Stream: Beaver Creek

Executive Summary

Water Division: 5
Water District: 51
CDOW#: 19196
CWCB ID: 08/5/A-011

Segment: Confluence Spring Creek to Confluence Colorado River

Upper Terminus: CONFLUENCE WITH SPRING CREEK AT
(Latitude 40° 1’ 45.21”N) (Longitude 106° 6’ 2.83”W)

Lower Terminus: CONFLUENCE WITH COLORADO RIVER AT
(Latitude 40° 2’ 52.58”N) (Longitude 106° 7’ 50.35”W)

Watershed: Colorado headwaters (HUC#: 14010001)
Counties: Grand
Length: 2.75 miles
USGS Quad(s): Parshall
Existing ISF: 5-86CW206; 1.5 cfs (January 1 – December 31)
Flow Recommendation (Increase): 0.45 cfs (April 1 - September 30)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated instream flow appendices (see CD entitled 2008 Instream Flow Recommendations) forms the basis for staff's instream flow recommendation to be considered by the Board. It is staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5.40.

Colorado's Instream Flow Program was created in 1973 when the Colorado State Legislature recognized "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3) C.R.S.). The statute vests the CWCB with the exclusive authority to appropriate and acquire instream flow and natural lake level water rights. In order to encourage other entities to participate in Colorado's Instream Flow Program, the statute directs the CWCB to request instream flow recommendations from other state and federal agencies. The Bureau of Land Management (BLM) and the Colorado Division of Wildlife (CDOW) recommended this segment of Beaver Creek to the CWCB for an increased water right in the Instream Flow Program. Beaver Creek is being considered for an increase because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Beaver Creek is approximately 14 miles long. It begins on the west flank of Sheep Mountain within the Arapaho National Forest at an elevation of approximately 10050 feet and terminates at the confluence with the Colorado River at an elevation of approximately 7950 feet. Approximately 91% of the land on the 2.75 mile segment addressed by this report is publicly owned. Beaver Creek is located within Grand County. The total drainage area of the creek is approximately 18.47 square miles. Beaver Creek generally flows in a northwesterly direction.

The subject of this report is a segment of Beaver Creek beginning at the confluence with Spring Creek and extending downstream to the confluence with the Colorado River. The proposed segment is located approximately two miles west of Hot Sulphur Springs. The staff has received one joint recommendation for this segment, from the BLM and the Colorado Division of Wildlife (DOW). The recommendation for this segment is discussed below.

Justification for Enlargement

BLM has determined the existing Instream Flow regime, a single year-round discharge value, is inadequate to protect the natural environment to a reasonable degree. This determination results from an assessment of the importance of a snowmelt-dominated flow regime to, among other things, the geomorphology of Beaver Creek. The single discharge value fails to provide for the periodic higher flows needed to remove accumulated sediment, provide spawning trigger flows, maintain adequate pool-water exchange and minimize warm season temperature stress. As a result, BLM completed additional field data collection and concluded all three of the flow factors considered (wetted perimeter, depth and velocity) had to be protected in the Instream Flow Water Right. With the existing year-round flow only two of the target values for these factors were regularly achieved, velocity was not. Only by increasing seasonal ISF values could the three factors, and the resulting geomorphic and biologic functions, be protected.

Instream Flow Recommendation(s)

BLM recommended an increase of 0.45 cfs, based on its October 5, 2006 data collection efforts. The modeling results from this survey effort are within the confidence interval produced by the R2Cross model.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence with Spring Creek	Confluence with Colorado River	2.75	9%	91%

100% of the public lands are owned and managed by the BLM and DOW.

Biological Data

The BLM has conducted field surveys of the fishery resources on this stream and have found a natural environment that can be preserved. As reported in the letter from BLM to the CWCB "Beaver Creek is a high gradient stream with large substrate size. Much of the reach covered by the recommendation is confined by a narrow valley. Beaver activity is widespread in the reach, with short riffles between beaver dams. The willow riparian community is extensive, and often covers the entire valley floor. The riparian community also provides substantial shading, nutrient supply for the creek, and overhanging banks for the fish population. Fishery surveys indicate that the creek supports a self-sustaining population of brown trout, with small number of brook trout, and mottled sculpin present. There are no permanent physical barriers between this reach and the Colorado River, so it is assumed that the brown trout population in the Colorado River utilizes the creek as a spawning and habitat nursery".

Field Survey Data & Biological Flow Recommendation

BLM staff used the R2Cross methodology to quantify the amount of water required to preserve the natural environment to a reasonable degree. The R2Cross method requires that stream discharge and channel profile data be collected in a riffle stream habitat type. Riffles are most easily visualized, as the stream habitat types that would dry up first should streamflow cease. This type of hydraulic data collection consists of setting up a transect, surveying the stream channel geometry, and measuring the stream discharge.

The CWCB staff relied upon the biological expertise of the cooperating agencies to interpret output from the R2Cross data collected to develop the initial, biologic instream flow recommendation. This initial recommendation is designed to address the unique biologic requirements of each stream without regard to water availability. Three instream flow hydraulic parameters, average depth, percent wetted perimeter, and average velocity are used to develop biologic instream flow recommendations. The CDOW has determined that maintaining these three hydraulic parameters at adequate levels across riffle habitat types, aquatic habitat in pools and runs will also be maintained for most life stages of fish and aquatic invertebrates (Nehring 1979; Espegren 1996).

For this segment of stream, two data sets were collected with the results shown in Table 1 below. The final flow recommendation was calculated as the average of the two data sets. Table 1 shows who collected the data (Party), the date the data was collected (Date), the measured discharge at the time of the survey (Q), the accuracy range of the predicted flows based on Manning's Equation (240% and 40% of Q), the summer flow recommendation based on meeting 3 of 3 hydraulic criteria and the winter flow recommendation based upon 2 of 3 hydraulic criteria.

Table 1: Beaver Creek R2Cross Summary

			Confidence Intervals	Recommended Flows (cfs)	
Party	**Date**	**Q (cfs)**	**250%-40%**	**Summer (3/3)**	**Winter (2/3)**
BLM	10/05/2006	1.21	3.0 – 0.5	1.86	(1)
BLM	10/05/2006	1.34	3.3 – 0.5	2.04	(1)

BLM = Bureau of Land Management
(1) Predicted flow outside of the accuracy range of Manning's Equation.

The summer flow recommendation, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model is 1.95 cfs. A 0.45 cfs increase to the existing 1.5 cfs appropriation is therefore necessary to bring the total ISF to 1.95 cfs. It is our belief that recommendations that fall outside of the accuracy range of the model, over 250% of the measured discharge or under 40% of the measured discharge may not give an accurate estimate of the necessary instream flow required.

Hydrologic Data and Analysis

After receiving the cooperating agency's biologic recommendation, the CWCB staff conducted an evaluation of the stream hydrology to determine if water was physically available for an instream flow appropriation. This evaluation was done through a computation that is, in essence, a "water balance". In concept a "water balance" computation can be viewed as an accounting exercise. When done in its most rigorous form, the water balance parses precipitation into all the avenues water pursues after it is deposited as rain, snow, or ice. In other words, given a specified amount of water deposition (input), the balance tries to account for all water depletions (losses) until a selected end point is reached. Water losses include depletions due to evaporation and transpiration, deliveries into ground water storage, temporary surface storage, incorporations into plant and animal tissue and so forth. These losses are individually or collectively subtracted from the input to reveal the net amount of stream runoff as represented by the discharge measured by stream gages. Of course, the measured stream flow need not be the end point of interest; indeed, when looking at issues of water use to extinction stream flow measurements may only describe intermediate steps in the complex accounting process that is a water balance carried out to a net value of zero.

In its analysis, CWCB staff has attempted to use this idea of balancing inputs and losses to determine if water is available for the recommended Instream Flow Appropriation. Of course, this analysis must be a practical exercise rather than a lengthy, and costly, scientific investigation. As a result, staff has simplified the process by lumping some variables and employing certain rational and scientifically supportable assumptions. The process may be

described through the following description of the steps used to complete the evaluation for this particular stream.

The first step required in determining water availability is a determination of the hydrologic regime at the Lower Terminus (LT) of the recommended ISF reach. In the best case this means looking at the data from a gage at the LT. Further, this data, in the best case, has been collected for a long period of time (the longer the better) including wet and dry periods. In the case of **Beaver Creek** no such gage is available at the LT. In fact, there is no gage on Beaver Creek. It is thus necessary to describe the normal flow regime at the Beaver Creek LT through a "representative" gage station. The gage station selected for this was TROUBLESOME CREEK NEAR PEARMONT, CO (USGS 09039000), a gage with a 40 year period of record (POR) collected between 1953 and 1993. The gage is at an elevation of 8049 ft above mean sea level (amsl) and has a drainage area of 44.6 mi^2. The hydrograph (plot of discharge over time) produced by this gage includes the consumptive uses of two upstream diversions. To make the measured data transferable to Beaver Creek the consumptive portions of these upstream diversions were added back to the measured hydrograph. The resulting adjusted hydrograph was then used on Beaver Creek by multiplying the adjusted Troublesome Creek discharge values (hydrograph) by the ratio of Beaver Creek basin area (18.5 mi^2 above the LT) to Troublesome Creek near Pearmont, CO basin area (44.6 mi^2). The resulting proportioned hydrograph was then adjusted (decreased) to reflect the existing depletions in Beaver Creek due to upstream consumptive irrigation use. The final hydrograph thus represents a distribution of flow over time that has been reduced to reflect existing human uses.

The following hydrograph depicts the mean monthly discharge of Beaver Creek (proportioned off Troublesome Creek near Pearmont, CO). Included in the hydrograph are the recommended ISF values. The data used in the creation of this hydrograph are displayed in Table #2.

