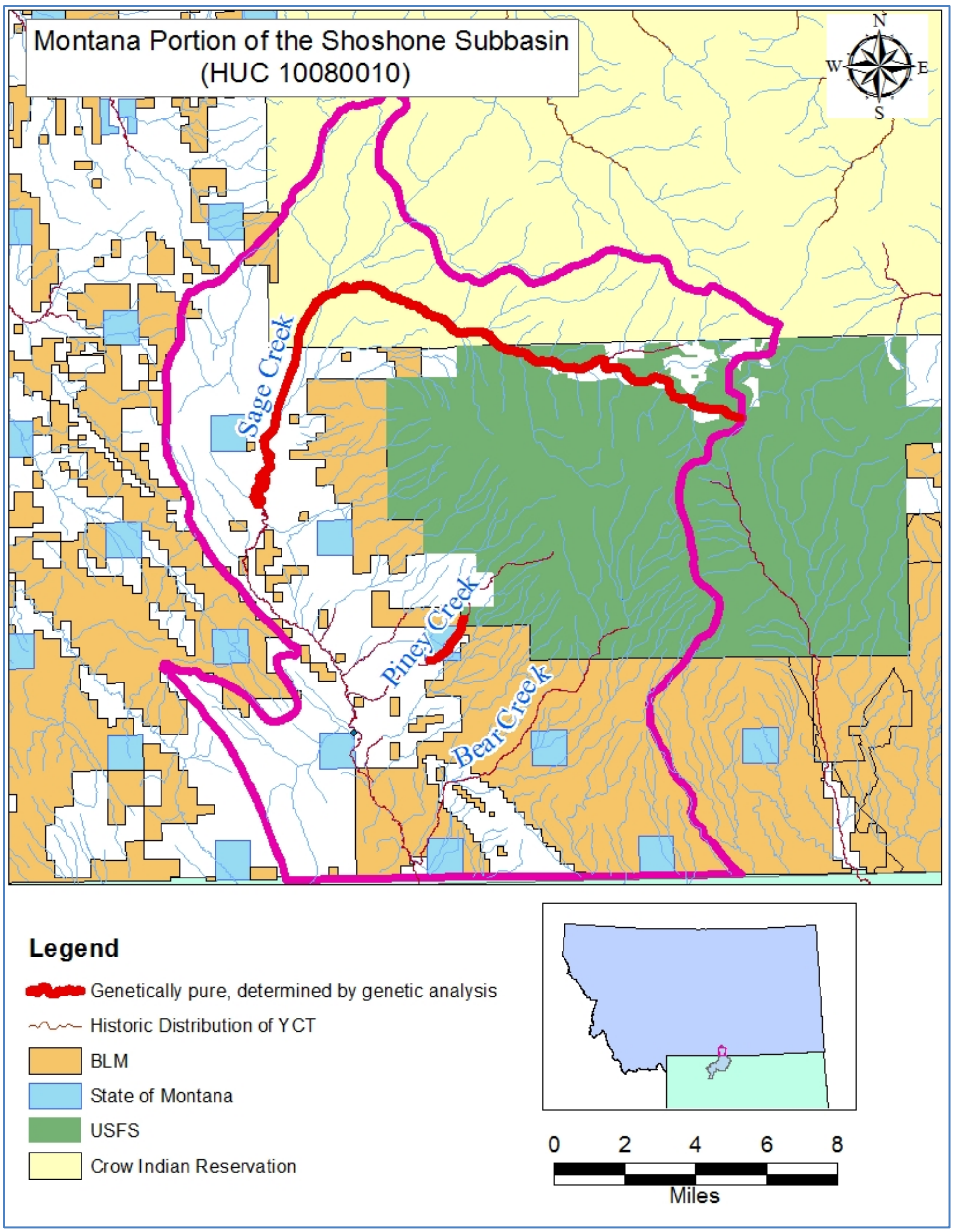

Figure 6-45: Montana portion of the Shoshone Subbasin.

Sage Creek has been the subject of current and ongoing actions to reestablish a population of Yellowstone cutthroat trout. Introductions of rainbow trout and brook trout in previous decades resulted in extirpation of the stream's native Yellowstone cutthroat trout population. In late summer of 2010, state and federal agencies, and the Crow Tribe, initiated a piscicide project to remove the existing fishery. Piscicide treatment began in the headwaters and extended through the Crow Reservation and several miles downstream into privately owned valley portions of the stream. As Sage Creek is typically dry downstream of irrigated pastures outside of the Crow Reservation, no barrier was required to prevent reinvasion of nonnatives from the Shoshone River in Wyoming.

Ideally, the first piscicide treatment results in a total fish kill; however, complex habitat can result in refugia for target organisms. Monitoring in 2011 found several brook trout, resulting in re-treatment of a portion of Sage Creek. Follow-up monitoring in 2012 yielded no brook trout, indicating the second treatment was sufficient in eradicating nonnative fishes. Monitoring will continue to ensure complete reclamation. As Sage Creek supported a popular recreational fishery for visitors to the CNF and locals, an interim reintroduction of Yellowstone cutthroat trout occurred soon after the first piscicide treatment. The objective was to provide anglers with catchable trout in an effort to mitigate the effects of piscicide treatment on recreation.

The Sage Creek Yellowstone cutthroat trout restoration project has substantial conservation benefit. Notably, Sage Creek will provide over 25 miles of stream habitat for native Yellowstone cutthroat trout that is also free of nonnative trout species. This extent of protected habitat is exceedingly rare throughout the Yellowstone cutthroat trout's historic range and is unprecedented along the fringe of the remaining distribution. Moreover, reestablishment of Yellowstone cutthroat trout into this amount of connected habitat in a watershed where they have been nearly extirpated is a substantial reversal of historic loss.

Additional conservation actions for Sage Creek relate to improving habitat quality in portions of this reestablished range. In some reaches, livestock grazing practices are incompatible with riparian health and function, and in-stream habitat quality. Implementing BMPs that maintain agricultural values while improving stream health would be beneficial to Sage Creek's restored Yellowstone cutthroat trout population.

6.10.2 Piney Creek

Piney Creek (Figure 6-45) emerges as a small spring creek in the foothills of the Pryor Mountains. Piney Creek supports the sole remnant population of Yellowstone cutthroat trout in the Shoshone HUC, and the fish-bearing portions of Piney Creek are restricted to less than a mile of channel. The stream flows through CNF, BLM lands, and state lands before entering private lands.

