Draft

Jefferson River Watershed Council (JRWC)

Watershed Restoration Plan

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NOTE: The Jefferson River Watershed Restoration Plan was created by first securing the views and objectives of key agencies, local organizations and individual landowner participation. In light of this organizational strategy is important to note that the following documents were reviewed and information was borrowed freely from the below documents.

1) The DEQ Jefferson River TMDL sedimentation draft
2) The Montana Department of Fish Wildlife and Parks Application for Reservation Of Water in the Missouri River Basin above Fort Peck Dam, Volume 2 Reservation Requests for Waters above Canyon Ferry Dam
3) Weed Management Plan for Jefferson County, Montana
4) Ground Water Study Area of the Waterloo Area, Prepared by Water & Environmental Technologies May 22,2006 for Trout Unlimited and the Jefferson River Watershed Council
5) Upper Jefferson River irrigation Delivery Improvement Project, prepared by Joe Van Mullem.P.E. Bozeman , Mt. for Trout Unlimited and the Jefferson River Watershed Council June 2006

Introduction

Watershed Location and Overview

The Jefferson River Valley is located in southwest Montana, surrounded by the peaks of the Continental Divide, Tobacco Root, Highland, Bull, and Elkhorn Mountains. Vuke et al (2004) described the upper Jefferson Valley as an asymmetrical valley with large, steep, west-dipping faults on the east flank, and east dipping faults of smaller magnitude on the west flank. Both mountain ranges consist mainly of Precambrian basement rock with a core of granite emplaced about 70 million years ago. The west flank of the Tobacco Root Mountains has thick deposits of Paleozoic and Mesozoic sedimentary rocks. Similar deposits are observed along the east flank of the highland mountains with tightly folded sedimentary formations in the Silver Star area. The east flank of the Tobacco Rot Mountains has a large terrace surface known as the Parrot bench that slopes gently westward toward the valley. It is believe the parrot bench is an older desert erosional surface developed during the Pliocene time, when the region had an extremely arid climate. The east side of the upper Jefferson Valley, as described by Vuke et al (2004), is almost entirely covered by alluvial fan deposits mainly of middle Pleistocene age or younger. A larger alluvial fan is present at the mouth of Fish Creek on the west side of the valley and differs from those on the east side of the valley. This alluvial fan contains large boulders believed to have resulted from glacial outbursts of melt waters derived from either a glacier or a glacier dammed lake.

The Jefferson River is formed by the convergence of the Ruby, Beaverhead, and Big Hole Rivers, near present day Twin Bridges and flows for nearly 80 miles before combining with the Madison and Gallatin Rivers at the headwaters of the Missouri River.

The Upper Jefferson Watershed area encompasses approximately 734 square miles of land in Jefferson, and Madison counties beginning at the Jefferson Rivers point of origin near Twin Bridges and extending to its confluence with the Boulder River near Whitehall. The watershed area includes a number of tributary streams which drain portions of the Tobacco Root Mountains to the south and the highland Mountains to the north. Land includes a mix of federal, state, and private lands.

Much of the Jefferson River is braided. During the irrigation season, virtually all of the tributaries to the Jefferson are diverted before reaching the river. Throughout its length, the Jefferson River is extensively used as a source of irrigation water. In below average years, portions of the river are severely dewatered. Two irrigation storage reservoirs (Ruby and Clark Canyon Reservoirs) on major upstream tributaries affect the flow pattern of the river.

The natural tendency of the river to migrate within its floodplain affects agricultural lands, pastures, home sites, bridges and irrigation diversions. Various methods to stabilize the channel and protect the floodplain development have been tried. Many projects especially those which block high water channels, have aggravated the instability problem. Many projects have also

increased sedimentation and removed overhanging bank vegetation, both detrimental to the aquatic resource.

Climate

In the Upper Jefferson Watershed average precipitation ranges from 10 inches/year in the valley to 18 inches/year at higher elevations, while average snow fall ranges from9 inches/year in the valley to 85.5 inches at higher elevations. May and June are consistently the wettest months of the year and winter precipitation is dominated by snowfall. Temperature patterns revel that July is the hottest month and January is the coldest throughout the watershed. Summertime highs are typically in the seventies to low eighties. Winter lows fall to approximately 11 degrees F.

Hydrology

Stream flows in the upper Jefferson Watershed are at their highest between May and June. These are also the months with the greatest amount of precipitation and snow melt runoff. Stream flows begin to decline in late June or early July and reach minimum flow levels in September, as many streams go dry. This decrease in steam flow correlates with a dwindling water supply and increasing water demands for irrigation and other uses. About 42,000 acres or 9% of the total Upper Jefferson River Watershed area is irrigated. Stream flows begin to rebound in October and November when irrigation has ended and fall storms supplement the base flow.

