Stream: Willow Creek

Executive Summary

Water Division: 5
Water District: 51
CDOW#: 22830
CWCB ID: 08/5/A-012

Segment: Confluence Cabin Creek to BLM Boundary

Upper Terminus: CONFLUENCE WITH CABIN CREEK
(Latitude 40° 12’ 51.09”N) (Longitude 106° 3’ 3.49”W)

Lower Terminus: BLM BOUNDARY AT
(Latitude 40° 11’33.19”N) (Longitude 106° 1’ 41.07”W)

Watershed: Colorado headwaters (HUC#: 14010001)
Counties: Grand
Length: 2 miles
USGS Quad(s): Cabin Creek
Existing ISF: 5-78W3774; 12 cfs (January 1 – December 31)
Flow Recommendation: 18 cfs (April 1 - July 31)
3 cfs (August 1 - November 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) recommended this segment of Willow Creek to the CWCB for an increased water right under the Instream Flow Program. Willow Creek is being considered for an increase because it has a natural environment that can be preserved to a reasonable degree with an increased instream flow water right.

Willow Creek is approximately 26.5 miles long. It begins on the south flank of Gravel Mountain within the Arapaho National Forest at an elevation of approximately 10300 feet and terminates at the confluence with the Colorado River at an elevation of approximately 7950. Approximately 80% of the land on the 2 mile segment addressed by this report is publicly owned. Willow Creek is located within Grand County. The total drainage area of the creek is approximately 101.65 square miles. Willow Creek generally flows in a southeasterly direction.

The subject of this report is a segment of Willow Creek beginning at the confluence with Cabin Creek and extending downstream to the headgate BLM boundary at latitude 40 11 33 North and longitude 106 01 39 west. The proposed segment is located approximately 2 miles west of Granby. The staff has received only one recommendation for this segment, from the BLM. 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 Willow 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. Without assurance of these seasonal high flows, the tendency toward wider, shallow stream reaches increases; this, in turn, leads to increased likelihood of reductions in amounts of suitable habitat. 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, depth 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 18.0 cfs, summer, and 3.0 cfs, winter, based on its 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 Cabin Creek	BLM Boundary	2	20%	80%

61% of the public lands are owned by the BLM and the National Forest Service owns 39%.

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 "Willow Creek is a moderate 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 certain portions of the reach. The willow riparian community is extensive, often covers the entire valley floor outside of the stream channel. The healthy riparian community provides good habitat complexity and nutrient supply for the fish population. Fishery surveys indicate that the creek supports a self-sustaining population of brown trout and mottled sculpin, with small numbers of brook trout present. Willow Creek provides a habitat linkage with multiple other streams in this watershed known to support fish populations, including Cabin Creek, Hall Creek and Buffalo Creek".

Field Survey Data & Biological Flow Quantification

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, three data sets were collected with the results shown in Table 1 below. 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: Willow Creek R2Cross Summary

			Confidence Intervals	Recommended Flows (cfs)	
Party	**Date**	**Q (cfs)**	**250%-40%**	**Summer (3/3)**	**Winter (2/3)**
BLM	06/19/2006	26.14	65.4 – 10.5	27.34	(1)
BLM	06/19/2006	23.83	59.6 – 9.5	39.27	(1)
BLM	10/05/2006	17.06	42.7 – 6.8	23.33	(1)

BLM = Bureau of Land Management

The snowmelt runoff flow recommendation, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model is 30.0 cfs. The late summer flow recommendation, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model is 15.0 cfs. As a result, the BLM recommended 18.0 cfs and 3 cfs respectively to increase the appropriations of 12 cfs to the modeled recommendations. The snowmelt flow recommendations was derived by averaging the results of the three data sets. 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 **Willow Creek** such a gage is available but located downstream of the LT. The gage station is WILLOW CREEK NEAR GRANBY, CO.. (USGS 09020000), a gage with a 19 year period of record (POR) collected between 1935 and 1953. The gage is at an elevation of 8,234 ft above mean sea level (amsl) and has a drainage area of 109 mi^2. The hydrograph (plot of discharge over time) produced by this gage includes no significant upstream consumptive losses from irrigation diversions. While the absence of significant diversions increases the value of this data set, its POR is less than ideal.

To keep the positive values of the Willow Creek gage while reducing the limitation of its borderline POR, a statistical procedure called linear regression was employed. The procedure gives us the means to relate characteristics of a limited (short) data set to those of a larger (longer) data set and, if the two data sets are similar enough, to predict the data values "missing" from the short data set. The outcome is a "predicted" (called "Y – Hat" or $\hat{Y}$) set of data that augments the short data set; creating, in effect, a longer POR that is reflective of climate variation (i.e., it includes more wet-dry cycles.) The gage that was selected to provide the longer POR was EAST FORK TROUBLESOME CREEK NEAR TROUBLESOME, CO. (USGS 09040000), a gage with a 38 year POR collected between 1937 and 1983. The East Fork Troublesome Creek gage is at an elevation of 7670 ft amsl and has a drainage area of 76 $mi^{2.}$

Before performing the linear regression described above, the measured hydrographs of both gages must be adjusted to remove the effects of water consumption by upstream irrigation diversion. As mentioned above, the hydrograph of the Willow Creek gage includes no significant upstream consumptive losses from irrigation diversions. East Fork Troublesome Creek, however, has a small number of upstream diversions. Thus, before performing the linear regression, The East Fork Troublesome Creek data records must be increased by the amount of consumptive loss due to upstream diversions. When the data sets are adjusted in the manner described, then the two gages can be regressed one against the other to produce a "predicted" hydrograph for Willow Creek that displays the important attributes of a gage that is located nearby, is un-impacted (by irrigation consumption), and exhibits a long-term POR.