This small population of Yellowstone cutthroat trout faces several threats, including small population size, isolation, entrainment into irrigation systems, and limitations in habitat quality.

Soon after entering private lands, an irrigation system intercepts Piney Creek's flows, and water occupies its historic channel only during spring run-off or storm events. The irrigation system presents a sink for Yellowstone cutthroat trout in Piney Creek, as fish entering the canals are lost. Livestock use of the riparian area has potential to reduce habitat quality and trample redds in the small amount of available spawning habitat. Pool habitat and areas with spawning gravels are also limited, which affects carrying capacity and recruitment of Yellowstone cutthroat trout.

Several actions have contributed to conservation of Piney Creek's Yellowstone cutthroat trout population. In 2010, modification of the downstream diversions established a means to continue delivery of water to water rights holders, while impeding entrainment of Yellowstone cutthroat trout. This project involved impounding the lower end of the fish-bearing portion of Piney Creek into an existing depression. Instead of culverts set at grade, installation of three screened standpipes allowed for delivery of water to irrigation ditches and the historic channel. The pond provides low-water refugia for Yellowstone cutthroat trout, and the standpipes discourage entrainment of juvenile and adult Yellowstone cutthroat trout. Young fish will be unlikely to venture into the water column and will not encounter the standpipes. The screens will prevent older fish from being entrained.

Habitat improvements have also been a part of conservation actions in Piney Creek. Riparian fencing and off-channel stock tanks now reduce the pressure exerted by livestock on the stream. Installation of rock and log structure promote scour of pools and allow for sorting of gravels to improve the availability and quality of spawning habitat.

Small population size and isolation continue as substantial risks to Piney Creek's Yellowstone cutthroat trout population. FWP will monitor the population and its genetic status. Reintroduction may be necessary in the event disturbance eliminates this small population. Likewise, supplementing the population may be warranted if inbreeding depression results in genetic risks.

6.10.3 Bear Creek

Bear Creek (Figure 6-45) is a tributary of Sage Creek that likely supported Yellowstone cutthroat trout historically. Its headwaters originate in the Pryor Mountains, and it flows through CNF lands, BLM lands, and private lands until its confluence with Sage Creek. No fisheries data are available for Bear Creek. Future efforts should include fish surveys and determination of Bear Creek's potential to support reintroduction of Yellowstone cutthroat trout.

6.11 Lower Bighorn Subbasin (HUC 10080015)

The lower Bighorn River hydrologic (Figure 6-46) unit begins at Yellowtail Dam, and encompasses the area contributing to the Bighorn River until its confluence with the Yellowstone River. The upstream portions of the watershed are within the Crow Reservation, and the downstream two thirds of the basin are on primarily private lands. Land uses include livestock grazing and irrigated crop production.

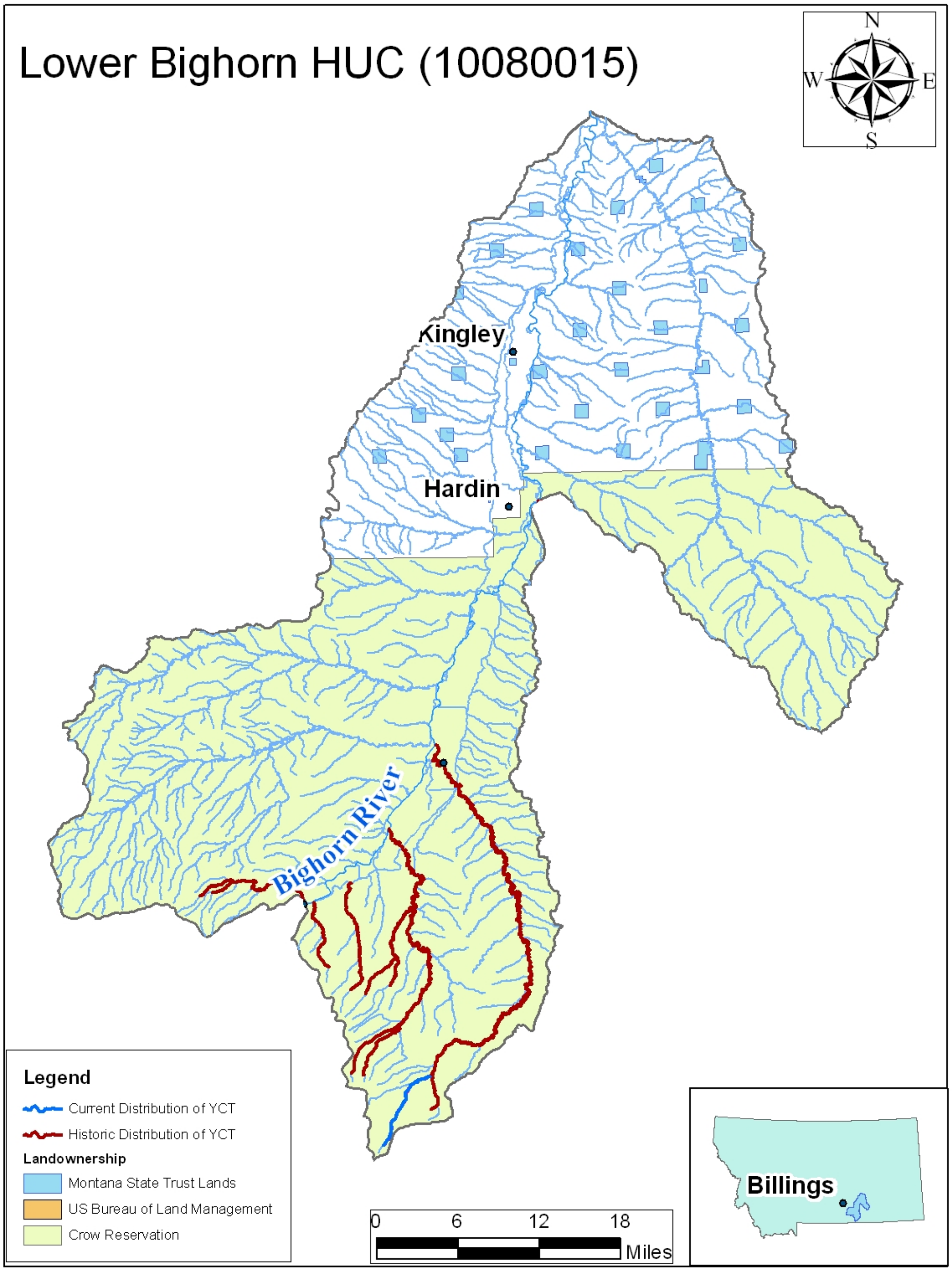

Figure 6-46: Lower Bighorn River Subbasin (HUC 100810015).

