Westslope Cutthroat Trout Conservation Strategy for the Missouri River Headwaters of Southwest Montana

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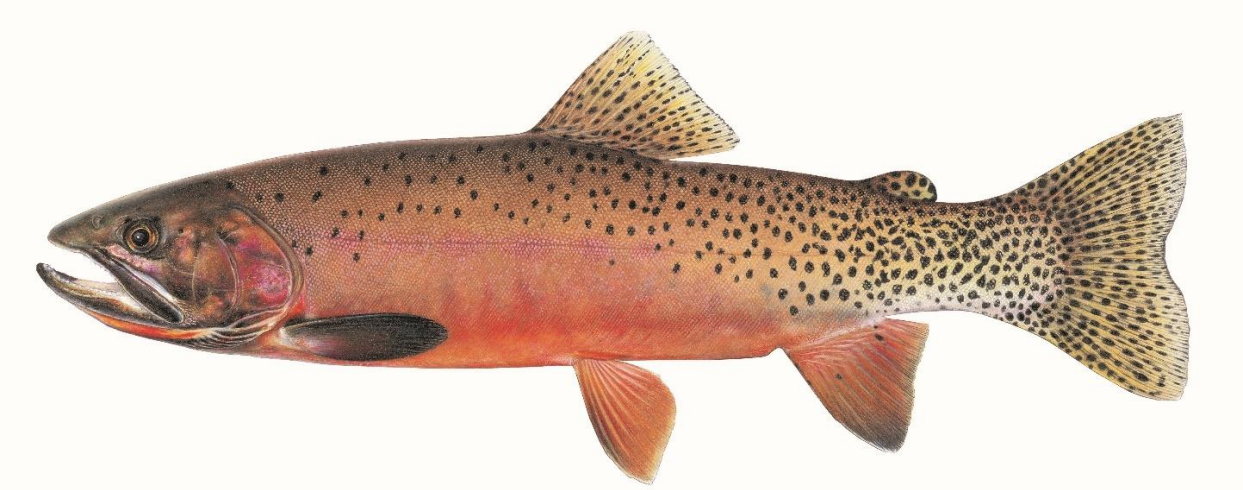

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Introduction and Overview

Westslope Cutthroat Trout, *Oncorhynchus clarkii lewisi* (WCT) were first described by the Lewis and Clark Expedition in 1805 near Great Falls, Montana, and are recognized as one of 14 interior subspecies of Cutthroat Trout. The historical range of WCT includes Idaho, Montana, Washington, Wyoming, and Alberta, Canada. The original distribution of WCT was the greatest of all sub-species of cutthroat trout. In Montana, WCT occupy the Upper Missouri and Saskatchewan River drainages east of the Continental Divide, and the Upper Columbia Basin west of the Divide. Although still widespread, WCT distribution and abundance in Montana has declined significantly in the past 100 years due to a variety of causes including introductions of nonnative fish, habitat degradation, and over-exploitation (Hanzel 1959, Liknes 1984, McIntyre and Rieman 1995, Shepard et al. 1997, Shepard et al. 2003). Reduced distribution of WCT is particularly evident in the Missouri River drainage where genetically unaltered WCT are estimated to persist in less than 5% of the habitat they once occupied, and most remaining populations are restricted to isolated headwater habitats (Shepard et al. 2003).

Declines in distribution and abundance of WCT led to its designation as a *Species of Special Concern* by the State of Montana and the Montana Chapter of the American Fisheries Society, a *Sensitive Species* by the U.S. Forest Service (USFS), and a *Special Status Species* by the U.S. Bureau of Land Management (BLM). In 1997 a petition was submitted to the U.S. Fish and Wildlife Service (USFWS) to list WCT as "threatened" under the *Endangered Species Act* (ESA). USFWS status reviews have found that WCT are "not warranted" for ESA listing (DOI 2003); however, this finding was in litigation until 2008 and additional efforts to list WCT under ESA are possible in the future. Since then, Montana Fish, Wildlife & Parks (FWP) and the Montana Natural Heritage Program have classified WCT as an "S2- species of greatest conservation need" which means they are "at risk because of very limited and/or potentially declining population numbers, range and/or habitat, making it vulnerable to global extinction or extirpation in the state" (FWP 2015). FWP has committed to conservation actions for the species in both the Statewide Action Plan (FWP 2015), and the Statewide Fisheries Management Plan (FWP 2019). In an effort to advance range-wide WCT conservation efforts in Montana, a Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana (MOU) was developed in 1999 and updated and revised in 2007 by several federal and state resource agencies (including BLM, FWP, USFS, and Yellowstone National Park), non-governmental conservation and industry organizations, tribes, resource users, and private landowners (FWP 1999, FWP 2007). The MOU outlined goals and objectives for WCT conservation in Montana, which if met, would significantly reduce the need for special status designations and listing of WCT under the ESA.

The primary management goal for WCT in Montana is to ensure the long-term self-sustaining persistence of the subspecies in its historical range (FWP 2007). In the Missouri River drainage, this goal will be achieved when secure WCT populations are restored to 20% of their historic distribution (FWP 2019).

Cooperative development of sub-basin level (4th order HUC) plans that describe the current status and required actions to meet the WCT conservation goal within each sub-basin were prescribed by the MOU. This document fulfills this obligation for nine sub-basins in the Upper Missouri River watershed of southwest Montana (Figure 1; Sections 1-9), and includes the following major elements recommended in the MOU for WCT conservation: 1) identification of WCT conservation populations (i.e., populations to be protected), 2) current status of each population, 3) short and long-term management actions required to maintain these populations, and 4) prioritized potential WCT restoration actions within each sub-basin. Where necessary, specific WCT conservation actions identified in this document (e.g., removal of nonnative trout to protect or restore a conservation population) will be developed with appropriate federal or state environmental assessment processes (MEPA/NEPA) that include public involvement.

This conservation strategy encompasses about 17,378 mi^2 of the Upper Missouri River drainage and includes the Beaverhead, Big Hole, Boulder, Gallatin, Jefferson, Madison, Red Rock, Ruby, and Upper Missouri sub-basins (Missouri River Headwaters; Figure 1). These nine sub-basins include over 26,000 miles of perennial and ephemeral streams, although there are only about 13,350 miles of named streams. Significant public land management entities within the assessment area include the Beaverhead–Deerlodge National Forest, BLM Dillon Field Office, FWP Region 3, Montana Department of Natural Resources, and United States Fish and Wildlife Service.

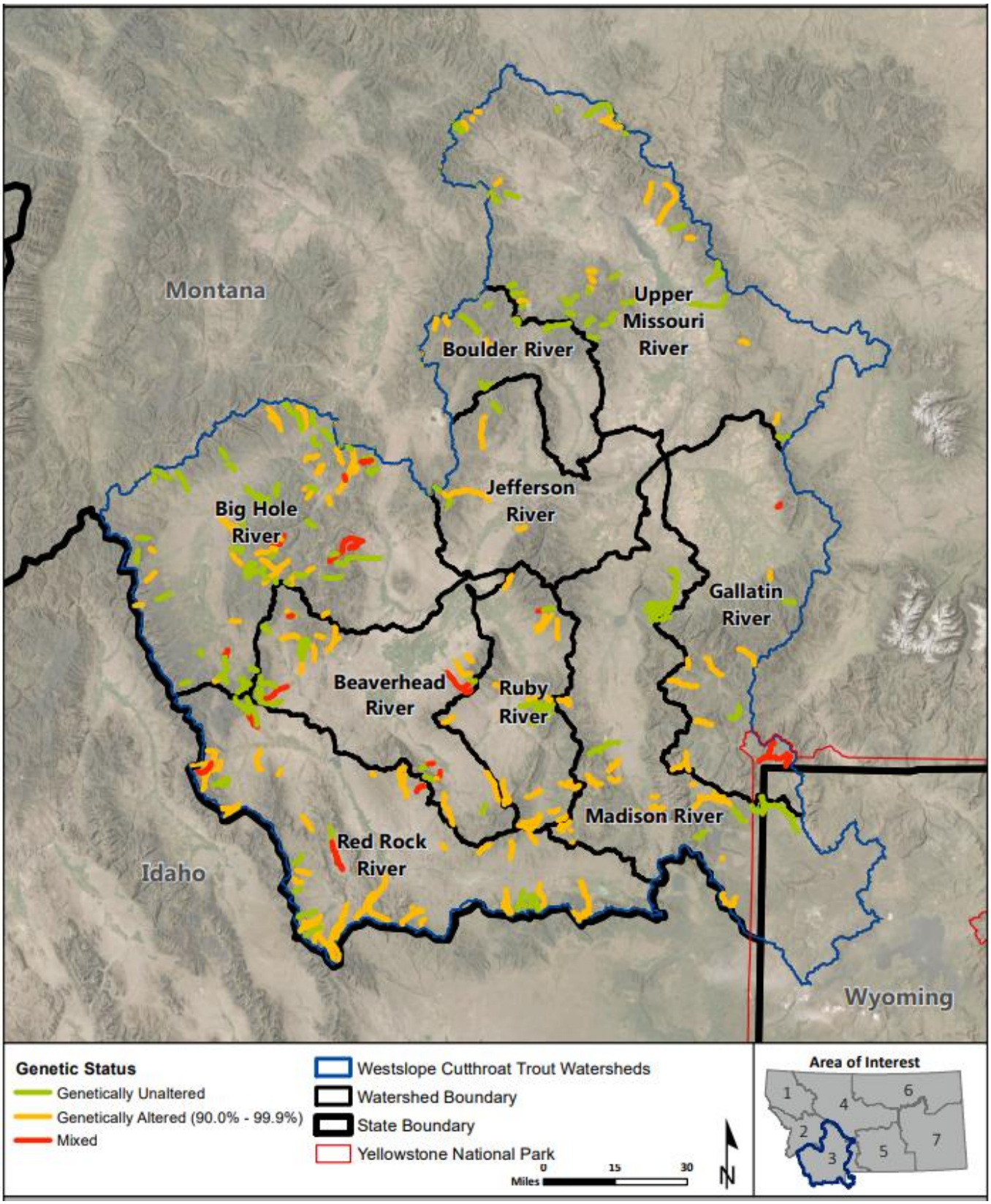

Figure 1. Distribution and genetic class of WCT conservation populations within the nine sub-basins (4th code HUC) of the upper Missouri River in southwest Montana.

WCT Status in the Missouri River Headwaters

Historically (circa 1800), WCT were the most broadly distributed fish species in southwest Montana and were estimated to have occupied about 15,739 miles of stream within the Missouri River headwaters, including all major rivers and connected tributaries (Table 1; Shepard et al. 2003). Historic WCT population characteristics would have included a large-bodied, fluvial life form, which migrated between the mainstem rivers and tributaries for spawning and rearing, and a smaller resident life form that would have resided in headwater streams where migration was limited (Liknes and Graham 1988). All remaining conservation populations in the assessment area are believed to persist as resident life forms and most occupy isolated headwater streams where distributions range from <2,000 feet to several miles (mean distribution = 5.6 miles). Few populations maintain more than 2,500 fish. An analysis by Shepard et al. (1997) indicated most remaining populations in the Missouri River drainage faced a high to very high risk of local extinction over the next 100 years due to threats such as habitat fragmentation and competition from or hybridization with nonnative trout. In this assessment, 70.1% (n=131) of the 187 conservation populations have been identified as "at-risk".

Table 1. Historic and current distribution of WCT in the Missouri River headwaters.

Sub-basin	Estimated miles of stream historically occupied by WCT [a]	Estimated miles of stream currently occupied by *genetically unaltered* WCT (% of historic distribution) [b]	Estimated miles of stream currently occupied by *all* identified WCT conservation populations (% of historic distribution)
Beaverhead	828	28.4 (3.4%)	82.2 (9.9%)
Big Hole	2,141	80.1 (3.7%)	220 (10.3%)
Boulder	988	20.0 (2.0%)	27.9 (2.8%)
Gallatin	1,048	25.7 (3.0%)	79.6 (7.6%)
Jefferson	2,176	5.0 (0.2%)	34 (1.6%)
Madison	1,256	131.8 (10.5%)	199.6 (15.9%)
Red Rock	1,638	42.1 (2.6%)	185.3(11.3%)
Ruby	900	31.6 (3.5%)	98 (10.9%)
Upper Missouri	4,764	65 (1.4%)	99.6 (2.1%)
Total	15,739	429.7 (2.7%)	1026.2 (6.5%)

[a] based on, May 2009 Inland Cutthroat Trout Assessment Protocol data

[b] includes genetically unaltered populations, and unaltered segments of populations comprised of unaltered and altered fish (i.e., mixed populations)

WCT conservation populations (i.e., populations that have conservation value and count towards conservation goals) are comprised of fish that are <10% hybridized (FWP 2007, FWP 2019), which is a generally accepted introgression level where the phenotypic characteristics of WCT have been maintained (Leary et al. 1996; Utah Division of Wildlife Resources 2000). This is a more conservative approach to defining conservation populations than the most recent USFWS status review which allowed up to 20% introgression (DOI 2003). Conservation populations are divided into four categories to describe genetic class and prioritize conservation efforts. *Genetically Unaltered* populations have no introgression or hybridization with nonnative trout based on genetic testing. *Genetically Altered* populations are ≤10% introgressed or have insufficient evidence to conclude that the entire population is ≥10% introgressed. *Mixed* populations occur

where a physical barrier isolates genetically unaltered WCT from a downstream genetically altered conservation population. Fundamentally, the only difference in management between the different conservation population classes is that in most situations, donor sources (gametes or live fish) for restoration efforts will only be from genetically unaltered populations and that in the short-term, genetically unaltered and mixed populations will receive a greater share of discretionary resources.

One hundred eighty-six WCT conservation populations occupy 1,033 miles of stream, or about 6.6% of their historic range, within the nine sub-basins in southwest Montana (Tables 1 and 2; Figure 1). Seventy-four genetically unaltered populations occupy 455 miles comprising about 2.8% of the historic range. Since 2010, 18 population restoration projects were completed in 5 sub-basins that added about 250 miles of unaltered WCT. Another 98 miles will be added following completion of ongoing projects in French Creek, South Fork Sixteenmile Creek, North Fork Spanish Creek, and Selway Creek. Streams in the assessment area with WCT conservation populations are listed in Table 3. Status, distribution, genetic class, and conservation needs for each population are presented in the individual sub-basin sections of this assessment (Sections 1-9).

Table 2. Number and genetic class of WCT conservation populations in the assessment area.

Sub-basin	**Number of Conservation Populations by Genetic Class**			
	Genetically Unaltered	Mixed	Genetically Altered	**Total**
Beaverhead	7	1	8	16
Big Hole	25	3	21	49
Boulder	6	0	3	9
Gallatin	3	0	8	11
Jefferson	2	0	2	4
Madison	7	0	13	20
Red Rock	10	0	21	31
Ruby	4	0	11	15
Upper Missouri	23	1	8	32
Total	**87**	**5**	**95**	**187**

Population-specific genetic information used for status determination can be accessed at the FWP web site (http://fwp.mt.gov/gis/maps/fishingGuide/) using the interactive Fishing Guide Mapper. The genetic class within each stream can be found by selecting Fish Distribution, Species of Concern – Genetic Status, and then selecting Westslope Cutthroat Trout from the drop-down window. Specific genetic samples can be viewed by selecting Sampling Locations, Genetic Samples, and then zooming in to select individual genetic sampling locations.

Table 3. Streams with WCT conservation populations, by sub-basin. Populations may include additional tributary streams not identified below.

Sub-basin	Streams with WCT Conservation Populations
Beaverhead	Alkali, Brays Canyon, Buffalo, Cat, Cottonwood, Dyce, Farlin, French, Jake Canyon, Pole, Reservoir, Rock, Stone, Taylor, Teddy, White
Big Hole	American, Bear, Bender, Big Lake, Blind Canyon, Bryant, Cherry, Doolittle, Dry, Gory, Governor, Halfway, Jacobson, Jerry, Johnson, Lacy, Lambrecht, Little American, Long Branch, McVey, Meadow, Mono, Moose, Mule, Mussigbrod, NF Divide, Odell, Pintler, Pioneer Trib, Plimpton, Rock (west Big Hole), Ruby, Schultz, Seymour, SF of NF Divide, Sixmile, Spruce, Squaw, Steel, Stine, Swamp, Tenmile, Trapper, Twelvemile, Warm Springs, WF Mudd, Woody, Wyman, York
Boulder	Curly, High Ore, Jack, Little Boulder, Muskrat, Red Rock, Rock, Sullivan, Thunderbolt
Gallatin	Beehive Basin, Dudley, EF Fan, EF Specimen, Elkhorn, Leverich, Lightning, NF Fan, NF Spanish, SWF Gallatin, Wild Horse
Jefferson	Fish, Halfway, Mill, Whitetail
Madison	Cabin, Cherry, Deadman, English George, Fox, Gibbon, Grayling, Horse, Little Teepee, Papoose, Pine Butte, Rose, Ruby, Soap, SF Madison, Garrott Creek, Wall, Wally McClure, WF Madison, Wigwam
Red Rock	Bean, Bear (Centennial), Bear (Horse Prairie), Browns, Carver, Deadman, EF Clover, Indian, Jones, Little Basin, Little Sheep, Long, Meadow, Middle (Centennial) Muddy, Nicholia, NF Divide, NF Everson, Odell, Painter, Peet, Price, Rape, Rock, Sage, Sawmill, SF Everson, Sheser, Shineberger, Simpson, Trapper
Ruby	Basin, California, Coal, Corral, Cottonwood, Greenhorn, Harris, Idaho, Jack, Mill, Nugget, Peterson, Ramshorn, Robb, Sweetwater
Upper Missouri	Avalanche, Clancy, Cottonwood, Duck, Dutchman, EF McClellan, Elkhorn, Eureka, Fool Hen, Greyson, Hall, Little Tizer, Log Gulch, Magpie, McCllelan, NF Gurnett, Page, Porcupine, Prickly Pear, Ray, Rooster Bill, Silver, Skelly, SF Crow, SF Quartz, SF Warm Springs, Specimen, Staubach, Stemple, Threemile, Whitehorse, White

WCT Conservation and Restoration in the Missouri River Headwaters

The restoration goal for WCT in the Missouri Headwaters is to restore protected conservation populations to 20% of their historic distribution within each sub-basin (FWP 2019). As described by the MOU, restoration should proceed in a manner that "*ensures the long-term, self-sustaining persistence of each subspecies distributed across their historical ranges,… 2) maintains the genetic integrity and diversity of non-introgressed populations, as well as the diversity of life histories represented by the remaining local populations, and 3) protects the ecological, recreational, and economic values associated with each subspecies"* (FWP 2007).

Attainment of this goal, or even continued persistence of native WCT in the assessment area, over the next century is uncertain without significant drainage-wide conservation efforts. Over the last 150 years, the distribution of genetically unaltered WCT in the assessment area has been reduced by more than 95%. The leading causes for this decline have not diminished, and in some cases, are increasing. Over the short-term (1 to 25 years), many remaining WCT populations face a moderate to high risk of local extinction because of nonnative trout, poor habitat conditions, isolation, reduced distribution and population size, and the random effects of natural disturbances (Shepard et al. 2005). Failure to address threats will increase the long-term (100+ years) likelihood that native WCT would be extirpated from most of their current range in southwest Montana.

Threats to Remaining WCT Populations

Nonnative trout – Nonnative trout are the primary factor limiting WCT persistence and attainment of conservation goals; failure to address this threat will reduce or eliminate the benefits of addressing other threats and preclude successful WCT conservation. Since the late 1800's, numerous nonnative fish species have been introduced throughout southwest Montana and nonnative Brook, Brown, Rainbow, Yellowstone Cutthroat, and hybrid trout have become the dominant species in most streams historically occupied by WCT. Brook and Brown Trout displace WCT through competition or predation, while Rainbow Trout and Yellowstone Cutthroat Trout readily hybridize with WCT resulting in populations entirely comprised of hybrid individuals or mixed populations of hybrid and genetically unaltered fish (Sheppard et al. 2005). The strongest remaining WCT populations are those isolated from nonnative species by natural or manmade barriers, while those not protected by barriers have reduced distribution and densities or are irreversibly hybridized. The likelihood of long-term persistence of conservation populations not protected by barriers is low.

Reduced distribution and abundance – Most remaining WCT populations in the assessment area occupy short sections of small headwater streams. Hilderbrand and Kershner (2000) suggested that a minimum population size of 2,500 individuals would be sufficient to avoid local extirpation and that 5 to 15 miles of stream habitat would be necessary to support this population size under high (30 fish/100 m) and low (10 fish/100 m) densities of fish. Several streams in the upper Missouri River support higher densities of fish (up to 50 fish/100 m) which may allow them to achieve the goal of 2,500 fish in less than five miles of habitat. Currently, few unaltered

populations in the assessment area occupy >5 miles of continuous habitat and most persist in less than 2 miles. Only a few populations contain more than 500 age-1 and older fish. Small populations are demographically more vulnerable to stochastic events (e.g., extreme drought, forest fire and discharge events) and being replaced by nonnative trout.

Spatial isolation – All remaining unaltered WCT populations in the assessment area are considered resident life forms that spend their entire life history within small stream systems isolated above natural (e.g., waterfalls, cascades, and beaver dam complexes) or man-made (e.g., dewatered stream reaches, perched culverts, irrigation diversions, and structures placed to purposely isolate populations) barriers. Although isolation is an important source of protection from nonnative trout, it can also create long-term threats to persistence if adequate habitat and genetic diversity is not present. Dispersal of fish between streams promotes gene flow among populations and recolonization of individual streams if local extinction occurs. These processes are prevented and populations may require intervention via genetic rescue to avoid inbreeding depression when they become disconnected.

Stream/riparian habitat condition – Stream habitat conditions vary greatly throughout southwest Montana. Near pristine habitat conditions can be found in many remote streams in most mountain ranges, while degraded streams are common in mid and low elevation areas. Reduced WCT abundance and distribution can be associated with historic and current land management activities (e.g., irrigation, logging, livestock grazing, and mining) that have resulted in chronic stream de-watering, sedimentation, channel alteration, riparian vegetation removal or modification, and temperature increases. Land management and stewardship practices, habitat protection guidelines and regulations, and habitat restoration projects have led to improvements in many areas; however, poor habitat condition remains a threat to some extant populations.

Many of the causes of population decline are well understood, corrective measures have been identified, and there are numerous examples of conservation efforts that have restored long-term viability to at-risk populations; however, threats to most populations have not been addressed. Formal regulations and management recommendations have been established to address some threats, including riparian and watershed health, stocking of headwater lakes, private pond establishment, and overexploitation by angling for stream dwelling WCT. However, regulations generally do not eliminate all limiting factors, and more direct management actions (e.g., barrier placement and nonnative trout removal) have been the most effective tool to protect individual populations. Although conservation of extant populations in their native habitat is essential for maintaining the existing genetic diversity that evolved through local adaptation, in some instances this may be impractical due to highly degraded and isolated habitats or an inability to eradicate nonnative trout. In these instances, transfer of fish or gametes from extant populations to new streams may be required to preserve the genetic diversity and legacy of the population. Approaches to reduce common threats are described in Appendix 1.

WCT Threat Status within the Missouri River Headwaters

Each WCT population has been characterized by threat status to describe and prioritize conservation needs. *At-risk* populations are those not isolated from nonnative fishes or other threats. Populations that have been isolated from nonnative fishes, usually by a physical barrier, and other threats are *protected*. For the purposes of this assessment, a population is deemed *secured* if it maintains at least 2,500 fish (> 75 mm) with no immediate threats and occupies enough habitat to ensure long-term persistence. Secured populations require minimal management to persist over the long-term (> 100 years). Factors that influence long-term persistence include population size, genetic variability, connectivity among populations, and demographic and environmental stochasticity. While many existing WCT populations have persisted for decades at low abundances (< 500 fish) that occupy short distances of stream (< 2 miles), the likelihood for long-term persistence of these populations is lower than for populations that maintain thousands of individuals over many miles of stream (Hilderbrand and Kershner 2000). Ultimately, attaining the goal of "*long-term self-sustaining persistence"* will require restoration of WCT to relatively long interconnected reaches of stream (i.e., >20 miles). Threat status of conservation populations within each sub-basin is described by Table 4 and Figure 2.

Table 4. Threat status of conservation populations in the assessment area.

Sub-basin	**Threat Status of Conservation Populations**			
	Total Number	Number At-risk (%)	Number Protected (%)	Number Secured (%)
Beaverhead	16	10 (62.5%)	5 (31.3%)	1 (6.3%)
Big Hole	49	34 (69.4%)	14 (28.6%)	1 (2.0%)
Boulder	9	7 (77.8%)	1 (11.1%)	1 (11.1%)
Gallatin	11	7 (63.6%)	4 (36.4%)	0 (0.0%)
Jefferson	4	1 (25.0%)	3 (75.0%)	0 (0.0%)
Madison	20	12 (60.0%)	2 (10.0%)	6 (30.0%)
Red Rock	31	25 (80.6%)	6 (19.4%)	0 (0.0%)
Ruby	15	12 (80.0%)	2 (13.3%)	1 (6.7%)
Upper Missouri	32	23 (71.9%)	9 (28.1%)	0 (0.0%)
Total	**187**	**131 (70.1%)**	**46 (24.7%)**	**10 (5.9%)**

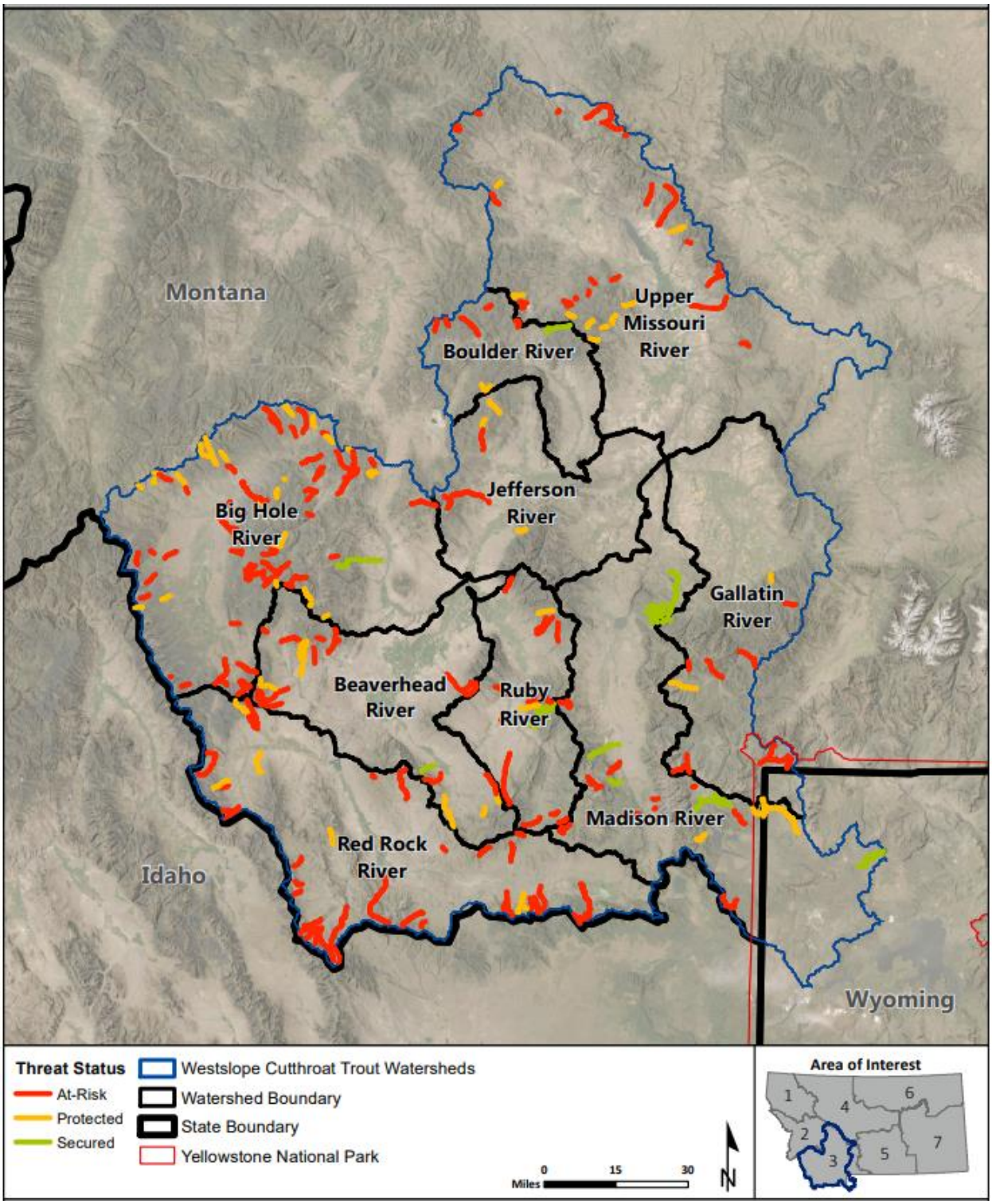

Figure 2. Threat status of WCT Conservation populations (genetically unaltered, genetically altered <10% introgressed and mixed) within the nine sub-basins in the upper Missouri.

Prioritization of Conservation Actions

Conservation actions will be prioritized by considering genetic class and threat status (Figure 3). Preserving extant populations that represent the genetic legacy of Missouri Headwaters WCT is the foundation of long-term conservation and will provide sources for restoration of the subspecies. To achieve long-term WCT conservation goals, all remaining at-risk populations must be protected from the immediate threat of nonnative trout. Accordingly, WCT conservation within the Missouri River headwaters will be initially directed towards 1) protecting genetically unaltered at-risk populations in place or 2) by replicating or translocating their genetic diversity into protected streams. Our third priority is protecting genetically altered at-risk conservation populations. Currently, 70.1% of unaltered and altered conservation populations are considered at-risk (Table 4 and Figure 2). All at-risk populations could be protected by installation of 98 barriers, removal of nonnative trout from 620 miles of stream, transfer of 23 populations, and genetic rescue of 19 populations (Table 5). Because most WCT populations require increases in distribution and abundance to secure long-term persistence, actions that simultaneously protect and secure populations will be emphasized. Our final priority is expanding the distribution of WCT to 20% of historical occupancy within each sub-basin by restoring secured unaltered populations. Eleven populations in the assessment area are presently considered secured (Table 4). All population conservation or restoration projects will follow guidelines described in Appendix 2.

Figure 3. Missouri River headwaters WCT conservation action priorities.

Highest Priority	→		**Lower Priority**
Protect and secure genetically unaltered at-risk populations in place	Replicate or translocate genetically unaltered at-risk populations that cannot be protected in place	Protect and secure genetically altered conservation populations	Restore secure genetically unaltered populations

Table 5. Conservation actions required to protect "at-risk" conservation populations. (Note: Some mixed populations may require multiple actions resulting in a sum that is greater than the total number of populations.)

Sub-basin	**"At-risk" Populations**	**Barriers**	**Miles of nonnative trout removal [a]**	**Replication**	**Genetic rescue [b]**
Beaverhead	10	8	45	3	2
Big Hole	34	16	140	15	8
Boulder	7	6	24	0	0
Gallatin	7	6	53	1	1
Jefferson	1	1	15	0	0
Madison	12	11	70	1	0
Red Rock	25	20	143	3	3
Ruby	12	12	58	0	2
Upper Missouri	23[c]	18	71	1	3
Total	131	98	620	23	19

[a] calculated by subtracting stream miles inhabited only by genetically unaltered WCT (i.e., no non-native trout) from total stream miles inhabited by conservation populations within each sub-basin (Tables 10, 14 and 18).
[b] genetically unaltered populations that are more than one standard deviation less than mean He (Appendix 6).

[c]Several populations in the Upper Missouri require non-native removal above existing barriers.

WCT conservation priorities 1-4 will be sequentially implemented throughout the assessment area to address the greatest conservation needs, while reducing competition for funding and conflict for personnel time. Because of limited funding options there is a significant opportunity cost associated with implementing WCT conservation projects. The fish barriers prescribed by priorities 1 and 3 cost a maximum of $50,000, whereas barriers associated with the fourth priority commonly exceed $500,000. Removal of non-native fish is limited to baseflow stream conditions and simultaneous projects throughout the assessment area during this 8-10 week period are common. Smaller conservation projects associated with the first three priorities may take 1-2 weeks each and can be completed using local personnel for relatively little cost, whereas repopulation projects associated with the fourth priority often take 3-4 weeks each and require personnel from overlapping federal and state jurisdictional boundaries. As such, 5-10 smaller projects to protect existing populations can be implemented for the same time and cost needed to implement one large population restoration project, although both types of projects are ultimately necessary to attain our conservation goal. Because attainment of the WCT conservation goal is limited by funding and capacity, we will focus exclusively on achieving our top two conservation priorities until they are completed throughout the assessment area to maximize our effectiveness. Ongoing projects to restore genetically unaltered WCT (priority 4; French, Selway, N.F. Spanish, and S.F. Sixteenmile creeks) will be completed and repopulated in a way that best contributes to attainment of these priorities. No additional priority 3 and 4 projects will be pursued until the first two priorities are satisfied. The following two exceptions exist because they will not detract from funding higher priority projects elsewhere in the assessment area. When funding sources are specific to a single sub-basin (e.g., Madison River MadTac), they will be applied within that sub-basin to sequentially address conservation priorities even if higher priorities have not yet been satisfied elsewhere in the assessment area. If private landowners donate barriers and solicit agreements to restore secure WCT populations to streams on their land they will be given priority for implementation in a manner that best contributes to the overarching WCT conservation goal.

Conservation Strategy and Approach

1) Protect and secure genetically unaltered at-risk populations in place – Populations with barrier opportunities that cost less than $50,000 and protect at least 5 miles of stream will be pursued as our highest conservation priority. Instances where barrier costs exceed $50,000 or protect fewer than 5 miles were evaluated on a case-by-case basis to determine whether in situ protection should occur or more cost-effective conservation measures (i.e., replication or translocation) were available. Immediacy of threat of introgression or extirpation were also considered. It is estimated that there are currently 31 unaltered populations which are at-risk and may be protected in place through barrier construction alone (one population), non-native removal above an existing barrier (six populations), or barrier construction or repair and a subsequent non-native removal project (24 populations; Table 6). Of the 25 populations which need barriers, seven have been funded for 2022 construction or repair and up to six others are planned for 2023 construction. The remaining 12 populations will be addressed beginning in

2024. Some of these populations have not been genetically tested in 15-20 years and require updated assessment before pursuing projects. Timelines for projects are given in Table 6. All non-native fish removals will follow the guidelines in Appendix 2.

Table 6. Genetically unaltered WCT populations in the Missouri Headwaters to protect in place.

Sub-basin	Stream	Miles	Expected Population size >2,500 WCT	Next Action	Timeline
Beaverhead	Buffalo	6.3	Yes	Barrier Construction	2022
Beaverhead	Reservoir	5	No	Barrier Construction	2022
Big Hole	Bender*	4.6	Yes	Non-native Fish Removal	2023
Big Hole	Blind Canyon	4	No	Barrier Site Identification	2022
Big Hole	Bryant	8	Yes	Barrier Construction	2022
Big Hole	Doolittle*	11	Yes	Non-native Fish Removal	2023
Big Hole	Governor	11.1	Yes	Population Assessment	2022
Big Hole	NF Divide	12	Yes	Population Assessment	2022
Big Hole	Rock	8	Yes	Population Assessment	2022
Big Hole	Schultz*	2.5	Yes	Non-native Fish Removal	2023
Big Hole	Trapper	12	Yes	Population Assessment	2022
Big Hole	Twelvemile	9	Yes	Barrier Site Identification	2022
Boulder	High Ore	6	Yes	Population Assessment	2022
Boulder	Red Rock	5.8	Yes	Population Assessment	2022
Gallatin	EF Specimen	32	Yes	Barrier Site Identification	2022
Jefferson	Fish	14	Yes	Population Assessment	2022
Red Rock	Browns	7	Yes	Barrier Construction	2022
Red Rock	Painter	5.5	Yes	Barrier Construction	2022
Red Rock	SF Everson	1.8	No	Barrier Site Identification	2022
Red Rock	Simpson	1.8	No	Barrier Site Identification	2022
Ruby	Mill	4.1	No	Population Assessment	2022
U. Missouri	Clancy	8	Yes	Population Assessment	2022
U. Missouri	Cottonwood*	8.2	Yes	Population Assessment	2022
U. Missouri	Dutchman	4	No	Barrier Construction	2022
U. Missouri	Log Gulch*	Pond	Yes	Population Assessment	2022
U. Missouri	McClellan	1.5	No	Population Assessment	2022
U. Missouri	NF Gurnett	4.2	No	Population Assessment	2022
U. Missouri	Ray	9.3	Yes	Barrier Repair	2022
U. Missouri	Rooster Bill	1.2	No	Population Assessment	2022
U. Missouri	SF Warm Springs	0.7	No	Population Assessment	2022
U. Missouri	Skelly*	5	Yes	Population Assessment	2022

*Barrier in place.

2) Replicate or translocate genetically unaltered at-risk populations that cannot be protected in place – An additional 19 streams with at-risk unaltered WCT populations were identified as candidates for replication or translocation based on our second priority (Table 7). Replication (establishing a new population by selectively mining the donor population following Appendix 2 guidelines) versus translocation (moving the entire population) will be based on population size

and immediacy of threats. Small populations (< 50 fish) or those at high risk of extirpation will be translocated whereas larger populations (>100 fish) with lower risk of near-term extirpation may be replicated. Single population translocation or replication will only be considered for aboriginal at-risk populations when barrier installation is not cost-effective (i.e., >$50,000 to protect < 5 miles of stream). Populations at stochastic or demographic risk of extirpation because of limited habitat (< 5 miles) may be considered as candidates for replication on a case-by-case basis (Table 8). Replication or translocation projects will be developed opportunistically and prioritized for implementation when cost-effective alternatives in nearby drainages are feasible. Prioritization among potential recipient streams will consider resiliency to climate change in addition to the aforementioned criteria. Because genetic status of unprotected populations can change rapidly through hybridization, it is possible that upon initiation of a transfer, genetic testing may reveal that all or some of a population is hybridized (e.g., Andrus Creek and Bear Creek in 2021). In these instances, any unaltered fish may be transferred as planned while fish that are genetically altered may be moved elsewhere or removed from the population. We estimate the cost of satisfying this priority to be $25,000 for genetic testing and anticipate it will be completed in 3-5 years. The exact cost will be dependent on the number of unaltered fish remaining in these populations and we anticipate that some of the listed populations may have no WCT remaining. Regardless, this exercise will satisfy our second conservation priority by replicating or translocating the remaining populations and will allow us to remove extirpated populations from our conservation schedule.

Table 7. Prioritization of genetically unaltered, at-risk WCT populations in the Missouri Headwaters for replication or translocation.

Sub-basin	At-Risk Population	Recipient Stream	Project Timeline	Next Action
Beaverhead	Pole	White (upper)	2021-2022	Final transfer to occur in 2022
Beaverhead	Stone	Curly	2021-2022	Final transfer to occur in 2022
Beaverhead	White	White (upper)	2022-2023	First transfer to occur in 2022
Big Hole	Mono	TBD	2023+	Population Assessment
Big Hole	Mussigbrod	TBD	2023+	Population Assessment
Big Hole	Ruby	TBD	2023+	Population Assessment
Big Hole	Squaw	TBD	2022-2023	First transfer to occur in 2022
Big Hole	Warm Springs	TBD	2023+	Population Assessment
Big Hole	Wyman	TBD	2023+	Population Assessment
Big Hole	Steel	TBD	2023+	Population Assessment
Big Hole	York	Long Branch	2021-2022	Final transfer to occur in 2022
Gallatin	Wild Horse	NF Spanish	2022-2023	Transfer of fertilized eggs* in 2022
Madison	Garrott Creek	Ruby	2022	First transfer to occur in 2022
Red Rock	Bean	Peet	2015-2022	Final transfer to occur in 2022
Red Rock	Bear	Peet	2015-2022	Final transfer to occur in 2022
Red Rock	Craver	TBD	2022-2023	Recipient Stream Identification
U. Missouri	Duck	SF 16-mile	2022-2023	Population Assessment
U. Missouri	Page	SF 16-mile	2022-2023	Population Assessment
U. Missouri	Porcupine	SF 16-mile	2022-2023	Population Assessment

*Whirling Disease was detected in Wild Horse Creek in 2021, prohibiting the transfer of live adult WCT.

3) Protect and secure genetically altered at-risk populations – All 75 genetically altered at-risk WCT populations will be inventoried to determine whether a suitable barrier location and type exists. Implementation of projects to isolate existing populations will be dependent on barrier cost and the number of stream miles they are likely to protect. Barriers that cost less than $50,000 and protect extant populations of genetically altered fish in at least 5 miles of stream will be pursued as our highest conservation priority. Instances where barrier costs exceed $50,000 or protect fewer than 5 miles will be evaluated on a case-by-case basis to determine whether in situ protection should occur or more cost-effective conservation measures are available. Genetic status (i.e., percent of hybridization), immediacy of the threat of continued introgression or extirpation, and resiliency to climate change will also be considered. We anticipate some altered conservation populations will either not have suitable and/or cost-effective barrier locations and will resultantly not be protected and eventually extirpated. These losses will be offset through completion of our fourth conservation priority. The maximum cost to protect all altered populations would be $3.8 million; however, based on barrier surveys and costs for unaltered populations a total cost of about $1.1 million is anticipated. Populations will be inventoried and barrier costs formally estimated and integrated into this Conservation Strategy from 2023-2025, barriers prioritized and constructed from 2025-2029, and, when applicable, non-native fish removed following the guidelines in Appendix 2 from 2029-2035.

4) Restore secure genetically unaltered populations – Reintroduction of unaltered WCT to longer, interconnected reaches of stream (i.e., > 5 miles) where they currently do not exist is an essential element of long-term WCT recovery in the Missouri Headwaters. These projects require barrier site prioritization and selection, fundraising and environmental compliance, barrier construction, non-native fish removal and evaluation, and re-population with genetically unaltered WCT. It typically takes 5-10 years to complete each project, although projects can be concurrently implemented. Past planning efforts have identified some potential restoration sites within most sub-basins (Table 8); however, project-specific information has been collected inconsistently throughout the assessment area. To guide assessment and prioritization of potential reintroduction sites within each sub-basin, we will contract basic survey and preliminary cost estimation for locations where barrier installation seems topographically feasible and at least 5 miles of habitat would be provided. Barrier cost, stream length, restored population size, long-term climate resiliency (i.e., drainage area >2400 meters in elevation with low solar insolation), and project cost per WCT restored will be provided for each potential restoration location. Public meetings will be convened within each sub-basin to select the most cost effective and socially acceptable combination of streams to restore 20% of historical WCT distribution and satisfy the long-term conservation goal for the sub-species. Restoration sites, barrier costs, and implementation timelines will be integrated into future iterations of this conservation strategy as they are developed and all projects will follow the guidelines in Appendix 2. This phase of conservation will be initiated in 2030, is expected to take at least 20 years, and cost several million dollars.

Table 8. Previously identified potential locations for restoration of genetically unaltered WCT.

Sub-basin	Stream	Miles of habitat
Big Hole	Bull Creek	8
Big Hole	Camp Creek	17
Big Hole	Moose (Divide) Creek	14
Big Hole	W. F. Lamarche	8
Big Hole	Willow Creek	10
Boulder	N.F. Little Boulder River	10
Madison	Elk River	32
Red Rock	Medicine Lodge Creek	192
Red Rock	Cabin Creek	127
Red Rock	Meadow Creek	19
Red Rock	Nicholia Creek	67
Red Rock	Deadman Creek	27
Red Rock	Odell Creek	29
Red Rock	Sage Creek	87
Red Rock	Divide Creek	27
Red Rock	Selway Creek	48
Ruby	Robb Creek	65
Ruby	Ledford Creek	45
Upper Missouri	Cottonwood Creek	8
Upper Missouri	Elkhorn Creek	NA
Upper Missouri	McClellan Creek drainage	15
Upper Missouri	N.F. Deep Creek	5
Upper Missouri	Tizer Basin	25
Upper Missouri	Willow Creek	2
Upper Missouri	Crow Creek Above the Falls	NA

Measuring WCT Conservation Success

The goal of WCT conservation is ensuring long-term self-sustaining persistence of WCT throughout 20% of their historic range. In the Missouri River headwaters, the best short-term measurements towards this goal are: 1) increasing the number of aboriginal populations that are protected and secured, and 2) increasing the number of genetically unaltered populations established from aboriginal sources.

Modifications to this Document

This document will be revised on an annual or biennial basis to document and detail changes in status and conservation needs of WCT in the assessment area, progress of conservation and restoration efforts, and changes in sub-basin priorities, costs, and timelines. Additional genetic studies and population inventories may result in gain or loss of conservation populations and adjustments to the current distribution. The number and status of conservation populations will be reviewed and updated annually for each sub-basin in conjunction with the range-wide WCT

status assessment and monitoring efforts outlined in the MOU for Westslope Cutthroat Trout and Yellowstone Cutthroat Trout in Montana (FWP 2007). Updates will be completed by the Region 3 Native Fish Biologist as part of a collaborative process using all available data sources.

Sub-basin Assessments: Sections 1 – 9

The following sections summarize WCT status and conservation needs in each of the nine sub-basins of the assessment area: the Beaverhead, Big Hole, Boulder, Gallatin, Jefferson, Madison, Red Rock, Ruby, and Upper Missouri (Figure 1). The primary objectives of these sections are to identify conservation populations, describe current status of each population, and propose actions necessary to protect and conserve each population.

By sub-basin and conservation population, these sections outline:

1. Status overview
2. Genetic class assignment and rationale
3. Threat status and rationale
4. Actions required to maintain populations and on-going conservation efforts

Conservation Population Identification Methodology

The foremost objective of this document is to identify WCT conservation populations in each of the nine sub-basins. While the best available information was used to identify and classify conservation populations (Table 1 and 3; Figure 1), in some instances, these were derived from sparse abundance, distribution, and genetic data. Once populations are identified and classified, actions to address threats can be accurately prescribed (Appendix 1). All restoration projects will consider criteria outlined in Appendix 2. To ensure data accuracy and consistency, all future information should be collected following the protocols and using the forms described in Appendix 3. All wild fish transfers will adhere to Montana's policies and protocols (Appendix 4 and 5) and donor populations will be chosen based on demographics, genetics, fish health, and AIS results (Appendix 6). Occasionally, smaller isolated populations with reduced genetic diversity will require genetic infusion, or genetic rescue, from neighboring populations (Appendix 7). It is expected that additional genetic testing will change the classification of some conservation populations from "genetically unaltered" to "mixed" or "genetically altered." Any populations that have not been sampled in the past 10 years or with less than 25 samples should be resurveyed to assess genetic composition (Appendix 8). Priority will be given to populations whose last genetic testing found unaltered fish and which remain "at-risk".

Section 1: Beaverhead Sub-basin

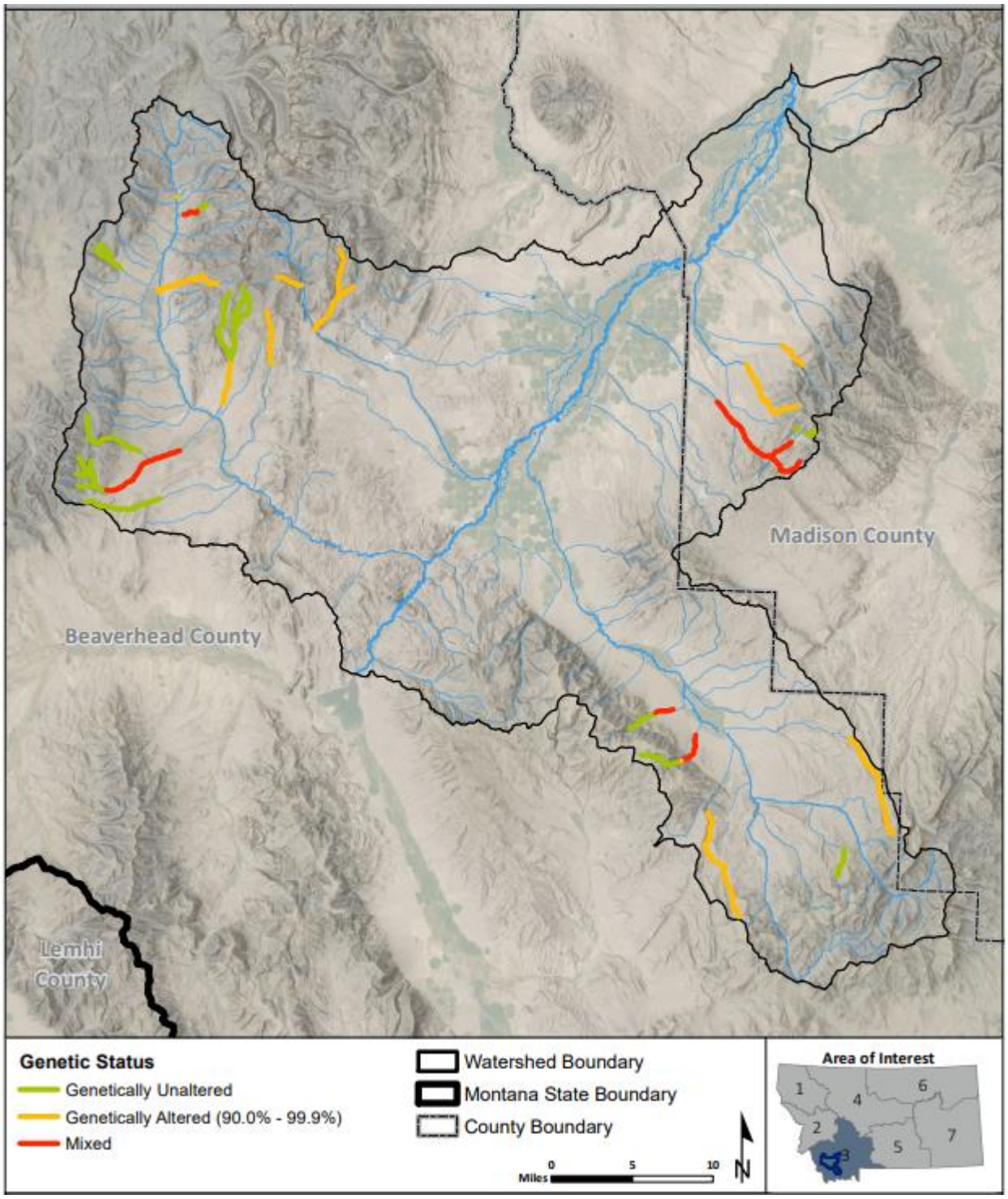

Figure 1.1. genetic status and distribution of WCT conservation populations in the Beaverhead River sub-basin.

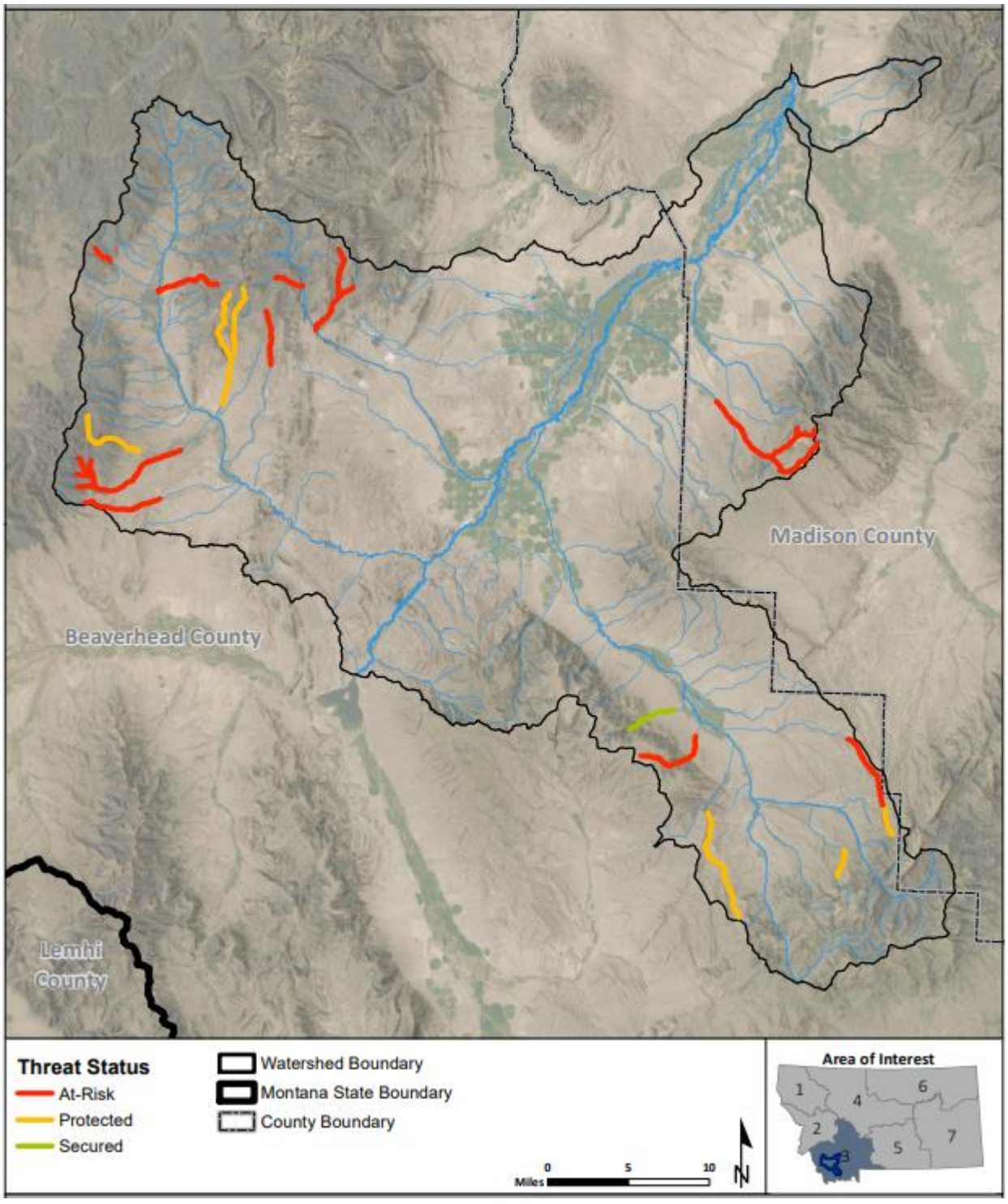

Figure 1.2. Threat status and distribution of WCT conservation populations in the Beaverhead River sub-basin.

Overview

Beaverhead WCT Status and Threats:

- Number of Conservation populations: 16 (7 unaltered; 1 mixed; 8 altered)
- Populations at risk: 63% (10 of 16)
- Genetically unaltered populations at risk: 43% (3 of 7)
- Populations considered protected: 31% (5 of 16)
- Populations considered secured: 1 (Jake Canyon Creek)
- Significant threats:
    - Brook Trout (EBT): 5 populations
    - Other trout (YCT, RBT, CT hybrids): 12 populations
    - Small population size: 7 populations (< 1,000 fish)
    - Livestock grazing: 14 populations
    - Limited distribution: 6 populations (inhabit < 5 miles of stream)

Table 1.1. Genetic class and threat status of WCT conservation populations in the Beaverhead River sub-basin.

Genetic Class	**Status of Conservation Populations**			
	At-risk	Protected	Secured	**Total**
Unaltered	3	4	0	**7**
Mixed	1	0	0	**1**
Altered	6	1	1	**8**
Total	**10**	**5**	**1**	**16**

Table 1.2. WCT conservation populations identified in the Beaverhead River sub-basin.

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Alkali (Blacktail)	4874 4564	Genetically Unaltered	Genetically tested as 100% WCT	7/27/16 FWP, Jaeger (25 SNP) 100% WCT 8/30/12 BLM, Hutchinson (25 SNP) 100% WCT
Brays Canyon (Grasshopper)	4891 4038 4011 3661 3007 316	Genetically Unaltered	Genetically tested as 100% WCT	8/14/17 FWP, Jaeger (50 SNP) Both Fish Transfers 100% WCT 8/8/16 FWP, Jaeger (50 SNP) 100% WCT 6/21/10 FWP, Nelson (26 Indel) 100% WCT
Buffalo (Grasshopper) - Straight Fork - Middle Fork - Left Fork -Right Fork	5086 4876 4875 3006 3005 3004 3003	Genetically Unaltered	Genetically tested as 100-99.8% WCT	8/21/18 FWP, Jaeger (50 SNP) 25 Above USFS Rd. Culvert, 25 Headwaters 99.8% WCT <0.2% RBT 7/12/16 FWP, Jaeger (25 SNP) Lower: 99.54% WCT 0.46% RBT Upper: 100% WCT 7/4/06 USFS, Brammer (17 PINE) 100% WCT LF & RF 7/7/04 (3 PINES) SF 7/7/04 (5 PINES)

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Cat (Rattlesnake)	4729 3002 1033	Genetically Altered	Genetically tested as 96.5% WCT	7/24/14 FWP, Jaeger (25 SNP) 96.5% WCT 3.5% RBT 6/29/2004 USFS, Brammer (10 PINE) 100% WCT 9/27/1994 USFS Brammer (3 Allozymes) 100% WCT
Cottonwood Above barrier (Blacktail) Below barrier	4889 4566 4565 3982 3259 3258 1353 650	Genetically Unaltered	Genetic tested as 100% WCT.	8/23/17 FWP, Jaeger (50 SNP) Fish Transfers 100% WCT 8/30/16 FWP, Jaeger (61 SNP) 7/8/13 BLM, Hutchinson (25 SNP) 100% WCT above waterfall 7/8/13 BLM, Hutchinson (25 SNP) 95% WCT below waterfall
Dyce (Grasshopper) - EF Dyce - WF Dyce	4034 3663 3312 1003 324 4019 3242 770	Genetically Unaltered	Genetically tested as 100% WCT	All genetic samples before 2010 are irrelevant because Dyce Creek was treated with rotenone that year and only E.F. WCT were salvaged EF 6/1/10 BLM, Hutchinson (25 SNP) 100% WCT WF 4/22/10 BLM, Hutchinson (25 SNP) 99.8% WCT 0.02 RBT
Farlin (Grasshopper)	5155 4732 3062 462	Genetically Altered	Genetically tested as 96.7% WCT	8/29/19 BLM, Hutchinson (24 SNP) 96.7% WCT 3.3% YCT 8/28/08 BLM, Hutchinson (25 Indel) 99.5% WCT 0.5% YCT 8/17/99 FWP, Oswald (25 PINES) 100% WCT 10/9/90 (5 Allozymes) USFS, Browning 100% WCT
French (Rattlesnake) - Trout	914	Genetically Altered	Genetically tested as 95.5% WCT	6/13/94 USFS, Browning (11 Allozymes) 95.5% WCT 4.5% RBT
Jake Canyon (Blacktail)	4970 4969 4924 4046 649	Genetically Altered	Genetically tested as >99% WCT.	7/13/18 BLM, Hutchinson (25 SNP) 100% WCT in headwaters 7/7/18 BLM, Hutchinson (25 SNP) 99% WCT 1% RBT 7/24/17 FWP, Jaeger (25 SNP) 99.92% WCT 0.08 RBT 7/28/10 BLM, Hutchinson (55 Indel) 100% WCT 7/28/1992 FWP, Oswald (10 Allozymes) 100% WCT
Pole (Grasshopper) - WF Pole	5225 3000 2993 321	Genetically Unaltered	Genetically tested as 100% WCT	6/30/2020 FWP, Jaeger (11 SNP) 100% WCT 9/7/04 USFS, Brammer (23 Indel) 100% WCT 7/20/04 USFS, Brammer (3 PINES) 100% WCT 11/15/89 USFS, Vore (8 Allozymes) 100% WCT
Reservoir (Grasshopper)	4925 4871 3042 3001	Genetically Unaltered	Genetically tested as 100% WCT	7/27/17 FWP, Jaeger (25 SNP) 100% WCT 7/13/16 FWP, Jaeger (25 SNP) 100% WCT 7/6/04 USFS, Brammer (10 PINES) 100% WCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
	202			
Rock (Blacktail)	4732 1236 1235 1099	Genetically Altered	Genetically tested as 96.9% WCT	7/18/14 FWP, Jaeger (25 SNP) 96.9% WCT 2.7% YCT 0.4% RBT 8/13/97 USFS, Brammer (5, 6 Allozymes) 100% WCT
Stone (Ruby Mtns.) - LF Stone - MF Stone - Mine Gulch - Winnipeg	4968 4967 4930 4730 3036 2976	Genetically Altered	Genetically tested as >98% WCT	8/2/18 BLM Hutchinson MF Stone (25 SNP) 98.6% WCT 1.4% YCT 7/24/18 BLM Hutchinson LF Stone (25 SNP) 97.8% WCT 2.2% YCT 8/8/17 BLM Hutchison (26 SNP) 100% WCT 7/23/14 FWP, Jaeger (25 SNP) 98.8% WCT 1.2% YCT 4/5/05 FWP, Nelson (30 PINES) 100% WCT 10/01/04 FWP Oswald (50 PINES) 100% WCT
Taylor (Grasshopper)	4374 2994 1258 1253	Genetically Altered	Genetically tested as 97.4% WCT	6/27/12 BLM, Hutchinson (24 SNP) 97.4% WCT 2.6% YCT 4/14/05 USFS, Brammer (24 PINES) 100% WCT 8/20/97 USFS, Browning (5 Allozymes) 81.6% WCT 8/13/97 USFS, Wagner (10 Allozymes) 100% WCT
Teddy (Blacktail)	4563 689	Genetically Altered	Genetically tested as 94.4% WCT	8/29/12 BLM, Hutchinson (25 SNP) 94.4% WCT 3.8% RBT 1.5% YCT 8/29/92 FWP, Oswald (10 Allozymes) 94.4 WCT 2.5% RBT 3.1% YCT
White (Grasshopper)		Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT.	2021 USFS, Weinner- 14 fish below waterfall appeared to be unaltered. Need more samples.

Table 1.3. Characteristics that define threat status of WCT conservation populations in the Beaverhead River sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Alkali	2.5	2.5	1 per100 m (40 unaltered Fish)	Natural barrier 7 ft. rock waterfall	State	Limited distribution, natural barrier could fail, poor habitat, livestock grazing, heavy siltation	Protected
Brays Canyon	5.1	5.1	19 per 100 m (1559 unaltered fish)	Perched culvert with concrete splash pad	FS	Livestock grazing	Protected
Buffalo - LF Buffalo - RF Buffalo - SF Buffalo	9.5	5.6 (Upstream of FS Rd. 7351)	14 per 100 m (2140 fish) (1261 unaltered fish)	Unknown, likely irrigation withdraws	FS, Private	No barrier, hybridization, livestock grazing	At-risk
Cat	1.7		14 per 100 m (383 fish)	None	FS	Limited distribution, hybridization, livestock grazing	At-risk
Cottonwood	3.3	0.6 (Upstream of waterfall barrier)	50 per 100 m (2655 Fish) (521 unaltered fish)	Cascades protect upper reach Man-made wood fish barrier	BLM, FS, Private	Limited distribution, Brook Trout, hybridization, livestock grazing	Protected
Dyce - EF Dyce - WF Dyce	6.9	6.9	17 per 100 m (1912 Unaltered Fish)	Fish Barrier (Perched culvert)	BLM, FS	Livestock grazing, heavy siltation	Protected
Farlin	3.7		13 per 100 m (751 Fish)	None	BLM, FS, Private	No barrier, Brook Trout, hybridization, poor habitat, livestock grazing	At-risk
French - Trout	5.7		Unknown	None	FS	No Barrier, Brook Trout, hybridization	At-risk
Jake Canyon	4.4	unknown	49 per 100 m (3298 fish)	Man-made wood fish barrier	BLM, State, Private	Hybridization, livestock grazing	Secured
Pole - WF Pole	1.9	1.9	1 per 100 m (31 unaltered fish)	None	FS, State	No Barrier, hybridization, Brook Trout, livestock grazing	At-risk
Reservoir	5.3	5.3	9 per 100 m (767 unaltered fish)	Unknown, likely irrigation withdraws	FS, State, Private	No barrier, hybridization, livestock grazing, heavy siltation	At-risk
Rock	6.9		14 per 100 m (1555 fish)	Dam protects upper portion of the drainage	State, Private	Poor habitat, hybridization, livestock grazing	Protected (upper) At-risk

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
							(lower)
Stone - LF Stone - MF Stone - Mine Gulch - Winnipeg	12.8	0.5	(Unaltered WCT Unknown) 10 per 100 m (2060 fish)	Dry channel subs out	BLM, Private	Hybridization, livestock grazing, heavy siltation	At-risk
Taylor	3.6		11 per 100 m (508 fish)	Dry channel subs out	FS, BLM, Private	Hybridization, no barrier, Brook Trout, livestock grazing	At-risk
Teddy	7.7		6 per 100 m (744 fish)	Reservoir levee with a spillway	BLM, State, Private	Hybridization, livestock grazing	Protected
White	0.8	0.8	25	Natural waterfall	USFS	Small population size (established from Pole Creek, N=25)	Protected (upper)
	0.9	0.9	14	None	USFS, Private	Hybridization, brook trout	At-risk (Lower)

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population that exist in the same stream.

[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 1.4. Actions required to maintain conservation populations in the Beaverhead River sub-basin.

