

Stream: Mule Creek

Executive Summary

Water Division: 5

Water District: 51

CDOW#: 23438

CWCB ID: 08/5/A-007

Segment: Confluence S. Fork Mule Creek to Confluence Lost Creek

Upper Terminus: CONFLUENCE WITH SOUTH FORK MULE CREEK

(Latitude 39° 53' 46.78"N) (Longitude 106° 8' 54.72"W)

Lower Terminus: CONFLUENCE WITH LOST CREEK

(Latitude 39° 55' 16.12"N) (Longitude 106° 7' 33.44"W)

Watershed: Colorado headwaters (HUC#: 14010001)

Counties: Grand

Length: 2.25 miles

USGS Quad(s): Battle Mountain

Flow Recommendation: 1.2 cfs (April 1 - October 31)

1.0 cfs (November 1 - March 31)



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 Mule Creek to the CWCB for inclusion into the Instream Flow Program. Mule Creek is being considered for inclusion into the Instream Flow Program because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Mule Creek is approximately 6 miles long. It begins on the northeast flank of the Williams Fork Mountains within the Arapaho National Forest at an elevation of approximately 10750 feet and terminates at the confluence with Lost Creek at an elevation of approximately 8350 feet. Approximately 99% of the land on the 2.25 mile segment addressed by this report is publicly owned. Mule Creek is located within Grand County. The total drainage area of the creek is approximately 7.34 square miles. Mule Creek generally flows in a northeasterly direction.

The subject of this report is a segment of Mule Creek beginning at the confluence with South Fork Mule Creek and extending downstream to the confluence with Lost Creek. The proposed segment is located approximately 16 miles southeast of Kremmling. The staff has received only one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Instream Flow Recommendation(s)

BLM recommended 1.2 cfs, summer, and 1.0 cfs, winter, based on its June 19, 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 South Fork Mule Creek	Confluence with Lost Creek	2.25	1%	99%

89% of the public lands are managed by the BLM and 11% of the public lands are managed by the U.S. Forest Service.

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 “Mule Creek is a low gradient stream with small substrate size. The stream is punctuated with numerous beaver ponds among dense willows, separated by short reaches of riffle habitat. The creek is often confined by a steep ridgeline on the southeast side, but the stream has some opportunity for natural meanders in the meadow on the northeast side of the creek. The riparian community provides substantial shading and nutrient supply for the creek, and it provides numerous pools and bank overhangs for the fish population. Fishery surveys indicate that the creek supports a self-sustaining population brook trout, as evidenced by a broad range of age classes”.

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, two 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: Mule Creek R2Cross Summary

Party	Date	Q (cfs)	Confidence Intervals	Recommended Flows (cfs)	
			250%-40%	Summer (3/3)	Winter (2/3)
BLM	06/19/2006	0.86	2.1 – 0.3	1.30	0.86
BLM	06/19/2006	1.20	3.0 – 0.5	1.15	1.09

BLM = Bureau of Land Management

The summer flow recommendation, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model is 1.2 cfs (See Table 1). The winter flow recommendation, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model is 1.0 cfs. These recommendations were derived by averaging the results of the two 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 **Mule Creek** no such gage is available at the LT. In fact, there is no gage on Mule Creek. It is thus necessary to describe the normal flow regime at the Mule Creek LT through a "representative" gage station. The gage station selected for this was DARLING CREEK NEAR LEAL, CO (USGS 09035800), a gage with a 41 year period of record (POR) collected between 1965 and 2006. The gage is at an elevation of 8,940 ft above mean sea level (amsl) and has a drainage area of 8.76 mi². The hydrograph (plot of discharge over time) produced by this gage includes virtually no upstream consumption through diversions. To produce the hydrograph needed for Mule Cr, the discharge values in the Darling Creek hydrograph were multiplied by the ratio of Mule Creek basin area (7.34 mi² above the LT) to Darling Creek near Leal, CO basin area (8.76 mi²). As noted above, no adjustments for losses to diversions were needed in the

Darling Creek basin. However, there are consumptive losses from diversions upstream of the Mule Creek LT. As a result, after the proportional hydrograph for Mule Creek was created, the computed discharge values were reduced by the amounts of upstream consumptive use.

The following hydrograph depicts the mean monthly discharge of Mule Creek (proportioned off Darling Creek near Leal). 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 - Mule Creek Mean Monthly Discharge (proportioned of Darling Cr nr Leal) & ISFs