The Lower Bighorn River Subbasin provides habitat to warm-water and cold-water fish assemblages. Streams with headwaters in the Bighorn Mountains have potential to support cold-water fisheries, and Yellowstone cutthroat trout occupied these streams historically. Otherwise, streams support warm-water fish assemblages composed mostly of native prairie species (Table 6-63).

Table 6-63: Distribution and abundance of fishes rating as common or abundant in the Bighorn River (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Data rating*
42	53	Brown trout	Common	EFMSO
53	84	Brown trout	Abundant	EFMSO
0	53	Burbot	Common	EFSSO
0	50	Channel catfish	Common	EFMSO
0	85	Common carp	Common	EFMSO
0	42	Flathead chub	Common	EFSSO
0	53	Goldeye	Abundant	EFMSO
53	66	Goldeye	Common	EFMSO
0	53	Longnose dace	Common	NSPJ
53	84	Longnose dace	Abundant	NSPJ
0	84	Longnose sucker	Abundant	EFMSO
0	53	Mountain sucker	Common	EFSSO
42	53	Mountain whitefish	Common	EFMSO
53	84	Mountain whitefish	Common	EFMSO
0	53	Rainbow trout	Common	EFMSO
53	84	Rainbow trout	Abundant	EFMSO
0	53	River carpsucker	Common	EFSSO
0	53	Shorthead redhorse	Common	EFMSO
0	42	Western silvery/plains minnow	Common	NSPJ
0	84	White sucker	Abundant	EFMSO

Completion of Yellowtail Dam altered the fisheries potential in this portion of the Bighorn River. Historically, this river supported a warm-water assemblage of riverine species. The hypolimnetic release of cold, clear nutrient-rich water now supports a popular tailwater fishery for rainbow and brown trout for 21 miles, with trout found throughout and often abundant for over 40 miles downstream of the dam. The Bighorn River then reverts to a warm-water prairie river. The abundance of brown trout and rainbow trout downstream of Yellowtail Dam means any Yellowstone cutthroat trout restoration in adjacent tributaries would require construction of barriers to prevent invasion of the nonnative fishes.

6.11.1 Rotten Grass Creek

Rotten Grass (Figure 6-47) emerges from numerous springs on the northern slope of the Bighorn Mountains on the Crow Reservation. The stream flows to the north for about 70 miles through a mixture of tribal, allotted, and private lands until its confluence with the Bighorn River near Saint Xavier.

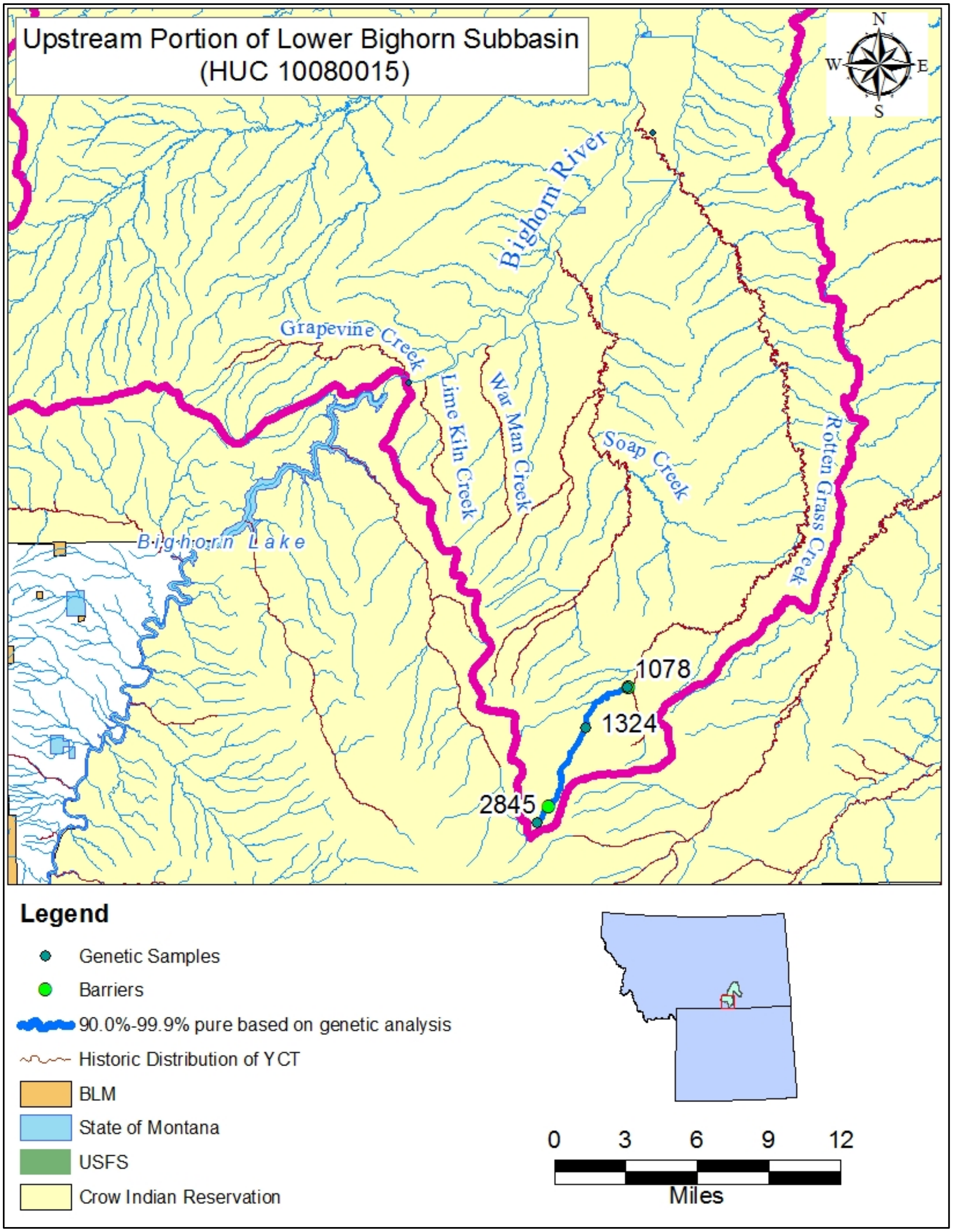

Figure 6-47: Portions of the lower Bighorn River watershed supporting cold-water fisheries.