Stream (s)	Population Status and Conservation Needs
Alkali	***Genetic Class:*** Genetically Unaltered ***On-going projects***: Demographic and genetic monitoring. The Nature Conservancy completed an incised channel restoration project within the core habitat of this population in 2016. The overall goal of this project is to raise the water table upstream of an old pond levee so that the stream can access its floodplain. Over time this is expected to improve riparian health and fish habitat within the treated stream reach. ***Short-term (protect):*** This population is protected by a natural barrier located at 44.86396 -112.24819. The barrier is a 7 ft. waterfall with no plunge pool; water splashes onto a flat rock surface. This barrier resulted from a head cut in the stream bed, which consists of compressed mud or shale. Based on field surveys, 2.5 miles of stream are protected and occupied by WCT above this barrier. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75 mm within Alkali Creek due to lack of fish-bearing habitat. Demographic surveys downstream of the barrier are needed to decide whether Alkali Creek could support a secured population of 2500 fish >75mm. A barrier that includes more habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** This is a small, sparse population; about 40 WCT are distributed at 1 fish per 100 m. Currently there are only genetically unaltered WCT and Rocky Mountain sculpin (RM COT) above the barrier. Genetic samples collected in 2016 (25 SNP) confirmed that this population is genetically unaltered, however three polymorphic loci were noted in the test results.
Brays Canyon	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Brays Canyon Creek WCT are protected by a perched culvert barrier with a concrete splash pad. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Removal of EBT alleviated all immediate threats. In 2019 eDNA samples were collected for the 3rd consecutive year, results showed that there were no EBT left throughout the drainage. Brays Canyon Creek supported 1795 and 1548 WCT in 2015 and 2016, respectively. EBT have effectively been eradicated from within the project area. There are presently about 19 WCT per 100 m of stream. Once WCT re-populate the lower 0.9 miles of stream that was chemically treated, secured status (2500 WCT >75 mm) will be attained. ***Additional comments:*** In 2015 and 2016 EBT were removed chemically from the 0.9 miles above a perched culvert barrier and by multiple pass electrofishing in the remainder of the upstream drainage. Beginning in 2017 and continuing in 2018, electrofishing removal was focused in reaches where EBT presence was suggested by drainage-wide eDNA sampling that was conducted at 250m intervals. Forty of 53 and 15 of 15 estimated EBT remaining in 2015 and 2016 were respectively removed. Following eDNA sampling, five EBT were removed in 2017 and three were removed in 2018. No EBT reproduction has been documented since 2016 and all three of the fish removed in 2018 were reproductively mature females between 148-154 mm. Brays Canyon Creek was one of six donor streams used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 47 and 57 WCT from Brays Canyon Creek were released into the N.F. of Greenhorn Creek in 2016 and 2017, respectively.
Buffalo - LF Buffalo - RF Buffalo - SF Buffalo	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Barrier Construction and demographic and genetic monitoring. In 2018 genetic samples were collected to better understand the spatial extent of hybridization and results were ambiguous; a small amount of Rainbow Trout admixture was detected but the samples did not appear to come from a hybrid swarm and were suggestive of non-random mating between hybridized and unhybridized fish. A barrier will be installed

Stream (s)	Population Status and Conservation Needs
	on US Forest Service land upstream of FS Rd. 7351 in 2022. Removal of altered fish will be subsequently evaluated. ***Short-term (protect):*** Establishment of a permanent barrier and removal of CT hybrids would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more downstream habitat followed by removal of altered fish would secure this population; however, 2018 surveys were unable to identify a suitable barrier location on USFS or private land. Based on recent demographic surveys Buffalo Creek would support a secured WCT population of 2500 fish >75mm. ***Additional comments:*** This population occupies up to 5.6 miles of stream upstream of the US Forest Service property boundary. Demographic surveys show an average of 14 WCT per 100 m. Buffalo Creek does not have any connection with Grasshopper Creek because of dewatering for irrigation, which creates an intermittent section of stream; however, no other barriers exist. CT hybrids and RM COT are currently present. Genetic samples collected in 2016 indicate the population downstream of FS Rd. 7351 is hybridized with 0.46% RBT alleles; however, the population in upper Buffalo Creek appears to be mixed. Overall, it is clear that rainbow trout admixture is likely present in the upper Buffalo Creek system but at a relatively low level (<0.2%). Rainbow trout alleles were non-randomly distributed among markers (X^2_{38}=7.39, P = 0.006) and individuals (X^2_1=64.67, P = 0.004) suggesting the sample was not collected from a hybrid swarm. This may indicate that there is non-random mating among hybridized and non-hybridized trout in Buffalo Creek, or there has been recent immigration of hybrids into Buffalo Creek.
Cat	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybrid CT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Cat Creek does not have enough habitat to support a WCT population of 2500 fish >75mm; the WCT population is only about 383 fish. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** A cascade near the bottom of this stream appears to be preventing the invasion of EBT and further hybridization from RBT. Rattlesnake Creek is located immediately downstream and flows directly into Kelley Reservoir and, because EBT and RBT are abundant in the downstream drainage, ongoing invasion is likely if the cascade is not a true fish barrier. Demographic surveys conducted in 2014 show an average of 14 WCT per 100 m. This population is an altered population; genetic samples indicated 96.5% WCT and 3.5% RBT. It is unclear how the RBT hybridization occurred, but it suggests that the cascade is not a barrier.
Cottonwood	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Fish removal and transfers. In 2021, a barrier was constructed and the first year of a two-year removal project with rotenone was completed. Unaltered fish above a natural waterfall were left in place and will be used to repopulate the stream once the lower stream has been verified as fishless. The unaltered population is comprised of 500-650 fish averaging 187 mm long and inhabits a short reach of stream (0.6 stream miles). ***Short-term (protect):*** The uppermost 0.6 miles of Cottonwood Creek is protected by a natural waterfall that is a 15-foot tall cascade located at 44.93443, -112.46935. Riparian habitat could be improved by mitigating cattle grazing impacts.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): Based on pre-treatment densities of fish in Cottonwood Creek, it is expected that this stream will support a secured population of 2500 fish >75mm once non-native fish are removed and the protected unaltered population expands into the downstream reach.. ***Additional comments:*** Cottonwood Creek was one of six donor streams used to repopulate the Greenhorn Creek WCT project area in 2016 and 2017 (via live fish transfers). A total of 111 WCT were moved from Cottonwood to Greenhorn over two separate years.
Dyce - EF Dyce - WF Dyce	***Genetic Class:*** Mixed ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Dyce Creek is protected by a culvert fish barrier located at 45.27761 -113.03360. Updated demographic and genetic surveys are needed to reevaluate the status of the population. The BLM is currently implementing a cattle grazing plan that mitigates impacts by using a three-year rest rotation where it is used by cattle 2 out of every 3 years. The first year, use is permitted prior to July 1st, the second year it is permitted after July 1st the third year is a rest year and use years cannot exceed thirty days of total use annually. ***Long-term (secure):*** Demographic surveys from 2011 indicate that Dyce Creek could support about 2,740 fish once repopulation occurs, which would result in a secured WCT population. Post-treatment monitoring conducted 8/5/2020 showed that the WCT population in Dyce Creek is starting to increase rapidly. Depletion estimates in the E.F. and W.F. showed that the population is now at about 1,912 fish. ***Additional comments:*** Dyce Creek was treated with rotenone in 2010 and 2011, except for the upper East Fork where genetically unaltered WCT remained. Some unaltered fish were transferred to a pond in the West Fork in 2013 and the remainder of the drainage is being allowed to recolonize naturally. Genetic samples suggest that the trout in this stream should conservatively be considered unaltered WCT. Two different WCT samples in the E.F. of Dyce creek had polymorphic hits at the same loci Occ35. Because it is unclear if these fish are unaltered or altered it is recommended that in the future, they are not used to repopulate other WCT populations.
Farlin	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. In 2019 the BLM conducted multiple depletion estimates, these demographic surveys indicate the ratio of WCT to EBT is now 25/75 or just under 25% WCT throughout the drainage. A 24 fish genetic sample was collected on 8/29/2019 and results showed a conservation population consisting of 96.7% WCT and 3.3% YCT. ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. The highway department installed a concrete box structure with the intention that it could be retro-fitted with some sort of fish barrier that would use the highway berm as a levee. Further reconnaissance is needed to clarify if this is a feasible option for a fish barrier. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75 mm within Farlin Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** The WCT population is relatively small and relegated to the top one-third of the drainage and EBT are abundant in the lower stream stretches. Historic demographic surveys indicate the ratio of WCT to EBT has been 50/50. Farlin Creek has good connectivity to Grasshopper Creek, which has an abundant population of nonnative trout.
French	***Genetic Class:*** Genetically Altered

Stream (s)	Population Status and Conservation Needs
- Trout	***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. Demographic surveys of the Rattlesnake drainage indicate a population of 2500 fish >75mm could be secured with this approach. ***Additional comments:*** Hybridization with RBT was documented 23 years ago, in 1994. Genetic samples collected by the USFS on 6/13/1994 showed that there were recent F1 hybrids within the system.
Jake Canyon	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Jake Canyon Creek is protected with a fish barrier (44.97890 -112.46646) that was built in 2016. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Jake Canyon Creek has adequate unaltered WCT (3115) and habitat (4.4 miles) to be considered secured. 2017 genetic samples identified low levels of localized RBT hybridization (99.92 % WCT and 0.08% RBT) resulting in an altered genetic class designation. ***Additional comments:*** Some unaltered fish remain in the headwaters; however, their diversity is substantially lower than other nonhybridized east-side westslope populations. Therefore, we elected to manage the population as genetically altered and accept that the population will be slightly admixed with rainbow trout - assuming random mating the proportion rainbow trout admixture will likely remain near 0.01. This approach was the most cost-effective conservation approach and in light of the genetic composition of the population sample (~99% WCT ancestry) it effectively conserves the vast majority of the evolutionary legacy of this population.
Pole - EF Pole - WF Pole	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Fish transfers and demographic and genetic monitoring. On 6/30/2020 FWP conducted multiple depletion estimates, which indicate that the ratio of WCT to EBT is now 1 to 5 or just under 20% occupied by WCT. The WCT population was estimated at about 31 fish, an average of 1 WCT per 100 m was observed. ***Short-term (protect):*** Barrier construction in Pole Creek is not physically feasible so this population was chosen for translocation into White Creek. In 2021, 25 unaltered WCT were moved to White Creek above a natural waterfall. Many YOY were observed in Pole Creek and these fish will be transferred in 2022. ***Long-term (secure):*** The replicated Pole Creek population in White Creek could be used to help repopulate future projects such as Selway Creek. ***Additional comments:*** Pole Creek will be removed from the conservation population list after the 2022 transfer, but this population will be replicated in White Creek.
Reservoir	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** A barrier will be installed in 2022 to protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure) It may not be feasible to secure a population of 2500 fish >75 mm within Reservoir Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream for WCT expansion is not an option because of intermittent stream flows. ***Additional comments:*** Downstream fish distribution and end of water was documented in 2017 along with genetic samples that reconfirmed unaltered WCT.
Rock	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Grazing practices were changed in 2016 to improve riparian health and mitigate cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more habitat downstream followed by WCT expansion could secure this population. Based on updated demographic surveys this would secure a population of 2500 fish >75 mm within Rock Creek. ***Additional comments:*** Rock Creek from RM 11.4 upstream is located entirely on FWP or BLM land. Downstream one private landowner owns land on Rock Creek (Rebish-Konen). There are two different impoundments located on this productive stream that have good vehicle access to them. More information about these impoundments needs to be collected to understand the feasibility of using one to establish a fish barrier.
Stone - LF Stone - MF Stone - Mine Gulch - Winnipeg	***Genetic Class:*** Genetically altered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Stone Creek was previously thought to be protected by an intermittent reach of stream and a downstream barrier. The putative barrier was an underground drain tile system that prevented overland stream connectivity and fish passage. Establishment of a more reliable barrier would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Improved road maintenance and drainage management is needed. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion would secure a population of 2500 fish >75mm. ***Additional comments:*** Although results from the latest genetic samples indicated slight hybridization, this population is considered an at-risk conservation population. On 7/23/2014 FWP collected genetic samples that were taken from the bottom end of WCT distribution within Stone Creek. Results showed slight hybridization, (98.8% WCT 1.2% YCT). On 8/8/2017 the BLM collected a 26 fish sample from the Left Fork of Stone Creek above a large open pit talc mine that indicated unaltered WCT, which were relocated to Curly Creek. In 2018 BLM collected two other genetic samples within the drainage that confirmed hybridization with YCT.
Taylor	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could protect about 7 miles of stream and secure a population of 2500 fish >75mm. ***Additional comments:*** Past BLM genetic monitoring found hybridized cutthroat up to within ¾ of a mile from the headwaters. Genetics taken on 6/27/2012 show that this population is genetically altered (97.4% WCT, 2.6% YCT) and is considered a conservation population.
Teddy	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Enhancement of an outlet structure on an already existing impoundment could be used to create a barrier. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. Installation of a barrier could protect up to 7.7 miles of stream and based on the productivity of neighboring streams a project would secure a population of 2500 fish >75mm. ***Additional comments:*** BLM genetic samples collected on 8/29/12 identified an altered population of 94.4% WCT 3.8% RBT 1.5 % YCT. More information is needed to develop a conservation plan for this stream.
White (Grasshopper)	***Genetic Class:*** Mixed ***On-going projects:*** In 2021, 25 unaltered fish were moved from Pole Creek into a fishless area of White Creek above a natural waterfall barrier. Additionally, sampling below the barrier identified a previously unknown mixed population of westslope cutthroat trout. Although some hybrids were detected, most fish in the sample appeared to be non-hybridized (n=14). ***Short-term (protect):*** In 2022, another salvage/transfer effort from Pole Creek to White Creek will occur. Additionally, all unaltered WCT captured below the barrier in White Creek will be transferred upstream. ***Long-term (secure):*** If fish become established in upper White Creek, this population may be incorporated into the repopulation plan for Selway Creek. ***Additional comments:*** Additional genetic analysis is necessary to confirm unaltered fish below the barrier.

Section 2: Big Hole Sub-basin

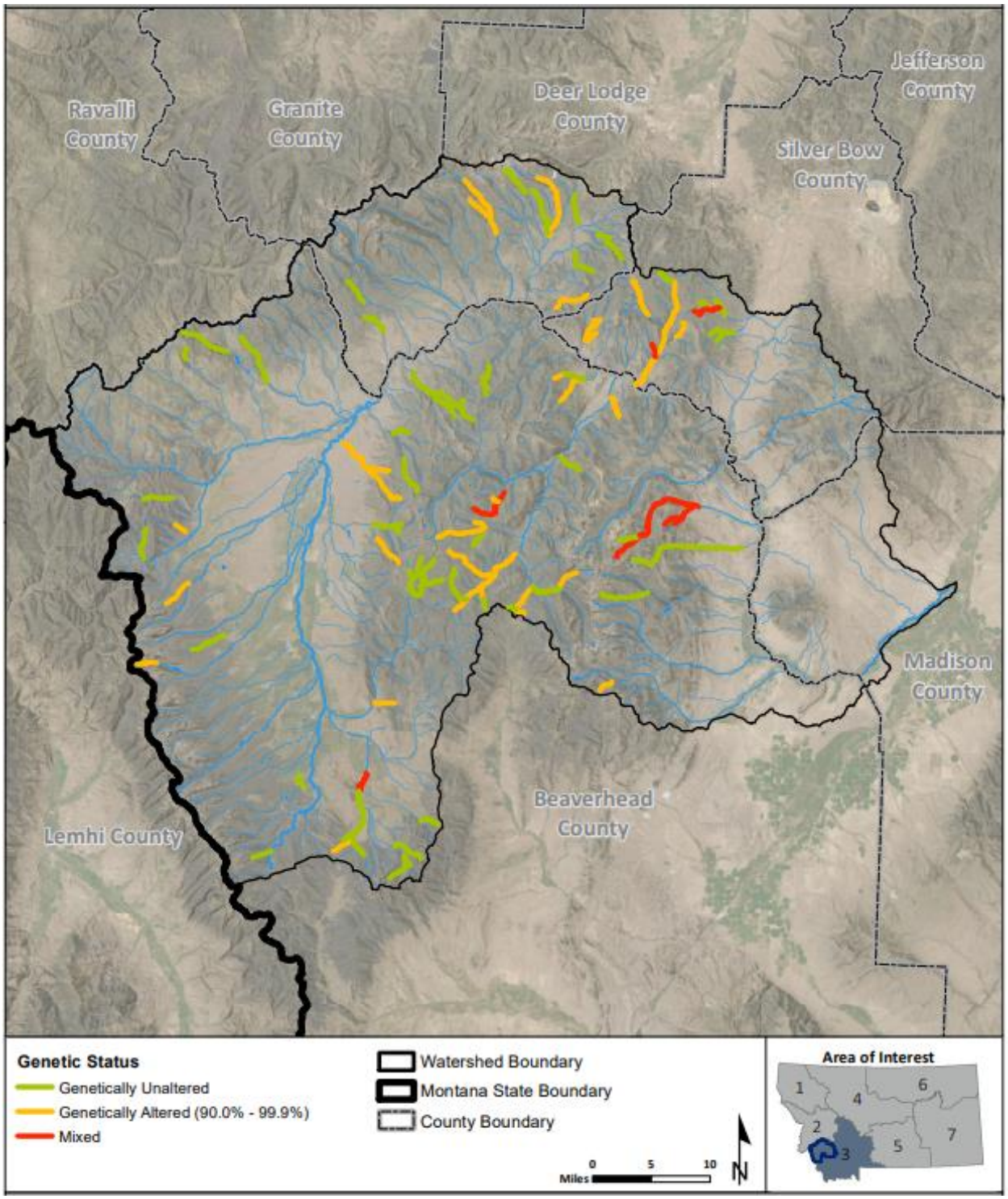

Figure 2.1. Genetic status and distribution of WCT conservation populations in the Big Hole River sub-basin.

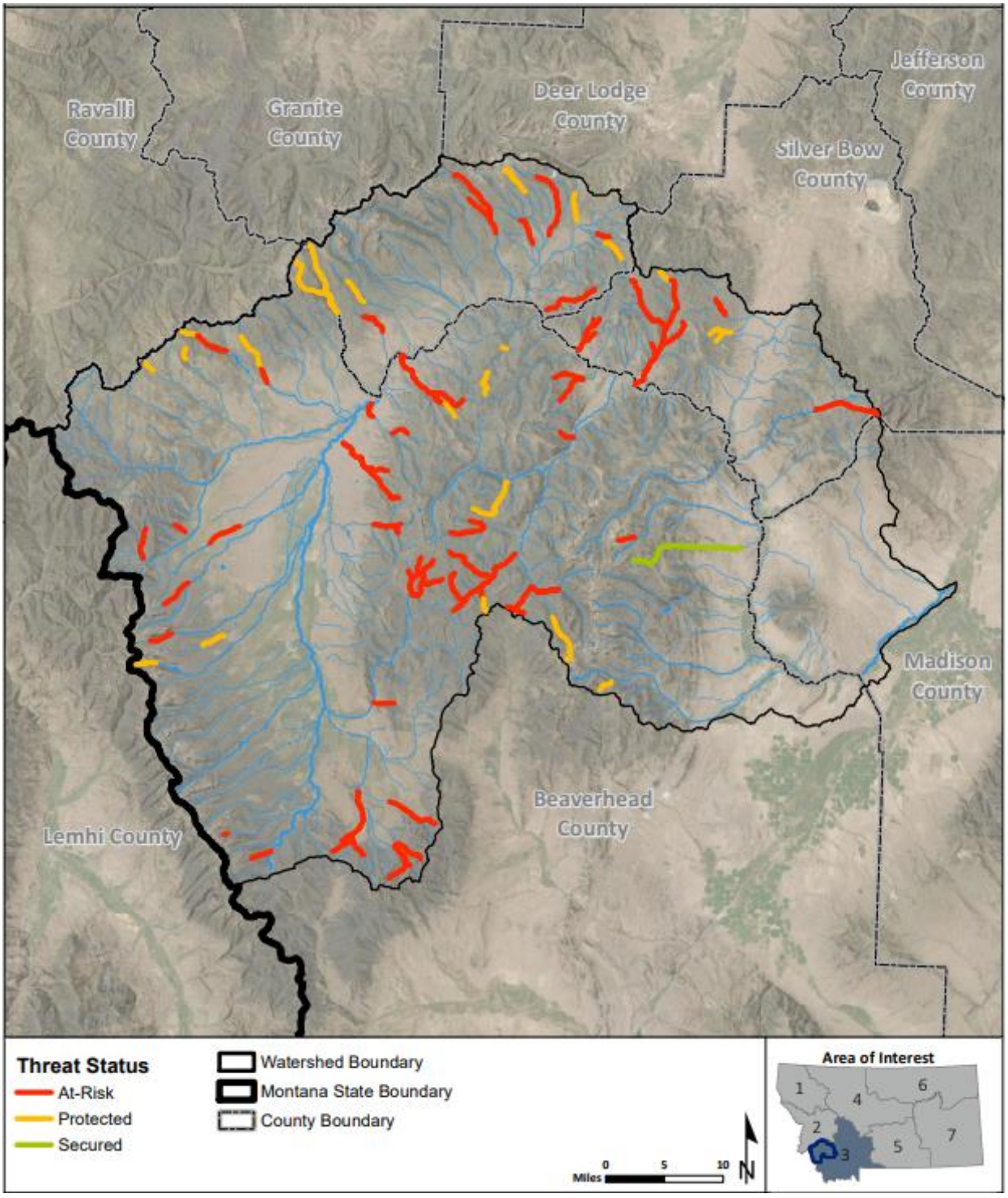

Figure 2.2. Threat status and distribution of WCT conservation populations in the Big Hole River sub-basin.

Overview

Big Hole WCT Status and Threats:

- Number of conservation populations: 49 (25 unaltered; 3 mixed; 21 altered)
- Populations at-risk: 69% (34 of 49).
- Genetically Unaltered populations at-risk: 64% (16 of 25)
- Populations considered protected: 14
- Population considered secured: 1 (Cherry)
- Significant threats:
    - Brook trout: 33 populations
    - Other trout (YCT, rainbow, hybrid): 16 populations
    - Small population size (< 1,000 fish): 32 populations
    - Livestock grazing: 5 populations
    - Limited distribution (< 5 miles of stream): 34 populations

Table 2.1. Genetic class and threat status of WCT conservation populations in the Big Hole River sub-basin.

Genetic Class	Status of Conservation Populations			
	At-risk	Protected	Secured	**Total**
Unaltered	16	8	1	**25**
Mixed	1	2	0	**3**
Altered	17	4	0	**21**
Total	**34**	**14**	**1**	**49**

Table 2.2. WCT conservation populations identified in the Big Hole River sub-basin.

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
American	4624	Genetically Unaltered	Genetically tested as 100% WCT	7/30/13 FWP, Olsen (23 SNP) 100% WCT
Bear	4955 4145 2171 1188	Genetically Altered	Genetically tested as 98.4% WCT	2021 FWP, Olsen (26 SNP) 98.4% WCT 10/2/2017 FWP, Olsen (16 SNP) 100% WCT? Genetic variation indistinguishable from RB? 7/19/2010 FWP, Olsen (24 Indel) 100% WCT? Genetic variation indistinguishable from RB? 6/26/2001 FWP, Opitz (8 PINE) 100% WCT 7/30/1996 USFS, Roberts (2 Allozyme) 100% WCT
Bender	4619 4625 1090 5078	Genetically Unaltered	Genetically tested as 100% WCT	7/07/2014 FWP, Olsen (12 SNP) 100% WCT 7/02/2013 FWP, Olsen (24 SNP) 100% WCT 7/26/1995 USFS, Roberts (1 Allozyme) 100% WCT **Unnamed trib**: 8/01/2018 FWP, Olsen (3 SNP) 100% WCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Big Lake	1005	Genetically Altered	Genetically tested as > 90% WCT	8/22/1994, USFS, Brammer (10 Allozyme) 93.3% WCT 6.7% RB
Blind Canyon	5182 4556 3773 1241	Genetically Unaltered	Genetically tested as 100% WCT	7/01/2020 FWP, Olsen (22 SNP) 100% WCT 7/19/2012 FWP, Olsen (23 SNP) 100% WCT 8/27/2008 USFS, Downing (25 Indel) 100% WCT 7/24/1997 USFS, Roberts (1 Allozyme) 100% WCT
Bryant - Trident	4751 4146 2184 1126 2183	Genetically Unaltered	Genetically tested as 100% WCT	**Bryant**: 6/20/2012 FWP, Nelson (39 Indel) 100% WCT 7/13/2010 FWP, Olsen (30 Indel) 100% WCT 7/03/2001 FWP, Opitz (25 PINE) 100% WCT 9/13/1995 USFS, Roberts (4 Allozyme) 100% WCT **Trident:** 7/3/2001 USFS, Brammer (9 PINE) 100% WCT
Cherry - Granite Lake - Cherry Lake - Trib	4504 3958 3994 3412 2948 933 5079 4902 4908 3778 3410 3021 5080 4907 4909 3050	Genetically Unaltered	Genetically tested as 100% WCT	**Cherry Cr**: 6/26/2013 Above barrier, FWP, Olsen (2 SNP) 100% WCT 8/19/2009 BLM, Hutchinson (25 Indel) 95.8% WCT 2.2% YCT 2% RB 8/20/2008 FWP, Olsen (20 Indel) Mix of fish from hybrid swarm 98.1% WCT 1.9% RB and some fish with higher admixture 8/30/2006 FWP, Nelson (21 Indel) 95% WCT 3.5% RB 1.5% YCT 4/7/2004 BLM, Hutchinson (31 PINE) 100% WCT 7/11/1994 USFS, Roberts (3 Allozyme) 100% WCT **Cherry Lake**: 7/9/2018 FWP, Olsen (94 SNP) 100% WCT. Growing sample size indicates previously in question allele likely represents WCT genetic variation rather than non-native admixture. 7/7/2017 FWP, Olsen (72 SNP) 100% WCT? Evidence of WCT genetic variation? 6/30/2016 FWP, Olsen (35 SNP) 100% WCT? Evidence of WCT genetic variation? 7/8/2008 FWP, Olsen (30 Indel) 81.6% WCT 16.4% YCT 2% RB 8/30/2006 BLM, Hutchinson (25 Indel) 84% WCT 15% YCT 1% RB 6/25/2005 USFS, Brammer (11 PINE) 100% WCT **Granite Lake**: 7/9/2018 FWP, Olsen (48 SNP) 100% WCT 7/7/2017 FWP, Olsen (99 SNP) 100% WCT 6/30/2016 FWP, Olsen (70 SNP) 100% WCT 6/25/2004 USFS, Brammer (25 PINE) 92% WCT 5% RB 3% YCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Doolittle Creek - MF Doolittle - NF Doolittle - SF Doolittle	5208 400 4557 409	Genetically Unaltered	Genetically tested as 100% WCT	**NF**: 9/14/2020 FWP, Olsen (10 SNP) 100% WCT 7/25/1990 USFS, Vore (6 Allozyme) 100% WCT **SF**: 9/14/2020 FWP, Olsen (15 SNP) 100% WCT 7/26/2012 FWP, Olsen (25 SNP) 100% WCT 8/01/1990 USFS, Vore (10 Allozyme) 100% WCT
Dry		Genetically Unaltered	Genetically tested as 100% WCT (Donor source was tested)	Stream was previously fishless. Stocked with 100% WCT from Blind Canyon in 2013. No genetics collected since.
Gory	3995 298	Genetically Altered	Genetically tested as > 90% WCT	7/22/2009 USFS, Downing (26 Indel) 97.6% WCT 2.4% YCT 07/18/1989 USFS, Vore (13 Allozyme) 100% WCT
Governor - Indian - Little Indian - Unnamed NF - Unnamed SF	352 1008 4956 3997 1132	Genetically Unaltered	Genetic analysis indicating presence of both unaltered and hybridized WCT	**Gov**: 9/12/1989 USFS, Browning (4 Allozyme) 100% WCT **Little Ind**: 8/25/1994 USFS, Roberts (4 Allozyme) 95% WCT 2.5% YCT 2.5% RB **UnSF**: 7/13/2017 FWP, Olsen (11 SNP) <100% WCT. Unusual sample indicating a low level of hybridization with YCT and RB, but still conservation population. 8/25/2009 USFS, Downing (22 Indel) 100% WCT? Unusual alleles detected. Uncertain if it represents hybridization or WCT variation. 7/12/1995 USFS, Roberts, (8 Allozyme) 100% WCT
Halfway	2182 2175	Genetically Altered	Genetically tested as > 90% WCT	8/1/2001 FWP, Opitz (8 PINE) 96.7% WCT 3.3% RB 8/1/2001 FWP, Opitz (25 PINE) 96.2% WCT 3.8% RB
Jacobson -Elkhorn	2205 1025 637 990 639 313	Genetically Altered	Genetically tested as > 90% WCT	**Jacobson:** 8/13/2001 Near David Cr. RM 3, FWP, Opitz (16 PINE) 76.2% WCT 12.6% YCT 11.2% RB 9/20/1994 Between David and Lamb Cr., RM 3.5 USFS, Roberts (15 Allozyme) 95% WCT 5% YCT 7/22/1992 USFS, Roberts (1 Allozyme) 100% WCT **Elkhorn:** 8/10/1994 USFS, Roberts (8 Allozyme) 79.7% WCT 20.3% RB 7/23/1992 USFS, Cowley (1 Allozyme) 100% WCT 8/03/1989 USFS, Vore (21 Allozyme) 98.6% WCT 1.4% RB
Jerry - Delano - Flume - Indian - Libby - Long Tom	4621 4149 4150 2856 1190 874	Genetically Altered	Genetic analysis indicating presence of both unaltered and hybridized WCT	**Jerry**: 6/30/2014 FWP, Olsen (30 SNP) 99.2% WCT 0.8% YCT 7/7/2010 Below confl. Flume Cr. FWP, Olsen (26 Indel) 99.4% WCT 0.6% RB 7/6/2010 Above culvert above confl. Flume Cr. FWP, Olsen (35 Indel) 100% WCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
- Unnamed trib	4709 4507 4147 2853 870 218 4338 1129 1130 4722 626			7/18/1999 FWP, Shepard (5 Allozyme) <100%WCT "might be slightly hybridized with YCT" 10/24/1996 Below confl.Long Tom Cr. USFS, Roberts (10 Allozyme) 82.5% WCT 17.5% RB 10/5/1993 USFS, Thompson (8 Allozyme) 100% WCT **Delano**: 7/14/2014 FWP, Olsen (107 SNP) "Some" may be non-hybridized but consider WCTxYCTxRB with >95% WCT contribution 6/18/2013 Above culvert, FWP, Olsen (25 SNP) WCT (22) and WCTxRB hybrids (3) present 7/6/2010 FWP, Olsen (25 Indel) WCT (15) and WCTxRB hybrids (10) present. Hybrids 87.3% WCT 12.7% RB. 7/13/1999 FWP, Shepard (2 Allozyme) 100% WCT 9/29/1993 USFS, Thompson (7 Allozyme) 100% WCT 7/23/1987 FWP, Shepard (8 Allozyme) 100% WCT **NF Delano**: 10/3/2011 FWP, Olsen (26 SNP) 99.5% WCT 0.5% YCT **Indian**: Lower 7/31/1995 USFS, Roberts (8 Allozyme) 85.8% WCT 14.2% RB Upper 7/31/1995 USFS, Roberts (1 Allozyme) 100% WCT **Long Tom:** 7/29/2014 FWP, Olsen (20 SNP) 97.2% WCT 2.8% YCT 7/6/1992 USFS, Brammer (10 Allozyme) 96.6% WCT 3.4% RB
Johnson **-**Cat -Dodgson		Genetically Altered		**Cat:** 6/21/2001 FWP, Opitz (6 PINE) 96.9% WCT 3.1% RB 8/10/1995 USFS, Roberts (2 Allozyme) 100% WCT
Lacy -Bobcat -Skull (Replicate)	2179 2178 876 2176	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT	**Lacy:** 2021 FWP, Olsen (20 SNP) 99.2% 8/28/2001 Below confl. Bobcat Cr. FWP, Opitz (13 PINE) 77% WCT 20.2% RB 2.8% YCT 8/28/2001 Above confl. Skull Cr. FWP, Opitz (5 PINE) 100% WCT 10/19/1993 USFS, Cowley (4 Allozyme) 100% WCT **Bobcat:** 7/19/2001 FWP, Opitz (4 PINE) 100% WCT **Skull (Replicated from Andrus, Bailey, Thayer, Fox):** 2021 FWP, 100% WCT (100 SNP) (Populated with 100 fish from Andrus Creek)

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
				Bailey: 6/30/2009 FWP, Olsen (29 Indel) Status Uncertain. Possibly WCT genetic variation indistinguishable from RB hybridization. 7/27/1999 USFS, Brammer (15 PINE) 100% WCT 9/12/1989 USFS, Browning (8 Allozyme) 100% WCT **Thayer**: 9/21/2020 FWP, Olsen (24 SNP) Mix of WCTxRB (6), WCT (17), and RB (1) 8/31/2010 USFS, Young (10 Indel?) 99.67% WCT 0.23% RB 0.1% YCT 7/01/2009 FWP, Olsen (14 Indel) 100% WCT 8/01/1989 USFS, Browning (25 Allozyme) 100% WCT **Fox**: 6/11/1987 FWP, Shepard (10 Allozyme) 95% WCT 5% RB **NF Fox**: 8/21/1989 USFS, Vore (5 Allozyme) 100% WCT
Lambrecht - Tolland - Dicks	2196 303 109 2168	Genetically Altered	Genetically tested as > 90% WCT	**Lambrecht**: 8/14/2001 FWP, Opitz (25 PINE) 97.3% WCT 2.7% RB 7/31/1989 USFS, Vore (21 Allozyme) 98.6% WCT 1.4% RB 8/15/1984 FWP, Holton (28 Allozyme) 100% WCT **Dicks**: 8/15/2001 FWP, Opitz (20 PINE) 94% WCT 4.7% RB 1.3% YCT
Little American	5205	Genetically Unaltered	Genetically tested as 100% WCT	8/10/2020 FWP, Olsen (30 SNP) 100% WCT
Long Branch		Genetically Unaltered	Founded with unaltered WCT from York Gulch and the Big Hole brood (Cherry and Granites lakes)	Repopulated in 2021 with 64 fish from York Gulch into the upper sections, and XXX fish from Cherry/Granite into the lower sections.
McVey	4794 3419 361	Genetically Altered	Genetically tested as > 90% WCT	9/30/2015 FWP, Olsen (16 SNP) 99.3% WCT 0.7% YCT 7/27/2006 FWP, Nelson (25 Indel) 100% WCT 10/2/1989 USFS, Vore (10 Allozyme) 100% WCT
Meadow - Harriet Lou	4151 2199 2209 3030 1139 2206 1135 627	Genetically Altered	Genetically tested as > 90% WCT	**Meadow**: 9/23/2010 FWP, Olsen (7 Indel) 97.3% WCT 2.7% YCT 7/19/2001 FWP, Opitz (16 PINE) 99.2% WCT 0.8% YCT 7/18/2001 FWP, Opitz (9 PINE) 100% WCT 7/18/2001 USFS, Brammer (8 PINE) 100% WCT 8/28/1995 USFS, Roberts (3 Allozyme) 100% WCT **Harriet Lou**: 7/18/2001 FWP, Opitz (10 PINE) 90.63% WCT 9.37% RB 8/28/1995 USFS, Roberts (10 Allozyme) 100% WCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
				7/7/1992 USFS, Brammer (6 Allozyme) 100% WCT
Mono - Sheldon	2204 2208 2201 697 200 2186	Unaltered	Genetic analysis indicating presence of both unaltered and hybridized WCT	**Mono**: 6/6/2018 Near confl. Sheldon Cr. RM 2.47, FWP, Olsen (16 SNP) 100% WCT 8/2/2001 RM 0.4, FWP, Opitz (16 PINE) 72.8% WCT 16.9% RB 10.3% YCT 8/1/2001 FWP, RM 1.24, Opitz (25 PINE) 98.8% WCT 1.2% RB 8/1/2001 RM 3.28, FWP, Opitz (2 PINE) 100% WCT 8/27/1992 USFS, Cowley (2 Allozyme) 100% WCT 5/19/1987 FWP, Shepard (13 Allozyme) 98.7% WCT 1.3% RB **Sheldon**: 7/31/2001 FWP, Opitz (7 PINE) 90% WCT 10% RB
Moose - Holland	1015	Genetically Altered	Genetically tested as > 90% WCT	**Holland**: 9/1/1994 USFS, Roberts (13 Allozyme) 97.7% WCT 2.3% YCT
Mule	5206	Genetically Altered	Genetically tested as > 90% WCT	9/23/2020 FWP, Olsen (30 SNP) 98.7% WCT 1.3% YCT
Mussigbrod - Hell Roaring	4793 1308	Genetically Unaltered	Genetically tested as 100% WCT	**Hell Roaring**: 8/4/2015 FWP, Olsen (18 SNP) 100% WCT 7/28/1998 USFS, Roberts (5 Allozyme) 100% WCT
NF Divide - SF Divide - Unnamed trib to SF Divide	1167 2181 2185 2189 2212	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT	**NF**: 8/27/1996 USFS, Sanborn (5 Allozyme) 100% WCT **SF**: 9/27/2001 FWP, Opitz (9 PINE) 95.25% WCT 4.75% RB 9/27/2001 FWP, Opitz (21 PINE) 100% WCT 9/20/2001 FWP, Opitz (21 PINE) 96.82% WCT 3.18% RB or YCT? Database says RB, genetic letter says YCT **UnTrib SF:** 9/19/2001 USFS, Brammer (3 PINE) 100% WCT
Odell	2203 2211 1138	Genetically Altered	Genetically tested as > 90% WCT	8/2/2001 FWP, Opitz (18 PINE) 91.7% WCT, 8.3% YCT 7/31/2001 FWP, Opitz (7 PINE) 97.53% WCT, 2.47% RB 8/30/1995 USFS, Roberts (8 Allozyme) 100% WCT
Pintler -Beaver		Genetically Unaltered (potentially 99.997%)	Source used for restocking has been Genetically tested as 100% WCT	Currently being restocked with fish from Cherry and Granite Lakes.
Pioneer Trib	5206 3782	Genetically Altered	Genetically tested as > 90% WCT	9/23/2020 FWP, Olsen (30 SNP) 98.7% WCT 1.3% YCT 8/13/2008 USFS, Downing (25 Indel) 100% WCT
Plimpton	4859 4371 4336	Genetically Unaltered	Genetically tested as 100% WCT	7/28/2016 FWP, Olsen (17 SNP) 100% WCT This sample size differs among reports 6/25/2012 FWP, Olsen (26 Indel) 100% WCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
	1192 868			10/11/2011 FWP, Olsen (53 SNP) 100% WCT 10/24/1996 USFS, Roberts (10 Allozyme) 100% WCT 9/27/1993 USFS, Thompson (1 Allozyme) 100% WCT
Rock (west Big Hole)		Genetically Unaltered	Population maintains fish characteristics phenotypic of WCT	Population is unaltered but needs updated genetic sampling and class assignment.
Ruby	1021	Genetically Unaltered	Genetically tested as 100% WCT	9/14/1994 USFS, Roberts (2 Allozyme) 100% WCT
Schultz	5207 5185	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT	10/1/2020 FWP, Olsen (91 SNP) Mix of WCTxYCT (33) and 100% WCT (58) 9/27/2019 FWP, Olsen (12 SNP) Mix of WCTxYCT (1) and 100% WCT (12)
Seymour - Chub	3266 354 365	Genetically Altered	Genetically tested as > 90% WCT	**Seymour**: 8/18/2005 USFS, Downing (6 PINE) WCTxYCT? No indication of hybridization in this sample, but with small sample size and since previous sample showed hybridization, it is likely that population may still be slightly hybridized (see genetics letter) 9/15/1989 USFS, Vore (9 Allozyme) 98.8% WCT 1.2% YCT **Chub:** 10/25/1989 USFS, Vore (8 Allozyme) 93.8% WCT 6.2% YCT
Sixmile	5183 5077 4383	Genetically Altered	Genetic analysis indicating presence of both unaltered and hybridized WCT	6/19/2020 FWP, Olsen (29 SNP) 100% WCT Samples taken upstream of #5077 which detected hybridization. Possibly failed to detect hybridization in upper samples simply due to sample size. 8/17/2018 FWP, Olsen (27 SNP) 100% WCT (19) and WCTxRB hybrids (8) present. Hybrids had predominant RB genetic component (see genetics letter) 8/28/2012 FWP, Olsen (10 SNP) 100% WCT (7) and WCTxRB hybrids (3) present.
SF of NF Divide - Unnamed trib	4502 3780 2187 1242 4148 2190 1247	Genetically Unaltered	Genetically tested as 100% WCT	**SFNF**: 6/6/2013 FWP, Olsen (9 SNP) 100% WCT 7/17/2008 FWP, Olsen (31 Indel) 100% WCT 9/5/2001 FWP, Opitz (27 PINE) 100% WCT 7/10/1997 USFS, Roberts (3 Allozymes) 100% WCT **UnTribSFNF**: 8/24/2010 FWP, Olsen (25 Indel) 100% WCT 9/5/2001 FWP, Opitz (23 PINE) 99.6% WCT 0.4% RB 7/10/1997 USFS, Roberts (2 Allozymes) 100% WCT
Spruce	4710 4506 4337	Genetically Altered	Genetically tested as > 90% WCT	7/15/2014 FWP, Olsen (105 SNP) Mix of fish from hybrid swarm (102) 99.8% WCT 0.2% RB and hybrid fish with higher admixture (3)

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
	3033			6/25/2013 Near headwaters above partial barrier, FWP, Olsen (26 SNP) 100% WCT 8/4/2011 Below suspected partial barrier, FWP, Olsen (30 SNP) Mix of 100% WCT (26) and WCTxRB (4) 7/15/1999 USFS, Brammer (15 PINE) 100% WCT
Squaw - Papoose	4505 4558 2192 2193 4503 4256 2172	Genetically Unaltered	Genetically tested as 100% WCT	**Squaw:** 6/13/2013 Squaw Lake, FWP, Olsen (30 SNP) 100% WCT 9/17/2012 FWP, Olsen (25 SNP) 100% WCT 7/19/2001 FWP, Opitz (7 PINE) 100% WCT **UnTribSquaw:**7/19/2001 USFS, Brammer (16 PINE) 100% WCT **Papoose**: 6/26/2013 FWP, Olsen (6 SNP) 100% WCT 11/4/2010 FWP, Nelson (25 Indel) 100% WCT 7/16/2001 FWP, Opitz (21 PINE) 100% WCT
Steel - Moose Meadows - SF Steel - NF Steel	478 1201 460 386 204	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT	**Steel**: 10/1/1990 USFS, Vore (6 Allozyme) 100% WCT **Moose Mead:** 8/22/1996 USFS, Roberts (2 Allozyme) 100% WCT 10/1/1990 USFS, Vore (6 Allozyme) 100% WCT **SF Steel**: 6/26/1990 USFS, Vore (2 Allozyme) 100% WCT 6/11/1987 FWP, Shepard (7 Allozyme) 98.8% WCT 1.2% RB
Stine	1136	Genetically Altered	Population maintains fish characteristics phenotypic of WCT	7/19/1995 USFS, Roberts (2 Allozyme) WCTxRBxYCT? Concluded hybridization, but unable to determine if hybridized with RB, YCT or both. Small N. Population needs updated genetic sampling and class assignment.
Swamp	4559 2195 1191	Genetically Altered	Genetically tested as > 90% WCT	5/18/2012 FWP, Olsen (23 SNP) Mix of fish from hybrid swarm (17) 99.8% WCT 0.2% RB and hybrid fish with higher admixture (6) 10/3/2001 FWP, Opitz (4 PINE) 83.9% WCT 16.1% RB 10/23/1996 USFS, Roberts (10 Allozyme) 100% WCT
Tenmile	4143 875 330	Genetically Altered	Genetic analysis indicating presence of both unaltered and hybridized WCT	9/20/2010 FWP, Olsen (13 Indel) Mix of fish from hybrid swarm (12) 99.7% WCT 0.3% RB and hybrid fish with higher admixture (1) 10/13/1993 USFS, Thompson (5 Allozyme) 100% WCT 8/22/1989 USFS, Vore (17 Allozyme) 100% WCT (11) and WCTxRB hybrids (6) present 90.6% WCT 9.4% RB
Trapper - Sappington - Sucker	949 938 877 4752 3996	Genetically Unaltered	Genetic analysis indicating presence of both unaltered and hybridized WCT	**Trap**: 7/20/1994 USFS, Roberts (14 Allozyme) 69.9% WCT 26.5% YCT 3.6% RB 7/12/1994 USFS, Roberts (16 Allozyme) 100% WCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
	1244 3779			10/25/1993 USFS, Thompson (5 Allozyme) 99% WCT 1% YCT **Sapp**: 6/15/2012 USFS, Downing (31 Indel) 100% WCT 7/23/2008 FWP, Olsen (30 Indel) 100% WCT 9/4/1997 USFS, Roberts (5 Allozyme) 100% WCT **Sucker**: 8/20/2008 FWP, Olsen (30 Indel) 98.2% WCT 1.8% RB
Twelvemile	5184 4860 4795 4144 3249	Mixed	Genetically tested as 100% WCT	6/23/2020 FWP, Olsen (30 SNP) 100% WCT 7/20/2016 FWP, Olsen (29 SNP) 100% WCT 8/9/2015 FWP, Olsen (11 SNP) 100% WCT 7/19/2010 FWP, Olsen (25 Indel) 100% WCT 8/19/2005 USFS, Brammer (17 PINE) 100% WCT
Warm Springs - West Fork - Unnamed trib to WF - East Fork - Unnamed trib to EF	680 2213 2180 2194	Genetically Unaltered	Genetically tested as 100% WCT	**WF**: 8/13/1992 USFS, Cowley (1 Allozyme) 100% WCT **UnTribWF:** 8/7/2001 USFS, Brammer (2 PINE) 100% WCT **EF**: 8/7/2001 FWP, Opitz (5 PINE) 100% WCT **UnTrib EF**: 8/7/2001 FWP, Opitz (21 PINE) 100% WCT
WF Mudd	5210	Genetically Unaltered	Genetically tested as 100% WCT	9/15/2020 FWP, Olsen (25 SNP) 100% WCT
Woody	3919 3048 1243	Genetically Altered	Genetically tested as > 90% WCT	7/29/2009 BLM, Hutchinson (10 Indel) 98.5% WCT 1.5% RB 6/29/2004 USFS, Brammer (9 PINE) WCTxRB. % admixture not calculated due to small N. 8/26/1997 USFS, Roberts (6 Allozyme) 100% WCT
Wyman - Rabbia - Deer	2177 673 4861 4618 2170 2173 1137	Genetically Unaltered	Genetic analysis indicating presence of both unaltered and hybridized WCT	**Wyman**: 7/31/2001 Upstream of Rabbia, FWP, Opitz (4 PINE) 95.5% WCT 4.5% RB 8/11/1992 USFS, Cowley (2 Allozyme) 54% WCT 37.5% RB 6.3% YCT. Samples likely taken just upstream of confluence with Wise River. **Rabbia**:9/20/2016 FWP, Olsen (30 SNP) 100% WCT 7/9/2014 FWP, Olsen (7 SNP) 100% WCT 8/2/2001 FWP, Opitz (7 PINE) 100% WCT 8/1/2001 FWP, Opitz (27 PINE) 8/24/1995 USFS, Roberts (7 Allozyme) 100% WCT
York	3781 3417 2191 1145	Genetically Unaltered	Genetically tested as 100% WCT	8/20/2008 FWP, Olsen (33 Indel) 100% WCT 9/7/2006 FWP, Petersen (12 Indel) 100% WCT 8/15/2001 FWP, Opitz (10 PINE) 100% WCT 8/29/1995 USFS, Roberts (10 Allozyme) 100% WCT

Table 2.3. Characteristics of conservation populations within the Big Hole Subbasin.

Conservation population	Population Distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	[c] Threat Status
American Creek	3	3	12 per 100m* (579 Unaltered fish)	Cascade/historic dam	FWP	Small population size	Protected
Bear	3.4	0	4 per 100m* (Likely < 219 altered fish)	None known	FS, BLM, Private	Brook trout, hybridization, likely small population size	At-risk
Bender	4.5	4.5	(based on # salvaged) (32 Unaltered fish)	Man-made wooden barrier	FS	Small founding population size/bottleneck	At-Risk
Big Lake	2.5?		Unknown	None known	FS	Brook, rainbow and hybrid trout	At-risk
Blind Canyon	1.8	1.8	4 per 100m* (115 Unaltered fish)	Boulder cascade	FS	Brook trout lower reach above road, likely small population size and limited distribution	Protected
Bryant - Trident	4.5	4.5	13 per 100m* (941 Unaltered fish)	Cascade	FS	Potentially small population size	Protected
Cherry - Granite Lake - Cherry Lake - Trib	11	11	Restocking of creek initiated in 2019	Concrete	BLM, FS, private	Brook and hybrid trout	Secured
Doolittle Creek - MF Doolittle - NF Doolittle - SF Doolittle	4.5	4.5	N Fk: 25 fish from SF moved to NF- population expanding MF: Extirpated SF: 13 per 100m* (314 Unaltered fish)	Man-made wooden (2020)	FS	Brook trout	At-risk
Dry	2	2	20 per 100 m (643 Unaltered fish)	Goes dry	BLM /FS	Small founding population size, limited distribution	Protected
Gory	0.9		14 per 100m* (203 fish)	Irrigation structure, beaver dams	FS	Small population size; limited distribution, barrier failure	At-risk
Governor - Indian	8.1	0?	2 per 100m* (261 Total fish)	None	FS, private	Brook trout, small population size	At-risk

Conservation population	Population Distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	[c] Threat Status
- Little Indian - Unnamed NF - Unnamed SF							
Halfway	1.6		Unknown	Cascade	FS	Brook trout in lowest reach (0.8 miles), limited distribution	Protected upper reach (1.2 miles)
Jacobson **-**Elkhorn Creek	5.2		Elkhorn: 33 per 100m but genetics not certain (2761 Total fish)	Unknown, but barriers may exist limiting brook and hybrid trout movements	FS	YCT and rainbow trout from headwater lakes	At-risk
Jerry **-** Delano - Flume - Libby - Long Tom - Unnamed trib	16		17 per 100m Total Fish: > 4376	Perched culverts block passage on upper Jerry	FS, private	Brook trout and hybridized fish in all mainstem and lower tribs	At-risk (Jerry protected; 1.7 miles)
Johnson - Cat **-** Dodgson	3.8		Rare (but still present) in Cat	Unknown, but genetics suggest isolating mechanism	BLM, FS, private	Small population size, brook trout, limited distribution	At-risk
Lacy - Bobcat - Skull	6.7	0.7 1.5 miles (Skull)	Unknown	Seasonal intermittent reach, but not 100%	FS	Brook trout, hybrids, livestock grazing	At-risk Protected (Skull and U. Lacy)
Lambrecht - Tolland - Dicks	4.2		Common	Waterfall	FS	None	Protected

Conservation population	Population Distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	[c] Threat Status
Little American	1.3	1.3	3 per 100 m (Based on number salvaged) (62 Unaltered Fish)	Unknown, but possibly series of very old beaver dams	FWP	Brook trout downstream, small population size	Protected
Long Branch Creek	6		Reintroduction will proceed after removal of hybrids	Cascade	FS	Hybrids still present in 2020	Protected
McVey - Unnamed trib 1 - Unnamed trib 2	11		27 per 100m (4778 slightly altered fish)	Man-made wooden	FS, DNRC and Private	Brook trout found in 2019	At-risk
Meadow - Harriet Lou	Meadow: 1.5		2 per 100m Harriet Lou:? (Meadow only 48 fish)	None		Brook trout (none found in headwaters but no barrier identified), small population size, limited distribution, livestock grazing	At-risk
Mono - Sheldon	4	Unknown	15 per 100m (965 total fish)	Cascades, but past evidence of hybrids above	FS	Hybrid trout, small size stream above cascade	At-risk
Moose - Holland	10		8 per 100m (Total fish: 1287)	Barrier on outlet of Schultz Res. Partial barrier	FS	Brook trout	At-risk
Mule	2		61 slightly hybridized fish introduced in 2020	Natural waterfall	FS	Small founding population size	Protected
Mussigbrod - Hell Roaring	2	2	13 per 100m* (Total unaltered fish 418)	Cascade in Hell Roaring Creek	FS	Brook trout throughout Mussigbrod, small population size in Hellroaring, limited distribution	Protected
NF Divide - SF Divide	2		2 per 100m* (63 total fish)	Boulder constructed barrier	FS	Brook trout present throughout drainage; small population size; livestock	At-risk

Conservation population	Population Distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	[c] Threat Status
						grazing; sediment from roads	
Odell	4.6		Rare	Intermittent reach, but not 100% (EBT above)	FS	Brook trout	At-risk
Pintler Creek - Beaver Creek	11	11	? Reintroduction began in 2017	Natural waterfall	FS (wilderness)	None	Protected
Pioneer Creek – Unnamed trib	0.4		Salvaged 61 fish and moved to Mule Cr. Likely very few left.	Cascade, partial barrier	FS	Brook trout, small population size	At-risk
Plimpton	4	4	12 per 100m* (772 Total unaltered fish)	Natural Cascade isolates 3 miles	FS	Brook trout in lower reach, limited distribution	Protected (upper 3 miles)
Rock (west Big Hole)	2	Unknown	Rare	None known	FS	Brook trout	At-risk
Ruby	1.5	Unknown	Rare	None	FS	Brook trout and small population size	At-risk
Schultz Creek	3.7	3.7	68 per 100m (4048 total fish)	Cascade	FS	Hybrids still present in 2020	At-risk
Seymour - Chub	5.8	Unknown-possibly present in upper Chub	Unknown	None known	FS	Brook, hybrid and rainbow trout	At-risk
Sixmile Creek	3		Will be restocked following treatment of French Creek	Blasted bedrock	FWP	None	Protected
SF of NF Divide - Unnamed trib	3	3	Restored in 2017 (451 total unaltered fish, but population should expand to fill habitat with EB removed)	S Fk Reservoir Dam	FS/Butte Silverbow	Small population size	Protected
Spruce	2		7 per 100m* (225 Total fish)	Diversion on private land limits	FS, private	Hybridization, limited distribution	At-risk

Conservation population	Population Distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	[c] Threat Status
				connection to Jerry Creek			
Christiansen (formerly) Squaw - Papoose - Squaw Lake	6	6	7 per 100m (676 total Unaltered fish)	Cascade in Papoose, Cascade in Squaw partial barrier, EB above	FS	Brook trout, limited distribution in Papoose	At-risk (short section protected in Papoose)
Steel Creek - Moose Meadows - SF Steel - NF Steel	Unknown		Extirpated?	None known	FS, private	Brook trout	At-risk
Stine	1.2		Unknown	Potential barriers (highway crossing/ irrigation structure),	FS	Brook and hybrid trout	At-risk
Swamp	2.5		4 per 100m* (161 Total fish)	Irrigation ditch?	FS/Private	Hybridization, limited distribution, livestock grazing	At-Risk
Tenmile	3.6		1.3 per 100m* (75 Total fish)	None known	FS	Brook and hybrid trout, small population size	At-risk
Trapper - Sappington - Sucker	15.4	2.2	10.5 per 100m (2601 total fish, 766 unaltered fish)	Sappington: Cascade? Sucker: Headcut Trapper: None	FS, private	Brook, brown and YCT, historic mining, roads	At-risk
Twelvemile	3	3	14 per 100m* (Avg of 1st and 2nd meadows) (676 total unaltered fish)	Cascade isolates upper reach of stream	FS	Brook trout below cascade; small population size	At-risk (Mixed; small unaltered segment is protected)
Warm Springs	5.9	Unknown	Rare	None known	FS	Brook trout	At-risk

Conservation population	Population Distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	[c] Threat Status
- West Fork - Unnamed trib 1 - Unnamed trib 2							
WF Mudd	3.2	3.2	68 per 100m (3500 Unaltered fish)	Man-made wooden	FS	Bottleneck from small founding population size	Protected
Woody	1.5		21 per 100m (506 total fish)	Irrigation diversion; not 100%	FS, BLM, private	Small population size, limited distribution, brook trout, potential of hybrid trout, barrier failure, livestock grazing	At-risk
Wyman - Rabbia -Deer	1.5	Unknown	Extirpated? Unaltered fish from Rabbia translocated to WF Mudd.	None	FS	Brook trout	At-risk
York	2.2	2.2	< 300 unaltered fish	Partial, wooden	FS and private	Brook trout, small population size, limited distribution	At-risk

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population, or where WCT are not believed present in all reaches of the identified conservation area.

[b]WCT population sizes were calculated by averaging 100 m population estimates or 100 m single pass densities from throughout the drainage and extrapolating to the number of river miles occupied. Single pass densities are denoted with an asterisk and may represent a minimum number of fish.

Table 2.4. Actions required to maintain conservation populations in the Big Hole River sub-basin

Stream (s)	Population Status and Conservation Needs
American	***Genetic Status:*** Unaltered. Genetic samples collected from American Creek indicate the fish were non-hybridized. Fish showed a high degree of heterozygosity relative to other populations east of the Continental Divide. ***On-going:*** American Creek will be included in the French Creek restoration as it is upstream of the barrier on French Creek. ***Short-term (protect):*** The WCT in American Creek downstream of the cascade fish barrier were salvaged and transported upstream where there are no brook trout prior to treatment. No WCT will be introduced to American Creek after treatment. Fish will be allowed to populate the stream downstream of the cascade barrier on their own from the upstream source. Five males will be crossed with 5 female WCT from Cherry and Granite lakes in 2022 and progeny will be incorporated into the brood at Cherry and Granite lakes. ***Long-term (secure):*** Because the population above the cascade is small and will not likely be connected to the WCT that will be introduced to French Creek monitoring should occur more frequently to ensure that population does not decline due to effects of inbreeding. ***Additional Information:*** American Creek and its neighbor Little American Creek are the only remining populations of aboriginal WCT in the French Creek drainage.
Andrus - Bailey - SF Andrus - Thayer	***Genetic status:*** Mixed. Significant hybridization has occurred in this population since last sampled. Additionally, cutthroat numbers have significantly declined. Several F1 individuals and 1 pure rainbow trout was found in 2020. It is imperative that if restoration actions are to occur in the Andrus Creek system that they occur immediately before there are no non-hybridized fish left in the stream. It is very likely that unless there is some pocket of cutthroat somewhere in the drainage that fewer than 50 non-hybridized WCT remain. ***On-going:*** In 2021, a land-swap between the Hairpin Ranch and the DNRC occurred for an isolated parcel of state land. In exchange for FWP's support in purchasing the parcel the ranch constructed a fish barrier on Andrus Creek below the confluence of Bailey Creek. The barrier was completed in late August and the first round of fish removals occurred in September. Prior to treatment, all WCT encountered were salvaged and genetically tested. A total of 109 WCT were encountered in Andrus Creek and its tributaries. Of those, two were definitive hybrids and were removed from the population, 12 were slightly hybridized and were transferred to Mule Creek (Birch Creek), and 96 were likely unaltered and were transferred to a fishless reach of Skull Creek (Wise River). ***Short-term (protect):*** The salvaged fish from Andrus Creek are expected to be protected in Skull Creek. Once Andrus Creek is confirmed fishless these fish can be used to repopulate Andrus Creek. ***Long-term (secure):*** Following the current fish removal project and subsequent confirmation of a fishless stream, approximately 11 miles of stream will be available for recolonization of unaltered westslope cutthroat trout and secure this population. It is expected that the stream will be repopulated with fish originally salvaged from Andrus Creek and transferred to Skull Creek. ***Additional Information:*** Twelve altered WCT (99.8%) from Andrus Creek were transferred to Mule Creek in the East Pioneers where other slightly hybridized fish have been transferred.
Bear	***Genetic status:*** Altered ***On-going projects:*** Wild fish transfer to Mule Creek ***Short-term (protect):*** Brook trout are found throughout Bear Creek, including upstream of the known WCT distribution. The population is at very low abundance and highly threatened. In 2021, after testing revealed

Stream (s)	Population Status and Conservation Needs
	these fish were slightly hybridized with RB (98.4% WCT), 25 fish were transferred to Mule Creek in the East Pioneers and combined with other previously salvaged but slightly hybridized populations of WCT (Pioneer Creek trib and slightly hybridized fish from Andrus/Fox). A barrier would ideally be placed at or near the Highway 43 crossing to gain the greatest amount of habitat possible in the drainage. A barrier at this location would also require 2 additional small barriers on irrigation ditches that leave Bear Creek and go under Highway 43 and eventually discharge to the Big Hole River. Brook trout removal upstream would include several beaver complexes and require the cooperation of several private landowners. ***Long-term (secure):*** The only way to secure an unaltered population in Bear Creek would be through the construction of a barrier, a chemical treatment, and repopulation with unaltered fish. ***Additional Information:*** The highest density of WCT in Bear Creek is in and around the failed bridge over the creek ¾ mi upstream of the Forest Service boundary. Upstream of the next crossing upstream (culvert) no cutthroat were found in recent surveys. The upper reaches of the creek are fishless, but it is unknown if suitable habitat is present to support a fishery year-round. It is unknown if cutthroat trout are present on private lands immediately downstream of the Forest service boundary, but no cutthroat have been found farther downstream on BLM lands.
Bender	***Genetic status:*** Unaltered ***On-going projects:*** Barrier and non-native fish removal ***Short-term (protect):*** A fish barrier was constructed in Bender Creek immediately upstream of Forest Service Road 1203. The WCT remaining in the headwaters were salvage and the stream was treated 2 consecutive years. A 3rd treatment was done on the lower and middle reaches of the creek following EDNA testing that showed the presence of brook trout in 2 potential locations. The fish barrier at this location isolates nearly 5 miles of habitat for cutthroat trout. Previous brook trout densities numbered between 2,000 and 4,000 fish per mile owing the high quality of habitat present. If WCT can eventually obtain ½ the density of brook trout the population will be secured. ***Long-term (secure):*** Because so few fish were salvaged prior to brook trout removal, this population will undoubtably go through a genetic bottleneck. The population expansion from upstream should be monitored. If fish numbers are slow to fill to the additional fishless habitat created, the addition of fish from surrounding drainages may be considered to augment the genetics of the Bender Creek fish. Potential nearby sources could include: Hellroaring Creek or Plimpton Creek. Brook trout densities prior to removal average 3500 fish/mile. Although the occupied stream length upstream of the fish barrier is only 4.6 miles (just under the 5 mile minimum to be considered secure), if WCT reach ½ the density of brook trout there will be over 8,000 WCT in the drainage which well exceeds the criteria for being secure. ***Additional Information:*** Previous data suggested that a cascade was present near the headwaters of the stream which precluded fish passage. In 2012 eggs were collected from this headwater source for use in Cherry Creek and 1 brook trout was found above the cascade. At the time of the first piscicide treatment in 2017 only 60 WCT were salvaged and held during the treatment and brook trout well outnumbered cutthroat in the headwaters of the stream. Prior to the second treatment in 2018 only 32 WCT were salvaged and released into the headwaters of the stream. In 2019 these fish were observed (not electrofished). A 3rd treatment was done on the middle and lower reaches of the stream where EDNA results indicated brook trout were present. No brook trout were observed in the middle reaches during the 3rd treatment but 3 brook trout were present in the lower reaches. Arctic grayling were introduced into the lower reaches of the stream beginning in 2020. The stream will be stocked for 3 consecutive years. This introduction is taking place to provide a fishery in the lower reaches of

Stream (s)	Population Status and Conservation Needs
	the stream while the WCT in the headwaters expand and to expand the range of grayling the in the Big Hole. A low gradient area with beaver activity is present in the lower reaches of Bender Creek. In 2018, 3 WCT were captured in the unnamed tributary of Bender Creek downstream and to the north and west of the fish barrier. These fish tested as 100% WCT. An effort was made in 2019 to capture any remaining fish in this tributary and transport them to Bender Creek to supplement the fish salvaged and released in the headwaters. Only 1 WCT was captured during this effort and it was one of the 3 fish captured the year before. It was released to Bender Creek. The entire Bender Creek drainage was burned in a fire in 2006 except the headwaters which harbored WCT. The aftermath of the fire has led to excellent habitat in Bender Creek with abundant wood in the stream channel.
Big Lake	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** The Big Lake system has not been surveyed in detail to determine specific options for WCT conservation. Brook trout are present throughout the Big Lake drainage, and M012 westslope cutthroat from the Anaconda Hatchery are stocked annually in Twin Lakes (downstream end of the population). Native lake trout and burbot also occupy Twin Lakes. Additional surveys are needed to determine the genetic status of this population and its distribution in Big Lake Creek. ***Long-term (secure):*** There is not five miles of habitat above Twin Lakes; therefore it is unlikely the population can be secured. The potential for a nonnative trout removal from Twin Lakes is not currently considered feasible because of the lack of a suitable barrier location upstream of the lake and the lack of access to the upper creek for barrier construction. If non-hybridized fish are present in the stream, they should be considered for relocation to another stream for long-term conservation.
Blind Canyon	***Genetic status:*** Unaltered ***On-going projects:*** None ***Short-term (protect):*** A high gradient reach roughly 0.5 miles upstream of the Forest Service road appears to preclude upstream brook trout movement. Only WCT are found upstream of this location. Brook trout are known to exist in the lower portion of the drainage. There is no definitive fish barrier in the high gradient reach where Blind Canyon Creek meets the Big Hole River valley but the small cascades appear to be keeping brook trout out based on 2020 surveys. The lower portion of the stream dries up in most years, seasonally limiting brook trout access. About 2.5 - 2.8 miles of habitat exist above this location. WCT are at a relatively low density in Blind Canyon Creek. To protect this population the Forest Service Road crossing should be modified to create a fish barrier. The road crossing is downstream of the reach where the stream goes dry but preventing fish passage at this location would keep brook trout from ever reaching the cascades. Modification of the culvert outlet would be relatively simple because the stream is high gradient downstream of the crossing. The stream could be excavated and lowered roughly 4 ft and a concrete splash pad could be installed to prevent a pool from forming. The upstream extent of WCT in Blind Canyon Creek has not been determined and should be investigated. ***Long-term (secure):*** Securing of the population would require a fish barrier in the mainstem Big Hole River and treatment of the very upper reaches of the Big Hole River, Darkhorse Creek, and several lakes which is not feasible at this time. The WCT in the stream may be protected and expanded somewhat if a fish barrier can be placed at or near the Forest Service road crossing. This would expand the existing population approximately ½ mile and more importantly would prevent potential invasion of brook trout farther upstream.