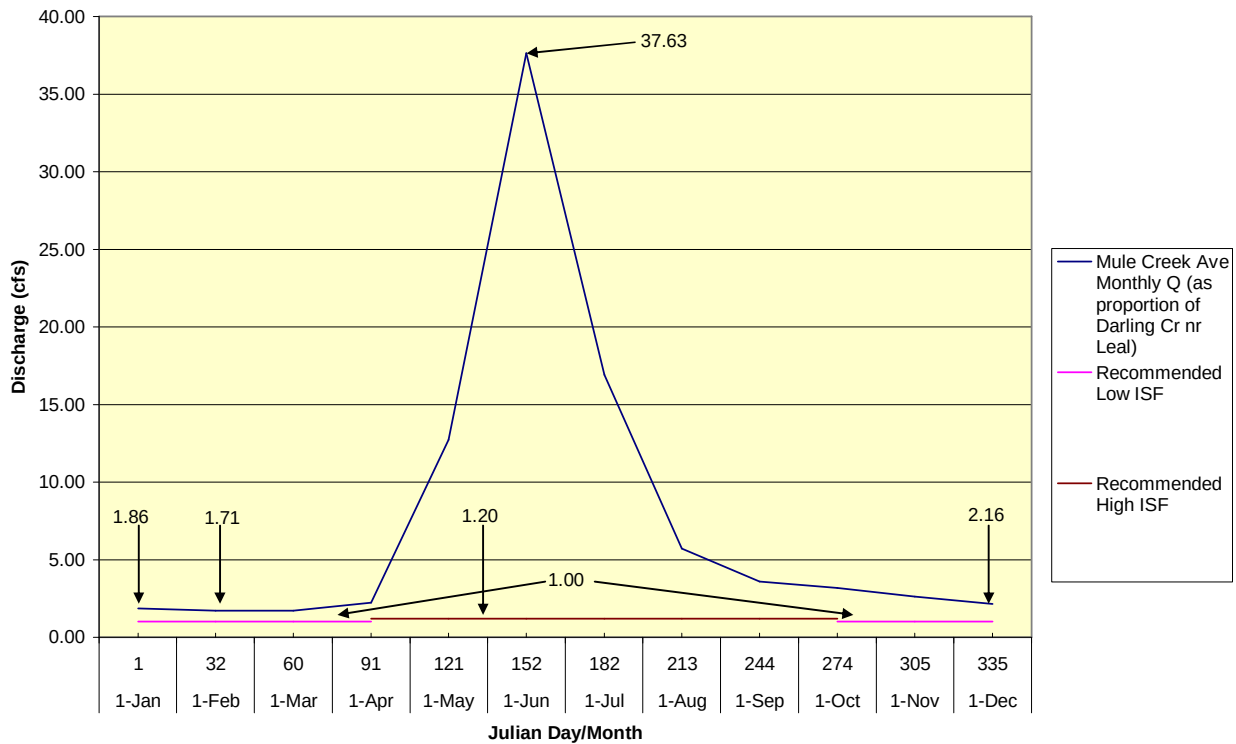


Table 2 – Mean Monthly Discharge and Recommended Instream Flows – Mule Cr.

Month	Julian Day	Mule Creek (cfs)	Recommended ISFs (cfs)
1-Jan	1	1.86	1.00
1-Feb	32	1.71	1.00
1-Mar	60	1.72	1.00
31-Mar	90	1.72	1.00
1-Apr	91	2.23	1.20
1-May	121	12.72	1.20
1-Jun	152	37.63	1.20
1-Jul	182	16.91	1.20
1-Aug	213	5.70	1.20
1-Sep	244	3.57	1.20
1-Oct	274	3.19	1.20
31-Oct	304	3.19	1.20
1-Nov	305	2.60	1.00
1-Dec	335	2.16	1.00

Existing Water Right Information

Staff has analyzed the water rights tabulation to identify any potential water availability problems. Historic records show that there were multiple decreed diversions from Mule Creek for irrigation purposes, including Mule Creek No. 1 Ditch, Mule Creek No. 2 Ditch, John Shore Ditch, John Shore #1 Ditch, and Burtcher Ditch. The ditches formerly irrigated lands are now owned by BLM. The water rights were purchased by Climax Molybdenum Company for conversion to augmentation uses for the Climax Molybdenum mine, which is located further upstream in the Williams Fork Watershed. Climax decreed an augmentation plan in case number 96CW3681, and these rights are no longer available for irrigation use. Based on this analysis staff has determined that water is available for appropriation on Mule Creek, between the confluence with South Fork Mule Creek and the Confluence with Lost Creek, 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: Confluence S. Fork Mule Creek to Confluence Lost Creek

Upper Terminus: CONFLUENCE WITH SOUTH FORK MULE CREEK

(Latitude 39° 53' 46.78"N) (Longitude 106° 8' 54.72"W)

UTM = 4416882.1 N UTM = 401812.3 E

S8 T2S R78W 6PM

Lower Terminus: CONFLUENCE WITH LOST CREEK

(Latitude 39° 55' 16.12"N) (Longitude 106° 7' 33.44"W)

UTM = 4419611.9 N UTM = 403777.2 E

SW SW S33 T1S R78W 6PM

1200' East of the West Section Line; 60' North of the South Section Line

Watershed: Colorado headwaters (HUC#: 14010001)