With the creation of the Willow Creek "predicted" hydrograph we have represented a distribution of flow over time. This hydrograph reflects existing conditions because of the lack of significant upstream consumptive losses from irrigation diversions

The following hydrograph depicts the mean monthly discharge of Baldy Creek (regressed on West Divide Creek near Raven). Included in the hydrograph are the recommended ISF values. The data used in the creation of this hydrograph are displayed in Table #2.

Figure 1 - Willow Cr Ŷ Q (proportioned on E Fk Troublesome near Troublesome) & ISFs

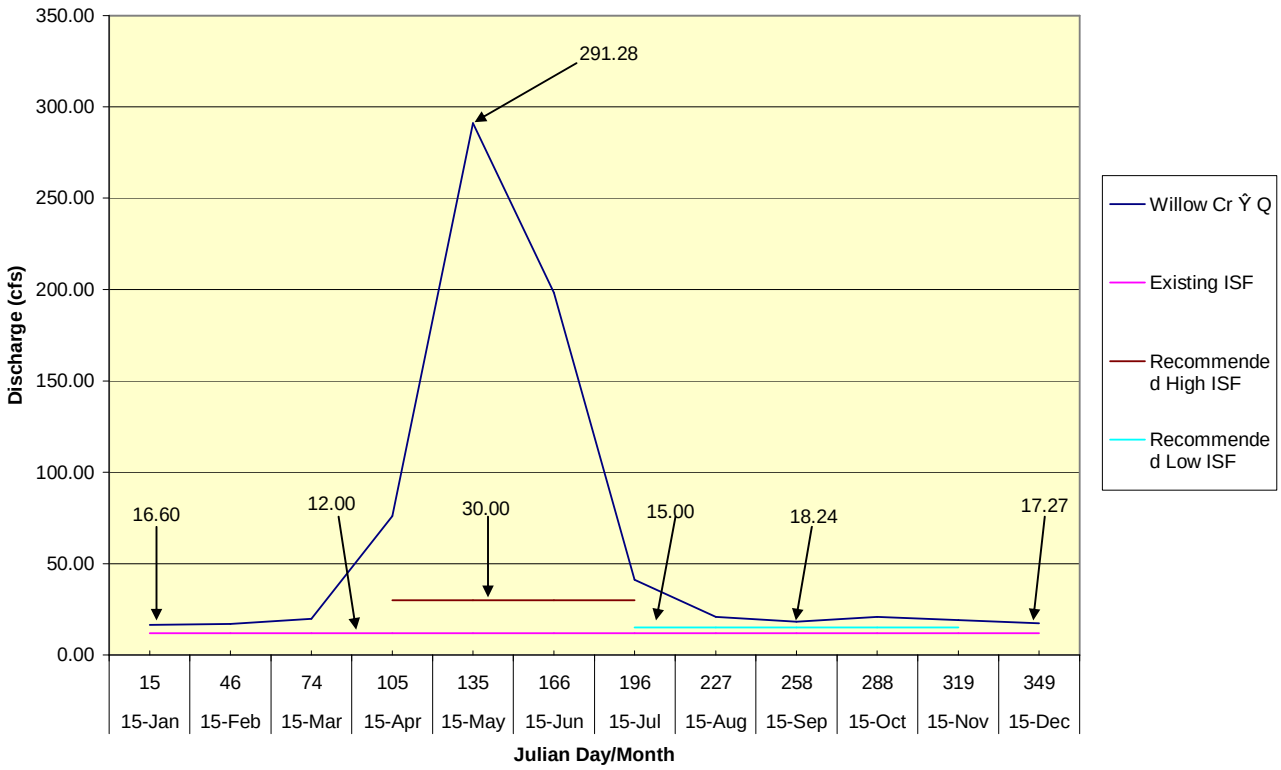


Table 2 – Mean Monthly Discharge and Recommended Instream Flows – Willow Cr.