Fig 1 - Beaver Creek Discharge (proportioned on Troublesome Cr near Pearmont) & ISFs

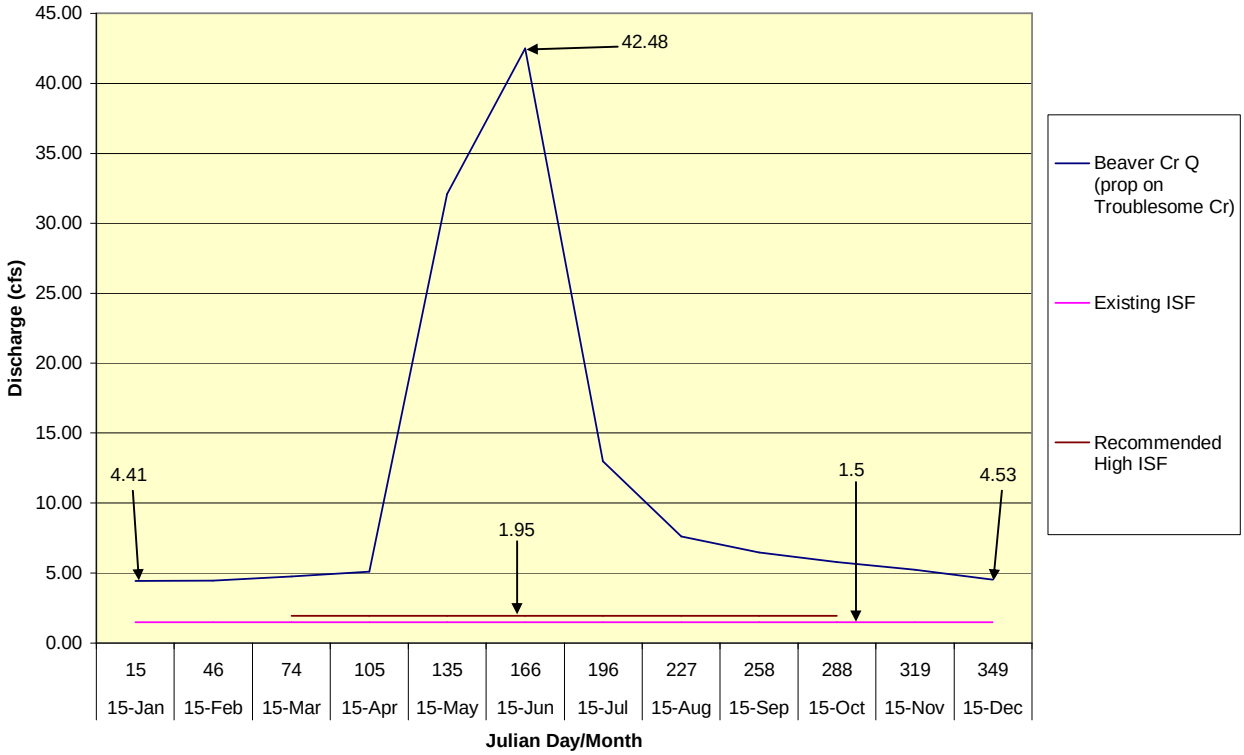

Table 2 – Mean Monthly Discharge and Recommended Instream Flows – Beaver Cr

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	Julian Day	Rabbit Ears Cr (cfs)	Existing ISF	Recommended ISF (cfs)
15-Jan	15	4.41	1.5	1.5
15-Feb	46	4.46	1.5	1.5
15-Mar	74	4.75	1.5	1.5
31-Mar	90	4.75	1.5	1.5
1-Apr	91	5.10	1.5	1.95
15-Apr	105	5.10	1.5	1.95
15-May	135	32.08	1.5	1.95
15-Jun	166	42.48	1.5	1.95
15-Jul	196	12.97	1.5	1.95
15-Aug	227	7.62	1.5	1.95
15-Sep	258	6.47	1.5	1.95
30-Sep	273	6.47	1.5	1.95
1-Oct	274	5.76	1.5	1.5
15-Oct	288	5.76	1.5	1.5
15-Nov	319	5.22	1.5	1.5
15-Dec	349	4.53	1.5	1.5

Existing Water Right Information

Staff has analyzed the water rights tabulation to identify any potential water availability problems. Upstream from the proposed enlargement, there is a 9.825 cfs water right for the Reini Brothers ditch. There is also one decreed stream diversion within the proposed reach. The Dolloff Ditch is decreed for 5.0 cfs, and it is owned by the Colorado Division of Wildlife. Based on this analysis staff has determined that water is available for appropriation on Beaver Creek, between the confluence with Spring Creek to the confluence with the Colorado River, to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid existing water rights.

CWCB Staff's Instream Flow Recommendation

Staff recommends the Board form its intent to appropriate on the following stream reach:

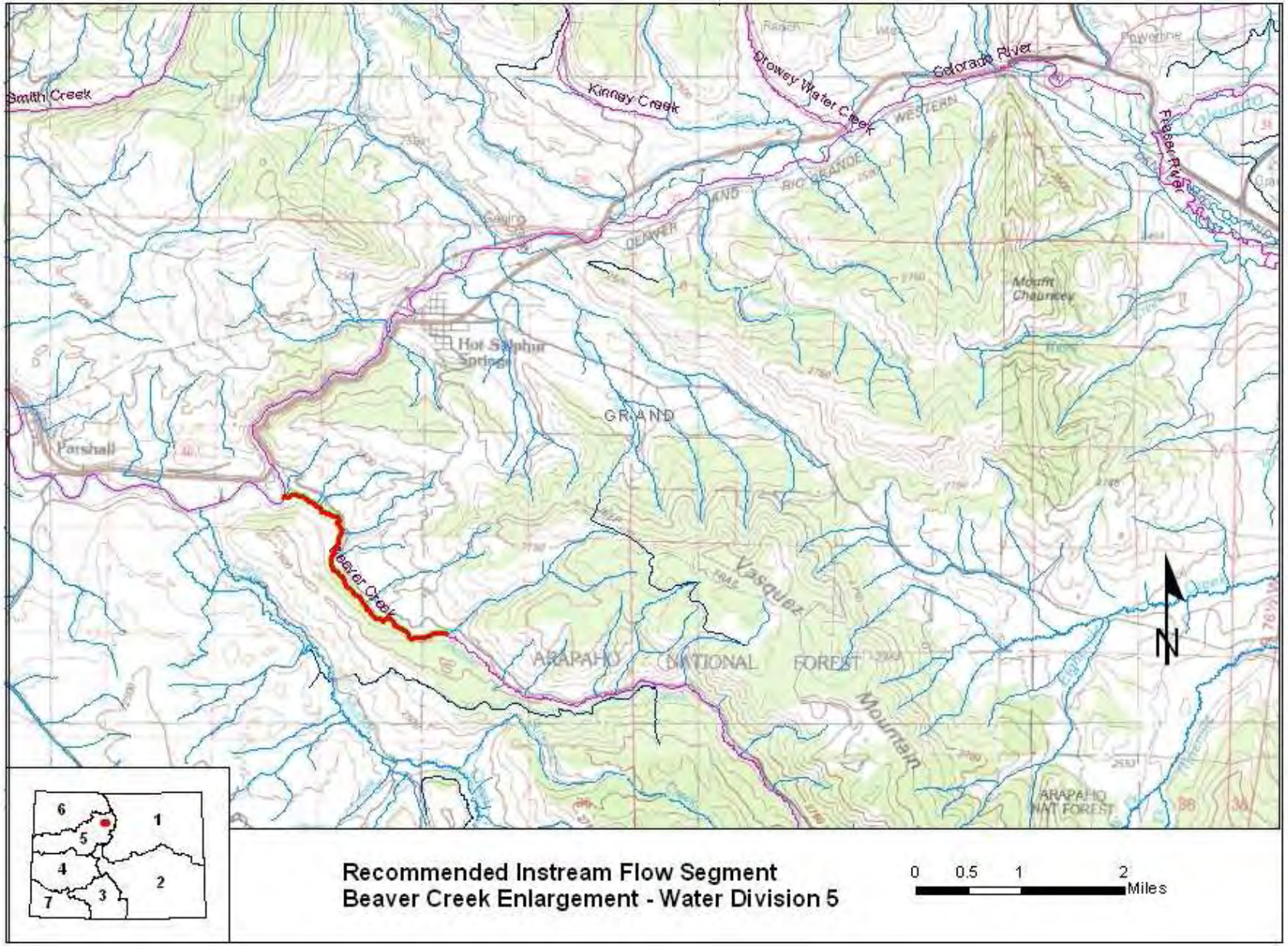
Segment: **C**onfluence Spring Creek to Confluence Colorado River

Upper Terminus: CONFLUENCE WITH SPRING CREEK AT
(Latitude 40° 1' 45.21"N) (Longitude 106° 6' 2.83"W)
UTM = 4431581.1 N UTM = 406076.2 E
SE SW S23 T1N R78W 6PM
1375' East of the West Section Line; 175' North of the South Section Line

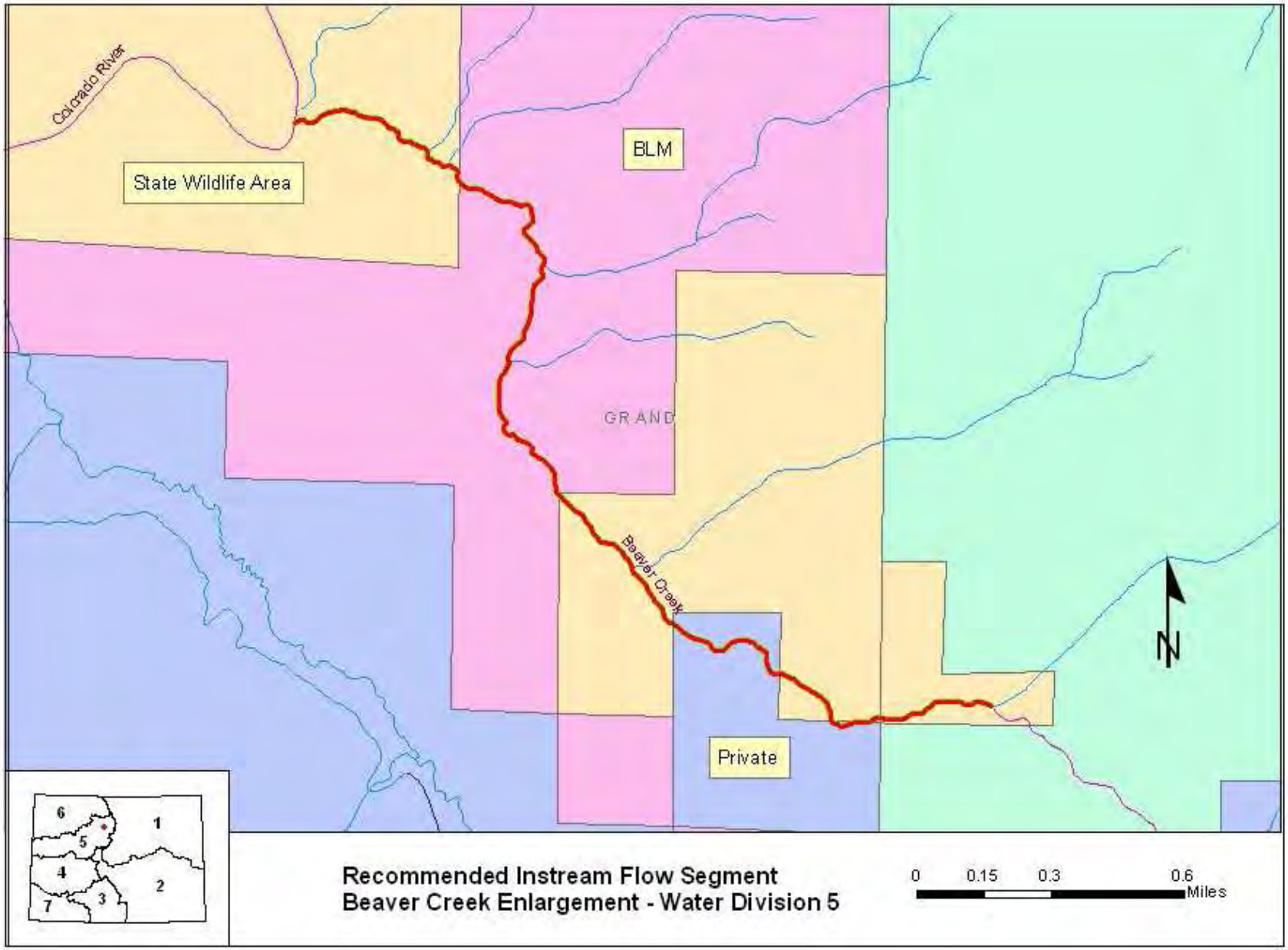
Lower Terminus: CONFLUENCE WITH COLORADO RIVER AT
(Latitude 40° 2' 52.58"N) (Longitude 106° 7' 50.35"W)
UTM = 4433690.2 N UTM = 403554.3 E
NW SE S16 T1N R78W 6PM
1730' West of the East Section Line; 1660' North of the South Section Line