Geology, Soils and Stream Morphology

The majority of soils in the Upper Jefferson Watershed is moderately susceptible to erosion and produce moderate amounts of runoff. The areas of land draining to Big Pipestone, Little pipestone, halfway, Whitetail, and Fitz creeks is dominated by the granitic Boulder Batholiths, which is nutrient poor and highly erodible, contributing to a naturally high sediment supply in these streams.

Alt and Hyndman, (1991) describe the Jefferson Valley as bound

Many tributary streams in the Upper Jefferson Watershed have been historically straightened, or channelized, to accommodate a variety of land uses and or transportation networks. These alterations can have significant effects on sediment transport dynamics of streams and may affect stability of stream banks.

Landownership

Private land dominates the upper Jefferson Watershed with 44.7% in private ownership. US Forest Service lands account for 38.6% of the area, the U.S. Bureau of Land Management controls another 11.5% of the area, and the State of Montana owns 4.7% (including water)

Business Industry Overview

Twenty-four percent of the combined workers in the towns Twin Bridges and Whitehall work in construction, extraction and maintenance occupations, while 23% work in management and professional occupations. Sales and office occupations employ 19%. Service occupations receive 14% of the workers and production, transportation, and material occupations receive 13% of workers. Seven percent of workers in these towns are employed in farming, fish and forestry occupations. Government is the largest employer in Jefferson county followed by education, manufacturing, mining, human services, construction, recreation, retail, transportation and the service sector.

A large open-pit cyanide-heap leach gold and silver mine operates at the south end of the Bull Mountains north of the town of Whitehall just on the NE edge of the watershed area. Limestone is quarried in the Pipestone Creek drainage and an open pit-chlorite mine operates intermittently south of Silver Star on the SW edge corner of the Watershed area.

Agriculture makes up the other major economic sector of the Jefferson River Watershed area.

Land use and land Cover

Evergreen forest (national Forests and other forested lands) is the dominate land use at higher elevations in the watershed comprising 40.83% of the watershed area. Grass rangelands comprise 37.7% of the land area while crop and pasturelands make up 11.86% of the area. Brush rangeland and mixed rangeland total an additional combined 5.79% of the land area.

Land cover is dominated by a combination of grassland types (40.03%). A mix of several forest types, including Douglas-Fir mixed xeric forest, Lodge pole pine, and mixed subalpine and White bark Pine accounts for 38.6% of the land cover in the watershed. Sage brush accounts for 6.6% dry irrigated agricultural lands make up 4.61% of the land cover and montane park lands and subalpine meadows comprise 3.22% of the watershed. The remaining 7% of land consists of minor amounts of 19 different vegetation types.

Population

The main towns in the upper Jefferson River Watershed include Twin Bridges in the south and Whitehall in the north. Twin Bridges saw an increase in human population from 374 in 1990 to 400 in 2000, while Whitehall had a slight decrease in population from 1,067 in 1990 to 1,044 in 2000. Estimates of the population outside the incorporated communities in the watershed area are not available. The median age of Jefferson County was 42.6 years of age in 2005. The total labor force in all of Jefferson County in 2006 was 5,696. The per capita income was $29,488 in 2005 the date of the last survey. The median Household income in Jefferson County at the same date was $47,513

Fish and Aquatic Life

Two fish species occurring within the upper Jefferson River watershed, the west slope cutthroat trout (Oncorhynchus clarki lewisi) and the Montana arctic grayling (Thymallus arcticus montanus) are listed by the State of Montana as species of special concern. West slope cutthroat trout are thought to occur in five streams, including four that appear on the 303 (d) lists. These include Halfway Creek, Fish Creek, Cherry Creek, and Hells Canyon Creek. Genetically pure populations of west slope cutthroat trout are thought to be limited to halfway and Fish Creeks. The present distribution of Montana fluvial arctic grayling in the Upper Jefferson watershed is not well known. However it is assumed that grayling may be present in the Jefferson River main stem as a result of an attempt to reestablish a population in the lower Beaverhead River upstream of the confluence of the Beaverhead and Big Hole Rivers.

The Jefferson River provides a good spring and fall brown trout fishery that is popular with local residents of the Butte-Whitehall area. Brown trout in the 1 ½ -2 pound class are common, with trout in excess of 5 pounds taken annually. Rainbow trout are also present, but comprise less than 10% of the trout population. Other species found in the Jefferson River and their relative abundance are: Mountain Whitefish, abundant; Longnose sucker, abundant; Carp, common;

Mountain sucker, uncommon; Longnose dace, uncommon; Flathead chub, uncommon; Mottled sculpin, uncommon; Golden shiner, rare; Stonecat, rare; Yellow perch, rare; Black crappie rare; Largemouth bass, rare; Brook trout, rare.

The upper Jefferson River above the major irrigation diversions supports a somewhat greater trout population. Over one three-year period, estimated numbers of 3-year and older brown trout ranged from 253 to 503 per mile and biomass estimates varied between 318 and 535 pounds per mile for a 3.1-mike long study section.