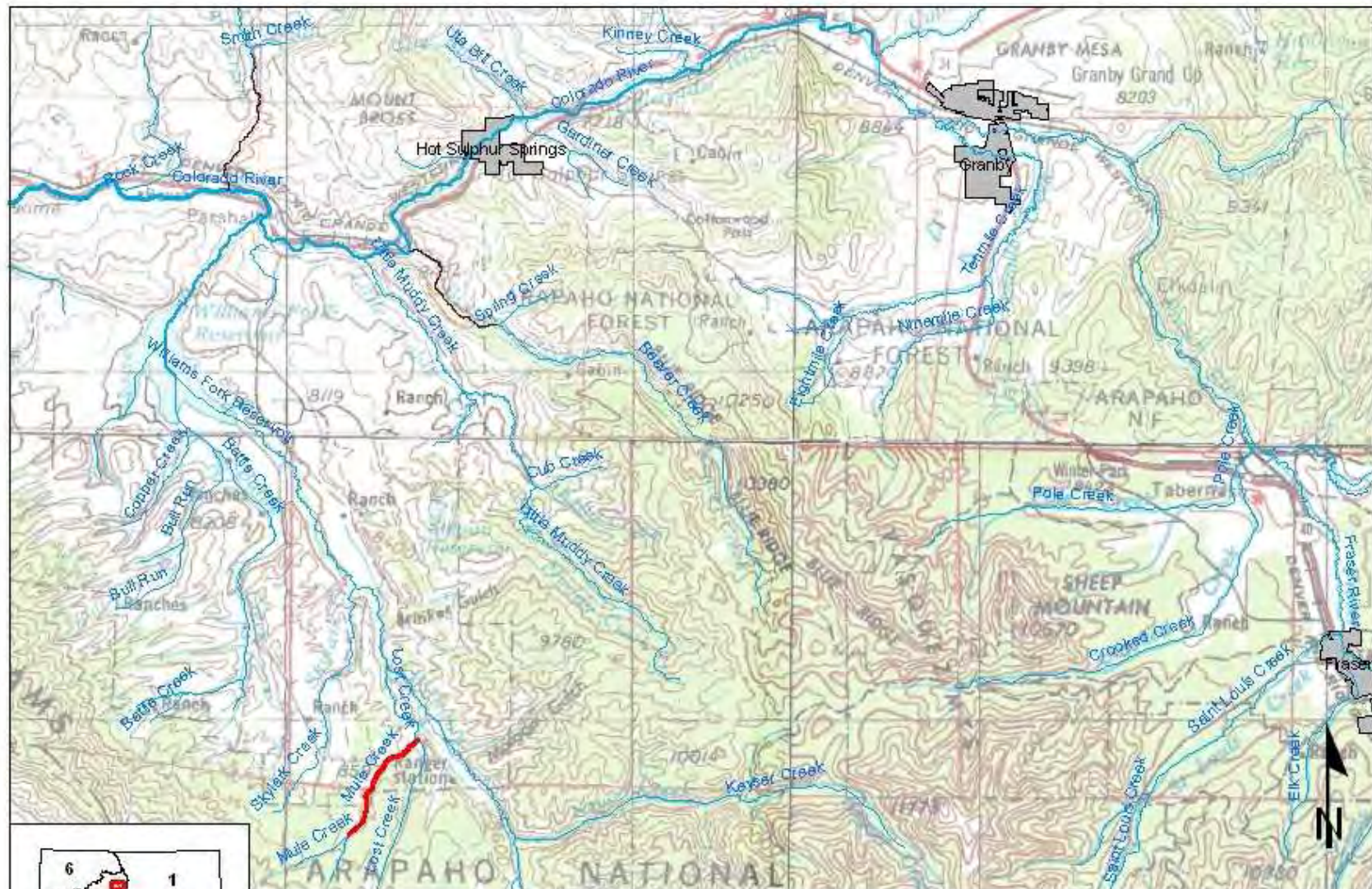
Counties: Grand

Length: 2.25 miles

USGS Quad(s): Battle Mountain

Flow Recommendation: 1.2 cfs (April 1 - October 31)
1.0 cfs (November 1 - March 31)