Watershed: Colorado headwaters (HUC#: 14010001)
Counties: Grand
Length: 2.75 miles
USGS Quad(s): Parshall
Existing ISF: 5-86CW206; 1.5 cfs (January 1 – December 31)
Flow Recommendation (Increase): 0.45 cfs (April 1 - September 30)

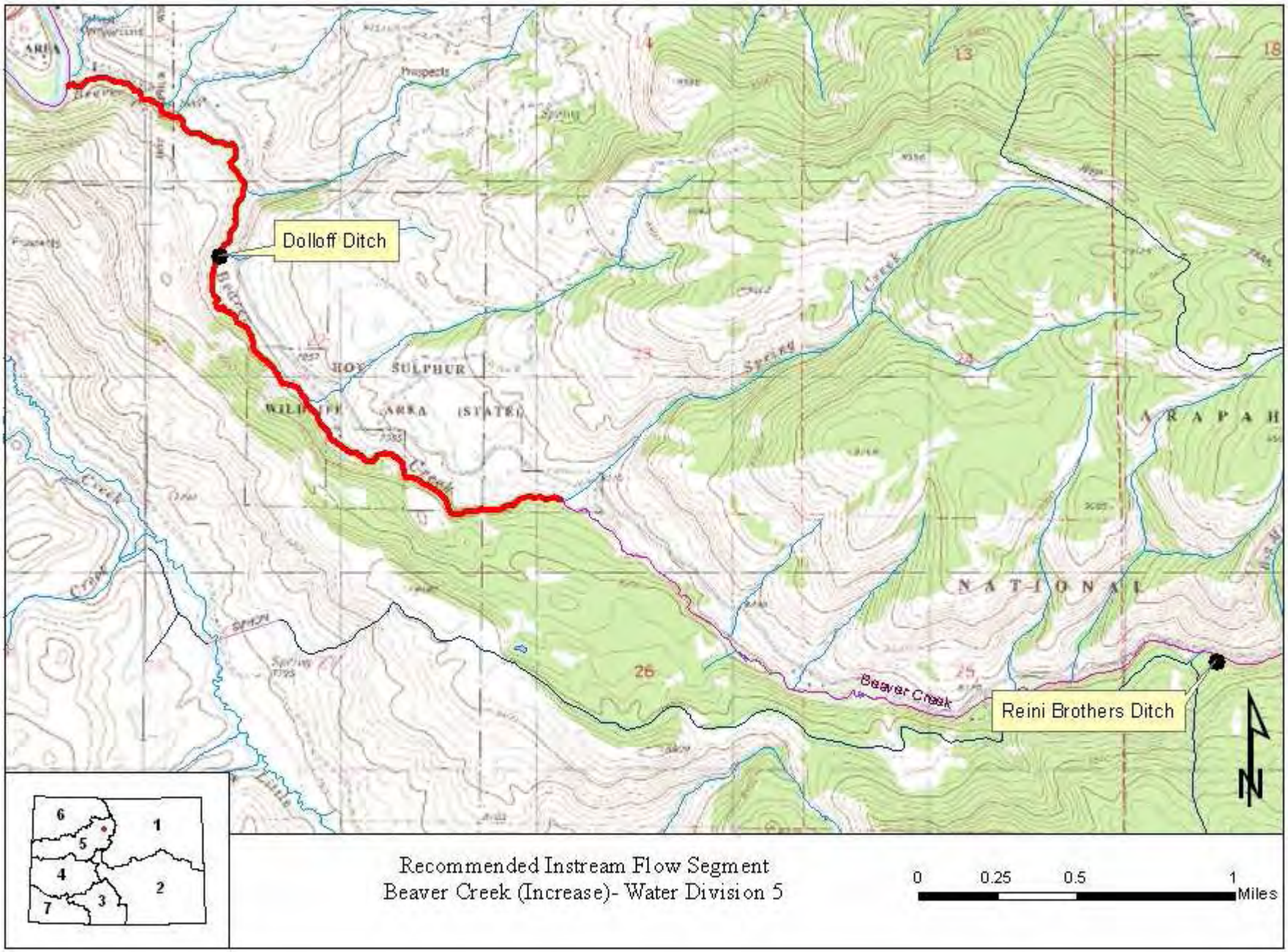
Vicinity Map



Land Use Map


Colorado River
State Wildlife Area
BLM
GRAND
Beaver Creek
Private
N
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Beaver Creek Enlargement - Water Division 5
0
0.15
0.3
0.6
Miles

Topographic & Water Rights Map



UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
COLORADO STATE OFFICE
2850 YOUNGFIELD STREET
LAKEWOOD, COLORADO 80215-7093

In Reply Refer To:
7250 (CO-932)

DEC 2 6 2007

Ms. Linda Bassi
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, Colorado 80203

Dear Ms. Bassi:

The Bureau of Land Management (BLM) and the Colorado Division of Wildlife (CDOW) are writing this letter to formally communicate our joint recommendation for an instream flow enlargement on lower Beaver Creek, located in Water Division 5. The existing instream flow water right on this creek is 1.5 cubic feet per second, year round, from the headwaters to the confluence with the Colorado River, a distance of 10 miles. The existing instream flow water right was established in 1986.

Location and Land Status. Beaver Creek is tributary to the Colorado River approximately two miles west of Hot Sulphur Springs, Colorado. The creek is located within the upper Colorado River watershed in Grand County. This recommendation covers the stream reach beginning at the confluence with Spring Creek and extending downstream to the confluence with the Colorado River. All of the land along 2.75 mile reach is owned and managed by the BLM and the Colorado Division of Wildlife, with the exception of ¼ mile of private land.

Biological Summary. Beaver Creek is a high gradient stream with large substrate size. Much of the reach covered by this recommendation is confined by a narrow valley. Beaver activity is widespread in the reach, with short riffles between beaver dams. The willow riparian community is extensive, and often covers the entire valley floor. The riparian community also provides substantial shading, nutrient supply for the creek, and overhanging banks for the fish population. Fishery surveys indicate that the creek supports a self-sustaining population of brown trout, with small numbers of brook trout, and mottled sculpin present. There are no permanent physical barriers between this reach and the Colorado River, so it assumed that the brown trout population in the Colorado River utilizes this creek as a spawning and nursery habitat.

R2Cross Analysis. BLM's data analysis, coordinated with CDOW, indicates that the following flows are needed to protect the fishery and natural environment to a reasonable degree:

- A 0.45 cubic feet per second enlargement is recommended during the high temperature period from April 1 through September 30, bringing the total instream flow right up to 1.95 cubic feet per second during this time period. This recommendation is driven by the average depth criteria.

Justification for Instream Flow Enlargement. The BLM and CDOW were prompted to re-examine the instream flow right on Beaver Creek because of high recreation use. The BLM and CDOW jointly manage this reach of Beaver Creek, emphasizing water-oriented recreation. The CDOW properties have roads, trails, and campsites that allow easy access to the creek. Since this reach is right off U.S. Highway 40 between Hot Sulphur Springs and Kremmling, the location receives high visitation by fishermen who are interested in the brown trout population in the Colorado River and Beaver Creek. CDOW and BLM believe that an enlargement is justified by the heavy usage and prominent location of this creek.

Beaver Creek is characterized by short riffles between numerous beaver ponds and plunge pools. Available physical habitat in riffles is very limited. In addition, the R2Cross surveys revealed that average depth is the most limiting factor for riffle habitat on this creek. The current instream flow right provides an average depth of approximately 0.16 feet during the summer. This flow rate could prevent many adult fish from using the limited amount of habitat that is available, simply because depths are too shallow for fish passage.

BLM and CDOW also believe that Beaver Creek provides important nursery habitat for the Colorado River. The creek corridor is characterized by extensive willows wetlands with overhanging banks and backwater pools. The slow water velocities in this habitat provide locations where young of the year fish can seek shelter from predators, find abundant food sources, and reduce energy expenditure during critical growth periods. BLM and CODW believe it is important to protect a higher flow rate in the creek, so as much of this habitat as possible can remain submerged during the summer growing season. In addition, the higher flow will result in higher water levels in the adjacent alluvial aquifer, which will help maintain riparian vigor across the valley floor.

Water Availability. Upstream from the proposed enlargement, there is a 9.825 cfs conditional water right for the Reini Brothers Ditch. There is also one decreed stream diversion within the proposed reach. The Dolloff Ditch is decreed for 5.0 cfs, and it is owned by the Colorado Division of Wildlife.

For an indication of water availability, BLM recommends utilizing the gage located on Little Muddy Creek, near Parshall, Colorado (USGS Gage 09040000), and calculating a comparison of the relative watershed size of the two basins. The Little Muddy Creek watershed is located immediately adjacent and to the west of Beaver Creek, so it has similar elevation, aspect, and precipitation patterns. In addition, this gage is located above all decreed diversions on Little Muddy Creek, so it provides a good indication of raw water availability.

Conclusion. The BLM and CDOW believe that there is strong justification for an additional instream flow appropriation on this high accessible creek. Our initial water availability analysis indicates there is sufficient water to support the appropriation without material injury to existing water rights. Accordingly, we urge the board to make an initial appropriation at its regular board meeting in January 2008.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section are enclosed to support this recommendation. We thank the Colorado Water Conservation Board for its cooperation in this effort.

If you have any questions regarding our instream flow recommendation, please contact Roy Smith, Water Rights Specialist, at 303-239-3940.