A number of environmental factors are responsible for the overall depressed trout populations of the Jefferson River, the most notable being the severe dewatering that occurs during most irrigation seasons in various river segments. Given adequate summer flows, the river is capable of supporting a greater biomass of trout.

Wildlife

The riparian habitat along the Jefferson River is extensive due to the many river meanders. This habitat supports excellent populations' excellent populations of furbearers, including beaver, mink and river otter. Both mule and whitetail deer inhabit the river bottom year round. Tributaries to the Jefferson River provide important winter range for Mule deer and Elk. Other inhabitants include black bear and bobcat.

Other resident big game species include an occasional moose and black bear. Bald eagles winter along the river. Great blue heron rookeries are located near Cardwell.

Waterfowl commonly breed within the Jefferson River valley. Substantial numbers of Canada geese nest on islands between Caldwell and Waterloo. Duck production is excellent in many sloughs along the river. Various waterfowl, including swans, visit the area during migration. Golden eyes and mergansers are common winter residents. Mountain grouse are present in the tributaries to the Jefferson River.

History of Watershed Planning in the Drainage

The Jefferson River Watershed Council (JRWC) was created in 1999. The JRWC is a Montana based 501-C (3) nonprofit organization which includes all interests that may be affected by water-use and natural resource management in the watershed. The council seeks to develop practical solutions to difficult problems which may impact the Jefferson River.

Thus local landowners, irrigators, ranchers, outfitters, businesses, sporting/recreation, nonprofit organizations, and government agencies contribute to creation and continued success of the council.

The organizational structure includes a board of directors, an overall Watershed Council made up of the above organizations and business sectors, and various committees on an as needed basis. In addition the JRWC contract for the service of a watershed coordinator on a part time basis.

Jefferson River Watershed Council Organizational Objective:

Improve Jefferson River Base 'flows and Quality

Management Strategies Developed to Achieve the Councils Objective:

- Develop a watershed restoration plan which coordinates the activities of all key organizations and agencies to achieve the JRWC's objective.
- Coordinate with Bureau of Land management & United States Forest Service to integrate the agencies work in priority TMDL drainages with the JRWC.
- Coordinate with the Natural Resources and Conservation Service(NRCS) to integrate the NRCS planning priorities into the JRWC planning process
- Coordinate with the Jefferson Valley Conservation /district to integrate the district's plan of work into the JRWC planning process
- Coordinate with the Jefferson County Weed District to identify priority weed control issues, & areas to integrate the districts priorities into the JRWC planning process.
- Coordinate with Montana Fish Wildlife and parks to integrate their planning priorities into the JRWC planning process
- Coordinate with Trout unlimited to integrate their planning priorities into the JRWC Planning process

- Meet with other local organizations including , agricultural, economic development, sportsman groups, recreational groups and others as identified to seek their continual input into the JRWC planning process

Priority Resource Issues

The following are the priority resource issues identified by the JRWC based on the completed assessments by agencies organizations and local group in the Jefferson River Watershed area.

Jefferson River main stem base flows and quality maintenance and restoration
Riparian Restoration
Noxious Weed Control
Flood plain planning
Conifer encroachment
Fisheries enhancement
Irrigation water management
Prescribed grazing systems
Sediment loading due to gully and rill erosion along interstate 90 and unpaved roads
Protection and maintenance of the local agricultural economy
Periodically evaluate the Drought Management Plan

Watershed Assessment

The following section outlines the existing resource and environmental assessments completed by the JRWC, Federal state and local agencies, and nonprofit organizations in the watershed area to date. As new assessments are completed and made available to JRWC thy will be added.

Montana Department of Environmental Quality Total maximum Daily Load

The most recent and complete assessment in the watershed area is the "Upper Jefferson River Tributary Sediment Total Maximum Daily Loads (TMDLs) and Framework Watershed Water Quality Improvement Plan" completed in 20009 by the Montana Department of environmental Quality. The TMDL forms the basis for much of the JRWC's plan of work. The following information is therefore taken directly from the TMDL. The first part of the assessment provides an overview of the entire area of the watershed with a general review of the situation and recommended activities to address the sedimentation issue followed by a more detailed assessment by tributary.

Sediment total maximum daily Load assessments (TMDLs) were completed for 6 tributary watersheds. The most important restoration approach for reducing sediment loading in the upper Jefferson River is streamside riparian restoration and long term riparian zone management. Stream Channel restoration may be necessary in areas that have lost channel integrity due to long term riparian vegetation and/or irrigation infrastructure impacts. Other sediment restoration actions would include unpaved road erosion control near streams and improved management of the I-90 corridor.

Erosion off of uplands was usually the second most predominant human influenced source of sediment identified in the TMDLs. The restoration approach for upland erosion is also to increase streamside riparian area sediment filtering capacity by restoring streamside vegetation zones. This approach reinforces the idea that riparian vegetation restoration and long term riparian zone vegetation management should be the predominant restoration approach to reduce sediment.