		Willow Cr (cfs)	Existing ISF (cfs)	Recommended ISF (cfs)
15-Jan	15	16.60	12.00	12.00
15-Feb	46	16.93	12.00	12.00
15-Mar	74	19.78	12.00	12.00
31-Mar	90	19.78	12.00	12.00
1-Apr	91	76.16	12.00	30.00
15-Apr	105	76.16	12.00	30.00
15-May	135	291.28	12.00	30.00
15-Jun	166	198.24	12.00	30.00
15-Jul	196	41.00	12.00	30.00
31-Jul	212	41.00	12.00	30.00
1-Aug	213	20.79	12.00	15.00
15-Aug	227	20.79	12.00	15.00
15-Sep	258	18.24	12.00	15.00
15-Oct	288	20.74	12.00	15.00
15-Nov	319	18.99	12.00	15.00
30-Nov	334	18.99	12.00	15.00
1-Dec	335	17.27	12.00	12.00
15-Dec	349	17.27	12.00	12.00

Existing Water Right Information

Staff has analyzed the water rights tabulation to identify any potential water availability problems. There are no decreed diversions within the reach proposed for an increase. However, there are a very limited number of water rights located upstream within the 127 square mile watershed. On Buffalo Creek, a tributary to Willow Creek, there is a private inholding within the National Forest where multiple water rights are located. These water rights include: Kings Reservoir (1,166.88 acre feet total), Little King Ranch Wells 2, 3 & 4 (0.176 cfs), The Colorado Reservoir Augmentation Plan (14 acre feet). The Little King Ranch wells are junior to the existing instream flow water right. Near the headwaters of Willow Creek, there is another private inholding within the National Forest that holds the following water rights: Vagabond Ranch Augmentation Plan (2.0 AF), Vagabond Ranch Pond (1.27 acre feet absolute, 1.74 acre feet, conditional) and Vagabond Ranch Irrigation Diversion (0.11 cfs, conditional). The water rights associated with the Vagabond Ranch are junior to the existing instream flow right. Based on this analysis staff has determined that water is available for appropriation on Willow Creek, between the confluence with Cabin Creek and the BLM boundary, 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:

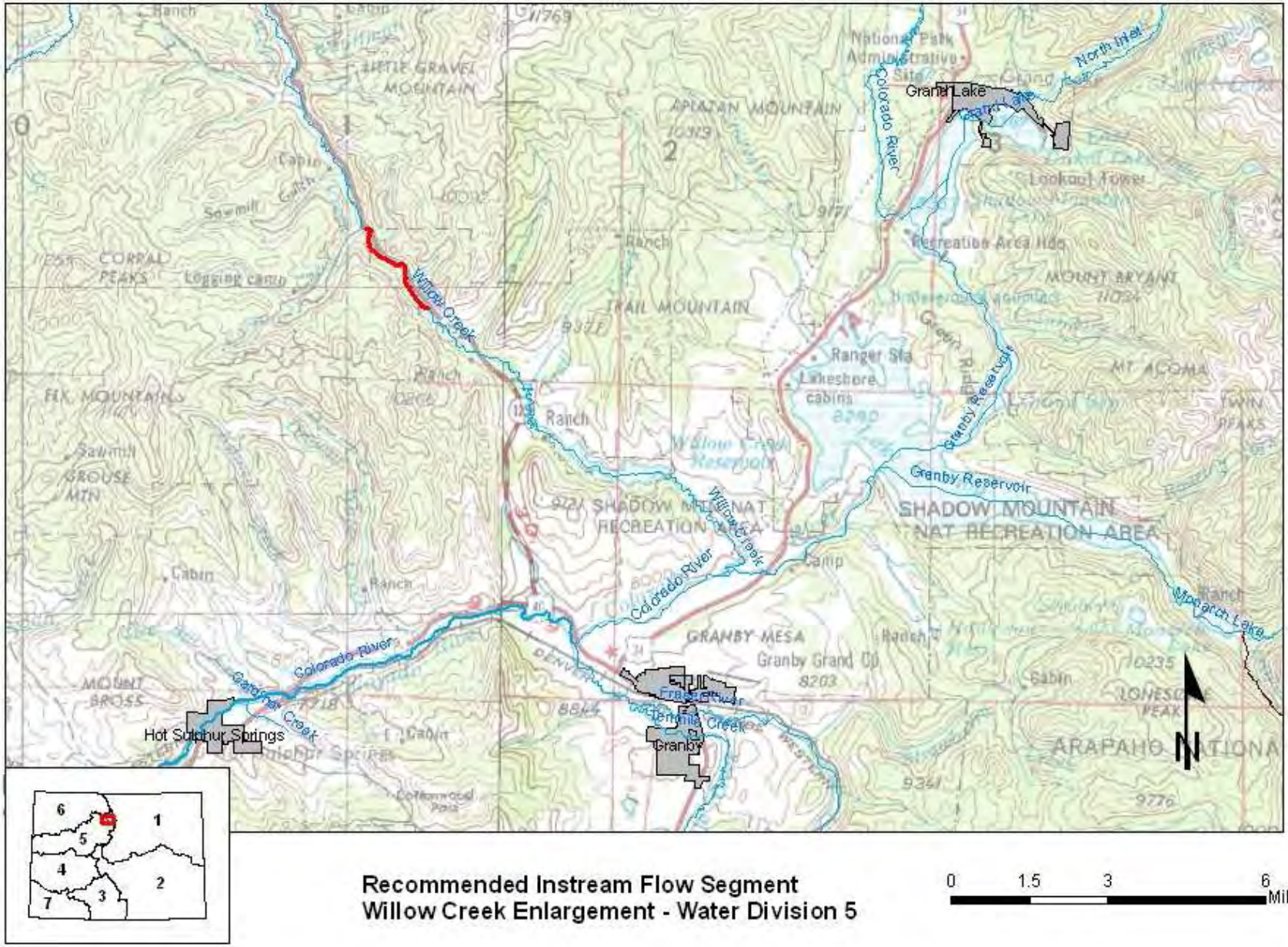
Segment: **C**onfluence Cabin Creek to BLM Boundary