Sincerely,

Dennis D. Zachman (ACTING)

for Linda M. Anañia
Deputy State Director
Resources and Fire

cc: Dave Stout, Kremmling FO
Paula Belcher, Kremmling FO
Tom Fresques, Glenwood Springs FO
Mark Uppendahl, CDOW

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Beaver Creek					CROSS-SECTION NO.: 1	
CROSS-SECTION LOCATION: new house at [illegible]						
DATE: 10-5-96	OBSERVERS: T. Smith, P. Belcher					
LEGAL DESCRIPTION	¼ SECTION: SE	SECTION: 16	TOWNSHIP: 1 (N)/S	RANGE: 79 E/(W)	PM: 6th	
COUNTY: Grand	WATERSHED: Colorado	WATER DIVISION: 5	DOW WATER CODE: 19196			
MAP(S):	USGS: Parshall 7.5'					
	USFS:					

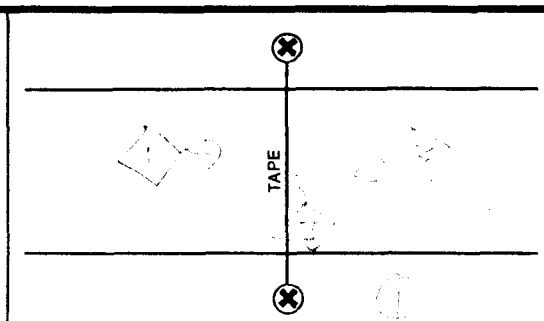
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES)/NO	METER TYPE: Marsh McBirney			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: surveyed ____ lbs/foot	TAPE TENSION: surveyed ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: 3" cobbles [illegible]	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	surveyed
⊗ Tape @ Stake RB	0.0	surveyed
① WS @ Tape LB/RB	0.0	[illegible]
② WS Upstream	[illegible]	[illegible]
③ WS Downstream	7.0'	[illegible]
SLOPE	[illegible] =	

SKETCH



AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/NO	DISTANCE ELECTROFISHED: ____ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: YES/NO

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:

caddisfly [illegible]

COMMENTS

Photos [illegible]

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Beaver Creek	CROSS-SECTION NO.: 1	DATE: [illegible]	SHEET __ OF __
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: [illegible] ft	TIME: [illegible]

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
LS	0.0		[illegible]								
	2.5		5.41								
W	7.5		[illegible]								
	[illegible]		5.94	[illegible]				0			
	[illegible]		6.05	[illegible]				[illegible]			
	[illegible]		6.08	[illegible]				[illegible]			
	[illegible]		6.10	[illegible]				[illegible]			
	[illegible]		6.06	[illegible]				[illegible]			
	[illegible]		6.04	[illegible]				[illegible]			
	[illegible]		6.16	[illegible]				[illegible]			
	[illegible]		6.15	[illegible]				[illegible]			
	[illegible]		6.03	[illegible]				[illegible]			
	[illegible]		6.04	[illegible]				[illegible]			
	[illegible]		6.06	[illegible]							
	[illegible]		6.04	[illegible]				[illegible]			
	[illegible]		6.09	[illegible]				[illegible]			
	[illegible]		6.18	0.30				[illegible]			
	[illegible]		6.20	0.38				[illegible]			
	[illegible]		6.14	[illegible]				[illegible]			
	[illegible]		5.97	[illegible]				[illegible]			
	[illegible]		5.96	[illegible]				[illegible]			
	[illegible]		5.96	[illegible]				[illegible]			
	[illegible]		5.94	[illegible]				[illegible]			
W	16.00		[illegible]								
RBS	[illegible]		[illegible]								
TOTALS:											

End of Measurement	Time:	Gage Reading: [illegible] ft	CALCULATIONS PERFORMED BY:	CALCULATIONS CHECKED BY:

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Beaver Creek						CROSS-SECTION NO.: 2	
CROSS-SECTION LOCATION: near house at campground							
DATE: 10-5-06	OBSERVERS: R. Smith, P. Belcher						
LEGAL DESCRIPTION	¼ SECTION: SE	SECTION: 16	TOWNSHIP: 1 (N)/S	RANGE: 78 E/(W)	PM: 6th		
COUNTY: Grand	WATERSHED: Colorado	WATER DIVISION: 5	DOW WATER CODE: 19196				
MAP(S): USGS: Parshall 7.5'							
USFS:							

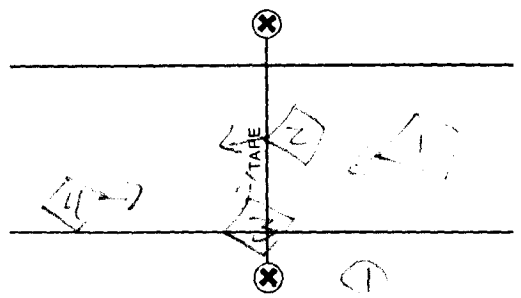
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES)/NO	METER TYPE: Marsh McBirney			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: surveyed ____ lbs/foot	TAPE TENSION: surveyed ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: 3" cobbles to 1-foot boulders	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: 4		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
(X) Tape @ Stake LB	0.0	surveyed
(X) Tape @ Stake RB	0.0	surveyed
(1) WS @ Tape LB/RB	0.0	4.75 / 4.75
(2) WS Upstream	10.0	4.55
(3) WS Downstream	8.0	5.10
SLOPE	0.55 / 18.0	

SKETCH



LEGEND:
- Stake (X)
- Station (1)
- Photo (1)
- Direction of Flow

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/(NO)	DISTANCE ELECTROFISHED: ____ ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: (YES)/NO

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:
mayfly, caddisfly

COMMENTS

Numerous fish sighted.
Ph= 6.7 TDS= 140 Temp= 8°C

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Beaver Creek	CROSS-SECTION NO.: 2	DATE: 10-6-06	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: 0.3 ft	TIME: 1:05

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
LS	0.0		3.55								
G	1.2		4.27								
W	1.8		4.75	Ø				Ø			
	2.2		4.79	0.05				Ø			
	2.6		4.88	0.15				0.19			
	3.0		4.94	0.20				1.16			
	3.4		4.90	0.15				1.47			
	3.8		4.91	0.15				0.74			
	4.2		5.02	0.25				1.38			
	4.6		4.86	0.10				2.15			
	5.0		4.95	0.20				0.55			
	5.4		4.95	0.20				1.60			
	5.8		5.11	0.35				2.24			
	6.2		4.97	0.20				1.77			
	6.6		4.97	0.20				1.60			
	7.0		4.94	0.20				0.75			
	7.4		4.80	0.05				Ø			
	7.8		4.77	Ø				Ø			
W	5.0		4.15	Ø				Ø			
G	9.3		4.70								
RS	11.1		3.95								
TOTALS:											

End of Measuremen.	Time: 1:25	Gage Reading: 0.3 ft	CALCULATIONS PERFORMED BY:	CALCULATIONS CHECKED BY:

COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	Beaver Creek
XS LOCATION:	near house at campground
XS NUMBER:	1
DATE:	5-Oct-06
OBSERVERS:	R. Smith, P. Belcher
1/4 SEC:	SE
SECTION:	16
TWP:	1N
RANGE:	79W
PM:	6th
COUNTY:	Grand
WATERSHED:	Colorado
DIVISION:	5
DOW CODE:	19196
USGS MAP:	Parshall 7.5'
USFS MAP:	0

SUPPLEMENTAL DATA

		*** NOTE *** Leave TAPE WT and TENSION at defaults for data collected with a survey level and rod
TAPE WT:	0.0106	
TENSION:	99999	

CHANNEL PROFILE DATA

SLOPE:	0.02

INPUT DATA CHECKED BY: .....DATE.....

ASSIGNED TO: .....DATE.....

STREAM NAME: Beaver Creek
XS LOCATION: near house at campground
XS NUMBER: 1

DATA POINTS= 26

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	S	0.00	5.09			0.00		0.00	0.00	0.0%
1	G	2.80	5.41			0.00		0.00	0.00	0.0%
	W	7.80	5.90	0.00	0.00	0.00		0.00	0.00	0.0%
		8.20	5.94	0.05	0.00	0.40	0.05	0.02	0.00	0.0%
		8.60	6.05	0.15	0.64	0.41	0.15	0.06	0.04	3.2%
		9.00	6.08	0.20	1.06	0.40	0.20	0.08	0.08	7.0%
		9.40	6.10	0.20	0.94	0.40	0.20	0.08	0.08	6.2%
		9.80	6.06	0.15	0.10	0.40	0.15	0.06	0.01	0.5%
		10.20	6.04	0.15	1.27	0.40	0.15	0.06	0.08	6.3%
		10.60	6.16	0.25	0.19	0.42	0.25	0.10	0.02	1.6%
		11.00	6.15	0.25	0.21	0.40	0.25	0.10	0.02	1.7%
		11.40	6.03	0.15	0.28	0.42	0.15	0.06	0.02	1.4%
		11.80	6.04	0.15	0.74	0.40	0.15	0.06	0.04	3.7%
		12.20	6.06	0.15	1.66	0.40	0.15	0.06	0.10	8.2%
		12.60	6.04	0.15	1.73	0.40	0.15	0.06	0.10	8.6%
		13.00	6.09	0.20	2.07	0.40	0.20	0.08	0.17	13.6%
		13.40	6.18	0.30	1.67	0.41	0.30	0.12	0.20	16.5%
		13.80	6.20	0.30	1.14	0.40	0.30	0.12	0.14	11.3%
		14.20	6.14	0.25	1.26	0.40	0.25	0.10	0.13	10.4%
		14.60	5.97	0.05	0.00	0.43	0.05	0.02	0.00	0.0%
		15.00	5.96	0.05	0.00	0.40	0.05	0.02	0.00	0.0%
		15.40	5.96	0.05	0.00	0.40	0.05	0.02	0.00	0.0%
		15.80	5.94	0.05	0.00	0.40	0.05	0.02	0.00	0.0%
	W	16.00	5.90	0.00	0.00	0.20		0.00	0.00	0.0%
1	G	16.50	5.39	0.00	0.00	0.00		0.00	0.00	0.0%
	S	16.50	5.39	0.00	0.00	0.00		0.00	0.00	0.0%
	TOTALS ----------					8.31	0.3 (Max.)	1.30	1.21	100.0%

Manning's n = 0.0649
Hydraulic Radius= 0.155747591

STREAM NAME: Beaver Creek
XS LOCATION: near house at campground
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.30	1.27	-1.8%
5.65	1.30	3.67	183.5%
5.67	1.30	3.45	166.7%
5.69	1.30	3.24	150.2%
5.71	1.30	3.03	134.1%
5.73	1.30	2.83	118.3%
5.75	1.30	2.63	102.9%
5.77	1.30	2.43	87.8%
5.79	1.30	2.24	73.1%
5.81	1.30	2.06	58.7%
5.83	1.30	1.87	44.7%
5.85	1.30	1.70	31.0%
5.86	1.30	1.61	24.2%
5.87	1.30	1.52	17.6%
5.88	1.30	1.44	11.1%
5.89	1.30	1.35	4.6%
5.90	1.30	1.27	-1.8%
5.91	1.30	1.19	-8.0%
5.92	1.30	1.11	-14.2%
5.93	1.30	1.03	-20.3%
5.94	1.30	0.96	-26.2%
5.95	1.30	0.88	-32.0%
5.97	1.30	0.74	-42.6%
5.99	1.30	0.62	-52.2%
6.01	1.30	0.50	-61.6%
6.03	1.30	0.38	-70.9%
6.05	1.30	0.27	-79.2%
6.07	1.30	0.19	-85.1%
6.09	1.30	0.13	-89.6%
6.11	1.30	0.09	-92.8%
6.13	1.30	0.06	-95.5%
6.15	1.30	0.03	-97.8%

WATERLINE AT ZERO
AREA ERROR = 5.897

STREAM NAME: Beaver Creek
XS LOCATION: near house at campground
XS NUMBER: 1

Constant Manning's n

GL = lowest Grassline elevation corrected for sag
WL = Waterline corrected for variations in field measured water surface elevations and sag