On average, erosion off of unpaved roads fell next in line of controllable sediment sources in the upper Jefferson Watershed. Restoration approaches for roads near streams should be to divert water off roads and ditches before it enters the stream. The diverted water should be routed through natural healthy vegetation, which will act as filter zones for the sediment laden runoff before it enters streams. Sediment derived from roads, as well as rill and gully wash erosion, may cause significant localized impact in some stream reaches, even though at a watershed scale it may be a moderate or small source. Sediment loads from culvert failure and culvert caused scour were not assessed by the TMDL source assessment, but should be considered in road sediment restoration approaches.

All of these best management practices are considered reasonable restoration approaches due to their benefit and generally low costs. Riparian protection/restoration and road erosion control are standard best management practices identified by the Natural Resources Conservation Service (NRCS) and not overly expensive to our society. Many riparian areas could benefit from more active grazing management (possibly with some additional fencing) and would typically recover naturally. Active riparian vegetation planting along with bank sloping may be slightly more costly, but still are a reasonable and relatively cost effective restoration approach. When stream channel restoration work is needed because of altered stream channels, cost increase and projects should be assessed on a case by case basis.

Historic placer mining as well as irrigation infrastructure may have very localized impacts that affect sediment production within the watershed. If found such sediment sources that can be restored at reasonable costs could be prioritized into a watershed restoration plan. Any unknown sediment sources could also be incorporated into the watershed restoration plan while considering cost and sediment reduction benefits.

An emerging concern is the issue of conifer encroachment on rangelands in the watershed. Riparian communities along stream corridors have been disrupted by encroaching conifers which can cause changes in riparian corridor functions. Native riparian vegetation, such as aspen over storey, and herbaceous and shrub understory, provides crucial sediment filtering and channel protection that is significantly reduced when conifers come to dominate riparian vegetation. Studies have been shown that soil loss or erosion can be elevated by up to 1o0 times in juniper-encroached areas in comparison with native vegetation providing natural vegetative protection (DeBoodt, et.al. 2005) In addition to effects on soil erosivity, as well as hydrologic changes such as reduced stream flow.

Through application of locally appropriate Best Management practices, the Montana Department of environmental quality estimates that sediment loads in individual streams can be reduced between 36 and 46 percent

Existing individual tributary assessments completed in the TMDL Framework plan:

Big Pipestone Creek

Ranked Controllable Sources

1) Eroding Banks needing sustainable riparian zone vegetative condition, Reduction in irrigation infrastructure effects

   Ranked Best Management Type
   Riparian grazing management,
   Riparian willow vegetation restoration,
   Move haying from riparian green line,
   Irrigation infrastructure mitigation

2) Upland Sediment from grazing

   Ranked Best Management Practices
   Riparian grazing management,
   Provide filter strips along streams

3) Paved and Unpaved roads

   Ranked Best management practices
   Road maintenance and runoff BMPs

Spatial Concerns Big Pipestone Creek

Eroding banks with insufficient riparian cover occur along significant but intermittent reaches of both the lower and upper portions of the creek.

Some riparian areas are managed well and others need riparian restoration work.

Riparian health appears to be fair in upper portions of the watershed while health markedly declines to a mix of fair and poor in the lower portions.

Tributaries should also be addressed to reduce sediment loads to Big Pipestone Creek.

In both the lower and upper portions of the watershed, effects from Irrigation infrastructure are apparent.

Road maintenance BMPs should occur on I-90 and many unpaved road crossings

Cherry Creek

Ranked Controllable source

1) Upland Sediment from grazing

   Ranked Best management Type
   Riparian grazing management,

Provide filter strips along streams

2) Eroding Banks needing sustainable riparian zone vegetative condition

Ranked Best management practice
Riparian grazing management,
Riparian willow vegetation restoration

Spatial Concerns Cherry Creek

A few improvements could be achieved in upper Cherry Creek but riparian management appears to be good to fair along the upper/middle of the watershed.

Grazing related impacts were noted in the area just downstream of public lands on private property. Much of grazing effects occur on private lands.

There may also be some effects from irrigation infrastructure.

Green line degradation in the floodplain and the loss of riparian habitat is much more prevalent in the lowest segments of the watershed.

Fish Creek

Ranked Controllable source

1) Eroding Banks needing sustainable riparian zone vegetative condition

Ranked Best Management Type
Riparian grazing management,
Riparian willow vegetation restoration in grazed and cropped areas

2) Upland Sediment from grazing and hay production

Ranked Best Management Type
Riparian grazing and cropping management,
Provide filter strips along streams

3) Unpaved roads

Ranked Best Management Practice Types
Road maintenance and runoff BMPS

Spatial Concerns Fish Creek

Eroding banks with insufficient riparian cover occur along significant but intermittent reaches of both the lower and upper portions of the creek.