Stream (s)	Population Status and Conservation Needs
	Additional Information: An egg collection was attempted in Blind Canyon Creek in 2013 for use in repopulating Cherry Creek. The egg take was not successful as no ripe females could be obtained. In 2020, 5 males from Blind Canyon Creek were collected and crossed with females from Cherry Lake for genetic infusion of wild genes into the Cherry Lake brood source. A total of 36 WCT were transported from Blind Canyon Creek and released to Dry Creek (Tributary to Rock Creek). Subsequent monitoring of Dry Creek indicated the WCT are thriving and filling the over 2 miles of habitat in the stream (2020 data).
Bryant - Trident	***Genetic status:*** Unaltered ***On-going projects:*** Barrier and non-native fish removal, genetic rescue ***Short-term (protect):*** The headwaters population is currently isolated by a cascade barrier that prevents upstream movement of brook trout. There are several drops in the reach which could function as fish barriers but no definitive site was identified in recent surveys. A significant population decline may have occurred in Bryant Creek in the past 10 years. The cause of this decline is unknown but has been postulated to be related to genetic isolation. A proposal was developed to introduce a small number of WCT (10) from Bear Creek to upper Bryant Creek to determine if the population decline may be related to genetic issues. Other potential donor sources could include Christiansen and Papoose creeks. None of these proposals are moving forward at this time. ***Long-term (secure):*** Suitable fish barrier locations are present on Bryant Creek near the first road crossing of the stream. The stream in this area is confined and a wooden-type barrier could be constructed. With placement of a barrier and removal of nonnative trout, the WCT population could be extended downstream roughly 8 miles. This would undoubtably secure the population of WCT in Bryant Creek. WCT from Bryant Creek could then also be introduced to the fishless Calvert Creek expanding the range of WCT in the drainage an additional 2 miles. ***Additional comments:*** Eggs were collected from Bryant Creek in 2012 for the repopulation of Cherry Creek. Subsequent monitoring in 2017 suggested the population had substantially declined. The idea of potential genetic rescue of the population through the introduction of a handful of fish from nearby populations was considered but not undertaken. Potential donors would include Bear Creek, Christiansen, and Papoose. These augmentation techniques are not being advanced at this time. Additional monitoring is needed to determine if the WCT in Trident Meadows are recovering.
Cherry - Granite Lake - Cherry Lake	***Genetic status:*** Unaltered ***On-going:*** Repopulation with WCT. ***Short-term (protect):*** A conservation population of WCT was present in Cherry Creek. This population was slightly hybridized with Yellowstone and rainbow trout. A concrete fish barrier was constructed on Cherry Creek approximately 2 miles upstream from the confluence with the Big Hole River in 2011. This isolates a little more than 11 miles of stream upstream and 2 headwater lakes. It was determined that Cherry Creek had the potential to serve as a brood source for future WCT restoration projects so it was decided that all fish in the drainage would be removed including the slightly hybridized WCT. The stream was treated twice in 2011 and restocked with WCT from 7 different sources across the Big Hole. Subsequently, in 2015 brook trout were discovered in the middle reaches of the stream near Cherry Creek ranch. The lower 6 miles stream were treated again 3 times in consecutive years starting in 2016. EDNA testing indicated brook trout were eliminated from the stream in 2019 and restocking efforts were initiated and continued into 2020. The source of fish for restocking were eggs collected from Cherry and Granite lakes which were founded from the collection of fertilized eggs from 7 sources across the Big Hole (see below). Stocking will continue for the next 3 years in the stream to repopulate the system with cutthroat trout.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): The restoration project as described above should eventually meet the criteria of a secure population. Because the lakes are used as a brood source for populating other restoration projects, infusion of wild genes should occur on a regular basis to ensure the brood remains as "wild" as possible. A brood management plan has been developed and is being implemented. ***Additional comments:*** Prior to the second treatment in 2016 all WCT in the lower 6 miles of Cherry Creek were salvaged and moved to Van Houten Lake. Genetic testing suggested that many of these fish came from the Cherry Creek pond which was stocked with M012 westslope cutthroat trout from the Anaconda Hatchery. Cherry and Granite lakes at the headwaters of the drainage serve as the primary brood source for collecting eggs for repopulating streams. Nine different sources of previously non-hybridized populations of westslope cutthroat trout were identified for contribution to the formation of the brood. These sources were: Plimpton Creek, Bryant Creek, Sappington Creek, Squaw (Christiansen) Creek, Papoose Creek, S Fk N Fk Divide Creek, Jerry Creek, Bender Creek, Blind Canyon Creek and American Creek. Jerry Creek turned out to be slightly hybridized and no viable eggs were collected from American and Blind Canyon Creek. In 2020, 5 males from Blind Canyon Creek were collected and crossed with females from Cherry Lake for infusion of wild genes into the Cherry Lake brood source. Also in 2020, 5 males from Twelvemile Creek were crossed with females from Granite Lake for genetic infusion of wild genes into the Granite Lake brood source.
Doolittle Creek - MF Doolittle - NF Doolittle - SF Doolittle	***Genetic status:*** Unaltered ***On-going projects:*** Barrier and non-native fish removal. ***Short-term (protect):*** Mechanical suppression of brook trout in the South Fork upstream of the road crossing and on the North Fork has occurred over the past 3 years. This effort is being done to prevent further WCT decline and aid in potential expansion of cutthroat prior to treatment ***Long-term (secure):*** A fish barrier was constructed on Doolittle Creek downstream of the confluence with the North Fork in the fall of 2020. At least 200 individuals remain in the Doolittle system and will be salvaged prior to brook trout removal and used to repopulate the system. Once WCT fill the habitat upstream of the fish barrier this should become a secure population occupying 11 miles of stream. ***Additional information:*** A fish barrier was constructed in the North Fork Doolittle Creek in 2011 by modifying the culvert outlet at crossing of Forest Road 2441. The stream upstream was treated with rotenone in 2012 and subsequent electrofishing failed to find any brook trout. Approximately 25 fish from the South Fork were transferred to the North Fork to repopulate the stream. Monitoring in 2018 showed that brook trout were not completely removed and subsequently dispersed downstream. Mechanical removal of brook trout commenced in 2019. During that effort it was found that WCT were thriving in the upper reaches of the stream with over 100 fish captured. Mechanical suppression of brook trout in the S Fk has been occurring for the past 3 years in an effort to expand the WCT numbers prior to treatment with rotenone. Doolittle Creek supports a population of tailed frogs.
Dry	***Genetic status:*** Unaltered because of source of fish but untested ***On-going projects:*** 36 WCT from Blind Canyon Creek were introduced to Dry Creek in 2013. 2020 surveys indicate fish are thriving in Dry Creek and expanding both upstream and downstream to fill most of the available habitat. ***Short-term (protect):*** Consultation with geneticist should occur to determine if WCT from other populations should be added to Dry Creek. Possible candidates for introduction could include Rock Creek (WCT found in headwaters but untested), , Doolittle Creek, Christiansen Creek.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): It is not likely that this population of fish will be secure because it will occupy a maximum of only 2 miles of stream. It may however, allow for a contribution of fish from populations that are likely to be extirpated or are very difficult to access and therefore not likely to contribute genetically to other restoration efforts. Having these genes represented in Dry Creek would allow for their use in other restoration efforts. Dry Creek will likely require long term genetic maintenance. ***Additional information:*** Dry Creek contained only Rocky Mountain sculpin prior to the introduction of 36 WCT from Blind Canyon Creek.
Gory	***Genetic status:*** Altered ***On-going projects:*** Genetic samples collected in 2009 indicated this population of fish is slightly hybridized with Yellowstone cutthroat trout which have not been detected in previous sampling. ***Short-term (protect):*** Although isolated, the Gory Creek conservation population is considered "at-risk" due to limited distribution, small populations size, and potential barrier failure (beaver dams) that currently prevents brook trout passage. There is very limited opportunity to expand the population due to short stream length, and it is a direct tributary to lower Ruby Creek where WCT conservation activities are not currently feasible. Securing the existing barrier, analysis of additional genetic samples, and replication of the population in a larger and more secure stream should be considered. ***Long-term (secure):*** Currently the only feasible way of securing the Gory Creek population of WCT would be to replicate the population into a fishless water outside its current range. This would likely be a lower priority over other conservation efforts because of the limited numbers of available fishless waters and the recent evidence of hybridization of WCT in Gory Creek.
Governor - Indian - Little Indian - Unnamed NF - Unnamed SF	***Genetic status:*** Mixed ***On-going:*** Recent population surveys. ***Short-term (protect):*** Based on sampling in 2008, 2009 and 2017 brook trout are present throughout Governor Creek and are the dominant fish species in most of its tributaries (one exception is the 2nd tributary to the north of Indian Creek where WCT outnumber EB). WCT are no longer present in Governor Creek on National Forest but are present in Indian Creek and the SF tributary at low abundance. In 2009, the NF tributary held no fish due to intermittent flows. It may be feasible to identify a barrier site in Governor or in one of the nearby tributary streams and remove the non-native fish from that stream. Then WCT from Governor Creek and surrounding tributaries could be moved into that stream while a long-term conservation strategy is developed for Governor Creek and its tributaries. There are no known possible barrier locations in the drainage, but below the confluence with Fox Creek would be the ideal location. It is not known if there is a suitable site and this location is on private property. Swamping efforts at Peterson Lake (in the Pine Creek drainage) are underway to try and reduce the abundance of rainbow trout as they are the only known source of a hybridizing species in the Governor Creek drainage. ***Long-term (secure):*** Any conservation project in Governor Creek should include a barrier structure in the drainage as far downstream as feasible to include Andrus, Pine and potentially Fox Creek. A barrier at this location could result in a large interconnected system for WCT but would require the permission and cooperation of the Hairpin Ranch, which owns a majority of the drainage. Rainbow trout from Peterson Lake would also have to be removed. The feasibility of such a project has not been thoroughly evaluated. ***Additional comments:*** Governor Creek was sampled in 2008 approximately ¼ mi downstream from the location in which the genetic samples were last collected in 1989. 1500 ft of the stream was sampled and only

Stream (s)	Population Status and Conservation Needs
	brook trout (79) and mottled sculpin were captured. Stream is very small in upper reaches on National Forest. Indian had a very limited number of WCT in 2007 relative to EB (average 12:1) and no evidence of reproduction. The 2nd tributary north of Indian Creek was surveyed in 2009 and WCT are still present and reproducing in this stream. They outnumber EB roughly 3:1 but the stream is very small with limited habitat. No WCT were found in Pine Creek.
Halfway	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** WCT are the only species in a 1.2 mile reach of upper Halfway Creek. The reach is isolated by a cascade barrier at RM 0.6. Below the barrier, brook and WCT are present to the stream mouth (Wyman Creek). Potential for barrier placement and brook trout removal in the lower reach of the stream has not been reviewed and is not considered a priority at this time due to the short stream length (0.6 miles) that would be added to the population. ***Long-term (secure):*** The only way to secure the population of fish in Halfway Creek besides moving them to additional habitat would be to construct a fish barrier on Wyman Creek. Given the low gradient nature of much of Wyman Creek, the barrier would likely have to be placed downstream of the confluence of Table Creek (see Wyman Creek below). Although it would not secure the population, a fishless reach of Deer Creek just to the south of Halfway Creek could serve as an introduction site for fish from Halfway Creek. If no WCT are present in Rabbia or upper Wyman, Halfway would be the nearest neighbor and this could expand the range of this population by 2 miles.
Jacobson -Elkhorn	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** WCT genetic samples from Jacobson Creek and its associated tributaries (Elkhorn and David) show a high level of hybridization variability, including several samples below < 80% WCT. A cascade near David Creek appears to isolate the headwaters of Jacobson Creek (about 2 stream miles). Surveys of this reach found no brook trout (1994 survey), and genetic sample collected the same year indicting 95% WCT (n=15). This is likely the only reach of stream with > 90% WCT. However, Tahepia Lake at the headwaters of Jacobson Creek supports a self-sustaining population of rainbow trout and Schultz Lakes support self-sustaining rainbow, Yellowstone cutthroat and westslope cutthroat trout. Current population status and genetic samples should be collected from upper Jacobson Creek upstream of the meadows. Elkhorn Creek was sampled in 2020. Downstream of the Elkhorn Mine site there were only limited number of brook trout. Cutthroat hybridization appeared significant at the Forest Service road crossing. No brook trout were encountered at and above the mine site. Although no genetic samples were collected, the cutthroat upstream of the mine site phenotypically appeared to be WCT. Past samples from this location indicated the fish were 79% WCT (1994) but samples collected years earlier from downstream suggests fish are > 90% WCT. Elkhorn Lake has a self-sustaining cutthroat population. There is no stocking record for the lake but it is unlikely that they represent a native WCT population given the high gradient nature of the stream below the lake. Hopkins and Hall lakes are also present in the drainage and are primarily stocked fisheries. Hall Lake has been stocked in the past with Yellowstone cutthroat trout. Past surveys of the lakes suggest that Hopkins lakes supports limited reproduction, so it is possible that Yellowstone cutthroat genes are present in the lake. Genetic samples should be collected from the stream to determine the genetic status of the fish. ***Long-term (secure):*** A suitable barrier location is present on Jacobson Creek upstream of the confluence of Mono Creek. This would isolate a significate portion of stream including all of Elkhorn and David creeks. A barrier at this location would isolate close to 20 miles of stream habitat. It would also encompass multiple lakes including Tahepia, East and West Schultz, and Torrey all of which have self-sustaining populations of

Stream (s)	Population Status and Conservation Needs
	rainbow or Yellowstone cutthroat trout and their hybrids. Hopkins and Hall lakes are currently stocked with westslope cutthroat trout but were historically stocked with Yellowstone cutthroat trout and Hopkins appears to support some natural reproduction, so it is likely that Yellowstone cutthroat are still present in this lake. Elkhorn Lake also likely contains Yellowstone cutthroat trout. The lack of a non-hybridized WCT in the drainage, the cost of a fish barrier in Jacobson Creek and the cost and social impact of having to remove fish from 5 large lake systems would likely make a project in the drainage a low priority. ***Additional comments:*** Elkhorn mine in Elkhorn Creek has significant water quality impacts on the stream. Past surveys indicate that the mine impacts form a chemical barrier to fish passage as no brook trout have been found in the stream and this was verified in 2020. Additional restoration efforts are planned at the site improve water quality. If these actions are successful it is likely that the chemical barrier will no longer be in place and brook trout will be able to move upstream. If there is a conservation population remining in Elkhorn Creek, a fish barrier may be necessary to protect Elkhorn Creek from brook trout evasion. A suitable barrier site appears to be present between the Forest Service Road crossing and the confluence with Jacobsen Creek.
Jerry - Delano - Flume - Libby - Indian - Long Tom	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** The Jerry Creek system is relatively complex with multiple tributaries that maintain WCT. Four streams contain isolated WCT populations (Upper Jerry Creek, Delano Creek, Spruce Creek and Long Tom Creek). Upper Jerry Creek and Libby Creek are isolated by perched road culverts and Long Tom Creek is isolated by a short cascade. Jerry and Delano WCT have tested pure in the past but recent genetic evidence suggests the fish are slightly hybridized. Recent surveys in the headwaters of Long Tom Creek did not find any brook trout and the genetics of the fish matched previous samples which showed slight hybridization with Yellowstone cutthroat trout, like Jerry and Delano creeks. WCT are present throughout the rest of the drainage but hybridization levels increase farther downstream. Jerry Creek is one of only a few streams in the Big Hole drainage where WCT seem to persist despite the widespread presence of brook trout. Hybridization is the most immediate threat to the WCT in the Jerry Creek system. Genetic evidence suggests that hybrid trout have recently invaded Delano Creek. Hybridization was also detected in upper Jerry Creek but evidence suggests that the hybridization was not recent, rather it was not detected in previous sampling. There are no barriers to fish migration from the Big Hole River into Jerry Creek. ***Long-term (secure):*** A suitable barrier site downstream of the confluence of Long Tom Creek has been identified and surveyed. A barrier at this location would isolate approximately 18 miles of stream habitat. It would not include Spruce or Indian creeks which are downstream. Once a barrier is in place, the non-native brook trout and hybrid trout should be removed. Before removal, current genetic samples should be collected and a strategy should be developed to salvage existing WCT in the system. There is a landlocked portion of private property on Jerry Creek between the confluence of Libby and Delano creeks and fish removal would require the cooperation of this landowner. Additional genetic samples are needed from Indian to determine if a conservation population of WCT is still present. ***Additional comments:*** Eggs collected from Jerry Creek upstream of the culvert fish barrier were introduced into an unnamed tributary of Long Tom Creek. The success of the introduction has not been evaluated.
Johnson - Cat - Dodgson	***Genetic status:*** Altered ***On-going projects:*** Livestock exclosure has been constructed on lower reach of Johnson Creek.

Stream (s)	Population Status and Conservation Needs
	Short-term (protect): WCT have been sampled in Johnson and Cat creeks but may only be seasonally present in Dodgson Creek due to its small size (2001 surveys). Cat Creek is marginal habitat but WCT persist (2016 survey). Brook trout are common and outnumber WCT throughout Johnson Creek, but no brook trout have not been found in Cat Creek. There are no known barriers preventing brook trout invasion into Cat Creek. Lower Johnson Creek is captured by an irrigation ditch from the Big Hole River near its confluence with the river. The diversion for this ditch is less than a mile upstream of the confluence of Johnson Creek. Limited distribution, small population size and the presence of brook trout indicates the Johnson Creek population is at high risk. Construction of a barrier below Cat Creek on private property, and removal of brook trout, would protect the greatest amount of habitat in the drainage (roughly 5 miles). However, before a barrier is considered the status of cutthroat trout in the drainage needs to be determined. Recent forest surveys failed to find WCT in Johnson Creek. WCT still persist in Cat Creek but additional inventory needs to be done and genetic samples collected to determine if a conservation population of WCT remains in the stream. Additionally, the upper reaches of Johnson Creek, were found to be fishless in 2001 surveys. This area should be investigated for possible upstream expansion of the WCT population using fish from Cat Creek. ***Long-term (secure):*** A barrier on private property downstream of the forest and removal of nonnative trout upstream may secure 5+miles of habitat. A suitable location has not been identified and the wide and relatively flat nature of the lower stream would make barrier placement difficult. Because Johnson Creek is a tributary to the Big Hole River, there is no ability to connect the WCT population with others.
Lacy - Bobcat - Skull	***Genetic status:*** Mixed ***On-going projects:*** Fish Transfers ***Short-term (protect):*** Brook trout are present throughout the stream reach occupied by WCT in Lacy and Bobcat Creek, though there is an intermittent reach just below the Lacy – Bobcat confluence that appears to act as at least a seasonal barrier semi-protecting the upper reach. Rainbow trout are found below the barrier. Two additional lakes in the drainage (Bobcat and Schwineger) are occupied by grayling and Lake of the Woods is stocked with WCT but has been stocked with hybridizing species in the past (see below). In 2021, 20 fish were captured in Lacy (n=18) and Bobcat (n=2) creeks which tested as 99.2% WCT. These fish were transferred to a fishless reach in upper Lacy Creek. Additionally, 104 unaltered fish from Andrus and Fox creeks were transferred to a fishless reach in Skull Creek. Skull Creek has 1 – 1.5 miles of suitable habitat above a waterfall barrier near the stream mouth. Lake of the Woods should be reviewed for species present and potential dispersal into Lacy Creek. ***Long-term (secure):*** A barrier downstream of the confluence of Bobcat Creek would isolate roughly 6 miles of habitat (if Skull Creek is included). Potential for barrier placement and nonnative trout removal have not been evaluated. Because Lacy Creek is a tributary to Wise River there is no current opportunity to connect the population with others. Unaltered WCT in Skull Creek will be transferred back to Andrus Creek once the treatment is completed there and the stream is confirmed to be fishless. ***Additional comments:*** Lake of the Woods, at the head of the Lacy drainage, has been stocked with both rainbow trout and "cutthroat" trout as recently as 2002. It is unknown if there is potential of downstream dispersal from the lake to Lacy Creek. Stocking has been recently changed to WCT (2006), and if there is no natural reproduction in the lake the threat from non-native trout may be absent (though stocked WCT could still be a concern). Angler reports suggest that no rainbow trout are present in Lake of the Woods but this should be confirmed through netting and genetic analysis. North Bobcat Lake and Schwineger Lake contain self-sustaining populations of Arctic grayling that have conservation value.
Lambrecht - Tolland	***Genetic status:*** Altered

Stream (s)	Population Status and Conservation Needs
- Dicks	***On-going projects:*** None ***Short-term (protect):*** The population is protected by a 40-ft waterfall near the stream mouth, and no actions appear necessary to protect the population. A private pond near Lambrecht Creek should be evaluated for species presence. Additional genetic samples should be collected in the headwaters of the stream to determine if genetically unaltered fish persist. ***Long-term (secure):*** The population occupies just under 5 miles of habitat, although it is unknown if it maintains > 2500 fish. The population is considered protected. The waterfall permanently isolates the population from others. Forest Service records indicate that Toland Creek which drains into Lambrecht Creek is fishless. Introduction of WCT to this stream, if successful, could increase the number of occupied stream miles to over 5 miles of stream. Additional population and current genetic information are needed in the system. It appears the most of the high quality habitat in the system in on private property. ***Additional comments:*** There are no stocking records for Lambrecht Creek, and it is unknown if the population is native, or when hybridization occurred. "Cutthroat" and rainbow trout stocking was common in the Pettengill system in the 1940's and 1950's. If advances in genetic testing could be used to show the population was established from a hatchery source, it could be warranted to replace it with a genetically unaltered source of native Big Hole WCT. The significant waterfall barrier and available habitat elevate the potential of such an effort.
Little American	***Genetic status:*** Unaltered ***On-going projects***: Little American Creek is part of the larger French Creek restoration project as it is located upstream of the French Creek barrier. ***Short-term (protect):*** A very small population of non-hybridized WCT was discovered in the upper part of Little American prior to treatment of the stream in 2020. Approximately 50 fish were salvaged and held above the treatment area and released back into the stream after the treatment. It appears a series of very old beaver dams may have prevented upstream invasion of EB in the upper part of Little American as below these old beaver dams EB were abundant. These old dams were partially notched in 2020 to ease treatment of the stream. Upon completion of the French Creek restoration project, WCT from the upper section of Little American will be allowed to populate the downstream habitat from the upper source. ***Long-term (secure):*** Little American flows for just over two miles before it joins with American Creek. Once the French Creek restoration project is complete, WCT from both streams will be allowed to populate the drainage and there should be some mixing of these two populations at least in the lower reaches. Both populations will be protected by the French Creek barrier. Because the aboriginal population in the upper part of Little American is so small, it should be monitored to ensure that inbreeding is not leading to declines and to see if breaching of the relic beaver dams has allowed for fish passage. If fish from downstream are still not able to reach the upper portions of Little American, it may be necessary to periodically move fish to the upper part of the stream to increase genetic diversity or find ways to facilitate greater connectivity between the two reaches. ***Additional comments:*** Little American Creek and American Creek are the only remaining aboriginal populations of non-hybridized WCT in the French Creek drainage.
Long Branch	***Genetic status:*** Unaltered ***On-going projects:*** Reintroduction of WCT ***Short-term (protect):*** A cascade fish barrier isolates Long Branch Creek from Rock Creek below. The cascade is roughly ½ mile long and in many places flows completely subterranean through a large boulder field. No specific barrier has been identified but there were no brook trout or brown trout upstream of the fish barrier

Stream (s)	Population Status and Conservation Needs
	which were present in Rock Creek downstream. Rotenone was used to remove Yellowstone cutthroat trout and rainbow trout from the stream in 2016 and again in 2018 once Tendoy Dam was removed (see below). EDNA testing is planned for Long Branch Creek in 2021 prior to WCT reintroduction. In 2021, the stream was confirmed to be fishless by eDNA and repopulation began. Sixty-four unaltered WCT from York Gulch were moved into the upper reaches of Long Branch Creek. Additionally, 7,000 fish from the Big Hole brood populations were moved into the lower sections of Long Branch Creek. Another transfer from York Gulch is planned for 2022. Because of cascades between the upper and lower sections of Long Branch Creek, it is expected that York Gulch fish on the upper end will remain isolated from Big Hole brood fish on the lower end. Future genetic monitoring will verify this. ***Long-term (secure):*** Once the stream is repopulated with cutthroat trout the total miles of occupied habitat will be roughly 5 miles. Future surveys will be necessary to determine if the minimum population size will be great enough to consider the population secure. Based on pre-treatment densities of hybrid trout, the stream is expected to carry a population of greater than 2,500 individuals. ***Additional comments:*** Long Branch Lake and the stream upstream and downstream of the lake contained primarily rainbow trout. Farther upstream more cutthroat trout were present but genetic analysis indicated these fish were primarily Yellowstone cutthroat trout. It was discovered that a failing dam on the outlet of Tendoy Lake at the head of the adjacent Willow Creek was forcing water from the lake into Long Branch Creek during snowmelt. This connection appears to have been the source of Yellowstone cutthroat trout. In 2017 the dam was removed with the permission of the water right holder by US Forest Service crews. Removal of the dam eliminated the connection between the lake and Long Branch Creek even during snowmelt events. Artic grayling have been introduced to Long Branch Lake and the lower creek but have thus far not been observed since.
McVey	***Genetic status:*** Altered. Previous samples suggested population was unaltered, but more recent SNP samples indicate very slight hybridization with YCT that was not detected with previous techniques. ***On-going:*** Removal of recent invading brook trout. ***Short-term (protect):*** Brook trout were discovered in McVey Creek in the fall of 2019 in the vicinity of the lower irrigation diversion by the fish barrier. Subsequent investigation in 2020 indicated that brook trout were present throughout the middle sections of the stream but density declined rapidly upstream of the Forest Service boundary. Densities were the greatest in the fork that enters the stream at the Forest Boundary (called Giem Fork in other reports). Initially it was postulated that brook trout may have moved upstream over the fish barrier or through an irrigation ditch, but these investigations suggested it was more likely that brook trout were not completely removed from the Giem Fork with the initial treatment of the stream. A plan is being developed to salvage the WCT from McVey Creek and retreat the stream. Removal of brook trout will be confirmed with EDNA. ***Long-term (secure):*** The population was thought to be secure as the salvage fish from the 2011 treatment rapidly expanded and filled the 11 miles of available habitat, but the discovery of brook trout in the drainage in 2019 indicated that WCT are once again sympatric with brook trout. Once brook trout are completely removed from McVey Creek WCT will be secured in the drainage. Because the WCT in McVey Creek are slightly hybridized and secured in their aboriginal habitat, they will not likely be used to repopulate other streams. ***Additional comments:*** Arctic grayling were introduced upstream of the fish barrier in 2018 and successfully reproduced in 2019 and 2020. Grayling will be removed at the time of the brook trout removals and not salvaged. They will be reintroduced following brook trout removal using the Axolotl brood source. The barrier on McVey Creek was constructed in the summer of 2011 at the Highway 43 crossing. A barrier at this location isolated approximately 11 miles of habitat upstream. The unnamed tributary to McVey Creek near

Stream (s)	Population Status and Conservation Needs
	the Forest Boundary was treated with rotenone and a temporary fish barrier was erected in the stream. Approximately 160 WCT were salvaged from the headwaters of McVey Creek and held in live cars in the unnamed tributary while the rest of the drainage was treated with rotenone. Three days after the treatment the fish were released into the stream. The salvaged WCT quickly repopulated the stream and in a reach downstream of the forest boundary where there were no WCT, the density of cutthroat nearly equaled that of the brook trout. Brook trout were discovered in McVey Creek in 2019.
Meadow - Harriet Lou	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** The distribution of WCT appears to be very limited in Meadow Creek. Recent surveys failed to find cutthroat downstream of the Forest Boundary suggesting the WCT occupy approximately 1 mile of stream. No brook trout were found in the reach occupied by cutthroat so there is likely some sort of impediment to fish passage (irrigation diversion or culvert) that precludes fish passage. No new information is available for Harriet Lou Creek. Meadow Creek is fishless upstream of a high gradient reach roughly 1 mile upstream of the road crossing. There is roughly 2 miles of suitable habitat upstream that is currently fishless. Current genetic samples should be collected from both Meadow and Harriet Lou creeks. If genetic results indicated both streams contain conservation populations, individuals from both populations should be moved into the currently fishless reach. An EA for this action has already been completed. This action could protect the remaining WCT in the drainage but would not secure the population. ***Long-term (secure):*** No suitable fish barrier locations are present on Meadow Creek that would encompass a minimum of 5 miles of stream. Further irrigation water from the Wise River influences Meadow Creek so a barrier farther downstream would still not secure the population from the potential threats from non-native fish.
Mono - Sheldon	***Genetic status:*** Mixed ***On-going projects:*** None ***Short-term (protect):*** A cascade barrier (6 ft) at RM 0.25 prevents invasion of brook trout; however, genetic results above the barrier indicate the presence of both unaltered and altered WCT (90 – 100%). Recent SNP genetic samples indicated that hybridization may be very minimal at the headwaters of the drainage. This contradicts the results of previous sampling in 2001 that suggested fish were only 90% WCT in this area. The recent samples are more similar to those from farther downstream which indicate only a small (1%) admixture with rainbow trout. Additional genetic samples are necessary farther downstream to determine the status of fish in the lower drainage. The results of these samples would shed light on potential fish passage in the lower reaches of the creek. If the barrier in the lower reaches of the creek is completely precluding upstream fish passage, between 4 and 5 miles of WCT habitat would exist upstream. If evidence indicates that fish passage is present from the lower reaches of the stream to the meadows above, construction of a fish barrier would become a high priority to protect this population of WCT. ***Long-term (secure):*** The Mono Creek system contains nearly 5 miles habitat upstream of the cascade fish barrier. Numbers of WCT in the system likely exceed 2500 fish. The habitat is high quality, but the stream is relatively small. Additional information on the distribution and density of WCT in the creek is needed to determine if the population could be considered secure. If genetic results indicate pure fish are only present in the headwaters of the stream it may warranted to move these fish to a fishless stream and create a new WCT population. ***Additional comments:*** Mono Creek was stocked with 7,000 “cutthroat” in 1942 and 2,900 fish in 1947.

Stream (s)	Population Status and Conservation Needs
Moose - Holland	***Genetic status:*** Altered ***On-going projects:*** Barriers have been constructed to block fish movement upstream of from Schultz Reservoir on Holland Creek. These are not likely to be complete barriers to fish passage, although surveys upstream only found WCT in Holland Creek in 2009. ***Short-term (protect):*** The Moose – Holland system is currently acting as two isolated units. Dewatering and constructed barriers (above Schultz Reservoir) isolate slightly hybridized WCT in Holland Creek. One barrier on Holland Creek is at a diversion structure that generally diverts the entire flow of the stream to Schultz Reservoir. Another structure blocking fish passage was placed on the overflow channel from the reservoir. As the normal "pipe" outflow from the reservoir is thought to be a fish passage barrier, the other two structures are added insurance to block non-native passage from Holland Creek. Brook trout are present in the reservoir at low density but have not been found in the ditch or Holland Creek upstream of the reservoir. Ovis Lake was stocked with WCT in 2010 and again in 2016 to create a sport fishery. Brook trout are also present in Holland Creek downstream of the reservoir, and all of Moose Creek. Current genetic samples need to be collected from Holland Creek and Shultz Reservoir. WCT are distributed throughout the lower and mid reaches of Moose Creek, but at very low density relative to brook trout. Genetic samples need to be collected from Moose Creek as this population is untested. Additionally, the upstream distribution of cutthroat needs to be determined. ***Long-term (secure):*** A barrier and removal of brook trout appears necessary to secure WCT in Moose Creek. Ideally a barrier would be constructed downstream of the Forest Road 944 which would isolate the greatest amount of stream habitat (approximately 10 miles). A barrier at this location would also include Holland Creek upstream. Additional population, distribution, genetic information from the headwaters of Moose Creek and barrier feasibility information are necessary to develop specific a conservation plan for this system.
Mussigbrod - Hell Roaring	***Genetic status:*** Unaltered ***On-going projects:*** None ***Short-term (protect):*** WCT in the Mussigbrod Creek drainage are confined to the uppermost reaches of Hell Roaring Creek. WCT in the stream are isolated by a short series of cascades, none of which could be individually identified as a fish barrier. Genetic samples collected in 2015 confirmed previous sampling that the fish are non-hybridized WCT. Brook trout are present below the barriers on Hell Roaring Creek and throughout Mussigbrod Creek at high density. Fish barrier options are very limited on Hell Roaring Creek due to its remote location. ***Long-term (secure):*** Barrier options in Mussigbrod Creek are extremely limited because of lack of access and the low gradient nature of the stream channel upstream of the lake. Any barrier in Mussigbrod Creek would likely have to be constructed by hand because there are no roads or possibility of constructing a road in the drainage. A barrier in the stream upstream of Mussigbrod Lake is not feasible until near the confluence of Hell Roaring Creek because of the low gradient nature of the stream channel near the lake. A barrier near this confluence would isolate approximately 5 miles of stream. The density of brook trout in Hell Roaring Creek downstream of the cascades was relatively high in 2015 so it is possible that a WCT population could exceed 2,500 fish in 5 miles of habitat. Mussigbrod Lake is home to a native suite of species including Arctic grayling. The lake elevation has been raised by an irrigation dam and the overflow channel has a quasi-fish barrier structure. However, because of the conservation value of the native species present in the lake, removal of brook trout in Mussigbrod Lake is not currently a viable option. Securing the population in Hellroaring Creek would require moving the fish to a fishless stream with over 5 miles of available habitat.

Stream (s)	Population Status and Conservation Needs
	Additional comments: Most of the Mussigbrod Creek drainage upstream of Mussigbrod Lake burned in the same fire that affected Bender Creek. Thus, there is abundant wood in the stream channel. The only portion of the drainage that did not burn is where the extant WCT are present. Native burbot are present in Mussigbrod Lake and are at least seasonally present in the lower reaches of Mussigbrod and Hell Roaring creeks.
NF Divide - SF Divide	***Genetic status:*** Genetically Unaltered ***On-going:*** Population surveys completed in 2008. ***Short-term (protect):*** 2008 surveys did not find any WCT in the N Fk of Divide Creek. Surveys conducted in 2009 indicate WCT are still present in the upper reaches of S Fk Divide Creek and the unnamed tributary that parallels FS Rd 96; however, WCT were found at low density and sympatric with brook trout. No WCT were captured in the vicinity of the Beaver Dam Campground. Past genetic samples collected from these fish indicate they are a mixed population with some unaltered fish and some slightly hybridized fish. A fish barrier was constructed on the N Fk Divide Creek in 2013 immediately upstream of the Forest Boundary with private property in Section 32. This structure was constructed using an excavator to remove material from downstream of an existing boulder drop structure to increase the drop from 2.5 ft to over 6 ft. The cost of the structure was $3,000. Given the structure is made of natural materials, it has been repeatedly evaluated to determine if it is impassable to brook trout. This was done by capturing several hundred brook trout from upstream, clipping one of their fins and releasing them downstream of the structure. After 1 year the stream upstream of the structure was surveyed again looking for clipped fish. One brook trout was found to have passed over the structure. Subsequently several modifications were made to the structure to prevent fish passage and additional modifications are necessary. Once these modifications are made, the structure will be reevaluated for fish passage. Current survey information is needed to determine if cutthroat trout are still present in the South Fork upstream of Beaver Dam Campground. It is likely that if present, there would have been no change in their genetic status given the lack of hybridizing species in the drainage, but this would need to be confirmed through genetic testing. ***Long-term (secure):*** To secure the population of cutthroat trout in the drainage, the fish barrier would have to be confirmed to preclude upstream fish passage and brook trout would need to be removed. The constructed fish barrier isolates roughly 12 miles of habitat. Given the density of brook trout in the stream and the quality of the habitat, it is likely there would be more than 2,500 WCT in the drainage once brook trout are removed. Assuming there are WCT in the S Fk Divide and they are still of conservation value, these fish would be salvaged prior to brook trout removal. Fish and/or gametes from the S Fk N Fk Divide Creek (non-hybridized) could also be used to help re-establish WCT in the N Fk where there are no WCT. ***Additional comments:*** Grazing in the drainage is impacting some reaches of the stream. It is not known if riparian grazing standards are currently being met.
Odell - Odell Lake	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** Brook trout are common throughout Odell Creek (about 5 miles of stream), and their removal and a barrier are necessary to protect the WCT population. Recent sampling of Odell Lake indicates the presence of grayling, WCT and EB. Surveys to determine the potential for barrier placement and brook trout removal are necessary before developing specific conservation plans for the Odell population.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): Two potential options exist to secure the Odell Creek population of WCT. The first would involve the placement of a fish barrier near the confluence with Wyman Creek. A suitable location has not been identified but the area has favorable geomorphology for barrier construction. A barrier at this location would isolate roughly 5 miles of stream and would include Odell Lake. The second option for securing Odell Creek is a fish barrier in Wyman Creek downstream of the confluence of Table Creek. A barrier at this location would isolate more than 20 miles of stream and would include Odell, Halfway, Rabbia and Wyman Creek populations of WCT. ***Additional comments:*** Grayling are present in Odell Lake and are of conservation value. Grayling have also been found in Odell Creek downstream of the lake to near the confluence with Wyman Creek. Any project in Odell Creek should aim to also conserve Arctic grayling.
Pintler Creek -Beaver	***Genetic status:*** Unaltered ***On-going projects:*** Reintroduction began in 2017 and was completed in 2020. ***Short-term (protect):*** Population is upstream of and protected by a natural waterfall barrier. ***Long-term (secure):*** Once repopulation and natural expansion is complete WCT are expected to occupy about 11 miles of stream and have a population of > 5,000 fish. ***Additional comments:*** EDNA testing following removal of rainbow trout removal indicated that rainbow trout were still present in Pintler Creek in the area immediately upstream of the meadows. The upper meadows and areas upstream were electrofished in 2018. Four rainbow trout were captured upstream of the confluence of Beaver Creek. In 2019 an additional 3 rainbow trout were captured upstream of the area where rainbows were captured the previous year. No rainbows were captured in the reach where they were found the previous year. There was no evidence of rainbow trout reproduction as all fish captured were >8 inches. No rainbow trout were captured in areas upstream where EDNA also indicated there were no rainbow trout. Because of the possible presence of rainbow trout. Eggs collected from Van Houten Lake which may have contained genes from M012 in addition to Big Hole origin fish were stocked into Pintler Creek in addition to eggs and fish from Chery and Granite lakes and York Pond which contain only Big Hole drainage fish.
Pioneer Creek	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** WCT occupy about one mile of the unnamed Pioneer Creek tributary. WCT co-exist with brook trout throughout the reach. Given the remote nature of this small tributary stream, it would be very difficult to construct a fish barrier to protect this population in place. A short-term management plan was developed to fly into the stream and salvage as many cutthroat as possible to replicate elsewhere (e.g., fishless stream). In 2020, a total of 61 cutthroat were captured in the stream and flown to the inlet stream to Van Houten Lake where they were held in a live car pending genetic testing. Genetic results indicated the fish were slightly hybridized with Yellowstone cutthroat (98.7% WCT). Because of the presence of non-native genes in the population, it was determined to introduce them to Mule Creek. Mule Creek in the East Pioneer Mountains was historically fishless and although it contains only 2 miles of stream, the habitat is high quality. This action should protect this population. In 2021, live WCT were observed in Mule Creek indicating the transfers had survived the winter. Additional conservation fish were introduced into Mule Creek in 2021 from Bear, Andrus, and NF Fox creeks. There are likely still some WCT and brook trout remaining in the Pioneer Creek tributary. ***Long-term (secure):*** Securing WCT in the tributary is not possible due to limited available habitat. Population expansion would have to include the mainstem of Pioneer Creek. The Pioneer Creek system includes 3 lakes and 8 – 10 miles of stream currently occupied by nonnative trout. No suitable barrier sites have been identified

Stream (s)	Population Status and Conservation Needs
	in Pioneer Creek. Given the presence of non-native genes in the population, it is unlikely that the population will be replicated into a larger amount of habitat so it can be considered secure.
Plimpton	***Genetic status:*** Unaltered ***On-going projects:*** None ***Short-term (protect):*** The uppermost 2.5 miles of Plimpton Creek WCT population is protected by a cascade barrier. WCT are common to abundant in this reach. A meadow reach near the headwaters provides abundant spawning habitat. The population extends downstream, in decreasing abundance, an additional 3 miles. The reach downstream of the cascade fish barrier is also occupied by abundant brook trout. No hybridizing species have been found in Plimpton Creek and genetic analysis of the WCT downstream of the barrier indicate they too are non-hybridized. Plimpton Creek represents the largest aboriginal population of non-hybridized WCT in Big Hole. ***Long-term (secure):*** There is limited current potential to expand the range of WCT in Plimpton Creek downstream from its current distribution. No suitable fish barrier sites have been identified in lower Plimpton Creek. Once the stream leaves the National Forest the valley bottom becomes extremely wide and there are several irrigation diversions. Access to the stream on National Forest is also only obtained through private property and the current landowners are unwilling to provide access. ***Additional comments:*** Plimpton Creek was used as one of the sources to form the Big Hole brood in Cherry Creek. Thirty fish were transported from Plimpton Creek to Schulz Creek to establish WCT in that stream (30 fish also from Hell Roaring Creek).
Rock (west Big Hole)	***Genetic status:*** Untested but possibly unaltered ***On-going projects:*** Inventory and location of potential barrier site. ***Short-term (protect):*** There is very little information to determine the status or conservation needs of WCT in Rock Creek. Several reaches of the stream were surveyed in 1989 (RM 16 - 19). WCT (n=3) were only captured at the uppermost section near RM 19. The persistence of limited numbers of WCT in this reach of stream was confirmed in 2017. Brook trout were common in all sampled sections, and rainbow trout are present in the lower reaches of Rock Creek. Updated information is necessary to determine current population status (including genetics) before a conservation plan can be developed for Rock Creek. ***Long-term (secure):*** If the WCT remaining in Rock Creek still constitute a conservation population, a potential barrier site exists on BLM lands which would secure 8 miles of habitat upstream. The site has not been investigated thoroughly and should only be considered as a potential site if there are WCT of conservation value in the watershed. If the barrier site is suitable, restoration of WCT upstream would likely secure this population of fish.
Ruby	***Genetic status:*** Unaltered ***On-going projects:*** None. ***Short-term (protect):*** WCT genetic status is based on only 2 samples (1994). In 2009, a Forest Service crew sampled 4 WCT in 2 days of sampling, suggesting the Ruby Creek population may be functionally extinct. Brook trout are common throughout Ruby drainage, including in reaches occupied by WCT. Additional surveys are necessary to determine population viability, genetic status and potential for conservation efforts. If a viable population persists and genetic samples indicate a continued unaltered status then translocating the fish to Dry Creek may be the most logical conservation measure given the lack of potential barrier sites in the Ruby

Stream (s)	Population Status and Conservation Needs
	Creek drainage. It is very unlikely that WCT still persist in Ruby Creek, but this can only be determined with additional surveys. ***Long-term (secure):*** The Ruby Creek drainage is large (15 – 30 stream miles and 12 – 15 tributaries) and may provide some opportunities to connect at least two conservation populations (Ruby and Gory creeks); however, given its low gradient nature the potential for barrier placement is likely limited. ***Additional comments:*** There are also private inholdings within the forest on Ruby Creek.
Schultz	***Genetic status:*** Genetically Unaltered ***On-going projects:*** Monitor population expansion. ***Short-term (protect):*** Hybridized cutthroat trout that survived the initial 2 treatments of Schultz Creek were found in 2019 and confirmed again in 2020. Extensive genetic testing has indicated that these hybridized fish have crossed with the fish introduced from Plimpton and Hellroaring creeks making it not cost-effective to test and segregate hybridized fish from non-hybridized fish. It was determined that a retreatment of the drainage would be the best measure to establish a non-hybridized population of WCT. The area of hybrid survival was identified and can be targeted in subsequent treatments. EDNA testing will be used prior to future reintroduction efforts. The 30 introduced WCT from Hellroaring and Plimpton creeks were thriving and population densities were found in excess of 1000 fish/mile. These fish are successfully reproducing and filling available habitat. There are 2.5 miles of habitat upstream of the fish barrier in Schultz Creek but the habitat is very high quality due to the fire and copious amounts of wood in the stream channel. ***Long-term (secure):*** There is no opportunity to secure the population in Shultz Creek in over 5 miles of habitat. However, population estimates done in 2020 indicated the stream can support population densities in excess of 1000 fish per mile. It is likely that the total population size in Schultz Creek will approach if not exceed 2500 fish. ***Additional comments:*** A cascade barrier roughly 0.5 miles upstream from the confluence with Johnson Creek isolates Schultz Creek. Prior to fish removal, Schultz Creek was populated by heavily hybridized cutthroat trout. In 2015 and 2016 the stream was treated with rotenone. Thirty WCT from Plimpton Creek and 30 WCT from Hell Roaring Creek were introduced into Schultz Creek in 2017.The Shultz Creek drainage was burned in the 2007 Rat Creek fire.
Seymour - Chub	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** Brook, hybrid and rainbow trout are present throughout the Seymour Creek drainage. Lower Seymour Lake contains an abundant, self-sustaining population of brook trout while upper Seymour Lake contains a self-sustaining population of rainbow trout. To date, detected levels of hybridization have been < 10% in samples collected from WCT, despite the wide-ranging occurrence of hybridizing species. Additional genetic samples, population surveys, and potential barrier location surveys are necessary to develop specific conservation plans for this drainage. No recent sampling has occurred in the drainage other than at Upper and Lower Seymour lakes. A skilled angler caught a WCT in Lower Seymour Lake in 2020. Forest Service inventories indicate that WCT are still present in Chub Creek. Past genetic samples from Chub Creek near the confluence indicate hybridization. However, WCT are also present above a high gradient reach in Chub Creek which may represent a fish barrier. Therefore, it is possible that non-hybridized fish exist in Chub Creek. Additional sampling is warranted in Chub Creek to determine the genetic status of WCT in the drainage.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): The Seymour Creek drainage includes about 12 – 15 miles of stream, and placement of a barrier and removal of nonnative trout could secure the population. There appear to be multiple suitable locations for a fish barrier in the lower reaches of Seymour Creek downstream of Lower Seymour Lake outside the Wilderness Area. Removal of non-native fish in the drainage would require the removal of rainbow trout from Upper Seymour Lake which is within the wilderness. This is a large and deep lake which would require a significant amount of rotenone to treat.
Sixmile	***Genetic status:*** Genetically Altered ***On-going projects:*** Reintroduction began in 2017 and is ongoing. ***Short-term (protect):*** Population is upstream of and protected by a man-made waterfall barrier. ***Long-term (secure):*** Once repopulation and natural expansion is complete WCT are expected to occupy about 3 miles of stream, which precludes secured status; however, population surveys will assess whether this habitat can support > 5,000 fish.
SF NF Divide - Unnamed trib	***Genetic status:*** Unaltered ***On-going projects:*** Habitat restoration project planned for short (200 yard) reach of stream upstream of reservoir that was placer mined. Fish passage at weir upstream of reservoir needs to be addressed. ***Short-term (protect):*** South Fork Reservoir is a fish passage barrier. The reservoir is part of the Butte-Silverbow drinking water supply. Brook trout were present in the system up to approximately 1 mile upstream of the reservoir, but WCT extend to the headwaters. WCT are also present in an unnamed tributary 1 mile upstream of the reservoir. A fishless reach of this tributary above a barrier cascade, with approximately 1 mile of suitable habitat is present upstream of the Forest Service Road 8504. Mechanical removal of brook trout occurred from 2012 to 2017. Multiple passes with multiple crews were performed each year in the stream to remove brook trout. The reservoir was drained and subsequently intensively netted. EDNA testing in 2017 indicated that no brook trout remained in the creek. Netting in the reservoir failed to catch any brook trout. The WCT population upstream of the reservoir will occupy roughly 3 miles of stream. The density of WCT in the stream is relatively low so it is unlikely that the population will ever exceed 2,500 fish. An additional short-term goal may be to introduce WCT in the unnamed tributary upstream of the Forest Service road crossing. This could increase the occupied habitat by approximately 1 mile. ***Long-term (secure):*** It does not appear that the population can be secured within the SF because of the limited miles of suitable habitat upstream of the reservoir and the low density of WCT in the system. Replication of the population into the N Fk Divide Creek would be an option for securing this population of fish. ***Additional comments:*** Fish passage from the reservoir to the stream upstream was constructed in 2013 by creating a step pool complex inlet stream. Mechanical removal of brook trout upstream of and including S Fk Reservoir initiated in 2013. EDNA indicated complete removal from stream in 2017. Riparian fence constructed in 2008 to reduce livestock impacts on stream immediately upstream of the reservoir. Eggs collected from WCT from S Fk N Fk Divide were used in the formation of the Big Hole Brood in Cherry Creek.
Spruce	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** Flows from Spruce Creek are diverted and are presumed to only reach Jerry Creek seasonally. Genetic samples have indicated that the WCT in Spruce Creek have become recently hybridized with rainbow trout. Because of the imminence of the threat of introgression a project was developed to move WCT from Spruce Creek to Lost Creek which was previously fishless. This introduction appears to have failed

Stream (s)	Population Status and Conservation Needs
	as only 2 WCT were found 2 years later and there was no evidence of natural reproduction. Additional surveys are warranted in the lower reaches of Lost Creek to determine if WCT have become established in the lower gradient reaches of the stream. There is some potential to construct a fish barrier in the lower reaches of Spruce Creek upstream of the Forest Boundary. However, Spruce Creek is very small and a barrier in this location would only secure about 2 miles of habitat. ***Long-term (secure):*** The Spruce system does not support five miles of habitat and to secure the population it would require expansion into Jerry Creek. It is possible that Spruce Creek could be used as one of the sources to refound Jerry Creek if a project proceeds in that portion of the drainage. See Jerry Creek narrative. ***Additional comments:*** Translocation to Lost Creek was not successful
Squaw - Papoose	***Genetic status:*** Unaltered ***On-going projects:*** None. Reciprocal transplant into Papoose Creek ***Short-term (protect):*** Brook trout occupy all of Squaw Creek. A barrier cascade on Papoose Creek isolates the upper 1 mile of stream where WCT exist in isolation. The drainage is relatively complex with four tributaries and 9 – 12 miles of stream and one lake with WCT. Squaw should be a high priority for relocation into another fishless stream because the presence of brook trout and the apparent lack of WCT in Squaw Lake put this population at high risk of extirpation. In 2021, plans to replicate this population elsewhere were thwarted due to the Christiansen fire. While Papoose is protected, the amount of habitat occupied in the stream is very small. Genetic maintenance will likely be necessary to reduce potential effects of inbreeding. ***Long-term (secure):*** The only suitable barrier locations are near the Forest Boundary or on private property downstream. A barrier at this location would secure roughly 12 miles of habitat. The potential for such an effort has not been explored but would likely be difficult with beaver activity and wide valley bottoms. ***Additional comments:*** Squaw Creek has been renamed Christiansen Creek. Both Squaw and Papoose have contributed to the founding of the Big Hole brood stock of fish in Cherry Creek.
Steel Creek - Moose Meadows - SF Steel - NF Steel	***Genetic status:*** Genetically Unaltered ***On-going projects:*** None ***Short-term (protect):*** The Steel Creek drainage is a large complex system. Genetically unaltered WCT were believed to persist in Steel Creek, the NF and Moose Meadows, while very slightly hybridized WCT occupy the upper reaches of SF of Steel. Recent sampling failed to find any WCT in the S Fk and in Moose Meadows. Brook trout are common throughout the drainage including reaches occupied by WCT. Lily Lake, at the headwaters of the NF has a self-sustaining population of rainbow trout. It appears that since the last sampling in 2001 that WCT may have been extirpated from the drainage. Additional surveys are necessary to verify population extirpation. If WCT are present, they would likely be at so low abundance that restoration in situ would not be effective. If WCT are present and non-hybridized they could be relocated to a stream like nearby Dry Creek. ***Long-term (secure):*** Extirpated?
Stine	***Genetic status:*** Genetically Altered ***On-going projects:*** None

Stream (s)	Population Status and Conservation Needs
	Short-term (protect): Little is known of the Stine population. In 2020 Forest Service crews confirmed that WCT are still present in Stine but are sympatric with brook trout. Further, it was noted that cutthroat appeared to be hybridized. No genetic samples were collected. A highway crossing (near the stream mouth) concrete structure and a nearby irrigation structure may limit or prevent upstream movement of nonnative trout from the Wise River; though both brook trout and hybrid trout are believed present upstream of these structures. Distribution, abundance and genetic status of WCT, and whether additional isolating mechanisms are present are basically unknown in the drainage. Surveys to address these basic questions are necessary before specific conservation plans can be developed. ***Long-term (secure):*** The Stine population cannot be secured within the drainage because suitable fish habitat is likely less than 4 miles, and the stream is a direct tributary to the Wise River where WCT conservation is not currently feasible.
Swamp	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** Swamp Creek is rarely directly connected to the Wise River. Its flows are captured by a ditch leading from the Wise River. No brook trout have been documented in Swamp Creek. WCT occupy roughly 2 miles of Swamp Creek. Recent (2012) genetic analysis of WCT in Swamp Creek indicate they are 99.8% WCT and 0.02% rainbow trout. Irrigation water is diverted from Swamp Creek for irrigating private property to the west of the stream. A road crossing culvert on private property provides the best opportunity to protect this population of WCT from potential brook trout invasion or further hybridization from rainbow trout. With permission from the landowner, this culvert could be extended downstream to obtain the elevation necessary to create a 3-4 ft drop from the outlet and prevent upstream fish passage. A barrier in this location would protect 2 miles of habitat. ***Long-term (secure):*** The Swamp Creek WCT population cannot be secured within the drainage because suitable fish habitat is likely less than 3 miles, and the stream is a direct tributary to the Wise River where WCT conservation is not currently feasible. ***Additional comments:*** WCT in Swamp Creek spawn much sooner than fish in other stream-dwelling WCT populations in the Big Hole (late May) which may be related to the spring-fed nature of the stream. The stream is very susceptible to grazing impacts and should be monitored closely.
Tenmile	***Genetic status:*** Altered ***On-going projects:*** None ***Short-term (protect):*** Recent (2010) genetics data suggest that WCT in Tenmile Creek are only slightly hybridized 99.7% WCT, 0.03% RB) but one fish captured had a much higher degree of hybridization than the other 12. WCT are at low abundance relative to brook trout (237 EB to 9 WCT). Three headwater lakes are present on Tenmile Creek. The lowest contains a self-sustaining population of rainbow trout, the middle contains a self-sustaining population of Yellowstone cutthroat and hybrid fish and the upper is thought to be fishless. There are no stocking records for the Tenmile Creek Lakes; however, the stream was extensively stocked with rainbow trout. Brook trout are present throughout Tenmile Creek but are absent from the lakes. It appears that suitable barrier locations are present on Tenmile Creek downstream of the Forest Road 2483 crossing, but the site has not been thoroughly investigated. ***Long-term (secure):*** If a fish barrier at the above identified location were feasible it would isolate 6 miles of habitat for WCT, including 2 lakes. The middle Tenmile Lake is located partially on private property and the upper lake is exclusively on private property. The upper lake when surveyed was fishless but anglers have reported fish being present in the lake. Fish would have to be removed from these lakes to secure the Tenmile

Stream (s)	Population Status and Conservation Needs
	population of WCT. However, once re-established, the population would likely meet the criteria of being secure.
Trapper - Sappington - Sucker	***Genetic status:*** Genetically Unaltered ***On-going:*** Recent genetic samples collected and population surveys ***Short-term (protect):*** Brook trout are present throughout the Trapper Creek drainage except for Trapper Lake. They are the dominant fish species (90:1) in the middle meadow reach of the stream, approximately 3.5 miles upstream of the Forest Service Boundary (2008 data). Brook trout are still the dominant species near the confluence of Sappington Creek (10:1). Brown trout are also present in Trapper Creek at low densities from the Forest Service boundary into the middle reaches. Trapper Lake contains a self-sustaining population of what appear to be hybridized WCT, but no genetic samples have been analyzed. Genetic samples from Trapper Creek support this hypothesis as hybridization levels increase closer to Trapper Lake. Two tributaries potentially harbor conservation populations of WCT that could be used to reestablish the population in Trapper Creek and Trapper Lake: Sappington Creek (non-hybridized) and Sucker Creek (98.2%). Both streams have historically harbored allopatric populations of WCT that are relatively abundant. A headcut creating a roughly 3 ft drop on Sucker Creek appears to keep non-native fish from accessing habitat farther upstream. A cascade reach on Sappington Creek near the mouth preludes fish passage in Sappington Creek; however, a brook trout was found in 2018 in the upper reaches of Sappington Creek. WCT occupy roughly 2 miles of habitat in Sappington Creek and 1mile in Sucker Creek. Short-term projects to protect the conservation populations in the Trapper Creek drainage should include the removal of hybridized trout from Trapper Lake and their replacement with fish from Sappington Creek. Brook trout should be mechanically removed from Sappington Creek. Sucker Creek should be surveyed for non-native fish. A fishless reach at the headwaters of Trapper Creek upstream of Trapper Lake should be investigated for fish introduction from Sappington Creek or Sucker Creek. ***Long-term (secure):*** Two potential barrier sites are present on Trapper Creek. The first is near Glendale and would yield approximately 12 miles of stream habitat and would include Sucker Creek. The second is located on the National Forest roughly 1 mile upstream of the Forest Boundary and would isolate roughly 8 miles of habitat but would exclude Sucker Creek. Either barrier site would likely yield a population of WCT > 2,500 individuals (brook trout population estimates were > 2,200/mile). ***Additional information:*** WCT from Sappington Creek were used in the formation of the Big Hole brood stock in Cherry Creek**.** Substantial mining has occurred in the Trapper Creek drainage and there is extensive erosion that occurs currently in some of the non-reclaimed areas. These sediments are sometimes washed directly into streams. Potential metals issues associated with the past mining practices are unknown. There are substantial localized impacts of roads in the drainage. In the upper drainage and near the mining areas, many of the roads are poorly maintained on steep, and highly erosive soil types. Substantial ATV use in the area also adds to the problems of erosion in some sections of the road.
Twelvemile	***Genetic status:*** Unaltered ***On-going projects:*** Fishless introduction in 2012 and 2015. ***Short-term (protect):*** Sixty-six WCT from downstream of a cascade fish barrier were transported upstream and released into approximately 1 mile of habitat. A second fish transfer was done in 2015 where 54 WCT were captured downstream of the cascade and moved to the 2nd meadow and released. Subsequent monitoring

Stream (s)	Population Status and Conservation Needs
	showed the fish in the lower meadow are thriving and successfully reproducing. In the upper meadow, multiple age classes of fish were observed in 2020. ***Long-term (secure):*** A potential barrier site downstream of the confluence of the West Fork was identified in 2020 and would provide the best opportunity for long-term conservation of fish in the Twelvemile system. A barrier in this location would isolate roughly 9 miles of stream. The grade of the steam channel in this area appears to be conducive to barrier installation but no survey information is available. This site would need to be surveyed prior to barrier construction because it is within an area with a wide floodplain. A berm may need to be constructed across the floodplain to fully contain flows up to the 100-year flood even within the stream channel. ***Additional information:*** In 2020, 5 males from Twelvemile Creek were collected and crossed with females from Granite Lake for genetic infusion of wild genes into the Granite Lake brood source.
Warm Springs **-** West Fork - Unnamed trib 1 - Unnamed trib 2	***Genetic status:*** Unaltered ***On-going projects:*** None ***Short-term (protect):*** Unknown if WCT still exist in drainage. A thorough inventory of Old Tim (tributary system to Warm Springs) yielded no WCT. No additional surveys have been performed recently in Warm Springs Creek or any of its forks. Additional inventory is necessary to determine a short and long-term plan for Warm Springs Creek WCT conservation. ***Long-term (secure):*** A very large-scale project is possible in Warm Springs Creek with a fish barrier being constructed in a narrow reach of the stream at approximately RM 9. A barrier at this location would isolate over 50 miles of stream in very high-quality habitat. There are 3 private landowners with small parcels of land upstream of the potential barrier location. Ideally a fish barrier in this location could incorporate some water storage in the form of a reservoir so water could be released to the Big Hole River when flows are low in late summer. This would make the concept much more palatable to local landowners and the public.
WF Mudd	***Genetic Status:*** Unaltered ***On-going:*** Monitor population expansion. ***Short-term (protect):*** The irrigation diversion leading to York Gulch (see below) was modified into a fish barrier and brook trout upstream were removed. Previous information suggested WCT occupied the W Fk Mudd Creek but prior to treatment no WCT could be found. To repopulate the stream 37 WCT from Rabbia Creek were salvaged and moved to W Fk Mudd Creek upstream of the barrier and released. Subsequent monitoring (2020) indicates the fish are reproducing and beginning to fill the available habitat. There are approximately 2.5 miles of habitat upstream of the barrier that were previously occupied by brook trout. An additional 2 miles of fishless habitat are present upstream of a 6-ft waterfall. In 2010 the cliff face above the waterfall collapsed and buried the waterfall in rubble. The stream at the time flowed through the rubble. It is possible that as the spaces in the rocks are filled with debris and the stream begins to flow over the surface that fish passage will be present to the upper reaches of the creek. This could double the amount of available habitat for WCT. Given the small number of fish that founded this population, monitoring should be conducted to determine if the population continues to thrive. ***Long-term (secure):*** Only roughly 4 miles of habitat are available for WCT in the W Fk Mudd Creek upstream but population surveys indicate that the stream will support more than 1,000 WCT per mile; therefore, it is highly likely that the number of WCT in the stream will exceed 2,500 individuals.
Woody	***Genetic status:*** Altered ***On-going projects:*** Mechanical removal of brook trout

Stream (s)	Population Status and Conservation Needs
	Short-term (protect): Irrigation diversion represents at least a partial fish barrier (all of the stream is diverted year round). Brook trout abundance is low in the lower reaches of the creek but are more abundant near the headwaters suggesting limited connectivity with Warm Springs Creek. Mechanical removal or suppression should be considered for Woody Creek. Such an effort may involve some riparian clearing to allow for effective removals. ***Long-term (secure):*** Woody Creek is < 2 miles of length and the population cannot be secured within the stream itself. Long-term conservation would have to involve translocating the fish to a drainage with more available habitat (Bull Creek?).
Wyman - Rabbia - Deer	***Genetic status:*** Mixed ***On-going projects:*** None ***Short-term (protect):*** Although identified as a single conservation population, the Wyman/Rabbia/Deer WCT conservation population currently acts as at least two isolated units. Rabbia Creek contains genetically unaltered WCT. Wyman and the lower reaches of Deer Creek are reported to have slightly hybridized WCT. WCT in upper Rabbia Creek were thought to be isolated by cascades but this was recently found not to be accurate as brook had invaded the upper reaches of the stream and were rapidly displacing the WCT. In 2016, 30 WCT were transported from Rabbia Creek to W Fk Mudd Creek which was made fishless. In 2018 an additional 7 fish were moved to W Fk Mudd Creek from Rabbia. No other WCT could be found in Rabbia Creek. WCT in W Fk Mudd are thriving. It is very likely that few WCT remain in upper Wyman and Deer creeks. Additional surveys are needed to determine if WCT remain in in Rabbia or upper Wyman. An EA has been completed for the introduction of WCT to the fishless reaches of Deer Creek. It should be a priority to move any remaining WCT in Wyman, Deer and Rabbia to the fishless reach of Deer Creek if genetic information indicates the fish still have conservation value. ***Long-term (secure):*** Ideally a fish barrier would be placed in Wyman Creek downstream of the confluence of Table Creek. Much of the stream upstream of this location is low gradient with a very wide floodplain which is not conducive to fish barrier construction. Downstream of Table Creek the stream is moderate gradient, but no suitable barrier locations have been identified. A fish barrier at this location would isolate 23+ miles of stream and 1 lake (Odell Lake). Odell Lake contains a self-sustaining population of Arctic grayling of conservation value. This potential project would secure Odell, Rabbia, Deer, Wyman and Halfway Creek conservation populations of WCT.
York	***Genetic status:*** Unaltered ***On-going projects:*** WCT salvage, chemical removal and restocking. Suppression of brook trout, riparian fence on National Forest. In 2021, 64 WCT from York Gulch were transferred to upper Long Branch Creek for repopulation of that stream following a fish removal project. A second transfer is expected to occur in 2022. ***Short-term (protect):*** York Gulch is very small stream that supports < 300 WCT in about 2 miles of habitat. The majority of water in the system comes from WF of Mudd Creek via an irrigation pipeline. In 2012 York Gulch and the W Fk Mudd were treated with rotenone. Prior to treatment York Gulch was electrofished and all captured WCT were transported to the private pond constructed on the York Ranch. This pond was recently constructed and was not stocked with fish prior to this time. Subsequently, fertilized eggs were collected from the pond and used to reestablish WCT in York Gulch. Most of the flows from York Gulch are diverted near the forest boundary. A low flow fish barrier was installed on York Gulch near the location of York Pond. In 2019 a limited number of brook trout were found in York Gulch on the forest. WCT are thriving in the reach of stream on National Forest but the presence of brook trout threatens the long-term persistence of this population.

