QUALITATIVE ASSESSMENT OF HABITAT IN EIGHT TRIBUTARIES TO UPPER CLARK FORK RIVER

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Section 1 INTRODUCTION

This report provides results of a project to assess fish habitat and fish migration barriers on the upper Clark Fork River and select tributaries conducted by Dennis Workman, retired state fisheries biologist, during the summer and fall of 2008. This project area covered 81 miles of upper Clark Fork River between the mouths of the Big Blackfoot River and the Little Blackfoot River and eight tributaries to the upper Clark Fork River (Figure 1). The Montana Natural Resource Damage Program (NRDP) funded this project, which was conducted under the oversight of that program and the Montana Department of Fish, Wildlife, and Parks (FWP).

Section 2 GOALS AND OBJECTIVES

This project was designed to collect information on the mainstem of the upper Clark Fork River (CFR) and lower reaches of tributaries to assist in prioritizing restoration efforts for maximum positive benefit to the CFR fisheries. The specific objectives in the scope of work for this project were to:

- Contact owners of land surrounding points of interest for habitat and fish passage assessments to obtain access permission and provide background on the State's restoration work in the Upper Clark Fork River Basin (UCFRB).
- Locate irrigation diversions in the upper CFR and selected tributaries and assess them for ease of fish passage, potential for fish entrapment in the ditches and potential effects of irrigation on instream flows.
- Locate the mouths of potentially important tributaries to the CFR, assess their connection to the mainstem for ease of fish passage, identify fish passage barriers, and assess habitat quality for a reasonable distance upstream from the mouth.
- Prioritize restoration needs based upon assessment findings.
- Produce a final report documenting the results with maps, photos, narrative descriptions and quantitative measurements.

This project is one of three fishery assessment projects currently being directed and funded by the State (NRDP and FWP) that are aimed at collecting needed information to prioritize restoration efforts for maximum positive effect on the UCFRB fisheries. These efforts were triggered by the conclusion of the State's natural resource damage lawsuit and the need to prioritize how settlement monies from that lawsuit could best be used to improve upper CFR fisheries.[1] The two other assessments, which are broader in scope and area than this project, involve:

[1] This State's draft prioritization effort is further outlined in the May 2008 "Draft Conceptual Framework for an UCFRB Restoration Priorities Road Map," prepared by the NRDP. Further information on this draft road map can be obtained for the NRDP's website at: http://doj.mt.gov/lands/naturalresource/restorationroadmap.asp.

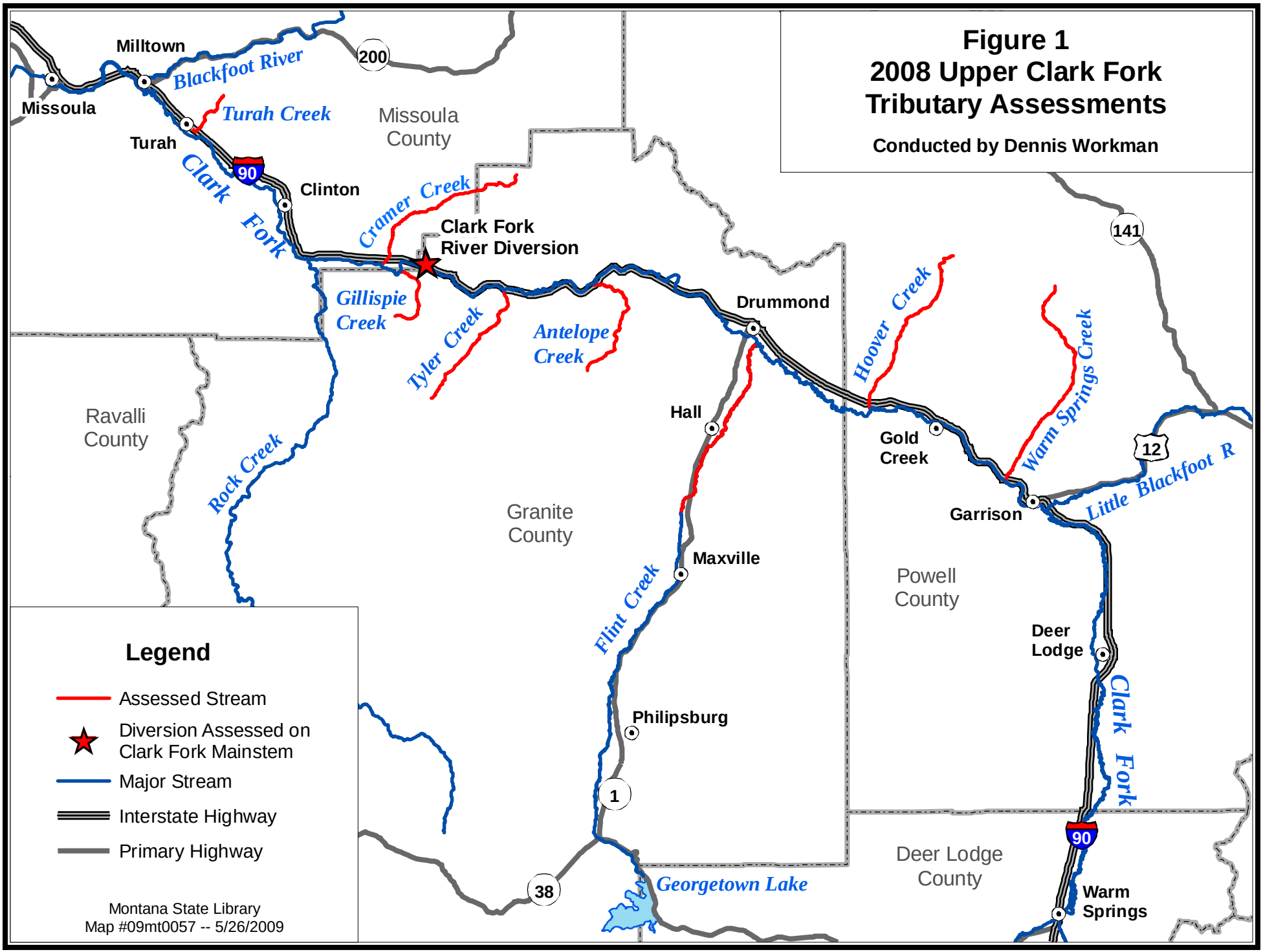


Figure 1
2008 Upper Clark Fork
Tributary Assessments
Conducted by Dennis Workman
Milltown
Missoula
Blackfoot River
200
Turah Creek
Turah
Missoula
County
90
Clark Fork
Clinton
Cramer Creek
Clark Fork
River Diversion
141
Gillispie
Creek
Tyler Creek
Antelope
Creek
Drummond
Hoover Creek
Warm Springs Creek
Ravalli
County
Hall
Gold
Creek
12
Rock Creek
Granite
County
Garrison
Little Blackfoot R
Maxville
Flint Creek
Powell
County
Deer
Lodge
Clark Fork
Philipsburg
1
90
38
Georgetown Lake
Deer Lodge
County
Warm
Springs
Legend
Assessed Stream
Diversion Assessed on
Clark Fork Mainstem
Major Stream
Interstate Highway
Primary Highway
Montana State Library
Map #09mt0057 -- 5/26/2009

- Riparian and stream habitat assessments and fish population surveys of UCFRB conducted by FWP biologists during the 2007 and 2008 field seasons.[2]

- A study of trout movement in the UCFRB conducted by Montana State University and FWP biologists from 2009 through 2012.[3]

With the removal of the Milltown Dam occurring under remediation and the additional restoration activities at the confluence of the Clark Fork and Big Blackfoot Rivers, fluvial trout are now able to migrate to upstream tributaries. This project focused on tributaries closest to the confluence area for which data was lacking; the other assessments underway cover tributaries further upstream. In consultation with NRDP and FWP, eight tributaries were selected for assessment in this project, with the option of conducting additional assessments as timing/resources allowed. Figure 1 indicates the assessed tributaries.

Users of this document should understand that the assessment and prioritization work conducted for this project is limited in its focus and is a small part of the State's larger basin-wide aquatic resource assessment and prioritization effort. The prioritization methodology used herein was strictly developed for this limited effort and is not be misconstrued as the prioritization methodology the State will use for its basin-wide aquatic resource prioritization effort. Similarly, the conclusions of this limited effort should not be misconstrued as indicative of the results of the State's more comprehensive effort to prioritize restoration in the UCFRB.

Section 3 METHODS

A. Assessment methodology

Land ownership was determined using Montana Cadastral Mapping Program. Landowners were contacted and permission to do the survey was granted before any field work was done. Stream and habitat conditions were measured, photographed and described by walking and/or floating and observing conditions on the selected stream reach. Stream discharge was determined by wading using a Marsh McBirney digital flow meter and methods described by the U.S. Geological Survey. Universal Transverse Mercator (UTM) locations were determined using a Garmin eTrex. Stream channel lengths and various distances were measured from Google Earth.

B. Prioritization methodology

The stream reaches surveyed were prioritized using a subjective, qualitative process as opposed to a more objective, numerical ranking. Therefore, the rankings are the best professional judgment of the author based primarily upon the perceived value of the stream reach to CFR fish

[2] *An Assessment of Fish Populations and Riparian Habitat in Tributaries of the Upper Clark Fork River Basin*, by Brad Liermann, Jason Lindstom, and Ryan Kreiner of Montana Fish, Wildlife and Parks, April 2008.

An Assessment of Fish Populations and Riparian Habitat in Tributaries of the Upper Clark Fork River Basin, Phase II, by Brad Liermann, Jason Lindstom, and Ryan Kreiner of Montana Fish, Wildlife and Parks, April 2009.

[3] *Proposal for study of trout movement to identify key resource areas and factors affecting trout in the UCFRB*, prepared by the NRDP and FWP, November 2008.

populations, the condition of the stream channel, and quality of the fish habitat. The highest priority rankings were given to the streams that have the highest potential for improving CFR fish populations and show the greatest need for restoration. In some cases low priority rankings were given to reaches that are in relatively good condition and have high quality habitat but no restoration is needed. High, medium and low rankings were used to separate major groups of stream reaches. These rankings may be adjusted as data analyses are completed from the other assessments and that could change the perceived value of a tributary stream reach to the CFR fish populations.

Section 4 RESULTS

This section briefly describes the location and condition of the stream reaches that were assessed and the results of prioritizing restoration work in these reaches. The reaches appear here in alphabetical order and their locations are described relative to the mouth of the Big Blackfoot River (BFR) using the Department of Natural Resources and Conservation's River Mile Index. The mouth of the BFR is at river mile 364.7. The detailed report of findings and recommendations for each tributary can be found in the appendices to this report.

Antelope Creek

This is an intermittent stream located 38 miles upstream from the BFR at river mile 407.7. At the time of the survey, Antelope Creek did not connect to the CFR. In the portion of the stream surveyed where there was surface flow, it was too small to measure. It was rated low on the priority list as having little or no potential to contribute to CFR fisheries (Appendix A).

Clark Fork River Diversion

The CFR diversion is located at river mile 390.8 placing it 26.1 miles upstream from the BFR. It is a seasonal irrigation dam across the mainstem of the CFR. It could be an important factor in upstream fish migration and is thus listed as a high priority among potential projects (Appendix B).

Cramer Creek

Entering the CFR on its right bank, Cramer Creek is located 21.7 miles upstream from the BFR at river mile 386.4. Cramer Creek is a high priority because of its size, potential importance to the CFR fisheries and potential for successful restoration in its lower 1.3 miles (Appendix C).

Flint Creek

The mouth of Flint Creek is near the town of Drummond at river mile 417.6, upstream from the BFBR 52.9 river miles. It is the largest tributary to the CFR surveyed in this project. The Flint Creek survey included the lower 13 miles of the creek and it is reported in 5 separate reaches. Because of its size, habitat condition and potential importance to the CFR fish populations, the lower reach of Flint Creek is ranked high priority. The next two reaches upstream are listed medium priority and the upper two reaches are rated low priority because of their relatively good habitat quality (Appendix D).

Gillespie Creek

Gillespie Creek is a small, low priority stream entering the CFR on its left bank 22.9 miles upstream from the BFR (RM 387.6). It has a multitude of problems which make successful restoration improbable (Appendix E).