Some riparian areas are managed well and others need riparian restoration work.

Riparian health appears to be fair in upper portions of the watershed with a few heavily impacted areas of poor health.

The lower portions of the watershed exhibit Good, Fair and Poor riparian condition and impacts are primarily associated with grazing and haying within the riparian zone.

In the upper portions of the watershed effects from placer mining including channelization and degraded riparian health are apparent.

Road maintenance should occur on many unpaved road crossings

Hells Canyon Creek

Ranked controllable source

1) Eroding Banks needing sustainable riparian zone vegetative condition

Ranked best management type
Riparian grazing management,
Riparian willow vegetation restoration in grazed and cropped areas

2) Upland Sediment from grazing and hay production

Ranked Best Management Type
Riparian grazing and cropping management,
Provide filter strips along streams

3) Unpaved Roads
Ranked Best Management Type
Road maintenance and runoff BMPS

Spatial Concerns Hells Canyon Creek

Eroding banks with insufficient riparian cover occur along significant but intermittent reaches of both the lower and upper portions of the creek.
Some riparian areas are managed well and others need riparian restoration work. Riparian health appears to be fair in upper portions of the watershed with a few heavily impacted areas of poor health.

The lower portions of the watershed exhibit Good, Fair and Poor riparian condition and impacts are primarily associated with grazing and haying within the riparian zone.

In the upper portions of the watershed effects from placer mining including channelization and degraded riparian health are apparent.

Road maintenance should occur on many unpaved road crossings

Little Pipestone Creek

Ranked Controllable Source

1) Eroding Banks needing sustainable riparian zone vegetative condition
    Ranked Best Management Type
        Riparian grazing management,
        Riparian willow vegetation restoration,
        Move haying from riparian green line

2) Upland Sediment from grazing
    Ranked Best management Type
        Riparian grazing management,
        Provide filter strips along streams

3) Paved and Unpaved roads
    Ranked Best management Type
        Road maintenance and runoff BMPS

Spatial Concerns Little Pipestone Creek

Eroding banks with insufficient riparian cover occur along significant but intermittent reaches of both the lower and upper portions of the creek.

Some riparian areas are managed well and others need riparian restoration work.

Riparian health appears to be fair in upper portions of the watershed while health markedly declines to a mix of fair and poor in the lower portions.

Tributaries should also address to reduce sediment loads to Little Pipestone Creek.

In both the lower and upper portions of the watershed effects from Irrigation infrastructure are apparent.

Road maintenance should occur on unpaved road crossings and road wash sources

Whitetail Creek

Controllable Sources Ranked

1) Eroding Banks needing sustainable riparian zone vegetative condition

    Ranked Best Management Type
        Riparian grazing management,
        Riparian willow vegetation restoration,
        Move haying from riparian green line

2) Upland Sediment from grazing,

    Ranked Best management Type

Riparian grazing management,
Provide filter strips along streams

Spatial Concerns Whitetail Creek

Eroding banks with insufficient riparian cover occur along significant but intermittent reaches of both the upper and lower portions of the creek.

Some riparian areas are managed well and others need riparian restoration work.

Riparian health appears to be fair in upper portions of the watershed while health markedly declines to poor in the lower portions.

Tributaries should also be addressed to reduce sediment loads to Little Pipestone Creek.

In both the lower and upper portions of the watershed effects from Irrigation infrastructure are apparent.

Jefferson County Board Weed Management

Noxious weed management in the watershed area is the responsibility of the Jefferson County Weed Board. The Board is granted certain powers and charged with certain duties under section7-22-2109 of the County Weed management Act. The board is required to administer the District's noxious weed program, establish management criteria for noxious weeds on all lands within the district, make all reasonable efforts to develop and implement a noxious weed program on land owned by a federal agency.

Weeds of concern in Jefferson County that are present in the watershed area are:

Dalmatian toadflax-Linaria genistifolia
Canada Thistle-Cirsium arvense
Spotted knapweed-Centaurea malculosa
Russian knapweed-Centaurea repens
Leafy spurge-Euphorbis esula
Yellow Toadflax-Linaria vulgaris
Field bindweed-Convolvulus arvensis
Sulfur cinquefoil-Potentilla recta
St Johnswort-Hypericum perforatum
White top- Cardaria draba

The majority of weed treatment in the watershed area is applied on the knapweeds, Leafy Spurge and Dalmatian toadflax.

A major weed mapping effort was undertaken in 2007 in the Fish Creek drainage in cooperation with the JRWC. A weed control effort was launched the same year in the drainage. To date this effort remains the most detailed survey of the noxious weed problem in the watershed area

Trout Unlimited , Ground Water Study of the Waterloo Area

Prepared by Water & Environmental Technologies; prepared for Trout Unlimited and the Jefferson River Watershed Council May 22, 2006.