Upper Terminus: CONFLUENCE WITH CABIN CREEK
(Latitude 40° 12' 51.09"N) (Longitude 106° 3' 3.49"W)
UTM = 4452060.4 N UTM = 410569.6 E
SW SW S18 T3N R77W 6PM
110' West of East Section Line; 55' North of South Section Line

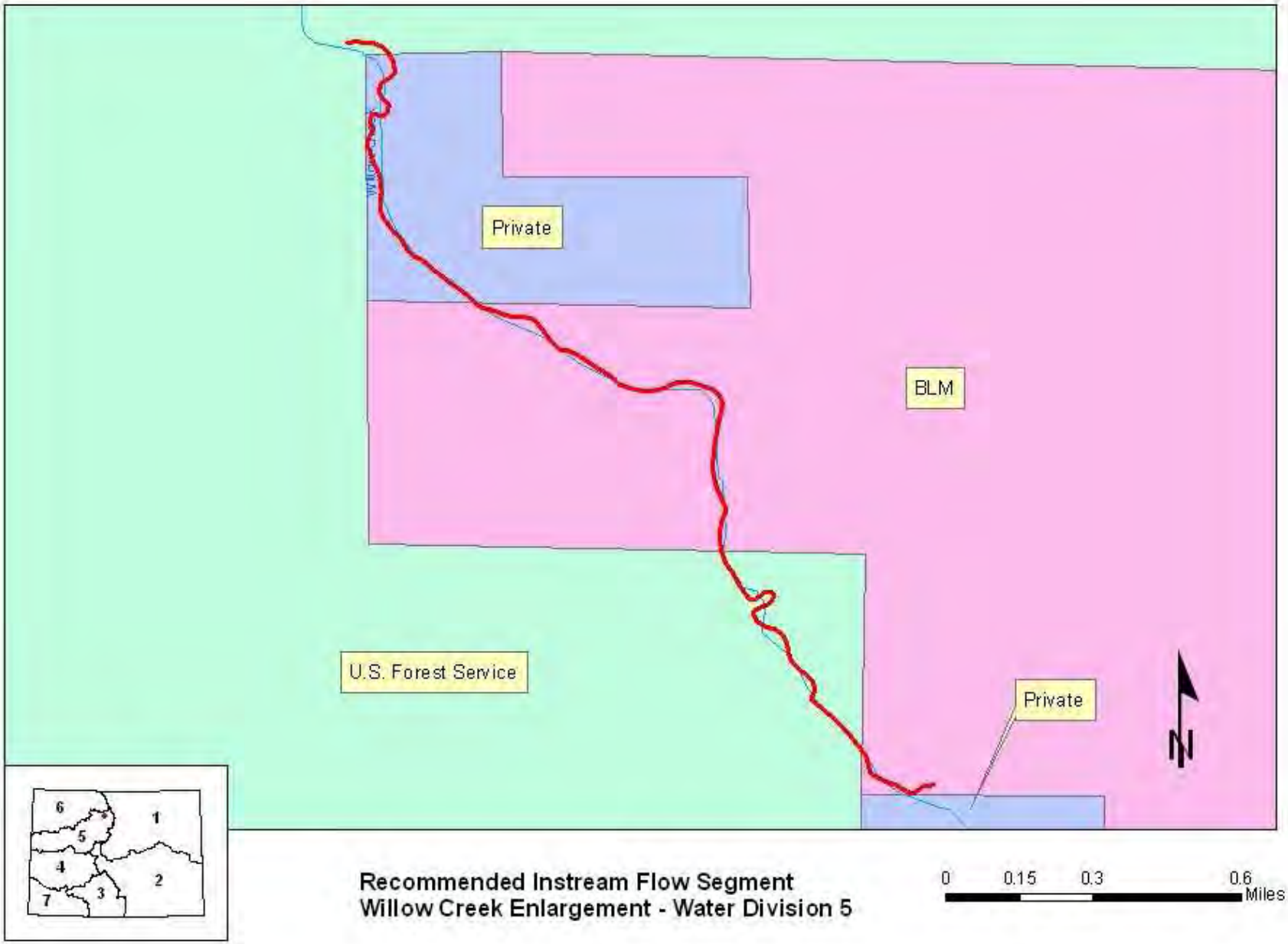
Lower Terminus: BLM BOUNDARY AT
(Latitude 40° 11' 33.19"N) (Longitude 106° 1' 41.07"W)
UTM = 4449635.9 N UTM = 412489.9 E
NW SW S28 T3N R77W 6PM
260' East of the West Section Line; 830' South of the North Section Line