Hoover Creek

Developments on the lower end of Hoover Creek have broken its connection to the CFR and created a fish passage barrier that would be nearly impossible to correct resulting in a low priority rating. It is located at river mile 429.4 on the right bank of the CFR 64.7 miles upstream from the BFR (Appendix F).

Turah Creek

At river mile 369.6 it is only 4.9 miles from the BFR. It is a small stream and because of its proximity to Rock Creek, Schwartz Creek, Deer Creek and Crystal Creek it is unknown what potential it has for improving CFR fish populations. It is listed as a low priority stream but is probably the highest priority stream among those rated low. In its current condition, it is unavailable to fish from the CFR, but channel restoration could make it available to them (Appendix G).

Tyler Creek

This tributary is 31.1 miles upstream from the BFR at river mile 395.8. It is located in a reach of the CFR where there is a paucity of tributaries that are useable by CFR fish, and it holds a high priority rating because of this situation. In its current condition, it represents a difficult and expensive restoration task, but one that deserves more investigation (Appendix H).

Warm Springs Creek

This tributary is located near Garrison at river mile 440.5 entering the CFR on its right bank 75.8 river miles upstream of the BFR. It holds a low priority rating because the stream channel and habitat quality are relatively good (Appendix I).

Other Streams

All of the most important streams listed in the original work plan were surveyed and reported in this report. Deer Creek, Brock Creek, Carten Creek, and Dog Creek (tributary to the Little Blackfoot River) were not surveyed due to time constraints during the survey season.

Prioritization Summary Table: Table 1 presents a summary of the prioritization results for the assessed reaches. Within each high, medium, and low ranking groups, reaches are listed in order of priority, with the first reach in each group the highest restoration priority and the last reach the lowest restoration priority.

ORDER OF PRIORITIES

Table 1. List of streams or stream reaches, their tentative priority ranking, with their locations, problems and comments.

STREAM	PRIORITY	LOCATION	SUMMARY OF PROBLEMS & RECOMMENDATIONS
Clark Fork River Diversion	HIGH	1.8 miles east of exit 130 I-90	Fish passage barrier occurs only during irrigation season Need to determine effects on fish migrations.
Cramer Creek I-90 to mouth	HIGH	¼ mile west of exit 126 I-90	Potential fish passage barrier at mouth, habitat degradation, irrigation pump station fish entrapment Could be important spawning tributary to the CFR.
Flint Creek Mullan Trail to mouth (Reach 5)	HIGH	1 mile south of Drummond	Habitat degradation, streambank erosion, loss of woody riparian vegetation, possible metals problem from Boulder Creek Could be important for spawning trout from CFR.
Tyler Creek USFS Boundary to mouth	HIGH	1 mile west exit 138 I-90	Fish passage barrier at mouth, lack of stream channel forest boundary to mouth, irrigation ditch fish entrapment; irrigation uses all of the water Spawning tributary to CFR needed in this area.
Flint Creek Hall Bridge to Mullan Trail (Reach 4)	MEDIUM	¾ mile east of Hall	Habitat degradation, streambank erosion, loss of woody riparian vegetation, irrigation ditch fish entrapment, fish passage barrier during irrigation season Could be important for spawning trout from CFR.
Flint Creek Douglas Creek to Hall Bridge (Reach 3)	MEDIUM	2.6 miles southwest of Hall	Habitat degradation, streambank erosion, loss of woody riparian vegetation, irrigation ditch fish entrapment Improve fish population in Flint Creek.
Warm Springs Creek	LOW	0.3 miles east of exit 170 I-90 (Phosphate)	Stream channel and fish habitat in good condition, possible water temperatures problem, possible temporary fish passage barrier at beaver dam near mouth.
Turah Creek	LOW	0.2 miles east of exit 113 I-90	Man-made channel with no fish habitat features, fish passage from CFR blocked near mouth, water all used for irrigation in summer Possible flow augmentation from CFR water right.
Flint Creek Hwy 1 bridge to Douglas Cr (Reach 2)	LOW	4.1 miles southwest of Hall	Stream channel and habitat condition good.
Flint Creek Allendale Div to Hwy 1 bridge (Reach 1)	LOW	4.5 miles southwest of Hall	Stream channel and habitat condition good.

STREAM	PRIORITY	LOCATION	SUMMARY OF PROBLEMS & RECOMMENDATIONS
Hoover Creek	LOW	At exit 161 I-90 (Jens)	No direct connection to the CFR, entire flow captured by irrigation ditch, fish passage blocked at the railroad.
Antelope Creek	LOW	4.9 miles east of exit 138 I-90	Ephemeral stream that does not connect to the CFR except during high flow periods.
Brock Creek	No priority	At exit 170 I-90	Not surveyed due to insufficient time.
Carten Creek	No priority	1 mile west exit 166 I-90	Not surveyed due to insufficient time.
Deer Creek	No priority	1 mile southeast of Milltown	Not surveyed due to insufficient time.
Dog Creek	No priority	2.5 miles east of Elliston	Not surveyed due to insufficient time.

Appendix A

Antelope Creek

ANTELOPE CREEK
Assessment Date: July 25, 2008

INTRODUCTION

Antelope Creek is an intermittent tributary to the Clark Fork River (CFR) flowing from a broad valley and low hills southeast of the river. It enters the river on the left bank 6.9 miles upstream from Tyler Creek.

METHODS

Land ownership was determined using Montana Cadastral Mapping Program. Landowners were contacted and permission to do the survey was granted before any field work was done. Stream and habitat conditions were measured, photographed and described by walking and observing conditions on the selected stream reach. Stream discharge was determined by wading using a Marsh McBirney digital flow meter and methods described by the U.S. Geological Survey. Universal Transverse Mercator (UTM) locations were determined using a Garmin etrex. Stream channel lengths were measured from Google Earth (Map A1).

DESCRIPTION

This survey began where Antelope Creek passes under the Montana Rail Link (MRL) grade. From that point, the channel turns southwest and parallels the railroad grade for approximately 0.4 of a mile. Then it turns more westward and passes under the beginning of the off ramp for the eastbound rest stop at Bearmouth on Interstate Highway 90 (I-90) and proceeds for 616 feet to a side channel of the CFR at river mile 402.7L. The channel is well defined all the way to the river, but surface flow did not continue past the outlet end of the I-90 culvert. Between the MRL culvert and the interstate culvert the channel was overgrown with tansy and a dense matt of grass. Downstream from the interstate, vegetation was much less dense and the area is dominated by large cottonwood trees and some shrubs. There were no fish passage barriers between the CFR and the MRL culvert, so fish could make their way to and from the CFR when there is flow all the way to the river.

FLOW

The flow out of the MRL culvert was too small to measure. It was estimated to be approximately one gallon per minute at the time of the survey. Water was standing in the interstate culvert but did not flow beyond the mouth of the culvert.

DISCUSSION

Because of the intermittent nature of the connection between Antelope Creek and the CFR, there is no apparent potential for developing Antelope Creek as a spawning tributary for trout from the CFR.

Map A1 – Antelope Creek

Appendix B

Clark Fork River Diversion

CLARK FORK RIVER DIVERSION
Assessment Date: April 1, 2009

INTRODUCTION

An irrigation diversion dam crosses the Clark Fork River (CFR) channel approximately 1.7 river miles upstream from the Gillespie Bridge (Maps B1 and B2). It diverts water into a ditch that crosses under Interstate Highway 90 (I-90) about 0.5 miles east of the Granite/Missoula County line.

DISCUSSION

During the irrigation season, this dam presents a passage barrier for fish moving up the river and an entrapment hazard for fish moving down the river. For people floating the river, there is a large sign upstream of the diversion warning floaters of the hazard. It would be dangerous to float over the dam, so portage is the only safe way around it (Photos B1, B2, B3). This is a very large dam for the diversion of a relatively small amount of water (Photo B4). The water passes under I-90 and is taken west to the hay/pasture land 0.3 miles east of Beavertail pond (Maps B1 and B2). Water is pumped from behind the dam to the field on the south side of the I-90.

The dam is removed after the irrigation season so that it does not present a problem during fall and winter (Photos B5, B6, B7). It would probably not be in place when westslope cutthroat trout and rainbow trout would be moving upstream to spawn; however, it would probably be in place when bull trout and brown trout are moving to upstream spawning areas. The tagging study will clarify the effects of the diversion on fish movements.

RECOMMENDATIONS

1. Study fish movements to determine if it creates a problem for migrating fish. The State's radio telemetry project that is now underway should provide this determination.[1]
2. Survey the irrigation ditch for trapped fish.

[1] *Proposal for study of trout movement to identify key resource areas and factors affecting trout in the UCFRB,* prepared by the NRDP and FWP, November 2008.

Map B1 – CFR Diversion

Map B2 – CFR Diversion

Photo B1

Photo B2

Photo B3

Photo B4

Photo B5

Photo B6

Photo B7

Appendix C

Cramer Creek

CRAMER CREEK
Assessment Date: July 17, 2008

INTRODUCTION

Cramer Creek is a tributary to the Clark Fork River (CFR) flowing into the river from the north approximately 38 miles east of Missoula and a quarter mile west of the Beavertail exit off I-90. In the DNRC river mile index, it is located at river mile 386.4R. The assessment covered only the lower 1.3 miles of Cramer Creek, from where it first flows under Interstate 90 to the Clark Fork.

METHODS

Land ownership was determined using Montana Cadastral Mapping Program. Landowners were contacted and permission to do the survey was granted before any field work was done. Stream and habitat conditions were measured, photographed and described by walking and observing conditions on the selected stream reach. Stream discharge was determined by wading using a Marsh McBirney digital flow meter and methods described by the U.S. Geological Survey. Universal Transverse Mercator (UTM) locations were determined using a Garmin etrex. Stream channel lengths were measured from Google Earth (Map C1).

RESULTS

The Cramer Creek survey was conducted along an approximately 1.34 mile section, from the outlet of the most upstream I-90 culvert to the CFR. This section of the creek was divided into reaches as identified in Table C1 and shown on Map C2. It was not surveyed upstream of I-90 because of a fish passage barrier created by that interstate culvert (Photos C1 and C2).

Photographs of the creek channel upstream of I-90 were taken from the county road (Photo C3). Stream restoration upstream of I-90 could improve conditions for fish in this section as well as downstream of I-90. Landowner contact would need to be made to determine the feasibility of doing restoration work on this property.

Table C1. Cramer Creek channel lengths from various points with reach designations.

DESCRIPTION	FEET	MILES	REACH
Most upstream I-90 culvert to CFR	7076	1.34	
Most upstream I-90 culvert to irrigation pump	1402	0.26	1
Pump site to culverts going to north side I-90	1678	0.32	2
Channel north of I-90	2174	0.41	3
Most downstream I-90 culvert to McFarland culvert	602	0.11	4
McFarland culvert to Mouth of CFR	265	0.05	5

REACH 1

The Cramer Creek channel surveyed in Reach 1 appears to be entirely man-made. Judging by the size of the trees and shrubs along its banks, and channel development, it has been in its current location for a long time (Photos C4 and C5). The constructed channel was straight and confined between high berms that prevent it from developing a floodplain; however, meanders, runs, riffles and pools have developed within the confined channel in a few locations. About 18% (1,315 feet) of this channel reach has heavy woody riparian vegetation. The stream banks are stable; it has developed a distinct thalweg and excellent trout habitat within this reach. Many trout that could not be identified as to species were observed in the pools and near the root wads and woody debris that is present in the reach.

Streambed materials consist of large cobble, course gravel in the riffles and runs and fine silts and fine gravels in the pools. All of the still or low velocity areas contain beds of fine silt.

REACH 2

Where the stream banks are vegetated with grasses (Reach 2), the channel has not developed meanders, runs, riffles or pools (Photo C6). Bottom materials are predominantly medium gravel to small cobble in size. The channel is stable throughout with the exception of one bend where livestock have trampled the bank and it is actively eroding (Photo C7).

REACH 3

North of I-90 (Reach 3), the creek flows parallel to the interstate (Photo C8) and then angles away (Photo C9) and into a pond that is 588 feet long, has a maximum width of 150 feet and averages 111 feet wide. The channel in and out of the pond is vegetated with grasses, sedges and a few scattered trees (Photo C10). Motorized access to this reach is from the Rock Creek exit and forest roads that travel across the hills above private property. Landowner contact for this reach of stream was not made; the information presented here is from Google Earth and observations made from the I-90 right of way.