Stream (s)	Population Status and Conservation Needs
	To protect the population, periodic brook trout suppression will be necessary. There is no suitable location for a cost-effective fish barrier on York Gulch that would completely block fish passage because of the width of the valley bottom and irrigation ditches that would bypass any barrier. ***Long-term (secure):*** The population cannot be secured due to inadequate habitat. The small size of York Gulch (base flow <0.5 CFS) would suggest the WCT population is threatened by stochastic events more than most populations. Further, the genetic diversity of the York Gulch population of WCT is very low. To secure the WCT genetics in York Gulch the fish would have to be moved to another stream with more available habitat. The WCT in W Fk Mudd may require genetic maintenance and York Gulch would be the nearest population source. ***Additional comments:*** Arctic grayling from the Big Hole River are known to use York Gulch for spawning and rearing. The pond on the York Ranch has subsequently been used as a Big Hole brood pond. Additional genetics from other sources including: Hell Roaring Creek, Plimpton Creek, Squaw Creek and Cherry/Granite lakes have been added to the pond.

Section 3: Boulder Sub-basin

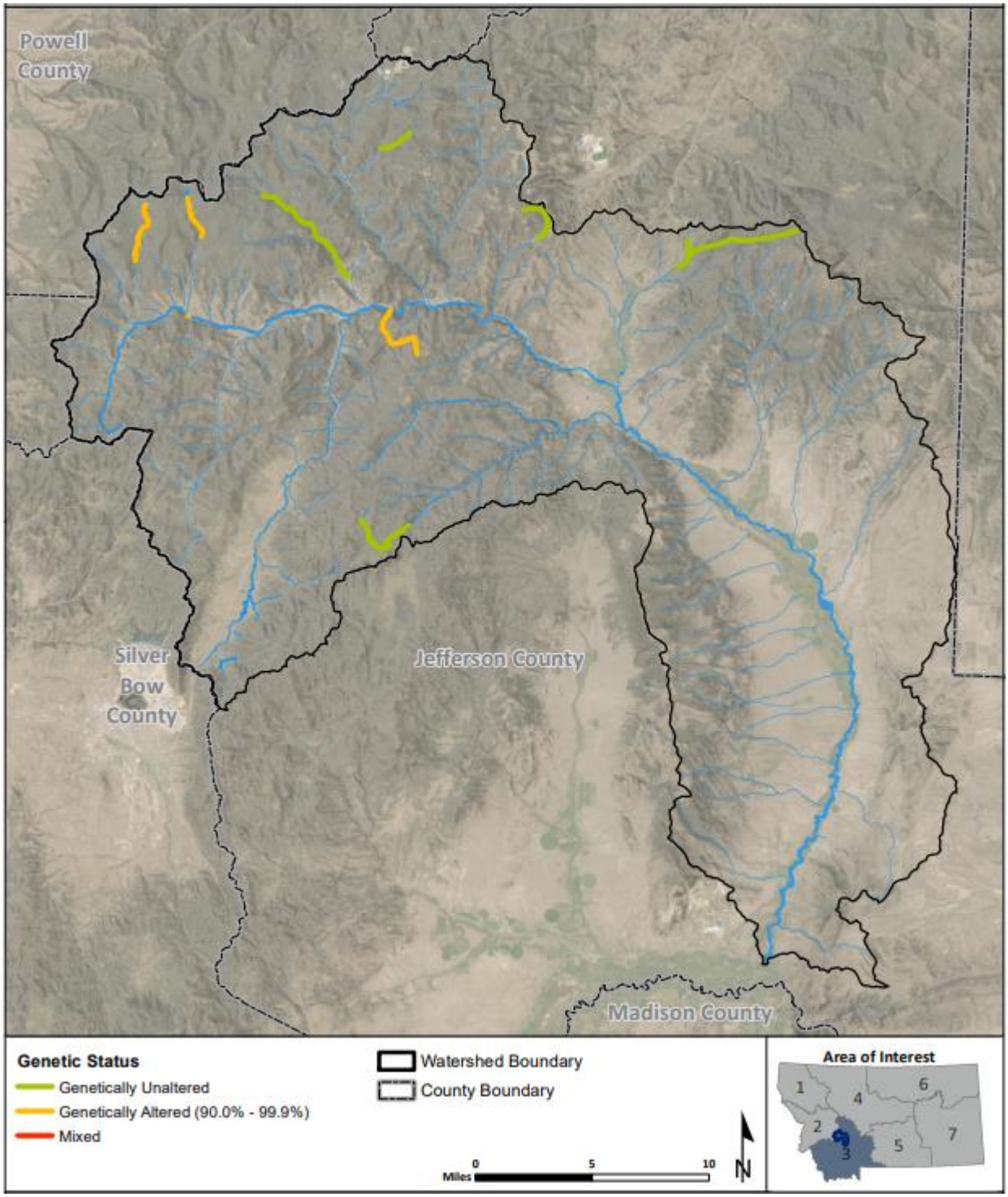

Figure 3.1. Genetic status and distribution of WCT conservation populations in the Boulder River sub-basin.

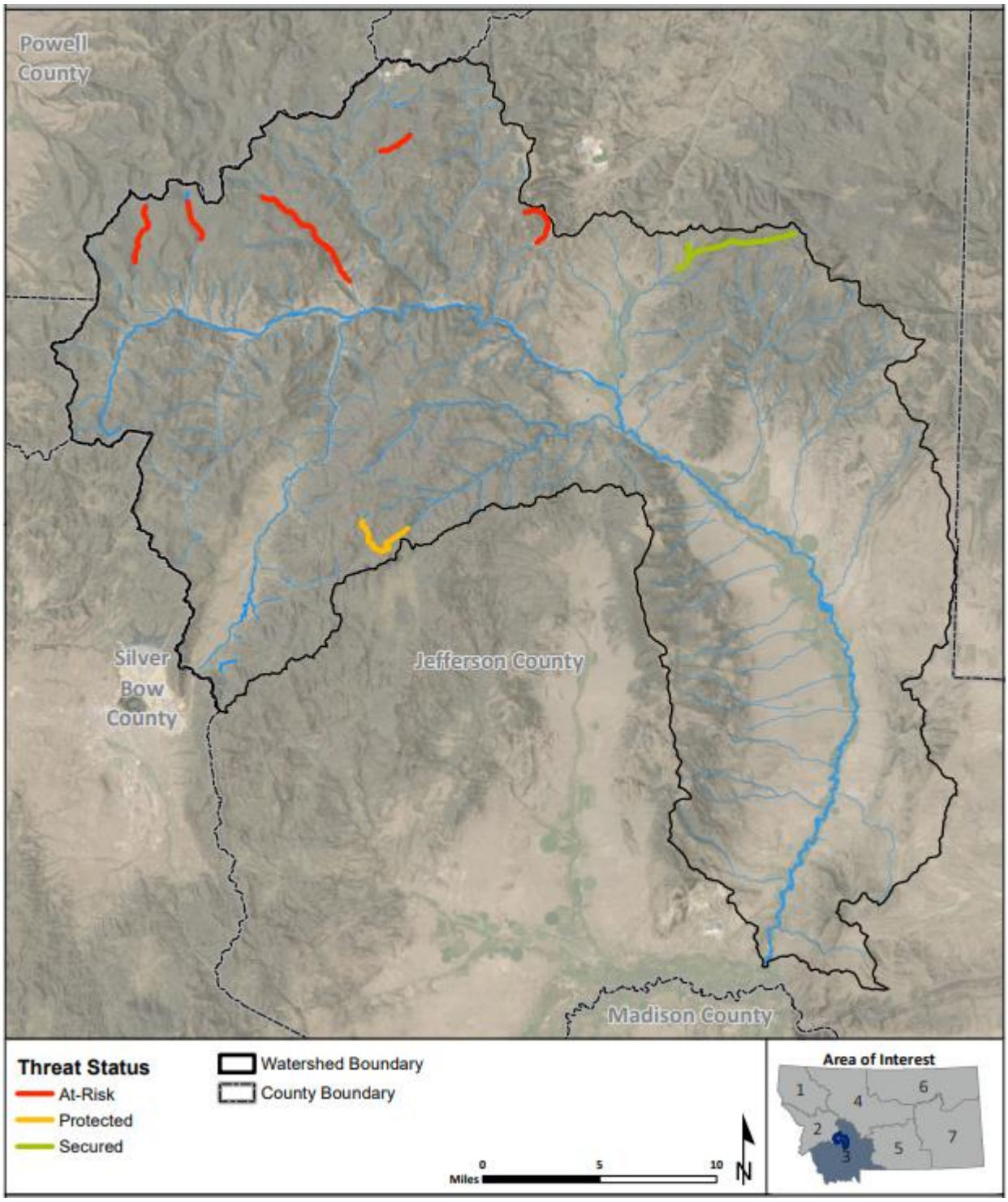

Figure 3.2. Threat status and distribution of WCT conservation populations in the Boulder River sub-basin.

Overview

Boulder WCT Status and Threats:

- Number of Conservation populations: 9 (6 unaltered; 0 mixed; 3 altered)
- Populations at risk: 67% (7 of 9)
- Genetically unaltered populations at risk: 67% (4 of 6)
- Populations considered protected: 11% (1 of 9)
- Populations considered secured: 11%; 1 of 9 (Muskrat)
- Significant threats:
    - Brook Trout (EBT): 4 populations
    - Other trout (YCT, RBT, CT hybrids): 2 populations
    - Small population size: 7 populations (< 1,000 fish)
    - Livestock grazing: 3 populations
    - Limited distribution: 8 populations (inhabit < 5 miles of stream)

Table 3.1. Genetic class and threat status of WCT conservation populations in the Boulder River sub-basin.

Genetic Class	Status of Conservation Populations			
	At-risk	Protected	Secured	***Total***
Unaltered	4	1	1	**6**
Mixed	-	-	-	**-**
Altered	3	-	-	**3**
Total	**7**	**1**	**1**	**9**

Table 3.2. Conservation populations identified in the Boulder River sub-basin.

Stream (s)	***Genetic Report Number***	***Conservation Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Curly	4930	Genetically Unaltered	Established from genetically unaltered WCT (Left Fork Stone Creek, n=10)	2021 FWP, Kreiner (10 SNP) 100% WCT 8/8/17 BLM Hutchison (26 SNP) 100% WCT (Left Fork Stone Creek)
High Ore	1207 3665	Genetically Unaltered	Genetically tested as 100% WCT	7/1/1996 USFS, Walch (12 Allozyme) 100%WCT 8/23/2008 FWP, Nelson (25 Indel) 100%WCT
Jack	952 1217 3260	Genetically Unaltered	Genetically tested as 100% WCT	7/25/1994 USFS, Sanborn (10 Allozyme) 100%WCT 7/8/1996 FWP, Brammer (5 Allozyme) 100%WCT 9/19/2003 BLM, LaMarr (11 PINEs) 100%WCT
Little Boulder	992 3024 3029 4255 4499	Genetically Unaltered	Genetically tested as 100% WCT	8/11/1994 USFS, Sanborn (20 Allozyme) 100%WCT 7/22/2004 USFS, Brammer (17 PINEs?) 100%WCT 7/29/2004 USFS, Brammer (36 PINEs?)

Stream (s)	***Genetic Report Number***	***Conservation Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
				11/1/2010 FWP, Nelson (25 Indel) 100%WCT 6/24/2013 FWP, Nelson (25 SNP) 100%WCT
Muskrat - Nursery	459 2872 3275 3300 3451 3707 3913 4240 4498	Genetically Unaltered	Genetically tested as 100% WCT	10/1/1990 FWP, Spoon (10 Allozyme) 100%WCT 8/27/2003 FWP, Nelson (50 PINEs) 100%WCT 6/30/2004 FWP, Nelson (22 PINEs) 100%WCT 6/21/2006 FWP, Nelson (24 PINEs) 100%WCT 6/20/2007 FWP, Nelson (38 Indel) 100%WCT 6/18/2008 FWP, Nelson (52 Indel) 100%WCT 6/18/2009 FWP, Nelson (59 Indel) 100%WCT 7/1/2011 FWP, Nelson (15 Indel) 100%WCT 6/24/2013 FWP, Nelson (13 SNP) 100%WCT
Red Rock	2996 2997	Genetically Unaltered	Genetically tested as 100% WCT	8/12/2004 USFS, Brammer (18 PINEs) 100%WCT 8/17/2004 USFS, Brammer (23 PINEs) 100%WCT
Rock	3041	Genetically Altered	Genetically tested as > 90% WCT	9/9/2004 USFS, Brammer (25 PINEs) 97.3%WCT 2.7%RB
Sullivan	1094 3049	Genetically Altered	Genetically tested as > 90% WCT	8/1/1995 FWP, Brammer (9 Allozyme) 95.6%WCT 4.4%YCT 6/8/2004 USFS, Brammer (12 PINEs) RB admixture present but level of hybridization not determined due to low sample size.
Thunderbolt	964 3038	Genetically Altered	Genetically tested as > 90% WCT	7/28/1994 USFS, Sanborn (5 Allozyme?) 87%YCT 13%WCT 7/22/2004 USFS, Brammer (20 PINEs) 98.7%WCT 1.3%YCT

Table 3.3. Characteristics that define threat status of WCT conservation populations within the Boulder River sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Curly	0.5	0.5	10	Natural waterfall	USFS	Small population size	At-risk
High Ore	2.3	2.3	Rare to common 19 WCT/100m	Mining operation & perched culvert	Private / FS / BLM	Grazing and associated degraded habitat, small population size	At-risk
Jack -Unnamed trib	1.7	1.7	Rare	Mine tailings / water toxicity	FS	Water quality, degraded physical habitat, and disjunct reaches due to historic mining	At-risk
Little Boulder	4.0	4.0	Abundant 10 WCT/100m	Cascade	FS & Private	None	Protected
Muskrat - Nursery	5.7 0.6	5.7 0.6	Abundant 16 – 100 WCT/100m	Wooden crib and waterfall	FS / BLM	No immediate threat, but potential for human transport of EBT above barrier	Secured
Red Rock	5.7	5.7	Rare to common 2 WCT/100m	Unknown	FS	Brook trout present	At-risk
Rock	2.7	-	Rare 2 WCT/100m	Unknown	FS	Brook trout present	At-risk
Sullivan	3.5	-	Rare 11 WCT/100m	Earthen dam	FS	Small population, barrier failure, livestock grazing and associated degraded habitat conditions	At-risk
Thunderbolt	1.7	-	Common 27 WCT/100m	Bedrock drop	FS	Small population size	At-risk

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population, or where WCT are not believed present in all reaches of the identified conservation area.

[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 3.4. Actions required to maintain conservation populations in the Boulder River Sub-basin.

Stream (s)	Population Status and Conservation Needs
Curly	***Genetic Class/Threat Status:*** Unaltered/At-risk ***On-going projects:*** In 2021, 10 unaltered WCT were transferred from the Left Fork Stone Creek into Curly Creek. Capture rates were lower than anticipated in 2021 due to difficulty sampling in the extremely low-water conditions. Additional effort will be directed at capturing the remainder of unaltered fish in LF Stone for replication into Curly Creek. ***Short-term (protect):*** More unaltered WCT need to be transferred into Curly Creek to increase the population founding size and ensure long-term persistence. ***Long-term (secure):*** If the population of WCT becomes established in the 1.5 miles of available habitat in Curly Creek, these fish can be used to repopulate larger project areas in the Beaverhead sub-basin. Although Selway Creek is in the Red Rock sub-basin, the Curly/LF Stone population could be used for repopulation there.
High Ore	***Genetic Class/Threat Status:*** Unaltered/At-risk ***On-going projects:*** Population and genetic surveys completed in 2008. ***Short-term (protect):*** The High Ore population is isolated by a perched culvert and rip-rap falls (related to the Comet Mine); however, riparian and stream damage due to livestock grazing (private and Forest Service) threatens the population. Livestock management (e.g., riparian exclosure) should be a focus of short-term protection of this population. Habitat improvement should lead to increases in population abundance, which will increase resiliency to stochastic events and reduce likelihood of inbreeding depression. ***Long-term (secure):*** The High Ore population could be expanded downstream 4 – 5 miles through placement of a barrier and removal of brook trout downstream of the Comet Mine to the Boulder River. Historic mining pollution eliminated fish from this reach of stream until recent reclamation efforts. Reestablishment of WCT in this reach of stream would secure the population; however, the large number of private landowners in the drainage could complicate a nonnative trout removal proposal.
Jack	***Genetic Class/Threat Status:*** Unaltered/At-risk ***On-going projects:*** Habitat reclamation projects (water quality and culvert replacement) have been completed to increase connectivity within the population. ***Short-term (protect):*** The Jack Creek population is considered at risk due to historic mining that has resulted in poor water quality, degraded physical habitat, and disjunct stream reaches. There is also a small risk that during periods of high discharge brook trout or rainbow trout (from Basin Creek) may invade upper Jack Creek by negotiating a 2 – 3 mile reach of Jack Creek that is normally too toxic to support fish. In the near term, effort to improve connectivity within the population should continue, and habitat improvement projects, e.g., pool development, should be initiated. These efforts should increase the size (abundance and distribution) of the WCT population and its resiliency to stochastic events. A periodic monitoring program of the currently fishless reach below the population should also be conducted to detect potential invasion of nonnative species. Appearance of nonnative species would dictate construction of a barrier and their removal as necessary. ***Long-term (secure):*** Water quality problems for the foreseeable future prevent possibility of downstream population expansion. A sub-basin priority should be to replicate the Jack Creek population in suitable location. This effort would maintain the genetic legacy of the population should the Jack Creek population be lost.
Little Boulder	***Genetic Class/Threat Status:*** Unaltered/Protected? ***On-going projects:*** Forest Service watershed assessment scheduled for 2009. ***Short-term (protect):*** The population is protected and there are no known immediate threats. Periodic surveys should be completed to monitor any changes to the population and habitat, and to detect invasion by nonnative trout.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): Suitable habitat may exist downstream of the current population to allow expansion to a secure status. Brook trout are present, and a barrier would be required. Basic survey information needed to determine potential for WCT restoration in this reach include: the feasibility of nonnative removal and barrier placement, habitat condition, and water quality. As a tributary to the Boulder River, the Muskrat population cannot be connected with other existing populations. ***Additional comments:*** Next to Muskrat Creek, the Little Boulder population has the greatest potential as a donor source for restoration efforts in the Boulder sub-basin, and updated population status information (additional genetics, abundance and health) should be collected to develop the population as a donor source. A substantial concrete barrier exists on the North Fork Little Boulder River which isolates close to ten miles of quality habitat above. Limited survey work above shows the population is comprised of rainbow trout and brook trout. A removal project here would provide a great opportunity to secure several at-risk populations.
Muskrat - Nursery	***Genetic Class/Threat Status:*** Unaltered/Secured ***On-going projects:*** The population has been secured through conservation efforts initiated in 1997. These efforts have included placement of a barrier (1997), mechanical removal of brook trout (eradicated in 2003, then reappeared in 2008 likely by human transport above barrier), and upstream transfer to a historically fishless reach (4.0 miles). The Muskrat Creek population has also been replicated in previously fishless SF of Crow Creek (Upper Missouri), introduced with other populations to Whitehorse (Upper Missouri) and Cherry (Madison) creeks, and incorporated into the Sun Ranch WCT brood. One-pass fish sampling conducted most years. In 2020, two brook trout were observed above wooden barrier and below concrete barrier. ***Short-term (protect):*** The population has no current threats; however, ease of access to the stream and barrier site increases the likelihood of reintroduction of brook trout. This appeared to be the case in 2007 when a small number of brook trout were found and removed above the barrier (n=5). The risk of brook trout reintroduction or barrier failure will remain, and periodic monitoring is necessary to ensure brook trout are not reestablished (see *Additional comment* below). In 2013, a concrete structure was installed at the road crossing 200 meters above the original wooden barrier. ***Long-term (secure):*** The population is considered secure, but evaluating brook trout invasion is a long-term requirements. Several miles of habitat downstream of the current population could support WCT; however, presence of beaver and private landownership would complicate a restoration effort. As a tributary to the Boulder River, the Muskrat population cannot be connected with others. The appearance of albino fry from gametes collected in Muskrat Creek suggests potential for inbreeding depression and monitoring of populations genetic health is warranted. ***Additional comments:*** The Muskrat Creek population is protected by two barriers. The man made barrier described above protects the historic reach of stream occupied by WCT (1.6 miles), and a natural barrier protects an upper 4 mile reach where WCT were introduced in 1997. The population has expanded from about 100 fish in 1997, to over 3,000 in 2008.
Red Rock	***Genetic Class/Threat Statu***s: Unaltered/At risk ***On-going projects:*** None ***Short-term (protect):*** Insufficient information is available to develop a specific conservation plan. Additional surveys should be conducted to determine current population status, genetics, distribution, potential threats, presence of barriers, or where a barrier may be placed. Lack of rainbow trout introgression suggests a barrier may be present in the lower part of the drainage; however, no barriers have been confirmed. Brook trout are believed present throughout most of the reach occupied by WCT, and will require removal. ***Long-term (secure):*** Insufficient information is available to develop specific long-term conservation plans for the Red Rock population. The current distribution of the population is 5.7 miles, but WCT are not abundant throughout the reach. Removal of brook trout, and or expansion of the population to include the South Fork of

Stream (s)	Population Status and Conservation Needs
	Red Rock should secure the population. Potential for population expansion and nonnative removals have not been evaluated.
Rock	***Genetic Class/Threat Status:*** Altered/At-risk ***On-going projects:*** None ***Short-term (protect):*** Insufficient information is available to develop a specific conservation plan. Additional surveys should be conducted to determine current population status, genetics, distribution, potential threats, feasibility of nonnative trout removal, presence of barriers, and where a barrier may be place if necessary. Brook trout are believed present throughout most of the reach occupied by WCT, and will require removal. ***Long-term (secure):*** Insufficient information is available to develop specific long-term conservation plans for the Red Rock population. The population would require downstream expansion to secure it.
Sullivan	***Genetic Class/Threat Status:*** Altered/At-risk ***On-going projects:*** None ***Short-term (protect):*** An earthen dam protects the Sullivan Gulch population from brook trout found below. The dam may require modification and maintenance to preserve its barrier characteristics. These needs have not been explored. Excess livestock disturbance has been observed, and grazing management options should be considered. Firewood cutting alongside FR105 / Trail 78 has significantly impacted LWD recruitment and habitat quality in Sullivan Gulch. Road/Trail management and LWD restoration will help correct these impacts. ***Long-term (secure):*** Cursory evaluations indicate that Sullivan Gulch below the existing barrier is marginal fish habitat due to steep grade; therefore, placement of an additional barrier and removal of nonnative trout do not appear to be a significantly beneficial actions (a maximum of 1 mile gained). These potential efforts should be evaluated in more detail however. Regardless of the potential for downstream expansion, the population cannot reach a secure status due to short stream length. The stream is a tributary of the Boulder River where there is no current WCT conservation potential. Habitat improvement efforts (e.g., pool development and riparian livestock exclosures) may increase the population size and its resiliency to stochastic events and inbreeding depression.
Thunderbolt	***Genetic Class/Threat Status:*** Altered /At-risk ***On-going projects:*** None ***Short-term (protect):*** Due to minimal survey information the current status and conservation needs of the Thunderbolt Creek population are mostly unknown. 2004 surveys indicated a small bedrock barrier prevents brook trout invasion into the reach of stream currently occupied by WCT; however, the population is considered at risk due to small population size. Additional surveys should be conducted to determine detailed population status, distribution, potential threats, presence of additional barriers, or where a barrier may be placed. Short-term protection measures would likely include placement of a barrier downstream of the current WCT distribution, and removal of nonnative trout. Cottonwood Lake (headwaters of Thunderbolt) was stocked with "cutthroat trout" in 1937 (Washoe Park), and the stream was stocked in 1946, 1950 and 1951 (Bozeman Tech Center). These fish were likely YCT, and resulted in the hybridization of the Thunderbolt population. Cutthroat trout are believed to persist in Cottonwood Lake, and surveys should be conducted to determine whether YCT persist and if their removal is warranted. ***Long-term (secure):*** Insufficient information is available to develop specific long-term conservation plans for the Thunderbolt population. The population would require downstream expansion to be secure.

Section 4: Gallatin Sub-basin

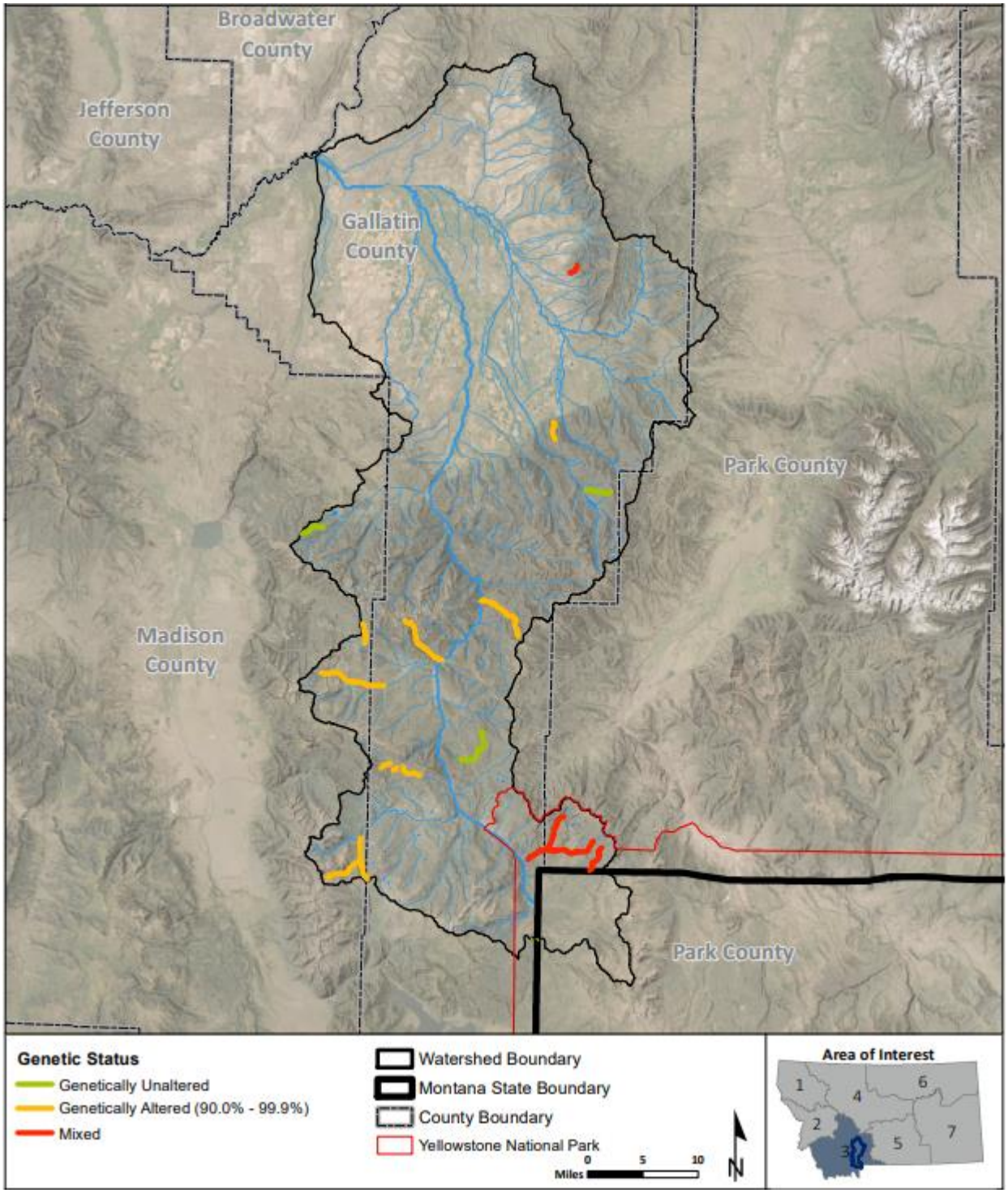

Figure 4.1. Genetic status and distribution of WCT conservation populations in the Gallatin River sub-basin.

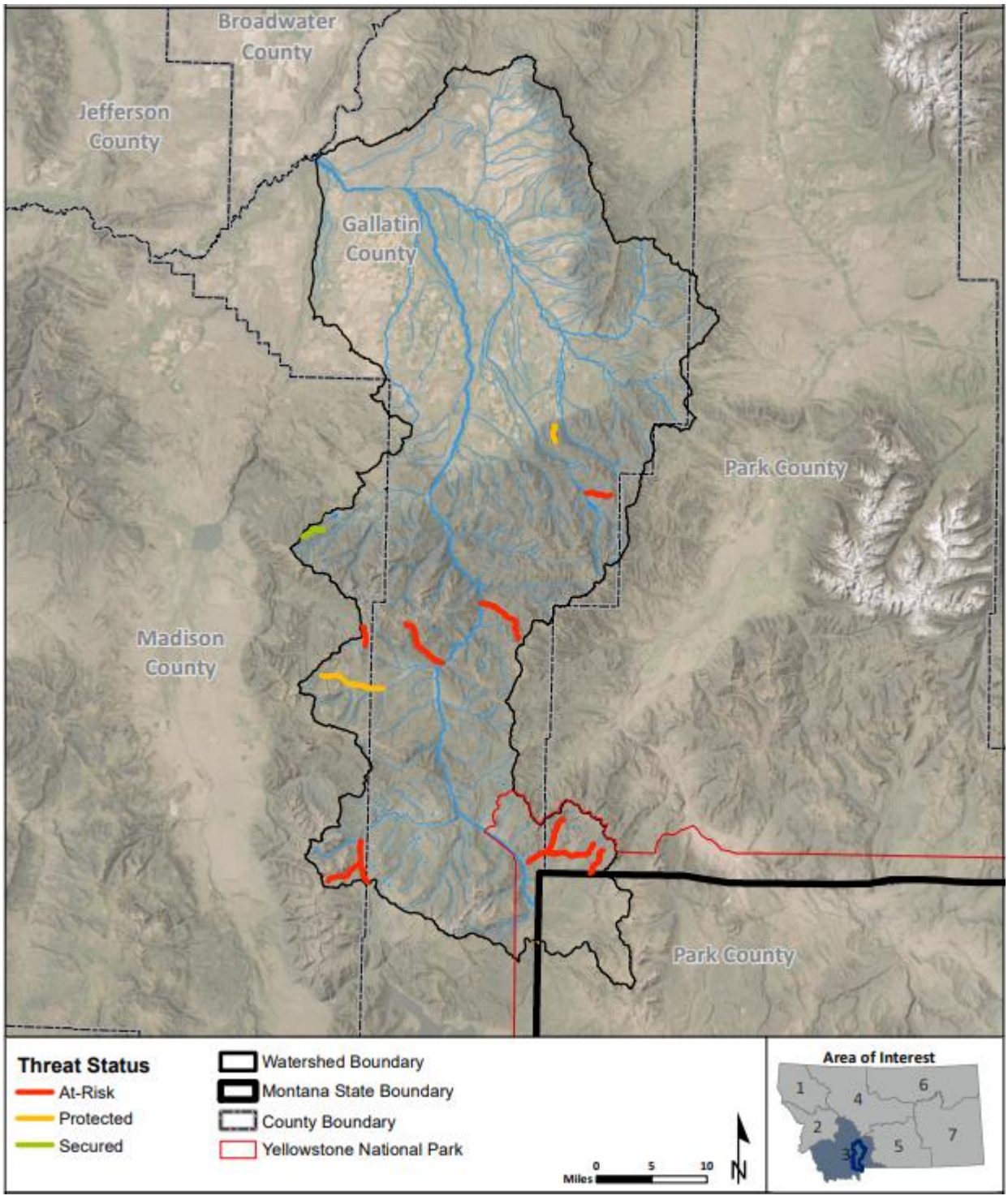

Figure 4.2. Threat status and distribution of WCT conservation populations in the Gallatin River sub-basin.

Overview

Gallatin WCT Status and Threats:

- Number of conservation populations: 11 (3 unaltered; 0 mixed; 8 altered)
- Populations at risk: 64% (7 of 11)
- Genetically unaltered populations at risk: 67% (2 of 3)
- Populations considered protected: 36% (4 of 11)
- Populations considered secured: 0 (Pending N Fk Spanish Creek)
- Significant threats:
    - Development: 2 populations
    - Brook or brown or trout: 3 populations
    - Nonnative trout (YCT, RBT, CT hybrids): 7 populations
    - Small population size: 2 populations (< 1,000 fish)
    - Limited distribution: 7 populations (inhabit < 5 miles of stream)

Table 4.1. Genetic class and threat status of WCT conservation populations in the Gallatin River sub-basin.

Genetic Class	Status of Conservation Populations			
	At-risk	Protected	Secured	**Total**
Unaltered	2	1	0	**3**
Mixed	0	0	0	**0**
Altered	5	3	0	**8**
Total	**7**	**4**	**0**	**11**

Table 4.2. WCT conservation populations identified in the Gallatin River sub-basin.

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Beehive Basin (W Fk Gallatin)	4243 4242 4005	Genetically Altered	Genetically tested as ≥ 96% WCT	10/20/10 FWP, Nelson (42), 99% WCT 1% RBT 10/20/10 FWP, Nelson (17), 96% WCT 4% RBT 6/11/09 USFS, Roberts (8), 100% WCT
Dudley	5315 4950	Genetically Altered	Genetically tested as 92%	9/2/20 FWP, McCormack (30), 92% WCT 8%RB 7/14/16 USFS, Roberts (9), 98% WCT 2% RBT
E Fk Fan (Fan)		Genetically Altered	Genetically tested as ≥ 94%	2003 NPS, (29), 94% WCT 4% YCT 2% RBT 2003 NPS, (29), 95% WCT 3% RBT 2% YCT 8/15/02 NPS, (9), 95% WCT 1994 NPS, (50), 98% WCT 2% YCT
E Fk Specimen	4729 3002 1033	Genetically Unaltered	Recent invasion by nonnatives have compromised genetically unaltered fish in lower half of project area	2019 MSU Andi Puchany, (273), 96% WCT 3% RBT 1% YCT

Elkhorn	5315	Genetically Altered	Genetically tested as 98% WCT	6/30/21 USFS, Stringer (26), 98% WCT 2% unknown salmonid
Leverich (E. Gallatin)	3418 3659	Genetically Altered	Genetically tested as 99% WCT	9/5/06 USFS, Roberts (2), 100% WCT 9/17/07 USFS, Roberts (50), 99% WCT 1% RBT
Lightning (Taylor Fork) -Alp	4953 4436	Genetically Altered	Genetically tested as 92% WCT	8/3/16 USFS, Roberts (11), 92% WCT 8% YCT 9/10/12 FWP, Moser (27), 92% WCT 8% YCT
N Fk Fan (Fan)	924	Genetically Altered	Unaltered WCT present but others genetically tested as 98% WCT	2003 NPS, (30), 99% WCT 1% RBT 2003 NPS, (35), 99% WCT 1% RBT 8/14/02 NPS, (41), 97% WCT 10/10/01 NPS, (18), 90% WCT 7/29/99 NPS, (30), 97% WCT 7/1/94 NPS, Kaeding (51), 98% WCT 2% YCT
N Fk Spanish (Spanish) - Camp - Placer - Swamp		Genetically Unaltered; Treatment in Process	Placer was previously fishless; established with genetically unaltered transplants from Bostwick Creek in 2014	
S Fk W Fk Gallatin (W Fk) - First Yellow Mule - Muddy - Second Yellow Mule -Third Yellow Mule	4989 4250 4251 4252 922	Genetically Altered	With exception of Second Yellow Mule Creek, genetically tested as ≥ 90% WCT	8/22/18 FWP, Moser (65), 94% WCT 5% YCT 1% RBT 9/23/10 USFS, Roberts (31), 90% YCT 8% YCT 2% RBT 9/23/10 USFS, Roberts (10), 98% WCT 1% YCT 1% RBT 9/23/10 USFS, Roberts (11), 89% WCT 7% YCT 5% RBT 6/30/94 USFS, May (25), 94% WCT 6% YCT
Wild Horse (Hyalite)	4772 4037 3768 3265 2940 1112 1111	Mixed	Preliminary 2020 genetics indicate one hybridized fish among unaltered WCT	9/3/20 USFS, Stringer (1), *awaiting results* 6/17/14 USFS, Roberts (17), 100% WCT 6/26/10 FWP, Nelson (8), 100% WCT 7/17/08 USFS, Roberts (50), 100% WCT 6/15/05 USFS, Roberts (7), 100% WCT 9/18/02 USFS, Barndt (17), 100% WCT 8/1/95 USFS, May (4), 100% WCT 7/12/95 USFS, May (2), 100% WCT

Table 4.3. Characteristics that define threat status of WCT conservation populations in the Gallatin River sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Beehive Basin	≈ 3.0	0.0	7 per 100 m (337 fish)	None	FS, Private	No barrier, brook trout, hybridization, development, limited distribution	At-risk
Dudley	≈ 3.0	0.0	9 per 100 m (434 fish)	None	FS, Private	No barrier, hybridization, limited distribution	At-risk
E Fk Fan	≈ 4.0	Unknown	Unknown	None	NPS	No barrier, hybridization, brown trout, limited distribution	At-risk
E Fk Specimen	12.9	8.2	Unknown	Constructed wooden barrier	NPS	Barrier failure, hybridization	At-risk
Elkhorn	4.5	4.5	39 per 100 m (2,826 fish)	Subsurface flows isolate population	FS, FWP	Potentially small population size, limited distribution	Protected
Leverich	≈ 1.0	≈ 1.0	21 per 100 m (331 fish)	Perched culvert	FS, Private	Suspected hybridization, limited distribution	Protected
Lightning - Alp	≈ 5.8	0.0	19 per 100 m (1,763 fish)	None	FS, Private	No barrier, hybridization	At-risk
N Fk Fan	≈ 3.2	Unknown	Unknown	None	NPS	No barrier, hybridization, brown trout, limited distribution	At-risk
N Fk Spanish - Camp - Placer - Swamp	2.3	2.3	Treatment in progress (Placer is unaltered)	Concrete barrier (Placer is protected by a natural waterfall)	FS, Private	None	Protected (Placer)
S Fk W Fk Gallatin - First Yellow Mule - Second Yellow Mule - Third Yellow Mule - Muddy	≈ 24.7	0.0	20 per 100 m (7,904 fish)	Waterfall	FS, Private	Development, stocked ponds with nonnative species	Protected

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Wild Horse	≈ 0.5	≈ 0.5	10 fish per 100 m (80 fish)	None	FS	Hybridization, small population, limited distribution	At-risk

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population that exist in the same stream.

[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 4.4. Actions required to maintain conservation populations in the Gallatin River sub-basin.

Stream (s)	Population Status and Conservation Needs
Beehive Basin	***Genetic Class:*** Genetically Altered ***On-going projects***: None ***Short-term (protect):*** Demographic and genetic monitoring. Establishment of a barrier and removal of nonnative EBT would protect this population. Need to evaluate potential to perch culvert, which occur on private lands, to protect existing WCT population. ***Long-term (secure):*** It is not feasible to secure a population of > 5 miles with 2,500 fish >75 mm in Beehive Creek because of limited habitat. ***Additional comments:*** Based on previous discussions, landowner cooperation appears to be favorable for barrier construction and nonnative EBT removal. Need to assess genetics of fish at uppermost stream reaches to confirm status of WCT upstream of locations where 2010 genetics were collected. Could potential relocate genetically unaltered WCT to N Fk Spanish Creek to preserve genetics from hybridization with altered WCT in lower reaches of Beehive Creek.
Dudley	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Need to analyze genetic samples collected in 2020 to determine if the population meets conservation status. RBT and WCT x RBT hybrids captured in lower reaches during 2020 genetic collections indicate conservation population is likely well below secure threshold of 5 miles and 2,500 WCT >75 mm. ***Long-term (secure):*** Need to assess barrier potential to protect and potentially facilitate population expansion for long-term security. ***Additional comments:*** None
E Fk Fan	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Genetic and demographic monitoring needed to confirm WCT conservation status. ***Long-term (secure):*** Securing the population would require a barrier in the mainstem of Fan Creek, which would likely include N Fk Fan Creek. Removal of hybrid WCT and nonnative RBT and BRT would also be needed to secure WCT population. ***Additional comments:*** This population is within Yellowstone National Park in Wyoming and thus falls under NPS authority.
E Fk Specimen	***Genetic Class:*** Mixed ***On-going projects:*** Genetic monitoring needed to assess the extent of hybridization and invasion of nonnative trout above compromised wooden barrier. NPS may conduct piscicide treatment immediately above barrier to increase short-term protection against hybridization until a functional barrier can be constructed. ***Short-term (protect):*** Determine feasibility and costs associated with construction of new concrete barrier near HWY 191 crossing. ***Long-term (secure):*** Construction of barrier near HWY 191 would secure about 32 miles of stream and provide the ability to establish unaltered populations in additional headwater lakes of Specimen Creek.

Stream (s)	Population Status and Conservation Needs
	Additional comments: This population is within Yellowstone National Park in Wyoming and thus falls under NPS authority. WCT in High Lake were established through stocking efforts (2007-2009) with fish and eggs from Sun Ranch (*N* = 4,044 eggs), Last Chance Creek (*N* = 463 eggs), and Geode Creek (*N* = 838 eggs; *N* = 2,964 fish of multiple age classes). The E. Fk. Specimen population was established used gametes from Geode (*N* = 9,353) and Muskrat (*N* = 1,000) creeks from 2010 to 2012.
Elkhorn	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** None ***Short-term (protect):*** Conduct demographic and genetic monitoring to determine need for genetic infusion and potential to use as founding source for N Fk Spanish Creek. ***Long-term (secure):*** It is not feasible to secure a population > 5 miles within Elkhorn Creek because of subsurface flows where a historical landslide isolates the headwaters and WCT population from the lower reaches of the stream and Gallatin River. However, WCT abundances may be greater than the security threshold of 2,500 fish > 75 mm since the population likely occupies over 4 miles of stream. ***Additional comments:*** Eyed eggs introduced from W Fk Wilson and Wild Horse populations in 2009 and 2010.
Leverich	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect)***: Genetic and demographic monitoring needed to confirm WCT conservation status. ***Long-term (secure):*** It is not feasible to secure a population of > 5 miles with 2,500 fish >75 mm in Leverich Creek above the existing barrier because of limited habitat. Increasing protected habitat with an additional barrier followed by WCT expansion could secure this population. However, such measures would have to occur on private property downstream of USFS lands and would likely need to take advantage of road crossings or diversions because of relatively wide floodplain habitats once the stream reaches the Gallatin Valley. ***Additional comments:*** None
Lightning -Alp	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring ***Short-term (protect):*** Need to assess potential to transfer fish to Taylor Fork above natural barrier to preserve genetics until a barrier can be built on Lightning Creek. ***Long-term (secure):*** Need to assess barrier potential to protect against further hybridization. ***Additional comments:*** Current owner, Sandy Martin, is actively trying to sell section of land on lower reaches of Lightning Creek. One-pass electrofishing indicated 27 fish per 100 m in Lightning Creek and 11 fish per 100 m in Alp Creek.
N Fk Fan	***Genetic Class:*** Mixed ***On-going projects:*** None ***Short-term (protect):*** Genetic monitoring needed to assess current conservation status ***Long-term (secure):*** Need to assess barrier potential/need to protect against further hybridization.

Stream (s)	Population Status and Conservation Needs
	Additional comments: This population is within Yellowstone National Park in Wyoming and thus falls under NPS authority.
N Fk Spanish - Camp - Swamp	***Genetic Class:*** Genetically Unaltered (eventually) ***On-going projects:*** A concrete barrier was constructed on N Fk Spanish Creek in 2018, several kilometers downstream of USFS lands. Piscicide treatments began in the headwaters of the project area in 2019 including Chiquita and Big Brother lakes. The entire project area was treated in 2020. Several CT were observed in the inlet of Big Brother Lake in 2020. Treatments downstream of natural barriers in Camp, Placer, and N. Fk. Spanish creeks are planned for 2021. Gill netting and electrofishing efforts anticipated in and around Big Brother and Chiquita lakes in 2021 to help confirm a complete removal. eDNA sampling planned for 2022 followed by the immediate relocation of WCT from appropriate upper Missouri Basin populations. ***Short-term (protect):*** Identify founding populations and fish transfer strategy for 2022 reintroduction efforts. ***Long-term (secure):*** Identify need for additional WCT reintroductions after 2022 to ensure sufficient genetic diversity persists throughout the project area. ***Additional comments:*** Unaltered WCT population established in Placer Creek using fish from Bostwick Creek in 2014. Personnel with Turner Enterprises Inc. sampled Placer Creek in 2018 and observed multiple age classes and good abundances of WCT; however, WCT distributions and population estimates were not formally assessed.
S Fk W Fk Gallatin - Third Yellow Mule - Second Yellow Mule - Muddy	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Demographic monitoring. ***Long-term (secure):*** None ***Additional comments:*** Ousel Falls, a large waterfall, serves as a natural barrier that protects this population from further hybridization. The population is too large to supplement with unaltered WCT, so no options exist to improve status of population. Two-pass electrofishing indicated 37 fish per 175 m in S Fk W Fk Gallatin and 22 fish per 109 m in First Yellow Mule Creek while one-pass electrofishing indicated 2 fish per 100 m in Second Yellow Mule Creek and 20 fish per 100 m in Muddy Creek.
Wild Horse	***Genetic Class:*** Unaltered ***On-going projects:*** Demographic and genetic monitoring ***Short-term (protect):*** Sampling conducted by USFS personnel in 2020 yielded one hybridized WCT among unaltered WCT. Further insight into genetic composition of population is needed before deciding on whether to secure, relocate, or abandon conservation efforts. ***Long-term (secure):*** Determine whether to protect existing population or relocate to Spanish Creek. The population is small (likely < 100 fish), which leaves it vulnerable to extirpation and genetic issues. ***Additional comments:*** Pathogen testing in 2021 on surrogate species detected the presence of whirling disease in Wild Horse Creek. This has eliminated the possibility of a wild-fish transfer to North Fork Spanish Creek. If Wild Horse fish are to be replicated elsewhere, it will likely be through on-site spawning and the use of a hatchery or RSIs.

Section 5: Jefferson Sub-basin

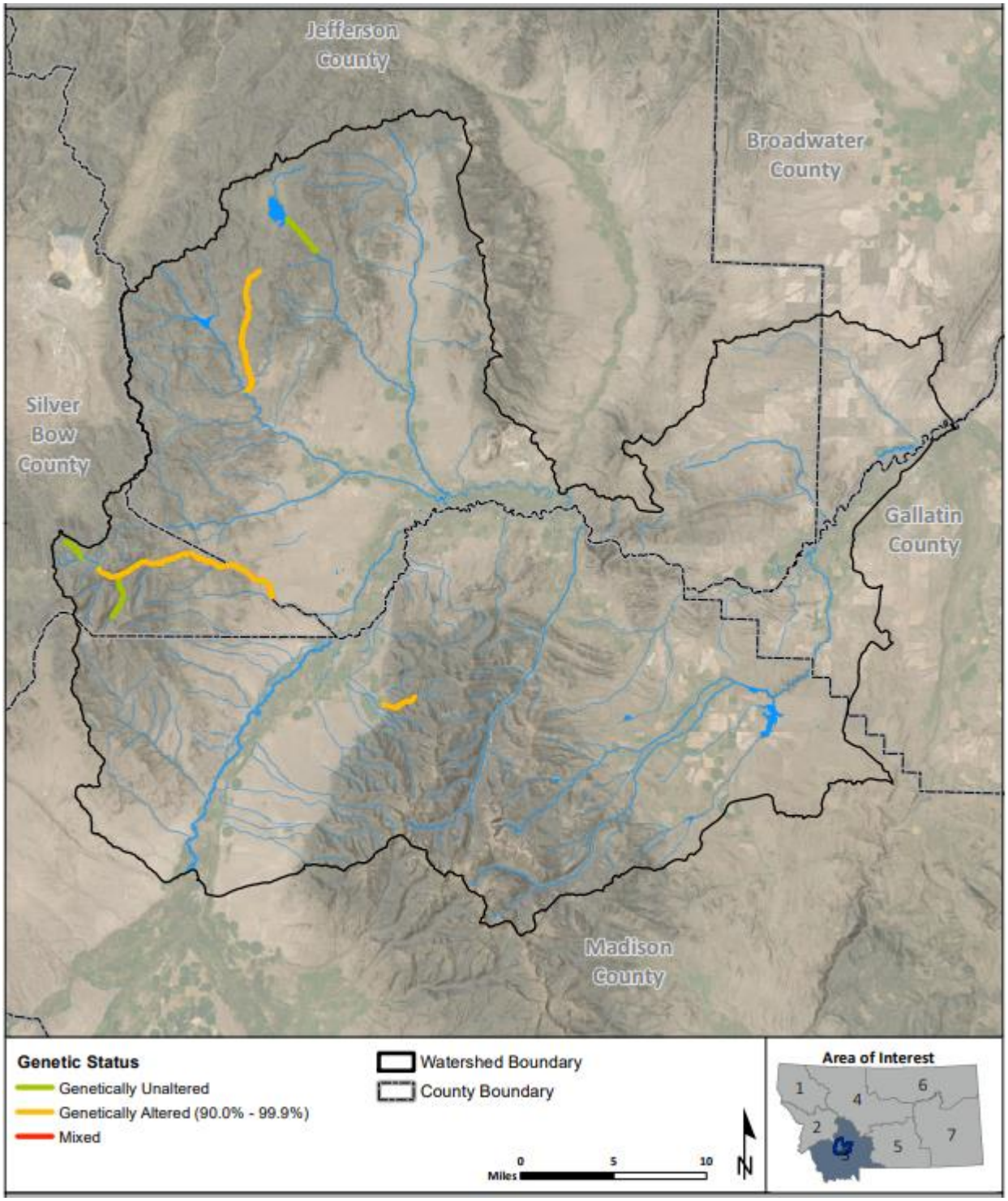

Figure 5.1. Genetic status and distribution of WCT conservation populations in the Jefferson River sub-basin.

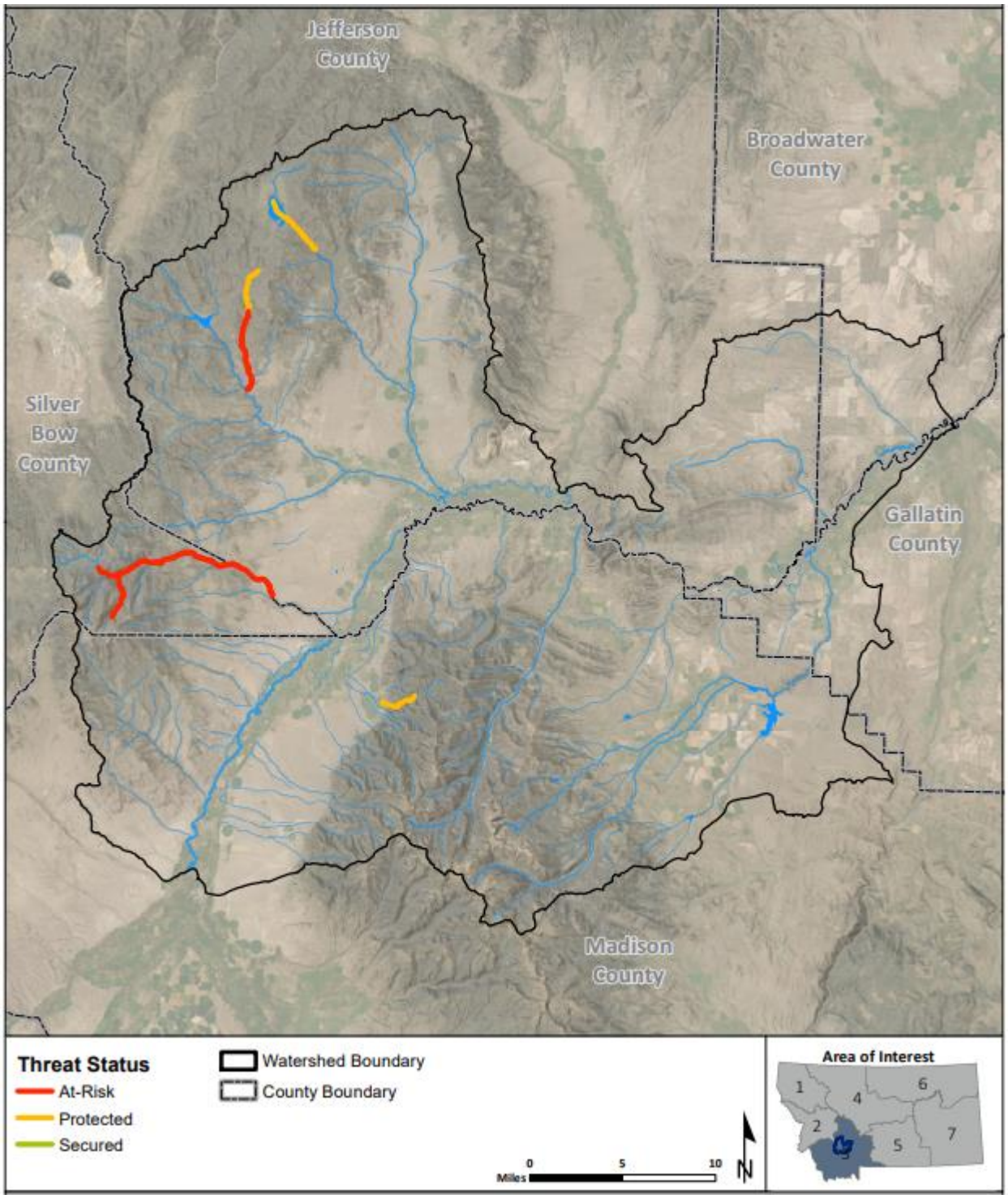

Figure 5.2. Threat status and distribution of WCT conservation populations in the Jefferson River sub-basin.

Overview

Jefferson WCT Status and Threats:

- Number of Conservation populations: (1 unaltered; 0 mixed; 3 altered)
- Populations at risk: 25% (1 of 4)
- Genetically unaltered populations at risk: 0% (0 of 4)
- Populations considered protected: 75 % (3 of 4)
- Populations considered secured: None
- Significant threats:
    - Brook Trout (EBT): 2 populations
    - Other trout (YCT, RBT, CT hybrids): 2 populations
    - Small population size: 4 populations (< 1,000 fish)
    - Livestock grazing: 2 populations
    - Limited distribution: 2 populations (inhabit < 5 miles of stream)

Table 5.1. Genetic class and threat status of WCT conservation populations in the Jefferson River sub-basin.

Genetic Class	Status of Conservation Populations			
	At-risk	Protected	Secured	**Total**
Unaltered	-	1	-	**1**
Mixed	-	-	-	**-**
Altered	1	2	-	**3**
Total	**1**	**3**	**-**	**4**

Table 5.2. Conservation populations identified in the Jefferson River sub-basin.

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Fish	980 3654 3655	Genetically Unaltered	Genetically tested as 99% WCT but unaltered fish are believed to be present in headwaters	8/2/1994 USFS, Sanborn (20 Allozyme) 100%WCT Lower 10/10/2007 FWP, Nelson (25 Indel) 97%WCT 3%RB/YCT Upper 9/19/2007 FWP, Nelson (30 Indel) 99.1%WCT 0.5%RB 0.4%YCT
- Horse	3181			**Horse** 9/11/2003 Brammer (25 PINEs?) 100%WCT
- Roaring Brook	981			**Roaring Brook** 8/2/1994 USFS, Sanborn (5 Allozyme) 100%WCT
Halfway	151 584 3657 3658	Genetically Altered	Genetically tested as 99% WCT	8/8/1985 USFS, Walch (36 Allozyme) 100%WCT 10/7/1991 FWP, Spoon (15 Allozyme) 100%WCT 8/8/2007 FWP, Nelson (25 Indel) 99.7%WCT 0.3%RB

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
				9/26/2007 FWP, Nelson (50 Indel) 99.9%WCT 0.1%RB
Mill	152 3660	Genetically Altered	Genetically tested as 99% WCT	8/8/1985 USFS, Walch (30 Allozyme) 98.8%WCT 1.2%YCT 6/26/2007 FWP, Spoon (20 Indel) 98.8%WCT 1.2%YCT
Whitetail - Whitetail reservoir	3252 3264	Genetically Unaltered	Genetically tested as 100% WCT	6/21/2005 USFS, Brammer (20 PINEs) 100%WCT 6/29/2005 USFS, Barndt (25 PINEs) 100%WCT

Table 5.3. Characteristics that define threat status of WCT Conservation populations within the Jefferson River sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Fish - Horse - Roaring Brook	14.5 1.3 2.5	0 (headwaters of Fish Creek may support unaltered WCT, though testing is required) Maybe 2 miles	Rare to common 20 WCT/100m	Culvert may protect headwater reach; may be other partial barriers	FS, BLM, state & private	EBT, hybrid trout and potentially RBT in mid and lower reaches; habitat degradation due to historic mining and grazing in upper reach	At-risk
Halfway	7.6	0	Rare to abundant 34 WCT/100m	Cascades isolate upper 2.6 miles	FS & BLM	EBT in lower 4.0-mile reach	Protected (upper 2.6 miles)
Mill	3.1	0	Common	Diversion dam and intermittent stream reach	FS, BLM, state & private	None	Protected
Whitetail	5.0	5.0	Rare to common	Cascades / dam	FS	Grazing, Lake Mgmt	Protected

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population that exist in the same stream.
[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 5.4. Actions required to maintain conservation populations in Jefferson River sub-basin.

Stream (s)	Population Status and Conservation Needs
Fish · Horse - Roaring Brook	***Genetic Class/Threat Status:*** Altered/At-risk (additional genetic sampling required in headwaters of Fish Creek) ***On-going projects:*** Genetic and population surveys completed in the middle segments of the population in 2008. Genetic analysis required in upper reach to determine if potential unaltered WCT exist. Update fish and flow monitoring due to ongoing mine operation. ***Short-term (protect):*** Differences in isolation and threat type dictate different management approaches for three reaches of Fish Creek. The upper most reach of Fish Creek (above Mammoth Creek) is isolated by a perched culvert and cascades. Nonnative trout are not established in the reach (about 2 miles of stream), but the WCT population is threatened by poor habitat conditions (historic mining and livestock grazing), and small population size. Riparian exclosures and placement of structures to increase habitat complexity should result in increased WCT abundance and population resiliency to stochastic events. WCT have not been genetically tested in this isolated reach, but the isolation suggests that unaltered fish may persist. Genetic samples should be collected to confirm current status. The middle reach of Fish Creek (Mammoth Creek to Pigeon Creek) supports robust populations of WCT and brook trout. Rainbow and hybrid trout invasion from lower in the drainage is possible, and genetic samples collected in 2007 indicated the presence of several fish with a high level of hybridization. No specific management plans have been evaluated for this reach of stream, but necessary protection actions should include removal of nonnative trout and placement of a barrier. Barrier construction becomes urgent if additional surveys indicate increased risk of rainbow or hybrid trout invasion from lower in the drainage. The lowest segment of the Fish Creek population (HWY 41 to Pigeon Creek) supports high densities of brook trout and few WCT. Rainbow trout invasion from the Jefferson River and associated irrigation canals is possible in this reach, although intermittent stream reaches, and irrigation structures may limit this threat. Additional surveys should be completed in the lower reach to determine current genetic status, and potential for nonnative trout removal and barrier need / placement. Presence of highly hybridized fish may also indicate exclusion of this segment from conservation status. In the near-term, the focus of WCT conservation efforts in the Fish Creek drainage should include: habitat reclamation and evaluation of genetics in the upper reach; surveys (genetic and barrier evaluation) to determine the potential of rainbow trout / hybrid trout invasion in the mid and lower reaches; and feasibility studies of nonnative trout removal and barrier placement in mid and lower reaches. ***Long-term (secure):*** The Fish Creek population would be secured through placement of a barrier and removal of nonnative trout from the middle to lower reaches of the stream. Feasibility of such efforts have not been reviewed.
Halfway	***Genetic and threat status:*** Altered/Protected (upper 2.6 miles) ***On-going projects:*** Detailed population and genetic surveys were completed in 2007. Updated monitoring needed. ***Short-term (protect):*** The upper 2.6 miles of the population are isolated from nonnative trout by a series of cascades and are considered protected. Occasional heavy livestock use of the riparian area has been observed and several deteriorating in-stream habitat structures are present in this section of stream. These issues should be addressed if monitoring indicates declining riparian health or if the habitat structures become barriers to fish migration. Below the cascade barrier, declining numbers of WCT and increasing numbers of brook trout are found to the mouth of the stream (3.7-mile stream reach). Placement of a barrier and removal of brook trout are necessary

Stream (s)	Population Status and Conservation Needs
	to protect this segment of the population. The feasibility of barrier placement and nonnative trout removal should be evaluated. ***Long-term (secure):*** Protection of the lower reach of the Halfway (3.7 miles of stream), by placement of a barrier and removal of nonnative trout, would result in secure population. There is no opportunity to expand the population beyond its current distribution. ***Additional comments:*** Detected levels of hybridization in Halfway Creek are very low (0.1 – 0.3%) but are believed to be indicative of introgression and not a variant WCT allele. Because the population is one of the last WCT populations in the Jefferson sub-basin, it may be a suitable donor source for future restoration efforts within the sub-basin.
Mill	***Genetic Class/Threat Status:*** Altered/Protected ***On-going projects:*** Population and genetic surveys completed in 2007. No fish population monitoring in past 5 years. ***Short-term (protect):*** The Mill Creek population is currently protected. Barriers that isolate the population (diversion dam and intermittent stream reach) do have potential for failure and should be annually monitored. The potential for illegal fish introductions is elevated by ease of public access and the presence of an on-stream pond. A periodic population monitoring program should be established to detect presence of introduced species, particularly near the pond. Intermittent heavy livestock use of the riparian area should be monitored annually to determine if remediation is necessary. ***Long-term (secure):*** Due to intermittent flow in the lower reaches of Mill Creek there are no opportunity to expand the population to a secure status. ***Additional comments:*** Detected levels of hybridization in Mill Creek are very low (0.2%) but are believed to be indicative of introgression and not a variant WCT allele. Because the population is one of the last WCT populations in the Jefferson sub-basin, it may be a suitable source for future restoration efforts in the sub-basin.
Whitetail	***Genetic Class/Threat Status:*** Unaltered/Protected ***On-going projects:*** Habitat restoration and placement of a livestock exclosure above Whitetail Reservoir; recent genetic, habitat, and population surveys. Exclosure completed? Genetics evaluation last done in 2005. USFS fish sampling and barrier description below the reservoir should be added to this narrative. Call new FS biologist. ***Short-term (protect):*** The population is currently protected, although habitat degradation from livestock grazing, channel alteration and reservoir operation do impact the population. Habitat concerns from livestock (above the reservoir) are currently being addressed with an exclosure, (complete?) and plans have been developed to reconnect a historic channel that is currently bypassed by a historic irrigation canal. Effort should be placed on a better understanding of how reservoir operation impacts this population, and if necessary, whether adjustments can be made to minimize these. The presence of Whitetail Creek reservoir increases the risk of illegal fish introductions to the system. For this reason, a periodic population monitoring program in the reservoir should be implemented. ***Long-term (secure):*** Potential exists to significantly expand this population downstream (4 – 8 miles). Such an effort has not been evaluated but would require removal of nonnative trout and likely construction of a large barrier. The western most tributary (unnamed) entering Whitetail Reservoir is fishless but may be suitable WCT habitat. Additional evaluation of this stream, and of the northern tributary (unnamed) to the reservoir, should be completed to determine potential for WCT introduction.

Stream (s)	Population Status and Conservation Needs
	Additional comments: The Whitetail Creek population may be the only remaining genetically unaltered population in the Jefferson sub-basin. As such, initial restoration efforts in the sub-basin should focus on use of this population as a donor source.