Watershed: Colorado headwaters (HUC#: 14010001)
Counties: Grand
Length: 2 miles
USGS Quad(s): Cabin Creek
Existing ISF: 5-78W3774; 12 cfs (January 1 – December 31)
Flow Recommendation: 18 cfs (April 1 - July 31)
3 cfs (August 1 - November 30)

Vicinity Map



Land Use Map


Private
BLM
U.S. Forest Service
Private
N
6
1
5
4
2
3
7
Recommended Instream Flow Segment
Willow 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) is writing this letter to formally communicate its recommendation for an instream flow enlargement on Willow Creek near Granby, located in Water Division 5. The existing instream flow water right on the lowest reach of this creek is 12.0 cubic feet per second, year round, from the confluence with Pass Creek to the BLM boundary where the creek exits public lands. The existing instream flow water right was established in 1978.

Location and Land Status. Willow Creek is tributary to the Colorado River approximately two miles west of Granby, Colorado, just upstream from Windy Gap Reservoir. The creek is located within the upper Colorado River watershed in Grand County. This recommendation covers the stream reach beginning at the confluence with Cabin Creek and extending downstream to the BLM boundary at latitude 40 11 33 North and longitude 106 01 39 West. The legal description of this location is near the southwest corner of the NW ¼, Section 28, T3N R77W. Approximately 80 percent of the land in the 2.0 mile reach is owned and managed by the federal government, while the remaining 20 percent is in private ownership.

Biological Summary. This reach of Willow Creek is a moderate 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 certain portions of the reach. The willow riparian community is extensive, often covers the entire valley floor outside of the stream channel. The healthy riparian community provides good habitat complexity and nutrient supply for the fish population. Fishery surveys indicate that the creek supports a self-sustaining population of brown trout and mottled sculpin, with small numbers of brook trout present. Willow Creek provides a habitat linkage with multiple other streams in this watershed known to support fish populations, including Cabin Creek, Hall Creek, and Buffalo Creek.

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

- A 18.0 cubic feet per second enlargement is recommended during the snowmelt runoff period from April 1 through July 31, bringing the total instream flow right up to 30.0 cubic feet per second during this time period. This recommendation is driven by the average depth criteria. Because the creek channel is wide, additional flow is needed to maintain suitable habitat depths for the salmonid population.

- A 3.0 cubic feet per second enlargement is recommended during the late summer and fall, from August 1 through November 30. This recommendation is driven by water availability. Late summer and early fall is an important time in the life cycle of fish populations at high altitudes, because the warmest water temperatures of the year allow them to actively feed and gain weight, increasing chances of overwinter survival.

When interpreting the attached cross sections, it is important to note that BLM used a 0.5 feet average depth criteria. Because Willow Creek has a large stream channel with variable width, BLM took cross sections in three representative locations. The average of the channel widths in those three locations is 50.0 feet. Accordingly, BLM used 1 percent of the average width, or 0.5 feet, for the average depth criteria. Because of the wide channel, BLM also used a 60% wetted perimeter criteria.

Justification for Instream Flow Enlargement. BLM was prompted to examine the current instream flow water right because of heavy recreation usage of the creek. The creek is located adjacent to State Highway 125, and there are several locations on BLM lands where cars can turn off from the highway and access the creek. In addition, the creek is only a short drive from population centers in Grand County, where stream-based recreation is an important part of the economy. BLM recreation staff is reporting consistently higher usage of this creek because of the opportunities to catch large brown trout.

Willow Creek has a wide channel with large substrate. The current instream flow water right provides an average depth of only 0.3 feet in riffles. BLM believes that this average depth is inadequate for several reasons. First, when average depth is at 0.3 feet, this implies that much of the stream channel is at less than 0.3 feet. At those shallower depths, it is difficult for the stream to provide sufficient physical habitat to support a large population of brown trout that are full adult size. Second, lower average depths do not create sufficient "cover" locations in the riffles behind rocks, where trout can rest in lower velocity water before proceeding to use the higher velocity riffle habitat for spawning or feeding. Third, the greater depth should provide additional habitat complexity, by insuring that the active river channel is connected to some side channels and willow wetlands. Finally, greater depth during the summer months translates into additional wetted surfaces where aquatic macroinvertebrates can establish, providing a greater food supply for the salmonids.

BLM also notes that the current instream flow water right has a uniform flow rate all the way between Pass Creek and the BLM – private lands boundary. This uniformity occurs despite the fact that several large tributaries with decreed instream flow water rights enter the creek between Pass Creek and the BLM – private land boundary. BLM believes that Willow Creek has seen consistently higher flow rates than the currently protected instream flow amounts. That higher flow rate has resulted in the outstanding fishery in the creek today. BLM believes protection of those higher flow rates will help insure the continued existence of the outstanding fishery.