REACH 4

Downstream of I-90 and railroad grades (Reach 4), the Creek flows approximately 600 feet in a low gradient channel. The creek bottom is dominated by fine silts and dense mats of rooted vegetation (Photos C11 and C12). Brown trout were observed in this section; however, it does not appear to offer habitat suitable for trout spawning. McFarland's culvert (Photos C13 and C14) may be set too high, creating a backwater during runoff and sediment accumulation in this reach.

REACH 5

The final 265 feet of channel (Reach 5) is single thread, meandered and partially tree and shrub lined. At one time, the creek probably flowed through the culvert shown in Photo C15 into the CFR. It has eroded around the culvert and now enters the river along both sides of it. On the

right side (Photo C16, looking upstream), there is a 2 foot drop over an accumulation of woody debris with a 2 foot deep plunge pool at its base. There is no barrier on the left side of the culvert. When the river and the creek are running at low stage fish passage might be difficult, but fish passage would not be a problem when the CFR is running at high stage.

The CFR in the vicinity of the mouth of Cramer Creek is a single thread channel with stable banks (Photos C17 and C18). The thalweg runs along the right (north) bank so Cramer Creek flows into the deepest part of the channel. The deep run along the right bank would provide good holding cover for river fish staging to move into Cramer Creek.

FISH PASSAGE AT CULVERTS

The most upstream culvert underneath I-90 is a large concrete structure (520 feet long). The difference in elevation between the inlet (Photo C1) and outlet of the culvert (Photo C2) required a steep concrete apron to be constructed from the lip of the inlet several feet into the culvert beneath the trash rack shown in Photo C1. The wide, steep apron is level causing the water to spread out in a thin sheet across its width. This, along with the steepness of the apron, results in a fish passage barrier at all stream flows. Photo C2 shows a concrete energy dissipater at the mouth of the culvert presumably to protect the railroad bridges located within a few feet of the outlet. There appears to be no way to make the current structure passable for fish.

After the creek flows through the most upstream I-90 culvert discussed above, it flows through an additional 7 sets of culverts for a combined total of approximately 700 feet of culvert. There are no apparent fish passage problems except that discussed above. The types of culverts used under the interstate and railroad grades are illustrated in Photos C19 and C20. There are no perched outfalls, steep gradients or blockages that would prevent fish passage.

IRRIGATION SYSTEM

There is one irrigation system on the stream reach surveyed. Photo C21 shows the pump and check dam being used to divert the water that supplies 2 wheel lines irrigating hay. Fish passage over the check dam should not be a problem at the present stream flow. There is a low risk of fish being entrained into the irrigation system at the flow measured during this survey. The risk of entrainment could increase with lower stream flow. There didn't appear to be screening that would prevent fish from entering the stilling basin for the pump.

STREAM FLOW

Stream discharge measurements taken above and below the pump site (Table C2) indicate that the pump diverts about 1 cubic foot per second. This represented approximately 18% of the flow coming into the pump site at that time. It does not dewater the stream to a significant degree at the current flow; however, it could dewater the stream to an extent that would harm the fish population in a year when water is less abundant.

From the pump to the river, the stream lost another 1.15 cfs probably to groundwater, pond storage and evapotranspiration (Table C2).

Table C2. Cramer Creek flows measured at 3 locations

LOCATION	WIDTH	Mean depth	FLOW
1,200 feet upstream of irrigation pump site	11.4 ft	0.72 ft	5.83 cfs
255 feet downstream of pump site	11.7 ft	0.51 ft	4.76 cfs
110 feet upstream from mouth	8.6 ft	0.44 ft	3.61 cfs

For future reference, Table C3 includes GPS locations of the pump site and the mouth of the creek on the CFR.

Table C3. GPS locations of various points of interest

DESCRIPTION	EASTING	NORTHING
Irrigation pump	12T 0301890	5177587
mouth of Cramer Creek	12T 0300698	5177424

DISCUSSION

This assessed portion of Cramer Creek surveyed supports a trout population in its current condition. Fish were observed in a few locations where there was either woody riparian vegetation and woody debris in the channel or heavy vegetation in the channel. Spawning habitat is limited to a few locations, because of excessive fine streambed sediments and limited hiding cover. In its current condition, Cramer Creek would be of limited value as a spawning tributary for CFR fish. There is a high potential for improving both resident trout populations and the streams' value to spawning trout from the CFR.

Three land owners control the land through which this section of stream flows; the two landowners contacted were very cooperative.

RECOMMENDATIONS IN ORDER OF PRIORITY HIGHEST TO LOWEST

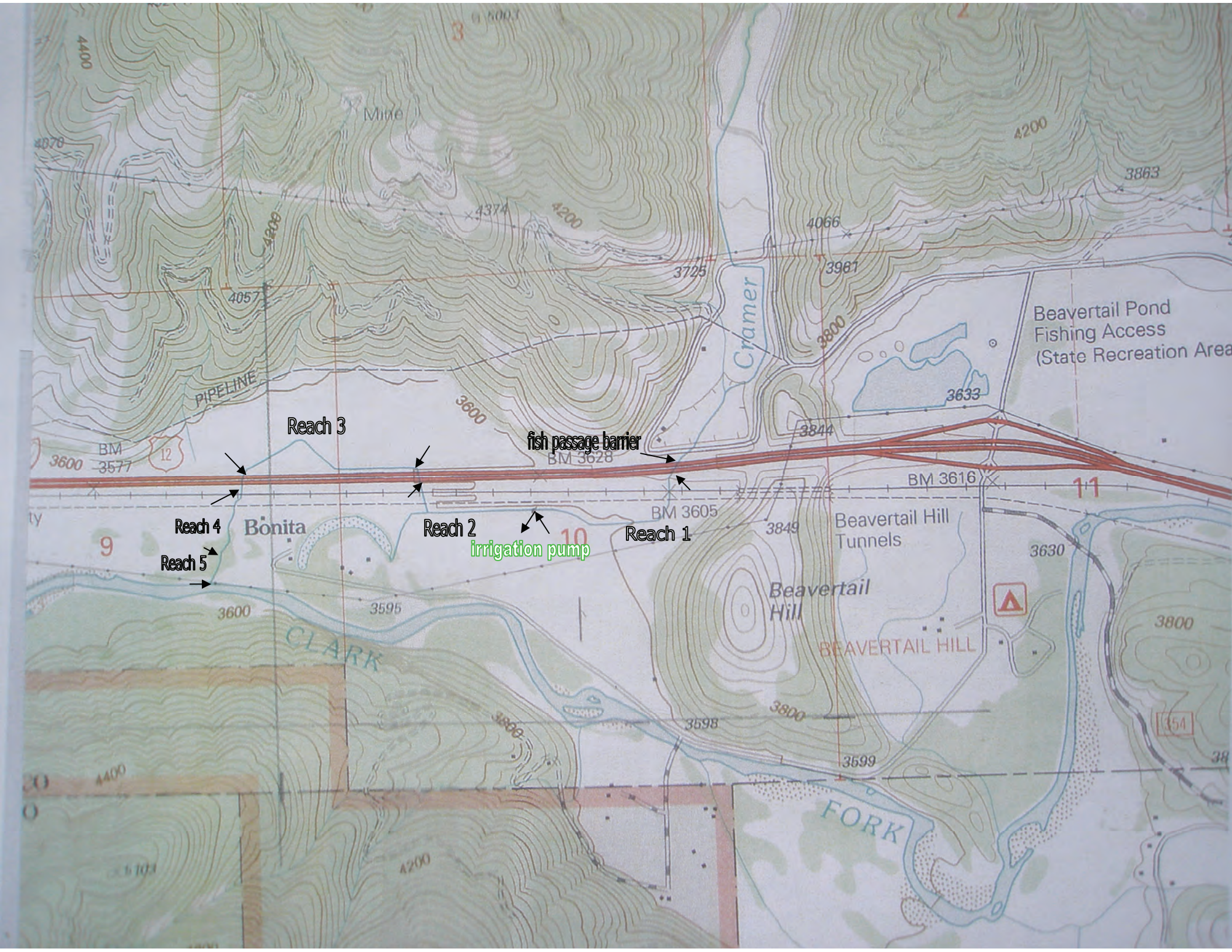
1. Remove the old culvert and debris jam at the mouth (Reach 5) to facilitate fish passage (Photos C14 and C15).

2. Restore low gradient reach (Reach 4) from the river upstream to the MRL culvert (Photos C11 and C12). McFarland's culvert (Photo C13) may be set too high, creating a backwater during runoff and sediment accumulation in this reach.

3. Increase woody riparian vegetation on all reaches where wood riparian vegetation is lacking.

4. Explore water rights acquisition on this section of Cramer Creek.

Map C1 – Cramer Creek


Reach 3
fish passage barrier
Reach 4
Bonita
Reach 2
irrigation pump
Reach 1
Reach 5
Beavertail Pond
Fishing Access
(State Recreation Area
Beavertail Hill
Tunnels
Beavertail
Hill
BEAVERTAIL HILL
Cramer
PIPELINE
CLARK
FORK
BM 3577
BM 3628
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BM 3616
3600
3595
3598
3599
3800
3633
3844
3849
3630
4200
4400
4374
4066
3961
3725
3863
4057

Photo C1 inlet of I-90 culvert steep apron under grate

Photo C2 outlet of I-90 culvert looking at energy dissipater

Photo C3 Cramer Creek above I-90

Photo C4 habitat in heavily wooded section

Photo C5 habitat in heavily wooded section

Photo C6 habitat in section with grasses

Photo C7 eroding bend

Photo C8 Cramer Cr north of I -90

Photo C9 Cramer Cr. north of I-90 flowing toward pond

Photo C10 Cramer Cr north of I-90 flowing out of pond toward highway

Photo C11 rooted aquatic vegetation in low gradient channel

Photo C12 low gradient channel between railroad & river

Photo C13 McFarland culvert inlet

Photo C14 McFarland culvert outlet

Photo C15 culvert at mouth

Photo C16 debris dam at mouth

Photo C17 CFR upstream of Cramer Creek

Photo C18 CFR downstream of Cramer Creek

Photo C19 interstate culvert

Photo C20 railroad culverts

Photo C21 irrigation pump and check dam

Appendix D

Flint Creek

FLINT CREEK
Assessment Date: August/September 2008

INTRODUCTION

Flint Creek is a tributary to the Clark Fork River (CFR) entering the river from the south 1.2 miles upstream from the Montana State Highway 1 Bridge across the CFR near Drummond. In the DNRC river mile index it is located at river mile 417.6L. It flows through private property throughout most of its course from the outlet of Georgetown Lake to the CFR. Flint Creek is paralleled and crossed once by Montana State Highway 1, and it is crossed by several county road bridges which are the only points where there is legal public access to the stream. Otherwise, permission from landowners is needed for legal access to the creek. Stream condition was surveyed on the lower 13 miles of the creek from the Allendale Diversion to the CFR. This section was divided into five reaches that were surveyed at different times depending upon flow and landowner contacts (Table D1).

Table D1. Flint Creek reach boundaries and lengths with total section length in miles and dates surveyed

REACH DESCRIPTION	SURVEY DATE	MILES
1 Allendale Diversion to Montana State Highway 1 Bridge	August 6, 2008	0.54
2 Montana State Highway 1 bridge to Douglas Creek Bridge	September 9, 2008	1.13
3 Douglas Creek Bridge to Hall Bridge	August 15, 2008	3.95
4 Hall Bridge to Mullan Road Bridge	September 4, 2008	4.85
5 Mullan Road Bridge (USGS Gage Station 12331500) to CFR	August 5, 2008	2.55
Total Distance		**13.02**

METHODS

Land ownership was determined using the Montana Cadastral Mapping Program. Major landowners along each reach were contacted before the surveys were conducted. Landowners were contacted and permission to do the survey was granted before any field work was done. Stream and habitat conditions were measured, photographed and described by walking, floating and observing conditions on the selected stream reaches. Stream discharge was determined by wading using a Marsh McBirney digital flow meter and methods described by the U.S. Geological Survey. Universal Transverse Mercator (UTM) locations were determined using a Garmin etrex. Stream channel lengths and other distances were measured from Google Earth (Maps D1, D2, D3, D4, and D5).