STAGING TABLE

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.41	13.68	0.48	0.79	6.63	14.02	100.0%	0.47	13.04	1.97
	5.45	13.26	0.46	0.75	6.13	13.59	96.9%	0.45	11.68	1.90
	5.50	12.70	0.43	0.70	5.48	13.01	92.8%	0.42	9.98	1.82
	5.55	12.15	0.40	0.65	4.86	12.43	88.6%	0.39	8.42	1.73
	5.60	11.59	0.37	0.60	4.27	11.84	84.4%	0.36	7.00	1.64
	5.65	11.03	0.34	0.55	3.70	11.26	80.3%	0.33	5.71	1.54
	5.70	10.47	0.30	0.50	3.16	10.68	76.1%	0.30	4.56	1.44
	5.75	9.91	0.27	0.45	2.66	10.10	72.0%	0.26	3.53	1.33
	5.80	9.35	0.23	0.40	2.17	9.51	67.8%	0.23	2.63	1.21
	5.85	8.79	0.20	0.35	1.72	8.93	63.7%	0.19	1.86	1.08
WL	5.90	8.23	0.16	0.30	1.29	8.35	59.5%	0.16	1.21	0.93
	5.95	7.43	0.12	0.25	0.90	7.54	53.7%	0.12	0.71	0.79
	6.00	6.13	0.09	0.20	0.57	6.22	44.4%	0.09	0.38	0.66
	6.05	4.86	0.06	0.15	0.28	4.93	35.1%	0.06	0.14	0.48
	6.10	2.14	0.06	0.10	0.12	2.18	15.5%	0.05	0.05	0.46
	6.15	1.35	0.02	0.05	0.03	1.36	9.7%	0.02	0.01	0.27
	6.20	0.07	0.00	0.00	0.00	0.07	0.5%	0.00	0.00	0.04

STREAM NAME: Beaver Creek
XS LOCATION: near house at campground
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.21	cfs
CALCULATED FLOW (Qc)=	1.21	cfs
(Qm-Qc)/Qm * 100 =	0.3	%
MEASURED WATERLINE (WLm)=	5.90	ft
CALCULATED WATERLINE (WLc)=	5.90	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.30	ft
MAX CALCULATED DEPTH (Dc)=	0.30	ft
(Dm-Dc)/Dm * 100	-0.9	%
MEAN VELOCITY=	0.93	ft/sec
MANNING'S N=	0.065	
SLOPE=	0.02	ft/ft
.4 * Qm =	0.5	cfs
2.5 * Qm=	3.0	cfs

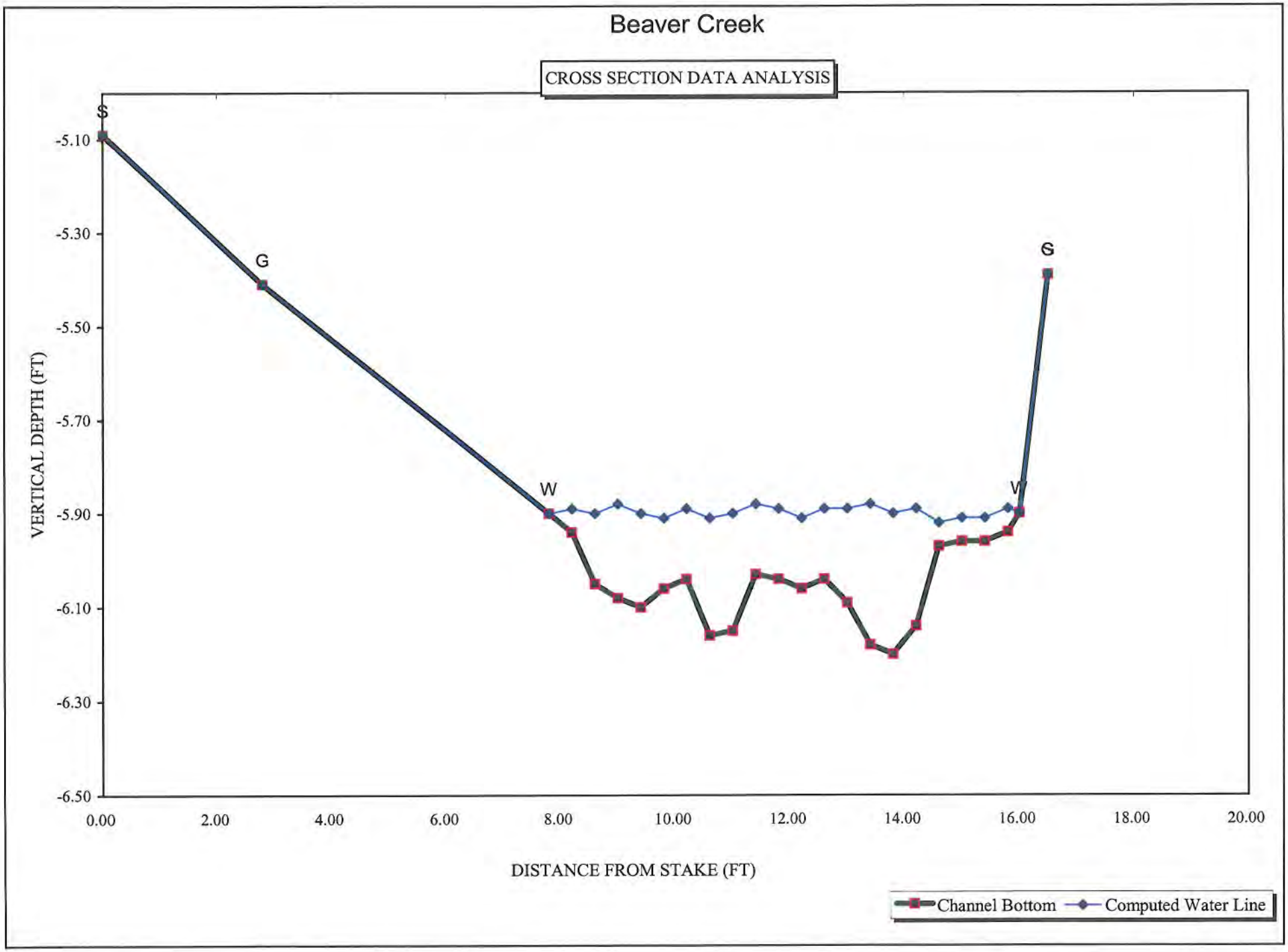
RECOMMENDED INSTREAM FLOW:
==========

FLOW (CFS)	PERIOD
==========	========
_____	_____
_____	_____
_____	_____
_____	_____

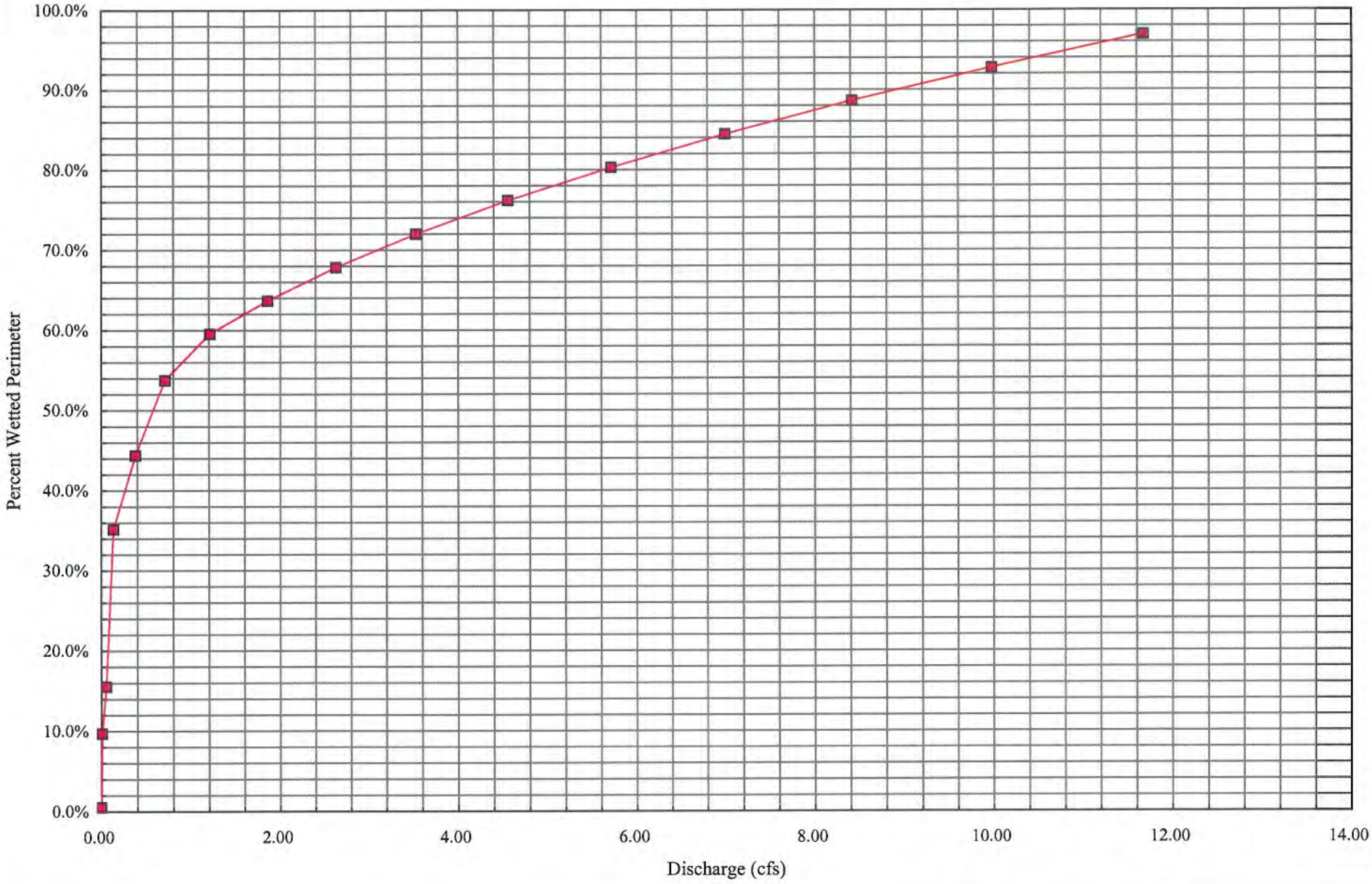
RATIONALE FOR RECOMMENDATION:
==========

RECOMMENDATION BY: ..... AGENCY..... DATE:.....

CWCB REVIEW BY: ..... DATE:.....


Beaver Creek
CROSS SECTION DATA ANALYSIS
S
G
W
W
G
-5.10
-5.30
-5.50
-5.70
-5.90
-6.10
-6.30
-6.50
VERTICAL DEPTH (FT)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line

Percent Wetted Perimeter vs. Discharge



COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	Beaver Creek
XS LOCATION:	near house at campground
XS NUMBER:	2
DATE:	5-Oct-06
OBSERVERS:	R. Smith, P. Belcher
1/4 SEC:	SE
SECTION:	16
TWP:	1N
RANGE:	78W
PM:	6th
COUNTY:	Grand
WATERSHED:	Colorado
DIVISION:	5
DOW CODE:	19196
USGS MAP:	Parshall 7.5'
USFS MAP:	0

SUPPLEMENTAL DATA

		*** NOTE *** Leave TAPE WT and TENSION at defaults for data collected with a survey level and rod
TAPE WT:	0.0106	
TENSION:	99999	

CHANNEL PROFILE DATA

SLOPE:	0.031

INPUT DATA CHECKED BY: .....DATE.....

ASSIGNED TO: .....DATE.....