Fish community composition varies along the length of Rotten Grass Creek (Table 6-64). The lower 60 miles of stream supports a warm-water assemblage of mostly native prairie species. Historically, Yellowstone cutthroat trout were present in the upper 20 miles of Rotten Grass

Creek, but are now relegated to the upper 9 miles above a natural barrier. These fish are slightly introgressed (Table 6-65) with westslope cutthroat trout genes originating from a fish car-stocking event in 1917. This slightly introgressed population is managed as a conservation population.

Table 6-64: Distribution and abundance of fishes in Rotten Grass Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Data Rating*
16	17	Fathead minnow	Unknown	EFSSO
16	17	Lake chub	Rare	EFSSO
0	75	Longnose dace	Common	EFSSO
0	75	Longnose sucker	Common	NSPJ
0	75	White sucker	Common	EFSSO
67	74	Yellowstone cutthroat trout	Common	NSPJ

Table 6-65: Summary of genetic analyses conducted in Rotten Grass Creek (MFISH database).

Sample. No.	*Sample Size*	*Target Species*	*Percent of Genes*	*Collection Date*
2845	29	YCT	98	06/21/2000
2845	29	WCT	2	06/21/2000
1324	16	YCT	99	10/29/1998
1324	16	WCT	1	10/29/1998
1078	10	YCT	100	08/20/1995

Habitat impairment presents a constraint on Rotten Grass Creek's ability to support a healthy Yellowstone cutthroat trout population. Current livestock grazing practices have adverse effects on riparian health and function, bank stability, and stream morphology. Irrigation withdrawals result in chronic dewatering in the stream's lower reaches. Implementing agricultural BMPs that are compatible with livestock production and Yellowstone cutthroat trout conservation would be beneficial to this isolated population of cutthroat trout.

6.11.2 Soap Creek

Soap Creek (Figure 6-47) emerges from two springs at the base of the north slope of the Bighorn Mountains on the Crow Reservation. The stream flows to the north for approximately 30 miles through a mixture of tribal, allotted, and private lands before its confluence with the Bighorn River.

Historically, Yellowstone cutthroat trout occupied the upper 15 miles of Soap Creek, but are no longer present. The existing fishery is a mixture of native minnows and suckers, and introduced brown trout, rainbow trout, and brook trout (Table 6-66).

Table 6-66: Distribution and abundance of fishes in Soap Creek (MFISH database).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Use Type*	*Data Rating*
0	38	Brook trout	Rare	Year-round resident	NSPJ
0	38	Brown trout	Common	Year-round resident	NSPJ
0	38	Fathead minnow	Common	Year-round resident	NSPJ
0	38	Lake chub	Rare	Year-round resident	NSPJ
0	38	Longnose dace	Common	Year-round resident	NSPJ
0	38	Longnose sucker	Common	Year-round resident	NSPJ
0	38	Mountain sucker	Common	Year-round resident	NSPJ
0	38	Rainbow trout	Common	Year-round resident	NSPJ
0	38	Shorthead redhorse	Rare	Year-round resident	NSPJ
0	38	White sucker	Common	Year-round resident	NSPJ

Potential conservation actions for Soap Creek include reintroduction of Yellowstone cutthroat trout, and implementation of grazing BMPs to restore stream health. Reestablishment of a Yellowstone cutthroat trout population would require removal of the existing nonnative species occupying this stream and construction of a barrier to prevent reinvasion by nonnatives in the neighboring Bighorn River. Future investigations should focus on identification of potential barrier sites.

6.11.3 War Man Creek

War Man Creek (Figure 6-47) is a small stream originating from springs on the northern slopes of the Bighorn Mountains and flowing to the north for about 13 miles until its confluence with the Bighorn River. Landownership is a mixture of tribal, allotted, and private lands. Currently, the Bighorn Canal captures the entire flow of War Man Creek about one mile from its confluence with the river.

Little information is available on fish distribution or fisheries potential of War Man Creek. Presumably, Yellowstone cutthroat trout occupied the entire stream, although extirpation is likely. The habitat available for support of cold-water fishes is probably limited to the upper 3.5 miles of stream. Current livestock grazing practices are incompatible with fisheries needs, which present another constraint on the potential of the fishery.

The conservation strategy for War Man Creek is to conduct field surveys to determine the potential for reestablishment of a Yellowstone cutthroat trout population. Factors needing consideration include the potential for the Bighorn Canal to be a source of nonnatives, and potential for sufficient stream habitat to be present with improvements in grazing management. If only 3.5 miles of the stream has potential for reintroduction, this project would be a relatively low priority compared to projects that would afford a greater extent of occupiable habitat.

6.11.4 Lime Kiln Creek

Lime Kiln Creek (Figure 6-47) is a small stream that enters the Bighorn River just below Yellowtail Dam. No data are available to describe the fishery or its potential. If this stream does support a fishery, species present likely reflect those present in the adjacent Bighorn River, which include nonnative rainbow and brown trout. Determining the potential for Lime Kiln Creek to provide sufficient habitat of suitable quality and identification of a potential barrier site are data needs.

6.11.5 Grapevine Creek

Grapevine Creek (Figure 6-47) is an 8-mile long tributary of the Bighorn River that joins the river downstream of Yellowtail Dam. No data are available to evaluate its current fishery or potential. Baseline surveys are necessary to determine if reestablishment of Yellowstone cutthroat trout is possible in Grapevine Creek.

6.12 Little Bighorn Subbasin (HUC 10080016)

The Little Bighorn HUC (Table 6-67) originates in Wyoming, but most of its area is in Montana. The Montana portion of the watershed is entirely within the Crow Reservation. Livestock grazing and irrigated crop production are the primary land uses.