GENERAL DESCRIPTION

Flint Creek flows north from the Allendale Diversion through agricultural land used for pasture and to produce hay and small grain. It is heavily used for irrigation. Most of the water

taken for irrigation is taken through headgate and ditch systems. Livestock has free access to the creek throughout most of this section. The creek does not flow through, or receive direct runoff, from any livestock confinement areas or feed lots. Fish were observed rising to insects, and evidence of clean-water insects (stoneflies, caddisflies and mayflies) were observed, suggesting that water quality is probably not seriously impaired (Figures 1 and 2).

REACH 1 ALLENDALE DIVERSION TO HIGHWAY 1 BRIDGE – Map D1

Habitat and Channel Condition

The channel from the Allendale Diversion to the highway was dominated by small to medium sized boulders and cobble. The banks were stable and lined with a mix of woody vegetation species, which provide some shading and a few undercut banks (Appendix D1, Photos 1 and 2). The railroad bridge, immediately upstream of the highway bridge, created a debris dam that has created a mid-channel island a short distance upstream (Appendix D1, Photo 3). There was no riparian fencing along either side of the reach and there was evidence of livestock accessing the creek (Appendix D1, Photo 4); however, the banks were stable and there was no sign of channel over-widening. Trout habitat consisted of pocket water around boulders and deep runs. Pools were in short supply in this reach.

Irrigation

The Allendale canal is a large irrigation system that provides irrigation for crops along the west side of the valley from the diversion to the CFR. The Allendale diversion was constructed of large rock with a concrete headgate structure and steel slide gates for control of flow into the canal (personal communication Brad Liermann and Charles Atkins). Two tenths of a mile downstream from the Allendale diversion, another large rock diversion serves two irrigation canals (Appendix D1, Photo 5). The two ditches served by the lower diversion run parallel with the Allendale and serve crops down slope from it. The middle ditch runs almost as far as the Allendale and the lowest ditch appears to end northwest of Hall.

The creek channel between the two diversions was inundated by a long still pond created by the lower diversion (Appendix D1, Photo 6). Neither the Allendale nor the lower headgates had fish screens to prevent fish from being trapped in the canals (Appendix D1, Photo 7).

Flows

On the day of the survey, Flint Creek average daily flow (adf) at the USGS gage at Maxville (4.5 miles upstream) was 104 cubic feet per second (cfs). The adf from Boulder Creek measured at Maxville was 25 cfs. Therefore, the flow of Flint Creek at the upper diversion should have been approximately 129cfs. Immediately below lower diversion (Appendix D1, Photo 8) it was 44 cfs; at the Mullan Road gage (10 miles downstream) it was 57 cfs. The flow below lower diversion (44 cfs) appeared to be a good flow for the size of the Flint Creek channel in that vicinity. It provided good cover and habitat diversity for fish and other aquatic organisms. No other irrigation diversions were found in Reach 1.

Discussion

Reach 1 habitat and channel condition appeared to be relatively good (Appendix D1, Photo 9). The two large irrigation divisions are potential fish passage barriers; however, since

they are structures made of large rock they are porous and there could be ways for fish to get through or over them (Appendix D1, Photo 5). In spring runoff water apparently over tops them, as was evidenced by the woody debris collected on the top of the lower one, giving fish an opportunity for passage during that season (Appendix D1, Photo 6). The unscreened ditches they feed are potential entrapment hazards for fish. Fish passage and entrapment are the two most significant issues in this reach during good water years. Low flow could become an important issue in poor water years.

REACH 2 MONTANA STATE HIGHWAY 1 TO DOUGLAS CREEK BRIDGE – Map D2

Habitat and Channel Condition

This reach was surveyed on September 9, 2008 due to high flows earlier. The creek channel throughout Reach 2 was dominated by boulders and large cobble with no pool development. Streambanks were stable except in a few locations where woody vegetation was absent and livestock had trampled the banks. Trout habitat was primarily pocket water around boulders and deep runs. There was some overhanging vegetation, large woody debris in the channel and undercut banks, making for excellent trout habitat (Appendix D2, Photos 1, 2, 3, 4, 5, 6).

Irrigation

Approximately 780 feet downstream of the Highway 1 Bridge a small irrigation headgate and ditch were located on the right bank. Flow through the flume at that time was 1.9 cfs. This was the only irrigation system found in Reach 2 (Appendix D2, Photo 7).

Flow

On the day of the survey, Douglas Creek flow, immediately upstream of its mouth, was 3.3 cfs (Appendix D2, Photo 8). Flint Creek flow immediately upstream of the mouth of Douglas Creek was 106 cfs (Appendix D2, Photo 9). The combined flow was approximately 109 cfs, and the gage height on the Douglas Creek Bridge read 2.04 feet. The adf at the USGS station at Mullan Road, for September 9, was 152 cfs.

Discussion

There were no major stream bank erosion problems in Reach 2. There was enough large woody debris, undercut banks and deep runs to make excellent trout habitat especially under the flow conditions that existed at the time of the survey. There were no signs of heavy livestock use along the immediate stream banks – although riparian fencing was not obvious. In places where woody vegetation was absent, the grass cover was heavy and did not appear to be heavily grazed (Appendix D2, Photos 10 and 11). The one small irrigation ditch in the reach could be an entrapment hazard for fish since it was not screened.

REACH 3 DOUGLAS CREEK BRIDGE TO HALL BRIDGE – Map D3

Habitat and Channel Condition

In the upper 0.6 of a mile of Reach 3 trout habitat primarily consisted of deep runs and pocket water around large rocks, with some large woody debris and undercut banks. Proceeding downstream from Douglas Creek, the Flint Creek channel appears to get less steep: the boulders

disappear, water velocity slows, and the channel gradually develops tighter meanders and more run, riffle, pool habitat (Appendix D3, Photos 1, 2, 3).

Stream banks were stable due to a good cover of woody riparian vegetation from Douglas Creek downstream for approximately 0.6 of a mile, except for erosion on the first meander below the Douglas Creek Bridge (Appendix D3, Photo 4). From the point 0.6 of a mile below Douglas Creek, for approximately 2 miles, nearly every outside bend was eroding and there was some over widening of the channel. Habitat quality was degraded due to the loss of depth, overhanging vegetation, large woody debris and undercut banks (Appendix 3, Photos 5 and 6).

Over-widened channels tend to be noticeably shallower and they lack woody riparian vegetation, large woody debris in the channel, and undercut banks. Most of the erosion that causes over-widening can be attributed to the lack of the deep binding root mass of woody vegetation and to livestock trampling of the stream bank soil (Appendix D3, Photos 7 and 8). In a few locations, streambed cobble had been used to stabilize eroding streambanks (Appendix D3, Photos 9 and 10).

Beginning approximately 1.3 miles upstream from the Hall Bridge there was a riparian fence on both sides of the stream with small signs attached that said:" Area boundary, wetland conservation, help protect this sensitive area, Montana Department of Transportation." From this point downstream to the Hall Bridge, stream banks were stable and habitat quality was good.

Irrigation

The five headgates located in this reach are listed in Table D2. All of them had a gravel dike to divert flow into the headgate which requires some disturbance to the streambed each summer (Appendix D3, Photos 11, 12, 13). All but one of the headgates was closed with only seepage getting into the ditches. The exception was the ditch a short distance upstream from the Hall Bridge that was taking approximately 14 cfs estimated by measuring the width and depth of the headgate opening and the velocity of water through the gate. None of the diversion dikes presented a fish passage barrier; however, they all presented entrapment hazards for fish since there were no fish screens in place.

Table D2**.** Location of irrigation diversions between Douglas Creek Bridge and Hall Bridge beginning upstream and proceeding to the most downstream location.

Description	Northing	Easting	Flow
Old wooden headgate left bank near 1st buildings below Douglas Creek Bridge	5157599	330338	0
Wooden headgate right bank at base of hill that was hydraulic mined	5157860	330633	0
Steel headgate right bank near building and just above farm bridge	5158571	330807	0
Wooden headgate right bank below second farm bridge downstream from Douglas Cr	5159623	331572	0
Wooden headgate right bank just above Hall bridge	5161002	332891	14 cfs

Flow

At 7:30 a.m. on August 15, 2008, the day this survey was conducted, the adf at the USGS station at Mullan Road was 148 cfs. This amount of water provided good depth and habitat quality where the channel was stable and woody vegetation dominated the riparian zone. Approximately 1.6 stream miles downstream from the Douglas Creek bridge (12T0331279, UTM5159624) a stream entered Flint Creek on the left side. At the time of the survey, it had a measured flow of 6.9 cfs. The USGS map does not show a named tributary in this vicinity, thus this is most likely irrigation return or ground water.

Discussion

There was evidence of more livestock grazing along the immediate streambanks in this reach than the previous reaches, and there were more irrigation diversions than in Reaches 1 and 2. Streambed disturbance at each irrigation diversion and the shortage of riparian fencing resulted in a general degradation of habitat quality (Appendix D3, Photos 14, 15, 16). Streambank erosion and the potential for entrapment of trout in irrigation ditches were the two most important issues in this reach, at the flow present during the survey. Low stream flow could result in a worsening of habitat quality, especially in areas where the channel was over-widened.

REACH 4 HALL BRIDGE TO MULLAN ROAD BRIDGE – Map D4

Channel and Habitat Condition

This is the longest of the 5 reaches at 4.8 miles (Table D1). It began at the bridge across Flint Creek approximately three fourths of a mile east of Hall. The stream channel was stable with heavy woody vegetation dominating the riparian zone for the first 0.8 of a mile below the Hall Bridge. Habitat was primarily riffles and runs with few pools. Overhanging vegetation and undercut banks provided good cover in this section (Appendix D4, Photos 1, 2, 3). At the flow present during the survey, water depth also contributed to good habitat quality. From the point 0.8 of a mile below the Hall Bridge downstream, for the next 4 miles, woody vegetation in the riparian zone began to thin out, grass began to dominate the riparian zone, and erosion became more common on the outside bends of the channel (Appendix D4, Photos 4 and 5). Some over-widening of the stream channel was apparent (Appendix D4, Photos 6 and 7). With lower flows, habitat conditions would be poor due to the loss of woody vegetation, increased streambank erosion, and over-widened stream channel. Water velocity was relatively high throughout the reach and the stream bottom was dominated by cobble.

Irrigation

Seven diversions were located in this reach (Table D3). Immediately downstream of the Hall Bridge a concrete diversion dam crosses the creek (Appendix D4, Photos 8 and 9). This was a passage barrier not only for fish but also for anyone floating the stream during the irrigation season. There was a ditch going off each end of the diversion (Appendix D4, Photos 10 and 11). This structure had a concrete foundation with posts and planks that appeared to be removable (Appendix D4, Photo 9). Passage could be possible when the posts and planks are not in place. All of the other diversions in this reach used dikes made of streambed gravel to divert the water except one that used woven wire and fabric (Appendix D4, Photos 12 and 13). All ditches lacked fish screens, thus they all presented entrapment hazards for fish.

Table D3. Location of irrigation diversions between Hall Bridge and Mullan Road Bridge beginning upstream and proceeding to the most downstream location.

Description	Northing	Easting	Flow
Concrete structure across Flint Cr below Hall Bridge	5161249	0332976	Left unk, right 0
Old wood headgate with wire fence and dam fabric diversion left bank side channel	5162857	0333458	0
Corrugated metal headgate with steel slide gate right bank	5163833	0334322	<1 cfs
Small wood headgate left bank	5164455	0334732	0
Wood headgate right bank streambed gravel dike all the way across Flint creek	5166005	0335232	0
No headgate diversion	5165172	0335303	0
New wood headgate right bank	5165295	0335296	0

Flow

On the day of the survey, Flint Creek was flowing 163 cfs at the Mullan Road USGS gage. Two named and three unnamed streams enter Flint Creek in this reach (Table D4). Eight tenths of a mile below the Hall Bridge the second inflow listed in Table D4 entered Flint Creek through a wetland complex created by several beaver dams (Appendix D4, Photos 14 and 15). On the south side of the mouth of Lower Willow Creek there was another wetland complex with several beaver dams. Many small rivulets entered Lower Willow Creek in this area. It was impossible to measure all of those small inlets so the actual flow entering Flint Creek from Lower Willow Creek was somewhat higher than the recorded measurement (Table D4). The two named tributaries entering Flint Creek in this reach were 0.2 of a mile apart and within 1.5 miles of Mullan Road Bridge.