STREAM NAME: Beaver Creek
XS LOCATION: near house at campground
XS NUMBER: 2

DATA POINTS= 21

VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
S	0.00	4.59			0.00		0.00	0.00	#DIV/0!
1 G	2.30	6.12			0.00		0.00	0.00	#DIV/0!
	10.40	5.02							
S	11.80	4.59			0.00		0.00	0.00	#DIV/0!
TOTALS ----------					0.00	0 (Max.)	0.00	0.00	#DIV/0!

Manning's n = #DIV/0!
Hydraulic Radius= #DIV/0!

STREAM NAME: Beaver Creek
XS LOCATION: near house at campground
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.00	14.73	#DIV/0!
-0.25	0.00	15.48	#DIV/0!
-0.23	0.00	15.42	#DIV/0!
-0.21	0.00	15.36	#DIV/0!
-0.19	0.00	15.30	#DIV/0!
-0.17	0.00	15.24	#DIV/0!
-0.15	0.00	15.18	#DIV/0!
-0.13	0.00	15.12	#DIV/0!
-0.11	0.00	15.06	#DIV/0!
-0.09	0.00	15.00	#DIV/0!
-0.07	0.00	14.94	#DIV/0!
-0.05	0.00	14.88	#DIV/0!
-0.04	0.00	14.85	#DIV/0!
-0.03	0.00	14.82	#DIV/0!
-0.02	0.00	14.79	#DIV/0!
-0.01	0.00	14.76	#DIV/0!
0.00	0.00	14.73	#DIV/0!
0.01	0.00	14.70	#DIV/0!
0.02	0.00	14.67	#DIV/0!
0.03	0.00	14.64	#DIV/0!
0.04	0.00	14.61	#DIV/0!
0.05	0.00	14.58	#DIV/0!
0.07	0.00	14.52	#DIV/0!
0.09	0.00	14.46	#DIV/0!
0.11	0.00	14.40	#DIV/0!
0.13	0.00	14.34	#DIV/0!
0.15	0.00	14.28	#DIV/0!
0.17	0.00	14.22	#DIV/0!
0.19	0.00	14.16	#DIV/0!
0.21	0.00	14.10	#DIV/0!
0.23	0.00	14.04	#DIV/0!
0.25	0.00	13.98	#DIV/0!

WATERLINE AT ZERO
AREA ERROR = #DIV/0!

STREAM NAME: Beaver Creek
XS LOCATION: near house at campground
XS NUMBER: 2

Constant Manning's n

STAGING TABLE

GL = lowest Grassline elevation corrected for sag
WL = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	6.12	0.00	#DIV/0!	0.00	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
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	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
WL	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
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	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Beaver Creek
XS LOCATION: near house at campground
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.00	cfs
CALCULATED FLOW (Qc)=	#DIV/0!	cfs
(Qm-Qc)/Qm * 100 =	#DIV/0!	%
MEASURED WATERLINE (WLm)=	0.00	ft
CALCULATED WATERLINE (WLc)=	#DIV/0!	ft
(WLm-WLc)/WLm * 100 =	#DIV/0!	%
MAX MEASURED DEPTH (Dm)=	0.00	ft
MAX CALCULATED DEPTH (Dc)=	#DIV/0!	ft
(Dm-Dc)/Dm * 100	#DIV/0!	%
MEAN VELOCITY=	#DIV/0!	ft/sec
MANNING'S N=	#DIV/0!	
SLOPE=	0.031	ft/ft
.4 * Qm =	0.0	cfs
2.5 * Qm=	0.0	cfs

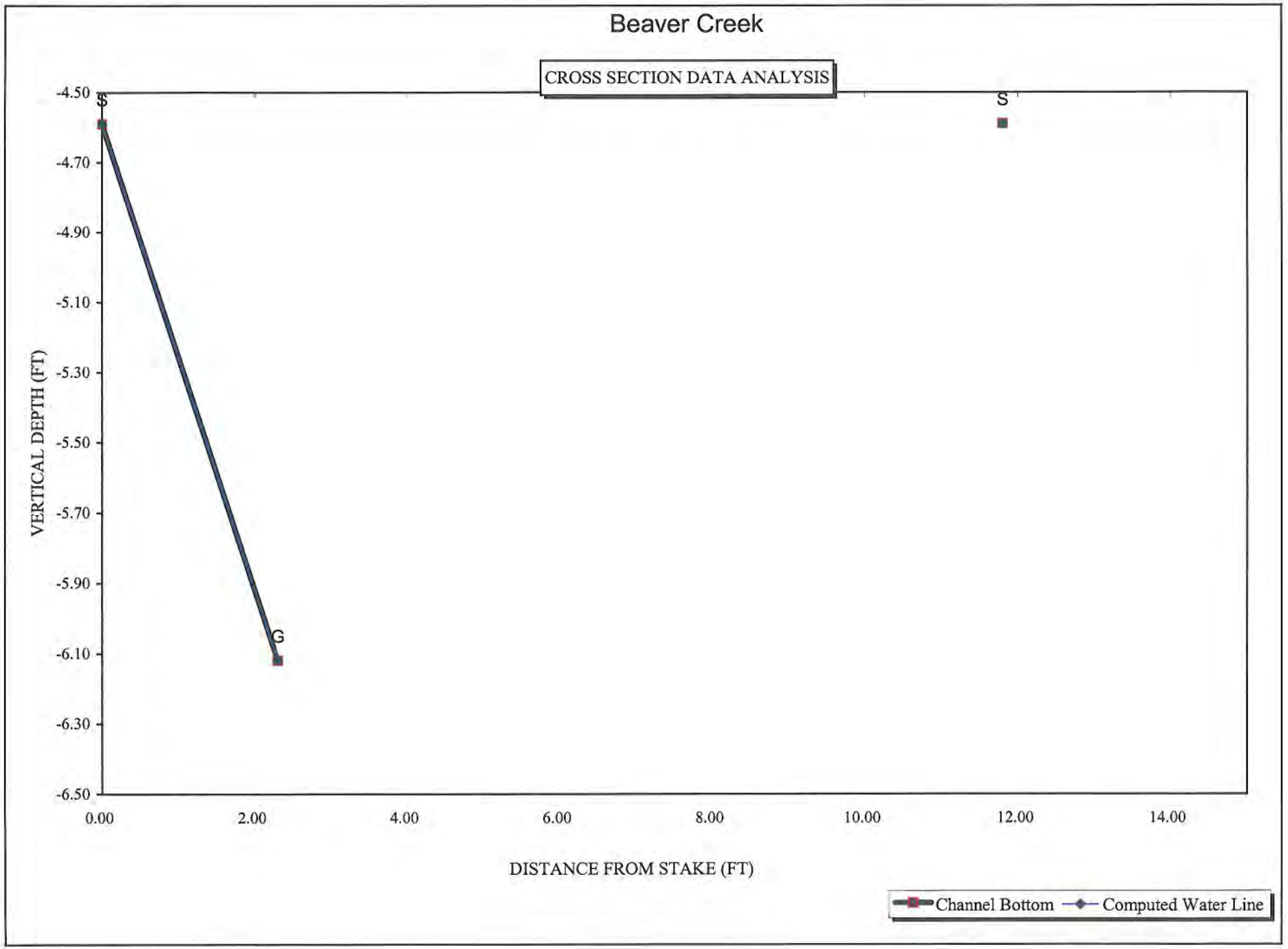
RECOMMENDED INSTREAM FLOW:

FLOW (CFS)	PERIOD

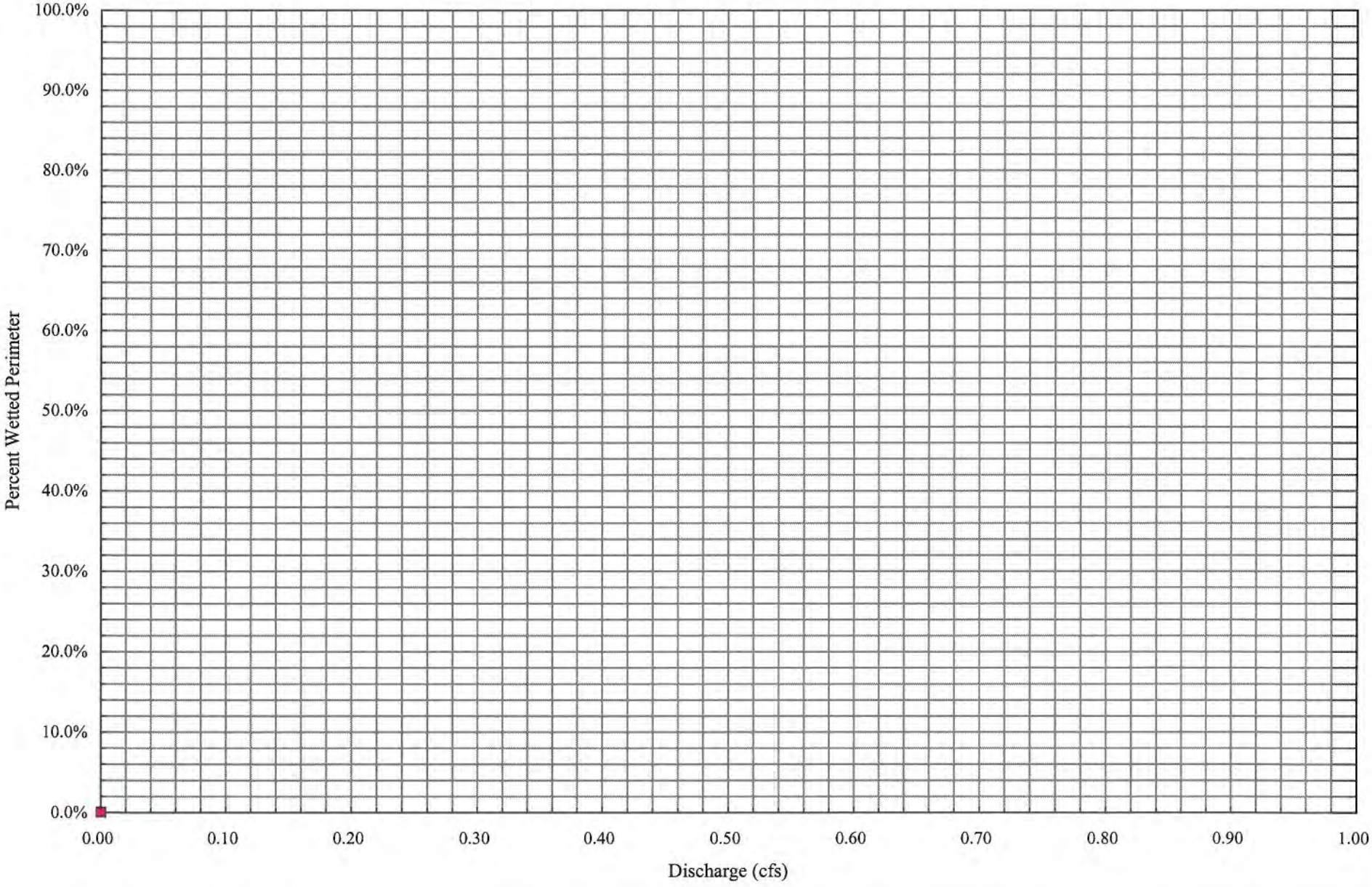
RATIONALE FOR RECOMMENDATION:

RECOMMENDATION BY: ..... AGENCY..... DATE:.....