Section 6: Madison Sub-basin

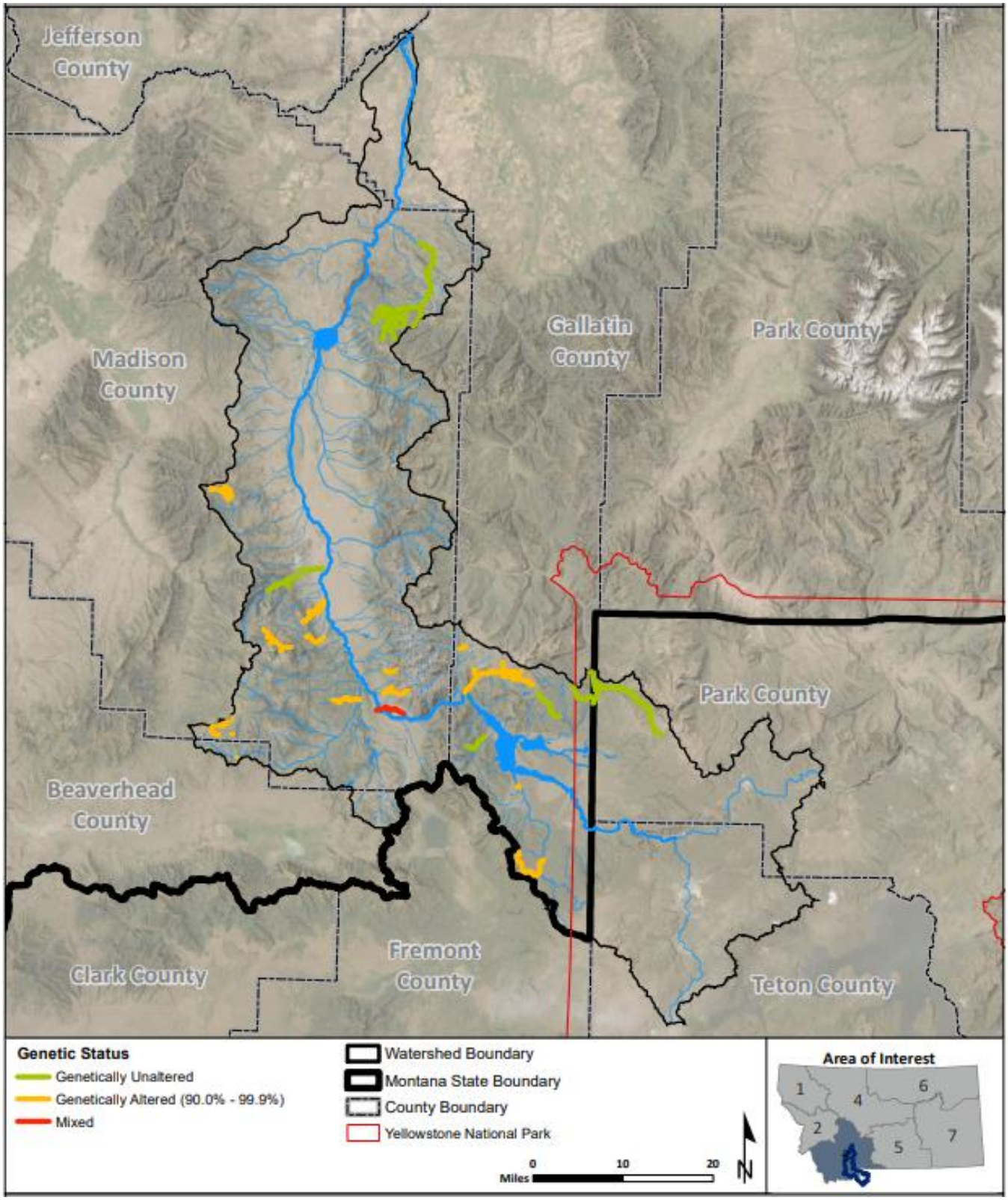

Figure 6.1. Genetic status and distribution of WCT conservation populations in the Madison River sub-basin.

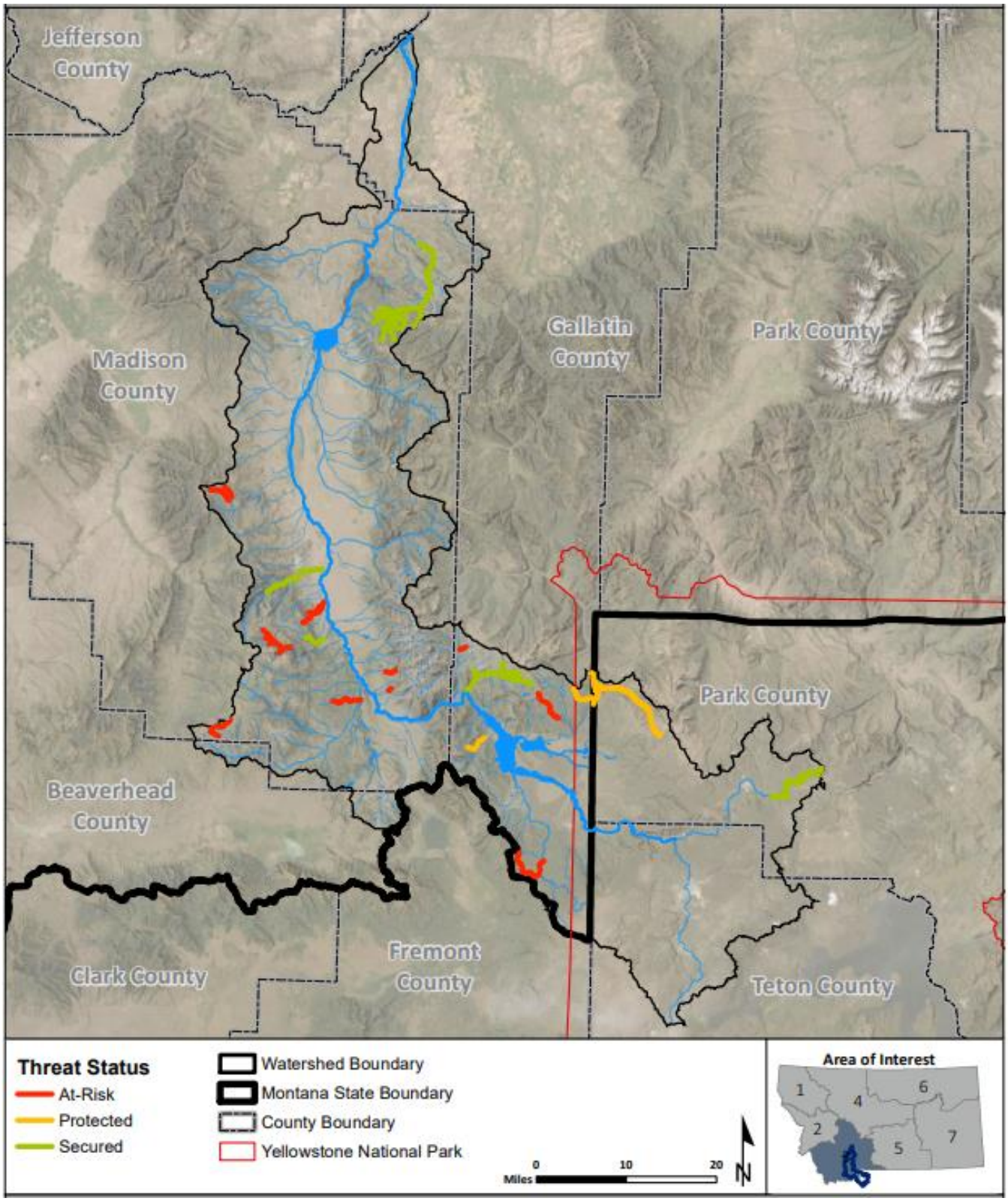

Figure 6.2. Threat status and distribution of WCT conservation populations in the Madison River sub-basin.

Overview

Madison WCT Status and Threats:

- Number of Conservation populations: 20 (7 unaltered; 0 mixed; 13 altered)
- Populations at risk: 58% (12 of 20)
- Genetically unaltered population at risk: 29% (2 of 7)
- Populations considered protected: 10% (2 of 20)
- Populations considered secured: 33% (6 of 20)
- Significant threats:
    - Brown trout: 2 populations
    - Other trout (YCT, RBT, CT hybrids): 11 populations
    - Small population size: 6 populations (< 1,000 fish)
    - Livestock grazing: 7 populations
    - Limited distribution: 10 populations (inhabit < 5 miles of stream)
    - Mining tailings: 1 population
    - Algae bloom: 1 population

Table 6.1. Genetic class and threat status of WCT conservation populations in the Madison River sub-basin.

Genetic Class	Threat Status of Conservation Populations			
	At-risk	Protected	Secured	**Total**
Unaltered	2	1	4	**7**
Mixed	0	0	0	**0**
Altered	10	1	2	**13**
Total	**12**	**2**	**6**	**20**

Table 6.2. WCT conservation populations identified in the Madison River sub-basin.

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Cabin	4568	Genetically	Genetically tested as ≥	9/23/13 FWP, Clancey (49), 97% WCT 3%
- Gully	3241	Altered	92 WCT	RBT
- M Fk	2744			10/17/05 FWP, Clancey (15), 97% WCT 3%
	2023			1/1/02, (41), 100% WCT
	1931			6/15/01, (26), 100% WCT
	1932			7/28/99 FWP, Shepard (27), 96% WCT 4%
	1933			RBT
	1934			7/27/99 FWP, Shepard (8), 92% WCT 8%
	1935			RBT
	1936			7/27/99 FWP, Shepard (10), 100% WCT
	1937			7/27/99 FWP, Shepard (10), 98% WCT 2%
	1938			RBT
	1333			7/27/99 FWP, Shepard (10), 99% WCT 1%
	1252			RBT
	747			

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
				7/27/99 FWP, Shepard (10), 98% WCT 2% RBT 7/27/99 FWP, Shepard (10), 100% WCT 7/27/99 FWP, Shepard (6), 100% WCT 4/19/99 FWP, Shepard (10), 93% WCT 7% RBT 8/13/97 FWP, McClure (7), 100% WCT 6/1/93, Hetrick (10), 100% WCT
Cherry		Genetically Unaltered	Reestablished with MO12s	
Deadman	4452 4451 4450	Genetically Altered	Genetically tested as 98% WCT	11/1/12 FWP, Clancey (8), 98% WCT 2% YCT 11/1/12 FWP, Clancey (22), 98% WCT 2% YCT 11/1/12 FWP, Clancey (8), 98% WCT 2% YCT
English George - S Fk	3942 2862 2861 2860 2859 2858 664	Genetically Altered	Genetically tested as ≥ 94% WCT	2018 FWP, Lohrenz (69), 97% WCT 2% YCT < 1% RBT 6/3/15 *(Report number unknown)* (25), 94% WCT 6% RBT/YCT 8/4/09 FWP, Clancey (25), 93% WCT 4% YCT 2% RBT 7/8/99 FWP, Shepard (1), 100% WCT 7/8/99 FWP, Shepard (1), 100% WCT 7/8/99 FWP, Shepard (3), 100% WCT 7/8/99 FWP, Shepard (3), 100% WCT 7/8/99 FWP, Shepard (2), 100% WCT 8/1/92 USFS, Brammer (15), 95% WCT 5% RBT
Garrott	5315 2022	Genetically Unaltered	Genetically tested as 100% WCT	6/14/21 FWP, Jaeger (14), 100% WCT
Fox (W Fk Madison)	4942 3772	Genetically Altered	Genetically tested as ≥ 92% WCT	6/28/16 FWP, Lohrenz (16), 92% WCT 8% RBT < 1% YCT 9/18/08 USFS, Brammer (18), 97% WCT 3% RBT
Gibbon		Genetically Unaltered	Reestablished with genetically unaltered WCT (M012, Sun Ranch, Cherry Creek)	
Grayling - Last Chance	4040 3454	Mixed	Last Chance Creek genetically tested as 100% WCT above barrier; Remaining population reestablished with genetically unaltered WCT, but WCTxRB hybrids were captured	6/25/10 FWP, Nelson (10), 100% WCT 7/2/08 NPS (21), 100% WCT 6/18/07 NPS, Koel (20), 100% WCT 6/5/06 NPS (30) 100% WCT 7/29 & 8/16/05 NPS (80) 100% WCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
			in isolated tributary in 2018 and 2019.	
Horse - Tepee	4737 4736 1342 1341 1340 1339 1338 1337 1336 1335 1334 1328 1095 1093	Genetically Altered	Genetically tested as ≥ 91%; samples < 90% were collected relatively low in Horse Creek	7/29/15 FWP, Clancey (29), 94% WCT 3% RBT 3% YCT 7/29/15 FWP, Clancey (30), 98% WCT 1% RBT 7/28/98 FWP, Shepard (18), 99% WCT 2% YCT 7/28/98 FWP, Shepard (3), 100% WCT 7/27/98 FWP, Shepard (8), 96% WCT 5% YCT 7/30/98 FWP, Shepard (16), 93% WCT 7% YCT 7/30/98 FWP, Shepard (7), 86% WCT 13% YCT 2% RBT 7/30/98 FWP, Shepard (11), 81% WCT 14% YCT 5% RBT 7/30/98 FWP, Shepard (24), 87% WCT 8% YCT 5% RBT 7/31/98 FWP, Shepard (7), 84% WCT 16% YCT 7/31/98 FWP, Shepard (5), 91% WCT 9% RBT 7/28/98 FWP, Shepard (13), 98% WCT 2% YCT 8/1/95 USFS, Brammer (5), 100% WCT 8/10/95 USFS, Brammer (8), 100% WCT
Little Tepee (Grayling)	4040 3737	Genetically Unaltered	Genetically tested as 100% WCT above waterfall; established with MO12s and Wally McClure WCT	6/25/10 FWP, Nelson (16), 100% WCT 7/2/08 NPS, Koel (21), 100% WCT
Papoose	4948 4256 2112 2111 953	Genetically Altered	Genetically tested as ≥ 98% WCT	6/29/16 FWP, Lohrenz (21), 98% WCT 2% YCT 11/4/10 FWP, Nelson (46), 100% WCT 7/27/99 FWP, Shepard (3), 100% WCT 7/27/99 FWP, Shepard (5), 100% WCT 7/26/94 USFS, Brammer (4), 100% WCT
Pine Butte	4452 4451 4450	Genetically Altered	Genetically tested as 98% WCT	11/1/12 FWP, Clancey (8), 98% WCT 2% YCT 11/1/12 FWP, Clancey (22), 98% WCT 2% YCT 11/1/12 FWP, Clancey (8), 98% WCT 2% YCT
Rose (Beaver)	3244 4334	Genetically Altered	Genetically tested as ≥ 94% WCT	7/27/11 USFS, Roberts (10), 94% WCT 5% RBT 1% YCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
				7/14/05 USFS, Roberts (12), 97% WCT 3% RBT
Ruby		Genetically Unaltered	Previously fishless; established with genetically unaltered WCT from Wally McClure and Last Chance creeks	
Soap (W Fk Madison)	3250 2144 701 574	Genetically Altered	Genetically tested ≥ 94% WCT	6/8/05 USFS, Brammer (10), 94% WCT 6% RBT 7/8/01 FWP, Nelson (51), 98% WCT 2% RBT 9/1/92 USFS, Brammer (16), 99% WCT 1% YCT 9/19/91 USFS, Brammer (10), 99% WCT 1% YCT
S Fk Madison	4957 4524 4382 4271 4269 3414 1297	Genetically Altered	Genetically tested as 97.4% WCT	7/20/16 USFS, Roberts (22), 95% WCT 5% RBT 10/7/14 *(report number unknown)* (188), ≥ 92 WCT% x ≤ 8% RBT (n = 133); < 92% WCT culled (n = 55) 9/18/13 USFS, Roberts (63), ≥ 85 WCT% x ≤ 15% RBT (n = 47); < 85% WCT culled (n = 16) 8/29/12 *(report number unknown)* (113), ≥ 85 WCT% x ≤ 15% RBT (n = 89); < 85% WCT culled (n = 24) 9/4/12 USFS, Roberts (113), 95% WCT 6% RBT 9/21/11 USFS, Roberts (242), 97 % WCT% x 3 RBT% (n = 216); hybrid WCT culled (n = 26) 8/3/11 (FWP, Lohrenz (55), 97% WCT x 3% RBT (n = 51); hybrid WCT culled (n = 3); 99% RBT x 1% WCT culled (n = 1) 7/16/09 *(report number unknown)* (25), 98 % WCT% x 2 RBT% (n = 15); hybrid WCT culled (n = 5) 7/10/06 FWP, Nelson (26), 97% WCT 3% RBT 10/13/98 FWP, Byorth (10), 96% WCT 4% YCT
Wall	1125	Genetically Altered	Genetically tested ≥ 95% WCT	6/4/15 *(report number unknown)* (25), 95% WCT 5% RBT/YCT 10/24/11 *(report number unknown)* (32), 95% WCT 5% YCT < 1% RBT 8/15/95 USFS, Brammer (8), 100% WCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Wally McClure		Gentically Unaltered	Genetically tested 100% WCT	10/7/12 *(report number unknown)* (16), 100% WCT 6/26/10 *(report number unknown)* (19), 100% WCT 10/7/09 *(report number unknown)* (49), 100% WCT 7/1/04 *(report number unknown)* (8), 100% WCT
W Fk Madison	3774 490	Genetically Altered	Genetically test as ≥ 94% WCT	7/23/08 USFS, Brammer (7), 95% WCT 5% RBT 6/1/91 USFS, Brammer (3), 94% WCT 6% RBT
Wigwam	4945 4944 4943 2865 2852 496 491	Genetically Altered	Genetically test as ≥ 92%	6/27/16 FWP, Lohrenz (22), 100% WCT 6/27/16 FWP, Lohrenz (27), > 99% WCT < 1% RBT 6/27/16 FWP, Lohrenz (11), 94% WCT 7/20/99 FWP, Shepard (3), 95% WCT 5% YCT 7/20/99 FWP, Shepard (2), 100% WCT 7/26/95 *(report number unknown)* USFS, Brammer (4), 100% WCT 6/1/91 USFS, Brammer (5), 92% WCT 8% RBT 6/1/91 USFS, Brammer (3), 92% WCT 8% RBT

Table 6.3. Characteristics that define threat status of WCT conservation populations in the Madison River sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Cabin	15.6	0.0	Unknown	Concrete barrier	FS	Hybridization, algae bloom	Secured
Cherry	60.0	60.0	100 per 100 m (> 75,000 unaltered fish)	Waterfall	FS, Private	Genetic status of MO12s	Secured
Deadman	≈ 1.5	0.0	Unknown	Intermittent flow	FS, Private	No barrier, small population, hybridization, limited distribution	At-risk
English George - S Fk	4.3	4.3	26 per 100 m (1,789 fish)	6 ft. constructed wooden barrier	State, FS	Livestock grazing, small population, limited distribution	Protected
Fox	≈ 1.3	0.0	Unknown	None	FS	Hybridization, small population, livestock grazing, limited distribution	At-risk
Garrott Creek	1.0	1.0	Unknown	Intermittent, Shallow flow	FS, Private	Hybridization, small population, livestock grazing, limited distribution	At-risk
Gibbon	21.2	21.2	Unknown	Waterfall	NPS	None	Secured
Grayling - Last Chance	34.9	34.9	Unknown	Concrete barrier	NPS	Hybridization	Secured
Horse - Tepee	13.0	0.0	17 per 100 m (3,536 fish)	Questionable waterfall	FS, Private	Questionable barrier, hybridization	At-risk
Little Tepee	≈ 1.5	≈ 1.5	Unknown	None	FS	Questionable barrier, hybridization, small population, genetic status of MO12s, limited distribution	At-risk
Papoose	≈ 4.9	0.0	7 per 100 m (549 fish)	None	FS, Private	No barrier, hybridization, entrainment in irrigation ditch, limited distribution	At-risk
Pine Butte	≈ 1.5	0.0	Unknown	Intermittent flow	FS, Private	No barrier, small population, hybridization, limited distribution	At-risk

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Rose	≈ 1.5	0.0	Unknown	Blasted waterfall	FS	Questionable barrier, hybridization, brown trout, limited distribution	At-risk
Ruby	7.5	7.5	2 per 100 m (200 fish)	Waterfall	State, FS	Livestock grazing, irrigation	Secured
Soap	2.5	0.0	30 per 100 m (1,200 fish)	Cascade/private pond	FS, Private	Hybridization, livestock grazing, brown trout, limited distribution	At-risk
S Fk Madison	3.5	0.0	Unknown	Modified aqueduct, intermittent flow	FS	Questionable isolation during high flows, hybridization, timber harvest, limited distribution	At-risk
Wall	7.5	0.0	20 per 100 m (2,400 fish)	Concrete barrier	FS	Irrigation	Secured
Wally McClure	1.4	1.4	4 per 100 m (90 fish)	Concrete barrier	FS	Small population, livestock grazing, limited distribution	Protected
W Fk Madison	≈ 2.7	0.0	Unknown	None	FS	Small population, livestock grazing, limited distribution	At-risk
Wigwam - Arasta - Buffalo	12.3	0.0	10 per 100 m (1,968 fish)	Waterfall	BLM, FS, Private	Hybridization, livestock grazing, irrigation, mining tailings	At-risk

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population that exist in the same stream.
[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 6.4. Actions required to maintain conservation populations in the Madison River sub-basin.

Stream (s)	Population Status and Conservation Needs
Cabin - Gully - M Fk Cabin	***Genetic Class:*** Genetically Altered ***On-going projects***: None ***Short-term (protect):*** Demographic monitoring. A man-made concrete barrier was constructed in 2015 on USFS land protects this population. ***Long-term (secure):*** None ***Additional comments:*** None
Cherry	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic monitoring ***Short-term (protect):*** None ***Long-term (secure):*** None ***Additional comments:*** There are presently about 100 WCT per 100 m of stream resulting in a population of about 75,000 WCT. The genetic lineage of the donor population (MO12s) remains unclear; however, it is likely they contain genetics from populations outside of the Missouri River basin. As a result, Cherry Creek should not be used as a donor source for future WCT reintroductions efforts.
Deadman	***Genetic Class:*** Genetically Altered ***On-going projects:*** Construction of wooden barrier in 2022. ***Short-term (protect):*** Demographic and genetic monitoring. Potential to perch existing culvert to provide long-term protection; wooden barrier may also be possible. ***Long-term (secure):*** Likely not possible to secure population a population of 2,500 fish > 75 mm because of limited habitat. ***Additional comments:*** None
English George - S Fk English George	***Genetic Class:*** Genetically altered ***On-going projects:*** Livestock exclusion fencing ***Short-term (protect):*** Establish fencing along both forks on WMA and USFS lands, which will likely increase abundances in both forks of English George. ***Long-term (secure):*** It may not be feasible to secure a population of 2,500 fish > 75 mm because of lack of habitat. ***Additional comments:*** The population is protected by a 6-ft constructed, wooden barrier on state lands. 35 fish per 100 m in N Fk English George; 16 fish per 100 m in SF
Fox	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Demographic and genetic monitoring. Need to assess barrier potential to protect population. Assess grazing impacts to determine fencing needs.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): Depending on barrier location, it may not be possible to secure population a population of 2500 fish > 75 mm ***Additional comments:*** None
Garrott	***Genetic Class:*** Genetically Unaltered ***On-going Projects:*** None ***Short-term (protect):*** Unaltered WCT are still present after a 20 year-gap between sampling events. These fish should be transferred to another stream to be protected. Need to assess long-term security, viability of the population because of questionable barrier and small population size. ***Long-term (secure):*** There is no way to secure this population in place due to a lack of habitat. It would require replication elsewhere. ***Additional Comments:*** Pathogen sampling in 2021 on brown trout revealed no known pathogens present. This stream is also known as Unnamed Spring, Garrot's Spring, The Creek near 3-dollar Bridge, and Joe Namath Creek.
Gibbon	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** The NPS is working to treat the lower reaches of the Gibbon River immediately above Virginia Cascades in 2020, which will be the last treatment within the project area. The NPS has been reintroducing WCT to Grebe Lake and its tributaries since 2017. Reintroduction efforts will continue between Grebe Lake and Virginia Cascades. ***Short-term (protect):*** Identify founding populations to use for reintroductions efforts in the Gibbon River and its tributaries. ***Long-term (secure):*** None ***Additional comments:*** This population is within Yellowstone National Park in Wyoming and thus falls under NPS authority. Once complete, an unaltered WCT population will be established in about 21.2 stream miles and 93.9 hectares of the upper Gibbon River basin. WCT were reintroduced to Wolf and Grebe lakes and their tributaries using eggs and fish from the Sun Ranch, Cherry Creek, and the Washoe Park Trout Hatchery (MO12s). Wolf Lake was stocked with 44,000 MO12s from Washoe in 2017 and 2018. Grebe Lake was stocked with 10,000 MO12s in 2017. RSIs were used to establish WCT in Grebe Lake tributaries in 2019 and 2020 (*N* = 17,631 Sun Ranch eggs; *N* = 3,159 Cherry Creek eggs).
Grayling	***Genetic Class:*** Mixed ***On-going projects:*** Demographic and genetic monitoring ***Short-term (protect):*** Thorough demographic and genetic assessment needed to determine distribution and level of hybridization upstream of constructed barrier. ***Long-term (secure):*** Depending on distribution and level of hybridization; continued stocking of WCT to swamp RBT genetics, localized rotenone treatments (e.g. dry reach tributary) targeting hybridized areas ***Additional comments:*** Last Chance Gulch supports an endemic, unaltered population, so genetic infusion is not recommended for that stream. WCT were reestablished in Grayling Creek using eggs and fish from Geode Creek and the Sun Ranch from 2015 to 2017 (*N* = 6,363 eggs and *N* = 943 fish from Geode Creek; *N* = 44,900 Sun Ranch eggs). Fish of multiple age classes from Geode Creek were stocked in the lower reaches of the project area in 2015 and 2016.
Horse -Tepee	***Genetic Class:*** Genetically Altered

Stream (s)	Population Status and Conservation Needs
	On-going projects: None ***Short-term (protect):*** Genetic monitoring ***Long-term (secure):*** Potential barrier site exists about 6.5 km below the current waterfall barrier, which would secure the population. ***Additional comments:*** None
Little Tepee	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** None ***Short-term (protect):*** Collect genetic samples and evaluate barrier potential. Need to conduct distribution and abundance estimates. ***Long-term (secure):*** Likely not possible to secure population a population of 2,500 fish > 75 mm because of limited habitat. ***Additional comments:*** None
Papoose	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Need to evaluate barrier potential of diversion structure to help protect, and potentially secure, population. ***Long-term (secure):*** Evaluate diversion structure to limit entrainment. Might be suitable location for farmer screen. ***Additional comments:*** None
Pine Butte	***Genetic Class:*** Genetically Altered ***On-going projects:*** Construction of wooden barrier in 2022. ***Short-term (protect):*** Demographic and genetic monitoring. Potential to perch existing culvert to provide long-term protection. ***Long-term (secure):*** Likely not possible to secure population a population of 2,500 fish > 75 mm because of limited habitat. ***Additional comments:*** None
Rose	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Demographic and genetic monitoring as well as evaluate barrier potential to help protect population. ***Long-term (secure):*** Likely not possible to secure population of 2,500 fish > 75 mm because of limited habitat. ***Additional comments:*** None
Ruby	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Wild fish transfers, demographic and genetic monitoring.

Stream (s)	Population Status and Conservation Needs
	Short-term (protect): Since 2015, 93 unaltered WCT have been introduced to Ruby Creek over the course of six years (69 fish from Wally McClure Creek, 24 fish from Last Chance Gulch). Current population estimate is <2 fish per 100 m. More transfers are likely necessary in the future. Ongoing effort to monitor genetic diversity of population and relative contribution of founding populations. ***Long-term (secure):*** Once fish recolonize to pre-treatment densities, the population will be secure. Depending on results of heterozygosity monitoring, genetic rescue from additional populations may be required. ***Additional comments:*** None
Soap	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Demographic and genetic monitoring. Need to evaluate the potential to modify the lower cascade or private pond to protect population. Contact landowner about fish in pond to limit hybridization potential. ***Long-term (secure):*** There is little opportunity to expand the Soap Creek population to a secure status (> 5 miles of stream). The W Fk of the Madison Road crossing, near the stream mouth, could be modified to create a barrier; however, this would only provide an additional 0.5 miles of habitat, and would require removal of nonnative trout on private land. This reach of stream also includes a private on-stream pond likely occupied by nonnative trout that would require removal. ***Additional comments:*** None
S Fk Madison	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Need to assess barrier functionality at railroad aqueduct. ***Long-term (secure):*** A significant intermittent reach acts as a secondary barrier during baseflow. Because the population has limited distribution and abundance, a result of the small size of the stream and intermittent stream reach, the “at-risk” status will likely remain indefinitely. Depending on barrier assessment, may need to collect genetic samples every 5-10 years to ensure hybridization does not threaten the conservation status of the population. ***Additional comments:*** None
Wall	***Genetic Class:*** Genetically Altered ***On-going projects:*** Barrier installation to be completed 2021,. ***Short-term (protect):*** None ***Long-term (secure):*** Likely not possible to secure population a population of 2500 fish > 75 mm. ***Additional comments:*** None
Wally McClure	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** None ***Short-term (protect):*** None

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): Likely not possible to secure population a population of 2500 fish > 75 mm because of limited habitat. ***Additional comments:*** Protected with constructed barrier in 2008. This is an endemic, unaltered population, so genetic infusion is not recommended. Could be used as a donor population for N Fk Spanish Creek.
W Fk Madison	***Genetic Class:*** Genetically Altered ***On-going projects:*** USFS is working to reduce erosion with bank stabilization measures and create additional pool habitat with large woody debris. ***Short-term (protect):*** Demographic and genetic monitoring. Potential to perch existing culvert to provide long-term protection. ***Long-term (secure):*** Likely not possible to secure population a population of 2500 fish > 75 mm because of limited habitat ***Additional comments:*** None
Wigwam - Arasta - Buffalo	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Genetic and demographic monitoring. An intermittent reach protects the population from rainbow and brown trout invasion during baseflow. However, the presence of rainbow hybridization throughout the drainage indicates invasions may occur during high discharges. A barrier is likely required to protect the population over the long-term. ***Long-term (secure):*** Waterfall exists 7.5 km above confluence with Canyon Gulch. However, barrier could be constructed below Haypress Creek to increase population distribution. Haypress Lakes in Shining Mountain Subdivision is above the barrier and contain rainbow and brown trout. ***Additional comments:*** 16 fish per 100 m in Wigwam; 7 fish per 100 m in Buffalo; 5 fish per 100 m in Arasta.

Section 7: Red Rock Sub-basin

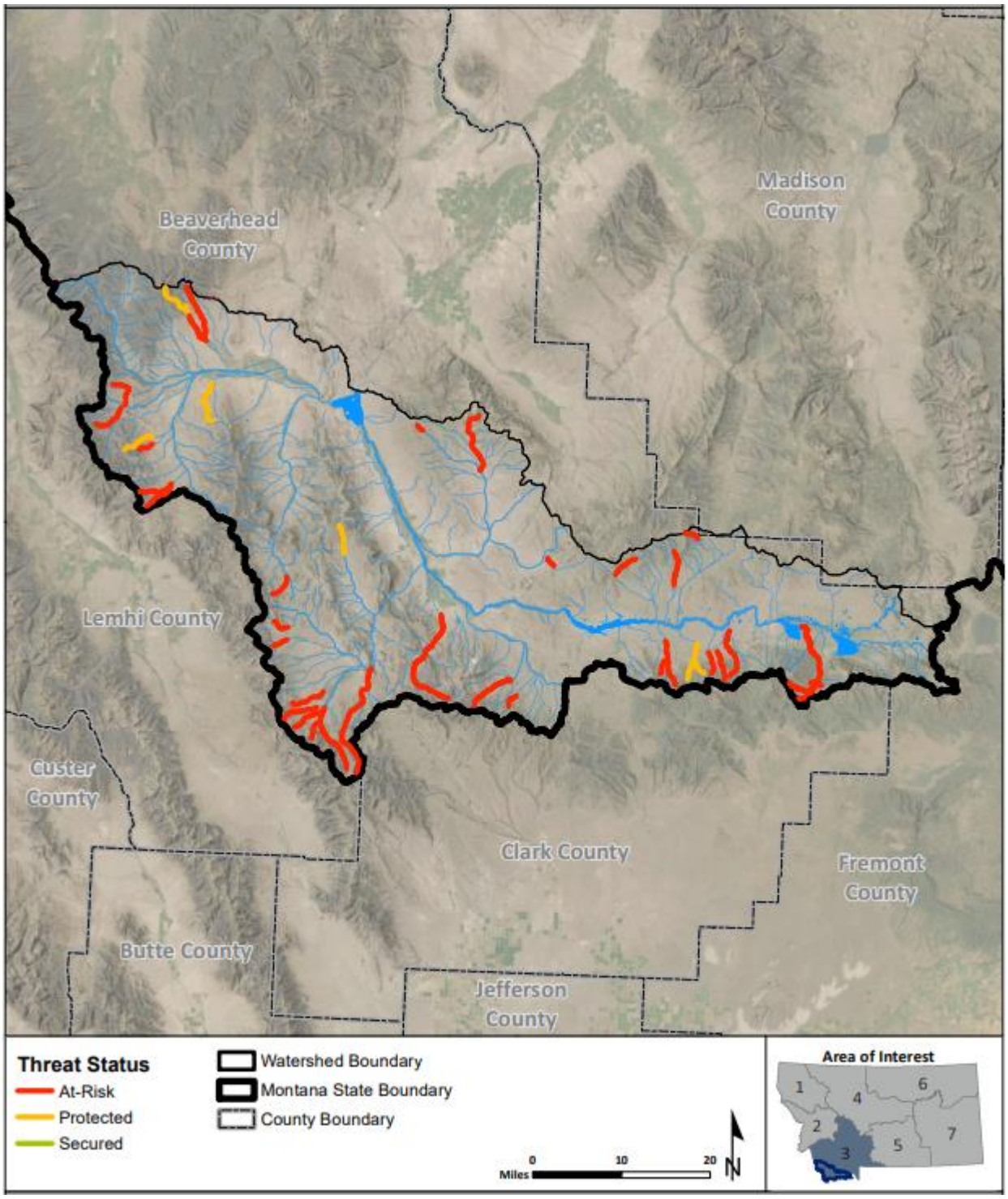

Figure 7.1. Genetic status and distribution of WCT conservation populations in the Red Rock River sub-basin.

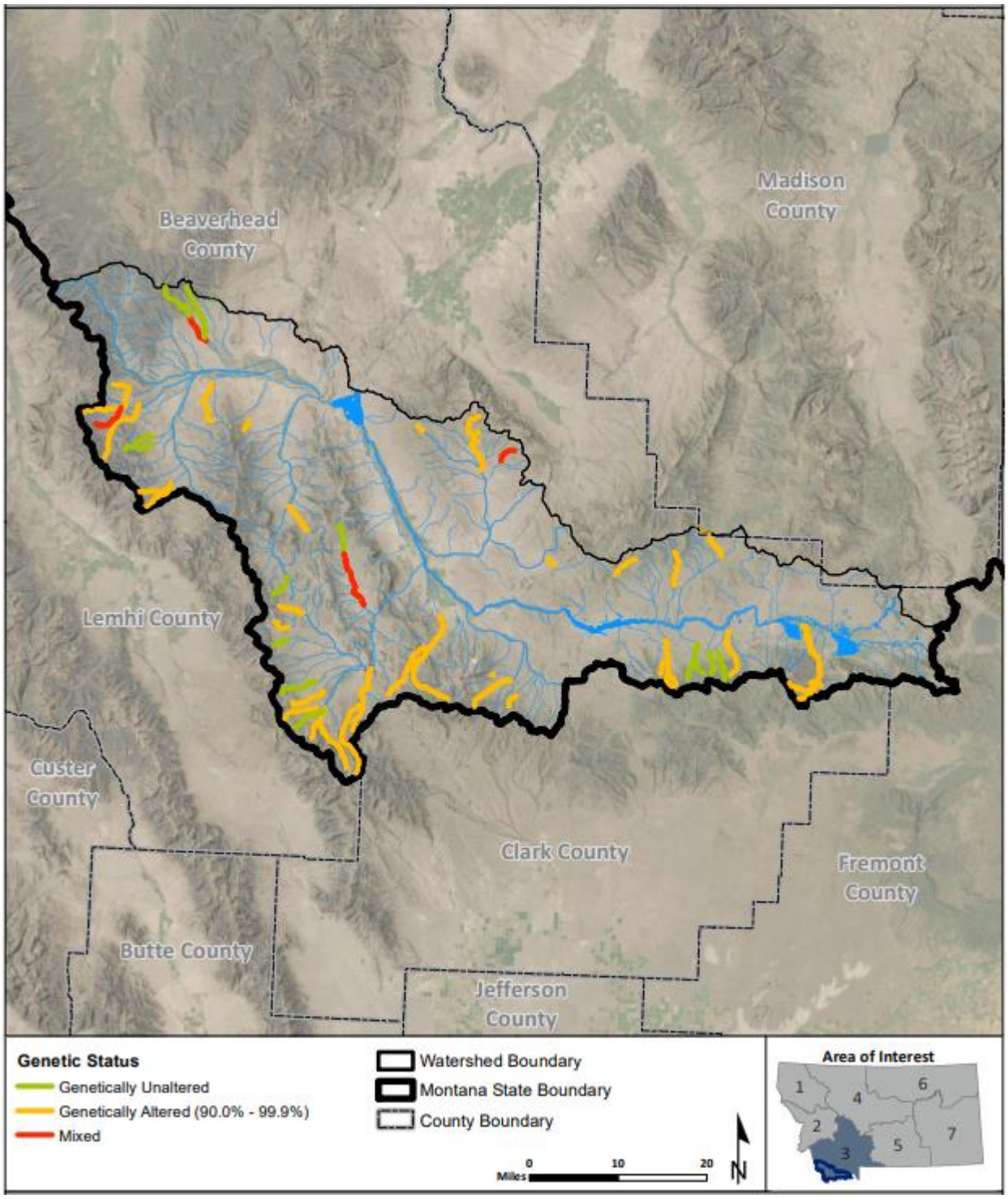

Figure 7.2. Threat status and distribution of WCT conservation populations in the Ruby River sub-basin.

Overview

Red Rock WCT Status and Threats:

- Number of Conservation populations: 31 (10 unaltered; 0 mixed; 21 altered)
- Populations at risk: 81% (25 of 31)
- Genetically unaltered populations at risk: 60% (6 of 10)
- Populations considered protected: 19% (6 of 31)
- Populations considered secured: None
- Significant threats:
    - Brook Trout (EBT): 13 populations
    - Other trout (YCT, RBT, CT hybrids): 24 populations
    - Small population size: 15 populations (< 1,000 fish)
    - Livestock grazing: 31 populations
    - Limited distribution: 15 populations (inhabit < 5 miles of stream)

Table 7.1. Genetic class and threat status of WCT conservation populations in the Red Rock River sub-basin.

Genetic Class	Threat Status of Conservation Populations			
	At-risk	Protected	Secured	**Total**
Unaltered	6	4	0	**10**
Mixed	0	0	0	**0**
Altered	19	2	0	**21**
Total	**25**	**6**	**0**	**31**

Table 7.2. WCT conservation populations identified in the Red Rock River sub-basin.

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Bean (Centennial)	4377 3421 2225 696	Genetically Unaltered	Genetically tested as 100% WCT	6/6/12 BLM, Hutchinson (25 SNP) Need to be Analyzed 9/18/06 FWP, Nelson (25 PINES) 100% WCT 10/29/01 FWP, Nelson (54 PINES) Inconclusive 8/27/93 FWP, Oswald (10 Allozymes) 100% WCT
Bear (Centennial)	3415 2226 832	Genetically Unaltered	Genetically tested as 100% WCT	9/19/06 FWP, Nelson (25 PINES) 100% WCT 10/30/01 FWP, Nelson (53 PINES) 100% WCT 8/30/93 FWP, Oswald (10 Allozymes) 99% WCT 0.5% RBT 0.5% YCT
Bear (Horse Prairie)	3413 984 983	Genetically Altered	Genetically tested as 98.2% WCT	7/25/06 FWP, Nelson (25 PINES) 98.2% WCT 1.5% RBT 0.3% YCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
	797			8/5/94 FWP, Oswald (15 and 25 Allozymes) 99.5% WCT 0.5% YCT 8/9/93 FWP, Oswald (9 Allozymes) 99% WCT 1% YCT
Browns (Horse Prairie)	4886 3298 3273 3217 3216 3215 3078 201	Genetically Unaltered	Genetically tested as 100% WCT	8/22/17 FWP, Jaeger (52 SNP) Both Fish Transfers 100% WCT 8/29/16 FWP, Jaeger (55 SNP) 100% WCT 6/22/06 FWP, Nelson (25PINES) 100% WCT 6/28/05 FWP, Nelson (15 PINES) 100% WCT 5/16/05 FWP, Nelson (30 Allozymes) 100% WCT 8/27/02 USFS, Brammer, Opitz (8, 17 and 65 PINES) 100%WCT 7/1/87 FWP, Shepard (10 Allozymes) 100% WCT
Craver (Medicine Lodge)	4926 3662 2125 548	Genetically Unaltered	Genetically tested as 100% WCT	7/13/17 FWP, Jaeger (25 SNP) 100% WCT 8/16/07 BLM, Hutchinson (25 PINES) 100% WCT 7/19/00 FWP, Shepard (14 PINES) 100% WCT 9/6/91 USFS, Browning (6 Allozymes) 100% WCT
Deadman (Big Sheep)	3233 3227 1158	Genetically Altered	Genetically tested as 93% WCT	7/17/02 USFS, Brammer (25 PINES) 93% WCT 5% RBT 2% YCT 7/15/02 USFS, Brammer (19 PINES) 97% WCT 3% RBT 9/20/86 USFS, Browning (10 Allozymes) 98.3 WCT 1.7% YCT
EF Clover (Centennial) -Above barrier -Below barrier	4449 4364 4363 3174	Genetically Altered	Genetically tested as >96% WCT	7/12/12 FWP, Jaeger (10 SNP) 100% WCT 9/27/11 FWP, Jaeger (20 SNP) above waterfall 100% WCT 9/27/11 FWP, Jaeger (15 SNP) below waterfall 95.9% WCT 4.1% RBT 8/7/02 USFS, Brammer (15 PINES) 92% WCT 8% YCT
Indian (Big Sheep**)**	5203	Genetically Altered	Genetically tested as 98.1% WCT	7/8/2020 BLM Hutchinson (25 SNP) 98.1% WCT, 1.2% RBT, 0.7 YCT
Jones (Centennial)	2224 695	Genetically Altered	Genetically tested as 96% WCT	8/27/02 FWP, Oswald (10 Allozymes) 100% WCT 10/30/01 FWP, Nelson (25 PINES) 96%WCT 1.4 RBT 2.6% YCT
Little Basin (Sage)	5288 796	Genetically Altered	Genetically tested as 93.42.7% WCT	6/11/2020 BLM, Hutchinson, (15 SNP) 93.4% WCT 1.2% YCT 5.4% RBT 7/22/93 FWP, Oswald (5 Allozymes) 92.7% WCT 5% RBT 1.3% YCT
Little Sheep - MF Little Sheep	4444 3018 674	Genetically Altered	Genetically tested as 96.3% WCT	8/2/12 FWP, Jaeger (25 SNP) 96.3% WCT 3.7% YCT

Stream (s)	Sample Number	Genetic Class	Rationale for status	Date, Collector, Number Sampled, Type of Test and Results
 - WF Little Sheep	582 866			7/7/03 USFS, Brammer (10 PINES) 100% WCT 8/12/92 USFS, Brammer (11 Allozymes) 95.1% WCT 4.9% YCT 10/03/91 USFS, Browning (6 Allozymes) 94% WCT 6% YCT W.F. Little Sheep 9/23/93 USFS, Brammer (8 Allozymes) 96% WCT 4% YCT
Long (Sage) - Cattle	1354	Genetically Altered	Genetically tested as 99.1% WCT	8/24/99 USFS, Brammer (25 PINES) 99.1% WCT 0.9% RBT
Meadow (Big Sheep)	4890 4704 2122 982	Genetically Unaltered	Genetically tested as 100% WCT	8/23/17 FWP, Jaeger (50 SNP) 100% WCT 8/29/16 FWP, Jaeger (155 SNP) 100% WCT 6/4/14 BLM, Hutchinson (25 SNP) 100% WCT
Middle (Centennial)	4362	Genetically Altered	Genetically tested as 97% WCT	9/28/11 FWP, Jaeger (25 SNP) 97% WCT 3% YCT
Muddy (Big Sheep) - Sourdough - Wilson	5088 4047 683	Genetically Altered	Genetically tested as 99.5% WCT	8/13/18 FWP Jaeger (25 SNP) 24 99.5% WCT 0.5% RBT, 1 85% WCT 15% RBT 8/5/10 BLM, Hutchinson (25 Indel) 24 WCT, 1 WCT x RBT F1 8/19/92 FWP, Oswald (10 Allozymes) 100% WCT
Nicholia (Big Sheep) - Bear - Cottonwood - Tendoy	3056 472 3232 3231 3230 3229 3228 1254 3210 3208 3207 3191 3190 3189 1256 915	Genetically Altered	Genetically tested as 92.3% WCT	Nicholia Cr. 7/8/02 USFS, Brammer (10 PINES) 92.3% WCT 7.7% RBTxYCT 6/6/90 USFS, Browning (7 Allozymes) 92.3% WCT 7.7% RBTxYCT Bear Cr. 7/8/02 USFS, Brammer (6, 8, 13 PINES) 99% to 87.8% WCT 9/10/97 USFS, Browning (10 Allozymes) 100% WCT Cottonwood Cr. 7/10/02 USFS, Brammer, Opitz (3, 6, 6, 12, 19 PINES) 95% to 98% WCT Tendoy Cr. 9/15/97 USFS, Browning (10 Allozymes) 98.7% WCT 1.3% YCT
NF Divide (Horse Prairie) - SF Divide	5153 3167 3166 2123 677	Genetically Altered	Genetically tested as 94.6% WCT	8/13/19 FWP, Jaeger (25 SNP) 94.6% WCT 0.2% RB 5.2% YCT 6/25/02 USFS, Brammer (25 PINES) 94% WCT 6% YCT 6/25/02 USFS, Brammer (25 PINES) 96% WCT 4% YCT 7/19/00 FWP, Shepard (26 PINES) 100% WCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
				8/13/92 FWP, Oswald (10 Allozymes) 98.7% WCT 1.3% YCT
NF Everson (Horse Prairie)	4869 3238 679	Genetically Unaltered	Genetically tested as 100% WCT	6/21/16 FWP, Jaeger (25 SNP) 100% WCT 9/20/05 FWP, Nelson (50 PINES)
Odell (Centennial) - EF Odell - MF Odell -Trib. 1 -Trib. 2	4448 4447 3016 1000 3015 3040	Genetically Altered	Genetically tested as 99.5% WCT	8/14/12 FWP, Jaeger (25 SNP) E.F. Odell 99.5% WCT 0.5% YCT Trib. 2 7/31/02 USFS, Brammer (7 PINES) 100% WCT 7/22/02 USFS, Brammer (10 PINES) 100% WCT Trib. 1 7/23/02 USFS, Brammer (4 PINES) WCT Hybrids 8/17/94 FWP, Oswald (10 Allozymes) 95% WCT 5% YCT
Painter (Horse Prairie)	4888 3225 3224 3223 3222 3079 706	Mixed	Genetic analysis indicating presence of both unaltered and hybridized WCT	8/22/17 FWP, Jaeger (60 SNP) Both Fish Transfers 100% WCT 8/22/16 FWP, Jaeger (50 SNP) 8/28/02 USFS, Brammer, Opitz (6, 11, 25 PINES) 100% WCT 5/2/05 FWP, Nelson (25 Allozymes) 22 WCT 3 RB 9/4/92 USFS, Brammer (12 Allozymes) 100% WCT
Peet (Centennial) 694	5148 4442	Genetically Unaltered	Genetically tested as 100% WCT	8/12/2019 FWP, Jaeger (25 SNP) 100% WCT All genetic samples before 2014 are irrelevant because Peet Creek was treated with rotenone that year. Transferred 25 WCT from Bean Cr. In summer of 2016 Transferred 26 WCT from Bear Cr. In summer of 2017 More fish transfers will occur in proceeding years. 7/17/12 FWP, Jaeger (25 SNP) 98.8% WCT 1.2% YCT 8/27/92 FWP, Oswald (10 Allozymes) 87.9% WCT 12.1% YCT
Price (Centennial) - WF Price	4277 4276 4275 3199 3198 3197 3196 3194 3193 3192	Genetically Altered	Genetically tested as > 90% WCT	8/10/11 BLM, Hutchinson (24 SNP) Upper 91.7% WCT (51 SNP) Lower 96.4% WCT (24 SNP) Trib. 97.9% WCT 7/31/02 USFS, Brammer, Opitz (1,2,2,11,12,12 PINES) 98% WCT to 93% WCT 7/30/02 USFS, Brammer, Opitz (5,6,19 PINES) 100% WCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
	3187 3186 3185			
Rape (Horse Prairie)	4868 3246 764	Genetically Altered	Genetically tested as 99.4% WCT	6/20/16 FWP, Jaeger (31 SNP) 99.4% WCT 0.6% RBT 8/12/05 BLM, Hutchinson (25 PINES) 100% WCT 7/20/93 FWP, Oswald (10 Allozymes) 99% WCT 0.5% RBT 0.5% YCT
Rock (Big Sheep)	4931 4732 1225	Genetically Altered	Genetically tested as 95.7 % WCT	7/28/15 FWP, Jaeger (25 SNP) 95.7% WCT 4.3% Admixture 9/15/97 FWP, Oswald (10 Allozymes) WCT? 1 polymorphic RBTxYCT
Sage	4153 1213 1210	Genetically Altered	Genetically tested as 96% WCT	7/29/16 FWP, Jaeger (25 SNP) 96% WCT 1.1% RBT 2.9%YCT 7/13/10 BLM, Hutchinson (24 SNP) 10/2/96 FWP, Oswald (10 Allozymes) 100% WCT
Sawmill (Snowline)	5287 3221 3220 3219 3218 3211 857	Genetically Altered	Genetically tested as 95% WCT	7/8/2021 FWP, Jaeger (23 SNP) 94.5% WCT 4.1% YCT 1.4% RBT 8/14/02 USFS, Brammer (2, 9, 14, 25 PINES) 96% WCT t0 88% WCT 5% to 12% Admixture 9/17/93 USFS, Browning (10 Allozymes) 97.2% WCT 2.8% YCT
SF Everson (Horse Prairie)	4044 799	Genetically Unaltered	Genetically tested as 100% WCT	7/22/10 BLM, Hutchinson (49 Indel) 100% WCT 8/9/93 USFS, Browning (5 Allozymes) 100% WCT
Sheser (Horse Prairie)	3959 1903	Genetically Altered	Genetically tested as 98.3% WCT	8/10/09 BLM, Hutchinson (25 Indel) 98.3% WCT 1.7% RBT 8/10/98 USFS, Kampwerth (10 Allozymes) 100% WCT
Shineberger (Snowline)	5286 3214 3213 3212	Genetically Altered	Genetically tested as 91.3% 95% WCT	7/7/2020 FWP, Jaeger (20 SNP) 91.3% WCT 6.7% YCT 2.0% RBT 8/14/02 USFS, Brammer (25 PINES) 94% WCT 5%YCT 1% RBT 7/23/98 USFS, Browning (6 Allozymes) 97.5 % WCT 2.5% YCT 9/20/91 USFS, Browning (4 Allozymes) 93.2% WCT 6.8% YCT
Simpson (Big Sheep) - Unamed trib.	4928 4705 3237 3020 685	Genetically Unaltered	Genetically tested as 100% WCT	7/26/17 FWP, Jaeger (25 SNP) 100% WCT 6/1/14 BLM, Hutchinson (25 SNP) 100% WCT 9/22/05 FWP, Nelson (50 PINES) 100% WCT 7/8/04 USFS, Brammer (3 PINES) 100% WCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
				8/19/92 FWP, Oswald (10 Allozymes) 100% WCT
Trapper (Horse Prairie) - NF Frying Pan - SF Fry Pan	5150 1154 798	Genetically Altered	Genetically tested as 98.5% WCT	8/13/2019 FWP, Jaeger (24 SNP) 98.5% WCT 1.3% RB 0.2% YCT 8/15/96 USFS, Browning (5 Allozymes) 100% WCT 8/9/93 FWP, Oswald (10 Allozymes) 94.2% WCT 5.8% RBT

Table 7.3. Characteristics that define threat status of WCT conservation populations in the Red Rock sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Bean	2.1	2.1	37 per 100 m (1239 unaltered fish)	Intermittent flow	BLM, Private	No Barrier, limited distribution, small population, livestock grazing	At-risk
Bear (Centennial)	2.9	2.9	14 per 100 m (674 unaltered fish)	Intermittent flow	BLM, Private	No Barrier, limited distribution, small population, livestock grazing	At-risk
Bear (Horse Prairie)	6.5		2 per 100 m (209 fish)	None	FS, Private	No barrier, Brook Trout, hybridization, livestock grazing	At-risk
Browns	6.5	6.5	25 per 100 m (2615 unaltered fish)	Intermittent flow	FS, Private	No Barrier, hybridization, livestock grazing	At-risk
Craver	1.4	1.4	3 per 100 m (67 Unaltered Fish)	None	BLM, Private	Brook Trout, limited distribution, small population size, livestock grazing	At-risk
Deadman	3		23 per 100m (1110 fish)	None	FS, Private	No barrier, hybridization, limited distribution, livestock grazing	At-risk
EF Clover	1.9		5 per 100 m (113 fish)	None	State, Private	Limited distribution, small population, Brook Trout, hybridization, livestock grazing	At-risk
Jones	3		Unknown	Intermittent flow	BLM, Private	No barrier, Brook Trout, limited distribution, heavy livestock grazing, siltation	At-risk
Indian (Big Sheep)	5.8		Unknown	Intermittent flow	FS, BLM, Private	Limited distribution, small population, no barrier, hybridization, livestock grazing	At-risk
Little Basin	3.7		4 per 100 m (238 fish)	Intermittent flow	BLM, State, Private	No barrier, Brook Trout hybridization, limited distribution, small population, livestock grazing, heavy siltation	At-risk

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Little Sheep - MF Little Sheep - WF Little Sheep	23.5		28 per 100 m (10,589 fish)	Intermittent flow	FS, BLM, State and Private	No barrier, Brook Trout, hybridization, livestock grazing	At-risk
Long - Cattle	5.5		33 per 100 m (2921 fish)	None	BLM, State	No barrier, Brook Trout, hybridization, livestock grazing, heavy siltation, bank erosion	At-risk
Meadow	4.5	4.5	13 per 100 m (941 unaltered fish)	Wooden man-made Barrier	FS, BLM, Private	No barrier, hybridization, limited distribution, livestock grazing, heavy siltation	Protected
Middle (Centennial)	4.2		5 per 100 m (334 fish)	None	FS, BLM, Private	No barrier, Brook Trout, hybridization, limited distribution, small population size, livestock grazing, irrigation	At-risk
Muddy - Sourdough - Wilson	10.7		3 per 100 m (518 fish)	Irrigation diversion (6 ft. drop)	BLM, FS, Private	Brown Trout, hybridization, small population, livestock grazing, heavy siltation	Protected
Nicholia - Bear - Cottonwood - Tendoy	19.3		Unknown	None	FS and Private	Hybridization, livestock grazing, irrigation	At-risk
NF Divide - SF Divide	7.7		9 per 100 m (1055 fish)	None	FS and Private	No barrier, Brook Trout, hybridization, livestock grazing	At-risk
NF Everson	3.3	3.3	4 per 100 m (1966 unaltered fish)	Perched culvert	BLM, Private	Small population size, limited distribution, livestock grazing	Protected
Odell	6.4		20 per 100 m (2073 fish)	None	BLM Wilderness, State, Private	No barrier, hybridization, Brook Trout, livestock grazing	At-risk
Painter	9.2	5.5	17 per 100 m (2517 fish) (1505 unaltered fish)	Perched culvert protects 5.5 miles	FS, Private	None in upper reach; lower threatened by hybridization, livestock grazing	Protected (above barrier) At-risk (below)
Peet	11.4	11.4	5 per 100 m (917 unaltered fish)	Impoundment	BLM, Private	Livestock grazing, small population, heavy siltation	Protected

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Price - WF Price	7.4		17 per 100 m (1,993 fish)	Intermittent flow	BLM, Private	No barrier, hybridization, livestock grazing	At-risk
Rape	5.3		13 per 100 m (1109 fish)	Levee Impoundment	BLM, State, Private	Hybridization, livestock grazing	Protected
Rock (Big Sheep drainage)	8.8		5 per 100 m (733 fish)	Unknown	FS and Private	No barrier, hybridization, livestock grazing, irrigation	At-risk
Sage	0.7		31 per 100 m (417 fish)	None	State, BLM, Private	Limited distribution, small population, no barrier, Brook Trout, hybridization, livestock grazing, irrigation	At-risk
Sawmill	4.8		15 per 100 m (1121 fish)	None	FS, State, Private	No barrier, hybridization, livestock grazing, irrigation	At-risk
SF Everson	2.1	2.1	1 per 100 m (34 unaltered fish)	Intermittent flow	BLM, Private	No barrier, hybridization, limited distribution, small population, livestock grazing	At-risk
Sheser	3.4		45 per 100 m (92 fish)	Intermittent flow	FS, Private	No barrier, limited distribution, Brook Trout, hybridization, livestock grazing	At-risk
Shineberger	1.9		2 per 100 m (51 fish)	Intermittent flow	FS, Private	No barrier, limited distribution, hybridization, livestock grazing	At-risk
Simpson - Crystal	1.9	1.9	16 per 100 m (495 unaltered fish)	Intermittent flow (Irrigation withdraws)	BLM, FS, Private	No barrier, hybridization, livestock grazing, heavy siltation	At-risk
Trapper - NF Frying Pan - SF Fry Pan	5.4		30 per 100 m (2616 fish)	None	FS, Private	No barrier, hybridization, Brook Trout, livestock grazing	At-risk

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population that exist in the same stream.

[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 7.4. Actions required to maintain conservation populations in the Red Rock River sub-basin

Stream (s)	Population Status and Conservation Needs
Bean	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Bean Creek upstream of the South Valley Road to the mouth of the canyon has been restored to have sinuosity, riffles and pools of appropriate size. In 2014 the BLM implemented a conifer encroachment removal project along the riparian corridor. The WCT population has increased and appears to have benefited greatly from this project. Post-project monitoring will continue because it is currently unclear what factors contributed the most to this population increase. Translocations from Bean Creek are being used to repopulate the Peet Creek WCT project area. In 2016, 2018 and 2019, 25, 23 and 51 WCT were transferred to Peet Creek Reservoir and Peet Creek, respectively. ***Short-term (protect):*** Irrigation withdrawals isolate and dewater the lower 3 miles of Bean Creek and prevent nonnative trout invasion from downstream (Red Rock River). Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Pre***s***ently, the Bean Creek population cannot be secured (5+ miles of habitat or 2500 fish >75 mm) due to lack of stream habitat and connectivity. The Bean Creek population is adjacent to the Bear Creek population (also genetically unaltered); however, connecting these two systems to allow gene flow is not feasible because of topography and irrigation needs. ***Additional comments:*** This population is small, and abundance is limited by natural low flow regimes. In 2019 the entire Bean Creek population was estimated at 1515 fish and many 1-year-old fish (2018 cohort) where observed.
Bear (Centennial)	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Translocations from Bear Creek are being used to repopulate the Peet Creek WCT project area. In 2017, 2018, 2019 and 2020 26, 25, 25 and 25 WCT were transferred to Peet Creek Reservoir and Peet Creek, respectively. To date 101 WCT have been transferred from Bear Creek to Peet Creek. ***Short-term (protect):*** Irrigation withdrawals isolate and dewater the lower 3.5 miles of Bear Creek and prevent nonnative trout invasion from downstream (Red Rock River). Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Presently, the Bear Creek population cannot be secured (5+ miles of habitat or 2500 fish >75 mm) due to lack of stream habitat and connectivity. The Bear Creek population is adjacent to the Bean Creek population (also genetically unaltered); however, connecting these two systems to allow genetic flow is not feasible because of topography and irrigation needs. ***Additional comments:*** This population is small, and abundance is limited by natural low flow regimes. In 2020 the entire Bear Creek population was estimated at 647 fish.
Bear (Horse Prairie)	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. On 7/23/2020 FWP conducted one depletion estimate, that demographic survey showed and 2 WCT per 100 m, high abundances of EBT were observed, 42 per 100 m. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): It may not be feasible to secure a population of 2500 fish >75mm within Bear Creek due to lack of fish-bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Genetics were collected from between stream mile 4.2 and 5.2 in 2006, they showed hybridization with both RBT and YCT. These fish were 98.2% WCT, 1.5% RBT and 0.3% YCT. Based on 2020 demographic information it appears that Bear Creek WCT are being replaced by EBT.
Browns	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** A barrier will be installed at an irrigation diversion on Forest Service land in 2022. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Short-term (protect):*** This population is isolated by irrigation diversion and flood irrigation practices that dewater and convert a relatively short reach of Browns Creek from stream to wet meadow. ***Long-term (secure):*** It is anticipated that barrier placement will result in a secured population of of unaltered WCT that exceeds 2500 fish >75 mm; however. ***Additional comments:*** This unaltered WCT population is very diverse when compared to other eastside WCT; its heterozygosity is 192% greater than the average for east side populations. Browns Creek is one of six donor streams being used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 55 and 52 WCT from Browns Creek were released into the N.F. of Greenhorn Creek in 2016 and 2017, respectively.
Craver	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Annual physical suppression of EBT using backpack electro-fishing. This population will be prioritized for translocation in 2022. The recipient stream has not been identified. ***Short-term (protect):*** A feasible barrier location to protect this population in place could not be identified and it will be prioritized for translocation in 2022. The recipient stream has not been identified. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Craver Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Surveys done in 2017 indicated very low numbers of remaining WCT (< 3 per 100 m); it took three crews an entire day to collect a 25-fish genetic sample. This is the last remaining genetically unaltered population of WCT left in the entire Medicine Lodge watershed.
Deadman	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Identification of a possible barrier location has already been completed. Updated demographic and genetic information are needed to determine if a WCT conservation population persists. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A fish barrier at the bottom of this drainage near the confluence with Big Sheep Creek could secure 18 or more stream miles and would include Little Deadman and Pine Creek tributaries. Based on demographic surveys of neighboring streams a project like this would secure 2500 fish >75mm.

Stream (s)	Population Status and Conservation Needs
	Additional comments: Updated information has been collected and will be used to manage this fishery and possibly develop a plan for a future WCT project. Deadman Creek is a highly productive stream in terms of both size and abundance of trout; protection of only a few miles of stream could secure a robust population.
EF Clover	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Establishment of a barrier and removal nonnative EBT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** This population of WCT is primarily located on private property, the genetically unaltered population at the headwaters could be used to repopulate this drainage from the top down.
Indian (Big Sheep)	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier would protect this population. Updated demographic and is needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Indian Creek due to lack of habitat and connectivity. ***Additional comments:*** On 7/8/2020 the BLM collected a 25 fish genetic sampled that revealed a conservation population that was previously unknown. The WCT in Indian Creek tested at 98.1% WCT, 1.2 RBT and 0.7 YCT.
Jones	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic and genetic information are needed to determine if unaltered WCT still persist. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Jones Creek due to lack of habitat and connectivity. ***Additional comments:*** Based on surveys conducted by the USFS in 2002, EBT occur with WCT in all but the upper reach of Jones Creek. Like adjacent Bear and Bean Creeks, Jones Creek is isolated from the Red Rock River (via Winslow Creek) and other nonnative species by channel alterations and irrigation withdrawals. This altered population is a small headwater population and the only population data for WCT is from 1982. It is uncertain if WCT still persist due to competition with non-native EBT. Genetic results indicated that the population is 96% WCT 1.4% RBT and 2.6% YCT.
Little Basin	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. On 6/11/2020 the BLM conducted depletion estimates within the lower, middle and upper WCT distribution, these demographic surveys showed an average of 4 WCT per 100 m. Brook trout were observed at high abundances, an average of 26 per 100 m. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic monitoring and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): It may not be feasible to secure a population of 2500 fish >75mm within Little Basin Creek due to lack of fish bearing habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Lack of suitable habitat, abundant EBT and Rocky Mountain Sculpin that are in direct competition with WCT are likely limiting factors in Little Basin Creek. On 7/22/1993 genetic samples show that these fish are genetically altered (92.7% WCT 5% RBT 1.3% YCT).
Little Sheep - WF Little Sheep	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic monitoring and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** On 8/2/12 genetic samples show that these fish are genetically altered (96.3% WCT 3.7% YCT). These samples were collected from the headwaters of the Middle Fork of Little Sheep Creek.
Long - Cattle	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic monitoring and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Long Creek due to lack of fish bearing habitat and connectivity. A barrier that includes more neighboring tributaries (Beech, Divide, Cattle, Pistol and Sage Creeks) followed by WCT expansion could secure this population. ***Additional comments:*** Long Creek has not been sampled since 1999, at that time surveys revealed this stream supported WCT, WCTxRBT hybrids, EBT and RM COT. On 8/24/99 a 25 fish genetic sample showed these hybrids were 99.1% WCT 0.9% RBT.
Meadow	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** A barrier was installed on BLM land in 2020 to protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within the upper Big Sheep Creek basin due to lack of connectivity. A barrier that includes more neighboring tributaries and habitat followed by WCT expansion is not an option due to lack of stream connectivity. ***Additional comments:*** In 2017 demographic monitoring indicated that this stream supports 13 fish per 100 m. Meadow Creek is one of two streams left that contain a genetically unaltered WCT population within the upper Big Sheep Creek basin, the other being Simpson Creek. This can be attributed to lack of connectivity (irrigation withdraws and intermittent flows) with neighboring streams in the basin. Meadow Creek is one of six donor streams that is being used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 55 and 50 WCT from Meadow Creek were released into the S.F. of Greenhorn Creek in 2016 and 2017, respectively.