Table D4. Locations of streams entering Flint Creek in Reach 4 along with estimated (est) or measured flow in cubic feet per second.

Description	Northing	Easting	Flow
Small inflow right bank	5161793	0333028	unknown
Inflow left bank no name, beaver ponds near mouth	5162093	0333065	3.3 cfs
Inflow left bank two points of entry no name	5162360	0333234	3 cfs est.
Barnes Creek right bank	5164082	03334615	2 cfs est.
Lower Willow Creek left bank measured in main channel above many small inflows	5164330	0334636	26.9 cfs

Discussion

There were small spots of streambank erosion even in the most stable portions of Reach 4 (Appendix D4, Photo 16). In the lower two miles of the reach, almost every outside bend was eroding, the streambanks were low and the channel was over widened. In low-flow years, habitat in the lower end of this reach would be poor due to the loss of streambank stability. Riparian fencing and irrigation ditch screening are again at the top of the priority list.

REACH 5 MULLAN ROAD BRIDGE TO THE MOUTH – Map D5

Habitat and Channel Condition

Flint Creek enters the left side of the CFR 1.2 river miles upstream from Montana State Highway 1 Bridge. Near the mouth of Flint Creek, the CFR riparian zone was dominated by grasses with some cottonwood trees. The stream banks were low and relatively stable (Appendix D5, Photos 1, 2, 3).

Throughout Reach 5 of Flint Creek, the stream bed composition was cobble, gravel and sand. Boulders and large cobble were no longer present. Habitat consisted of runs, riffles and pools with very few deep, high-quality pools (Appendix D5, Photos 4, 5, 6). The entire reach lacked woody riparian vegetation; however, streambanks were stable for the first 0.9 of a mile downstream from Mullan Road due to heavy cover of tall grass (Appendix D5, Photos 7, 8, 9). This portion of the reach was evidently fenced on both sides since there were no recent signs of livestock accessing the stream. Without the deep binding root mass of woody riparian vegetation there were few undercut banks. Without woody riparian vegetation there was no shading and no large woody debris in the reach except on a bend a short distance upstream of the mouth (Appendix D5, Photos 10 and 11).

There was evidence of mechanical straightening in the lower mile of the reach that was probably done many years ago (Appendix D5, Photo 12 and 13). This, along with the lack of woody riparian vegetation, has resulted in over widening of the channel in the lower mile of the reach (Appendix D5, Photos 10 and 14). Livestock have access to the lower 1.6 miles, resulting in eroding streambanks and a lack of woody riparian vegetation.

Irrigation

Only one diversion was found in Reach 5. It had a rock diversion dam and wooden headgate on the left bank approximately 0.7 mile downstream from Mullan Road (Appendix D5, Photos 15 and 16). At the time of the survey, it was diverting approximately 1 cfs. This diversion lacked a fish screen.

Flow

On the day of the survey, the USGS gage at Mullan Road measured 59 cfs, and at the mouth the flow was measured at 60 cfs (Appendix D5, Photo 17). Under these flow conditions habitat quality was fair but it would be poor under lower flow conditions.

Discussion

Reduced grazing pressure for the first 0.9 of a mile, downstream from the Mullan Road Bridge, the use of heavy grass cover and streambed-cobble rip-rap have improved channel stability and habitat conditions in this portion of the reach (Appendix D5, Photo 18). Although heavy grass cover improves channel stability, it does not provide the shade, deep binding root mass or other amenities that come with woody vegetation. In addition, the heavy grass cover could prevent the establishment of woody bank cover. Woody vegetation would require help to become reestablished in this portion of the reach. The entire reach will need some work to begin to restore it to a high quality habitat condition.

ENTIRE STUDY SECTION DISCUSSION

Habitat

Reaches 1 and 2 appeared to be in good condition with stable stream banks and good riparian cover with woody vegetation. These two reaches would not need to be included in a habitat enhancement project.

Reaches 3, 4 and 5 all had problems related to livestock use of the riparian zone. Livestock trampling has resulted in loss of deep binding root mass of woody vegetation, over-widened stream channel, and a general loss of high quality trout habitat in portions of each of the three reaches. Riparian zone fencing is important to the success of any habitat enhancement project on Flint Creek.

Irrigation

Fifteen irrigation diversions were found in the study section. One diversion represented a fish passage barrier during the irrigation season and all 15 were without fish screens representing a significant entrapment hazard for migrating fish. Fish screen technology has advanced over time and some Montana Fish, Wildlife and Parks fisheries biologists have gained significant experience with the costs and benefits of ditch screening. Screening is very expensive and deserves careful consideration and extensive field research to determine the value at each location before a commitment to screen is made. To be successful, it also requires whole-hearted support from the landowners involved because screens create maintenance issues and cause changes in the landowner's operations.

Flow

Stream flow in Flint Creek was very good during the time the field data for this report was collected. However, when water is in short supply, trout habitat could be in poor condition in much of the lower end of the study section. Water temperature could also be a problem during periods of low flow due to the lack of shading and water volume.

Water Quality

Many years of water quality data have been collected at the USGS gage station at Mullan Road. A cursory evaluation of the data indicates that state copper standards, after adjusting for hardness, have been exceeded many times. A thorough study of the water quality data collected on Flint Creek could help evaluate habitat conditions and the current status of the trout populations. The Montana Department of Environmental Quality (DEQ) is conducting water quality sampling and analysis as part of its total maximum daily load (TMDL) project for Flint Creek, which is scheduled for completion in November 2010.[1]

RECOMMENDATIONS

1. Evaluate the lower ends of Reaches 3 and 4 and the entire Reach 5 for riparian fencing and vegetation enhancement. This evaluation would begin with a discussion with landowners to determine their degree of acceptance of such a project.

[1] More information on the DEQ TMDL project is provided in DEQ's "Flint Creek TMDL Project Plan," which is available upon request from DEQ TMDL Program or NRDP.

2. Determine trout numbers in as many of the irrigation canals as possible to get an estimate of the number of trout lost from the Flint Creek population annually and to determine which ditches take the most trout. This would be the first step in evaluating the need for ditch screening.

3. Study historic flow data to determine the potential need for leasing water during the irrigation season to augment instream flow. Review the Fish, Wildlife and Parks application for the reservation of instream flow in the upper CFR drainage to determine the wetted perimeter values used on Flint Creek. Determine if those values are still relevant and if additional instream flow needs information would be useful.

4. Research the scope of DEQ's TMDL efforts to evaluate whether that effort will provide the needed data on exceedances of water quality standards, paying particular attention to metals, hardness and temperature. Conduct additional water quality studies, if needed.

5. Determine the level of whirling disease infection if it hasn't already been done.

Map D1 – Reach 1 of Flint Creek

Map D2 – Reach 2 of Flint Creek

Map D3 – Reach 3 of Flint Creek

Map D4 – Reach 4 of Flint Creek

Map D5 – Reach 5 of Flint Creek

Figure 1

Figure 2

Appendix D1 – Photos for Reach 1 of Flint Creek: Allendale Diversion to Highway 1 Bridge

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

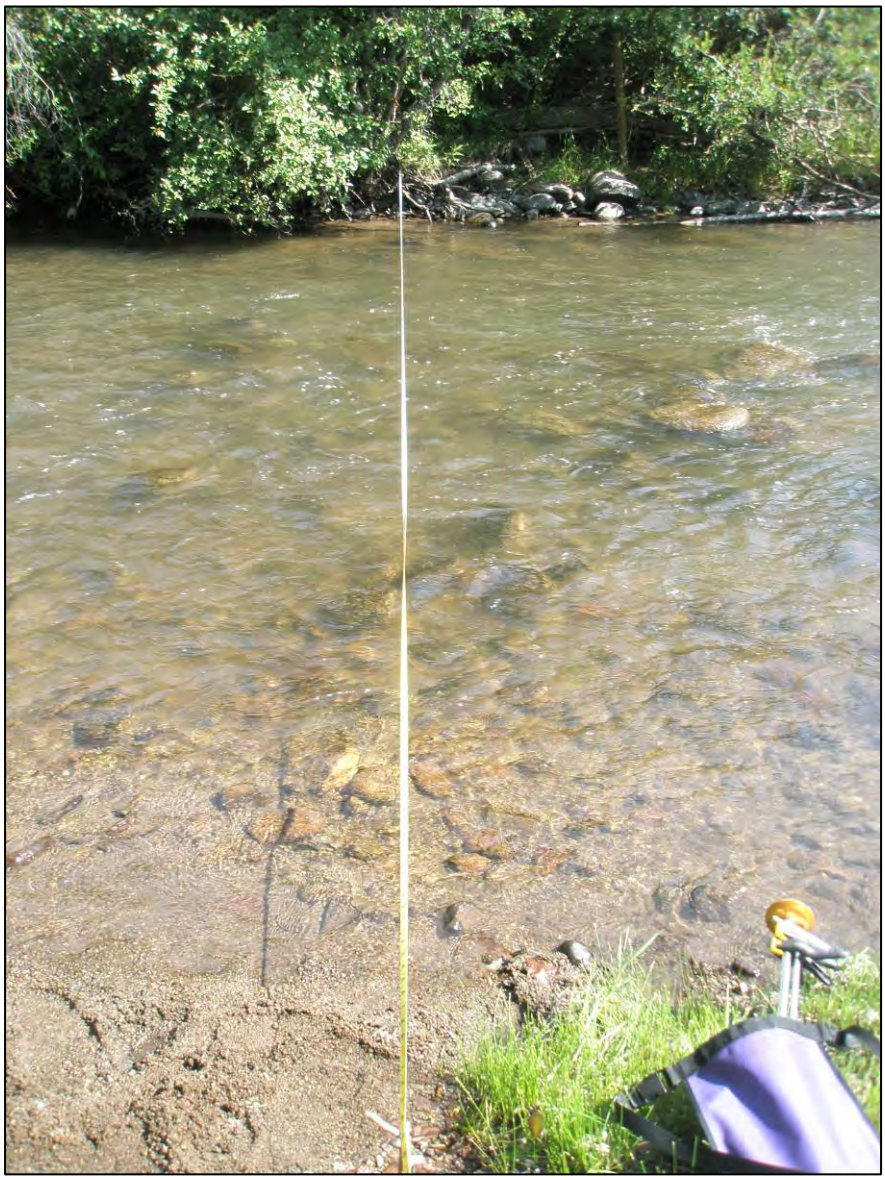


Photo 9

Appendix D2 – Photos for Reach 2 of Flint Creek: Highway 1 Bridge to Douglas Creek Bridge

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Appendix D3 – Photos for Reach 3 of Flint Creek: Douglas Creek Bridge to Hall Bridge

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

Photo 15

Photo 16

Appendix D4 – Photos for Reach 4 of Flint Creek: Hall Bridge to Mullan Road Bridge

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

Photo 15

Photo 16

Appendix D5 – Photos for Reach 5 of Flint Creek: Mullan Road Bridge to CFR

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

Photo 15

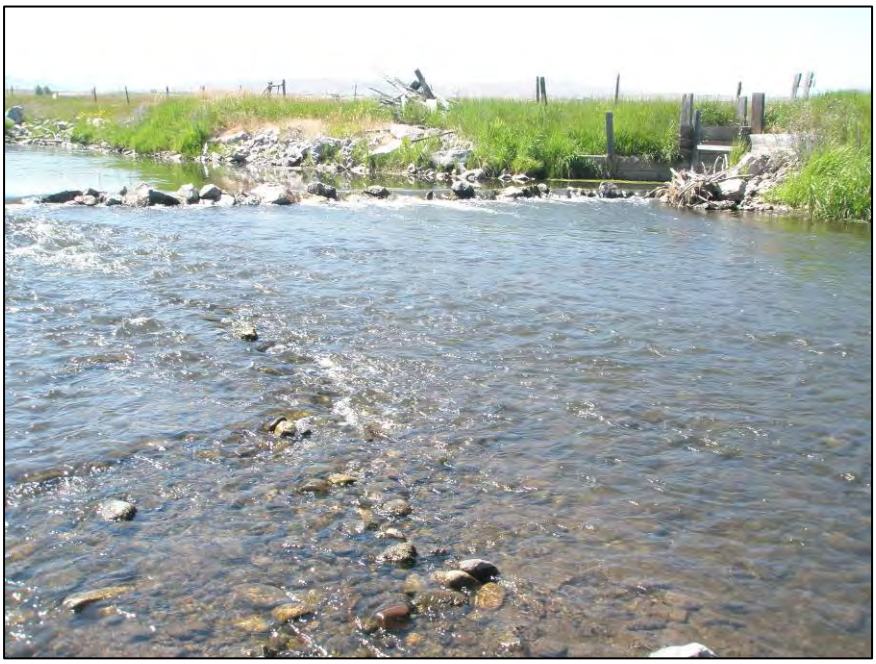


Photo 16

Photo 17

Photo 18

Appendix E

Gillespie Creek

GILLESPIE CREEK
Assessment Date: July 18, 2008

INTRODUCTION

Gillespie Creek is a tributary to the Clark Fork River that is accessed from the Beavertail exit off Interstate 90, 25 miles east of Missoula and forest road 354. In the DNRC river mile index, the mouth of the creek is at river mile 387.6L. This report is the result of a survey conducted July 18, 2008 after a brief meeting with the landowner.