CWCB REVIEW BY: ..... DATE:.....


Beaver Creek
CROSS SECTION DATA ANALYSIS
-4.50
-4.70
-4.90
-5.10
-5.30
-5.50
-5.70
-5.90
-6.10
-6.30
-6.50
VERTICAL DEPTH (FT)
S
S
G
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line

Percent Wetted Perimeter vs. Discharge

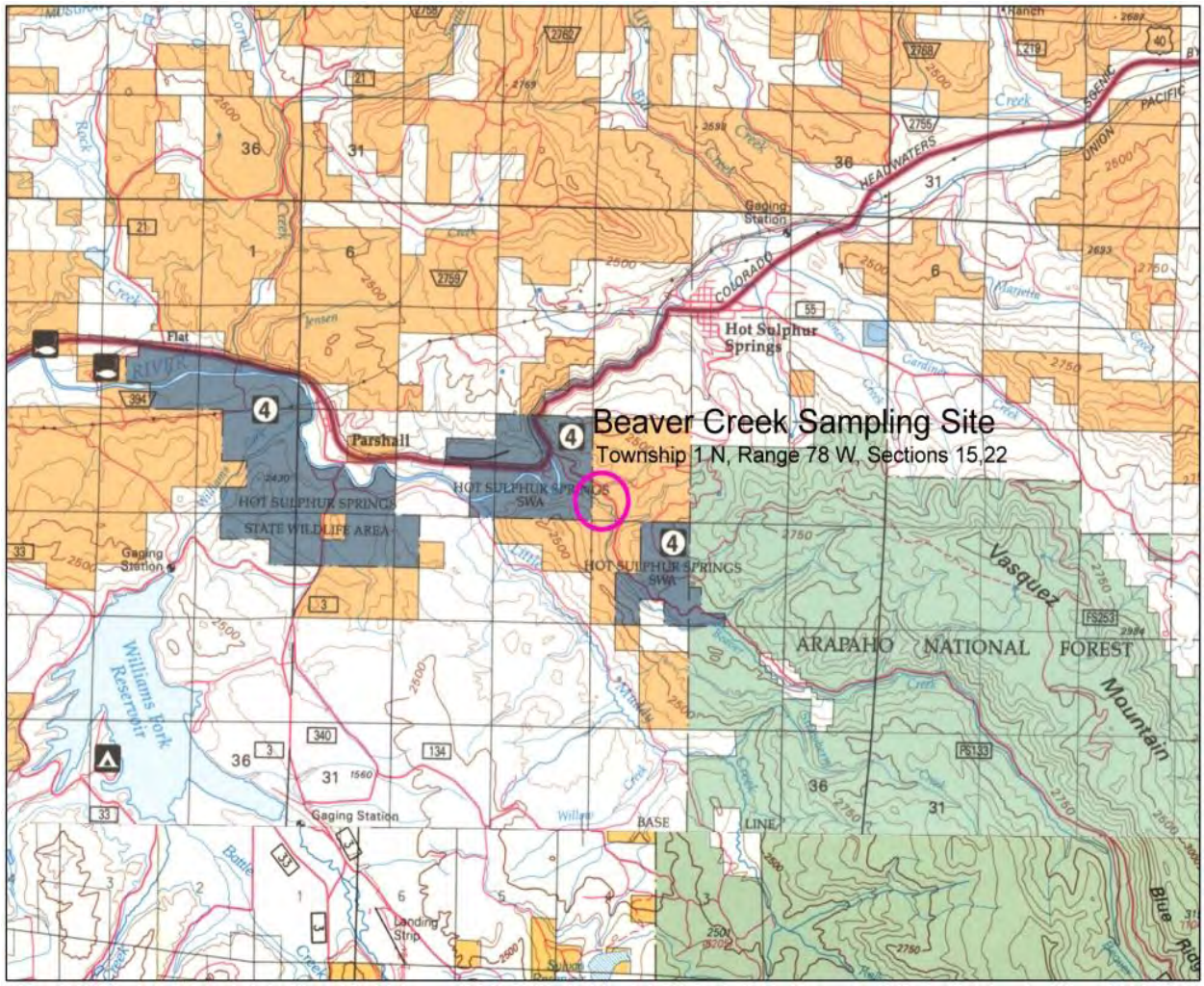


Kremmling Field Office Stream Surveys
October 2006

Beaver Creek - Water Code #19196

Beaver Creek, located near Hot Sulphur Springs, CO and located on BLM lands managed by the Kremmling Field Office was sampled on October 12, 2006. Beaver Creek is tributary to the Colorado River. Presence/absence sampling was done in support of the Colorado BLM in-stream flow program. Sampling was conducted via backpack electro-shocker and approximately 200 feet of stream was sampled. Personnel present were Paula Belcher, KRFO, Hydrologist, Tom Fresques, BLM West Slope Fisheries Biologist, and Malia Boyum, Biological Technician, GSFO.

A total of 22 fish were collected including 14 brown trout, 4 brook trout, 3 sculpin, and 1 rainbow trout. See the data sheet below for size class distributions.


Beaver Creek Sampling Site
Township 1 N, Range 78 W, Sections 15,22
Parshall
Hot Sulphur Springs
HOT SULPHUR SPRINGS SWA
STATE WILDLIFE AREA
ARAPAHO NATIONAL FOREST
Vasquez Mountain
Williams Fork Reservoir
Gaging Station
Landing Strip
COLORADO
PACIFIC
UNION
HEADWATERS
SCENIC
BASE LINE

FISH SAMPLING FORM

WATER Beaver Creek CODE 19196 DATE 10-12-06

GEAR backpack shocker EFFORT 200 ft STATION #___ PASS #__

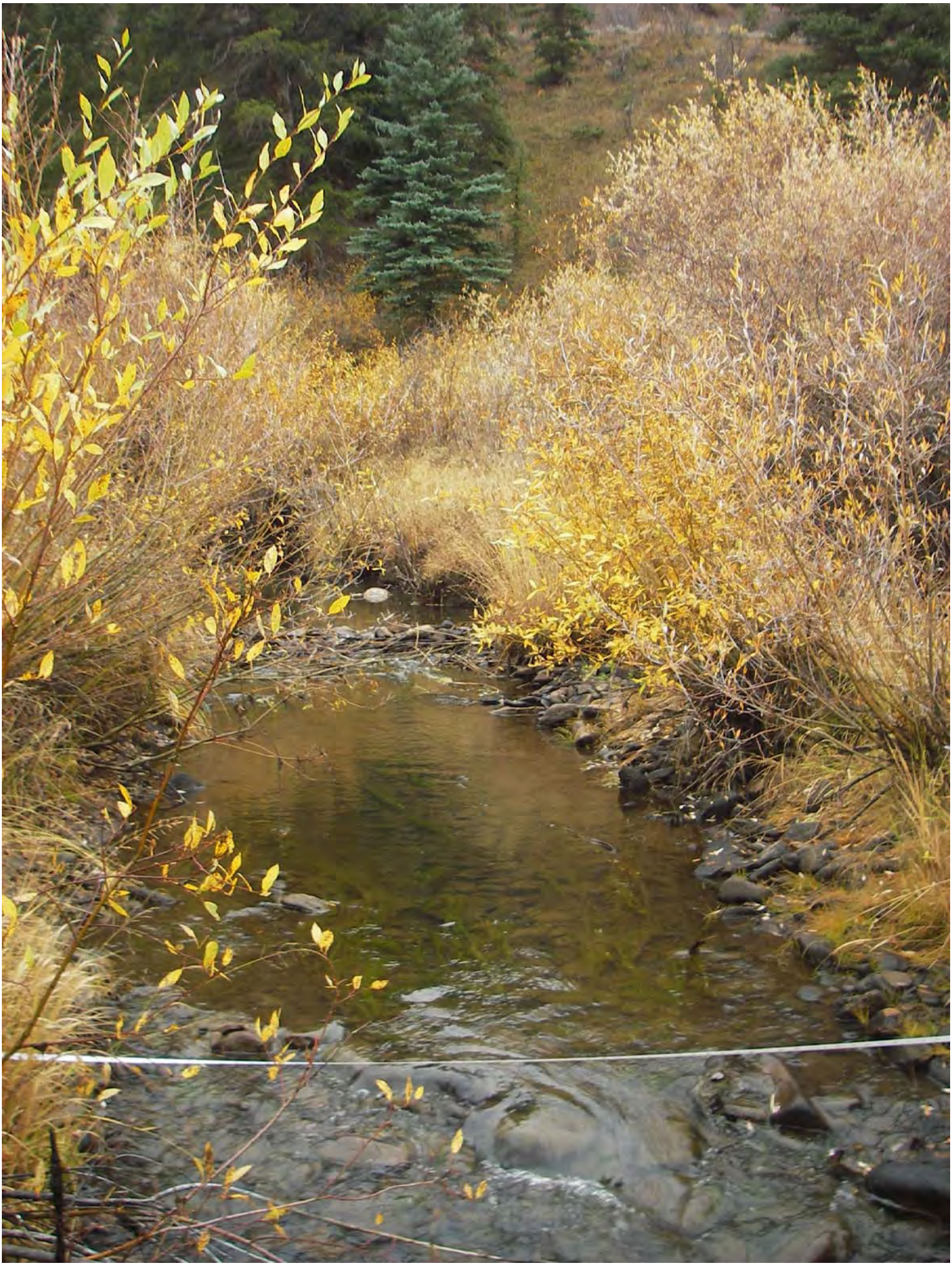
(mm)