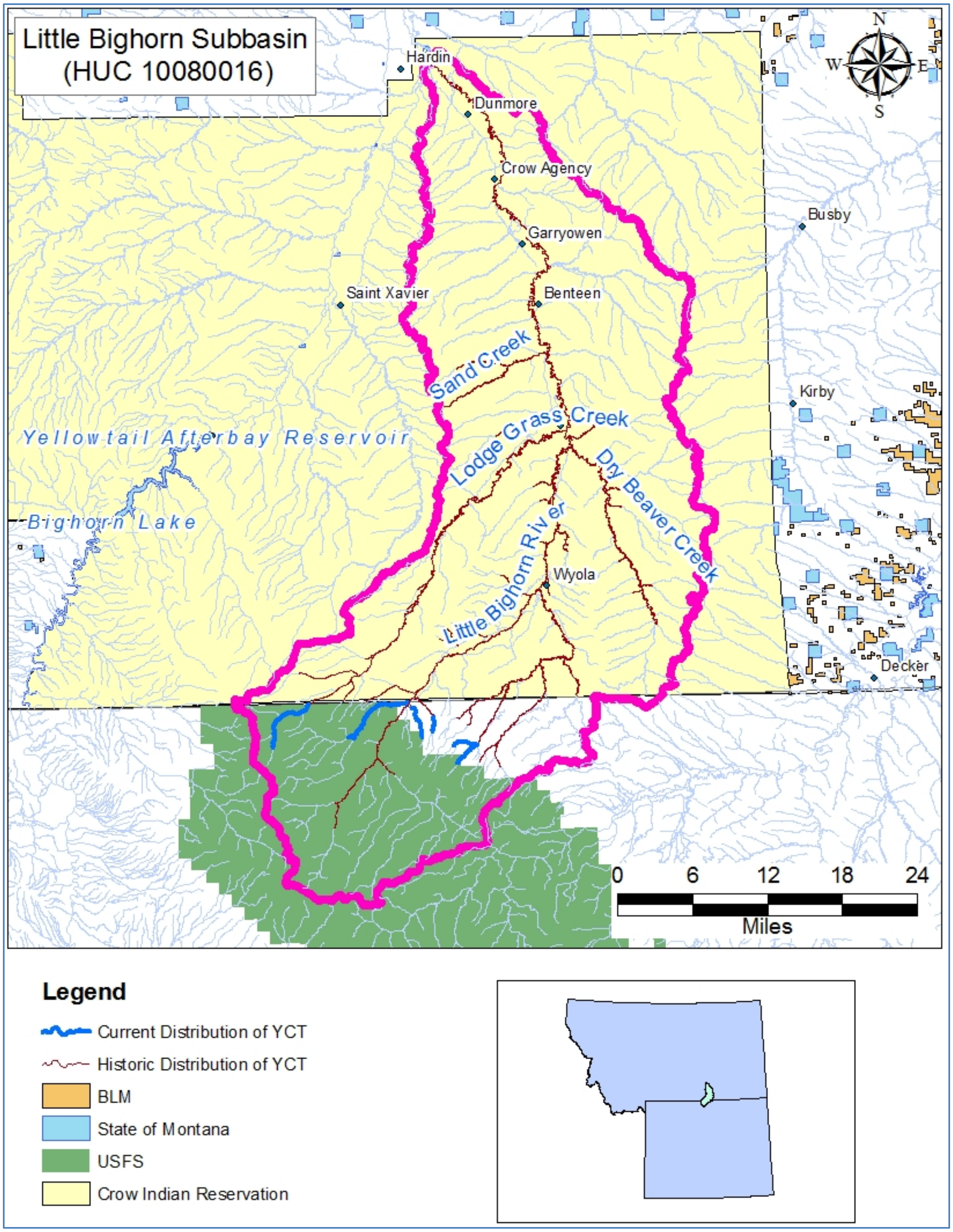

Table 6-67: Little Bighorn River Subbasin (HUC 10080016)

Historically, Yellowstone cutthroat trout occurred throughout the watershed; however, cutthroat trout are now present in several isolated streams in the Wyoming portion of the drainage (Table 6-67). Although Yellowstone cutthroat trout were presumed present in much of the basin, streams within the Bighorn Mountains were the most likely to provide substantial habitat for Yellowstone cutthroat trout historically. This watershed also supports warm-water prairie fish communities, and these streams have low potential for Yellowstone cutthroat trout restoration. Fish distribution and abundance data from MFISH (Table 6-68) illustrate the tendency for cold-water species to occupy higher elevation reaches and for warm-water species to be most abundant in the downstream portions of the watershed.

Table 6-68: Distribution and abundance of fishes in the Little Bighorn River (data from MFISH).

Begin Mile	*End Mile*	*Species*	*Abundance*	*Data Rating*
0	32	Brassy minnow	Unknown	EFMSO
0	31	Brown trout	Rare	NSPJ
31	118	Brown trout	Common	NSPJ
0	31	Channel catfish	Common	EFMSO
0	31	Common carp	Unknown	EFMSO
0	32	Fathead minnow	Common	EFMSO
0	32	Flathead chub	Common	EFMSO
0	32	Longnose dace	Common	EFMSO
0	118	Longnose sucker	Common	NSPJ
0	32	Mountain sucker	Common	EFMSO
31	118	Mountain whitefish	Common	NSPJ
31	118	Rainbow trout	Common	NSPJ
0	32	River carpsucker	Rare	EFMSO
0	32	Shorthead redhorse	Abundant	EFMSO
0	31	Smallmouth bass	Common	NSPJ
28	29	Stonecat	N/A	EFSSO
0	31	White sucker	Common	EFMSO

A lack of fish survey data is a major constraint in developing a specific strategy for Yellowstone cutthroat trout in the Montana portions of the Little Bighorn watershed. Biologists from the USFWS and BIA began survey efforts in 2010. Subsequent iterations of this strategy will include their findings and recommendations.

7.0 Summary

Conservation of Yellowstone cutthroat trout in Montana will require an integrated approach that addresses the various threats to the species. The Agreement for cutthroat trout conservation establishes goals, objectives, and priorities for cutthroat trout conservation (MCTSC 2007), and this strategy provides a framework for meeting these goals and objectives

The available information on waters within the historic range of Yellowstone cutthroat trout in Montana provides an initial screen in evaluating potential conservation needs. The identified needs relate to goals and objectives of the Agreement, and conservation priorities (Table 7-1). Review of the available information for each body of water or sub-watershed allowed generation of a list of potential conservation needs. This analysis provides the basis for prioritizing potential projects following the framework detailed in the Agreement. Summary tables for each stream or sub-watershed described in Chapter 6.0 are in Appendix A.

Table 7-1: Basis for prioritizing potential actions to meet goals and objectives of the Agreement.