METHODS

Land ownership was determined using Montana Cadastral Mapping Program. Landowners were contacted and permission to do the survey was granted before any field work was done. Stream and habitat conditions were measured, photographed and described by walking and observing conditions on the selected stream reach. Stream discharge was determined by wading using a Marsh McBirney digital flow meter and methods described by the U.S. Geological Survey. Universal Transverse Mercator (UTM) locations were determined using a Garmin etrex. Stream channel lengths were measured from Google Earth (Map E1).

GENERAL DESCRIPTION

Gillespie Creek flows out of steep mountainous terrain and is crossed by forest road 354, where this survey began, approximately 2 miles from the river (Photo E1). From this point to the river the gradient appears much less steep than above the road and the creek flows through portions of two local ranches. Approximately one mile from the forest road culvert it enters a pasture of the main ranch through which it flows. At this point it enters a straightened channel, flows along the edge of the pasture and enters the barnyard of the ranch (Photos E2 and E3).

The barnyard is on the edge of a bench which drops off to the river level terrace (Photos E4 and E5). When the river occupied the channel scars that are at the base of the bench, Gillespie Creek would have entered the river on the surface. However, the river is over 700 feet away from the base of the bench where the creek currently flows.

Once off the bench, the creek flows in an old Clark Fork River channel scar and creates small marshes and ponds along the channel (Photos E6, E7, and E8). The creek has no defined channel and is on the surface only intermittently for 1.2 miles from the bench to where the river and old channel scar converge (Photo E9).

STREAM FLOW

Gillespie Creek appears to be a perennial stream, but it was too small to measure with the Marsh McBirney flow meter at the time of the survey. It does not appear to be used for irrigation, but is used mostly for stock water.

FISHERY

No fish were observed in the creek. There is some potential for a fish population in the stream above the barnyard, but it is isolated from the river. In addition, the culvert under forest road 354 is a fish barrier due to a perched outlet (Photo E1).

RECOMMENDATIONS

Because of the small flow, isolation from the river and lack of a reservoir to augment stream flow, I recommend no further action be taken on Gillespie Creek at this time.

Map E1 – Gillespie Creek

Photo E1. Gillespie Creek at forest road 354

Photo E2. Gillespie Creek above barnyard bridge

Photo E3. Gillespie Creek below barnyard bridge

Photo E4. Gillespie Creek leaving barnyard

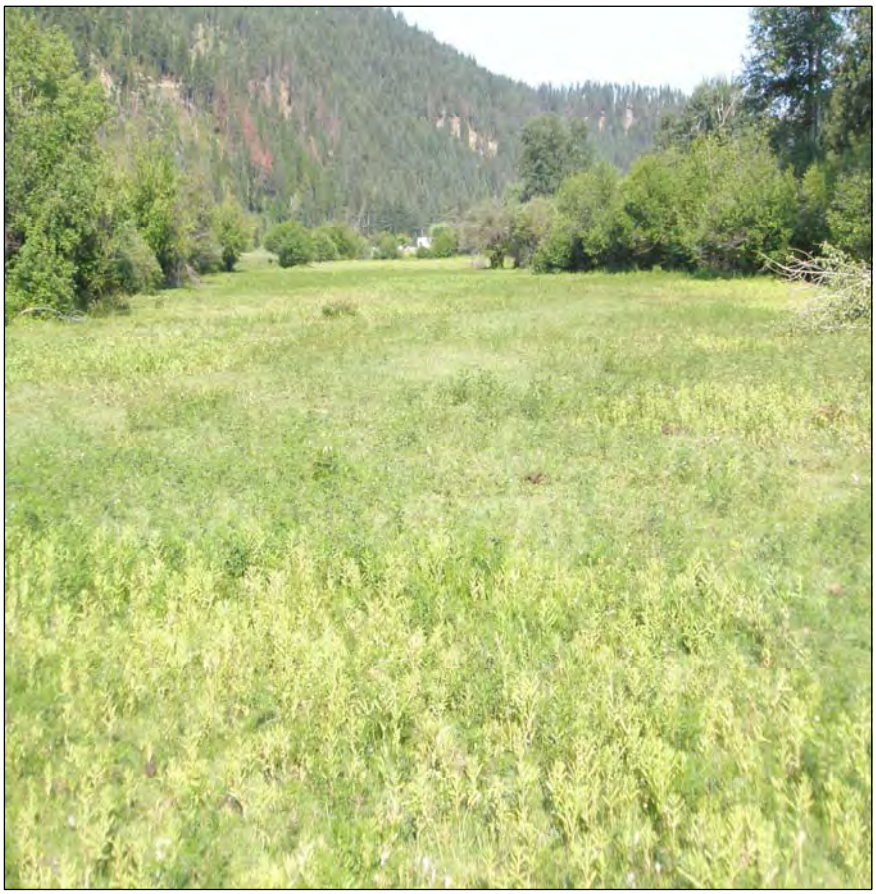
Photo E5. Gillespie Creek near base of bench

Photo E6. Gillespie Creek on the river terrace

Photo E7. Gillespie Creek in old river channel

Photo E8. Gillespie Creek in old river channel

Photo E9. Old river channel that carries Gillespie Creek



Appendix F

Hoover Creek

HOOVER CREEK
Assessment Date: August 7, 2008

INTRODUCTION

Hoover Creek is a tributary to the Clark Fork River (CFR) that is accessed from Interstate Highway 90 (I-90) at the Jens exit 8 miles east of Drummond. The creek flows under the interstate at the Jens exit and parallels the county road south for a short distance. The DNRC river mile index places the mouth of Hoover Creek at river mile 429.4R, 11.8 miles upstream from the mouth of Flint Creek, although, at the present time, Hoover Creek does not flow into the river.

METHODS

Land ownership was determined using Montana Cadastral Mapping Program. Landowners were contacted and permission to do the survey was granted before any field work was done. Stream and habitat conditions were measured, photographed and described by walking and observing conditions on the selected stream reach. Stream discharge was determined by wading using a Marsh McBirney digital flow meter and methods described by the U.S. Geological Survey. Universal Transverse Mercator (UTM) locations were determined using a Garmin etrex. Stream channel lengths were measured from Google Earth (Maps F1 and F2).

GENERAL DESCRIPTION

Hoover Creek flows out of steep, mountainous terrain from the north toward the CFR near the Jens exit off I-90. Arriving out of the mountains, 1.2 miles north of I-90, it flows under the county road through a culvert that is perched 2.7 feet above the creek bed (Photos F1, F2, F3). From this point, it flows into an irrigation ditch that serves a long hay field/pasture immediately north of the Jens exit off I-90 (Photo F4). It flows under the interstate, on the west side of the Jens underpass, through a 310 foot long culvert that appears to be passable by fish (Photo F5). It flows through a smaller concrete culvert under the frontage road on the south side of I-90 (Photo F6). A short distance from the frontage road it drops approximately 25 feet from the top of the terrace near the frontage road to the Montana Rail Link (MRL) grade below through near-vertical twin concrete culverts (Photos F7 and F8). After passing under the MRL grade, it flows through an inactive livestock confinement area and under the county road 0.3 miles south of I-90 (Photos F9 and F10). It then joins a large irrigation ditch coming from the east (Photo F11). This ditch begins on a side channel of the CFR approximately three quarters of a mile east of the mouth of Hoover Creek and flows to a small pond north of the interstate approximately 1.5 miles west of Hoover Creek. Hoover Creek has no direct connection with the CFR.

FISH PASSAGE

Fish passage is a significant issue on the 1.8 mile long portion of Hoover Creek included in this survey. There are two complete barriers to fish passage beginning with the 25 foot drop from the frontage road to the MRL grade, and the perched county road culvert 1.2 miles north of I-90. Although the I-90 culvert is 310 feet long, it does not appear to be a passage barrier. For fish passage to and from the CFR, the headgate on the irrigation ditch 0.7 miles upstream is the only connection.

CHANNEL CONDITION AND HABITAT

From the point that it leaves the mountains until it disappears in the large irrigation ditch, it flows through man-made ditches and channels. Upstream of I-90 it is in a ditch along either the east or west side of the hay field/pasture where there is very little woody riparian vegetation. Habitat quality is poor throughout the entire 1.8 miles of stream surveyed. Livestock have damaged the streambanks and created water quality problems (Photos F12 and F13).

FLOW

At the time of the survey Hoover Creek was flowing 2.9 cubic feet per second (cfs) at the county road crossing 1.2 miles upstream from I-90. At the county road crossing 0.3 miles south of I-90, it was flowing 2.5 cfs (Photos F14 and F15).

IRRIGATION

Irrigation use is primarily flood irrigation of the hay field/pasture upstream of the I-90. There probably are times when the entire flow is used for this purpose.

DISCUSSION

During a fisheries survey in summer of 2008, a Fish, Wildlife and Parks fisheries crew found a small population of mixed species in the lower end. They surmised that these fish came in through the irrigation ditch at the mouth of Hoover Creek. In the upper reaches, they found primarily brook trout except for some westslope cutthroat trout in the headwaters. A complete report of this survey can be obtained from the Fish, Wildlife and Parks office in Deer Lodge.[1] In addition, whirling disease is an apparent problem in the drainage (personal communications, Jason Lindstrom, FWP).

Fish passage represents a major challenge to making Hoover Creek a viable spawning tributary to the CFR. While the problem with the perched county road culvert could be corrected, it would be much more difficult, if not impossible, to correct the problem at the MRL grade. The connection with the CFR could also be improved, barring any difficulties with water rights. The long I-90 culvert could be examined more closely to determine its potential as a passage barrier.

Improving water quality and habitat quality would require channel restoration and changes in livestock management.

RECOMMENDATIONS

1. Engage in discussions with Fish, Wildlife and Parks personnel regarding the potentials and problems with fish and wildlife management in the Hoover Creek drainage before approving any projects.

[1] *An Assessment of Fish Populations and Riparian Habitat in Tributaries of the Upper Clark Fork River Basin, Phase II*, by Brad Liermann, Jason Lindstrom, and Ryan Kreiner of Montana Fish, Wildlife and Parks, April 2009.