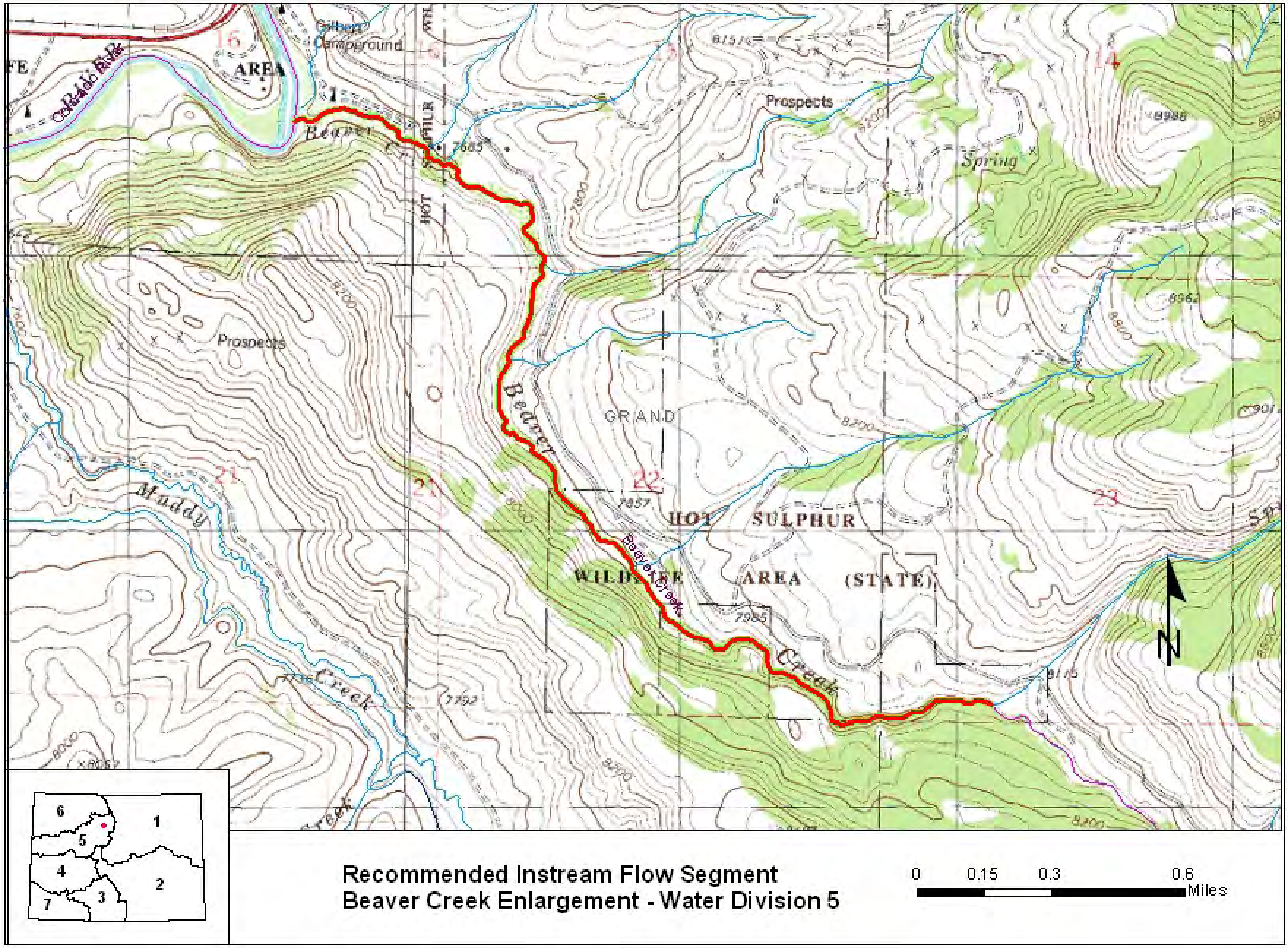
species	length	weight	mark		species	length	weight	mark
BRN	135							
BRN	168							
BRN	141							
BRK	110							
BRN	116							
BRN	154							
RBT	197							
BRN	172							
BRN	179							
BRN	169							
BRN	154							
BRN	158							
BRK	131							
BRN	144							
BRK	142							
BRN	165							
BRN	132							
BRK	156							
BRN	150							
MOSC	68							
MOSC	54							
MOSC	86							

GPS Location:

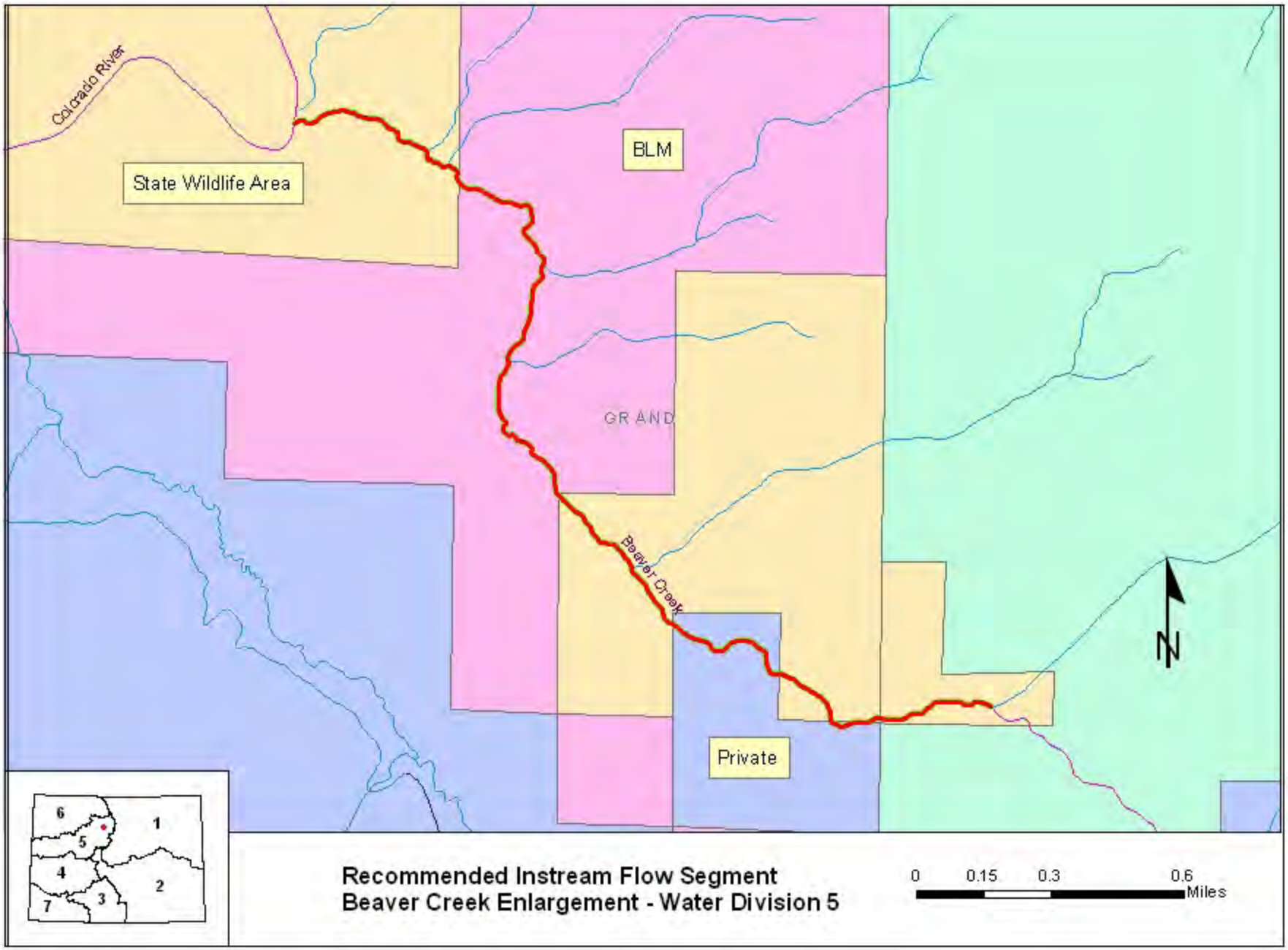
Notes (water temp, etc.):

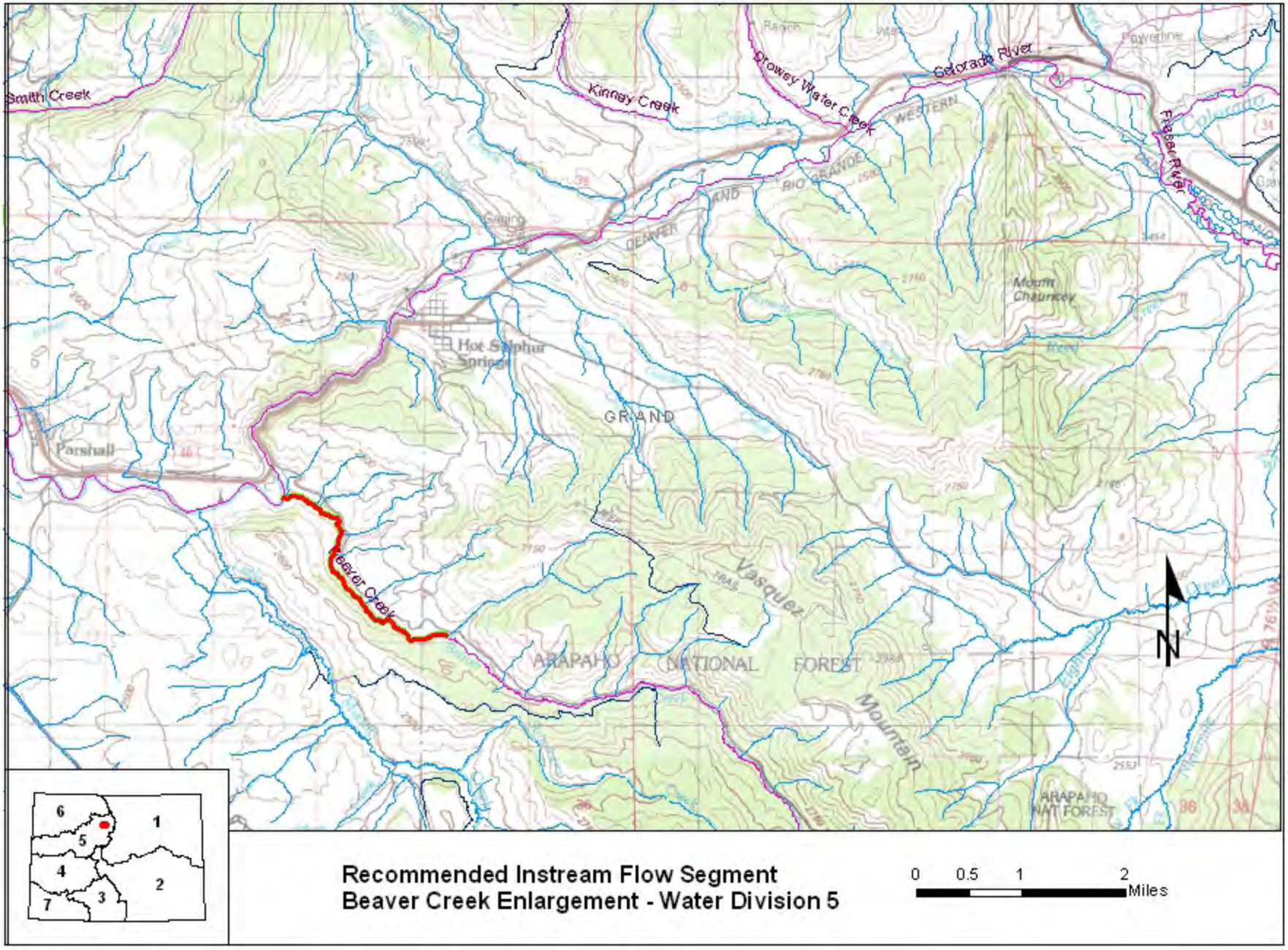
22 total fish: 14 brown trout (*Salmo trutta* morpha *fario*); 4 brook trout (*Salvelinus fontinalis*); 3 mottled sculpin (*Cottus bairdi*); 1 rainbow trout (*Oncorhynchus mykiss*)





Recommended Instream Flow Segment
Beaver Creek Enlargement - Water Division 5


Colorado River
State Wildlife Area
BLM
GRAND
Beaver Creek
Private
N
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Beaver Creek Enlargement - Water Division 5
0
0.15
0.3
0.6
Miles


Smith Creek
Kinney Creek
Drowsy Water Creek
Colorado River
Fraser River
Hot Sulphur Springs
Parshall
Beaver Creek
Mount Chauncey
Vasquez Mountain
ARAPAHO NATIONAL FOREST
GRAND
DENVER
RIO GRANDE
WESTERN
N
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Beaver Creek Enlargement - Water Division 5
0 0.5 1 2
Miles