Potential Conservation Needs	***Relation to Agreement and Conservation Planning***
Maintain, secure, and enhance existing conservation populations	The highest conservation priority is to maintain, secure, and enhance conservation populations
Identified opportunities to restore YCT in historic range	Restoring YCT to stream where they have been extirpated is the 2nd highest priority
Identified opportunities to establish YCT in historically fishless waters	This action is 3rd highest priority if introductions would not harm other species
Identified opportunities to protect a fluvial life history strategy	Maintaining the diversity of life-history strategies is a goal of the Agreement.
Potential opportunities to restore fluvial life history strategy	Maintaining the diversity of life-history strategies is a goal of the Agreement.
Presence of nonnative salmonids	Nonnative salmonids pose a considerable threat to YCT, and removal or suppression is often consistent with the first and second priorities for YCT conservation
Potential need for barrier	The agreement acknowledges isolating YCT from nonnative salmonids may be necessary to allow populations to persist.
Identified need for survey due to a lack of fisheries data or the age of the available data	This category relates to two objectives of the Agreement, which entail continued survey to identify populations and monitoring to evaluate trends and status of YCT populations.
Identified projects to restore habitat or otherwise improve conditions for YCT	The Agreement includes habitat restoration among needed conservation actions to maintain conservation populations, or to increase the suitability of the habitat in restoring populations.
Subject of current or pending conservation actions	This category provides an accounting of the number of projects completed or pending, and assists in determining if efforts to meet conservation goals and objectives are sufficient.

Reviews in Chapter 6.0 allow calculation of the number of potential conservation projects identified in the categories described in Table 7-1. This review identified 51 known or potential conservation populations, and maintaining these is consistent with the highest priority for Yellowstone cutthroat trout conservation in Montana. Most of these populations are in the Upper Yellowstone Subbasin, although most HUCs retain at least one conservation population. Review of the available information identified 41 opportunities to restore Yellowstone cutthroat trout within historically occupied streams, which is consistent with the second highest priority in cutthroat trout conservation. Establishing Yellowstone cutthroat trout populations in previously fishless water is the third highest priority, and 16 potential projects exist in Montana.

Table 7-2: Summary of potential conservation actions per 4th code hydrologic unit. Column headings follow potential conservation needs listed in Table 7-1)

HUC	*Maintain, Secure, and Enhance Conservation Populations*	*Restore within Historic Range*	*Establish or Protect in Previous-y Fishless Waters*	*Protect Fluvial Life-History Strategy*	*Restore Fluvial Life-History Strategy*	*Remove Non-native Fishes*	*Construct Barriers to Prevent Invasion by Non-natives*	*Survey Needed*	*Potential Habitat Restoration Projects Identified*	*Subject of Past or Current Conservation Actions*
10070001	7	3				5	5	6	1	1
10070002	28	13	9	15	18	31	24	41	25	23
10070003	4			1	2	2		5	4	1
10070004										
10070005	3	5	4			6	3	7	1	3
10070006		10	1			11	1	8		2
10070007										
10070008	2	3	1			5	3	2		1
10080010	4	3	1			6	4	5	4	3
10080014	1	1				1		1	2	2
10080015	1	3				3	3	3	3	
10080016								1		
Grand Total	**51**	**41**	**16**	**16**	**20**	**70**	**43**	**79**	**40**	**36**

Protecting the diversity of life histories is among the goals of the Agreement, and numerous opportunities exist to protect or restore fluvial runs, with most being in the Upper Yellowstone Subbasin. Most of these potential projects would entail efforts to increase water use efficiency and obtain voluntary contributions from water rights holders to maintain sufficient stream flow during spawning, incubation, and drift. Related projects may include alterations to diversion structures or other features blocking fish passage to allow spawners access to streams. Likewise, installation of screens on diversions may be useful in preventing losses of adults or fry.

Nonnative species present a widespread constraint on remaining conservation populations and are abundant in streams where reestablishment of Yellowstone cutthroat trout is possible. The data review identified 70 cases where removal of nonnatives may be among actions needed to conserve or restore specific Yellowstone cutthroat trout populations (Table 7-2). The preferred approach to removal will need to be decided on a case-by-case basis. In some situations, mechanical removal using electrofishing in streams, or gill nets in lakes, may be the best option. In others, chemical removal may provide the most efficient means in meeting conservation goals. Factors to be considered in prioritizing waters for removal of nonnatives will include presence of a conservation population of Yellowstone cutthroat trout. Reestablishing a population in waters where they have been extirpated is a lower priority than securing existing populations. Other considerations include the amount of habitat available for a secured population and the feasibility of achieving full removal. Complex habitat, such as beaver dam complexes, makes mechanical and chemical removal more challenging.

As Yellowstone cutthroat trout populations do not typically fare well in sympatry with nonnative species, barrier construction to prevent invasion is among the potential conservation actions required to secure habitat for Yellowstone cutthroat trout. Review of stream narratives in Chapter 6.0 identified 43 scenarios where a barrier may be a preferred option. The cost of barriers varies with the type employed. For example, perched culverts are relatively inexpensive options. In contrast, stream-spanning concrete structures can cost more than $400,000. Factors to consider in prioritizing a stream for a barrier includes the amount of protected habitat, the genetic status of the population being protected, and the potential for the barrier to have negative consequences in terms of limiting access to important habitat. Evaluation of the trade-offs between securing a population and limiting fish movement and gene flow must be at a major consideration with every potential barrier project.

The Agreement places continued sampling to identify remaining Yellowstone cutthroat trout populations, and monitoring to determine trends as key objectives. The stream narratives in Chapter 6.0 identified 79 streams or sub-watersheds where survey was warranted to meet the objectives of the agreement. These investigations will be incorporated into future iterations of this conservations strategy, and the findings will likely result in modification of appropriate conservation actions for waters in Montana.

Data reviews identified numerous potential habitat restoration projects for streams in the planning area. These included habitat restoration projects and streams where implementation of agricultural BMPs would benefit habitat and water quality. The number of streams with identifiable projects is likely to grow as conservation partners conduct additional field surveys. In addition, water quality planning efforts underway to meet water quality goals will also identify projects likely to benefit Yellowstone cutthroat trout.

Review of the available information for waters in the Yellowstone cutthroat trout's historic range in Montana found that agencies and landowners have been actively working towards meeting the goals and objectives of the Agreement, with 36 streams or sub-watersheds having completed, ongoing, or pending projects. The agreement calls for implementation of 10 projects per year to benefit Yellowstone cutthroat trout. The number of identified potential projects will likely grow in future iterations of this strategy, as conservation partners work towards meeting the goals and objectives of the Agreement.