The Waterloo area ground water study was performed in order to define the ground water/surface water interaction in the Waterloo area of the Jefferson River. Three major irrigation ditches are located in this reach of the river, (Creeklyn, Parrot, and Fish Creek) and water shortages regularly occur during low flow summer conditions when irrigation needs are high. The project study area consists of the area between the Jefferson River and the Tobacco Root Mountain Range, from the parrot Ditch diversions to the confluence of willow Springs. Parsons Slough and Willow Springs, two important spawning tributaries, are located in the study area.

The specific goals of the project were to define the nature of water movement though the study area and broadly define the interaction between the Jefferson River, spawning tributaries, the Parrot Ditch, mountain recharge and ground water flow. The project completed during the second half of the 2004 irrigation season and the entire 2005 season was completed using a combination of historical data review, groundwater and surface water monitoring, aquifer testing, and interviews.

Irrigation in the Waterloo area generally begins in mid April when the parrot Ditch is opened and runs through early July, when the first cutting takes place. During this time period, spring precipitation and snowmelt results in high river flows and there is an excess of water for both irrigation and fisheries needs. /the ditch is generally shut down for a week over the 4th of July weekend, and reopened in mid-July through late October. During the period from mid-July through mid September irrigation needs are the greatest at a time when river flows are at their lowest and water temperatures are at their highest. This two-month period is when frequent water shortages have occurred in the Jefferson River, creating a strain on both the fishery and agriculture operations: and the potential exists to dry up the river.

A detailed evaluation of monitoring results shows a complex connection between ground water, surface water, and irrigation practices throughout the study area. In the first part of the irrigation season, ground water and surface water exhibit distinct characteristics that would generally be expected in a system with no ground water/surface water interaction: warmer ground water temperatures, stable water quality parameters, and rising ground water elevations and surface flows in response to spring precipitation and snowmelt. A component of ground water inflow from the Tobacco Root Mountains is also visible in water quality results. The parrot ditch is shutoff in early July and there is a brief stop in irrigation, while ranchers harvest their first cutting. The impacts of this shutdown can be seen in groundwater elevations across the Parson-Willow area, which indicates a connection between irrigation practices and ground water. Ground water quality begins to show impacts from surface water, specifically in the Parson-willow area.

During the peak irrigation season (mid-July through mid-September), groundwater elevations continue to rise due to irrigation impacts, and surface water temperature and conductivity values show strong correlations with ground water. During this critical time, ground water and irrigation return flow provide the majority of water to the Jefferson River in the study area. Ground water inflow enters the river as discharge through various slough channels, Parson's Slough, Willow Springs, and direct flux into the river. Irrigation return flow appears to be the primary component of ground water inflow, and enters the aquifer by ditch seepage, crop return flow, and flood irrigation returns.

Late in the irrigation season (September-October), ground water elevations reach their seasonal highs, most notably in the lower project area, as the ditch continues to flow but the majority of late season irrigation is flood irrigation. Surface flows in Parson's Slough and Willow springs are also at their peak

levels, which is consistent with a strong groundwater/surface water Interaction. Ground waters and surface water are very well mixed based on uniform water quality parameters throughout the valley. During the off-season (November-march), data show ground water and surface water slowly returning to base flow conditions.

During periods of low stream flow and high irrigation needs, the river flows remain only due to conservation efforts by irrigators, and a significant amount of ground water and irrigation return flows. The first reaction to remedy this situation is to decrease ditch diversions, and increase on farm efficiency by converting from flood to sprinkler irrigation methods. Although some water savings can be achieved by more closely managing diversions and irrigation needs, and an increase in the minimum base flow in the river is needed, caution should be taken before making widespread changes to the current irrigation regime.

Irrigation return flow supplies water to the alluvial aquifer, which in turn discharges to surface water bodies and helps maintain river flows during the late season water shortages. If this important ground water recharge source is reduced to drastically, it could change the hydrologic system and reduce or eliminate historical return flow that helps support the river during critically low flows. A certain percentage of base flow during the off-season exists due to irrigation return flow from the precious season: however, it is unknown what that amount is

The study concluded that there are a number of improvements and water savings that can be achieved, but the majority of these savings are aimed at water delivery and reduction of blow off water then on-farm efficiency. Stakeholders must walk a fine line between finding available water savings without significantly altering the hydrology of the valley.

Specific recommendations include:

Surface Water Administrative Efforts

1) Increasing ditch oversight and management by the ditch walker.
2) Find a long term funding source to continue the JRWC Drought Management Plan.
3) Conduct a return flow study between the USGS station near Twin Bridges to the mouth of Willow Springs.
4) Educate landowners on Irrigation Timing.

Surface Water Structural Efforts

1) Installation of new canal structures with continuous flow monitoring equipment on the three major irrigation ditches.