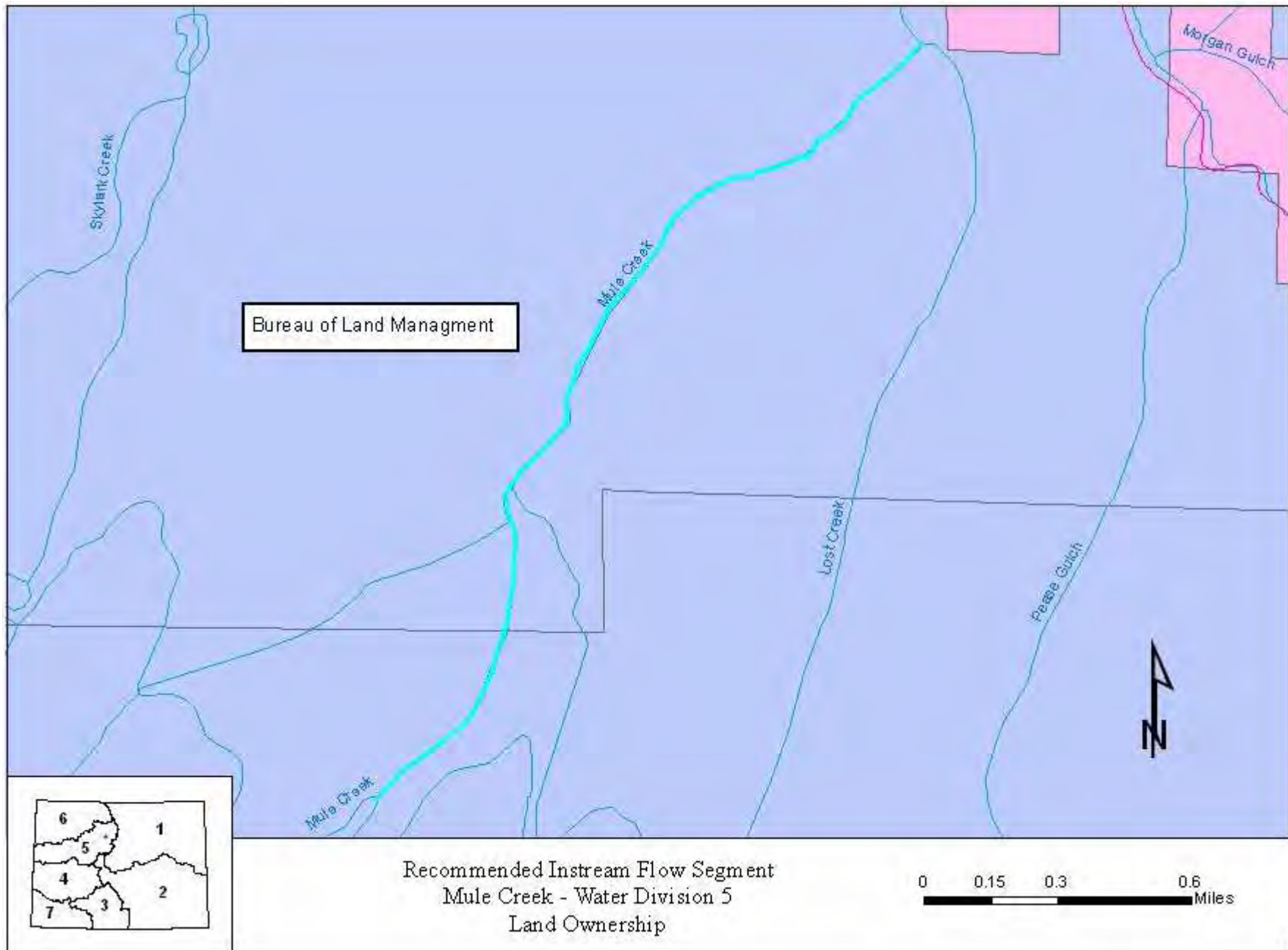
Vicinity Map



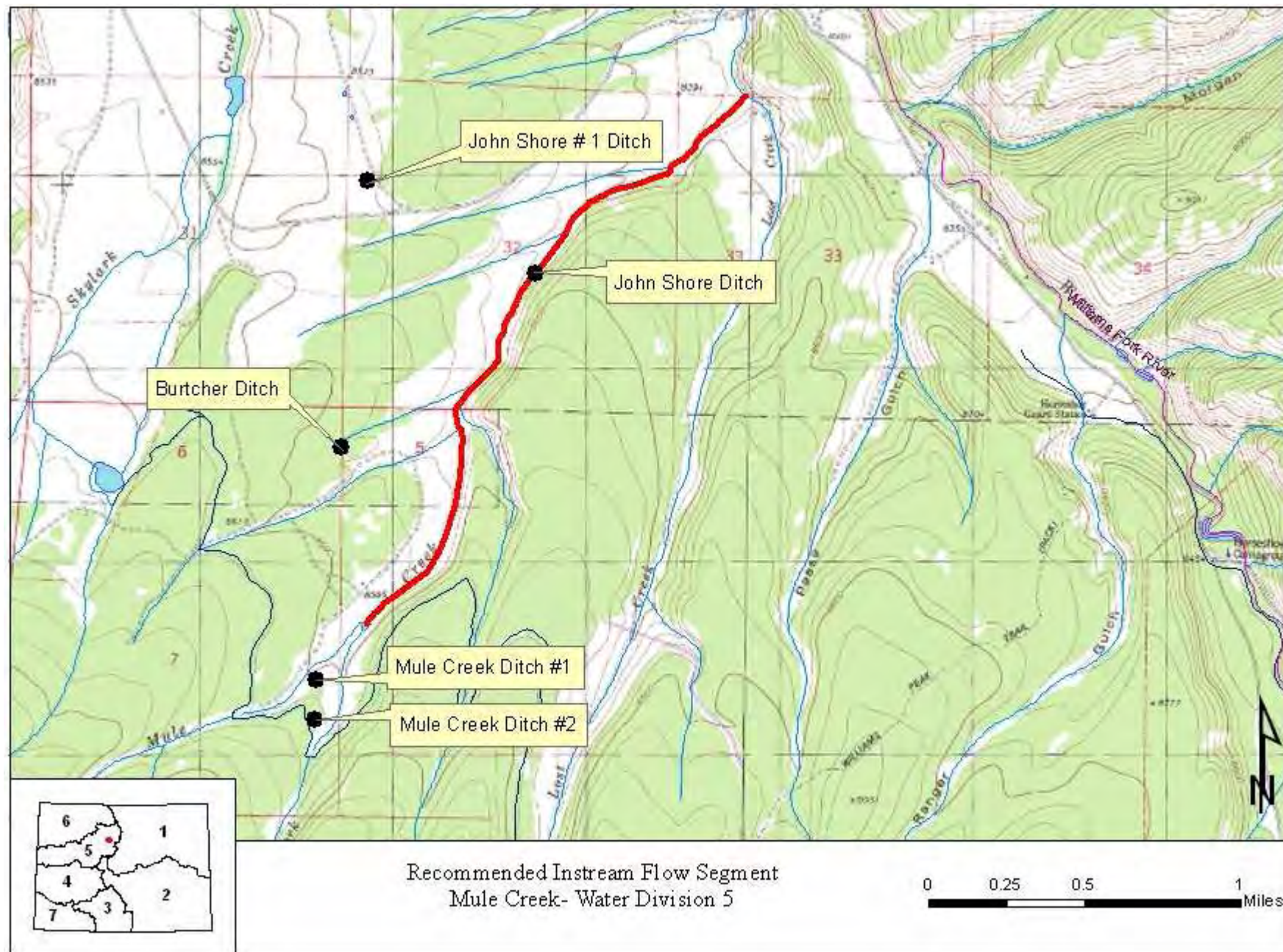
Recommended Instream Flow Segment
Mule Creek - Water Division 5

0 1 2 4
Miles

Land Use Map



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 26 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 instream flow recommendation for Mule Creek, located in Water Division 5.

Location and Land Status. Mule Creek is tributary to Lost Creek and the Williams Fork River approximately six miles upstream from Williams Fork Reservoir. The creek is located within the upper Colorado River watershed in Grand County. This recommendation covers the stream reach beginning at the confluence of Mule Creek and South Fork Mule Creek, and extends downstream to the confluence of Mule Creek with Lost Creek. All of the land along the creek is federally owned and managed, with the exception of the last 120 feet of the creek before the confluence with Lost Creek. The U.S. Forest Service manages the uppermost ¼ mile of the reach, while the BLM manages the remainder. The BLM acquired the land along the creek in 1994, from the Daniel L. Ritchie Foundation.

Biological Summary. This reach of Mule Creek is a low gradient stream with small substrate size. The stream is punctuated with numerous beaver ponds among dense willows, separated by short reaches of riffle habitat. The creek is often confined by a steep ridgeline on the southeast side, but the stream has some opportunity for natural meanders in the meadow on the northwest side of the creek. The riparian community provides substantial shading and nutrient supply for the creek, and it provides numerous pools and bank overhangs for the fish population. Fishery surveys indicate that the creek supports a self-sustaining population brook trout, as evidenced by a broad range of age classes.

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

- 1.20 cubic feet per second is recommended during the high temperature period from April 1 through October 31. This recommendation is driven by the average velocity and wetted perimeter criteria. Because the creek is characterized by short riffles between numerous beaver ponds, it is very important to maintain adequate velocity and depth in the limited riffle habitat.
- 1.0 cubic feet per second is recommended for the cold temperature period from November 1 through March 31. This recommendation is driven by the depth criteria. This flow will allow passage between pools during the winter, and should prevent complete icing of the water column.

Water Availability. Historic records show that there were multiple decreed diversions from Mule Creek for irrigation purposes, including Mule Creek No. 1 Ditch, Mule Creek No. 2 Ditch, John Shore Ditch, John Shore #1 Ditch, and Burtcher Ditch. The ditches formerly irrigated lands that are now owned by BLM. The water rights were purchased by Climax Molybdenum Company for conversion to augmentation uses for the Climax Molybdenum mine, which is located further upstream in the Williams Fork watershed. Climax decreed an augmentation plan in case number 96 CW 3681 and these water rights are no longer available for irrigation use.

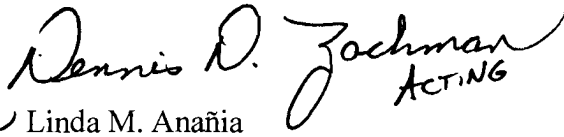
For water availability analysis, BLM recommends using the Williams Fork stream gage above Darling Creek, near Leal, Colorado (USGS Gage 09035700). This gage is located close to Mule Creek within the Williams Fork watershed, and it measures discharge from an area with similar elevation, aspect, and precipitation patterns. In addition, the gage has a 40-year period of record.