Stream (s)	Population Status and Conservation Needs
Middle (Centennial)	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Middle Creek flows into West Creek which maintains < 90% WCT; invasion of these hybrid fish into the upper reaches of Middle Creek is a threat. Riparian habitat could be improved by mitigating cattle grazing impacts. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan for this population. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Middle Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population; however, maintaining an open system is a priority for grayling conservation. ***Additional comments:*** The top (< 1.0 mile) reach of upper Middle Creek appears to be fishless. This reach should be evaluated for potential upstream expansion of the WCT population.
Muddy - Sourdough - Wilson	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. A new fish barrier built on private land by replacing an existing irrigation headgate was documented in August 2018. ***Short-term (protect):*** Muddy Creek is presently protected by a barrier on private land near river mile 2.2. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. In the past, a wooden pin and plank barrier with a 3 ft. drop restricted fish movement upstream. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Muddy Creek due to lack of fish bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** A long period of drought prior 2003 may have negatively impacted this population. Consistent bad water years and high levels of sedimentation and erosion are limiting factors for this WCT population. A genetic sample collected on 8/5/2010 revealed 24 unaltered WCT and 1 WCT x RBT F1 first generation hybrid above the barrier between river miles 2.2 and 2.9.
Nicholia - Bear - Cottonwood - Tendoy	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion would secure this population. Barrier placement could secure 15-20 stream miles and a WCT population greater than 2500 fish >75 mm. ***Additional comments:*** The Nicholia Creek system was extensively surveyed by the USFS in the early 2000's. Surveys found a well-distributed WCT population with relatively high fish densities on National Forest lands. Identification as "at-risk" is based on < 88% WCT at the mouth of Bear Creek, and their potential to invade less hybridized (upstream) segments of the population. Stocking records indicate 19,800 "CT" (Washoe Park Hatchery) were planted in Nicholia Creek in 1936, and 3,600 "CT" (Bozeman Fish Tech Center) were planted in Nicholia Creek in 1950.
Divide	***Genetic Class:*** Genetically Altered

Stream (s)	Population Status and Conservation Needs
(Horse Prairie) - SF Divide	***On-going projects:*** Demographic and genetic monitoring. In 2019 the BLM and FWP conducted three depletion estimates on the S.F. and one on the N.F. These demographic surveys showed an average of 9 WCT per 100 m. A 25 fish genetic sample was collected on 8/13/2019 and results showed a conservation population consisting of 94.6% WCT, 0.2% RB and 5.2% YCT. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within N.F. Divide Creek due to lack of habitat. A barrier that includes more neighboring tributaries (Black Canyon, Maiden, Prairie, S.F. Divide) and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Population surveys conducted on the North and South forks of Divide Creek from 1992 through 1994 indicated healthy populations of WCT and RM COT. In 2002 the USFS collected genetic samples in both the North and South forks that indicated hybridization (94% WCT and 6% YCT).
NF Everson	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. N.F. Everson Creek has a culvert barrier that drops 4 ft. onto a concrete splash pad that is located were FS/BLM Rd. 1882 crosses the N.F. Everson Creek. There has been an ongoing EBT removal project on the N.F. Everson Creek since the barrier was constructed. Since June of 2016 no EBT have been observed in N.F. Everson Creek. During the Summer of 2020 the Bear Creek Fire Complex burnt a large area of national forest within the immediate area. The S.F. of Everson Creek was burnt severely in its headwaters. It was decided to move as many S.F. Everson WCT as possible over to the N.F. of Everson Creek. On 7/8/2020 67 WCT were captured and moved over to The N.F. Everson Creek. Fish will be translocated back into the S.F. of Everson Creek beginning in 2022. ***Short-term (protect):*** N.F. Everson Creek is considered protected because of the man-made fish barrier coupled with the successful physical removal of nonnative EBT. Over about 5 years 3800 EBT were removed from N.F. of Everson Creek. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within N.F. Everson Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** On 6/21/16 genetic samples confirmed this population is still genetically unaltered WCT.
Odell	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. ***Long-term (secure):*** A barrier near the mouth of Odell Canyon followed by downstream expansion of WCT would secure this population. Based on demographic surveys Odell Creek would support a secured population greater than 2500 fish >75 mm. ***Additional comments:*** During the summer of 2012 FWP conducted drainage-wide population monitoring to characterize the fishery in upper Odell Creek. Genetic testing revealed that only altered WCT remain in the drainage. A potential location for barrier construction was identified and population surveys were completed.
Painter	***Genetic Class:*** Mixed

Stream (s)	Population Status and Conservation Needs
	On-going projects: Demographic and genetic monitoring. The culvert barrier will be modified in 2022 by adding a splash pad and raising the culvert. ***Short-term (protect):*** Painter Creek is considered protected because of a man-made culvert fish barrier that was installed around 2008. Riparian habitat could be improved by mitigating cattle grazing. ***Long-term (secure):*** A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. Based on 2016 demographic surveys there are about 1505 unaltered WCT above the barrier. A barrier that includes more habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** The barrier is located at N 45.10801 W -113.25527 about 0.2 miles upstream of the USFS boundary. Painter Creek is one of six donor streams being used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 50 and 60 WCT from Painter Creek were released into the N.F. of Greenhorn Creek in 2016 and 2017, respectively.
Peet	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Peet Creek is a WCT restoration project area that is presently being repopulated from Bean and Bear Creeks (via translocation). In 2019 monitoring began throughout the Peet Creek project area to evaluate the repopulation effort and attempt to document natural reproduction. Seven locations within the project area were sampled; five from pre-project monitoring were resurveyed and two others were added to fill spatial gaps. Population estimates were conducted on the East Fork, West Fork, Middle Fork, above the upper reservoir and upstream on the lower BLM and upper BLM sections. These surveys showed the drainage averaged 2 WCT per 100 m and supported an estimated population of about 306 genetically unaltered WCT. Surveys also revealed low but rebounding populations of Rocky Mountain Sculpin. In 2020 natural reproduction was documented for the second consecutive year and surveys showed the drainage averaged 5 WCT per 100 m and supports an estimated population of 917 genetically unaltered WCT. This population estimate of 917 is somewhat inflated because 16 WCT were sampled in a 100 meter section of the Middle Fork of Peet Creek, which has been identified as the main fish spawning tributary within the project area. The Peet Creek WCT project area is repopulating at a faster rate each of the last two years and the same should be expected in the future until the stream is fully repopulated. ***Short-term (protect):*** Peet Creek is considered protected because of two barriers within the project area; both are impoundments (ponds). A small number of hybridized CT were not killed during the treatment in the upper half of the E.F. Peet Creek. These fish are being physically removed using backpack electrofishing and they have not had a successful spawn and appear to be aging out. No hybridized Cutthroat have been captured since 2018. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Peet Creek will be considered a secured population once it has reached the criteria of 2500 fish >75mm. ***Additional comments:*** Peet Creek was treated with rotenone in 2013 and 2014 to remove hybridized CT. 11.4 stream miles were treated upstream from an already existing fish barrier located at 44.60338 -112.05934. Historically, both donor streams (Bean and Bear Creeks) have been negatively affected by consecutive years of low flows. It was decided to never take more than 10% of either WCT population from each donor stream annually for repopulating efforts. Transfers of 25 and 26 genetically unaltered fish were released into the upper Peet Creek pond from Bean and Bear Creeks in 2016 and 2017, respectively. In 2018, 23 Bean Cr. and 25 Bear Cr. were transferred, in 2019, 51 Bean Cr. and 25 Bear Cr and in 2020 50 Bean Cr. and 25 Bear Cr. genetically unaltered WCT were released into Peet Creek About ½ mile upstream of the upper pond. Currently a total of 250 WCT have been transferred to Peet Creek for repopulation purposes.
Price - WF Price	***Genetic Class:*** Genetically Altered ***On-going projects:*** None

Stream (s)	Population Status and Conservation Needs
	Short-term (protect): Establishment of a barrier and removal of nonnative EBT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Price Creek due to lack of habitat and connectivity. A barrier that includes more habitat downstream followed by WCT expansion could secure a population of 2500 fish >75 mm. ***Additional comments:*** Genetic results from 2011 indicated that this population is genetically altered with a higher percentage of hybridization occurring in the upper end of Price Creek located near a small private land inholding.
Rape	***Genetic Class:*** Genetically Altered ***On-going projects:*** None. ***Short-term (protect):*** Rape Creek is protected by an impoundment (pond) and updated information and documentation of this barrier are needed. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Rape Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. The estimated population for 6.4 miles of stream is about 1306 total fish. ***Additional comments:*** Genetic samples collected on 6/20/16 revealed that this population is genetically altered (99.4% WCT and 0.6% RBT).
Rock (Big Sheep)	***Genetic Class:*** Genetically Altered ***On-going:*** None. ***Short-term (protect):*** Establishment of a barrier would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Rock Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat within the upper Big Sheep Creek drainage followed by WCT expansion could secure this population. ***Additional comments:*** FWP collected a 25 fish genetic sample on 7/28/15, results show an altered population consisting of 96.9% WCT 0.4% RBT and 2.7% YCT. Rock Creek is diverted overland in multiple locations to flood irrigate hay fields before reconnecting with Nicholia Creek, which would explain the hybridization within the last 15 years.
Sage	***Genetic Class:*** Genetically Altered ***On-going projects:*** None. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Sage Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries (Beech, Divide, Cattle, Long, Pistol) followed by WCT expansion would secure this population. ***Additional comments:*** FWP collected genetic samples on 7/29/16 and results showed an altered population of 96% WCT 1.1% RBT 2.9% YCT. Tributaries within the Sage Creek basin are productive fisheries in terms of

Stream (s)	Population Status and Conservation Needs
	trout per river mile. Based on multiple genetic samples all WCT populations within the greater Sage Creek basin appear to be genetically altered.
Sawmill	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. On 7/8/2020 FWP conducted depletion estimates in the lower, middle and upper parts of the drainage. These demographic surveys showed an average of 15 WCT per 100 m. This is the most abundant WCT population within the Snowline area, the population was estimated at about 1121 fish. ***Short-term (protect):*** Establishment of a barrier would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Sawmill Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. Rocky Mountain Sculpin are abundant in the lower part of Sawmill Creek and EBT are not present. ***Additional comments:*** Downstream Little Beaver Creek maintains < 90% WCT and should be considered a hybridization threat. Historical records show "CT" were stocked in Big Beaver Creek (within the Sawmill/Junction drainage) in 1950 (n=6120 from Bozeman Tech Center).
SF Everson	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Translocation from N.F. Everson. ***Short-term (protect):*** A large forest fire called the Bear Creek Fire Complex destroyed much of the fisheries habitat in upper S.F. Everson Creek during the summer of 2020. It was decided to move as many S.F. Everson WCT as possible over to the N.F. of Everson Creek. On 7/8/2020 67 WCT were captured and moved over to The N.F. Everson Creek. It is unknown to what extent this will negatively affect this stream's small WCT population, but it was likely substantial. Establishment of a barrier would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within S.F. Everson Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** It is clear there is no connectivity downstream with Everson Creek during most years. Lack of water and available habitat are the main limiting factors for this very small population of genetically unaltered WCT (1 fish per 100 m, about 34 fish).
Sheser	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. In 2019 the BLM conducted a depletion estimate lower in the drainage on BLM land. This current demographic survey showed abundant WCT at 45 fish per 100 m. Depletion estimates in the middle and upper drainage are needed and lower and upper WCT distribution is needed to estimate population size. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan for this population. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Sheser Creek due to lack of habitat. A barrier that includes more neighboring tributaries (Bear, Frying Pan, Trapper Creeks) followed by WCT expansion would secure this population.

Stream (s)	Population Status and Conservation Needs
	Additional comments: The tributaries of Trail creek are all genetically altered populations with some of them remaining >90% WCT. It is unclear where these genetic separations take place due to good connectivity throughout the greater Trail Creek drainage.
Shineberger	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. On 7/7/2020 FWP conducted depletion estimates in the lower, middle and upper parts of the drainage. These demographic surveys showed an average of 2 WCT per 100 m. ***Short-term (protect):*** Establishment of a barrier would protect this population. Updated genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Shineberger Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** Shineberger Creek has only been surveyed on FS lands at the headwaters of the drainage. The 2002 surveys found WCT to be rare to common in about 1 mile of stream. Only hybridized WCT have been captured in Shineberger, no other non-native salmonids have been found.
Simpson - Unnamed trib.	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. There is an off-stream pond that is on private property at the bottom of Simpson Creek. Iit was decided to start a Simpson Creek WCT brood in this pond because of lack of barrier location and risk of nonnative trout invasion. On 8/26/2020 31 WCT ranging from 74-180 mm were transferred from Simpson Creek to this pond that is located at 44.59310 -112.97544. ***Short-term (protect):*** Establishment of a barrier would protect this population. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Simpson Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and protects more habitat downstream for WCT could secure this population. ***Additional comments:*** Simpson Creek is one of two streams left that contain a genetically unaltered WCT population in the upper Big Sheep Creek basin, the other being Meadow Creek. This can be attributed to lack of connectivity (irrigation withdrawals and intermittent flows) between neighboring streams. This stream should be prioritized for translocation or replication.
Trapper - NF Frying Pan - SF Fry Pan	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. In 2019 the BLM and FWP conducted two depletion estimates on the Trapper Creek. These current demographic surveys showed and average of 30 WCT per 100 m and 3 EBT per 100 m. A 24 fish genetic sample was collected on 8/13/2019 and results showed a conservation population consisting of 98.5% WCT, 1.3% RB and 0.2% YCT. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Trapper Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional comments:*** The tributaries of Trail creek are all genetically altered populations with some of them remaining >90% WCT conservation populations. It is unclear where these genetic separations take place due to good connectivity throughout the greater Trail Creek drainage.

Section 8: Ruby Sub-basin

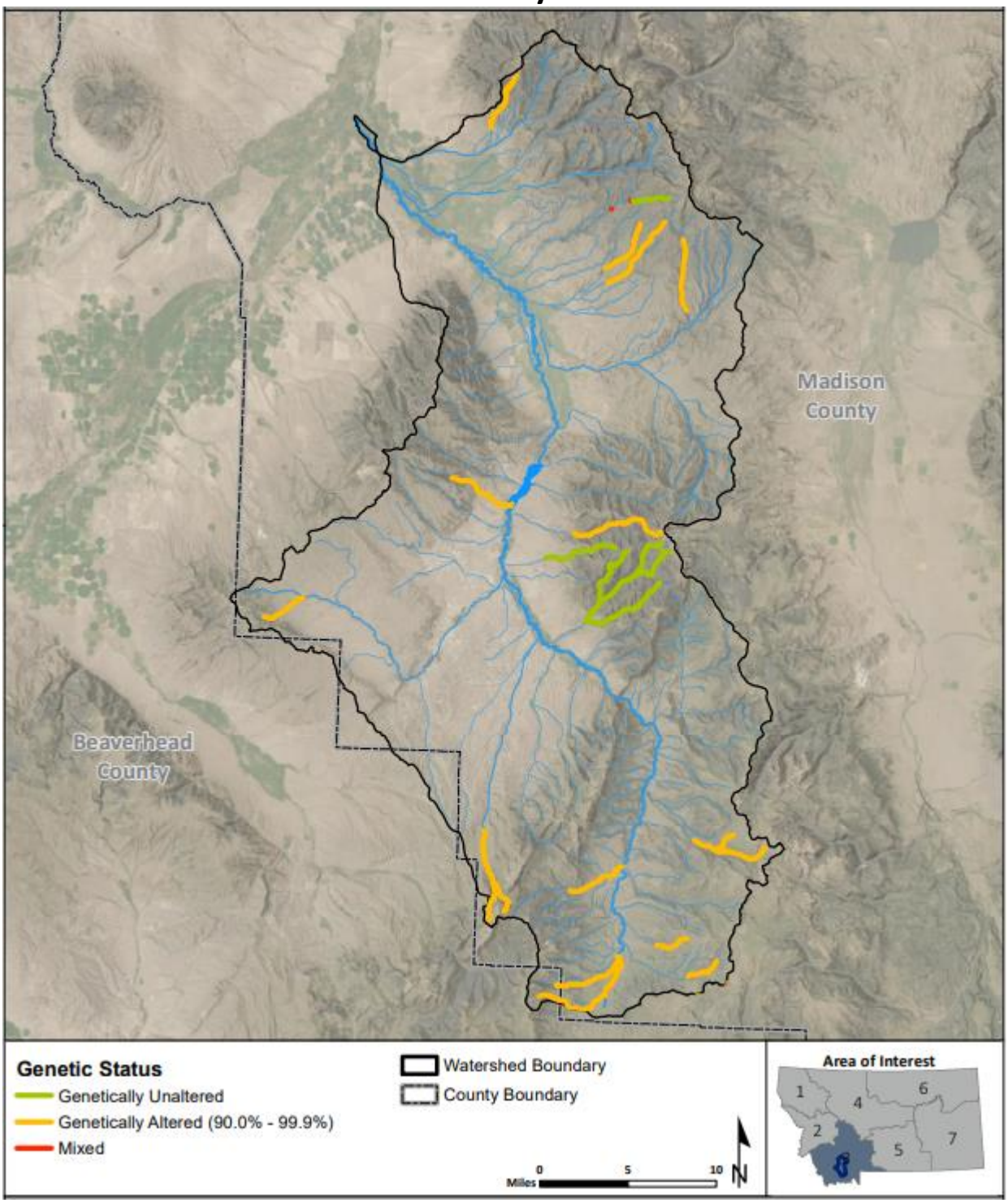

Figure 8.1. Genetic status and distribution of WCT conservation populations in the Ruby River sub-basin.

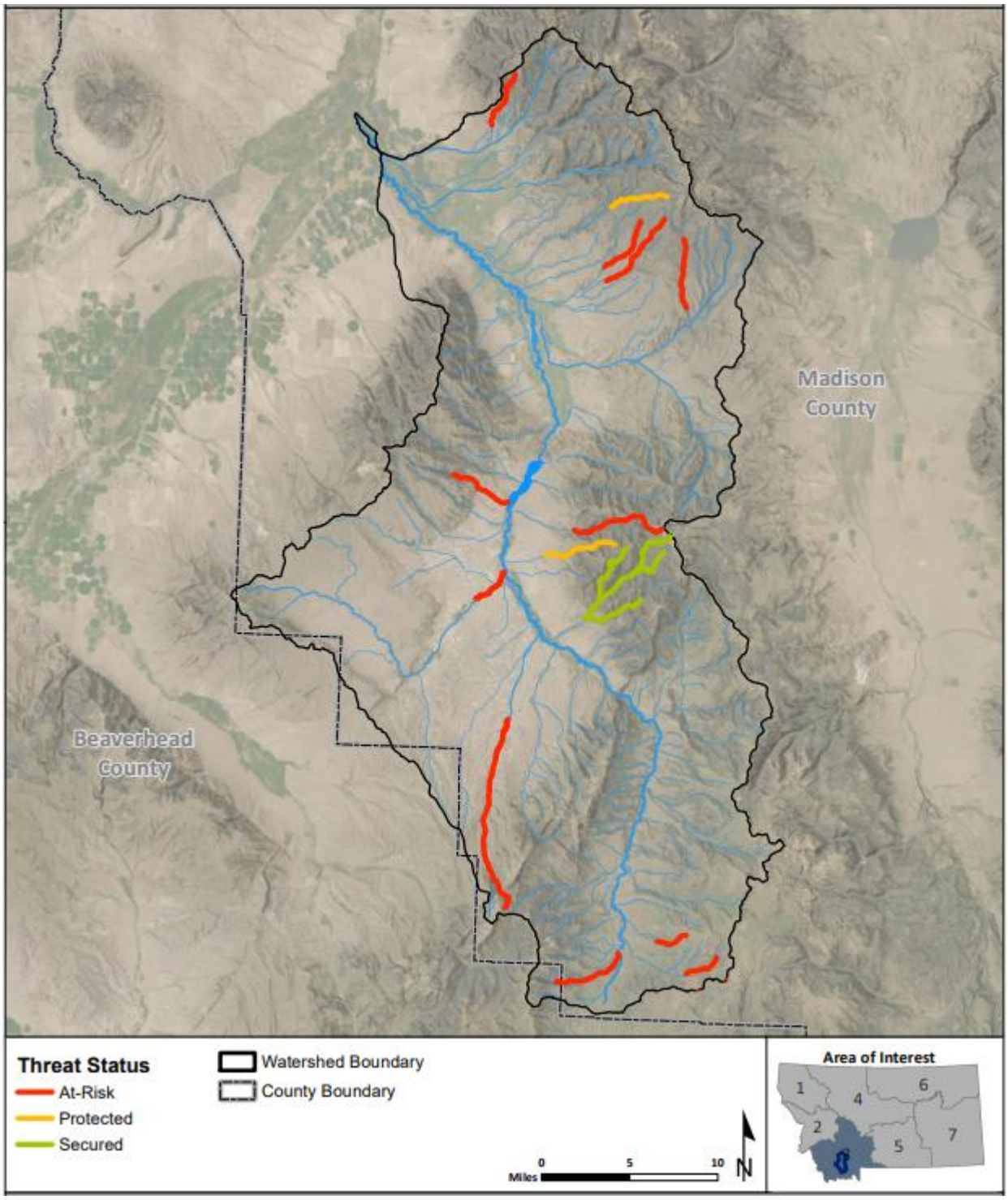

Figure 8.2. Threat status and distribution of WCT conservation populations in the Ruby River sub-basin.

Overview

Ruby WCT Status and Threats:

- Number of Conservation populations: 15 (4 unaltered, 0 mixed, 11 altered)
- Populations at risk: 80% (12 of 15)
- Genetically unaltered populations at risk: 25% (1 of 4)
- Populations considered protected: 18% (3 of 15)
- Populations considered secured: 1 (6.7%)
- Significant threats:
    - Brook Trout (EBT): 8 populations
    - Other trout (YCT, RBT, CT hybrids): 12 populations
    - Small population size: 10 populations (<1,000 fish)
    - Livestock grazing: 15 populations
    - Limited distribution: 7 populations (inhabit <5 miles of stream)

Table 8.1. Genetic class and threat status of WCT conservation populations in the Ruby River sub-basin.

Genetic Class	Threat Status of Conservation Populations			
	At-risk	Protected	Secured	**Total**
Unaltered	1	2	1	**4**
Mixed	0	0	0	**0**
Altered	11	0	0	**11**
Total	**12**	**2**	**1**	**15**

Table 8.2. WCT conservation populations identified in the Ruby River sub-basin.

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Basin (Ruby R.)	3053	Genetically Altered	Genetically tested as 91.3% WCT	9/15/04 USFS, Brammer (15 PINES) 91.3% WCT 5% YCT 3.7% RBT
California (Ruby R.)	5290 1237 703	Genetically Altered	Genetically tested as 97.6% WCT	7/21/2020 FWP, Jaeger, (21 SNP) 97.6% WCT 2.3% YCT 0.1% RBT 8/18/97 USFS, Brammer (8 Allozymes) 100% WCT 9/2/92 USFS, Browning (15 Allozymes) 95.3% WCT 4.7%YCT
Coal (Ruby R.)	4562 3058 3057 223	Genetically Altered	Genetically tested as 93.2% WCT	7/23/12 USFS, Watschke (31 SNP) 93.2% WCT 4.4% YCT 2.4% RBT 9/29/04 USFS, Brammer (15 PINES) 100% WCT 9/22/04 FWP, Brammer (10 PINES) WCTxRBTxYCT 8/19/87 FWP, Shepard (19 Allozymes) 88.4% WCT 9% RBT 2.6% YCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Corral (Ruby R.) - NF Coral	 3054 467	Genetically Altered	Genetically tested as 91% WCT	8/17/04 USFS, Brammer (10 PINES) 91% WCT 7% RBT 2% YCT 10/11/90 USFS, Brammer (12 Allozymes) 91% WCT 7% RBT 2% YCT
Cottonwood (Ruby R.) - Lower Geyser - Upper Geyser	4561 4560 3044 1055	Genetically Altered	Genetically tested as 93.4% WCT	7/12/11 USFS, Watschke (13, 29 SNP) 93.4% WCT 1.6% RBT 5% YCT 8/12/04 USFS, Brammer (18 PINES) WCTxRBT 6/9/90 USFS, Browning (16 Allozymes) 100% WCT
Greenhorn - Dark Hollow - Meadow Fork - NF Greenhorn - SF Greenhorn	5147	Genetically Unaltered	Removed non-native trout and re-established with unaltered WCT	8/21/2019 TEI, Cruse (26 SNP) Dark Hollow Cr. 100% WCT GU WCT live fish Transfers 2016-17 104 Brays Canyon Creek 145 Jack Creek 110 Painter Creek 107 Browns Creek 111 Cottonwood Creek 105 Meadow Creek WCT Transfer total: 682
Harris (California)	4739 4378 4365 3416 704	Genetically Altered	Genetically tested as 99.4% WCT	7/8/14 USFS, Watschke (25 SNP) 99.4% WCT 0.6% YCT 7/2/12 BLM, Hutchinson (24 SNP) WCTxYCT 5/22/12 BLM, Hutchinson (25 SNP) 97.9% WCT 2.1% RBT 7/14/06 BLM, Hutchinson (25 Indel) 100% WCT 9/2/92 USFS, Brammer (10 Allozymes) 100% WCT
Idaho (Ruby R.)	4304 4237 3014 1140 1044 1024	Genetically Altered	Genetically tested as 94.8% WCT	9/11/11 BLM, Hutchinson (20, 41 SNP) 99% WCT to 94.8% WCT 5.2% 10 1% Admixture 9/14/04 USFS, Brammer (10 PINES) 100% WCT 9/15/95 USFS, Browning (9 Allozymes) 100% WCT 10/14/94 USFS, Browning (10 Allozymes) 100% WCT 9/20/94 FWP, Oswald (9 Allozymes) 76.8% WCT 13.9% RBT 2.8% YCT
Jack (Ruby R.)	4887 4274 3013	Genetically Unaltered	Genetically tested as 100% WCT	8/22/18 FWP, Jaeger (49 SNP) 100% WCT 8/22/17 FWP, Jaeger (49 SNP) 100% WCT 8/17/16 FWP, Jaeger (49 SNP) 100% WCT

Stream (s)	***Sample Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Mill Gulch (Granite)	5289 719	Genetically Unaltered	Genetically tested as 100% WCT	7/20/2021 FWP, Jaeger (12 SNP) 100% WCT in Headwaters 9/16/92 USFS, Brammer (6 Allozymes) 94.4% WCT 5.6% RBT
Nugget (Wisconsin)	5151 785	Genetically Altered	Genetically tested as 98.3% WCT	8/14/2019 FWP, Jaeger (25 SNP) 98.3% WCT 1.7% RB 8/3/93 USFS, Browning (7 Allozymes) 91.4% WCT 8.6% RBT
Peterson (Ruby R.)	4446 1094	Genetically Altered	Genetically tested as 95% WCT	7/10/12 FWP, Jaeger (25 SNP) 95% WCT 5% RBT 8/13/91 USFS, Browning (12 Allozymes) 100% WCT
Ramshorn (Ruby R.) - Currant - NF Ramshorn - SF Ramshorn - Stonewall	4738	Genetically Unaltered	Genetically tested as 100% WCT	Rotenone was used in 2019 and 2020 to remove all nonnative trout **NF Ramshorn**: 8/21/14 FWP, Jaeger (25 SNP) 100% WCT
Robb (Ruby R.) - The Notch	5152 596	Genetically Altered	Genetically tested as 94.8% WCT	7/10/2019 FWP, Jaeger (25 SNP) 94.8% WCT 2.1% RB 3.1% YCT 11/1/91 USFS, Brammer (7 Allozymes) 98.1% WCT 1.9% RBT
Sweetwater (Ruby R.) - NF Sweetwater - WF Sweetwater	4731 4445 1098 1020 1016	Genetically Altered	Genetically tested as 97.2% WCT	7/22/14 FWP, Jaeger (50 SNP) 97.2% WCT 2.8% RBT 7/9/12 FWP, Jaeger (25 SNP) 99.8% WCT 0.2% RBT 8/17/95 FWP, Oswald (15 Allozymes) 87.2% WCT 12.8% RBT 9/14/94 FWP, Oswald (10 Allozymes) WCT? 1 polymorphic RBT or YCT 9/8/94 FWP, Oswald (10 Allozymes) 100% WCT

Table 8.3. Characteristics that define threat status of WCT conservation populations in the Ruby River sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Basin	3.1		18 per 100 m (917)	None	FS	No barrier, hybridization, limited distribution, livestock grazing	At-risk
California	5.9		1 per 100 m (95 fish)	None	BLM, FS, Private	Small population, no barrier, Brook Trout, hybridization, livestock grazing, past mining	At-risk
Coal	2.1		32 per 100 m (1087 fish)	None	FS	No barrier, hybridization, limited distribution, small population size, livestock grazing, heavy siltation, bank erosion	At-risk
Corral - NF Corral	5.8		24 per 100 m (2240 fish)	None	FS	No barrier, hybridization, livestock grazing, heavy siltation, bank erosion	At-risk
Cottonwood - Geyser	5.6		Unknown	None	FS	No barrier, hybridization, livestock grazing, heavy siltation	At-risk
Greenhorn - Dark Hollow - Meadow Fork - NF Greenhorn - SF Greenhorn	26.1	26.1	2020 Post-Treatment Monitoring (14,865 unaltered fish)	Concrete Man-made Barrier	FS, BLM, Private	Livestock Grazing	Secured
Harris	6.4		3 per 100 m (544 fish)	None	BLM, FS, Private	Limited distribution, small population, no barrier, Brook Trout, hybridization, livestock grazing, poor habitat conditions due to placer mining, irrigation	At-risk
Idaho	5.9		8 per 100 m (712 fish)	None	BLM, State, FS	Limited distribution, small population, no barrier, Brook Trout, hybridization, livestock grazing	At-risk
Jack	3.3	3.3	15 per 100 m (797 unaltered fish)	Wooden man-made Barrier	BLM, Private	Small population size, poor habitat conditions, livestock grazing	Protected
Mill Gulch	1.3	1.3	2 per 100 m (35 unaltered fish)	None	BLM, FS	No barrier, Brook Trout, hybridization, livestock grazing,	At-risk

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Nugget	4.6		9 per 100 m (640 fish)	None	BLM, FS, Private	No barrier, Brook Trout, hybridization, livestock grazing,	At-risk
Peterson	3.4		11 per 100 m (580 fish)	None	State, Private	No barrier, Brook Trout, hybridization, livestock grazing, heavy siltation	At-risk
Ramshorn - Currant - NF Ramshorn - SF Ramshorn - Stonewall	13.8	0.9	Pre-Treatment densities 12 per 100 m (492 fish) (170 unaltered fish)	Wooden man-made Barrier	BLM, FS, Private	Livestock grazing, poor habitat conditions due to placer mining	Protected
Robb - The Notch	11.4		3 per 100 m (550 fish)	None	FS, State, Private,	No barrier, Brook Trout, livestock grazing, hybridization, heavy siltation, bank erosion	At-risk
Sweetwater - NF Sweetwater - WF Sweetwater	1.3		10 per 100 m (203 fish)	None	State, Private	No barrier, Brook Trout, hybridization, livestock grazing, heavy siltation, bank erosion	At-risk

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population that exist in the same stream.

[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 8.4. Actions required to maintain conservation populations in the Ruby sub-basin

Stream (s)	Population Status and Conservation Needs
Basin	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Basin Creek due to lack of fish bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** 8,500 "CT" were stocked in Basin Creek in 1931, which could explain why the upper Ruby River is a hybrid swarm. The upper Ruby River drainage (including Basin, Coal, Corral, Cottonwood and Divide creeks) is part of fluvial Arctic grayling (AG) restoration area. Any WCT recovery efforts, particularly barrier construction, would require coordination with AG recovery efforts.
California	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. On 7/21/2020 the FWP conducted depletion estimates in the lower and upper parts of the drainage, which indicate there is an average of 1 WCT per 100 m throughout 5.9 miles of stream. The genetic sample collected on 7/21/202 showed a population of 97.6% WCT. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within California Creek due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries (Harris, Quaking Aspen and Wakefield Creeks) followed by WCT expansion would secure this population. ***Additional information:*** BLM population surveys conducted in 2016 revealed low abundances of WCT and high densities of EBT were observed in the upper half of the drainage.
Coal	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan for this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Coal Creek due to lack of fish bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** 10,200 "CT" were reported to be stocked in 'Coal Creek' in 1931, this could explain why the upper Ruby River is basically a hybrid swarm. The upper Ruby River drainage (including Basin, Coal, Corral, Cottonwood and Divide Creeks) is part of a fluvial AG restoration area. Any WCT recovery efforts, particularly barrier construction, would require coordination with AG recovery efforts.
Corral - NF Coral	***Genetic Class:*** Genetically Altered

Stream (s)	Population Status and Conservation Needs
	On-going projects: None ***Short-term (protect):*** Establishment of a barrier would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Corral Creek due to lack of fish bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** 10,200 "CT" were reported to be stocked in 'Corral Creek' in 1931. The reported stocking location could also be referencing a section of the Ruby River, which could explain why the upper Ruby River is a hybrid swarm. The upper Ruby River drainage (including Basin, Coal, Corral, Cottonwood and Divide Creeks) is part of a fluvial AG restoration area. Any WCT recovery efforts, particularly barrier construction, would require coordination with grayling recovery efforts.
Cottonwood - Geyser	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Cottonwood Creek due to lack of fish bearing habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** On 7/12/11 the USFS collected two different groups of genetic samples. The results showed that this population is altered at 93.4% WCT 1.6% RBT 5% YCT. 32,900 "CT" were stocked in Cottonwood Creek in 1931 and 1932, which could explain why the upper Ruby River is a hybrid swarm.
Greenhorn - Dark Hollow - Meadow Fork - NF Greenhorn - SF Greenhorn	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Based on 11 depletion estimates conducted drainage-wide during the summer of 2020 the genetically unaltered WCT population is estimated to be 12,067 fish, up from 9,176 fish based off 13 depletion estimates in 2019. Fin clips were collected from 486 juvenile 1 and 2-year-old WCT that were progeny of fish translocated to Greenhorn Creek beginning in the summer of 2016. Post-project monitoring was designed to assess genetic diversity and interpret how F1 WCT represent the different donor sources that were used to repopulate the drainage. This monitoring and genetic study is part of a master's program through collaboration with the University of Montana Conservation Genetics Lab Based on data collected during the summer of 2019 and 2020 it appears that there were very successful spawns in the springs of 2017, 2018 and 2019 and that Greenhorn Creek was repopulated in a very short time (2 or 3 years) Post-project monitoring by the BLM on Dark Hollow Creek showed WCT at 24 per 100 m at the upper BLM boundary with USFS land. ***Short-term (protect):*** A man-made concrete barrier was constructed in 2013 on DNRC land that protects about 26.1 miles upstream of the confluence of the South and North Forks of Greenhorn Creek. ***Long-term (secure):*** As of August 2020 Greenhorn Creek is considered secured. ***Additional information:*** Greenhorn Creek was treated with rotenone in 2013 and 2014, except for upper Dark Hollow Creek where genetically unaltered WCT remained. In 2015 eDNA sampling every 250 m followed by backpack electrofishing were used to verify treatment success. Genetically unaltered fish were transferred from 6 different streams to 7 locations throughout the project area during 2016, 2017 and 2018. WCT donor populations include: 104 Brays Canyon, 107 Browns, 145 Jack and 110 Painter creeks fish in the N.F. of

Stream (s)	Population Status and Conservation Needs
	Greenhorn Creek; 111 Cottonwood and 105 Meadow creeks fish in the S.F. of Greenhorn Creek. To date a total of 682 genetically unaltered WCT have been transferred into the Greenhorn WCT project area. Genetically unaltered WCT from Dark Hollow and the Meadow Fork of Greenhorn Creek were salvaged during the 2013-14 rotenone fish removals. WCT from donor streams were captured, VI Tagged and held instream until genetic results confirmed unaltered status and were then transferred into the Greenhorn WCT project area.
Harris	***Genetic Class:*** Genetically Altered ***On-going projects:*** Conifer removal occurred along the riparian corridor and were left in the floodplain to reduce riparian use by livestock. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Harris Creek due to lack of habitat. A barrier that includes more neighboring tributaries (California, Quaking Aspen) and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** Genetic samples collected on 7/8/14 by the USFS revealed that this population is altered at 99.4% WCT 0.6% YCT into the headwaters of Harris Creek.
Idaho	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. On 6/23/2020 the BLM conducted two depletion estimates on the lower and upper parts of the drainage. These demographic surveys indicated there is 4.7 miles of stream with an average of 2 WCT per 100 m and 25 EBT per 100 m. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Idaho Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** Genetic samples collected by the BLM on 9/11/11 (25 SNP) revealed that the Idaho Creek population is altered at 94.8% WCT 5.2 % RBT. Based on 2020 demographic information it appears that Idaho Creek WCT are being outcompeted by EBT especially in the headwaters where only EBT were found.
Jack	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Demographic and genetic monitoring. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Short-term (protect):*** Jack Creek is presently considered to be protected with a man-made fish barrier that was built in 2016, which is located on state land (45.15614, -112.12882). The barrier protects about 6 miles of stream, 3.3 miles of which are occupied by genetically unaltered WCT. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It is not possible to secure a population of 2500 fish >75mm within Jack Creek due to lack of habitat and connectivity. This population is presently estimated at 797 total fish. ***Additional information:*** Historically, intermittent stream flow has protected 3.8 miles of habitat from hybridization and nonnative trout. Jack Creek is one of six donor streams being used to repopulate the Greenhorn Creek WCT project area (via live fish transfers). Transfers of 47, 49 and 49 WCT (145 total) from Jack Creek were released into the Meadow and North forks of Greenhorn Creek in 2016, 2017 and 2018.
Mill Gulch	***Genetic Class:*** Genetically Unaltered

Stream (s)	Population Status and Conservation Needs
	On-going projects: Demographic and genetic monitoring. On 7/20/2020 FWP conducted three more depletion estimates in the lower, middle, and upper parts of the drainage. These demographic surveys showed abundances of 2 WCT per 100 m and about 5 EBT per 100 m. A 12 fish genetic sample was collected in the headwaters and the sample showed a small population of genetically unaltered WCT; however, flows were high and WCT abundances low, which prevented collecting a 25 fish genetic sample. ***Short-term (protect):*** Establishment of a barrier and removal of hybridized CT and nonnative EBT would protect this population. Barrier feasibility is needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. Funding for a barrier is being pursued by the Ruby Valley Conservation District associated with a MDT bridge project on Granite Creek. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Mill Gulch due to lack of habitat and connectivity. A barrier that includes more neighboring tributaries (Downey, Dulea, Granite, E.F. Granite, Gibbs) followed by WCT expansion would secure this population. ***Additional information:*** Six WCT collected at river mile 5 for genetic analysis in 1992 indicated 94% WCT. In 1948 5,000 RBT were stocked into Mill Gulch. Upper and lower WCT distribution was identified and about 1.3 miles of upper Mill Gulch are occupied by lower numbers of WCT.
Nugget	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. In 2019 the BLM and FWP conducted two depletion estimates on Nugget Creek, one in the middle of the drainage on BLM land and another up in the headwaters on USFS land. These current demographic surveys showed and average of 9 WCT per 100 m. Lower WCT distribution and a lower depletion estimate are needed. A 25 fish genetic sample was collected on 8/13/2019 and results showed a conservation population of 98.3% WCT 1.7% RB. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic surveys, genetic testing and barrier feasibility are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Nugget Creek due to lack habitat and connectivity. A barrier that includes more neighboring tributaries (Noble Fork, Wisconsin) followed by WCT expansion would secure this population. ***Additional information:*** In 1991, a survey at the stream mouth found only WCT. In 1995, a survey in the mid reaches of the stream also found only WCT. There are no stocking records for Nugget Creek; however, between the 1930's and 1950's the Wisconsin Creek drainage was stocked with large numbers of RBT, YCT, and "CT". All the lakes in this drainage should be sampled to identify fish species presence/absence.
Peterson	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It is not possible to secure a population of 2500 fish >75mm within Peterson Creek due to lack of habitat because it flows directly into Ruby Reservoir. ***Additional information:*** On 7/10/12 FWP collected genetic samples (25 SNP) that showed an altered population of 95% WCT 5% RBTxYCT admixture.
Ramshorn - Currant - NF Ramshorn	***Genetic Class:*** Genetically Unaltered ***On-going projects:*** Re-population with genetically unaltered WCT. Demographic and genetic monitoring. .

Stream (s)	Population Status and Conservation Needs
	Short-term (protect): Ramshorn Creek is protected by a man-made wooden barrier (45.40951 -112.12399) that was built in the Fall of 2018. This barrier protects about 13.8 miles of stream and includes Current and N.F. Ramshorn Creek, Stonewall Creek and tributaries. Removal of hybridized CT and nonnative EBT protected this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** Future translocation and genetic rescue may be needed to improve abundances and heterozygosity of the remaining unaltered WCT (He = 0.003, -100% of eastside WCT average He). Once WCT expansion and repopulation is completed Ramshorn Creek will be secured with a population of 2500 fish >75mm. ***Additional information:*** In 2019 rotenone was used to treat about 13.8 miles of streams and tributaries upstream of the Ramshorn Creek barrier. In 2020 this project area was treated for a second time. In 2017 a barrier (45.45732 -112.01191) was established by modifying the culvert on USFS road 159 to protect unaltered WCT in the upper 0.9 miles of stream. Upstream of this culvert was not treated to avoid removing unaltered WCT, however there were some Brook Trout present upstream of this culvert that were removed using eDNA sampling in conjunction with backpack electrofishing removals. Four EBT were removed and their locations were documented on 9/10/2019 during a 3-pass backpack electrofishing physical removal effort. In 2021 Ramshorn Creek and its tributaries were surveyed using eDNA to assess the success of the removal project. Multiple hits for cutthroat trout and brook trout were detected; however, follow-up three pass electrofishing surveys yielded only one brook trout. The stream is believed to be fishless below the modified culvert and above the wooden fish barrier. In 2019 prior to rotenone treatment genetic samples were collected from above a barrier on Stonewall Creek a tributary within the project area, results showed a conservation population of 94.5% WCT 5.5% RB, these fish were treated and removed during 2020. Genetic samples collected in 2016 and 2017 identified an unaltered population of WCT in the headwaters of Ramshorn Creek (170 estimated fish). Genetically unaltered WCT would be salvaged in the headwaters from RM 12.3 upstream and then used as a source population to repopulate the rest of the WCT project area. Extensive drainage-wide field surveys were conducted prior to the rotenone by multiple agencies (BLM, FWP, USFS) during July 2016 and July 2017. Between 1946 and 1951 Ramshorn Creek was stocked with 9,700 “CT”, 4,750 RBT, and 4,800 Yellowstone CT.
Robb - The Notch	***Genetic Class:*** Genetically Altered ***On-going projects:*** Demographic and genetic monitoring. In 2019 the BLM and FWP conducted two depletion estimates, one in the lower drainage and one in the upper headwaters of Robb Creek near the USFS Notch Cabin. A demographic survey in the middle drainage and WCT distribution is needed. Demographic surveys showed EB 24 per 100m and RM COT 25 per 100m and no WCT in lower Robb Creek, in the headwaters WCT 3 per 100 m were observed. A 25 fish genetic sample was collected on 7/10/2018 and 8/14/2019 and results showed a conservation population of 94.8% WCT 2.1% RB and 3.1% YCT. ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Updated demographic surveys and genetic testing are needed to develop a conservation plan. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Robb Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** Genetic samples collected by the USFS on 11/1/91 from just 7 fish showed an altered population of 98.1% 1.9% RBT. Stocking records indicate 12,880 “CT” (1946) and 8,700 RBT (1951) have been stocked in the Robb Creek system.

Stream (s)	Population Status and Conservation Needs
Sweetwater - NF Sweetwater - WF Sweetwater	***Genetic Class:*** Genetically Altered ***On-going projects:*** None ***Short-term (protect):*** Establishment of a barrier and removal of nonnative EBT would protect this population. Riparian habitat could be improved by mitigating cattle grazing impacts. ***Long-term (secure):*** It may not be feasible to secure a population of 2500 fish >75mm within Sweetwater Creek due to lack of habitat. A barrier that includes more neighboring tributaries and habitat downstream followed by WCT expansion could secure this population. ***Additional information:*** 2013 genetic results showed a 99.8% WCT 0.2% RBT population. 2014 genetic samples showed a slightly higher hybridized population at 97.2% WCT 2.8% RBT. 4,500 RBT were stocked in Sweetwater Creek in 1950.

Section 9: Upper Missouri Sub-basin

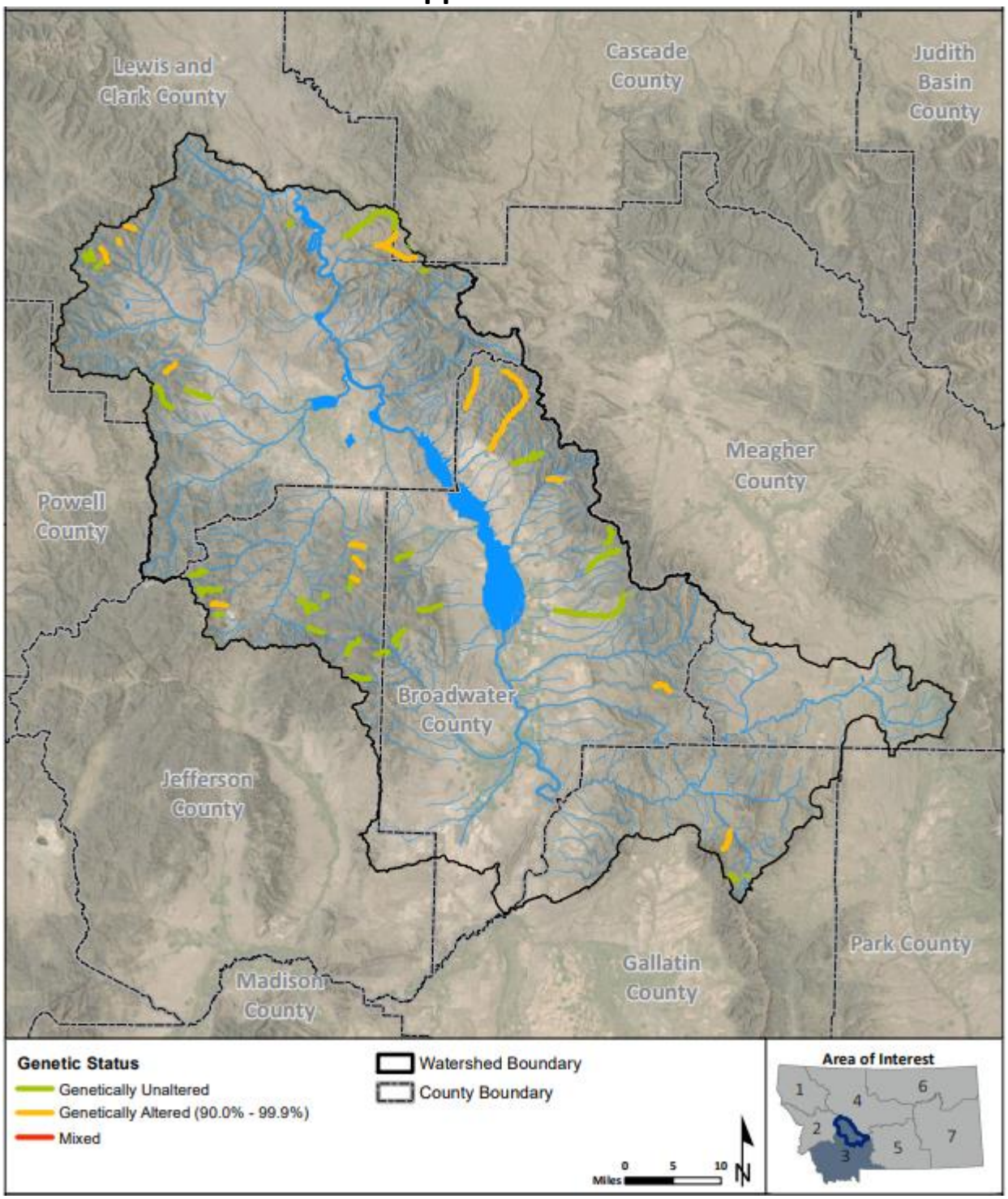

Figure 9.1. Genetic status and distribution of WCT conservation populations in the Upper Missouri River sub-basin.

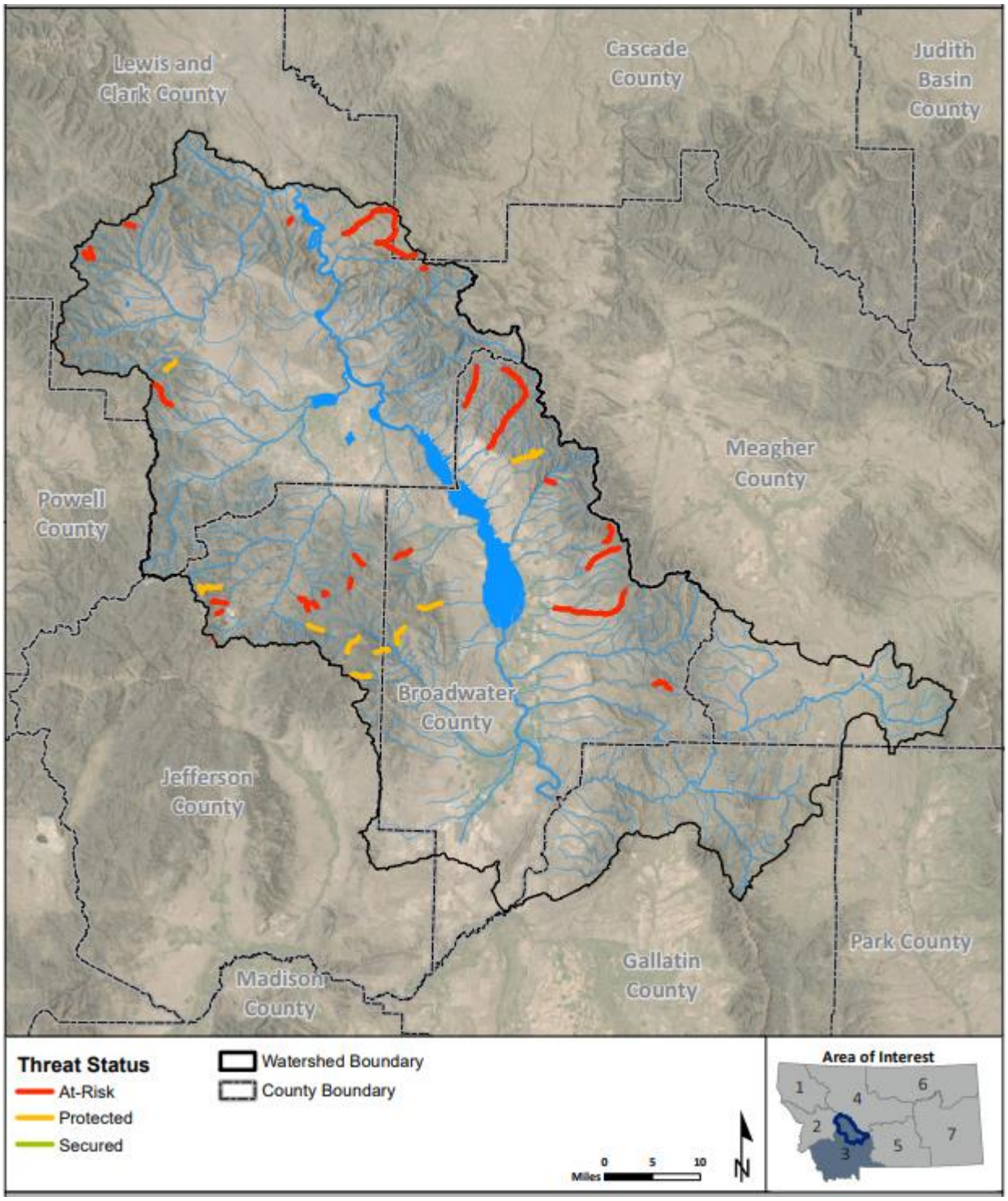

Figure 9.2. Threat status and distribution of WCT conservation populations in the Upper Missouri River sub-basin.

Overview

Upper Missouri WCT Status and Threats:

- Number of Conservation populations: 32 (23 unaltered; 1 mixed; 8 altered)
- Populations at risk: 72% (23 of 32)
- Genetically unaltered populations at risk: 65% (15 of 23)
- Populations considered protected: 28% (9 of 32)
- Populations considered secured: None
- Unaltered Distribution (Miles): 58% (65/113 miles)
- Significant threats:
    - Brook Trout (EBT): 16 populations
    - Other trout (YCT, RBT, CT hybrids): 14 populations
    - Small population size: 13 populations (< 1,000 fish)
    - Livestock grazing: 9 populations
    - Limited distribution: 27 populations (inhabit < 5 miles of stream)

Table 9.1. Genetic class and threat status of WCT conservation populations in the Upper Missouri River sub-basin.

Genetic Class	Status of Conservation Populations			
	At-risk	Protected	Secured	**Total**
Unaltered	15	8	--	**23**
Mixed	1	--	--	**1**
Altered	7	1	--	**8**
Total	**23**	**9**	**0**	**32**

Table 9.2. WCT conservation populations identified in the Upper Missouri River sub-basin.

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Avalanche	251 1888	Genetically Altered	Genetically tested as > 90% WCT	8/1/1988 USFS, Walch (10 Allozyme) 88.3%WCT 11.7% RB 10/30/1997 USFS, Walch (20 Allozyme) 92.4%WCT 92.4%RB 2017 USFS- Clips collected but not analyzed
-Cooney	1893 3270			**Cooney** 11/31/1997 USFS, Walch (10 Allozyme) **Cooney** 7/1/2004 FWP, Nelson (20 PINEs) 95%WCT 5%RB
Clancy	1892 1889	Genetically Unaltered	Genetically tested as 100% WCT	8/11/1997 USFS, Walch (10 Allozyme) 100%WCT 10/9/1997 USFS, Walch (5 Allozyme) 100%WCT
- Kady	305 1086 3666 ####		Genetically tested as > 90% WCT	**Kady** 8/1/1989 USFS, Walch (13 Allozyme) 100%WCT **Kady** 9/19/1995 USFS, Walch (12 Allozyme) 100%WCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
				Kady 9/19/2007 FWP, Nelson (25 Indel) 100%WCT **Kady** 7/24/2019 FWP, Pipinich/Godfrey (32 SNP) Maybe 99.3%WCT 0.7%RB
Cottonwood		Genetically Unaltered	Established from genetically unaltered populations.	Genetic evaluation needed in future. Strainer to check on Genetics. Recent health screening and AIS in 2019. Donor for Log Gulch in 2019.
Duck	2939 3070 4253	Genetically Unaltered	Genetic analysis indicating presence of both unaltered and hybridized WCT.	9/16/2002 FWP, Nelson (25 PINEs) 100%WCT 4/13/2005 FWP, Nelson (50 PINEs) Mix of 100%WCT and low number of hybrids WCTxRB =1 out of 49 *Genetics to be analyzed winter 2021-2022* **Below Barrier** 10/28/2010 FWP, Nelson (25 Indel) 100%WCT
Dutchman - SF Dutchman - NF Dutchman	411 2345 4966 ----	Genetically Unaltered	Genetically tested as 100% WCT	8/1/1990 USFS, Hadley (10 Allozyme) 100%WCT **S.F.** 10/1/2002 FWP, Nelson (52 PINEs) 100%WCT 8/22/2018 FWP, Pipinich (50 SNP) 100%WCT
EF McClellan	252 4898	Genetically Altered	Genetically tested as > 90% WCT	8/1/1988 USFS, Walch (6 Allozyme) 88.9%WCT 11%YCT 0.1%RB 9/4/2015 USFS, Russell (31 SNP) 95.3%WCT 4.7%RB
Elkhorn	1039 1056 2718 2342 3743 3948 3949 3951 4435	Genetically Altered	Segments of the populations are believed to be > 90% WCT.	10/4/1994 FWP, Shepard (8 Allozyme) 100%WCT 10/4/1994 FWP, Shepard (2 Allozyme) 100%WCT 8/18/1996 FWP, Humphrey (25 Allozyme) 100%WCT 9/26/2002 FWP, Humphrey (25 PINEs) 87.6%WCT 12.4RB 10/7/2008 FWP, Moser (50 Indel) 88%WCT 12%RB 7/29/2009 FWP, Moser (26 Indel) 98.1%WCT 1.9%RB 7/29/2009 FWP, Moser (49 Indel) 99.5%WCT 0.5%RB 7/29/2009 FWP, Moser (50 Indel) 99.6%WCT 0.4%RB 9/20/2012 FWP, Moser (25 SNP) 98.5%WCT 1.5%RB
Eureka - Longfellow - Tin Cup - Teakettle	----	Genetically Unaltered	Established from genetically unaltered population (Prickly Pear Creek)	Genetic evaluation needed in future

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Fool Hen	----	Genetically Unaltered	Population maintains fish characteristics phenotypic of WCT	Genetic evaluation needed in future
Greyson	3783 4254	Genetically Altered	Genetically tested as > 90% WCT	9/24/2008 FWP, Nelson (Indel 26) 98.1%WCT 1.9%RB 10/18/2010 FWP, Nelson (Indel 25) 97.5%WCT 2.5%RB
Hall	749 972 1451 3274 3664	Genetically Unaltered	Genetically tested as 100% WCT	6/1/1993 USFS, Walch (10 Allozyme) 100%WCT 8/1/1994 USFS, Walch (10 Allozyme) 100%WCT 8/9/1999 FWP, Shepard (50 PINEs) 100%WCT 7/9/2004 FWP, Nelson (2 PINEs) 100%WCT 9/20/2007 FWP, Nelson (50 Indel) 100%WCT 2017 UM, Bell- 99.5% WCT
Little Tizer		Genetically Unaltered	Established from genetically unaltered populations (Prickly Pearl, Hall and Ray creeks)	Genetic evaluation needed in future
Log Gulch, Upper Reservoir	-----	Genetically Unaltered	Established from genetically unaltered population (Cottonwood)	Genetic evaluation needed in future
Magpie	1897 3269 3291	Genetically Altered	Genetically tested as > 90% WCT	10/1/1997 USFS, Walch (9 Allozyme) 93.3%WCT 6.7%RB 7/1/2004 FWP, Nelson (20 PINEs) 100%WCT 7/1/2004 FWP, Nelson (20 PINEs) 97%WCT 3%RB 2017 USFS, *Samples Collected but not analyzed*
McClellan - Teepee	9 410 1063 2024 3311 974 2025	Genetically Unaltered	Genetically tested as 100% WCT	10/1/1980 USFS, Hadley (13 Allozyme) 100%WCT 8/1/1990 USFS, Walch (10 Allozyme) 100%WCT 1/1/1995 USFS, Walch (10 Allozyme) 100%WCT 8/10/1999 FWP, Nelson (24 PINEs) 100%WCT 6/15/2006 FWP, Nelson (50 PINEs) 100%WCT *2021 USFS- Current genetics are in hand* **Teepee** 8/1/9994 USFS, Walch (11 Allozyme) 99%WCT 1%YCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
	3670			**Teepee** 8/9/1999 FWP, Nelson (25 PINEs) 100%WCT
- Crystal	1070			**Teepee** 7/17/2007 FWP, Nelson (50 Indel) 98.5%WCT 1.5%YCT **Crystal** 7/1/1995 USFS, Walch (10 Allozyme) 95.4%WCT 4.6%YCT
NF Gurnett	158	Mixed	Genetically tested as 100% WCT	4/1/1986 FWP, Rehwinkel (11 Allozyme) 100%WCT
- Unnamed trib	2216			10/30/2001 FWP, Nelson (20 PINEs) 1/20 WCTxYCT hybrid.
Page	1899	Genetically Unaltered	Genetically tested as 100% WCT	9/22/1997 USFS, Walch (6 Allozyme) 100%WCT 2021 USFS, Russell- *Genetics to be analyzed winter 2021-22*
Porcupine	1900 1901 4366	Genetically Unaltered	Genetic analysis indicating presence of both unaltered and hybridized WCT	6/5/1997 USFS, Walch (4 Allozyme) 100%WCT 6/5/1997 USFS, Walch (5 Allozyme) 58.3%WCT 41.7%RB 9/18/2011 FWP, Humphrey (50 SNP) Mix of WCTxRB hybrids with small to moderate admixture.
Prickly Pear	748 1064 1494 4012 4041	Genetically Unaltered	Genetically tested as 100% WCT	6/1/1993 USFS, Walch (10 Allozyme) 100%WCT 1/1/1995 USFS, Walch (15 Allozyme) 100%WCT 8/17/1999 FWP, Shepard (50 PINEs) 100%WCT 10/1/2009 FWP, Nelson (50 Indel) 100%WCT 6/1/2010 FWP, Nelson (19 Indel) 100%WCT
Ray	2344 3272 3297 3452 3708 3914	Genetically Unaltered	Genetically tested as 100% WCT	10/7/2002 FWP, Nelson (36 PINEs) 100%WCT 7/1/2004 FWP, Nelson (5 PINEs) 100%WCT 6/20/2006 FWP, Nelson (35 PINEs) 100%WCT 6/21/2007 FWP, Nelson (45 Indel) 100%WCT 6/19/2008 FWP, Nelson (60 Indel) 100%WCT 6/19/2009 FWP, Nelson (49 Indel) 100%WCT
Rooster Bill	907	Genetically Unaltered	Genetically tested as 100% WCT	5/13/1994 USFS, Walch (10 Allozyme) 100%WCT 2021 USFS- *Genetics to be analyzed winter 2021-22*
Silver - Sawmill Gulch	1902	Genetically Altered	Genetically tested as > 90% WCT	8/12/1997 USFS, Walch (10 Allozyme) 95.4%WCT 4.6%YCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Skelly - East Skelly	487 2215 2343 4511 ####	Genetically Unaltered	Genetically tested as 100% WCT	8/1/1991 USFS, Harper (10 Allozyme) 100%WCT 8/1/2001 FWP, Humphrey (7 PINEs) 100%WCT 9/25/2002 FWP, Humphrey (39 PINEs) 100%WCT 6/16/2013 FWP, Nelson (27 SNP) 100%WCT *(Presence of six polymorphisms indicate the population is likely hybridized, need new samples)*
SF Crow		Genetically Unaltered	Established from genetically unaltered population (Muskrat Creek)	Genetic evaluation needed in future
SF Quartz **-** Unnamed trib	1208 2217 3669 4500 4883	Genetically Unaltered	Genetically tested as 100% WCT	7/1/1996 USFS, Walch (9 Allozyme) 100%WCT 8/29/2001 FWP, Nelson (15 PINEs) 100%WCT 9/11/2007 FWP, Nelson (50 Indel) 100%WCT 6/24/2013 FWP, Nelson (25 SNP) 100%WCT 6/1/2017 FWP, Spoon (15 SNP) 100%WCT
SF Sixteenmile Headwaters				*To be repopulated in 2022 with unaltered WCT*
SF Warm Springs - Hogan	2147 2148	Genetically Unaltered	Genetically tested as 100% WCT, hybrids removed	Lower 9/26/2001 FWP, Nelson (5 PINEs) 2 out of 5 = WCTxRB hybrids Upper 9/26/2001 FWP, Nelson (27 PINEs) 100%WCT 2021 FWP & USFS- *Analysis to be conducted winter 2021-22*
Specimen	3111	Genetically Altered	Genetically tested as > 90% WCT	8/2/2000 FWP, Burns (10 PINEs) 93%WCT 7%RB
Staubach	498 4884	Genetically Unaltered	Genetically tested as 100% WCT	8/1/1991 USFS, Walch (32 Allozyme) 100%WCT 8/30/2016 FWP, Spoon (11 SNPs) 100%WCT 2018 UM, Bell- 100% WCT
Stemple	3112	Genetically Altered	Genetically tested as > 90% WCT	9/23/2002 FWP, Burns (10 PINEs) 96%WCT 4%YCT
Threemile	2737 3102 3777 4368 4512 4664	Genetically Unaltered	Genetically tested as 100% WCT	6/1/2001 FWP, Dalby (30 Allozyme) 100%WCT 5/1/2005 FWP, Dalby (25 PINEs) 100%WCT 4/16/2009 FWP, Humphrey (49 Indel) 100%WCT 6/2/2012 FWP, Humphrey (22 SNP?) 100%WCT 6/12/2013 FWP, Humphrey (11 SNP) 100%WCT 6/13/2014 FWP, Moser (34 SNP) 100%WCT

Stream (s)	***Genetic Report Number***	***Genetic Class***	***Rationale for status***	***Date, Collector, Number Sampled, Type of Test and Results***
Whitehorse		Genetically Unaltered	Established from genetically unaltered populations (Dutchman, Muskrat, and Ray creeks)	Genetic evaluation needed in future
White - Spring Gulch - LH Fork	236 613 3245 3295 3445 3709 3916 4241 4501 4622	Genetically Unaltered	Genetically tested as 100% WCT	1/1/1988 USFS, Vore (10 Allozyme) 11%WCT 4/29/1992 USFS, Vore (7 Allozyme) 100%WCT 9/8/2005 FWP, Nelson (50 PINEs) 100%WCT 6/12/2006 FWP, Nelson (31 PINEs) 100%WCT 6/12/2007 FWP, Nelson (24 Indel) 100%WCT 6/11/2008 FWP, Nelson (54 Indel) 100%WCT 6/10/2009 FWP, Nelson (57 Indel) 100%WCT 6/22/2011 FWP, Nelson (12 Indel) 100%WCT 6/16/2013 FWP, Nelson (24 SNP) 100%WCT 6/11/2014 FWP, Clancey (59 SNP) 99+%WCT Possible WCT variation present at YCT marker

Table 9.3. Characteristics of conservation populations within the Upper Missouri River Sub-basin.