Water Availability. There are no decreed diversions within the reach proposed for an enlargement. However, there are a very limited number of water rights located upstream within the 127 square mile watershed. On Buffalo Creek, a tributary to Willow Creek, there is a private inholding within the National Forest where multiple water rights are located. These water rights include:

- Kings Reservoir – 1090 acre feet , 48.4 acre feet, 28.48 acre feet – 1,166.88 acre feet total
- Little King Ranch Wells 2, 3, & 4 – 0.176 cfs
- The Colorado Reservoir Augmentation Plan – 14 acre feet

The Little King Ranch wells are junior to the existing instream flow water right.

Near the headwaters of Willow Creek, there is another private inholding within the National Forest that holds the following water rights:

- Vagabond Ranch Augmentation Plan – 2.0 acre feet
- Vagabond Ranch Pond – 1.27 acre feet absolute, 1.74 acre feet conditional
- Vagabond Ranch Irrigation Diversion – 0.11 cfs, conditional

The water rights associated with the Vagabond Ranch are junior to the existing instream flow water right.

For an indication of water availability, BLM recommends utilizing USGS Gage 09020500, Willow Creek above Willow Creek Reservoir. This historic gage is located only 1.5 miles downstream terminus of the proposed enlargement. In addition, this gage is located upstream from most of the major senior water right diversions on this creek system.

Conclusion. The BLM requests that the Board recognize that this recommendation is based only upon the minimum flows necessary to support cold-water and cool-water fishery values. BLM may wish to work with the Board and/or through the Colorado water rights system to appropriate flows to optimally protect fish values and to protect other water-dependent values specified in BLM resource management plans.

Data sheets, R2Cross output, fishery survey information, and photographs were forwarded with our draft recommendation in February 2007. We thank both the Division of Wildlife and the Water Conservation Board for their 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

Appendix - B

Field Data

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Willow Creek					CROSS-SECTION NO.: 1	
CROSS-SECTION LOCATION: At BLM cabin						
DATE: 10-5-06	OBSERVERS: K Smith, P. Belcher					
LEGAL DESCRIPTION	¼ SECTION: NE SW	SECTION: 20	TOWNSHIP: 3 (N)S	RANGE: 77 E(W)	PM: 6th	
COUNTY: Grand	WATERSHED: Colorado	WATER DIVISION: 5	DOW WATER CODE: 23595			
MAP(S): USGS: Cabin Creek 7.5'						
USFS:						

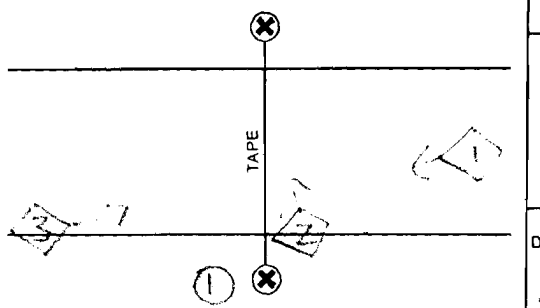
SUPPLEMENTAL DATA

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: 6" cobbles to 1 foot boulders	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	5.72 / 5.91
② WS Upstream	64.0'	5.50
③ WS Downstream	46.0	6.15
SLOPE	1.25/100.0 =	

SKETCH



LEGEND:
Stake ⊗
Station ①
Photo ◇
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

Ph: 7.0 Stream Temp: 7.5°
TDS: 100

DISCHARGE/CROSS SECTION NOTES

STREAM NAME:	CROSS-SECTION NO.:	DATE:	SHEET ___ OF ___
Willow Creek	1	10-05-06	

BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: 0.5 ft	TIME: 2:35

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)
RS	0.0		3.62								
G	2.8		5.12								
W	4.0		5.94								
	6.0		6.32	0.4				0.51			
	8.0		6.28	0.35				0.52			
	10.0		6.52	0.55				0.14			
	12.0		6.67	0.70				1.11			
	14.0		6.64	0.70				1.22			
	16.0		6.56	0.60				0.47			
	18.0		6.20	0.25				0.70			
	20.0		6.24	0.30				1.59			
	22.0		6.49	0.55				0.50			
	24.0		6.40	0.45				1.33			
	26.0		6.42	0.45				1.39			
	28.0		6.53	0.60				1.19			
	30.0		6.51	0.60				1.24			
	32.0		6.53	0.60				1.16			
	34.0		6.36	0.40				1.62			
	36.0		6.25	0.30				0.19			
	38.0		6.28	0.35				1.82			
	40.0		6.02	0.10				0.16			
	42.0		6.24	0.30				1.54			
	44.0		6.01	0.10				0.27			
W	45.3		5.92								
G	47.5		5.14								
LS	51.6		4.92								
TOTALS:											

End of Measurement	Time: 4:00	Gage Reading: 0.5 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: Willow Creek						CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: 100 ft downstream from BLM - private boundary at BLM cabin						
DATE: 7-19-06	OBSERVERS: K. Smith, P. Belcher					
LEGAL DESCRIPTION	¼ SECTION: NE SW	SECTION: 20	TOWNSHIP: 3 (N/S)	RANGE: 77 E/W	PM: 6	
COUNTY: Grand	WATERSHED: Colorado	WATER DIVISION: 5	DOW WATER CODE: 23595			
MAP(S): USGS: Cabin Creek 7.5'						
USFS:						