Relationship to Management Plans. In the future, BLM will manage this parcel to emphasize riparian and recreation values. Grazing management has been changed to foster recovery of the riparian community and to decrease the width to depth ratio of the stream, with the goal of creating additional fish habitat. The parcel has high recreation values because it is easily accessed from county roads, and because it provides one of the only public access routes to the east side of the Williams Fork Mountains. BLM believes instream flow protection is justified by the high public visibility and improving aquatic conditions on this parcel.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included 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,


for Linda M. Anañia
Deputy State Director
Resources and Fire

cc: Dave Stout, Kremmling FO
Paula Belcher, Kremmling FO
Tom Freques, Glenwood Springs FO



FIELD DATA FOR INSTREAM FLOW DETERMINATIONS



COLORADO WATER
CONSERVATION BOARD

LOCATION INFORMATION

STREAM NAME: Mule Creek		CROSS-SECTION NO.: 1	
CROSS-SECTION LOCATION: 150' upstream from headgate			
DATE: 6-19-00		OBSERVERS: R. Smith, P. Belcher	
LEGAL DESCRIPTION	1/4 SECTION: NW	SECTION: 33	TOWNSHIP: 1 N/S
COUNTY: Grand		WATERSHED: Colorado	RANGE: 78 E/W
WATER DIVISION: 5		PM: 611	
DOW WATER CODE: 23438			
MAP(S):	USGS: Battle Mtn. 7.5'	Zone 13	0403141
	USFS:		4417145

SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES) NO	METER TYPE: Marsh-McBrenny			
METER NUMBER:	DATE RATED:	CALIB/SPIN: sec	TAPE WEIGHT: surveyed lbs/foot	TAPE TENSION: surveyed lbs
CHANNEL BED MATERIAL SIZE RANGE: sand to 2" cobbles		PHOTOGRAPHS TAKEN (YES/NO)	NUMBER OF PHOTOGRAPHS: 3	

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	6.96/6.96
(2) WS Upstream	23.0	6.80
(3) WS Downstream	8.0	7.02
SLOPE: 0.22/31.0 = 0.007		

SKETCH

LEGEND:

Stake (X)

Station (1)

Photo (1)

Direction of Flow (arrow)

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: 7.8	Abundant disk spotted
TDS = 60	
Temp: 58°F	

DISCHARGE/CROSS SECTION NOTES

[illegible]



LOCATION INFORMATION

STREAM NAME:		Mule Creek				CROSS-SECTION NO.:		2	
CROSS-SECTION LOCATION:		250' upstream from headgate							
DATE:		6-19-06		OBSERVERS:		R. Smith, P. Belcher			
LEGAL DESCRIPTION		1/4 SECTION:		SECTION:		TOWNSHIP:		RANGE:	
		NW		33		1 N 5		79 E 10	
COUNTY:		WATERSHED:		WATER DIVISION:		DOW WATER CODE:		PM:	
Grand		Colorado		5		23438			
MAP(S):		USGS: Battle Mtn. 7.5'							
		USFS:							

SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: ☒ YES / ☐ NO		METER TYPE: Marsh-Murray	
METER NUMBER:	DATE RATED:	CALIB/SPIN: _____ sec	TAPE WEIGHT: _____ lbs/foot
CHANNEL BED MATERIAL SIZE RANGE: sand to 2" cobbles		PHOTOGRAPHS TAKEN: YES/NO	TAPE TENSION: _____ lbs

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	6.81 / 6.81
②	WS Upstream	15.0	6.62
③	WS Downstream	14.0	7.24
SLOPE		0.62 / 29.0 = 0.0213	

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-7.8
TUS. 60
Temp: 58° F

DISCHARGE/CROSS SECTION NOTES

[illegible]

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

LOCATION INFORMATION

STREAM NAME: Mule Creek
XS LOCATION: 150 ft. upstream from headgate
XS NUMBER: 1

DATE: 19-Jun-06
OBSERVERS: R. Smith, P. Belcher

1/4 SEC: NW 1/4
SECTION: 33
TWP: 1 N
RANGE: 78 W
PM: 6th

COUNTY: Grand
WATERSHED: Colorado
DIVISION: 5
DOW CODE: 23438

USGS MAP: Battle Mtn. 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: 0.007

INPUT DATA CHECKED BY:DATE.....

ASSIGNED TO:DATE.....

STREAM NAME: Mule Creek
 XS LOCATION: 150 ft. upstream from headgate
 XS NUMBER: 1

DATA POINTS= 24

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	0.0%
1 G	2.30	6.12			0.00		0.00	0.00	0.0%
W	2.40	6.96			0.00		0.00	0.00	0.0%
	2.50	7.13	0.20	0.09	0.20	0.20	0.04	0.00	0.4%
	2.80	7.15	0.20	0.38	0.30	0.20	0.06	0.02	2.7%
	3.10	7.15	0.20	0.66	0.30	0.20	0.06	0.04	4.8%
	3.40	7.11	0.15	0.55	0.30	0.15	0.05	0.02	2.9%
	3.70	7.11	0.15	0.88	0.30	0.15	0.05	0.04	4.6%
	4.00	7.20	0.25	1.25	0.31	0.25	0.08	0.09	10.9%
	4.30	7.27	0.30	1.39	0.31	0.30	0.09	0.13	14.6%
	4.60	7.26	0.30	1.33	0.30	0.30	0.09	0.12	14.0%
	4.90	7.26	0.30	1.42	0.30	0.30	0.09	0.13	14.9%
	5.20	7.12	0.15	0.87	0.33	0.15	0.05	0.04	4.6%
	5.50	7.09	0.15	0.81	0.30	0.15	0.05	0.04	4.3%
	5.80	7.05	0.10	0.65	0.30	0.10	0.03	0.02	2.3%
	6.10	7.06	0.10	0.73	0.30	0.10	0.03	0.02	2.6%
	6.40	7.10	0.15	0.75	0.30	0.15	0.05	0.03	3.9%
	6.70	7.19	0.25	0.62	0.31	0.25	0.08	0.05	5.4%
	7.00	7.20	0.25	0.66	0.30	0.25	0.08	0.05	5.8%
	7.30	7.24	0.30	0.23	0.30	0.30	0.06	0.01	1.6%
W	7.40	6.96			0.30		0.00	0.00	0.0%
1 G	7.50	6.11			0.00		0.00	0.00	0.0%
	10.40	5.02			0.00		0.00	0.00	0.0%
S	11.80	4.59			0.00		0.00	0.00	0.0%

TOTALS -----

5.37 0.3 1.00 0.86 100.0%
 (Max.)