Ground Water Conservation Efforts

1) Development of a scaled back groundwater monitoring network to be implemented annually in conjunction with JRWC Drought Management plan Monitoring.
2) Maintaining the current irrigation practices in the willow Springs area in their current configuration, as any significant changes could lead to a different flow and temperature regime in the stream, which could impact the valuable Rainbow trout spawning tributary,.
3) Implementation of a pilot study in the Parson;\'s Slough area that consist of stopping flood irrigation in the immediate area, and closely monitoring impacts on the slough.
4) Limit Ground Water Withdrawal within the Study Area.

Trout Unlimited Upper Jefferson River Irrigation Delivery Improvement Project

An engineering study was completed in June 2006 to investigate and determine alternative approaches to increase the flow in the Jefferson River during periods of drought. The intent of the work was to identify viable measures to increase flows thereby improving fish population numbers. Drought conditions over the previous years had reduced wild trout populations by approximately 70%. Ideally, solutions would offer ways to maintain agricultural production while improving the fishery. The emphasis of the study was on improving the irrigation delivery systems but the investigations also included on-farm practices and reservoir storage so that these costs could be compared.

A review of historic information resulted in defining severe flow shortages below the Waterloo Bridge at discharges less than 100 cfs. The existing Jefferson River Watershed Council Voluntary Drought Management Plan works to maintain a minimum flow of 50 cfs. The 80% chance August stream flow of 367 cfs is only slightly larger than the normal August combined the diversion of 330 cfs for the Creeklyn Parrot and Fish Creek/Jefferson ditches. Whenever the steam flow drops to this level, the river is in danger of drying up.

The recommended plan has three components: canal sealant, canal management, and canal structures. These are the least costly measures as determined on a cost per acre-foot of water saved. The canal sealant and canal management programs will be initiated only during dry years when a water shortage is imminent, estimated to be 30% of the time. The proposed canal structures will reduce leaking and will enable both better measurements and better management of the systems.

Implementation of the plan is expected to increase the Jefferson River flow by 45 cfs during drought periods. Of this, 22 cfs is expected from reduced canal seepage as a result of the sealant program. Fifteen cfs is expected from reduce d canal spills as a result of improved management and eight cfs will be saved at canal structures.

Additional canal discharge measurements and seepage tests determined that canal seepage is not excessive and areas with high losses could not be found. Permanent lining of the ditches was therefore found to be too costly to be justified. On-farm sprinklers and upstream storage reservoirs were also found to be much more costly than recommended plan measures. The cost per acre-foot for on-farm pipelines is comparable to the cost of canal structures but the water savings is dependent on abandoning the farm ditches and this practice was not selected for the plan.

The impact of this plan on springs and wetlands is minor and temporary. The greatest impact of these actions will be the beneficial effect of more water in the Jefferson River during periods of drought.

Fish Creek Habitat Enhancement Project

Fish Creek originates in the Highland Mountains and enters the Jefferson River upstream of Whitehall, Montana. The upstream reaches of Fish Creek provide valuable fish and wildlife habitat and contain a small population of native westslope cutthroat trout. Habitat alterations and relatively poor riparian health in the upper reaches of the stream result in a tenuous situation for maintaining the cutthroat trout population. Thus, the Jefferson River Watershed Council is exploring measures to improve the health of the stream and the associated riparian corridor to enhance habitat conditions in the drainage.

In 2007, Montana Fish, Wildlife and Parks and U.S. Forest Service conducted fish surveys in 11 sections of Fish Creek to determine abundance of westslope cutthroat trout and eastern brook trout. Cutthroat trout were found in the upper four sections without competition from brook trout due to the presence of a natural barrier above the confluence with Mammoth Creek. Downstream of this natural barrier to fish movement near Mammoth Creek, moderate numbers of brook trout were found with cutthroat trout, and downstream of Pigeon Creek, brook trout were found in relatively large numbers were they are apparently out-competing native cutthroat trout (Figure 1).