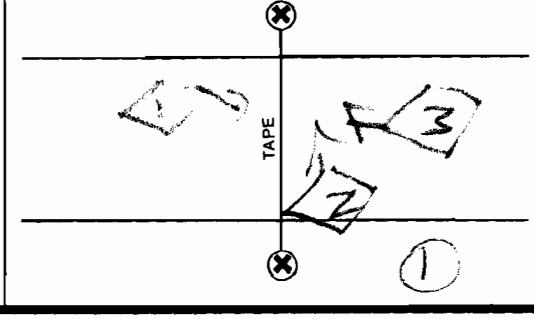
SUPPLEMENTAL DATA

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: 6" to 2-foot boulders	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	
(2) WS Upstream	20.0	5.26
(3) WS Downstream	20.0	5.66
SLOPE	0.4 / 40.0 = 0.010	

SKETCH



LEGEND:
- Stake (⊗)
- 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

pH: 8.2

TDS: 100

Temp: 64°F

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Willow Creek	CROSS-SECTION NO: 1	DATE: 7/17/96	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: 0.2 ft	TIME: 1:30 p.m.

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)
S (RB)	0.0		3.14								
G	1.5		4.03								
	3.0		4.87								
W	4.5		5.42								
	[illegible]		5.74	0.3				0			
	7.0		6.01	0.6				0.73			
	9.0		5.77	0.35				0.28			
	11.0		5.80	0.4				1.41			
	13.0		5.81	0.4				1.63			
	15.0		6.21	0.8				1.63			
	17.0		6.10	0.7				1.45			
	19.0		6.12	0.7				1.42			
	21.0		6.15	0.7				0.39			
	23.0		5.89	0.5				2.13			
	[illegible]		5.85	0.45				1.87			
	[illegible]		5.82	0.4				2.64			
	[illegible]		5.87	0.45				2.10			
	31.0		5.81	0.4				1.41			
	33.0		6.00	0.6				0.93			
	[illegible]		5.81	0.4				1.81			
	37.0		6.04	0.65				0.90			
	39.0		6.96	0.55				1.64			
	41.0		5.86	0.45				0.81			
	43.0		5.65	0.25				0.44			
	45.0		5.54	0.15				0.91			
W	46		5.40								
	49.5		4.43								
G	53.5		4.02								
	51.6		4.19								
RB	55.1		3.90								
TOTALS:											

End of Measurement	Time: 2:15	Gage Reading: ___ ft	CALCULATIONS PERFORMED BY:	CALCULATIONS CHECKED BY:

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO WATER CONSERVATION BOARD

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Willow Creek					CROSS-SECTION NO.: 2
CROSS-SECTION LOCATION: 400 ft. downstream from BLM/private boundary near BLM cabin					
DATE: [illegible]	OBSERVERS: R. Smith, P. Belcher				
LEGAL DESCRIPTION	¼ SECTION: NE SW	SECTION: [illegible]	TOWNSHIP: 3 N/S	RANGE: 77 E/W	PM: 6th
COUNTY: Grand	WATERSHED: [illegible]		WATER DIVISION: 5	DOW WATER CODE: 23595	
MAP(S):	USGS: Cabin Creek 7.5'				
	USFS:				

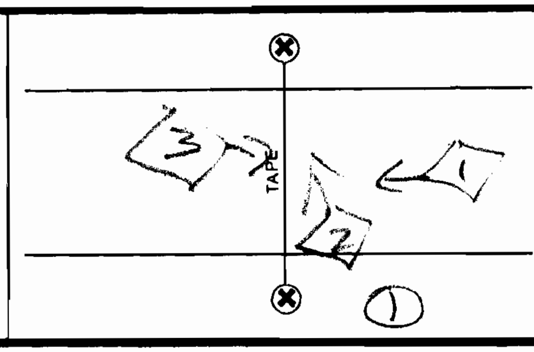
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / NO	METER TYPE: [illegible] McBirney			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ______ sec	TAPE WEIGHT: ______ lbs/foot [illegible]	TAPE TENSION: ______ lbs [illegible]
CHANNEL BED MATERIAL SIZE RANGE: 6" cobbles to 2' foot boulders		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	5.43 [illegible] 46
② WS Upstream	20.0	5.08
③ WS Downstream	20.0	5.96
SLOPE	0.88/40.0 = 0.022	

SKETCH



LEGEND:

Stake ⊗

Station ①

Photo

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

pH 8.2

TDS: 100

Temp: 62°F

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Willow Creek | CROSS-SECTION NO.: 2 | DATE: 7-19-06 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: 0.3 ft | TIME: 2:35