Manning's n = 0.0473
 Hydraulic Radius= 0.18610296

STREAM NAME: Mule Creek
 XS LOCATION: 150 ft. upstream from headgate
 XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.00	0.97	-3.4%
6.71	1.00	2.22	122.3%
6.73	1.00	2.12	112.2%
6.75	1.00	2.02	102.1%
6.77	1.00	1.92	92.0%
6.79	1.00	1.82	81.9%
6.81	1.00	1.72	71.9%
6.83	1.00	1.62	61.8%
6.85	1.00	1.52	51.7%
6.87	1.00	1.42	41.7%
6.89	1.00	1.32	31.7%
6.91	1.00	1.22	21.6%
6.92	1.00	1.17	16.6%
6.93	1.00	1.12	11.6%
6.94	1.00	1.07	6.6%
6.95	1.00	1.02	1.6%
6.96	1.00	0.97	-3.4%
6.97	1.00	0.92	-8.4%
6.98	1.00	0.87	-13.4%
6.99	1.00	0.82	-18.4%
7.00	1.00	0.77	-23.3%
7.01	1.00	0.72	-28.3%
7.03	1.00	0.62	-38.2%
7.05	1.00	0.52	-48.0%
7.07	1.00	0.43	-57.2%
7.09	1.00	0.34	-65.6%
7.11	1.00	0.27	-73.4%
7.13	1.00	0.20	-79.8%
7.15	1.00	0.15	-85.1%
7.17	1.00	0.11	-89.1%
7.19	1.00	0.07	-92.7%
7.21	1.00	0.05	-95.5%

WATERLINE AT ZERO
 AREA ERROR = 6.953

STREAM NAME: Mule Creek
 XS LOCATION: 150 ft. upstream from headgate
 XS NUMBER: 1

Constant Manning's n

GL = lowest Grassline elevation corrected for sag

STAGING TABLE

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	5.20	1.01	1.15	5.25	7.07	100.0%	0.74	11.33	2.16
	6.15	5.19	0.98	1.12	5.08	7.00	99.1%	0.73	10.78	2.12
	6.20	5.18	0.93	1.07	4.82	6.90	97.6%	0.70	9.97	2.07
	6.25	5.17	0.88	1.02	4.56	6.80	96.2%	0.67	9.19	2.02
	6.30	5.16	0.83	0.97	4.30	6.70	94.8%	0.64	8.42	1.96
	6.35	5.14	0.79	0.92	4.04	6.60	93.4%	0.61	7.67	1.90
	6.40	5.13	0.74	0.87	3.79	6.49	91.9%	0.58	6.95	1.84
	6.45	5.12	0.69	0.82	3.53	6.39	90.5%	0.55	6.25	1.77
	6.50	5.11	0.64	0.77	3.27	6.29	89.1%	0.52	5.57	1.70
	6.55	5.10	0.59	0.72	3.02	6.19	87.7%	0.49	4.92	1.63
	6.60	5.08	0.54	0.67	2.77	6.09	86.2%	0.45	4.29	1.55
	6.65	5.07	0.50	0.62	2.51	5.99	84.8%	0.42	3.70	1.47
	6.70	5.06	0.45	0.57	2.26	5.89	83.4%	0.38	3.13	1.39
	6.75	5.05	0.40	0.52	2.01	5.79	82.0%	0.35	2.60	1.30
	6.80	5.04	0.35	0.47	1.76	5.69	80.5%	0.31	2.10	1.20
	6.85	5.03	0.30	0.42	1.50	5.59	79.1%	0.27	1.64	1.09
	6.90	5.01	0.25	0.37	1.25	5.49	77.7%	0.23	1.23	0.98
WL	6.95	5.00	0.20	0.32	1.00	5.39	76.2%	0.19	0.86	0.86
	7.00	4.96	0.15	0.27	0.75	5.28	74.7%	0.14	0.54	0.72
	7.05	4.79	0.11	0.22	0.50	5.05	71.4%	0.10	0.29	0.57
	7.10	3.82	0.08	0.17	0.29	4.01	56.7%	0.07	0.13	0.46
	7.15	2.04	0.07	0.12	0.14	2.15	30.4%	0.07	0.06	0.43
	7.20	1.30	0.04	0.07	0.05	1.35	19.1%	0.04	0.02	0.31
	7.25	0.69	0.01	0.02	0.01	0.69	9.8%	0.01	0.00	0.11

STREAM NAME: Mule Creek
 XS LOCATION: 150 ft. upstream from headgate
 XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.86 cfs
CALCULATED FLOW (Qc)=	0.86 cfs
(Qm-Qc)/Qm * 100 =	0.2 %
MEASURED WATERLINE (Wlm)=	6.96 ft
CALCULATED WATERLINE (Wlc)=	6.95 ft
(Wlm-Wlc)/Wlm * 100 =	0.1 %
MAX MEASURED DEPTH (Dm)=	0.30 ft
MAX CALCULATED DEPTH (Dc)=	0.32 ft
(Dm-Dc)/Dm * 100	-5.6 %
MEAN VELOCITY=	0.86 ft/sec
MANNING'S N=	0.047
SLOPE=	0.007 ft/ft
.4 * Qm =	0.3 cfs
2.5 * Qm=	2.1 cfs

RECOMMENDED INSTREAM FLOW:

=====

FLOW (CFS)

PERIOD

=====

=====

RATIONALE FOR RECOMMENDATION:

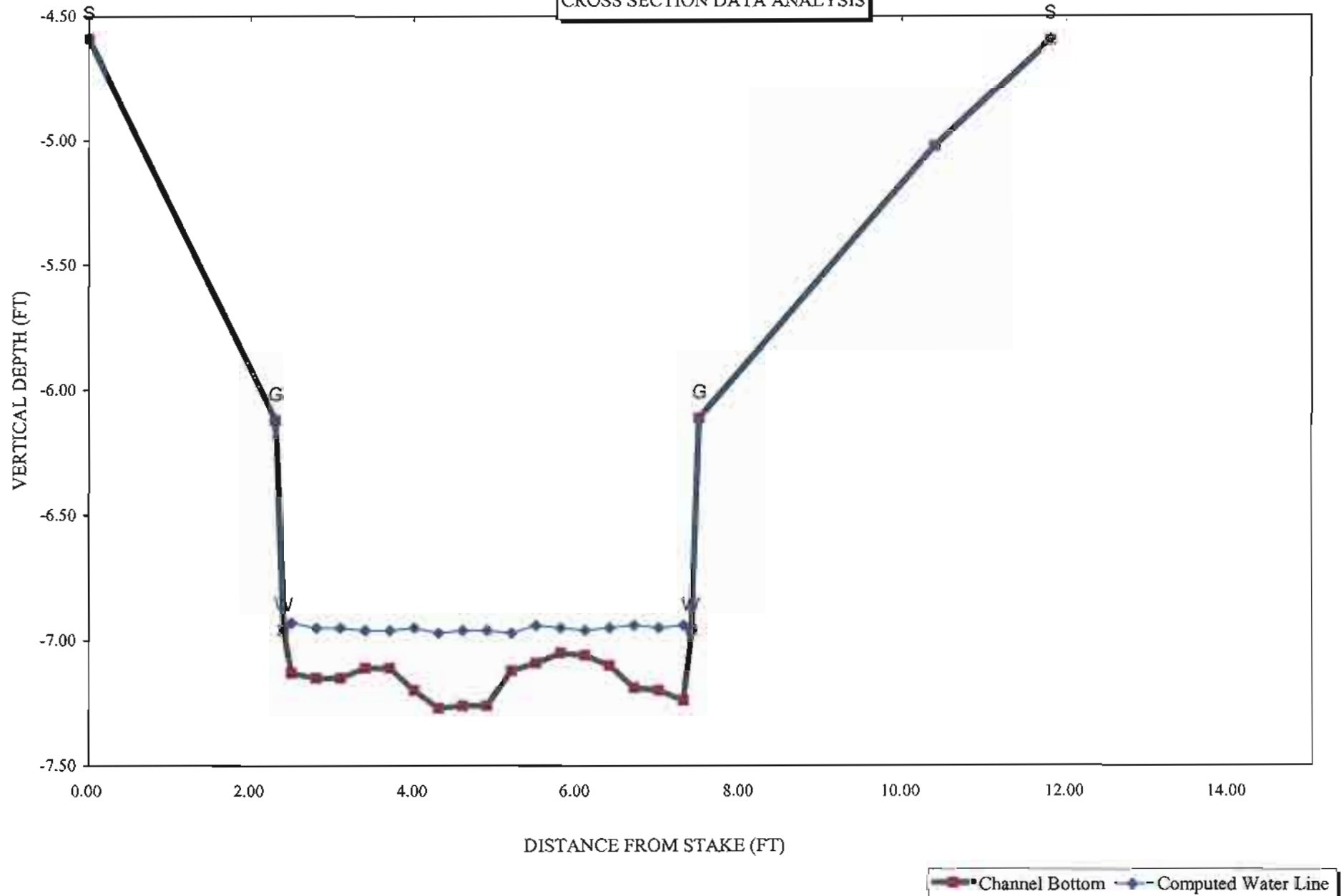
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RECOMMENDATION BY: AGENCY..... DATE:.....

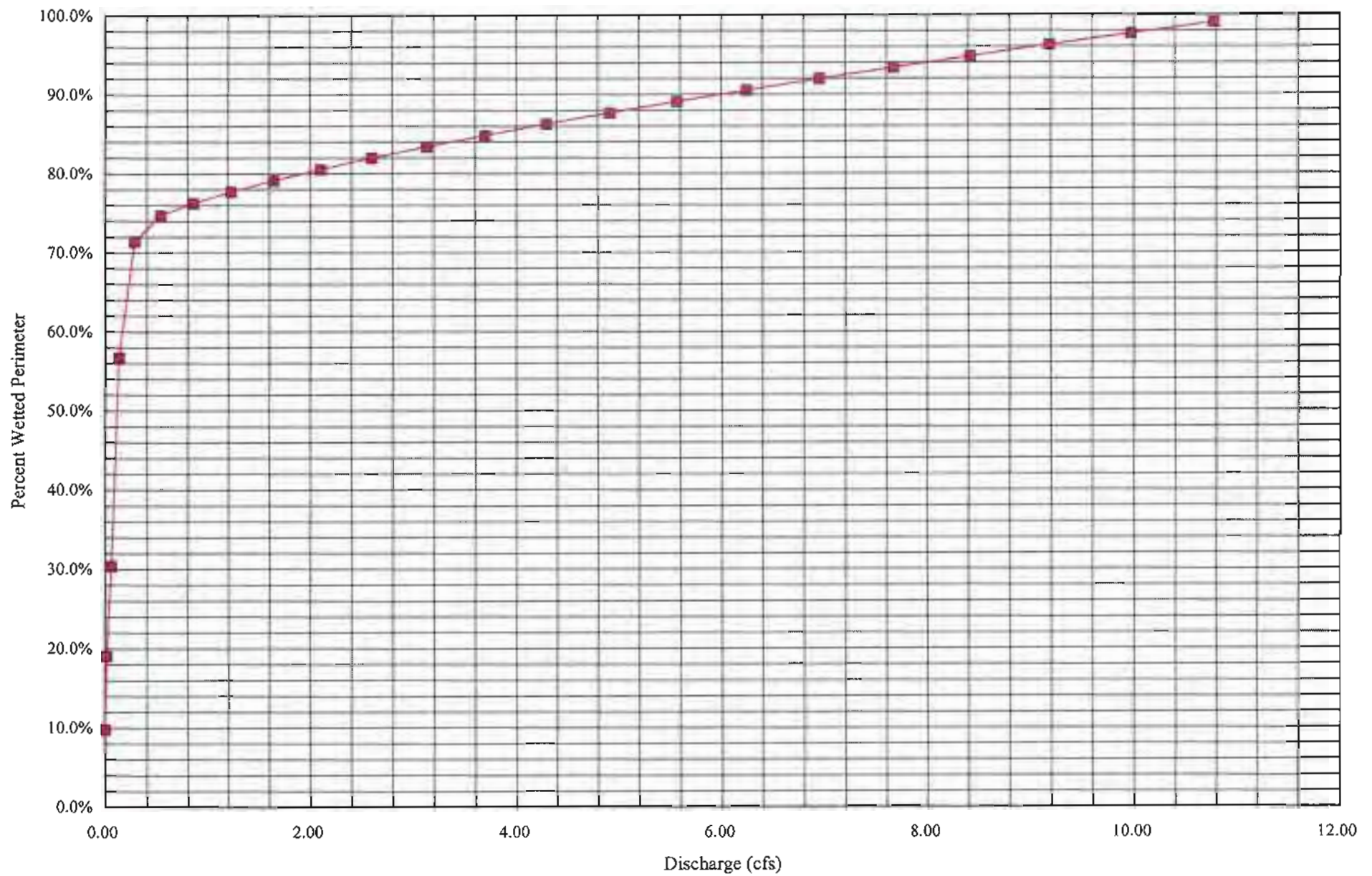
CWCB REVIEW BY: DATE:.....