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Avalanche - Cooney - Nary Time	12	0	Rare to common 3-30/100m	Chronic dewatering below WCT habitat reach.	FS & private	Brook and Rainbow trout throughout the entire drainage. Livestock grazing and associated habitat impacts, historic mining impacts	At-risk
Clancy - Kady	2.2 1.6	2.2 1.6	Rare Relatively common 4-8/100m	None	FS, BLM & private	**Clancy-** grazing incised stream, adits spewing. Few fish remaining in the population; habitat degradation from historic mining and livestock grazing; presence of brook trout **Kady-** relatively pristine, ungrazed. presence of brook trout and likely rainbow trout	At-risk
Cottonwood *	7.7	7.7	Common	Concrete barrier	State	Potential EBT presence	At-Risk
Duck	2.3	1.12	Rare to common 7-58/100m	Waterfall isolates upper 0.8-mile reach	FS	Brook and rainbow trout in lower 0.7 miles (below barrier); grazing and associated poor habitat conditions throughout	At-risk
Dutchman - NF Dutchman - SF Dutchman	3.0	3.0	Common 4-35/100m	Cascade, not 100%	FS & BLM	Barrier failure (brook trout below)	At-risk
EF McClellan	1.5	0	Rare 2/100m	None	FS	Brook trout presence, admix-rainbow McClellan	At-risk
Elkhorn - NF Elkhorn	9.9	0	Abundant	Concrete barrier 2012	State	Low numbers of brook and hybrid trout presence.	At-Risk
Eureka * - Longfellow - Tin Cup - Teakettle	3.3	3.3	Rare to Abundant 6-89/100m	Waterfall	FS	None, Warmer relatively	Protected

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Fool Hen	0.8	Unknown	Common	Gradient	FS	Unknown	At-risk
Greyson	2.7	0	Rare 5/100m	None	FS & private	Brook trout presence; small population size; grazing and associated degraded habitat	At-risk
Hall	1.4	1.4	Common 2-32/100m	Two culverts (each > 75 ft length)	FS	None	Protected
Little Tizer *	2.2	2.2	Rare 1-19/100m	Waterfall	FS	None, although persistence is questioned due to cold water temperatures	Protected
Log Gulch, Upper Reservoir *	Unknown (0.86 surface acres)	Unknown (0.86 surface acres)	86 individuals transferred in 2019	Shallow, high gradient outlet	Private	Low level brown trout population in reservoir	At-risk
Magpie	4.5	0	Rare to common 6-50/100m	Intermittent reach, not 100%	FS & private	Barrier failure (brook and rainbow trout below); sustained runoff may allow invasion	At-risk
McClellan - Tepee	2.6 0.9	2.9	Common 9-29/100m	Logjams, not 100%	FS	Brook and hybrid trout presence	At-risk
NF Gurnett - Unnamed trib	4.1	4.1	Rare 9/100m	Unknown	Private	Brook trout present: possible RB present; grazing and associated degraded habitat	At-risk
Page	0.8	0.8	Common	None	FS	Brook trout presence and potential rainbow trout	At-risk
Porcupine	2.4	0.6	Unknown	Unknown	FS & private	Mostly unknown but includes limited distribution and small population size	At-risk
Prickly Pear	1.9	1.86	Common 6-19/100m	Cascade	FS & private	None	Protected
Ray	9.2	9.2	Common to abundant 4-82/100m	Ineffective perched culvert & intermittent reach	FS & private	Brook trout present, barrier failure.	At-risk
Rooster Bill	1.2	1.2	Abundant	Culvert	FS	Brook trout presence	At-risk
Silver - Sawmill Gulch	3.7 1.5	0 0	Rare to common	Unknown (likely mining related)	FS & BLM	Minor grazing impacts; historic mining in Silver Creek	Protected (Sawmill Gulch segment)

Conservation population	Population distribution (stream miles)	[a] Unaltered WCT distribution (stream miles)	[b] WCT abundance estimates	Barrier type	Land ownership	Significant and immediate threats to the population	Threat status
Skelly - East Skelly	3.2 0.7	3.2 0.7	Common	Culvert (not 100%)	FS & private	Brook trout present; grazing and associated degraded habitat	At-risk
SF Crow *	2	2	Common 1-26/100m	Cascade	FS	Brook trout present in SF Crow Lakes nearby	Protected
SF Quartz - Unnamed trib	2.5 0.7	2.5 0.7	Common 4-18/100m	Cascade	FS	None	Protected
SF Sixteenmile Headwaters	7.1	0.0	None, Treated in 2018, 2019, 2021	Concrete barrier	FS	Small population; Limited overwintering habitat	Protected
SF Warm Spring - Hogan	2.1 0.4	2.1 0.4	Rare 0.03-10/100m	Cascade potentially isolates upper 0.25 miles	FS	Brook trout present; small population size	At-risk
Specimen	1	0	Rare	None	FS & private	Brook and rainbow trout present; degraded habitat due to grazing; small population size	At-risk
Staubach	2	2	Rare to common 1-70/100m	Perched culvert	FS & private	Small population size; low density; grazing pressure	At-risk
Stemple	1.7	0	Unknown	Unknown	FS & BLM	None known	At-risk
Threemile	2.5	0	Unknown	Earthen dam	Private	Fish kill in 2017; Risk of illegal fish introduction; Potential housing development	At-risk
Whitehorse *	2.5	2.5	Rare 3-26/100m	Dry reach and cascades	FS & private	None	Protected
White - Spring Gulch - LH Fork	3.4 0.5	3.4 0.5	Common 7-58/100m	Precast concrete barrier replaced wooden crib in 2015	FS	None	Protected

[a] relevant to "mixed" populations where there are genetically unaltered and altered segments of the population that exist in the same stream.

[b] WCT population sizes were calculated by averaging 100 m population estimates from throughout the drainage and extrapolating to the number of river miles occupied.

Table 9.4. Actions required to maintain conservation populations in Upper Missouri River sub-basin.

Stream (s)	Population Status and Conservation Needs
Avalanche - Cooney	***Genetic Class/Threat Status:*** Genetically Altered/At Risk ***On-going projects:*** Population surveys were completed in 2008. Occasional WCT presence monitoring and EBT removals. ***Short-term (protect):*** A wooden head gate below Nary Time Gulch served as a fish barrier until Avalanche Creek flanked around the barrier in 2011. This barrier once protected the upper 4.3 miles of the Avalanche population from brook and rainbow trout, which along with WCT are found downstream of the barrier (8.2 miles of stream). Currently, there is no effective barrier and brook and rainbow trout can access the entire length of Avalanche Creek. However, lower Avalanche Creek below the FS boundary is chronically dewatered and may slow or prevent additional nonnative trout invasion. Recent observation (2016-2019) found that fish collected throughout Avalanche were highly hybridized. Recent genetic analysis from 2017 (need 2017 results) indicates that above Nary Time Gulch the population has experienced more rainbow trout introgression. It is anticipated that brook trout will eventually replace WCT unless removal efforts are initiated. Surveys to determine current WCT genetic status, and the feasibility of a toxicant or electrofishing removal project are necessary below Nary Time Gulch (8.2 miles of stream). The presence of highly hybridized fish would indicate need for barrier construction, a reduction in the reported size of the conservation population, and an increased urgency to remove nonnative trout from the system. ***Long-term (secure):*** Removal of brook trout and potentially highly hybridized trout in all or part of the stream (12-miles) would secure the population. Habitat improvements (recreation, road, grazing, and historic mining) could increase total population size. Placer mine reclamation is important but difficult to implement because operations are located primarily on patented lands outside of FS jurisdiction. Private landowner cooperation is needed to improve stream habitat condition. The Middleman Project hopes to address some grazing concerns including weed infestations, and improvement of dispersed campsites and road infrastructure that are sources of sediment delivery. Future work could also include improved aquatic organism passage and/or barrier placement. ***2020 Update:*** • Population Observations: 2002, 2008, 2009, 2011 • Genetic Observations: USFS 2017 • Barrier Observations: Not effective. Possibly a good time for improvement with middleman project USFS. • Land Management: Upcoming Middleman Project
Clancy - Kady	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** Since 2005 surveys have been used determine the current status (genetics, abundance, and distribution) of WCT and brook trout in Clancy Creek and Kady Gulch. Several hundred brook trout have been marked and released below a structure (below Clancy / Kady confluence) to determine its potential as a barrier and anchor point for brook trout removal efforts. This barrier more recently has shown to be ineffective. Historic mining activities (Montana Tunnels), grazing, and private land management continue to impact the fishery on Clancy and Kady Gulch. ***Short-term (protect):*** Recent surveys have indicated a retraction of the WCT population in Kady Gulch. Sampling efforts in the very headwaters of Clancy Creek in 2005 suggested that WCT are nearly extinct and may only be present in the extreme headwaters at very low numbers above mine effluent acting as a barrier to further upstream invasion by brook trout. Further surveys are needed to confirm possible WCT distribution in upper Clancy Creek. A barrier, and brook trout removal are necessary over approximately 2 miles of stream (all of Kady and lower Clancy) to protect the population. A structure currently exists (downstream of confluence of Kady and Clancy) which only acts as a partial barrier.

Stream (s)	Population Status and Conservation Needs
	Current livestock grazing on public lands and water quality issues related to historic mining require remediation. Genetic samples taken from Kady gulch in 2019 have created uncertainty in the purity of the population. The data strongly suggest that hybridization may be a recent phenomenon in Kady Gulch. ***Long-term (secure):*** Connection of the Clancy, Kady and SF Quartz populations could be possible with the construction of a barrier below Quartz creek and subsequent removal of established nonnative trout from about 8 miles of stream. Secured area would total about 10 stream miles, a large portion of which is on private property. The feasibility of a toxicant application and barrier construction for this potential project have not been assessed in detail, and there are no current plans to initiate the efforts. ***Additional notes:*** The Clancy Creek population is considered one of the most threatened conservation populations in the Upper Missouri sub-basin. There is potential this population will be used as a donor source to supplement fish moved into South Fork of Sixteen Mile creek. Only 0.3 miles of Clancy Creek and 1.2 miles of Kady Gulch are found on Federal lands. Since the majority of these streams are on private lands it poses a unique challenge for future WCT management. Remediation of Upper Clancy Creek affected by MT tunnels operations poses as one of the more difficult obstacles for e.g., Clancy Creek was placed in a 24" pipe in 2013 to prevent further erosion into a mine pit. There is active grazing on BLM lands and fuel reduction efforts on FS lands in upper Clancy Creek watershed. ***2020 Update:*** • Population Observations: 2004, 2011?? **Possibly extinct in Clancy, rapidly declining in Kady. • Genetic Observations: 2019 • Barrier Observations: Not effective *New barrier due to MT tunnels pipeline • Land Management:
Cottonwood (R4)	***Genetic Class/Threat Status:*** *Established/At-risk* ***On-going projects:*** in 2015, several EBT were detected and removed from the headwaters. The origin of these fish is unknown, but likely they were undetected in the system despite annual monitoring. In 2016, an effort was made to extirpate remaining EBT from the nearly eight miles of habitat upstream of the barrier but no EBT were detected, although the headwaters past the state boundary were not sampled at that time. In the spring of 2018, several WCT individuals were submitted for disease and AIS testing. ***Short-term (protect):*** Annual monitoring of the WCT population above the barrier should continue to ensure that any remaining EB are not given an opportunity to repopulate. Since this population was replicated in Upper Log Gulch Reservoir (2019), an opportunity now exists to use that population as a source of pure WCT that could be made available for future project needs. ***Long-term (secure):*** Very extensive sampling (including above the state boundary) to remove any remaining brook trout would secure the population.
Duck	***Genetic Class/Threat Status:*** Mixed/At-risk ***On-going projects:*** Recent population monitoring and genetic surveys. Grazing concerns are being addressed through allotment revisions. ***Short-term (protect):*** The upper section of Duck Creek (0.8 stream miles) is currently protected by a small waterfall, and only genetically unaltered WCT are present. The WCT population in this reach is likely fewer than 100 fish, and habitat condition is very poor due to extensive livestock grazing and small stream size – these issues indicate the population is at-risk. Better management of grazing (currently being implemented) and placement of pool-forming structures could result in increased WCT

Stream (s)	Population Status and Conservation Needs
	abundance; however, a minor stochastic event could lead to local extinction. As such, replication of this segment of the population should be considered a sub-basin priority. Brook trout, hybrid cutthroat trout, and genetically unaltered cutthroat trout are found below the natural barrier for 0.7 stream miles. Below this reach, stream flow is intermittent for several miles. Spring runoff through the intermittent reach permits invasion of nonnative trout in some years. Abundance of WCT in the lower reach is much higher than above the waterfall – a result of annual stream restriction and WCT dispersal from the upper reach. Placement of a permanent barrier in the lower reach of stream would be very difficult with no areas of valley constriction, and the remote location. Nonnative trout removal is feasible with electrofishing and could be employed to suppress their abundance; however, periodic re-invasions would be expected. Like the upper reach, better management of grazing (currently being implemented) and placement of pool-forming structures may help increase the abundance of this population; however, a minor stochastic event could lead to local extinction. ***Long-term (secure):*** Securing the population within Duck Creek would require removal of nonnative trout and placement of a barrier in the lower reaches of the drainage (below the intermittent reach and current extent of the population). Opportunities for such an effort have not been specifically explored, but periodic poor habitat conditions and private property are known issues. In the near term, replication of the population (above the waterfall) in a higher quality and more secure system should be a sub-basin priority. ***Additional notes:*** The Duck Creek population is considered one of the most threatened conservation populations in the Upper Missouri sub-basin. In 2011 there were changes to allotment boundaries and stocking numbers on the Gurnett Allotment. Duck Creek has been completely removed from the Gurnett Allotment. ***2020 Update:*** • Population Observations: 04 05 06 08 10 11 12 13 14 15 16 17 • Genetic Observations: 2017 • Barrier Observations: Reinforced in 2013 after EBT were found. Still potential for fish passage but no EBT present in 2014. (Check more recent data) • Land Management: See above
Dutchman - NF Dutchman - SF Dutchman	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** Since 2003 electrofishing has been periodically used to remove a small number of invading brook trout from a partially isolated 2.2-mile stream reach. These efforts were effective at removing existing brook trout (< 50); however, in recent years it appears additional invasions have occurred. The stream was last surveyed in 2018, with upper fish distribution determined in 2019. Potential design and location for construction of a "natural" waterfall barrier have been assessed (2019). ***Short-term (protect):*** Barrier placement / modification is necessary to prevent additional nonnative trout invasions into the upper reaches of Dutchman Creek. The existing partial barrier (cascades) could be modified to increase its effectiveness. Cost for such an effort has been estimated at near $100,000 due to the remote location of the site. In lieu of this, downstream barrier construction is more feasible and cost effective. Upon construction of a barrier, a toxicant project would follow, treating close to 4 miles of stream. This would require private landowner consent. Until a more secure barrier is constructed, periodic surveys are necessary to remove any nonnative trout that have invaded the upper reaches of the stream. ***Long-term (secure):*** The population can be expanded downstream approximately 3 miles to the confluence with Prickly Pear Creek, which would secure the population. This would require a substantial barrier near the confluence with Prickly Pear Creek, and removal of nonnative trout (brook and

Stream (s)	Population Status and Conservation Needs
	rainbow) from the lower 3 miles of stream. Given the wide flood plain and poor habitat conditions on the lower reach of Dutchman, building a barrier here would likely be unsuccessful. The lower portion of the project would be on private properties, while the upper portion lies on Forest Service ground. Observations suggest a toxicant or de-water project is feasible the lower reach. There is no opportunity to connect this population with others. ***Additional notes:*** Sixty-one age-1 and age-2 WCT were transferred from Dutchman Creek (one of three donor sources) to Whitehorse Creek (Elkhorn Mountains) in 2003 and 2004 to help establish a new population. ***2020 Update:*** • Population Observations: 99 02 03 04 05 06 14 15 18 19 • Genetic Observations: Updated 2018 • Barrier Observations: Explored barrier construction site downstream of FS • Land Management: Unchanged, no easy access to the public
EF McClellan	***Genetic Class/Threat Status:*** Genetically Altered/At-risk ***On-going projects:*** None ***Short-term (protect):*** Insufficient information is available to develop specific conservation plans for the EF McClellan population. The most recent surveys (2001, 2016) indicated WCT were relatively rare and outnumbered by brook trout. Removal of brook trout and placement of a barrier near the confluence with McClellan Creek would be the appropriate steps to protect the population. Genetic analysis of a 2016 sample showed McClellan Creek should be considered to contain hybrids between westslope cutthroat and rainbow trout with an appreciable (westslope = 95.3%, rainbow = 4.7%) amount of admixture. Surveys should be conducted to determine potential for nonnative trout removal and barrier placement. ***Long-term (secure):*** The population cannot be secured within EF McClellan because the stream is less than 3 miles in length. Conversion of the McClellan Creek drainage into a WCT would allow connection and securing of this population. However, because the McClellan Creek drainage includes two potentially unaltered populations (upper McClellan and Tepee creeks), a large-scale restoration would likely include removal of all hybrids in the system, including those in EF McClellan. There are no current plans to initiate restoration of WCT throughout McClellan Creek due to its status of a municipal water source, and likely issues related to toxicant use. ***Additional comments***: Originally, the only genetic surveys completed in the EF of McClellan were in 1988 (n=6 fish). These samples indicated 88.9% WCT, 11% YCT, and 0.1% RBT. The population is currently considered a conservation population because existing genetic information is insufficient to conclude the population is entirely < 90%. Analysis from a sample in 2016 provided conclusive evidence of hybridization between westslope cutthroat (95.3%) and rainbow trout (4.7%) and no evidence of hybridization between westslope and Yellowstone cutthroat trout. ***2020 Update:*** • Population Observations: 1999 2001 • Genetic Observations: EF= 2016 • Barrier Observations: None • Land Management: Unchanged
Elkhorn (R4) - NF Elkhorn	***Genetic Class/Threat Status:*** Genetically Altered/At-risk

Stream (s)	Population Status and Conservation Needs
	On-going projects: In 1972, a gabion fish barrier was constructed in the lower reaches of Elkhorn Creek. Piscicides were used to remove hybridized WCT from above the constructed barrier. The treated reach of stream naturally re-colonized from an extant source of non-hybridized WCT in the headwaters of Elkhorn Creek. Genetic samples collected in 1996 one mile below the upper forks indicated that the Elkhorn Creek population was still non-hybridized. In 2002, genetic samples indicated a recent hybridization event had occurred. A sample collected from the same area in 2008 revealed that the WCT population in Elkhorn Creek had become a hybrid swarm. In addition, a single brook trout was captured upstream of the gabion fish barrier during genetic collections in early 2008. It has determined that site characteristics, primarily lack of incisement and beaver activity, would preclude the original site from consideration for barrier retrofit. An alternate barrier site was identified much further upstream and features bedrock control points and a narrow-incised channel. A barrier design and cost opinion was developed by EMC2 Engineering in 2008 (Funded by PPL Montana). A barrier was installed in 2012, all trout were mechanically removed upstream of the barrier from 2013-2015, and WCT (via Sun Ranch; Whites Gulch WCT) eggs were placed in RSI's in 2016 and 2017. ***Short-term (protect):*** After a barrier was constructed on Elkhorn Creek in 2012, and because the fish upstream of the barrier tested only approximately 87% pure for WCT genetics, suppression of all fish (RBs and WCT X RB hybrids) upstream of the barrier has occurred annually. Results from suppression have been promising- about 1000 fish removed in 2014, and about 200 fish removed in 2015. Additionally, this area is being swamped with WCT genetics obtained from the Sun Ranch brood stock (primarily this stock was derived from the Upper Missouri River Drainage). In 2014 and 2015, RSI's were filled with up to 10,000 eyed eggs each year; this occurred again in 2016. Annual suppression/swamping efforts should continue in order to reduce the percentage of genetic hybridization, competition and predation. If non-hybridized WCT are present in the upper reaches they will be preserved. If not, the entire upper reaches of Elkhorn Creek may need to be treated and restored with non-hybridized WCT obtained from another stream. ***Long-term (secure):*** Expansion of non-hybridized Elkhorn Creek WCT downstream (its original extent) is not feasible; areas of stream below the current barrier are likely too complex to effectively treat with piscicides, the old barrier site would likely pass fish at extreme flow events, and with continued beaver activity. Continue monitoring as necessary.
Eureka - Longfellow - Tin Cup - Teakettle	***Genetic Class/Threat Status:*** Genetically Unaltered/Protected ***On-going projects:*** Continued monitoring. ***Short-term (protect):*** No effort necessary to protect the population; though excess livestock disturbance of the riparian area is common, and grazing management options should be considered. ***Long-term (secure):*** Because the Eureka drainage is isolated above a waterfall there is no potential to secure the population through expansion. The drainage may eventually support 800 – 1500 WCT. Some habitat improvement may increase overall fish abundance, but periodic genetic supplementation may be necessary to maintain fitness over the long-term. ***Additional comments:*** WCT eggs (n=799) were introduced to this historically fishless stream between 2001 and 2003. Prickly Pear Creek (Upper Missouri Sub-basin, Elkhorn Mountains) was the donor stream for the project. The introduction included gametes from 29 individuals. Natural reproduction has been observed in Eureka Creek since 2004, and the population is considered abundant in the upper reaches of the drainage. ***2020 Update:*** • Population Observations: 00 01 02 03 05 06 07 08 09 14 18 Stable • Genetic Observations: None Established • Barrier Observations: Unchanged/functioning

Stream (s)	Population Status and Conservation Needs
	• Land Management: Unchanged
Fool Hen (R4)	***Genetic Class/Threat Status:*** Unknown/Unknown ***On-going projects:*** None ***Short-term (protect):*** Insufficient information is available to determine status of the Fool Hen population or its management needs. No genetic samples have been collected. Preliminary surveys in 2005 indicated WCT are likely isolated from brook trout by high gradient and dry stream reaches. Additional surveys should be conducted to determine current population status, genetics, distribution, potential threats, presence of barriers, or where a barrier may be placed. ***Long-term (secure):*** There is no opportunity to secure the population within Fool Hen Creek because the length of the stream is < 2 miles. The stream is also a tributary to Virginia Creek which has been identified as having no current WCT restoration potential. If the population is found to be genetically unaltered, it should be a sub-basin priority to replicate it in a larger and more secure system.
Greyson	***Genetic Class/Threat Status:*** Altered/At-risk ***On-going projects:*** Population and genetic surveys were completed in 2007, 2008, and 2010. ***Short-term (protect):*** Genetic status of the population was determined to be altered in 2008 and 2010. These results showed to population to be 97.5%WCT and 2.5%RB. Insufficient information has been collected to identify necessary conservation measures, although known threats include presence of brook trout, small population size, and excessive livestock grazing on private and FS lands. Investigations of the downstream extent of the population (on private property), potential for brook trout removal, and barrier placement are necessary. Improved livestock grazing methods or exclosures are necessary. The stream is very small (< 2 ft wetted width), and removal of current threats may not remove the "at-risk" status due to small population size. If the population is found to be genetically unaltered, it should be a sub-basin priority to replicate it in a larger and more secure system. ***Long-term (secure):*** Insufficient information is available to determine if the population can be secured. Downstream expansion of the population would require removal of nonnative trout, a barrier, and access to private land. ***Additional notes:*** Primarily Private. Only a small portion on FS lands but, The Deep Grassy Allotment Management Plan will include allotment recommendations to improve stream conditions in upper Greyson Creek. ***2020 Update:*** • Population Observations: 08 09 10 • Genetic Observations: 2010 • Barrier Observations: Unknown • Land Management: Primarily Private
Hall	***Genetic Class/Threat Status:*** Genetically Unaltered/Protected ***On-going projects:*** Gametes have been collected from the Hall Creek population and introduced to Little Tizer Creek (combined with Prickly Pear gametes) and incorporated into the Sun Ranch Brood. Received WCT from SF Quartz as part of a genetic rescue study (Bell). ***Short-term (protect):*** The Hall Creek population is currently protected. Two culvert barriers (each about 100 ft in length) have prevented invasion of brook and rainbow trout. Habitat conditions are generally

Stream (s)	Population Status and Conservation Needs
	excellent, however, livestock grazing within the drainage requires annual monitoring. Excess livestock damage has not been recently observed. A popular campsite is located on the stream and may result in a greater likelihood of nonnative trout introduction. Population surveys should be maintained in order to detect changes in population status and presence of nonnative trout. ***Long-term (secure):*** With barrier placement and removal of nonnative trout the Hall Creek population could be expanded downstream approximately 0.5 miles to the confluence of Crow Creek, but this would not result in a secure status. There are currently no plans to restore WCT to the lower reaches of Crow Creek. ***2020 Update:*** • Population Observations: 99 2000 01 02 03 07 14 15 2017 and 2018 genetic rescue sampling (See D.Bell report) • Genetic Observations: 2007 2017 and 2018 genetic rescue sampling (See D.Bell report) • Barrier Observations: Unchanged/Functioning • Land Management: Unchanged
Little Tizer	***Genetic Class/Threat Status:*** Genetically Unaltered/Protected ***On-going projects:*** WCT eggs (n=3176) were introduced to this historically fishless stream between 2002 and 2006. Donor streams for the project were Hall and Prickly Pear creeks in the Elkhorn Mountains and Ray Creek from the Big Belt Mountains (all Upper Missouri sub-basin populations). ***Short-term (protect):*** No effort necessary to protect the population. Continued monitoring is necessary to determine if a viable population will persist. The stream may eventually support 300 – 500 WCT in 1.3 miles of stream. ***Long-term (secure):*** Because the Little Tizer Creek is isolated above a waterfall there is no potential to secure the population through expansion. The stream is also a tributary to Crow Creek, a drainage which is currently considered too complex for a WCT restoration effort. Periodic genetic supplementation may be necessary to maintain fitness over the long-term. ***Additional comments:*** Egg survival in the 4 years of introduction to Little Tizer Creek were highly variable due to cold stream temperatures; as a result, it is currently unknown if a viable WCT population will persist. Additional introductions are not recommended unless they are necessary to supplement the genetics of a naturally reproducing population. ***2020 Update:*** • Population Observations: 00 03 05 07 08 09 10 12 13 14 • Genetic Observations: Established • Barrier Observations: Unchanged/functioning • Land Management: Unchanged; Cold water due to aspect and canopy cover.
Log Gulch, Upper Reservoir (R4)	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** Fish transfer occurred in early May 2019, in which 86 pure WCT were taken from two locations upstream of a barrier on Cottonwood Creek in the Beartooth Wildlife Management Area, and relocated to the reservoir. ***Short-term (protect):*** The WCT population should be monitored in the future to assess how much predation occurs, and whether the WCT are able to reproduce naturally unlike the LL population. If/when it is ascertained that the WCT are able to naturally reproduce in the system, another transfer of at least 80 more individual WCT from Cottonwood Creek should occur again in order to increase the genetic diversity of the population and reduce Founder's effects.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): Continued monitoring of brown trout, with removals to ensure this population ages out and is not a continued source of predation/competition. If all goes as planned and this population can persist in the reservoir, it will be a good candidate to provide a pure WCT donor population to be used in future projects in other areas.
Magpie	***Genetic Class/Threat Status:*** Genetically Altered/At-risk ***On-going projects:*** Population and sediment monitoring surveys from 2002-2008 after 2000 Cave Gulch fire. Nonnative trout expansion monitored post Cave Gulch fire (2012-2017). ***Short-term (protect):*** Prior to the Cave Gulch fire in 2000, the Magpie Creek population was protected by an intermittent stream reach. The fire increased the extent and duration of flow throughout the Magpie drainage, leading to expanded brook and rainbow trout distribution into reaches that were previously fishless. Surveys through 2008 had not detected nonnative species within the WCT conservation area. However, USFS surveys (2015-19) have detected nonnative trout within WCT area. A barrier site has been identified near Washout Gulch; however, nonnative trout are believed to persist above the location and a removal effort would be necessary after barrier construction. Mechanical removal used to be a feasible option owing to the small size of the stream and short reach. It is now believed that nonnative trout are well distributed above this location and mechanical removable may not be realistic anymore. ***Long-term (secure):*** In addition to the constraints of the intermittent reach, Magpie Creek is a tributary to Canyon Ferry Reservoir, therefore there is no opportunity to expand the population beyond its current distribution (3.9 miles) or to a secure status. ***2020 Update:*** • Population Observations: 04 05 06 08 09 10 12 (12-17 USFS) • Genetic Observations: 2004, 2017 pending • Barrier Observations: difficult logistics • Land Management: Unchanged
McClellan - Tepee	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** Since 2003 electrofishing has been used to annually remove brook trout from sections of McClellan and Tepee creeks. Unaltered WCT are being used as a control for a genetics rescue study (D. Bell). ***Short-term (protect):*** While considered a single conservation population, the McClellan and Tepee creek population segments currently function separately (isolated by 0.5 miles of stream and partial barriers). The McClellan Creek segment is currently isolated by a partial, natural log barrier. A small number of brook trout have been found above the barrier and removed with electrofishing. Annual surveys were conducted with removals until 2009, which led to WCT recovery. However, EBT concentrations increased again in 2011. A cascade barrier near the mouth of Tepee Creek is not 100%, and brook trout may negotiate the structure during some flows. Annual electrofishing removal efforts have been used to suppress brook trout abundance in Tepee Creek, and an eradication could be achieved if a more effective barrier is constructed. In order to protect both segments of this population, the installation of one or more barriers and effective nonnative trout removal efforts will be necessary. Cursory evaluation of barrier opportunities below the confluence of the streams (near Willard Creek) indicates barrier potential in this reach of stream is low due to the remote site and large size of the stream and valley. A barrier specialist should

Stream (s)	Population Status and Conservation Needs
	evaluate the drainage for barrier opportunities including fortification of the existing structures on the Tepee and McClellan segments. Management priorities for the conservation population include: periodic surveys of McClellan to monitor barrier effectiveness and to remove invading of brook trout; continued suppression of brook trout in Tepee Creek; modification of existing barrier in Tepee Creek to improve performance in all flows; and evaluation of additional barrier and nonnative trout removal opportunities below the confluence of the streams. ***Long-term (secure):*** The McClellan population would be secured with construction of a barrier and removal of nonnative trout below the confluence of Tepee and McClellan Creeks. Barrier construction would be problematic in this reach of stream do to size of the drainage and remote location. ***Additional Comments:*** The McClellan Creek drainage is a municipal watershed, which may limit potential use for toxicants; however, nonnative trout have been effectively removed in short reaches of the drainage with electrofishing. Genetic status of the population is uncertain due to inconsistencies in results from Tepee Creek that have shown slight hybridization with YCT. The present allele could be a WCT variant or true hybridization (made more likely with the presence of YCT hybrids lower in the drainage). Additional genetic analysis should be completed prior to use of the population as a donor. As a genetically altered conservation population the EF of McClellan Creek could be considered a threat to the McClellan population, and its removal may be warranted if barrier (s) are not established to isolate the McClellan / Tepee creek reaches. ***2020 Update:*** • Population Observations: 99-01 03-09 11 12 14 15 2017 and 2018 genetic rescue sampling (See D.Bell report) Teepee: 99 01 03-06 08-12 14 EBT removals until 2009 leading to WCT recovery. EBT bounced back to higher concentration in 2011. • Genetic Observations: 2006 Mclellen. (D.Bell report 17 18) 2007 Teepee. • Barrier Observations: Unchanged. Teepee: 2011 barrier failure. • Land Management: Unchanged
NF Gurnett - Unnamed trib	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** 2 culvert barriers removed on FSR 4179 under the Big Belts Travel Plan. Area located within the Boulder-Baldy Vegetation Project area, implementation 2022-2023. ***Short-term (protect):*** Although recent surveys have not been conducted NF Gurnett Creek, threats to the population are known to include brook trout (and potentially hybrid trout), poor habitat conditions, and small population size. Additional surveys are necessary to develop projects (barrier, brook trout removal, habitat improvement) that could address these threats. The stream is very small (< 3 ft wetted width), and removal of current threats may not remove the "at-risk" status due to small population size. Expanding the population is likely necessary to protect it. ***Long-term (secure):*** Securing the NF Gurnett population would require downstream expansion into the mainstem of Gurnett Creek (private and state property). A barrier and removal of nonnative trout would be necessary, but potential for these have not been assessed. ***Additional notes:*** The NF Gurnett population is considered genetically unaltered; however, the most recent genetic analysis (n=20; 2001) indicated one fish of highly hybridized origin (YCT). This fish was the only fish captured in lowest reach sampled in NF Gurnett (RM 1.55) in 2001. The source of this

Stream (s)	Population Status and Conservation Needs
	hybridized fish is unknown. ***2020 Update:*** • Population Observations: 86 01 • Genetic Observations: 2001 • Barrier Observations: none • Land Management: Unchanged
Page (R4)	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** None ***Short-term (protect):*** Insufficient information is available to develop a specific conservation plan for the Page Gulch population. The population is considered genetically unaltered based on 6 samples collected in 1997. The Stemple Road crossing (culvert) is believed to be a partial barrier, and additional investigations should be conducted to determine if this can be modified to a complete barrier. Brook trout are present and require removal. New surveys should be completed to determine current population status (including genetics), ability to remove brook trout, additional threats, presence of barriers, or where a barrier may be placed. ***Long-term (secure):*** There is no potential to secure the population within Page Creek. Page Creek is short (< 1 mile) and is a tributary to Virginia Creek where there is no current WCT restoration potential. If additional genetic samples indicate the population is unaltered, then this becomes a high priority to replicate the population in a larger and more secure drainage.
Porcupine (R4)	***Genetic Class/Threat Status:*** Mixed/At-risk ***On-going projects:*** None ***Short-term (protect):*** Surveys in 1997 indicated a short-isolated reach (0.5 miles; unknown barrier) of Porcupine Creek that maintained genetically unaltered WCT (4 fish sample). Additional genetic samples indicted highly hybridized fish below the isolated reach. No barriers were found in surveys in 2001, however, only WCT or hybrid trout were found in the uppermost reaches of the stream, while rainbow, hybrids (based on visual appearance) and brook trout were found in lower reaches. Prior to development of specific conservation plans additional surveys are necessary to determine current population status (distribution, abundance and genetics), and whether nonnative trout removal and barrier efforts are feasible. ***Long-term (secure):*** The total length of stream occupied by trout in Porcupine Creek is < 2 miles; therefore, securing the population would require a much larger effort that includes restoring WCT to the entire upper Beaver Creek drainage, which includes several tributaries including Porcupine Creek. This potential project has not been explored in detail but has been identified sub-basin WCT restoration opportunity requiring additional analysis.
Prickly Pear	***Genetic Class/Threat Status:*** Genetically Unaltered/Protected ***On-going projects:*** None. ***Short-term (protect):*** The Prickly Pear population is currently protected by cascades that prevent invasion of brook trout found below. Periodic monitoring should be completed to detect any invasion or illegal introduction of nonnative trout and to monitor the populations status. The Prickly Pear road has been a source of sediment to the stream, and remediations should be considered.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): There is the possibility of expanding the Prickly Pear population downstream 2 – 4 miles; however, this project has not been explored in detail. The project would require removal of nonnative trout and a barrier on what is primarily private lands. A fishless reach upstream of the current population has been deemed too cold to support an introduced population. This should be revisited with an updated temperature analysis. ***Additional comments:*** Gametes from the Prickly Pear Creek conservation population were used to establish WCT in historically fishless Eureka Creek (2001) and combined with gametes from Hall and Ray creeks to establish WCT in historically fishless Little Tizer Creek (2002). ***2020 Update:*** • Population Observations: 99 00 01 02 03 09 • Genetic Observations: 2010 • Barrier Observations: Unchanged • Land Management: Unchanged
Ray	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** Significant brook trout presence discovered above the perched culvert barrier. Early surveys in 2020 indicate reproduction of EBT above ineffective barrier. Further sampling is needed to determine extent of nonnative trout invasion. ***Short-term (protect):*** The Ray Creek population went from protected/secure to at-risk with the failure of culvert barrier. A perched culvert on private property was thought to isolate the stream from brook trout. A short intermittent reach above the culvert is likely protection for the uppermost population of WCT, with no EBT observed in 2019 above here. Monitoring throughout the WCT distribution should be completed to detect nonnative trout distribution. There is potential for upgrades to one or more perched culverts in order to create a true barrier. ***Long-term (secure):*** The population is no longer considered secure. Prospects for additional downstream expansion of the population is prevented by intermittent stream flow. ***Additional comments:*** The Ray Creek conservation population is among the largest and most robust populations in the assessment area. Gametes have been collected from the Ray Creek population for introduction to Little Tizer Creek (2006) and Cherry Creek (2007), and for incorporation into the Sun Ranch Brood. Multiple sources, including Ray Creek, were also used in a live fish introduction to Whitehorse Creek (2003). ***2020 Update:*** • Population Observations: 01 02 03 06 07 09 19 • Genetic Observations: 2009 • Barrier Observations: Perched culvert failure, EBT passage observed. • Land Management: RMEF purchase of Nield Ranch on upper section.
Rooster Bill (R4)	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** None ***Short-term (protect):*** The Rooster Bill population was last survey in the early 1990's. At the time, the Stemple Creek Road crossing (culvert) was identified as a complete barrier isolating the population in 1.2 miles of stream; however, brook trout were also abundant above the culvert. Prior to development of specific conservation plans additional surveys are necessary to determine current population status (distribution, abundance and genetics), and whether nonnative trout removal and barrier efforts are feasible.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): There is no opportunity to secure the Rooster Bill population because the length of the stream is < 2 miles. The stream is a tributary to Virginia Creek which has been identified as having no WCT restoration potential. If the population is found to be genetically unaltered, it should be a sub-basin priority to replicate it in a larger and more secure system.
Silver Creek (R4) **-** Sawmill Gulch	***Genetic Class/Threat Status:*** Genetically Altered/Protected (Sawmill Gulch segment) ***On-going projects:*** None ***Short-term (protect*)**: A very large culvert on Sawmill Creek under an old abandoned railroad line on BLM lands may present a partial barrier at high flow- needs evaluation. WCT in Sawmill Creek extend above the culvert currently for about ½ mile on BLM land. Minor to moderate livestock grazing impacts are present on various reaches of Sawmill-conduct more intensive review to determine overall risk from grazing on Sawmill Creek. Additional survey on Silver Creek to address risks associated with disconnected habitat due to unidentified barriers and old mining impacts. **Long-term (secure):** There is over 1 mile of occupied habitat in Sawmill and about 4.5 miles of mostly connected habitat between Sawmill and Silver Creek. This population will likely persist at low population levels throughout the 5 miles of occupied habitat even with the degraded habitat conditions due to the absence of nonnative fish interactions. Due to the extent of habitat degradation and potential for future mining proposals this drainage may not be a priority for extensive habitat improvement. Severe placer/dredge mining impacts with entrenchment of the stream channel occurs t portions of Silver Creek for several miles from its headwaters near Marysville. Mercury contamination of fish flesh is present.
Skelly (R4) - East Skelly	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** Monitor livestock drift fences installed in 2008 to reduce grazing impacts. Periodic mechanical removal, via electrofishing, of brook trout above culvert fish barrier installed in 2011. ***Short-term (protect):*** Drift fences installed in 2008 corrected an ongoing problem with unauthorized livestock on Forest Service reaches of Skelly Gulch, however, downstream grazing impacts remain extreme on private land. Annual reviews need to be conducted to ensure fence integrity is maintained. East Skelly (private) where grazing impacts are believed to be extreme, should also be reviewed annually. A culvert fish barrier was installed in 2011, but brook trout remain present in the system and require periodic mechanical removal. Periodic fish surveys are needed to determine the extent of brook trout distribution. ***Long-term (secure*)**: Long- term security will require periodic brook trout removals above the culvert fish barrier. Approximately 5-miles of habitat is available for WCT upstream of the current culvert barrier location. Periodic fish surveys are needed to determine the extent of brook trout distribution.
SF Crow	***Genetic Class/Threat Status:*** Genetically Unaltered/Protected ***On-going projects:*** WCT eggs (n=3,912; 51 donating individuals) were introduced to this historically fishless stream in 2005 and 2006. Muskrat Creek (Elkhorn Mountains; Boulder sub-basin) was the donor stream for the project. The population should eventually maintain 300 – 500 fish over 1.4 miles of stream.

Stream (s)	Population Status and Conservation Needs
	Short-term (protect): No effort is necessary to protect the SF Crow population. It appears that sampling shows persistence of viable population. Continued monitoring is necessary to determine if the population will persist, and to monitor continued performance of the natural barrier that prevents ingress of brook trout found downstream. The cascade barrier is not substantial. Additional introductions of fish or gametes could be necessary in the future to maintain the genetic integrity of the population. ***Long-term (secure):*** The population could be extended 4 – 5 miles downstream with removal of brook trout and barrier construction lower in the SF Crow drainage. This area includes a popular recreational fishery (SF Crow Lakes) and has not been considered for WCT restoration. The lakes contain EBT and RB and could potentially pose as a threat to the adjacent WCT reach. More scouting is needed in order to understand this dynamic. ***2020 Update:*** • Population Observations: 04 06 07 08 09 10 11 13 14 15 • Genetic Observations: Established from genetically unaltered pop. • Barrier Observations: Lakes pose possible invasion threat. • Land Management: Unchanged
SF Quartz - Unnamed trib	***Genetic Class/Threat Status:*** Genetically Unaltered/Protected ***On-going projects:*** Selected as donor source in 2017 for Hall and Staubach as part of a genetic rescue study (D. Bell). ***Short-term (protect):*** A barrier (high gradient reach) protects (from brook trout) the upper 2.0 miles of the population. WCT extend downstream an additional 0.4 miles into a reach also occupied by brook trout (WCT above and below the barrier have been tested as genetically unaltered). It may be possible to protect this lower 0.4 mile reach with a barrier at an existing road crossing, and removal of brook trout with either toxicants or electrofishing. Below the existing WCT distribution the stream enters a meadow and decadent beaver pond complex where brook trout removal would be difficult, and the NF Quartz enters the system (occupied by brook trout). ***Long-term (secure):*** The SF Quartz Creek population could be expanded downstream an additional 1.5 miles if brook trout could be removed from the beaver pond complex and if a barrier was placed near the stream mouth on Quartz Creek. This project would also capture the NF Quartz Creek, which is an additional 2.0 stream miles (currently occupied by brook trout). A larger effort, primarily on private property, would be to combine the Clancy, Kady, and NF Quartz creek populations by placing a barrier on Clancy Creek downstream of Quartz Creek and removing established nonnative trout. The feasibility of a toxicant application and barrier construction in these reaches of stream have not been assessed in detail, and there are no current plans to initiate the efforts. ***Additional notes:*** Population, health and genetic surveys completed in 2007 and 2008. Transfer of fish from SF Quartz to Crazy Creek (Elkhorn Mountains, Upper Missouri sub-basin) is scheduled for 2009. ***2020 Update:*** • Population Observations: 01 07 08 12 2017 • Genetic Observations: 2017 • Barrier Observations: Unchanged • Land Management: Unchanged
SF Sixteenmile Headwaters	***Genetic Class:*** Fishless TBD2020/Protected

Stream (s)	Population Status and Conservation Needs
	On-going projects: Fish toxicant projects starting in 2018 with a follow up partial treatment in 2019. Given the results of extensive electrofishing surveys in 2020, a third treatment may be necessary. Donor sources will be evaluated and chosen from other WCT populations in the Upper Missouri River Basin. ***Short-term (protect):*** Extensive electrofishing is required to determine if the treatments were successful. There may be potential for eDNA analysis if funding is available. ***Long-term (secure):*** With the installation of a concrete barrier in October of 2015, there is over 7 miles of habitat protected from nonnative trout invasion. Given the potential for distribution, this population could one day be considered secured. However, small stream size may limit the population from reaching the minimum 2,500 fish for this classification. Due to isolation and down stream private landowners, there was no potential to expand WCT distribution by constructing the barrier downstream of the selected site. ***Additional comments:*** Extensive data collection leading up to the treatments (2013-2019). WCTxRB ranged from 27 to 122 fish/meter. ***2020 Update:*** • Population Observations: Now potentially fishless, ongoing evaluation. • Genetic Observations: Full treatment in 2018, partial treatment on western half 2019. • Barrier Observations: Concrete barrier construction October 2015. • Land Management: Unchanged
SF Warm Springs - Hogan	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** Since 2002 electrofishing has been used to annually remove brook trout from a 1.6-mile reach of SF Warm Springs Creek. Based on surveys in the fall of 2008, brook trout abundance was reduced by > 95% due to these efforts. A wooden dam was added to an existing cascade in 2002 to increase its function as a barrier, however, it is unknown if the modified structure is a complete barrier during high discharges. Suppression efforts after the barrier construction continue, however, there has been little success with eradicating brook trout. Recent observations have seen a significant retraction in WCT presence, and the population is at high-risk of extirpation. ***Short-term (protect):*** Eradication of brook trout and construction of complete barrier are necessary to protect the SF Warm Springs population. Habitat is considered excellent. Recent efforts have not been successful at significantly reducing the brook trout in the system, and removal with a toxicant should be considered in addition to mechanical suppression efforts. Construction of a more effective barrier has been difficult due to remoteness of the barrier site and an uncooperative landowner. As resources allow, brook trout suppression efforts should continue and upgrades to the barrier should be made. ***Long-term (secure):*** The SF Warm Spring population could be expanded downstream through the lowest reaches of SF Warm Springs Creek, and into the mainstem of Warm Springs Creek to its confluence with Prickly Pear Creek (up to 3.5 stream miles). Warm Springs Creek flows entirely through highly developed private land. The feasibility of nonnative trout removal and barrier placement in these lower reaches have not been reviewed and are not currently being considered. A small reach (0.5 miles) of upper SF Warm Springs Creek (immediately above the existing population) is currently isolated by a waterfall and is fishless. Habitat conditions in this section of stream, including temperature, appear favorable for WCT. While the reach is short it may provide an opportunity to increase the number of fish in the population if brook trout removal is not successful in the lower reaches. ***Additional notes:*** WCT are the only species present in isolated but short sections of upper SF Warm Springs Creek and Hogan Creek. In SF of Warm Springs Creek, a small cascade isolates about 300 ft of stream from brook trout. Similarly, a 1000 – 2000 ft reach of Hogan Creek is isolated by a 150 ft high gradient / boulder field reach located near the stream mouth. The number of WCT in both sections of

Stream (s)	Population Status and Conservation Needs
	stream is believed to be < 100. The WCT population below these isolated reaches (i.e., those co-existing with brook trout) have not increased in abundance (< 50 fish) or distribution (< 2000 ft) since initiation of the removal effort (> 95% EBT reduction). Potential reasons for poor population growth include continued presence of a small number of brook trout; consecutive years of poor spawning conditions / success; or a genetically limited population. ***2020 Update:*** • Population Observations: 01 02 03 04 05 06 07 08 09 10 14 15 (USFS EBT removals…….) WCT declining. • Genetic Observations: 2001 • Barrier Observations: Ineffective • Land Management: Unchanged
Specimen (R4)	***Genetic Class/Threat Status:*** Genetically Altered/At-risk ***On-going projects:*** Population information collected in 2007 and 2008. ***Short-term (protect):*** Based on information from recent surveys the Specimen conservation population may be near extirpation. Sampling conducted in 2008 in relation to sampling in the 1990s and 2002 indicates that brook trout have essentially replaced WCT. Brook trout are currently present throughout the entire reach earlier occupied by WCT and only one WCT was found in 2008. Restoration would require immediate removal of brook trout, placement of a barrier, and improved grazing practices for reaches sustaining impacts from domestic livestock grazing. Additional surveys are necessary to evaluate and develop conservation strategies and to determine if a conservation population persists. ***Long-term (secure):*** Based on sampling efforts in 2008 and habitat reviews in 2007 it is likely that a reintroduction of WCT in Specimen Creek would be necessary along with barrier construction within Specimen Creek near the confluence with Canyon Creek, removal of brook trout, rainbows, and hybrid trout, and improved grazing practices. Available habitat in Specimen Creek is about 2 miles, therefore increasing the distribution of the population to a secure status would require expansion into Canyon Creek; which is not very feasible. Thus, at best Specimen Creek could be managed as an isolate population. Canyon Creek has low potential for WCT management unless an intensive nonnative salmonid removal program were to be undertaken. Brook trout extend into the extreme headwaters of Canyon Creek upstream of Highway # 279 crossing (a total of 5 miles upstream of the confluence with Specimen Creek). Brook trout also are present in three unnamed tributaries to Canyon Creek upstream of the Highway #279 crossing. Brook trout are also common in Big Sawmill Creek. Rainbow trout are also present in Canyon Creek in the vicinity of the confluence of Specimen Creek with Canyon Creek.
Staubach	***Genetic Class/Threat Status:*** Genetically Unaltered/At-risk ***On-going projects:*** Received WCT from SF Quartz as part of ongoing genetic rescue study starting 2017 (D. Bell). ***Short-term (protect):*** Although WCT have been isolated from brook trout in Staubach Creek, the population remains "at-risk" due to small population size and poor habitat conditions. There was an immediate response from the population to brook trout eradication, from 42 to about 200 fish in the population by 2002; however, the number and distribution (about 0.5 stream miles) of WCT have not increased since. Failure of the population to disperse downstream into currently fishless habitat (over 1 mile of stream) indicates the population may be genetically limited, or habitat is not favorable in that reach of stream (though the reach previously supported a robust brook trout population). Monitoring of the barrier and population status should continue annually. Genetic supplementation has occurred, and response is being monitored closely as part of the genetic rescue study.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): Habitat below the current barrier is marginal (reduced stream flow), but it cannot be excluded as a potential restoration area to help increase the distribution of the Staubach population. A barrier and removal of nonnative brook trout would be required. In total, about one mile of habitat could be developed for WCT, but this effort would not secure the population as total occupied habitat would be < 3 miles. If WCT abundances increase substantially, the population should be considered a sub-basin priority for replication (likely mixed with other populations). ***Additional comments:*** Through placement of a barrier (perched culvert) and multiple-pass electrofishing (starting in 2000) brook trout were eradicated from a 1.6-mile reach of Staubach Creek in 2004. A fenced exclosure and spring developments have been used to reduced livestock grazing impacts in the riparian area. Genetics and whirling disease studies were done in 2009 to help identify potential causes of poor population growth. ***2020 Update:*** • Population Observations: 00 01 02 03 04 05 06 08 12 15 (Genetic rescue 2017, 2018 see D. Bell report) Upper population is stable, lower population near barrier remains minimal. • Genetic Observations: 2016 (see D. Bell report) • Barrier Observations: Unchanged (barrier eval 2018) • Land Management: Unchanged
Stemple (R4)	***Genetic Class:*** Genetically Altered/ Unknown ***On-going projects:*** None. ***Short-term (protect):*** Insufficient information is available to develop a specific conservation plan for the Stemple Creek population. Surveys in 2002 did not detect presence of brook trout within the reach of stream occupied by WCT, which suggests the Stemple Creek road crossing is a barrier. Additional surveys should be conducted to determine current population status, genetics, distribution, potential threats, presence of barriers, or where a barrier may be placed. ***Long-term (secure):*** There is no opportunity to secure the Stemple population because the length of the stream is < 2 miles. The stream is a tributary to Virginia Creek which has been identified as having no WCT restoration potential.
Threemile (R4) **-Reservoir; creek upstream of Reservoir**	***Genetic Class/Threat Status:*** Genetically Unaltered/Unknown ***On-going projects:*** From 2004 to 2005, 45,779 illegally introduced white suckers were removed from Three Mile Creek Reservoir (Hardie Pond; lower extent of the WCT population) to try to buoy its rapidly declining WCT population. In 2004, mark recapture estimates indicated that Hardie Pond held approximately 141 WCT. In 2005, white suckers were eradicated from Three Mile Creek and its reservoir using rotenone. Prior to treatment, forty-two WCT were transferred from Hardie Pond to Fosket Pond. Thirty-one of the transferred fish were moved back to Hardie Pond following treatment. 2.5 miles of Three Mile Creek is habitable and likely supports 150 to 200 individual WCT. The majority of Three Mile Creek and its pond are located on private property and the risk to the population remains high. (Fish kill, livestock grazing, harvest, and potential for illegal transfers). ***Short-term (protect):*** In the future, adipose clipped triploid WCT from the Washoe Fish Hatchery in Anaconda may be used as sentinel fish to verify whether the fish mortality event was an infrequent occurrence caused by a unique set of circumstances or if current environmental conditions in the reservoir prevent fish survival. If the sentinel fish survive, the reservoir could potentially be replanted with pure WCT from a nearby donor population. Cottonwood Creek WCT (Upper Missouri River Drainage/Beartooth WMA) would be the likely donor population to reintegrate Threemile Creek/Reservoir WCT genetics back into the drainage. A concerted effort to educate old and new landowners of the rarity and importance of the Threemile population should be initiated.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): Investigate the late 2010's die off and initiate reintroduction efforts using Cottonwood Creek or other applicable fish sources. The proximity of Threemile Creek to numerous private in holdings means this population will never be secure from illegal non-native fish transfers. ***Additional comments:*** An unknown mortality event occurred in this reservoir in either 2017 or 2018. It is possible this was caused by an algal bloom and successive anoxic conditions driven by excessive nutrient loading from upstream agricultural land use. Water pollution and fish health parameters were tested and came back negative. The source of the mortality event remains unknown.
Whitehorse	***Genetic Class/Threat Status:*** Genetically Unaltered/Protected ***On-going projects:*** None. ***Short-term (protect):*** No effort necessary to protect the population. Continued monitoring necessary to determine if a viable population has been established. Sampling in 2015 seems to indicate successful establishment of a viable population. Additional sampling is needed to confirm or deny the population status. A low level of about 2.5 WCT/100ft was found in 2011-13 and a bump to 8 WCT/100ft was found in 2015. ***Long-term (secure):*** Because the Whitehorse is isolated above a dry stream reach there is no potential to expand the population. Additional introductions of fish or gametes could be necessary in the future to maintain the genetic integrity of the population, particularly in upper isolated reaches of the stream. ***Additional comments:*** WCT juveniles (n=201) were introduced to this historically fishless stream between 2003 and 2005. Donor streams for the project were Dutchman Creek (Upper Missouri), Muskrat Creek (Boulder) and Ray Creek (Upper Missouri). WCT could eventually occupy about 3 miles of stream in Whitehorse Creek, resulting in a population of 800 – 1000 fish. The stream includes about 3 miles of suitable fish habitat however, several natural migratory barriers split the stream into three 1-mile reaches. Natural reproduction (presence of fry) in the uppermost reach of the drainage was observed in 2007. ***2020 Update:*** • Population Observations: 2002 04 05 06 07 8 09 11 12 13 15. • Genetic Observations: Established from Dutchman, Muskrat, and Ray Creek • Barrier Observations: Unchanged • Land Management: Unchanged
Whites - Spring Gulch - LH Fork	***Genetic Class/Threat Status:*** Genetically Unaltered/Protected ***On-going projects:*** Ongoing barrier and nonnative species invasion monitoring. Fish rescue occurs in the upper intermittent stream section near the end of summer, saving dozens of WCT. ***Short-term (protect):*** *Mainstem (Number Two Gulch to just above Spring Gulch)* - A new barrier was installed in Whites Creek in the spring of 2009. This barrier has provided protection to the population. Thus far no detection of new brook trout invasions has occurred. *LH Fork* – The LH Fork population segment is isolated from the mainstem segment by a 2-mile intermittent stream reach. It has likely been several decades since fish transfer has occurred between the population segments. The LH Fork segment is composed of < 100 fish, and it occupies generally poor habitat (intermittent flow and very small channel). Genetic investigations should be initiated to determine the genetic fitness of the population segment, and whether supplementation from the mainstem reach is necessary. Habitat improvements (e.g., pool development) should be explored that could increase the size of the population and to provide some resiliency to stochastic events.

Stream (s)	Population Status and Conservation Needs
	Long-term (secure): There is potential to expand the White Creek population downstream about 2 – 3 miles to a point where the stream is significantly dewatered. This effort would require installation of a barrier, and removal of brook trout. A removal project would be complicated by a large beaver dam complex which is a popular recreational fishery. The upper bounds of the mainstem segment and the lower bounds of the LH Fork segment are restricted by subsurface stream flow in a 2-mile reach. Studies should be initiated to determine if surface flow could be established in this, which should lead to natural recolonization and reconnection of the population segments. Each of these efforts would bring the population to a secure status. ***Additional comments:*** Electrofishing removal of brook trout was initiated in Whites Creek in 1993. By 2001, brook trout were considered eradicated in a 1.3 mile project reach. Occasional barrier failures (human tampering and sediment deposition) have allowed periodic brook trout ingress since 2005, but these fish (< 50 individuals) have been removed prior to spawning. Large-scale channel restoration and installation of a wooden crib barrier were completed in 1995. Livestock grazing concerns are being addressed with the installation of an exclosure fence in 2009. Since recovery efforts were initiated the Whites WCT population has increased from < 100 fish to > 1000 fish. Gametes have been collected the Whites population and introduced to Cherry Creek and incorporated into the Sun Brood. ***2020 Update:*** • Population Observations: Stable based on persistent sampling since 1995. • Genetic Observations: 2014 Possible WCT variation present at YCT marker. • Barrier Observations: Remains effective based on annual sampling • Land Management: Unchanged

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Appendix 1: WCT Conservation Actions

The individual sub-basin sections of this assessment identify specific threats and conservation actions. The effect of each threat on WCT and how they are mitigated by each conservation action are described in detail in Table A1.1.

Table A1.1. Threats, their effects on WCT, and how they are mitigated by conservation actions.

Threat	Effect	Mitigation
Nonnative trout	**Rainbow and Yellowstone cutthroat trout:** Hybridization resulting in the permanent alteration of a conservation population's genome. May lead to outbreeding depression, and appearance and behavioral changes. **Brook Trout:** Competition and displacement of WCT by EBT, particularly young-of-the-year, is associated with reduced distribution, abundance, and loss of WCT populations. **Brown trout**: Not currently common in streams occupied by WCT conservation populations; however, they have the potential of competition and predation interactions with WCT.	**Suppression and eradication of nonnative trout:** Removal of nonnative trout using piscicides, electrofishing or other method is necessary to protect and secure conservation populations. **Piscicides** (rotenone and antimycin) are essential tools to remove nonnative trout from large complex streams where mechanical removal techniques are ineffective. Piscicides would be a primary removal technique for expansion of current populations, and to provide areas to establish new populations. **Electrofishing:** Multiple-pass electrofishing is a suitable method to remove nonnative trout that occupy the same stream reaches as WCT in very specific instances. The technique will be a primary tool to protect existing populations but is only suited for relatively small streams with minimal habitat complexity. **Protection with fish migration barriers:** Barriers are necessary to prevent new or continued invasion of nonnative trout into streams or reaches occupied by conservation populations. A variety of barrier types are available depending on availability of funding, site accessibility, and channel size and type and size; these include small dams, culverts, and modifications of natural stream features.
Reduced distribution and abundance	**Populations of < 2,500 fish are more prone to loss of genetic variability and demographic stochasticity.** Over the long-term, reduced abundance can lead to direct genetic problems, or reduce the ability of populations to adapt to changing environments. Small, isolated populations are also more vulnerable to extreme environmental events and the influence of nonnative trout.	**Expanding the abundance and distribution** of conservation populations to include, where possible, >2,500 fish and 5 miles of occupied habitat is the primary method to secure long-term persistence. Abundance increases will typically occur with removal of nonnative trout within a population, expanding distribution downstream to reaches not currently occupied (typically by removal of nonnative trout), and habitat improvement efforts.

Spatial Isolation	**Loss of connectivity:** Habitat changes, loss of migratory life forms, and placement of migratory barriers have resulted in a loss of connectivity among conservation populations. Lack of connectivity results in reduced gene-flow and demographic support between populations and prevents recolonization of a stream if local extinction occurs. In the short-term, spatial isolation provides protection for conservation populations, but long-term management must address isolation consequences.	**Genetic rescue/supplementation** (i.e., infusion of outside genes from a few individuals to reduce inbreeding depression and increase fitness) may be necessary in smaller populations where opportunities do not exist to increase their abundance. **Establishment of new larger WCT populations** is necessary to significantly increase the distribution of WCT.
Stream/ riparian habitat condition	**Degraded stream and riparian habitats** can result in a reduced number of fishes occupying a stream or reach, and potentially increase the likelihood of nonnative trout invasion, particularly EBT. The consequences of these were described above.	**Restoration of proper stream and riparian function** will generally lead to increases in abundance, distribution, and resiliency to natural disturbance. Some impacts may be addressed with relatively simple actions; for example, riparian exclosure fences to project from livestock grazing impacts. Other impacts like chronic de-watering due irrigation and historic placer mining may require costly and complicated restoration efforts.

Appendix 2: Restoration Project Guidelines

Because restoration projects are inherently expensive and time consuming to develop and implement they have a high opportunity cost; careful prioritization and successful implementation is critical to efficient and cost-effective attainment of the WCT conservation goal. The cost of barrier installation is the primary limitation to WCT conservation in the Missouri River headwaters. Following barrier construction, complete removal of non-native fish is a prerequisite of WCT restoration; if non-native fish are not eradicated they will hybridize with or replace restored WCT resulting in project failure. Finally, repopulation approach will dictate whether genetic and demographic characteristics result in efficient establishment of self-sustaining populations or ongoing and potentially long-term maintenance is required. Therefore, criteria were established to guide selection, evaluation, and repopulation of potential restoration projects.

Project selection – All potential restoration projects should meet the minimum criteria described in Table A2.1 prior to being prioritized for implementation.

Table A2.1 Standards and requirements for WCT restoration projects.

Criteria	**WCT Restoration Standards / Requirements**
Habitat Suitability	*Fishless*: The restoration area is naturally fishless, or nonnative trout can be eradicated using piscicides or other removal techniques. Nonnative trout removal opportunities can be limited by habitat complexity, water chemistry, and social constraints. No repopulation shall occur prior to verification that the project area is fishless. *Stream Length*: Introduction of WCT to drainages with >5 miles of stream length, particularly those with multiple tributaries, will provide the best opportunities for long-term population survival. Shorter stream reaches are suitable locations to replicate "at-risk" populations until larger stream reaches are available. *Habitat characteristics*: The restoration area maintains stream flow, temperature, productivity, and habitats (pools, spawning gravel, vegetation, etc.) that are suitable for long-term population persistence.
Stream Isolation	It is essential that the restoration area is isolated from nonnative trout by a natural fish barrier or a permanent man-made structure. Barrier construction can be limited by topography (e.g., wide valley widths) or cost (e.g., large or remote streams). Barriers costing over $50,000 should be engineered to function up to the 50-year storm event and be structurally stable up to the

Criteria	WCT Restoration Standards / Requirements
	100-year storm event. All barriers should have a functional life span of >50 years.
Social Impacts	Broad public support is necessary for successful WCT conservation. WCT restoration issues, such as loss of important nonnative trout fisheries, wilderness area introductions, nonnative trout removal techniques, and cost, should be thoroughly examined in an Environmental Assessment process open to the public. Landowner support and formal agreements should be obtained prior to project implementation. All applicable stream (124, 404), floodplain, and other permitting requirements should be determined prior to project selection.
Restoration Area Management	Land and fisheries management practices within identified restoration areas should be consistent with WCT conservation and population viability. For example, these may include restrictive angling regulations for WCT and restrictive lake and pond stocking policies. Management that contributes to sustainable riparian and stream health are also important; however, pursuing larger projects often de-emphasizes the need for more restrictive land use changes because of the overall quantity of habitat.

Removal of non-native fish- Removal method should be selected based on likelihood of success; short reaches (< 1 mi) of simple habitat may be suitable for electrofishing removal whereas complex habitats or long reaches (>1 mi) will require removal with piscicides. All piscicide projects shall follow the FWP Piscicide Policy and AFS Piscicide SOP's and be developed to ensure all non-native fish are removed as efficiently and as with as much certainty as possible. This entails treating all stream reaches theoretically capable of supporting non-native fish above a barrier and completing enough treatments to completely remove all non-native fishes (at least two treatments unless evaluation indicates all non-natives have been removed).

Evaluation of non-native fish removal – To determine whether non-native fish are successfully removed either eDNA analysis at 250 m intervals (Carim et al. 2020) or traditional sampling (i.e., electrofishing or gill netting) of the entire project area shall occur. If traditional sampling is used it should be designed so theoretical detection probability is 100%. Because most streams have a detection probability of <50% during single-pass backpack electrofishing, it would be necessary to achieve three "fishless" passes over the entire length of stream in a project area to verify it as fishless using this technique. When piscicide is used to remove non-native fish, two treatments in consecutive years throughout the project area are recommended prior to evaluation. Repopulation should not occur until evaluation indicates all non-native fish have been removed from the project area.

Repopulation guidelines – In most cases, the primary reintroduction method will be translocation of live, wild WCT. All translocations shall follow the FWP Wild Fish Transfer Policy (Appendix 4). Unaltered populations from within a sub-basin should be evaluated first as potential donors (Appendix 5). Populations which are protected above barriers and have recent genetic results can be used as donors without testing individual fish. To ensure transfers maximize viability of the restored population while minimizing impacts to healthy donor populations, 1) no more than 20% < 75mm and no more than 10% of >75 mm fish in the donor population should be transferred, 2) transfer should occur over at least two years, 3) fish should be collected from throughout the donor stream, and 4) multiple age classes should be selected. Fish should be handled as described in Appendix 6 to minimize risk of mortality during transportation to recipient stream. There are currently four population restoration projects ongoing within Region 3 (French Creek, Selway Creek, North Fork Spanish Creek, and South Fork Sixteenmile Creek.) Once complete, these projects will increase the total occupied area of unaltered westslope cutthroat trout by more than 100 steam miles and will provide biologists with robust populations fish derived from locally sourced genetics for translocations. All four projects will be repopulated within the next five years.

Vulnerable populations with a low likelihood of long-term persistence that cannot be protected in place should also be considered as potential donor populations. Translocation of any fish from unprotected populations must involve individual marking and testing of fish using a rapid response test. However, because rapid response testing utilizes a "chip" which analyzes only 95 single nucleotide polymorphisms (SNPs), it is necessary to first obtain a more thorough population level sample using new genomic mapping techniques (RAD-capture) which considers >3,000 SNPs. To increase the likelihood of successful translocation of a vulnerable population, multiple capture events should be conducted to remove all (or most) of the population for transfer. Single populations may be replicated individually if, 1) a multi-year removal project occurs on the natal stream and a temporary (i.e, 2-4 years) home must be found must be found for the salvaged fish and 2) if genetic diversity and founding population size are sufficient to recolonize available habitat and not trigger the need for genetic rescue (Kovach et al. 2021). If population size of a vulnerable donor population is found to be lower than expected upon initiation of a transfer, it may be necessary to combine multiple small populations to increase genetic diversity and probability of long-term persistence.