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)
S	0.0		3.66								
G	2.0		4.26								
W	3.0		5.43								
	5.0		5.90	0.45				1.82			
	7.0		5.94	0.5				2.48			
	9.0		6.07	0.6				2.53			
	11.0		5.75	0.5				2.49			
	13.0		6.01	0.55				0.87			
	15.0		5.73	0.3				1.67			
	17.0		5.98	0.5				1.10			
	19.0		5.74	0.3				1.62			
	21.0		5.97	0.5				2.06			
	23.0		6.00	0.55				1.91			
	25.0		5.89	0.45				1.27			
	27.0		5.71	0.25				1.24			
	29.0		5.56	0.10				1.30			
	31.0		5.76	0.35				1.73			
	33.0		5.67	0.20				2.16			
	35.0		6.06	0.60				0.94			
	37.0		5.77	0.3				0.38			
	39.0		5.60	0.15				0.07			
	41.0		5.55	0.1				0			
W	41.9'		5.16								
	43.9'		4.91								
S, G	56		3.56								
(Bank)											
TOTALS:											

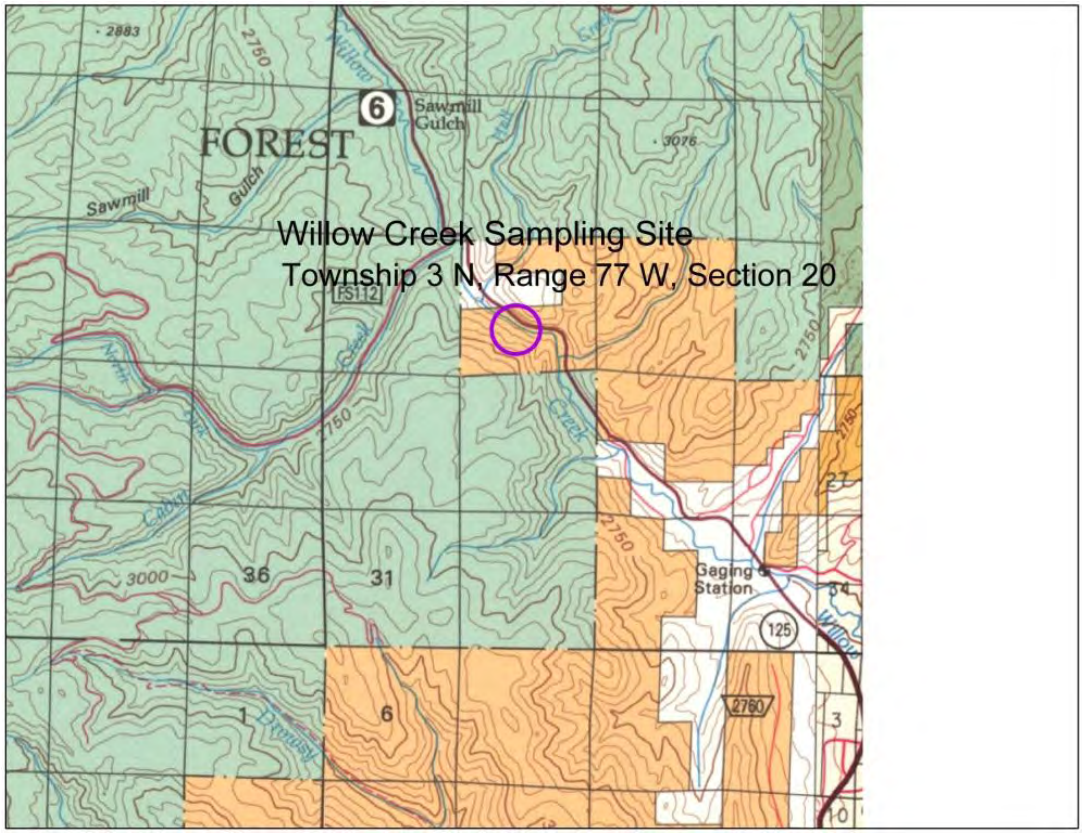
End of Measurement | Time: 3:10 | Gage Reading: 0.3 ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

Kremmling Field Office Stream Surveys
October 2006

Willow Creek - Water Code #22830

Willow Creek, located north of Hot Sulphur Springs, CO and located on BLM lands managed by the Kremmling Field Office was sampled on October 12, 2006. Willow Creek is tributary to Willow Creek Reservoir and then 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 21 fish were collected, 7 brown trout, 2 brook trout and 12 sculpin. See the data sheet below for size class distributions.


Willow Creek Sampling Site
Township 3 N, Range 77 W, Section 20
FOREST
Sawmill Gulch
FS112
Gaging Station
125
2760
36
31
6
1
3000
2750

FISH SAMPLING FORM

WATER Willow Creek CODE 22830 DATE 10-12-06

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

(mm)

species	length	weight	mark		species	length	weight	mark
BRN	360							
BRN	412							
BRK	365							
BRN	234							
BRN	243							
BRK	226							
MOSC	88							
MOSC	87							
MOSC	62							
MOSC	73							
BRN	81							
BRN	421							
BRN	388							
MOSC	102							
MOSC	53							
MOSC	105							
MOSC	71							
MOSC	69							
MOSC	58							
MOSC	85							
MOSC	101							

GPS Location:

Notes (water temp, etc.):

Abundant MOSC – did not attempt to capture all

21 total fish: 7 brown trout (*Salmo trutta* morpha *fario*); 2 brook trout (*Salvelinus fontinalis*); 12 mottled sculpin (*Cottus bairdi*)