Map F1 – Hoover Creek Assessed Reaches (1)

Map F2 – Hoover Creek Assessed Reaches (2)

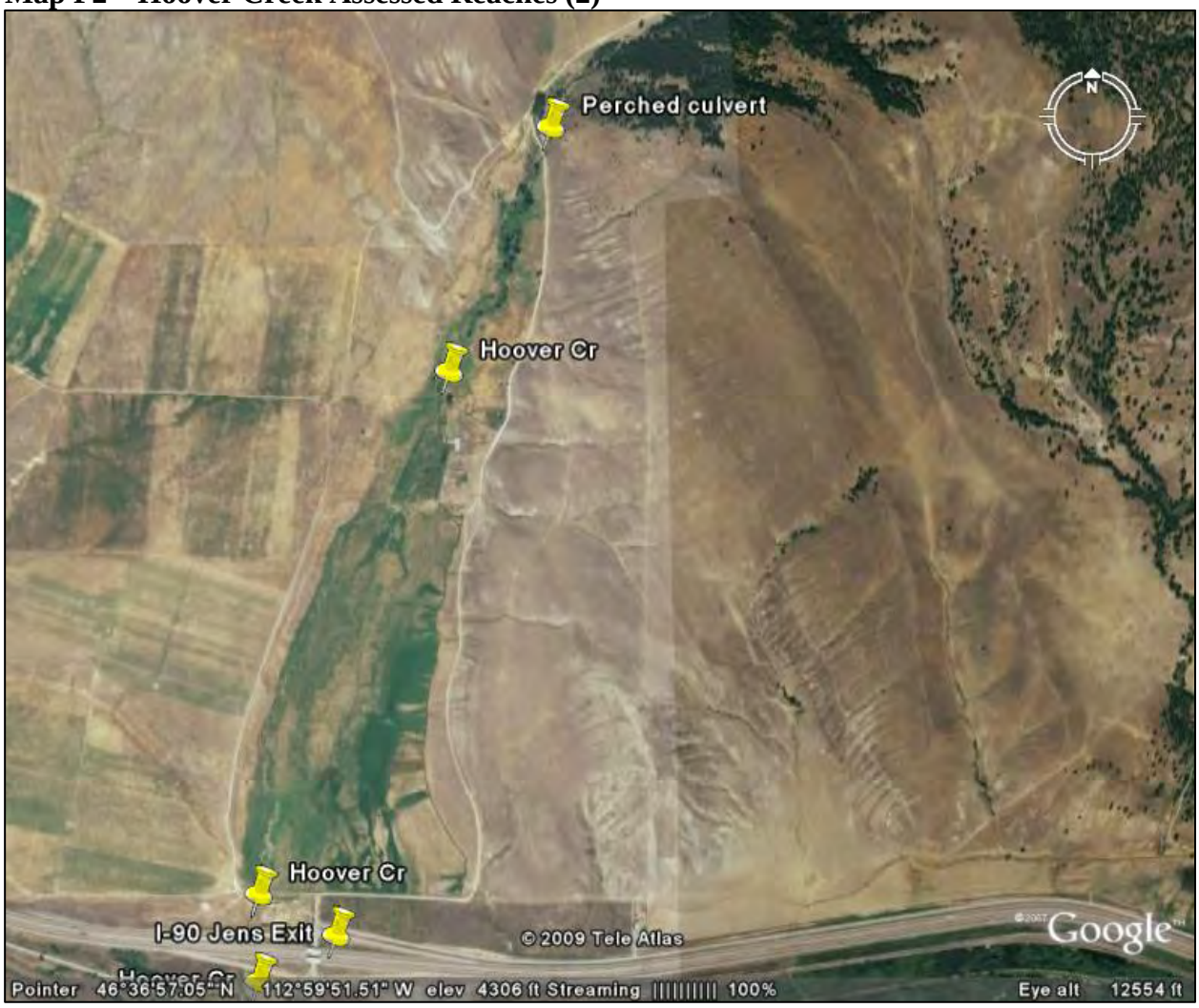


Photo F1

Photo F2

Photo F3

Photo F4

Photo F5

Photo F6

Photo F7

Photo F8

Photo F9

Photo F10

Photo F11

Photo F12

Photo F13

Photo F14

Photo F15

Appendix G

Turah Creek

TURAH CREEK
Assessment Date: August 7, 2008

INTRODUCTION

Turah Creek is a perennial tributary to the Clark Fork River (CFR) flowing out of the mountains from the northeast and entering the river on the right bank 1.1 miles downstream from the Turah Bridge. After flowing under Interstate Highway 90 (I-90), the Montana Rail Link grade and frontage roads on both sides of I-90 it enters private property where this survey was conducted. The property is mostly river bottom land between the south frontage road and the river running from Turah Bridge downstream for a little over 1 mile. There are several small ponds on the west end of the property that appear to be the result of gravel mining. Most of the land is used for livestock grazing; however, the livestock is fenced out of the riparian zone of the river (Map G1).

METHODS

Turah Creek was added to our list at the request of the landowner. I met with him on two separate occasions on the land to discuss ideas he had for use of the land and water to improve fish habitat and fish populations. Measurements were taken from Google Earth (Maps G1, G2, and G3) and stream discharge was determined by wading using a Marsh McBirney digital flow meter and methods described by the U.S. Geological Survey.

GENERAL DESCRIPTION

From the point at which Turah Creek crosses under the north frontage road of I-90 until it reaches the river it flows in a man-made channel for 0.62 miles. It is used in its entirety during the summer for flood irrigation of pasture land. The pasture land is heavily grazed and in poor condition. The creek channel is mostly straight and best described as an irrigation ditch – it has no habitat features (Map G2, Photo G1). It leaves the pasture land and flows into a small pond created by a gravel dike across the channel approximately 230 feet upstream from the mouth (Photos G2, G3, G4, G5). The pond and the remainder of the creek channel are surrounded by a mixture of woody shrubs and trees. Turah Creek drops into the CFR behind a point bar on the river (Photos G6 and G7).

FLOW

Stream discharge was measured on August 7, 2008 immediately below the culvert under the driveway into the private property. On that day it was flowing 0.74 cubic feet per second. The landowner informed me that he also owns a water right out of the CFR that is diverted at a headgate 0.44 miles upstream from Turah Bridge (Photos G8 and G9). There was water flowing from the river through the headgate, but it flowed into a marsh near Turah Bridge and then back into the river below the bridge. There was no water in the lower end of the ditch on either day that I met with the landowner. Some maintenance work would need to be done on the system to get water to the landowner's property (Photo G10).

DISCUSSION

The landowner has a deep interest in the welfare of the fishery. He also wants to have some income from the property so livestock and irrigated pastureland will probably remain a part of the use of his property and the creek. He believes that putting Turah Creek into and through the ponds would be good for fisheries (Map G2). While pond fisheries would probably be of the most value to the landowner, it would probably not serve the recreating public or the CFR fishery. Restoring the Turah Creek channel and creating an environment that would support resident trout and spawning trout from the CFR would probably better serve the public resource. The use of his CFR water might make it possible to do both.

On October 16th I toured the upper portion of the property a short distance downstream from the Turah Bridge with the landowner. The purpose of the meeting was to discuss his idea of creating a spawning channel in an abandoned channel of the CFR. The channel was only recently abandoned by the river and probably carries flow most years during spring runoff. This would most likely be a difficult project to maintain because of the seasonal nature of the water supply and disruption from spring flooding (Map G3). Improvements to the Turah Creek channel would probably be a more cost-effective way to create a useable spawning environment for CFR trout.

It is unclear how much potential Turah Creek has for improving the trout population in the CFR considering that Rock Creek and Schwartz Creek are both in close proximity to Turah Creek. Trout populations in the CFR between Milltown and Rock Creek have been respectable in past years, indicating that there is probably not a shortage of spawning habitat available to river trout in this reach of the river. Before anymore effort is expended on Turah Creek there should to be a discussion of the needs of the river and the potential of Turah Creek to fill any of those needs with Fish, Wildlife and Parks fisheries personnel.

RECOMMENDATIONS

1. Discuss potential of Turah Creek with FWP fisheries personnel and, if it is decided to go ahead with a project on Turah Creek, then:
    - Research the landowner's water right from the CFR.
    - Make flow measurements on Turah Creek during different seasons of the year to get a more complete picture of annual hydrograph.
    - Develop a project proposal for discussion with the landowner.

Map G1 – Turah Creek Assessed Reaches (1)

Map G2 – Turah Creek Assessed Reaches (2)

Map G3 – Turah Creek Assessed Reaches (3)

Photo G1

Photo G2

Photo G3

Photo G4

Photo G5

Photo G6

Photo G7

Photo G8

Photo G9

Photo G10

Appendix H

Tyler Creek

TYLER CREEK
Assessment Date: July/August 2008

INTRODUCTION

Tyler Creek is a tributary to the Clark Fork River (CFR) that is accessed from Interstate 90 (I-90) at the Bearmouth exit, 37 miles east of Missoula, and then west on the frontage road south of I-90 to the locked gate on the Tyler Creek road. The first mile of the road is through private property and then it enters Forest Service property. In the DNRC river mile index the mouth of the creek is at mile 395.8L. The following report is a result of a tour of the private property with the landowner on July 25, 2008 and return trips on August 27 and 30, 2008 for a flow measurement and pictures.

METHODS

Land ownership was determined using Montana Cadastral Mapping Program. Landowners were contacted and permission to do the survey was granted before any field work was done. Stream and habitat conditions were measured, photographed and described by walking and observing conditions on the selected stream reach. Stream discharge was determined by wading using a Marsh McBirney digital flow meter and methods described by the U.S. Geological Survey. Universal Transverse Mercator (UTM) locations were determined using a Garmin etrex. Stream channel lengths were measured from Google Earth (Map H1).

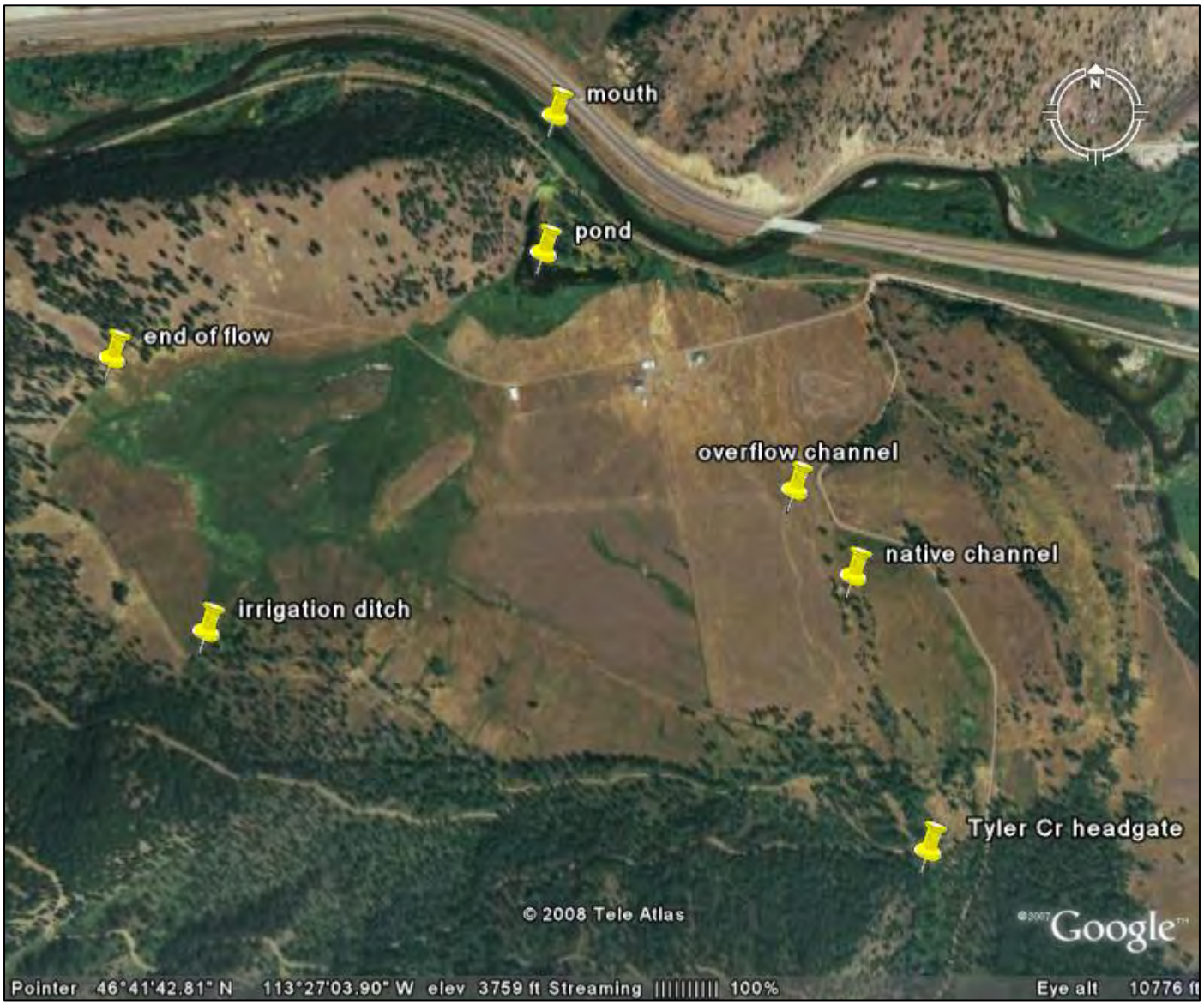
GENERAL DESCRIPTION

Tyler Creek flows north through steep mountainous terrain to a point approximately one mile south of the CFR (Photo H1). At this point it enters private property through which it flows until it joins the river CFR 0.3 mile downstream from the I-90 bridge west of the Bearmouth exit (Table H1, Map H1). A short distance downstream of the Forest Service boundary it flows into an irrigation ditch which takes it west around the rim of a large bowl-shaped pasture (Photos H2 and H3). A short distance down the ditch there is a split and a small ditch can take part of the flow north for about one-half mile into a pit where gravel was taken for highway construction (Photos H4 and H5). There, according to the landowner, it seeps into the ground.