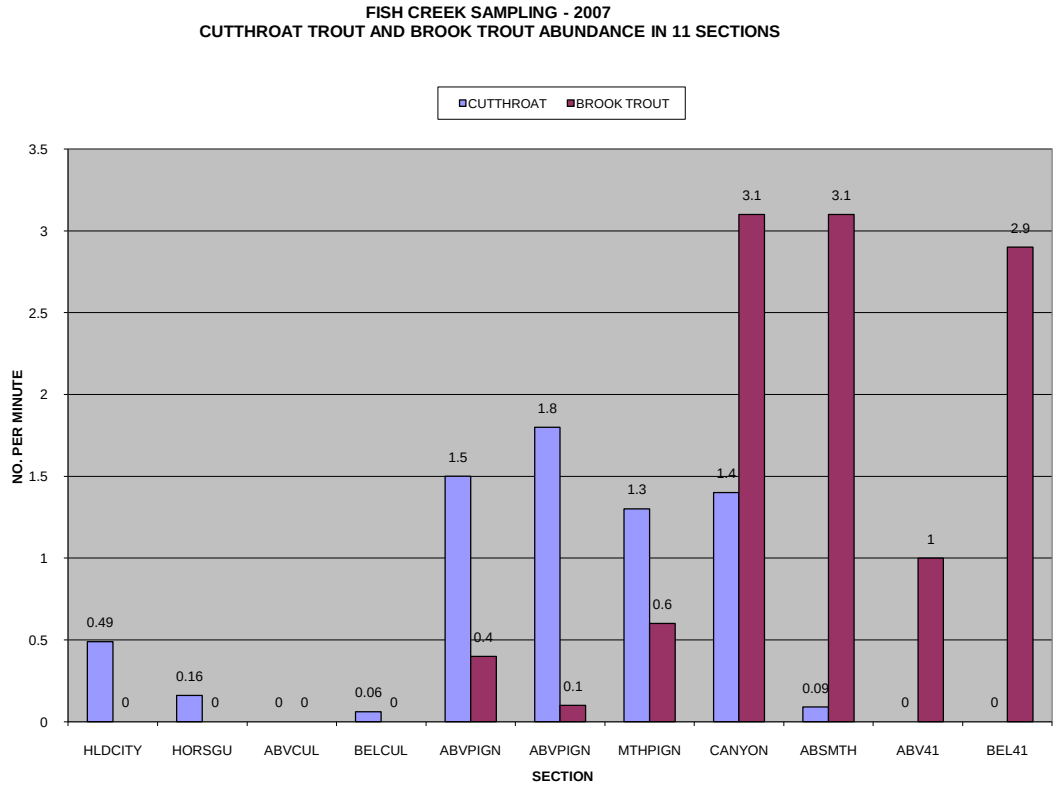

Figure 1. Relative abundance of cutthroat trout and brook trout in 11 sections of fish creek. Highland City is the upper-most sampling section and below highway 41 represents the lower-most sampling section.

The relatively low numbers of fish in the upper four sections are probably a result of low flow and poor habitat conditions. Projects to improve riparian health in these four reaches have significant potential for improving the fish population. Stream channel enhancement by conducting placer reclamation, riparian protection and other projects is recommended in this reach of Fish Creek.

Jefferson Valley Conservation District

Jefferson County

Montana Department of Fish Wildlife and Parks

Montana Department of Natural Resources and Conservation (State lands)

Montana Department of Transportation

Federal lands

Bureau of Land Management

U.S. Forest Service

Remaining Technical and Financial Resource Needs

As identified in the Trout Unlimited Ground Water Study of the Waterloo Area

Additional funding needs to be sought through various grant programs to increase the on-site oversight time during the mid-July to mid September time period. The goal of a greater on-site presence would be to shorten the reaction time on canal flow adjustments, and reducing the amount of excess diverted water. More on-site time could also be used to improve communication between waters users and the ditch manager.

The need exists to secure a long term source of funding for implementation of the JRWC Drought Management Plan.

Irrigators in the watershed area and the Creeklyn, Parrot and Fish Creek ditch companies have been extremely cooperative in water conservation efforts, but they can only do as good of a job as their equipment will allow. Many diversion structures along major canals, although serviceable, should be replaced with more efficient structures. These new structures should be equipped with flow measuring equipment which would allow for more accurate adjustments by ditch walkers. Structures could also be equipped with telemetry equipment, which would allow remote flow adjustments. Capital cost could vary depending on the project; however.

As identified in the Upper Jefferson River Irrigation Delivery Improvement Project

The recommended plan has three components: Canal sealant, canal management, and canal measurement and operating structures. The implementation of theses recommendations will require funding. Only the canal structures (of which two are now in place) will require capital expenditure. A preliminary cost for the three operating structures and three measuring structures was $200,000. That cost is now

considerably less with the earlier construction of two of the operating structures. The remaining costs is currently undefined.

The canal sealant and canal management programs will only require funding during dry years. This funding could be obtained whenever a drought year is expected or a reserve fund could be set up to fund one or more years of future needs. In 2006 the estimated cost of the sealant program was estimated at $445 per mile or $17,800 for 40 miles. /the estimated canal system management to save 15cfs, also in 2006dollars, was 12,100.

Five Year Plan

Measureable Accomplishments

Monitoring and Long Term Evaluation

Outreach and Education

Information & Education

Objective: Compile and provide resource information to realtors, residents and local groups in the watershed area

A. Priority groups
   New residents

Realtors
Land managers
Local groups
Local governments
Canal Managers
Legislators & congressional delegation

B. Key resource issues
Weed control (biological & chemical)
Riparian ecology
Water Quality and Quantity issues
Fisheries enhancement
Conifer encroachment
Irrigation timing

C. Implementation Tools
JRWC Web site
Workshops
Educational/ Field tours
Continue to review and distribute materials that already exist
Assist in advertising workshops, conferences and other informational and education activities being implemented by JRWC partners.
JRWC news letter

Reassessment Plan