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9.0 Appendix A

This appendix contains tables detailing findings of data reviews for individual streams or sub-watersheds addressed in 5.0 Conservation Schedule and Milestones.

Table 9-1: Summary of potential conservation actions to maintain, restore, and enhance Yellowstone cutthroat trout in the Yellowstone Headwaters Subbasin (HUC 10070001).

Stream	*Maintain, Secure, and Enhance Conser-vation Populations*	*Restore YCT within Historic Range*	*Establish or Protect in Previously Fishless Waters*	*Protect Fluvial Life-History Strategy*	*Restore Fluvial Life-History Strategy*	*Remove Non-native Fishes*	*Construct Barriers to Prevent Invasion by Nonnatives*	*Survey Needed*	*Potential Habitat Restoration Projects Identified*	*Subject of Past or Current Conser-vation Actions*
Soda Butte Creek	✓	✓				✓	✓		✓	✓
Pebble Creek	✓					✓	✓			
Slough Creek	✓					✓	✓			
Buffalo Creek	✓							✓		
Hellroaring Creek	✓							✓		
Yellowstone River	✓							✓		
Bear Creek		✓				✓	✓	✓		
Eagle Creek		✓				✓	✓	✓		
Reese Creek	✓							✓		
Total	**7**	**3**	**0**	**0**	**0**	**5**	**5**	**6**	**1**	**1**

Table 9-2: Summary of potential conservation actions to maintain, restore, and enhance Yellowstone cutthroat trout in the Upper Yellowstone Subbasin (HUC 10070002).

Stream	*Maintain, Secure, and Enhance Conser-vation Populations*	*Restore YCT within Historic Range*	*Establish or Protect in Previously Fishless Waters*	*Protect Fluvial Life-History Strategy*	*Restore Fluvial Life-History Strategy*	*Remove Nonnative Fishes*	*Construct Barriers to Prevent Invasion by Nonnatives*	*Survey Needed*	*Potential Habitat Restoration Projects Identified*	*Subject of Past or Current Conser-vation Actions*
Yellowstone River	✓								✓	✓
Beattie Gulch					✓			✓		
Little Trail Creek	✓				✓			✓		
Bassett Creek		✓			✓	✓	✓	✓	✓	
Mulherin Creek	✓	✓		✓		✓		✓		✓
Cedar Creek		✓		✓		✓	✓		✓	✓
Tom Miner Creek	✓			✓		✓	✓			
Rock Creek	✓	✓			✓				✓	✓
Donahue Creek	✓							✓		
Big Creek	✓	✓		✓		✓	✓	✓	✓	✓
Dry Creek		✓			✓			✓	✓	

Stream	Maintain, Secure, and Enhance Conser-vation Populations	Restore YCT within Historic Range	Establish or Protect in Previously Fishless Waters	Protect Fluvial Life-History Strategy	Restore Fluvial Life-History Strategy	Remove Nonnative Fishes	Construct Barriers to Prevent Invasion by Nonnatives	Survey Needed	Potential Habitat Restoration Projects Identified	Subject of Past or Current Conser-vation Actions
Table 9-2 Continued										
Sixmile Creek	✓					✓	✓	✓	✓	✓
Emigrant Spring Creek				✓				✓		✓
Fridley Creek	✓			✓		✓	✓	✓		✓
Emigrant Creek		✓				✓	✓	✓	✓	
Eightmile Creek	✓			✓		✓	✓	✓	✓	
Mill Creek	✓			✓		✓		✓	✓	✓
Elbow Creek	✓	✓		✓		✓	✓	✓	✓	
Strawberry Creek		✓			✓			✓	✓	
Cascade Creek						✓		✓		
Trail Creek	✓	✓				✓	✓	✓	✓	✓
Pine Creek	✓	✓			✓	✓	✓		✓	
Deep Creek	✓				✓	✓	✓	✓	✓	
Nelson Spring Creek				✓				✓		✓
McDonald Creek				✓				✓		✓
Armstrong Spring Creek				✓				✓		✓
Suce Creek	✓				✓	✓	✓	✓	✓	
Billman Creek	✓					✓		✓	✓	
Fleshman Creek	✓				✓	✓	✓	✓	✓	✓
Mission Creek	✓			✓		✓	✓	✓	✓	
Work Creek	✓			✓				✓	✓	
Locke Creek	✓				✓		✓	✓	✓	✓
Greeley/Peterson	✓			✓		✓	✓	✓		
Duck Creek	✓		✓		✓	✓	✓	✓	✓	✓
Big Timber Creek	✓	✓			✓	✓	✓	✓		
Otter Creek	✓				✓	✓	✓	✓	✓	
Boulder River watershed above Hawley Falls			✓			✓				✓
Boulder River between Natural Bridge Falls and Hawley Falls			✓			✓				

Table 9-2 Continued

Stream	*Maintain, Secure, and Enhance Conser-vation Populations*	*Restore YCT within Historic Range*	*Establish or Protect in Previously Fishless Waters*	*Protect Fluvial Life-History Strategy*	*Restore Fluvial Life-History Strategy*	*Remove Nonnative Fishes*	*Construct Barriers to Prevent Invasion by Nonnatives*	*Survey Needed*	*Potential Habitat Restoration Projects Identified*	*Subject of Past or Current Conser-vation Actions*
Hawley Creek								✓		
Bramble Creek			✓							
Speculator Creek								✓		
West Chippy Creek								✓		
Great Falls Creek			✓					✓		✓
Falls Creek										
Froze-to-Death Creek								✓		
Fourmile and Meatrack creeks			✓			✓				✓
West Boulder River watershed			✓					✓		
Davis Creek			✓			✓				✓
East Boulder River			✓							
Upper Deer Creek	✓				✓	✓	✓			✓
Lower Deer Creek	✓				✓	✓	✓			✓
Bridger Creek								✓		
unmapped spring creeks					✓				✓	✓
Total	**27**	**12**	**9**	**15**	**17**	**29**	**22**	**39**	**24**	**23**

Table 9-3: Summary of potential conservation actions to maintain, restore, and enhance Yellowstone cutthroat trout in the Shields River watershed downstream of Chadbourne diversion (HUC 10070003).