On larger population restoration and expansion projects, many miles of habitat may need to be repopulated in a timely manner. In these instances, the use of a brood population may be advantageous if there are not adequate extant populations from which fish can be translocated to meet project goals. Fertilized eggs can be transported to a hatchery and reared for a later release or can be released immediately to the stream via remote site incubator (RSI). Brood populations require ongoing maintenance and monitoring of genetic status and should not be initiated without a specific project need. Recent genetic results revealed slight hybridization in the Big Hole River brood population, further emphasizing the complexity of managing a new brood source.

When repopulating larger projects, it is possible to replicate individual populations (potentially vulnerable populations with low total population size) in separate tributaries while refounding the larger mainstem habitat with an abundant source of WCT such as healthy protected populations of wild fish or a brood population. Fish from different tributaries may remain genetically isolated during the initial recolonization period (5-10 years; Feuerstein et al. 2021) and may retain unique genetic traits of the original donor population during that time.

The use of hatchery WCT (e.g., FWP's MO12 strain) will be limited to sterile (i.e., triploid) fish and only considered when public demand calls for large numbers of fish to be introduced over a short period of time to rapidly establish recreational fisheries while wild strains are concurrently introduced as the long-term founding source.

Populations that have less than 2,500 individuals and/or occupy short, isolated stream segments may require periodic supplementation (i.e., introduction of individuals from other populations) to maintain or increase genetic variability. WCT genetic variation is significantly lower in human-isolated populations and strategic genetic rescue via translocation of small numbers of fish (<10) could strongly increase genetic variation (Kovach et al. 2021). These efforts would mimic natural interchange that occurred between populations prior to human-induced isolation. Genetic rescue can increase the resiliency of local populations through the conservation of unique genetic characteristics which may have been lost at the local population level, but which still exist in other populations throughout the Upper Missouri River basin. Genetic rescue will be considered for populations with below average genetic variation and high genetic divergence ($\bar{F}_{SR} > 0.40$; Appendix 7). Donor populations from within the same sub-basin will be considered first. If unaltered populations within a sub-basin are rare (e.g., Madison, Gallatin, Jefferson) donor populations from an adjacent drainage may be selected. Population combinations which maximize genetic diversity should be prioritized.

Appendix 3: WCT Status Assessment Field Packet

Consistency in data collection is the foundation of this assessment and allows accurate description of present status and comparison within and among WCT populations through time. Accurately describing each conservation population is also essential to future project prioritization, repopulation, and expansion. Data collection must follow established protocols and methodologies and include all common minimums specified by established data sheets to be included in this status assessment. Failure to follow these methods or collect all information will likely result in return trips and/or collected data being discarded. To assess status of putative conservation populations:

1) **Look for and document barriers to fish passage by filling out all fields using an FWP Barrier Data Collection Form (Figure 3.1) to describe threat status.**

- Focus searches on confined, high gradient canyon sections where natural waterfalls or cascades may form, road crossings, irrigation infrastructure, impoundments, and reaches of natural or anthropogenically influenced intermittent flow.
- Physical barriers generally have at least 6 feet of drop and local conditions (i.e., gradient, substrate, velocity, etc.) may also combine to result in functional isolation. If you are unsure, document any potential isolating mechanisms as fish barriers.
- Potential fish barriers should be documented as such by completing all fields of the FWP Barrier Form (Form 2) and by taking accompanying photos.
- Record barrier location by specifying longitude and latitude using decimal degrees.
- Potential isolating mechanisms should be validated as fish barriers with demographic and genetic population surveys above and below the putative barrier.

2) **Identify the distribution (stream miles) of the WCT population to describe threat status, distribution, and population size.**

- Locate the downstream distribution of WCT by electro-fishing presence/absence survey and record the GPS location in decimal degrees. Professional judgement is not an acceptable substitute.
- Locate the upstream distribution of WCT by electro-fishing presence/absence survey and record the GPS location in decimal degrees. Professional judgement is not an acceptable substitute.

3) **Complete 100-meter depletion estimate(s) using FWP Electrofishing Datasheet (Figure 3.2) to describe threat status and population size and density.**

- Select 100-meter electrofishing sections that are representative of the habitat types where most of the population occurs. Each section should include at least seven of each habitat unit.
- If habitat quality or quantity varies among stream reaches complete a depletion estimate in each reach.
- Measure section length using a GPS odometer or track log and record the top and bottom of the section in decimal degrees.

- Collect and record all header information on the FWP data sheet (Form 3.2) using a GPS and a water quality meter before you begin backpack electrofishing.
- If a stream is overly wide or deep or has many fish use block nets.
- Adjust the backpack electrofisher settings based on water conductivity to sample effectively and avoid causing fish injuries.
- A good starting point within the assessment area (i.e., conductivities 100-300 µS) is 300 volts and 20 Hz.
- In higher conductivities use lower voltages and in lower conductivities use higher voltages.
- Adjust voltage and frequency depending on electrofishing efficiency but avoid using more than 600 volts or 30 Hz unless conductivities are very low.
- Try to net all fish, including YOY's. Use extreme care with juvenile fish to ensure they survive the sampling event.
- Capture as many fish as possible on the first pass (preferably 25-50 fish).
- Equal effort (shocking time) should be used on each electrofishing pass, try to slow down on your 2nd and 3rd passes.
- Each time you electrofish another pass within a section it is less likely to capture fish that have already been missed on previous passes. Conducting more than three passes is not recommended.
- If you capture less than 50% of the fish you captured on the previous pass, the depletion is done.

4) Collect fin clip samples for genetic testing following appropriate sampling protocols to describe genetic class.

- A monitoring protocol should be selected from the below options and strictly adhered to. In most situations Protocol 1 (HEADWATER STREAMS OR REACH SPECIFIC MONITORING) should be selected.
- Pre-fill 1.5-2 ml screw top vials (with o-ring cap) with 95% non-denatured ethanol. Non-denatured ethanol is available at a University Chem Store or online from a variety of companies. Vials available at Fisher Scientific www.fishersci.com Catalog # 02-862-557.
- Labels for individual fish can be placed inside or outside the vial. Use an "ethanol safe" pen for labeling the vials on the outside of the tube. Fisher brand Marking Pens will not smear when subjected to water or alcohol. www.fishersci.com, Catalog # S32179. It is best to use pencil on small pieces of paper for vials labeled on the interior.
- Record GPS coordinates of beginning (downstream) of each sampling reach. For Protocol 1, about three GPS locations should be collected. Provide GPS coordinates in decimal degrees
- Individual fin clips should be labeled with a unique identifier based on the location, sampling year, and sequential numbers beginning with 1. For example, labeling for a lower reach of Coal Creek 2019 would begin with CoalLow19-1 and continue sequentially thereafter (CoalLow19-2, CoalLow19-3, etc.).
- For each fish, record the total length and use scissors to take a fin clip from the anal fin that is approximately $1cm^2$ (the size of a hole punch).
- Place the fin directly into a unique 1.5-2 ml screw top tube (with o-ring cap) with 95% (or higher) ethanol. Also include a small label with each fish's ID in the tube vial with ethanol.

Screw the cap on tightly, and place in a Ziploc bag with the Fish Sample Collection Form (Form 3.3) for each population.

- It is a good idea to have a few extra vials filled and ready to go (without labels) as a backup in case a vial gets spilled. Carry extra labels or have an ethanol safe pen available to label the vial accordingly.
- Store the fin samples at room temperature.
- Samples should be shipped to:
  University of Montana
  Conservation Genetics Lab
  32 Campus Drive
  DBS - HS 104
  Missoula, MT 59812
  ATTN: Sally Painter
- Questions can be directed to:
  lab phone (406) 243-6749 (Sally Painter or Angela Lodmell)
  email: sally.painter@umontana.edu or Angela.Lodmell3@mso.umt.edu

Protocol for genetic monitoring westslope cutthroat, Yellowstone cutthroat and redband rainbow trout

Ryan Kovach (MFWP), Andrew Whiteley (UM)

Genetic monitoring serves multiple needs for conservation of native trout in Montana, including (but not limited to): (1) describing population status based on extent of hybridization, genetic diversity, and origination (i.e., indigenous vs. non-indigenous ancestry); (2) temporal monitoring of genetic and population trend; (3) determining population connectivity; (4) describing individual ancestry; and (5) identifying donor sources for population restoration and brood stock collection.

The ability of genetic data to address these needs is greatly impacted by field-methodologies used to collect genetic samples. In short, the genetic data and resulting recommendations can be strongly influenced by how samples are collected, especially *where* they are collected (i.e., locations within a stream), *how many* are collected (i.e., sample size), and *who* is collected (i.e., different age classes). Although genetic methods are becoming more powerful over time, our results will always reflect how samples are collected in the field.

To ensure that sample collections are aligned with conservation and management needs, this document can be used as a template that can help clarify sampling objectives and the sample collection protocol needed to meet that objective. Please contact us with any questions regarding sampling prior to initiating a new project, especially when objectives and necessary sampling are project specific (i.e., not described below) (Ryan.Kovach@mt.gov; 505-231-6692).

SAMPLING OBJECTIVES

MONITORING HYBRIDIZATION

Historically, most genetic samples in Montana have been collected to detect and quantify the extent of non-native hybridization in a population (or stream reach) of interest. The optimal sampling strategy to detect and describe hybridization depends on the spatial area and/or biological unit of interest.

- If sampling is focused on describing hybridization within a population in a relatively small stream (1st order) see sampling Protocol 1.
- If sampling is focused on a ***single reach*** within a larger system (2nd and 3rd order) see sampling Protocol 1.
- If sampling is focused on describing hybridization in larger populations and/or stream (2nd and 3rd order) see sampling Protocol 2.
- If sampling is focused on detecting hybridization in a putatively nonhybridized population see Protocol 1a, whereas sampling focused on quantifying the amount of admixture in a population with known hybridization (e.g., conservation population) should use Protocol 1b.

MONITORING GENETIC VARIATION, AND POPULATION STRUCTURE

It is increasingly valuable to quantify and compare genetic variation among nonhybridized populations in order to inform genetic status, management opportunity (e.g., donor populations) and identify populations at higher risk of inbreeding depression. Patterns in genetic variation can also be used to quantify population structure which can inform (1) our understanding of connectivity and movement, and (2) whether a population is indigenous or derived from a stocking event.

- If sampling is focused on describing genetic variation within a population in a relatively small stream (1st order) see sampling Protocol 1.
- If sampling is focused on describing genetic variation in larger populations and/or stream (2nd and 3rd order) see sampling Protocol 2.

MONITORING THE EFFECTIVE NUMBER OF BREEDERS

Monitoring the number of effective breeders (N_b) provides a powerful means to simultaneously monitor population genetic and population demographic status. Furthermore, N_b provides a monitoring statistic that is predictive of future dynamics (the rate of loss of genetic variation is influenced by N_b). Monitoring N_b tends to be more labor and cost-intensive than either hybridization or genetic diversity because estimates are based on single cohorts and we generally need larger samples collected from more locations within a stream. Monitoring N_b is currently less commonly used in native *Oncorhynchus* than other native salmonids (e.g., bull trout and grayling). Nevertheless, N_b can be valuable under certain circumstances, and if implemented strategically, we can attempt to minimize the cost.

- See sampling Protocol 3.

GENETIC SAMPLING PROTOCOLS

In general, genetic samples should represent a random collection of fish from a spawning population or stream reach. All of the protocols described below aim to achieve that goal, but each is specifically tailored to meet different objectives or questions (see above), or address processes at different spatial or biological levels.

PROTOCOL 1: HEADWATER STREAMS OR REACH SPECIFIC MONITORING

For putatively nonhybridized populations (Protocol 1a): A total of ~25 to 30 fish should be collected by sampling within three separate reaches of approximately 100m each. At each reach, dispersed spot-shocking should be used to collect ~10 individuals of any age class. It is preferable to collect a mixture of age classes. In streams with high densities, collect only one-fish per habitat unit (e.g., pool). In streams with very low densities (i.e., <10 fish in ~100m) fish will need to be collected where they are found and likely over a slightly larger area. When 10 fish are not available in a 100-200m reach of stream, a smaller sample size (i.e., total number captured in that reach) is acceptable and likely representative of the population (i.e., it is reasonable to collect more fish from one reach if fish aren't found elsewhere). Reaches should be separated by a minimum of 500m and no more than 2km apart. Protocol 1 aims to minimize the likelihood of overrepresenting a few families, as trout tend to remain close to their siblings, particularly as juveniles (Figure 1).

For hybridized populations (Protocol 1b): In some cases, it is valuable to quantify the amount of non-native ancestry in populations where hybridization is known to be present, but the population may still have some conservation value (e.g., conservation populations with >90% WCT, YCT, or Redband ancestry). If the primary question is whether the proportion of non-native admixture exceeds some predetermined threshold (e.g., 10%) than a smaller sample size of 15-20 individuals is sufficient, provided that sampling is conducted as described in Protocol 1a. Please note, however, that the sample size depends critically on the question. If it is of value to estimate change in admixture over time, rather than population status, please follow sample size recommendations in Protocol 1a.

Figure 1: A hypothetical distribution of sampling in a first order tributary. Note that sampling is dispersed across three reaches that are >500m apart.

PROTOCOL 2: LARGER STREAMS

Protocol 2 aims to identify and account for genetic differentiation (population structure), including gradients in hybridization, that can occur within larger streams and populations. A total of ~25 fish should be collected by sampling within multiple reaches of approximately 250m each. Scale the number of reaches with stream order; sample 2 reaches in a 2nd order system, and 3 reaches in a 3rd order system. At each reach, dispersed spot-shocking should be used to collect 25 individuals of mixed age-classes. It is very important to minimize the number of fish collected in any single habitat unit (e.g., pool) and equally space sampling over 250m reach. Reaches should be separated by a minimum of 2km (Figure 2).

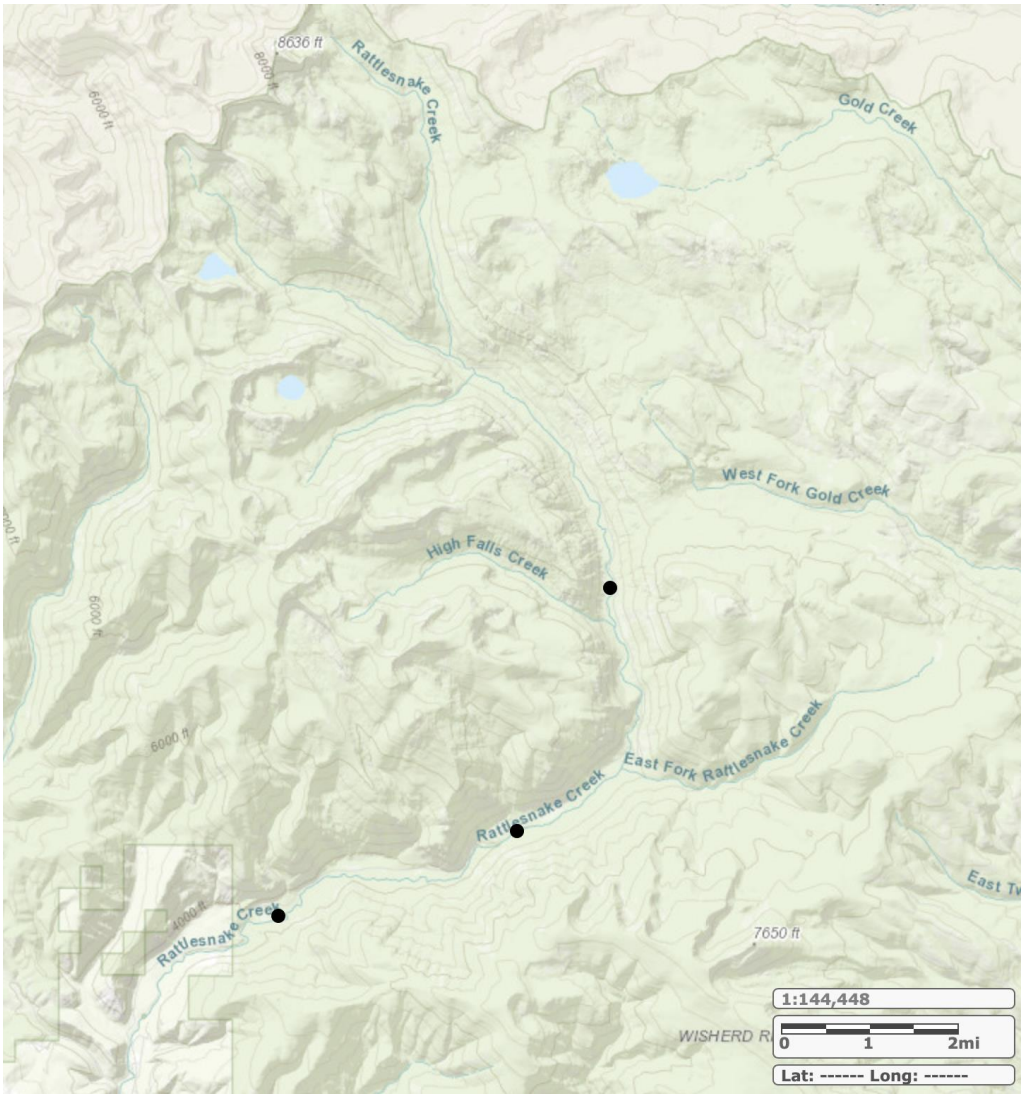

Figure 2: A hypothetical distribution of sampling in a second to fourth order tributary. Note that sampling is dispersed across three reaches that are ~2km apart.

PROTOCOL 3: NUMBER OF EFFECTIVE BREEDERS

A total of at least 50 fish from a single cohort (i.e., age class), or each of multiple cohorts, should be collected by sampling within three separate reaches of at least 100m each. Since YOY are often too small during summer sampling, it will often be easiest to target age-1 fish as they can be field-identified. Sampling older age classes requires reliable aging and assignment of each individual to cohort (i.e., scale sampling is also be necessary). Sampling effort should scale with known/expected effective population size; in very small populations small samples sizes are sufficient (~30), and in larger populations much larger samples may be needed (~100-200) to obtain accurate and precise estimates of N_b. At each reach, dispersed spot-shocking should be used to collect approximately 15 to 20 individuals from the target age class(es). Reaches should be separated by a minimum of 500m. At this point in time, N_b is most easily estimated and applied to small streams (1st and 2nd order). We are working on a representative reach approach for larger streams, please contact us if you are interested in N_b monitoring in larger streams.

DATA COLLECTION AND SAMPLE STORAGE

1. Record GPS coordinates of beginning (downstream) of each sampling reach. For Protocol 1, ~three GPS locations should be collected. Provide GPS coordinates in decimal degrees.
2. Individual fin clips should be labeled with a unique identifier based on the location, sampling year, and sequential numbers beginning with 1. For example, labeling for a lower reach of Coal Creek 2019 would begin with CoalLow19-1 and continue sequentially thereafter (CoalLow19-2, CoalLow19-3, etc).
3. For each fish, record the total length and use scissors to take a fin clip from the anal fin that is approximately 1cm^2 (the size of a hole punch).
4. Place each fin clip in a unique 1.5-2 ml screw top tube (with o-ring cap) with 95% (or higher) ethanol. Also include a small label with each fish's ID in the tube.

OTHER RELATED TOPICS

INTEGRATED GENETIC AND POPULATION MONITORING

Genetic samples are often collected during population monitoring. Population monitoring itself often focuses on relatively intensive sampling of a short stretch of stream (i.e., 100m triple-pass electrofishing surveys). Unfortunately, intensive sampling of a single relatively short reach is not ideal for genetic sampling. As such, we strongly recommend spot shocking two additional reaches such that a population is sampled in a manner similar to Protocol 1.

LAKE ENVIRONMENTS

The Protocols above are focused on stream and river environments. Lake environments are, in theory, easier to sample. That is, obtaining a random and representative sample of the population is often easier as fish (likely) freely mix with one another in the lake. That said, it is critical to obtain a sample that appropriately targets the "mixed" population; some violations may include sampling juveniles in small areas near a lake inlet or outlet. Like stream environments, this would increase the likelihood of over-representing a small subset of families. If there are multiple spawning tributaries to a lake, it is possible that the 'mixed' sample contains individuals from two or more subpopulations. Please contact us to discuss this type of situation.

LARGE RIVER ENVIRONMENTS

Since trout generally spawn in smaller streams and rivers, fish in mainstem rivers (~4th order and larger) are usually a "mixed-stock" representing multiple spawning populations. In these environments it is reasonable to collect genetic samples as convenient. It can, however, be useful to obtain discrete collections (e.g., along certain monitoring sections) and then compare stock composition across a river gradient. For this type of analysis, we also need a genetic baseline from contributing populations.

Form 3.1 Fish Barrier Datasheet.

MONTANA FISH, WILDLIFE AND PARKS BARRIER DATA COLLECTION FORM

Waterbody Name:_____ **Barrier Location Description :**_____

Lat/Long(up) (Decimal Degrees NAD83):_____/_____ **Lat/Long**(down)_____/_____

Date___/____/____ **Observers:**_____ **Name of feature**(e.g. Joe Creek Falls):_____

Blockage direction: ❒upstream ❒downstream ❒both ❒unknown

Reason: ❒velocity barrier ❒physical impediment ❒lack of suitable habitat

Origin: ❒manmade ❒natural ❒unknown **Persistence:** ❒permanent ❒temporary or seasonal ❒unknown

Barrier Type: ❒culvert ❒beaver dam ❒concrete dam ❒debris dam ❒earthen dam ❒water diversion (screened? Y/N) ❒cascade ❒waterfall ❒bedrock ❒poor water quality ❒insufficient flow ❒degraded stream and/or riparian habitat ❒ fish culture facility ❒ utility crossing

Barrier height (m):_____ **Barrier width** (m):_____ **Barrier length** (m):_____
Stream Discharge (cfs):_____ Estimated or Measured? Circle one **Stream wetted width** (m):_____
Percent of stream channel obstructed(%):_____ **Plunge-pool present:** ❒No ❒Yes Pool depth (m)_____
Barrier Gradient (rise/run):_____ **Velocity top** (m/s):_____ **Velocity tail** (m/s):_____

Barrier materials: ❒bedrock ❒rock/boulders ❒metal ❒wood ❒debris ❒soil ❒other_____

Fishway present? Y/N **Fishway functioning?** Y/N / Unknown **Fishway Comment:**_____

Fishway type:❒denil ❒step-pool ❒bypass channel ❒vertical slot ❒ ❒other_____

❒installed for conservation purposes **install date:**___/___/___**removal date:**___/___/___ **project name:**_____

Owner of barrier (if applicable or known)_____

Management actions associated with barrier (check all that apply): ❒maintain barrier into perpetuity
❒temporarily maintain ❒modify to allow for limited passage ❒remove
❒strengthen or fortify ❒fish sampling needed - revisit ❒ none ❒ unknown

Species affected by barrier (use numbers from lookup tables to add information, if known and where appropriate):

Species	Blockage extent*	Life stage affected**	Is the feature a barrier to fish migration or movement?	Barrier position◆	Barrier significance+
			❒definitely ❒probably ❒possibly ❒unlikely		
			❒definitely ❒probably ❒possibly ❒unlikely		
			❒definitely ❒probably ❒possibly ❒unlikely		
			❒definitely ❒probably ❒possibly ❒unlikely		
			❒definitely ❒probably ❒possibly ❒unlikely		
			❒definitely ❒probably ❒possibly ❒unlikely		

* **Blockage extent:** 1-Complete, 2-Partial, 3-Intermittent depending on flow, 4-unknown
** **Life stage lookup:** 1- ALL life history stages, 2-juvenile, 3-adult, 4-unknown

◆ **Barrier position lookup:**
1. upstream from current distribution
2. defines upstream end of distribution
3. within current distribution
4. defines downstream end of distribution
5. downstream from current distribution
6. unknown

+ **Barrier significance lookup:**
1. prevents introgression
2. prevents ingress of competing species
3. migration barrier
4. temporarily prevents introgression or ingress of competing species
5. confines population to small area of usable habitat
6. limits or precludes opportunity for refounding
7. limits expression of life history characteristics
8. historically significant
9. unknown

Photo Number(s):_____ **Other Comments:** _____

_____

Barriers Form, Version 3 - Last Updated 09/24/2014

Form 3.2. Montana FWP Electrofishing Datasheet (Front and Back)

MONTANA FISH, WILDLIFE AND PARKS ELECTROFISHING DATA FORM

Water Name:_____Section_____ Date ____/____/____

Observers:_____ Purpose_____Page:_____of _____

Gear: ☐boat ☐boom ☐mobile ☐backpack ☐bank ☐crawdad ☐other_____Trip Type:☐M☐R Pass# or run#_____

Rectifying Unit: Name:_____model:_____ Volts: _____ Amps:_____ Shock Time:_____secs

Shocked:☐left bank ☐right bank ☐middle ☐All % Sect. Sampled: _____ Sect. Length:_____Sect. Width:_____

Lat/Long: UP_____/_____ DOWN _____/_____Time:Start ____:____ end____:____

Turbidity _____ ☐NTU ☐cm ☐m ☐disk ☐tube ☐meter Time: ____:____ Cond._____ µs Time: ____:____

Water Temp.____° __Time____:____ Discharge _____☐CFS ☐CMS ☐Meas.☐Est.☐USGS_____Time: ____:____

Fish Measurement Units: L _____W_____ Mark location and type:_____

	Sp.	L	W	M/C		TAG/ MISC.	Sp.	L	W	M/C		TAG/ MISC.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												

Did you look for any other: Fish? ☐Yes ☐No Herptiles? ☐Yes ☐No Other spp. _____☐Yes ☐No

Sp._____# obs._____☐est. Life stage _____Length range:_____to _____Wt range:_____to _____

Sp._____# obs._____☐est. Life stage _____Length range:_____to _____Wt range:_____to _____

Comments:_____

_____

_____Updated 04/05/12 50fishJaeger

DATA FORM INSTRUCTIONS

Water Name: e.g., Blackfoot River **Section:** e.g.: Johnsrud , if it is a new section use stream name and distance upstream from mouth **Date** MM/DD/YYYY

Observers: Name of crew, first & last names or initials-fill out completely when entering in database **Page:** Current page **of** Total # of pages

Purpose: e.g., long-term monitoring (e.g., historic section), experimental (one time), research (related to a project that may last one or more years), pilot study (may be repeated), sub-sampling (work conducted within a long-term monitoring reach), presence/ absence, genetic sample collection, or "other"

Gear: ☐**boom** ☐**mobile** =anode type ☐boat ☐bkpack ☐bank ☐crawdad e.g., tote barge **Trip Type:** ☐**M**= Marking Run ☐**R** = Recapture M and R are only checked if conducting a mark/ recapture estimate **Pass #** could be pass# or run #,e.g., 1st marking run, or 1st pass of depletion estimate

Volts: Average or range **Amps:** Average or range **Shock Time:** From rectifying unit, time of entire survey **secs**

Sect. Length: Length of entire survey section. Include units (m, km, miles) **Sect. Width:** Wetted width, either average or range, include units

Lat/Long: UP_. DOWN_. Up- & down-stream bounds State standard is NAD 83, decimal degrees **Time: Start** e.g., 07:15 **end** 16:46 (total time of the survey, 24 hr)

Turbidity ____ ☐**NTU** ☐**cm** ☐**disk** ☐**tube** ☐**meter** **Time:** ____:____ (24 hour) **Cond.**_____ **µs** **Time:** ____:____ (24 hour)

Water Temp.____° C or F **Time**____:____ (24 hr) **Discharge** ____☐**CFS** ☐**CMS** (cubic feet per second or cubic meters per second) ☐Meas.☐Est.- describes how discharge was obtained ☐USGS write usgs station name or number here if applicable **Time:** ____:____ (24 hr)

Meas. Units: L __W__ unit of measurement for fish (mm, inches, grams, kg, lbs) **Mark location and type:** e.g., upper caudal clip

	Sp.	L	W	M/C		TAG/ MISC.	NOTES	Sp.	L	W	M/C		TAG/ MISC.	NOTES
1														

Sp= species: Use FWP official abbreviations or codes only (see below, also found in Fisheries Little Blue Book). Only use unspecified codes or abbreviations if species cannot be determined, **L**= length (also note method of length e.g., Fork Length or Total Length), **W**= weight, **M/C**= Mark (1) or Unmarked (0)
Blank, **TAG**= tag number or color and number. This field could also be used for anything else,
The blank, "Tag" or "Notes" fields can be used for anything, e.g., Hook Scar, genetic samples, mortality, otolith removed, etc... They are user defined.

CODE	NAME	ABBR	CODE	NAME	ABBR	CODE	NAME	ABBR	CODE	NAME	ABBR
000	No Fish Caught	NO FISH	033	Northern Pikeminnow	N PMN	066	Yellow Bullhead	YL BH	119	Trout / Salmon (unknown salmonid)	TR SAL
001	Rainbow Trout	RB	034	Goldeye	GE	071	Brook Stickleback	BR SB	120	Rainbow Trout X Golden Trout Hybrid	RBxGT
002	Cutthroat Trout (unknown cutthroat sub. sp.)	CT	035	Utah Chub	GILA	072	White Bass	W BS	121	Upper Missouri Cutthroat	UMCT
003	Brook Trout	EB	036	Freshwater Drum	DRUM	073	Smallmouth Bass	SMB	122	Native Rainbow Trout	NRB
004	Brown Trout	LL	037	Minnow (unknown cyprinid)	MN	074	Bluegill	BG	123	Cutthroat Trout X Golden Trout Hybrid	CTxGT
005	Bull Trout	BULL	038	Shortnose Gar	GAR	075	Pumpkinseed	PUMP	124	Brook Trout X Bull Trout Hybrid	EBxBULL
006	Lake Trout	LT	039	Longnose Dace	LN DC	076	Green Sunfish	G SUN	125	Cisco	CIS
007	Golden Trout	GT	040	Buffalo (unspecified)	BUFF	077	Black Crappie	BL CR	126	Atlantic Salmon	AL SAL
008	Kokanee	KOK	041	Redbelly / Finescale Dace	NRB/F DC	078	White Crappie	WH CR	130	Mottled Sculpin	M COT
009	Coho Salmon	SS	042	Brassy Minnow	BR MN	079	Rock Bass	R BS	131	Slimy Sculpin (unspecified)	SL COT
010	Arctic Grayling	GR	043	Western Silvery / Plains Minnow	WS/P MN	081	Sauger	SGR	132	Torrent Sculpin	T COT
011	Rainbow X Cutthroat Hybrid	RBxCT	044	Flathead Chub	FH CH	082	Walleye	WE	133	Shorthead Sculpin	SH COT
012	Westslope Cutthroat Trout	WCT	045	Lake Chub	LK CH	083	Iowa Darter	IOWA	134	Spoonhead Sculpin	SP COT
013	Yellowstone Cutthroat Trout	YCT	046	Sturgeon Chub	ST CH	085	Mountain Whitefish	MWF	135	Rocky Mountain Sculpin	RM COT
014	Whitefish (unspecified)	WF	047	Emerald Shiner	EM SH	086	Pygmy Whitefish	PWF	136	Clark Fork Sculpin	CF COT
015	Lake Whitefish	L WF	048	Sand Shiner	SD SH	087	Chinook Salmon	CK SAL	137	Columbia Slimy Sculpin	CSL COT
016	Sculpin (unspecified)	COT	049	Redside Shiner	RS SH	088	Splake (brook trout x lake trout)	SPLK	140	Western Silvery Minnow	WS MN
017	Largemouth Bass	LMB	050	Creek Chub	CR CH	089	Salmon (unspecified)	SAL	141	Plains Minnow	PL MN
018	Bass (unspecified)	BASS	051	Pearl Dace	P DC	090	White Sturgeon	W STRG	142	Finescale Dace	FC DC
019	Sunfish (unk. centrarchid)	SUN	052	Fathead Minnow	FH MN	091	Pallid Sturgeon	P STRG	143	Northern Redbelly Dace	NRB DC
020	Yellow Perch	YP	053	Golden Shiner	G SH	092	Shovelnose Sturgeon	S STRG	144	Peamouth X N Pikeminnow	PEAxNPMN
021	Crappie (unspecified)	CR	054	Sicklefin Chub	SF CH	099	Rainbow Smelt	RB SM	145	Spottail Shiner	SP SH
022	Sauger / Walleye	SAWE	055	River Carpsucker	RC SU	100	Trout-perch	TR PR	146	Peamouth X Redside Shiner Hybrid	PEAxRSSH
023	Nothern Pike	NP	056	Longnose Sucker	LN SU	103	Plains Killifish	PKF	147	Redbelly Dace X Finescale Dace Hybrid	NRBxFCDC
024	Channel Catfish	C CAT	057	White Sucker	W SU	106	Mosquitofish	MQF	148	Northern Pike X Muskie Hybrid	NPxMK
025	Bullhead	BLHD	058	Largescale Sucker	LS SU	108	Sailfin Molly	SFM	149	Sauger X Walleye Hybrid	SGRxWE
026	Burbot	LING	059	Blue Sucker	B SU	109	Shortfin Molly	SHM	150	Golden Trout X Rainbow X Cutthroat Trout Hybrid	GTxRBxCT
027	Sturgeon	STRG	060	Bigmouth Buffalo	BM BUF	110	Rainbow X Westslope Cutthroat Hybrid	RBxWCT	152	Sunfish Hybrid	SUN HY
028	Paddlefish	PF	061	Smallmouth Buffalo	SM BUF	111	Rainbow X Yellowstone Cutthroat Hybrid	RBxYCT	153	Central Mudminnnow	CM MN
029	Peamouth	PEA	062	Shorthead Redhorse	SH RH	112	Variable Platy	VPF	154	Brook Trout X Brown Trout Hybrid	EBxLL
030	Goldfish	GDF	063	Mountain Sucker	MT SU	113	Rainbow X Yellowstone X Westslope Cutthroat	RBYCTWCT	155	Striped Bass	ST BS
031	Sucker (unknown catostomid)	SU	064	Stonecat	S CAT	115	Green Swordtail	GST	156	Gizzard Shad	GZ SHAD
032	Common Carp	CARP	065	Black Bullhead	BL BH	118	Trout (unspecified)	TRT	800	Survey Site Dry	DRY

Did you look for any other Fish? ☐Yes ☐No Herptiles? ☐Yes ☐No Other spp. Example: benthic macroinvertebrates **☐Yes ☐No**

Sp._____**# obs.**_____**☐est.** check this box if it is an estimate, otherwise it will be considered a "count", could also be qualitative e.g., common.

Life stage Examples: egg, tadpole, metamorphosed frog, larvae, etc... **Length range:** _____**to** _____**Wt**= Weight **range:** _____**to** _____

Comments: This is a place to record any other sampling event details, notes or observations

Form 3.3. Genetic Sample Submission Form

Agency: _____________FWP Region: _____

Collector: ____________________________

Phone:______________________________

Email:_______________________________

Collection Date:___/___/______

Target Return Date: ___/___/______

Sub-basin:____________________________

Stream/Lake Name:___________________

Suspected Species:____________________

Number of samples:___________________

Funding Source: ______________________

Comments:

Agency: _____________FWP Region: _____

Collector: ____________________________

Phone:______________________________

Email:_______________________________

Collection Date:___/___/______

Target Return Date: ___/___/______

Sub-basin:____________________________

Stream/Lake Name:___________________

Suspected Species:____________________

Number of samples:___________________

Funding Source: ______________________

Comments:

Agency: _____________FWP Region: _____

Collector: ____________________________

Phone:______________________________

Email:_______________________________

Collection Date:___/___/______

Target Return Date: ___/___/______

Sub-basin:____________________________

Stream/Lake Name:___________________

Suspected Species:____________________

Number of samples:___________________

Funding Source: ______________________

Comments:

Agency: _____________FWP Region: _____

Collector: ____________________________

Phone:______________________________

Email:_______________________________

Collection Date:___/___/______

Target Return Date: ___/___/______

Sub-basin:____________________________

Stream/Lake Name:___________________

Suspected Species:____________________

Number of samples:___________________

Funding Source: ______________________

Comments:

Appendix 4: FWP Wild Fish Transfer Policy

All transfers of WCT must be approved by the FWP Fisheries Division Administrator and conform with the FWP Wild Fish Transfer Policy. Decisions regarding wild fish transfers will be made at quarterly (January, April, June, October) Aquatic Health Advisory Committee meetings. To be considered, a project must have a completed FWP Wild Fish Transfer Form and all applicable fish health and AIS testing completed prior to the meeting. Disease and AIS testing may take up to 12 months to complete; advance planning is needed and expected.

The FWP Wild Fish Transfer Policy and Wild Fish Transfer Form are included on the following page and should be read in detail before considering a transfer.

POLICY
MONTANA FISH, WILDLIFE & PARKS
FISHERIES BUREAU

ISSUED	REVISED
4/18/96	4/18/12

APPROVED BY:
Bruce Rich, Fisheries Bureau Chief

TITLE: WILD FISH TRANSFER POLICY

SUBJECT: FISH STOCKING

PURPOSE:
This policy has been prepared to ensure that movement of wild fish by Montana Fish, Wildlife and Parks (FWP) personnel is compatible with overall stewardship of Montana's fishery resources.

RELATED STATE STATUTES/ADMINISTRATIVE RULES:
87-5-713

GENERAL:
The procedures associated with this policy are intended to prevent the transfer of fish pathogens and aquatic invasive species when moving fish for management purposes.

POLICY:
This policy, along with its standard operating procedures, will apply to all wild fish transfers (including eggs) within the State by FWP personnel. Employees of other agencies and entities who need to move fish within the State must work through the appropriate fisheries management staff and must follow the same procedures.

All wild fish transfers need to be approved by the Fish Health Committee (FHC), Aquatic Invasive Species (AIS) Coordinator, Regional Fisheries Manager, Fisheries Management Section Supervisor and Fisheries Bureau Chief. The role of the FHC is an advisory Board to make recommendations to the Fisheries Bureau Chief on fish transfers. The intent of this policy is to ensure that the risks of moving fish pathogens or aquatic invasive species are evaluated and minimized.

Testing Requirements.
Oversight of FWP's disease testing procedures is the responsibility of the fish health committee and the State Fish Health Coordinator. FWP's AIS Coordinator is responsible for oversight of the AIS program and conducts AIS inspections.

It is FWP's policy that all live fish movements will be preceded by both a fish health inspection and an aquatic invasive species inspection, as detailed by FWP fish health policy. A standard sample size for a fish health inspection is 60 fish of the target species to be moved. An aquatic invasive species inspection must by conducted by AIS program personnel when water temperatures are above 50° F. AIS inspections are not required for transfers of eggs. Deviations from these standards will be considered by the fish health committee on a case-by-case basis. Guidelines that will be used by the fish health committee to help determine the number and frequency of required tests on donor populations can be found in Appendix A.

Procedures
The attached wild fish transfer approval form is to be completed and approved by the fish health committee prior to any transfer of wild fish by fisheries management personnel. This form, along with information described in the appendices, is intended to collect necessary information needed to evaluate wild fish transfer proposals and also ensures that a centralized record of all wild fish transfers is maintained by FWP.

Note: Fish moved relatively short distances and placed in areas where they would normally have free access to are exempt from this policy. Examples would be fish entrained in irrigation ditches and dewatered streams that are being salvaged. Only regional approval is necessary for these fish movements. In order to maintain a record of these transfers, post-transfer reporting requirements must be met by submitting: a wild fish transfer form and a record of all fish (species and number) moved to the fish health coordinator, and a planting ticket to the fisheries section administrative assistant.

Wild fish transfers of non-salmonid fish, occurring in the Eastern Fishing District (portions of Regions 4 and 5 and all of Regions 6 and 7) will comply with the following modified procedures.

1) **All live fish movements will be preceded by both a fish health inspection and an aquatic invasive species inspection of the source body of water, as detailed by FWP fish health policy**.

2) **If the wild fish transfer satisfies all of the following criteria, no approval is required by the Fish Health Committee and the Regional Fish Manager is free to authorize the transfer**:

   a) Fish Health Inspection report of the donor species in question is free of pathogens or pathogens found are deemed by the Fish Health Committee to be low/no risk organisms.

   b) An aquatic invasive species inspection has been completed and no significant organisms have been detected, as determined by the AIS Coordinator.

   c) The Wild Fish Transfer proposal is intra-regional and no wild salmonids are present in the donor or recipient waters.

   d) MEPA requirements are met

   e) Copy of the WFT form is sent to the Fish Health Coordinator for filing

   f) Post transfer reporting requirements must be met by submitting a record of all fish (species, number) moved should be sent to the Fish Health Coordinator for filing.

   g) Planting ticket must be sent to the Fisheries Section Administrative Assistant.

Transfer proposals should be submitted well in advance of the planned transfer date. Depending on the transfer, disease and AIS testing may take up to 12 months to complete, as provided by FWP Fish Health Policy. It is the responsibility of applicants to plan accordingly and allow sufficient time for disease and AIS testing and the review process.

APPENDIX A
Guidelines for Determining the Number and Frequency of Fish Health and AIS Inspections

Any time fish or eggs are moved from one location to another, there is a risk of moving undesirable organisms along with them. Fish health and AIS inspections are tools that we have to help manage those risks. In order to use those tools most effectively, we must understand both the benefits of having the information they provide, as well as their inherent limitations. An inspection is somewhat of a snapshot in time that gives us a better feel for what organisms may be present in a body of water. It is important to recognize that the presence of organisms, as well as our ability to detect them, is a dynamic process that can and does change over time. From a general standpoint, inspections have historically been considered valid for up to one year. From a practical standpoint, they are only good until a new harmful organism is introduced into that water. There are a variety of characteristics, or risk factors that can impact the chances that harmful organisms are introduced into a body of water and could be subsequently be spread along with the transfer of fish. These characteristics are numerous and will vary greatly between different water bodies.

In order to more fully understand and mitigate the risks of moving potentially harmful organisms in these fish transfers, it is prudent to consider some of these characteristics, in addition to just conducting inspections, when evaluating wild fish transfer proposals.

These factors include (in no particular order):

- species composition
- presence of salmonids
- species being moved
- size of the water body
- relative proximity to other water bodies
- water source (ie. perenniel or intermittent stream, run-off, etc.)
- connectivity to other waters
- proximity of water body to urban areas
- amount of angling pressure
- angler demographics (resident vs. non-resident)
- use of live bait
- level of boat use
- distance between donor and recipient waters
- fish health and AIS testing history

These characteristics will be used to rank the various water bodies based on their relative level of risk of containing and spreading harmful organisms. Since annual sampling of all fish sources is not practical, guidelines are offered as to the frequency of sampling of the various categories. As a very rough guideline, three levels of risk should be considered.

High risk waters

- Would require annual fish health and AIS sampling
- Characteristics – larger size, close to population centers or heavy angler use, especially non-resident anglers, heavy boat traffic, open system that connects to other water bodies.
- Examples – Tongue River Reservoir, Ft Peck Reservoir, Nelson Reservoir and Fresno Reservoir

Medium risk waters

- Would require testing every 2-3 years
- Characteristics – smaller to medium size, somewhat isolate but still receive moderate boat traffic and angler use,
- Examples – South Sandstone Reservoir, Cow Creek Reservoir

Low risk waters

- Would require testing every 4-5 years
- Characteristics – small, isolated ponds, no salmonids present, relatively low angler use, little or no boat traffic, fairly close proximity to receiving water.
- Examples – characteristic of ponds generally found in the Eastern Fishing District.

These Water Body Risk Criteria are guidelines. This will be a subjective process and the ability to identify and quantify these characteristics will, at times, be challenging. However, we would be remiss to not consider them in the decision making process. Various waters will possess combinations of the aforementioned characteristics and it will be difficult to assess the relative risks between them. Regional fisheries personnel will be relied on to provide data and knowledge relating to the various water bodies involved in order to facilitate discussion and make decisions.

FWP policy stipulates that no fish will be moved from sources that have not been tested for fish pathogens and aquatic nuisance species. This information is intended to be discussed by the fish health committee when an application for fish transfer is made in order to provide important feedback to regional personnel for use in planning future wild fish transfers as well as determining any additional precautions that may be necessary, as outlined in Appendix B.

APPENDIX B
Protocols and Guidelines for Wild Fish Transfers

It is recognized that there are additional precautions that can be taken to further reduce the likelihood of moving unwanted organisms while moving wild fish for management purposes. Due to the endless variations in circumstance surrounding these transfers, such as locations, equipment, personnel, etc., it is difficult to develop a one-size-fits-all protocol. The use of pathogen free water is a requirement on all transfers, and additional suggested measures should be taken when it is practical to do so.

Required Measure

Water supply –Pathogen-free water obtained from closed water supplies such as springs or wells must be used for hauling fish. Surface waters from the donor source must not be utilized. Water from any State fish hatchery should be considered an optimal source. Use municipal water supplies with caution as they usually contain chlorine. When approved by the Regional Fisheries Manager, water from the receiving water may be used for hauling fish.

Suggested Measures

Use of hatchery equipment – The use of hatchery equipment to conduct wild fish transfers poses additional risks of bringing harmful organisms into the State hatchery system and is strongly discouraged. The use of hatchery trucks for hauling wild fish is at the discretion of individual hatchery managers.

Care of equipment – All equipment used to conduct wild fish transfers should be thoroughly cleaned and dried between uses. If complete drying is not possible, chemical disinfection such as bleach, quaternary ammonias, Virkon Aquatic™, etc. should be a priority. Please contact the fish health lab for specific information or to procure disinfectants.

WILD FISH TRANSFER FORM

A wild fish transfer form must be completed for each request to transfer <u>any</u> fish from <u>any</u> water in Montana to another water in Montana

Mail completed form to:
Fish Health Lab
Montana Fish, Wildlife and Parks
4801 Giant Springs Road
Great Falls, MT 59403

Date: _____

I. Stocking Request

Species: _____

Number and size to be stocked: _____

Stocking objective: _____

Proposed collection method and date: _____

Will hatchery system equipment be involved in transfer? _____

_____ Yes _____ No If yes, describe equipment and hatchery role:

II. Collection Site

Name of Water: _____

Region: _____ County: _____

Legal Description: _____

Water Code: _____ Drainage: _____

Fish species composition: _____

Describe any know disease or parasite concerns: _____

Have fish been collected and transferred from this water before? _____

III. Stocking Site

Name of Water: _____

Region: _____ County: _____

Legal Description: _____

Water Code: _____ Drainage: _____

Fish species composition: _____

Describe any known disease or parasite concerns: _____

Has the proposed species been stocked in this water before? _____ Yes _____ No

IV. Summary of Transfer Type

Species	Salmonids Present in donor water?	Salmonids present in receiving water?
_____ Salmonid	_____ Yes	_____ Yes
_____ Non-salmonid	_____ No	_____ No

Are donor and receiving water within the same region? _____ Yes _____ No

Is an EA required? (if yes, attach to form) _____ Yes _____ No

Date of last fish health inspection: _____

Date of last Aquatic Invasive Species inspection: _____

Will proposed transfer impact any species of special concern of threatened/endangered species?
(if yes, describe impacts and submit form for Division approval) _____ Yes _____ No

V. Approval

Project Biologist _____

Area Management Biologist: _____

Regional Fisheries Manager: _____

State Fish Health Coordinator: _____

Aquatic Invasive Species Coordinator: _____

Fish Management Bureau Chief: _____

_____

Date Received: _____ WFT No: _____

Appendix 5: WCT Transfer Protocol

The following protocols were developed to maximize survival of wild WCT being transferred from donor populations to restoration projects. These protocols should be followed for any wild fish transfer. Prior to transferring live fish ensure that FWP has approved the transfer and all applicable fish health and AIS sampling has been completed.

Equipment needed:

- Cooler with four aerators firmly attached
- Extra D cell batteries
- Extra aerators with hardware to attach/remove
- Two ratchet straps per cooler
- Ice bags
- Large internal frame packs
- O_2 tank
- O_2 tank hoses
- Electrical tape
- Heavy duty garbage bags
- Milk Cans with aerators
- Thermometer or multimeter

Instructions for packing fish with O_2:

1) Put one garbage bag inside another one
2) Put in external frame pack
3) Add about four gallons of water
4) Measure stream temperature
5) Add ice to reduce temperature to 6-8 C (43-47 F) but by no more than 5 C total
6) Put no more than 25 fish in the bag
7) Attach a tube to the nipple on the regulator of the O_2 tank
8) Turn on O_2 tank (handle at the top of the tank)
9) Insert the tube in the bags and work all air out by holding the top tightly
10) Turn the O_2 regulator on and inflate bag to the top of the pack
11) Turn off O_2 tank
12) Hold bag tightly closed and remove tube
13) Tie bag top in knot, double tag end on its self, wrap tightly with electrical tape

Instructions for moving fish in coolers:

1) Add water to cooler and test all aerators
2) Add water to a milk can in case of spills in transit
2) Measure stream temperature
3) Add ice to reduce temperature to 6-8 C (43-47 F) but by no more than 5 C total
4) Put no more than 50 fish in the cooler
5) Strap cooler shut with at least two straps and strap into back of truck
6) Check water temperatures and levels every hour
7) When arriving at release site, slowly acclimate fish to new water by removing part of a bucket from cooler
and replacing with recipient stream water.
8) **Do not dump any water from donor stream into the recipient stream.**

Appendix 6: Potential WCT Donor Streams

Restoration projects will be re-founded using transfer of live wild fish from genetically unaltered WCT populations within the assessment area such that the donor populations are not adversely affected. To avoid impacts and maximize genetic diversity no more than 20% < 75mm and no more than 10% of >75 mm fish in the donor population should be transferred, 2) transfer should occur over at least two years, 3) fish should be collected from throughout the donor stream, and 4) multiple age classes should be selected. Up to 50 fish may be moved from a donor population each year. All populations used as donors will have genetic samples collected and analyzed prior to transfer and comply with FWP wild fish transfer and fish health policies. The number of fish transferred from a given population will be determined based on the most recent population surveys and project goals. Candidate WCT populations within the assessment area and the results of recent surveys that inform their suitability as donors are described below in Table A.6.1.

Table A.6.1. Demographic, genetic, fish health, and AIS sampling results from potential WCT donor streams.

Sub-basin	Donor Stream	Pop. Est.	Threat Status	Genetic Status	Most Recent Genetics (Sample #)	Most Recent Fish Health (result)	Most Recent AIS (+/-)
Beaverhead	Brays Canyon	1559	Protected	Unaltered	2017 (4891)	2016 (-)	NA
Beaverhead	Buffalo	1261	At-Risk	Unaltered	2018 (5086)	NA	NA
Beaverhead	Cottonwood	521	Protected	Unaltered	2017 (4889)	2016 (+ WD)	NA
Beaverhead	Jake Canyon	3298	Secured	Altered	2018 (4970)	2017 (-)	NA
Beaverhead	Pole Creek	31	At-Risk	Unaltered	2021 (5328)	2021 (-)	2021 (-)
Beaverhead	Reservoir	767	At-Risk	Unaltered	2017 (4925)	NA	NA
Beaverhead	Stone Creek	2060	At-Risk	Altered	2018 (4968)	2021 (-)	2021 (-)
Beaverhead	Stone Creek	30	At-Risk	Unaltered	2021 (5315)	2021 (-)	2021 (-)
Big Hole	Bear Creek	219	At-Risk	Altered	2021 (5315)	2021 (-)	2021 (-)
Big Hole	Cherry Creek	unk	Secured	Unaltered	2021	2021 (-)	2021 (-)
Big Hole	Lacy Creek	unk	Protected	Mixed	2021 (5315)	2021 (-)	2021 (-)
Big Hole	Mono Creek	965	Protected	Mixed	?	?	?
Big Hole	Mussigbrod	418	At-Risk	Unaltered	?	?	?
Big Hole	Ruby	unk	At-Risk	Unaltered	?	?	?
Big Hole	Squaw	676	At-Risk	Mixed	2021	2021 (-)	2021 (-)
Big Hole	Warm Springs	unk	At-Risk	Unaltered	?	?	?
Big Hole	Wyman	unk	At-Risk	Unaltered	?	?	?
Big Hole	Steel Creek	unk	At-Risk	Unaltered	?	?	?
Big Hole	York Gulch	300	At-Risk	Unaltered	2021 (5326)	2021 (-)	2021 (-)
Boulder	Jack	unk	At-Risk	Unaltered	?	?	?
Boulder	Red Rock	unk	At-Risk	Unaltered	?	?	?
Gallatin	Placer	unk	Protected	Unaltered	?	?	?
Gallatin	Wild Horse	80	At-Risk	Unaltered	2021	2021 (+ WD)	2021 (-)
Madison	Garrott Creek	unk	At-Risk	Unaltered	2021	2021 (-)	2021 (-)
Madison	Last Chance	unk	Protected	Unaltered	?	?	?
Madison	McClure Creek	90	Protected	Unaltered	?	?	?
Madison	Ruby	200	Protected	Unaltered	?	?	?

Sub-basin	Donor Stream	Pop. Est.	Threat Status	Genetic Status	Most Recent Genetics (Sample #)	Most Recent Fish Health (result)	Most Recent AIS (+/-)
Red Rock	Bear (CV)	612	At-Risk	Unaltered	2006 (3415)	NA	NA
Red Rock	Browns Creek	2615	At-Risk	Unaltered	2017 (4886)	2016 (-)	NA
Red Rock	Craver	67	At-Risk	Unaltered	2017 (4926)		
Red Rock	Meadow	941	At-Risk	Unaltered	2017 (4890)	2016 (-) (Myxozoa spores in heads)	NA
Red Rock	Painter Creek	1505	Protected	Unaltered	2017 (4888)	2016 (-)	NA
Red Rock	Simpson Creek	966	At-Risk	Unaltered	2017 (4928)	???	2021
Ruby	Jack Creek	797	Protected	Unaltered	2017 (4887)	NA	NA
U. Missouri	Duck	unk	At-Risk	Unaltered	?	NA	NA
U. Missouri	Eureka	unk	Protected	Unaltered	?	NA	NA
U. Missouri	McClellan	unk	At-Risk	Unaltered	?	NA	NA
U. Missouri	Page	unk	At-Risk	Unaltered	?	NA	NA
U. Missouri	Porcupine	unk	At-Risk	Unaltered	?	NA	NA
U. Missouri	Rooster Bill	unk	At-Risk	Unaltered	?	NA	NA
U. Missouri	SF W. Springs	unk	At-Risk	Unaltered	?	NA	NA

Appendix 7: Genetic Rescue

The mean and standard deviation of average expected heterozygosity (He) for this set of populations are 0.036 and 0.024, respectively. Populations with He that is below 1 standard deviation of the mean (0.012) will be considered as potential candidates for genetic rescue. At this time two populations, Bear and Ramshorn creeks, are below this threshold. Genetic rescue plans (i.e., donor source, number of fish transferred, duration, etc.) will be developed on a case-by-case basis.

Table A.7.1. Genetic variation (H_e and P), differentiation ($\overline{F}_{SR}$ – mean differentiation among all local populations east of the divide) watershed, barrier type, and sample size for westslope cutthroat trout populations east of the Continental Divide. Populations that were potential candidates for genetic rescue are highlighted in bold (From Kovach et al. 2021).

Sub-basin	Population	Barrier	N	H_e	P	$\overline{F}_{SR}$
Beaverhead	Alkali	Natural - waterfall	50	0.124	0.438	0.463
Beaverhead	**Brays Canyon**	**Anthro - demographic**	**105**	**0.062**	**0.281**	**0.424**
Beaverhead	Cottonwood	Natural - waterfall	111	0.035	0.125	0.549
Beaverhead	**Jake Canyon**	**Anthro - demographic**	**25**	**0.064**	**0.156**	**0.513**
Beaverhead	Left Fork Stone	Anthro - mine	26	0.129	0.406	0.500
Beaverhead	Reservoir	Natural - intermittent	75	0.063	0.25	0.485
Beaverhead	**Upper Buffalo**	**Anthro - demographic**	**25**	**0.098**	**0.313**	**0.354**
Big Hole	American	Anthro - dam	29	0.159	0.531	0.394
Big Hole	Bear	Anthro - demographic	16	0.121	0.375	0.407
Big Hole	**Bender**	**Anthro - demographic**	**36**	**0.034**	**0.125**	**0.583**
Big Hole	**Blind Canyon**	**Anthro - demographic**	**25**	**0.054**	**0.125**	**0.423**
Big Hole	Hell Roaring	Natural - cascade	18	0.018	0.097	0.486
Big Hole	**Little American**	**Anthro - demographic**	**30**	**0.056**	**0.258**	**0.459**
Big Hole	Mono	Natural - cascade	15	0.095	0.344	0.413
Big Hole	Papoose	Natural - cascade	25	0.037	0.125	0.598
Big Hole	Plimpton	Natural - cascade	70	0.107	0.344	0.373
Big Hole	**Rabbia**	**Anthro - demographic**	**37**	**0.087**	**0.344**	**0.416**
Big Hole	**Doolittle**	**Anthro - demographic**	**49**	**0.057**	**0.156**	**0.435**
Big Hole	**S. Fork N. Fork Divide**	**Anthro - dam**	**9**	**0.045**	**0.097**	**0.439**
Big Hole	Spruce	Anthro - irrigation	26	0.221	0.594	0.389
Big Hole	Squaw	Anthro - demographic	26	0.101	0.5	0.481
Big Hole	**Squaw Lake**	**Anthro - demographic**	**30**	**0.076**	**0.25**	**0.501**
Big Hole	**Twelvemile**	**Anthro - demographic**	**41**	**0.104**	**0.281**	**0.408**
Boulder	Little Boulder	Anthro - mine	25	0.189	0.563	0.438
Boulder	Muskrat	Anthro - demographic	13	0.253	0.781	0.487
Gallatin	**Wild Horse**	**Natural - cascade**	**17**	**0.038**	**0.125**	**0.449**
Red Rock	**Bean**	**Anthro - irrigation**	**50**	**0.063**	**0.188**	**0.438**
Red Rock	**Bear**	**Anthro - irrigation**	**25**	**0.02**	**0.063**	**0.541**

Red Rock	**Craver**	**Anthro - demographic**	**25**	**0.066**	**0.188**	**0.416**
Red Rock	Browns	Anthro - irrigation	158	0.283	0.906	0.222
Red Rock	E. Fork Clover	Natural - cascade	25	0.113	0.313	0.439
Red Rock	Meadow	Natural - intermittent	130	0.126	0.438	0.329
Red Rock	N. Fork Everson	Anthro - culvert	28	0.097	0.323	0.332
Red Rock	Simpson	Natural - intermittent	50	0.087	0.25	0.346
Red Rock	Painter	Anthro - culvert	111	0.179	0.813	0.236
Red Rock	S. Fork Everson	Natural - intermittent	27	0.067	0.281	0.426
Ruby	**Dark Hollow**	**Anthro - demographic**	**50**	**0.055**	**0.344**	**0.548**
Ruby	Jack	Natural - intermittent	143	0.05	0.156	0.554
Ruby	**Meadow Fork Greenhorn**	**Anthro - cascade**	**25**	**0.096**	**0.323**	**0.355**
Ruby	**Ramshorn**	**Anthro - irrigation**	**90**	**0.004**	**0.031**	**0.776**
Ruby	**S. Fork Greenhorn**	**Anthro - demographic**	**10**	**0.086**	**0.281**	**0.387**
Upper Missouri	Dutchman	Anthro - demographic	50	0.183	0.563	0.393
Upper Missouri	**Hall**	**Anthro - culvert**	**28**	**0.06**	**0.188**	**0.556**
Upper Missouri	Skelly Gulch	Anthro - culvert	27	0.1	0.406	0.367
Upper Missouri	**S. Fork Quartz**	**Anthro - culvert**	**40**	**0.027**	**0.125**	**0.638**
Upper Missouri	**Staubach**	**Anthro - demographic**	**32**	**0.021**	**0.094**	**0.593**
Upper Missouri	**Threemile**	**Anthro - dam**	**44**	**0.086**	**0.313**	**0.339**
Upper Missouri	Whites	Natural - intermittent	24	0.082	0.281	0.470

Appendix 8: WCT Conservation Population Monitoring Schedule

Table A.8.1. Monitoring schedule for conservation populations within the assessment area.

Sub-basin	Stream	Previous Genetic Status	# of Samples	Purpose	Year
Big Hole	Governor	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
Big Hole	Mono	Unaltered	25	Identify remaining unaltered WCT for transfer	2022
Big Hole	Mussigbrod	Unaltered	25	Identify remaining unaltered WCT for transfer	2022
Big Hole	NF Divide	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
Big Hole	Rock	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
Big Hole	Ruby	Unaltered	25	Identify remaining unaltered WCT for transfer	2022
Big Hole	Trapper	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
Big Hole	Warm Springs	Unaltered	25	Identify remaining unaltered WCT for transfer	2022
Big Hole	Wyman	Unaltered	25	Identify remaining unaltered WCT for transfer	2022
Big Hole	Steel	Unaltered	25	Identify remaining unaltered WCT for transfer	2022
Boulder	High Ore	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
Boulder	Red Rock	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
Ruby	Mill	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
U. Missouri	Clancy	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
U. Missouri	Cottonwood	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
U. Missouri	Log Gulch	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
U. Missouri	McClellan	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
U. Missouri	NF Gurnett	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
U. Missouri	Rooster Bill	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
U. Missouri	SF Warm Springs	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
U. Missouri	Skelly	Unaltered	25	Identify remaining unaltered WCT for protection in place	2022
Beaverhead	Cat	Altered	15	Tested as 96.5% WCT in 2014	2023-2025
Beaverhead	Rock	Altered	15	Tested as 96.9% WCT in 2014	2023-2025
Big Hole	Big Lake	Altered	15	Tested as 93.3% WCT in 1994	2023-2025
Big Hole	Gory	Altered	15	Tested as 97.6% WCT in 2009	2023-2025
Big Hole	Jacobson	Altered	15	No testing since 2001	2023-2025
Big Hole	Jerry	Altered	15	Tested as >99% WCT in 2014	2023-2025
Big Hole	Johnson	Altered	15	Tested as 96.9% WCT in 2001	2023-2025

Big Hole	Meadow	Altered	15	Tested as 97.3% WCT in 2014	2023-2025
Big Hole	Moose	Altered	15	Tested as 97.7% WCT in 1994	2023-2025
Big Hole	Odell	Altered	15	Tested between 91.7% and 97.5% WCT in 1994	2023-2025
Big Hole	Seymour	Altered	15	Unknown results in 2005	2023-2025
Big Hole	Spruce	Altered	15	Tested as 99.8% WCT in 2014	2023-2025
Big Hole	Stine	Altered	15	Unknown hybridization found in 1995	2023-2025
Big Hole	Swamp	Altered	15	Tested as 99.8% WCT in 2012	2023-2025
Big Hole	Tenmile	Altered	15	Tested as 99.7% WCT in 2010	2023-2025
Big Hole	Woody	Altered	15	Tested as 98.5% WCT in 2009	2023-2025
Boulder	Rock	Altered	15	Tested as 97.3% WCT in 2004	2023-2025
Boulder	Sullivan	Altered	15	Unknown hybridization found in 2004	2023-2025
Boulder	Thunderbolt	Altered	15	Tested as 98.7% WCT in 2004	2023-2025
Gallatin	Beehive Basin	Altered	15	Tested as 96-99% WCT in 2010	2023-2025
Gallatin	EF Fan	Altered	15	Tested as 94-95% WCT in 2003	2023-2025
Gallatin	Lightning	Altered	15	Tested as 92% WCT in 2016	2023-2025
Gallatin	NF Fan	Altered	15	Tested as 99% WCT in 2003	2023-2025
Madison	Deadman	Altered	15	Tested as 98% WCT in 2012	2023-2025
Madison	Horse	Altered	15	Tested as 95% WCT in 2015	2023-2025
Madison	Pine Butte	Altered	15	Tested as 98% WCT in 2012	2023-2025
Madison	Rose	Altered	15	Tested as 94% WCT in 2011	2023-2025
Madison	Soap	Altered	15	Tested as 94% WCT in 2005	2023-2025
Madison	WF Madison	Altered	15	Tested as 95% WCT in 2008	2023-2025
Red Rock	Bear (H. Prairie)	Altered	15	Tested as 98% WCT in 2006	2023-2025
Red Rock	Deadman	Altered	15	Tested as 93% WCT in 2002	2023-2025
Red Rock	Jones	Altered	15	Tested as 96% WCT in 2002	2023-2025
Red Rock	Little Sheep	Altered	15	Tested as 96% WCT in 2012	2023-2025
Red Rock	Long	Altered	15	Tested as 99% WCT in 1999	2023-2025
Red Rock	Middle (CV)	Altered	15	Tested as 97% WCT in 2011	2023-2025
Red Rock	Nicholia	Altered	15	Tested as 92% WCT in 2002	2023-2025
Red Rock	Odell	Altered	15	Tested as 99% WCT in 2012	2023-2025
Red Rock	Rock	Altered	15	Tested as 96% WCT in 2015	2023-2025
Red Rock	Sheser	Altered	15	Tested as 98% WCT in 2009	2023-2025
Ruby	Coal	Altered	15	Tested as 93% WCT in 2012	2023-2025
Ruby	Corral	Altered	15	Tested as 91% WCT in 2004	2023-2025

Ruby	Cottonwood	Altered	15	Tested as 93% WCT in 2011	2023-2025
Ruby	Peterson	Altered	15	Tested as 95% WCT in 2012	2023-2025
Ruby	Sweetwater	Altered	15	Tested as 97% WCT in 2014	2023-2025
U. Missouri	Avalanche	Altered	15	Tested as 95% WCT in 2004	2023-2025
U. Missouri	EF McClellan	Altered	15	Tested as 95% WCT in 2015	2023-2025
U. Missouri	Elkhorn	Altered	15	Tested as 98% WCT in 2012	2023-2025
U. Missouri	Greyson	Altered	15	Tested as 97% WCT in 2010	2023-2025
U. Missouri	Specimen	Altered	15	Tested as 93% WCT in 2000	2023-2025
U. Missouri	Stemple	Altered	15	Tested as 96% WCT in 2002	2023-2025