Table H1. Distances between points of interest on Tyler Creek in feet and miles

DESCRIPTION	FEET	MILES
I-90 bridge to mouth Tyler Creek	1,970	0.37
Length of West arm of pond	830	0.16
Length of East arm of pond	912	0.17
Headgate to end of flow	7,644	1.45
Headgate to end of native channel	2,132	0.40

Map H1. Aerial photograph of the Tyler Creek bowl with markers on points of interest



On the day of the survey, it flowed 1.4 miles, around the rim of the large pasture, before it had all seeped away (Table H1, Map H1). On the north side of the pasture there is a pond that is created by the old Milwaukee Railroad grade (Photo H6). Water from the large pasture collects there before it seeps under the railroad grade and into the river (Photos H7 and H8). No culvert could be found under the railroad grade – it filters through large rocks at the base of the grade. Photos H7 and H8 were taken on the downstream side of the Milwaukee grade at the point where the water emerged from under the grade fill. From there it flows through a beaver pond and small channel approximately 200 feet to the CFR (Photos H9, H10, H11).

STREAM FLOW

Tyler Creek is a perennial stream. On August 27, 2008, it was flowing 3.2 cubic feet per second at the Forest Service boundary. There is only one irrigation system on the creek – the

one described above. The ditch is the only channel the creek has from the Forest Service boundary to the river, and it flows in it year around. There appears to be the remnants of two stream channels visible in Map H1 going north off of the forest. The one labeled overflow appears to go around the gravel borrow pit and to the railroad grade on the east side of the pond. The one labeled native has a more defined channel and some woody vegetation along the banks, and delivers water to the gravel borrow pit. It is impossible to tell where the original channel might have been located across the private property.

FISHERY

A Fish, Wildlife and Parks fisheries crew surveyed Tyler Creek on Forest Service property this summer. They found only westslope cutthroat trout (Oncorhynchus clarki lewisi).[1] The landowner reported seeing fish in his ditch and thinks they are eastern brook trout (Salvelinus fontinalis). An electrofishing survey would be needed to determine the nature of the fish population on private property. Fish populations in Tyler Creek probably have been isolated from the CFR for many decades.

DISCUSSION

Studies of trout populations in the CFR completed by the Natural Resource Damage Program[2] indicate that trout populations were at their lowest numbers in the reach of the river where Tyler Creek enters. The trout population in this reach of river is far below levels expected for a river the size of the CFR. A shortage of spawning tributaries in this vicinity could contribute to the paucity of trout.

In many cases, trout can get from their natal stream into the CFR but not back into that stream to spawn after they mature due to various kinds of passage barriers. In the case of Tyler Creek, the passage barriers stop both up and downstream migration. There are no signs that the pond at the mouth of the creek has ever overtopped the railroad grade so trout in Tyler Creek are totally isolated from the river. Reconnecting Tyler Creek to the river to allow fish passage would require several steps:

1. Obtain permission from the landowner to reconnect Tyler Creek with the CFR.

2. Culvert the old Milwaukee Railroad grade. The landowner owns it and uses it to access river bottom pasture land downstream.

3. Conduct a detailed land survey to find the best location for the stream channel from the Forest boundary to the river.

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[1] *An Assessment of Fish Populations and Riparian Habitat in Tributaries of the Upper Clark Fork River Basin, Phase II*, by Brad Liermann, Jason Lindstrom, and Ryan Kreiner of Montana Fish, Wildlife and Parks, April 2009.

[2] State of Montana. (1995). Natural Resources Damage Program, Aquatic Resources Injury Assessment Report Appendices A – H.

4. Construct over a mile of stream channel. The soils appear to be rocky, which might make it necessary to put some sort of liner in the new channel to keep the water flowing on the surface.

5. Fence the new channel.

6. Develop an alternative method of irrigation for the bowl pasture.

RECOMMENDATIONS

1. Discuss the pros and cons of reconnecting Tyler Creek with the CFR with Fish, Wildlife and Parks fisheries personnel.

2. If it would be desirable, then reassess trout populations in the CFR near the mouth of Tyler Creek to see if they have changed since the earlier surveys.

3. Discuss the project with the landowner.

Photo H1: Tyler Creek at Forest Boundary

Photo H2: Bowl Pasture

Photo H3: Pasture

Photo H4: At the Split

Photo H5: Gravel Pit

Photo H6: Pond

Photo H7: Pond Outlet

Photo H8: Pond Outlet

Photo H9: Tyler BevPond Below OMRR

Photo H10: Tyler at CFR

Photo H11: CFR at Tyler Mouth

Appendix I

Warm Springs Creek

WARM SPRINGS CREEK
AT PHOSPHATE
Assessment Date:

INTRODUCTION

Warm Springs Creek enters the Clark Fork River (CFR) approximately 2.6 miles west of Garrison, flowing into the river from the north at river mile 440.5R, 5.2 miles downstream from the mouth of the Little Blackfoot River. It is accessed either from the Phosphate exit from Interstate Highway 90 (I-90) or from the Garrison exit. From the Phosphate exit, the frontage road runs east along the north side of the highway and intersects the Warm Springs Creek road 1.7 miles from the I-90 exit. From Garrison, the frontage road runs west along the north side of the river for 3.3 miles before it goes under I-90 and up the Warm Springs drainage. The survey that forms the basis of this report was completed on August 27, 2008 and includes the lower 1.6 miles of stream channel (Table I1 and Map I1).

METHODS

Land ownership was determined using Montana Cadastral Mapping Program. Landowners were contacted and permission to do the survey was granted before any field work was done. Stream and habitat conditions were measured, photographed and described by walking and observing conditions on the selected stream reach. Stream discharge was determined by wading using a Marsh McBirney digital flow meter and methods described by the U.S. Geological Survey. Universal Transverse Mercator (UTM) locations were determined using a Garmin etrex. Stream channel lengths were measured from Google Earth (Map I1).

GENERAL DESCRIPTION

Warm Springs Creek flows from the low mountains north of I-90 over a rock cropping 5 miles north of the interstate highway (Photo I1). From the falls, it flows in a meandering channel confined in a narrow valley between low, grass and tree covered hills. There were many beaver dams along this reach of the stream. Approximately 2 miles downstream from the falls, the valley began to open up and enter the ranching section of the valley. Throughout most of its course to CFR the channel was lined with a mixed population of woody shrubs and heavy grass through hay and pasture land down to near I-90 (Photos I2, I3, I4). From the ranch buildings near I-90, it flowed in a man-made channel to the CFR in front of a home recently built on the riverbank near where the frontage road passes under I-90 (Photos I5, I6, I7, I8). The channel was deeply incised and stable throughout most of its course through the pasture/hay land (Photos I9, I10, I11).

Immediately downstream of the ranch barnyard, it flowed through the interstate culvert that was 223 feet long. It did not present a fish passage barrier (Photos I12 and I13). From I-90 it flowed 160 feet to the frontage road bridge, which was fish-passage friendly, and then 0.2 miles to the CFR. A beaver dam across the channel created a potential fish passage barrier 528 feet upstream from the mouth (Photo I14) (Table I1).

The stream channel was stable with good run and pool development, but riffles are in short supply (Photos I15, I16, I17). There were some undercut banks and some large woody debris creating excellent trout habitat (Photos I18, I19, I20). Fish of unknown species were observed in the stream during the survey. There were some signs of livestock accessing the stream, but not to the extent that it had damaged habitat or channel stability (Photos I21 and I22).

Table I1. Warm Springs Creek lengths and distances between various points of interest.

DESCRIPTION	FEET	MILES
Mouth to beaver dam	528	0.1
Mouth to I-90	1,482	0.28
I-90 culvert length	223	0.04
South end I-90 culvert upstream to irrigation diversion	7,115	1.35
Total length of stream surveyed	8,597	1.63

FLOW

Stream flow was measured at two locations – two miles downstream from the falls and at the mouth (Table I2).

There were no signs of high flows as you would expect of a basin-fed stream during spring runoff. Several indicators suggest that it is a spring creek: the large extent of sand and silt streambed sediments, the abundance of rooted aquatic plants and filamentous algae, and no clean rocky riffles due to the lack of scouring flows (Photos I23, I24, I25, I26).

Table I2. Warm Springs Creek flow measured in cubic feet per second at 2 locations.

DESCRIPTION	DATE	FLOW
2 miles downstream from the falls	8/7/08	8.6
At the mouth	8/27/08	7.7

IRRIGATION

Only one irrigation diversion was found, and it was located at the head of the survey section (Photos I27 and I28). It feeds a ditch between the county road and the pasture/hay land east of the county road. After reaching the lower end of the pasture/hay land (0.5 miles) it turns west under the county road and irrigates land between the Interstate highway and the frontage road for about 1/2 mile. Any water left could enter a pond on the north side of I-90 approximately one-half mile east of the Phosphate exit. On August 27, 2008 flow in the ditch was 3.9 cfs as measured at a flume approximately 400 feet upstream from where the ditch turns west under the county road.

DISCUSSION

Warm Springs Creek trout habitat was in good condition, the channel was stable and the riparian zone was dominated by woody vegetation. There doesn't appear to be a need for riparian zone fencing since there was very little sign of livestock use of the riparian zone, which

could be a result of the incised nature of the stream channel in the survey section. The lack of scouring flow results in a more stable stream channel; however, the accumulation of fine sediments on the streambed could reduce its value as a spawning tributary for CFR trout. The irrigation diversion at the head of the survey section is the only potential problem for trout since it did not have a fish screen and it appears to be a fish passage barrier during the irrigation season.

RECOMMENDATIONS

1. Given that the lower 1-½ miles of stream has good spawning habitat, no action relative to the seasonal fish barrier is recommended at this time.
2. Explore the ownership and value of the pond near the Phosphate exit as a potential fishery.
3. Water temperatures may be elevated and would need to be checked before making a major investment in improvement.

Map I1


diversion dam, end survey
N
Warm Springs Cr
ditch to pond near Phosphate exit
Warm Springs Cr
© 2009 Tele Atlas
Google
Frontage Road from Garrison
Pointer 46°32'48.34" N 112°50'23.73" W elev 4341 ft Streaming 100%
Eye alt 7879 ft

Map I2


Warm Springs Cr
N
Frontage Road from Garrison
Clark Fork River
Warm Springs Cr
mouth Warm Springs Cr
Beaver dam
© 2009 Tele Atlas
Google
Pointer 46°32'28.82" N 112°50'44.21" W elev 4285 ft Streaming 100%
Eye alt 5872 ft

Photo I1

Photo I2

Photo I3

Photo I4

Photo I5

Photo I6

Photo I7

Photo I8

Photo I9

Photo I10

Photo I11

Photo I12

Photo I13

Photo I14

Photo I15

Photo I16

Photo I17

Photo I18

Photo I19

Photo I20

Photo I21

Photo I22

Photo I23

Photo I24

Photo I25

Photo I26

Photo I27

Photo I28