Stream	***Maintain, Secure, and Enhance Conser-vation Populations***	***Restore YCT within Historic Range***	***Establish or Protect in Previously Fishless Waters***	***Protect Fluvial Life-History Strategy***	***Restore Fluvial Life-History Strategy***	***Remove Non-native Fishes***	***Construct Barriers to Prevent Invasion by Nonnatives***	***Survey Needed***	***Potential Habitat Restoration Projects Identified***	***Subject of Past or Current Conser-vation Actions***
Shields River	✓			✓					✓	
Bangtail Creek	✓					✓			✓	
Willow Creek	✓				✓	✓		✓	✓	
Falls Creek								✓		
Chicken Creek	✓				✓			✓	✓	✓
Adair Creek								✓		
Crazy Head Creek								✓		
Total	**3**	**0**	**0**	**1**	**1**	**2**	**0**	**4**	**3**	**0**

Table 9-4: Summary of potential conservation needs to maintain, restore, and enhance Yellowstone cutthroat trout in the Stillwater River Subbasin (HUC 10070005).

Stream	*Maintain, Secure, and Enhance Conservation Populations*	*Restore YCT within Historic Range*	*Establish or Protect in Previously Fishless Waters*	*Protect Fluvial Life-History Strategy*	*Restore Fluvial Life-History Strategy*	*Remove Nonnative Fishes*	*Construct Barriers to Prevent Invasion by Nonnatives*	*Survey Needed*	*Potential Habitat Restoration Projects Identified*	*Subject of Past or Current Conser-vation Actions*
Goose Creek		✓				✓				✓
Woodbine Creek	✓							✓		
Little Rocky Creek	✓					✓	✓	✓		
Bad Canyon	✓					✓				✓
Trout Creek		✓	✓			✓	✓			
Iron Creek			✓					✓		
Picket Pin Creek			✓					✓		
Castle, Meyer, and Lodgepole creeks		✓	✓			✓	✓	✓		
East Rosebud Creek										
West Rosebud Creek										
Fiddler Creek		✓				✓				
Fishtail Creek										
East Fishtail Creek								✓		
West Fishtail Creek								✓		
Island Lake		✓							✓	✓
Total	**3**	**5**	**4**	**0**	**0**	**6**	**3**	**7**	**1**	**3**

Table 9-5: Summary of potential conservation needs to maintain, restore, and enhance Yellowstone cutthroat trout in the Clarks Fork of the Yellowstone Subbasin (HUC 10070006).

Stream	***Maintain, Secure, and Enhance Conser-vation Populations***	***Restore YCT within Historic Range***	***Establish or Protect in Previously Fishless Waters***	***Protect Fluvial Life-History Strategy***	***Restore Fluvial Life-History Strategy***	***Remove Nonnative Fishes***	***Construct Barriers to Prevent Invasion by Nonnatives***	***Survey Needed***	***Potential Habitat Restoration Projects Identified***	***Subject of Past or Current Conser-vation Actions***
Line Creek			✓							
Bluewater Creek								✓		
Lake Fork Rock Creek		✓				✓				
West Fork Rock Creek		✓				✓				
Clear Creek		✓				✓		✓		
Volney Creek								✓		
West Red Lodge Creek	✓					✓		✓		
Barlow Creek								✓		
Hogan Creek		✓				✓				
East Red Lodge Creek		✓				✓				
Cole and Power creeks		✓				✓		✓		
Thiel Creek		✓				✓	✓			✓
Harney Creek		✓				✓				
Willow Creek		✓				✓		✓		
Spring Creek								✓		
Brush Fork Willow Creek		✓				✓				✓
Total	**1**	**10**	**1**	**0**	**0**	**11**	**1**	**8**	**0**	**2**

Table 9-6: Summary of potential conservation needs to maintain, restore, and enhance Yellowstone cutthroat trout in the Pryor Creek Subbasin (HUC 10070008).

Stream	***Maintain, Secure, and Enhance Conservation Populations***	***Restore YCT within Historic Range***	***Establish or Protect in Previously Fishless Waters***	***Protect Fluvial Life-History Strategy***	***Restore Fluvial Life-History Strategy***	***Remove Nonnative Fishes***	***Construct Barriers to Prevent Invasion by Nonnatives***	***Survey Needed***	***Potential Habitat Restoration Projects Identified***	***Subject of Past or Current Conservation Actions***
Pryor Creek		✓				✓	✓	✓		
East Fork Pryor Creek								✓		
East Pryor Creek		✓				✓	✓			
Shively Creek	✓	✓				✓				
Hay Creek	✓					✓				
Lost Creek			✓			✓	✓			✓
Total	**2**	**3**	**1**	**0**	**0**	**5**	**3**	**2**	**0**	**1**

Table 9-7: Summary of potential conservation needs to maintain, restore, and enhance Yellowstone cutthroat trout in the Bighorn Lake Subbasin (HUC 10080015).

Stream	*Maintain, Secure, and Enhance Conservation Populations*	*Restore YCT within Historic Range*	*Establish or Protect in Previously Fishless Waters*	*Protect Fluvial Life-History Strategy*	*Restore Fluvial Life-History Strategy*	*Remove Nonnative Fishes*	*Construct Barriers to Prevent Invasion by Nonnatives*	*Survey Needed*	*Potential Habitat Restoration Projects Identified*	*Subject of Past or Current Conservation Actions*
Dry Head Creek	✓					✓		✓	✓	✓
Hoodoo Creek		✓				✓	✓		✓	
Pitchfork Creek								✓	✓	
Spring Creek		✓				✓			✓	
Black Canyon Creek	✓					✓	✓	✓		
Big Bull Elk Creek	✓					✓	✓			
Little Bull Elk Creek			✓					✓		✓
Porcupine Creek		✓						✓		
Crooked Creek	✓					✓	✓			✓
Total	**4**	**3**	**1**	**0**	**0**	**6**	**4**	**5**	**4**	**3**

Table 9-8: Summary of potential conservation needs to maintain, restore, and enhance Yellowstone cutthroat trout in the Shoshone HUC (10080014)

Stream	*Maintain, Secure, and Enhance Conservation Populations*	*Restore YCT within Historic Range*	*Establish or Protect in Previously Fishless Waters*	*Protect Fluvial Life-History Strategy*	*Restore Fluvial Life-History Strategy*	*Remove Nonnative Fishes*	*Construct Barriers to Prevent Invasion by Nonnatives*	*Survey Needed*	*Potential Habitat Restoration Projects Identified*	*Subject of Past or Current Conservation Actions*
Sage Creek		✓				✓			✓	✓
Piney Creek	✓								✓	✓
Bear Creek								✓		
Total	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**2**	**2**