Mule Creek

CROSS SECTION DATA ANALYSIS



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: Mule Creek
XS LOCATION: 250 ft. upstream from headgate
XS NUMBER: 2

DATE: 19-Jun-06
OBSERVERS: R. Smith, P. Belcher

1/4 SEC: NW 1/4
SECTION: 33 S
TWP: 1 S
RANGE: 78 W
PM: 6th

COUNTY: Grand
WATERSHED: Colorado
DIVISION: 5
DOW CODE: 23438

USGS MAP: Battle Mtn. 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: 0.0213

INPUT DATA CHECKED BY:DATE.....

ASSIGNED TO:DATE.....

STREAM NAME: Mule Creek
 XS LOCATION: 250 ft. upstream from headgate
 XS NUMBER: 2

DATA POINTS= 17

VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL
S	0.00	5.14		
1 G	1.10	5.81		
W	1.20	6.81		
	1.40	7.16		
	1.70	7.17	0.35	2.14
	2.00	7.11	0.35	1.75
	2.30	7.02	0.30	1.16
	2.60	7.03	0.20	1.33
	2.90	7.06	0.25	1.36
	3.20	7.04	0.25	2.15
	3.50	7.00	0.25	1.99
	3.80	7.00	0.20	2.09
	4.10	6.87	0.20	1.85
W	4.60	6.81	0.05	0.00
	5.40	6.50		
G	7.00	5.78		
S	11.30	4.60		

WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
0.00		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%
0.30	0.35	0.11	0.22	17.6%
0.31	0.35	0.11	0.18	14.4%
0.31	0.30	0.09	0.10	8.2%
0.30	0.20	0.06	0.08	6.2%
0.30	0.25	0.08	0.10	8.0%
0.30	0.25	0.08	0.16	12.6%
0.30	0.25	0.08	0.15	11.7%
0.30	0.20	0.06	0.13	9.8%
0.33	0.20	0.08	0.15	11.6%
0.50	0.05	0.03	0.00	0.0%
0.86		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%
0.00		0.00	0.00	0.0%

TOTALS -----

4.11 0.35 0.76 1.28 100.0%
 (Max.)

Manning's n = 0.0416
 Hydraulic Radius = 0.184180815

STREAM NAME: Mule Creek
 XS LOCATION: 250 ft. upstream from headgate
 XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.76	0.63	-16.8%
6.58	0.76	1.55	104.5%
6.60	0.76	1.47	94.0%
6.62	0.76	1.39	83.6%
6.64	0.76	1.31	73.4%
6.66	0.76	1.24	63.3%
6.68	0.76	1.16	53.3%
6.70	0.76	1.09	43.5%
6.72	0.76	1.01	33.8%
6.74	0.76	0.94	24.2%
6.76	0.76	0.87	14.8%
6.78	0.76	0.80	5.6%
6.79	0.76	0.77	1.0%
6.80	0.76	0.73	-3.5%
6.81	0.76	0.70	-8.1%
6.82	0.76	0.66	-12.5%
6.83	0.76	0.63	-16.8%
6.84	0.76	0.60	-21.0%
6.85	0.76	0.57	-25.1%
6.86	0.76	0.54	-29.0%
6.87	0.76	0.51	-32.9%
6.88	0.76	0.48	-36.6%
6.90	0.76	0.42	-44.0%
6.92	0.76	0.37	-51.3%
6.94	0.76	0.31	-58.4%
6.96	0.76	0.26	-65.4%
6.98	0.76	0.21	-72.2%
7.00	0.76	0.16	-78.8%
7.02	0.76	0.12	-84.4%
7.04	0.76	0.08	-88.8%
7.06	0.76	0.06	-91.7%
7.08	0.76	0.05	-93.8%

WATERLINE AT ZERO
 AREA ERROR = 6.792

STREAM NAME: Mute Creek
 XS LOCATION: 250 ft. upstream from headgate
 XS NUMBER: 2

Constant Manning's n

GL = lowest Grassline elevation corrected for sag

STAGING TABLE

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	5.81	5.83	0.92	1.36	5.35	7.20	100.0%	0.74	22.89	4.28
	5.84	5.76	0.90	1.33	5.16	7.09	98.5%	0.73	21.80	4.22
	5.89	5.64	0.86	1.28	4.88	6.92	96.1%	0.71	20.16	4.13
	5.94	5.53	0.83	1.23	4.60	6.75	93.7%	0.68	18.58	4.04
	5.99	5.41	0.80	1.18	4.33	6.58	91.3%	0.66	17.07	3.95
	6.04	5.29	0.77	1.13	4.06	6.40	88.9%	0.63	15.62	3.85
	6.09	5.18	0.73	1.08	3.80	6.23	86.5%	0.61	14.24	3.75
	6.14	5.06	0.70	1.03	3.54	6.06	84.1%	0.58	12.91	3.65
	6.18	4.95	0.67	0.98	3.29	5.89	81.7%	0.56	11.65	3.54
	6.24	4.83	0.63	0.93	3.05	5.71	79.3%	0.53	10.45	3.43
	6.29	4.71	0.60	0.88	2.81	5.54	77.0%	0.51	9.31	3.31
	6.34	4.60	0.56	0.83	2.58	5.37	74.6%	0.48	8.23	3.19
	6.39	4.48	0.52	0.78	2.35	5.20	72.2%	0.45	7.21	3.07
	6.44	4.37	0.49	0.73	2.13	5.03	69.8%	0.42	6.25	2.94
	6.49	4.25	0.45	0.68	1.91	4.85	67.4%	0.39	5.36	2.80
	6.54	4.12	0.41	0.63	1.70	4.67	64.8%	0.36	4.53	2.66
	6.59	3.98	0.38	0.58	1.50	4.48	62.2%	0.33	3.77	2.51
	6.64	3.85	0.34	0.53	1.30	4.29	59.6%	0.30	3.08	2.36
	6.69	3.72	0.30	0.48	1.12	4.10	57.0%	0.27	2.44	2.19
	6.74	3.58	0.26	0.43	0.93	3.91	54.3%	0.24	1.87	2.00
WL	6.79	3.45	0.22	0.38	0.76	3.73	51.7%	0.20	1.37	1.80
	6.84	3.11	0.19	0.33	0.59	3.35	46.5%	0.18	0.97	1.64
	6.89	2.80	0.16	0.28	0.45	3.00	41.7%	0.15	0.65	1.46
	6.94	2.66	0.12	0.23	0.31	2.82	39.2%	0.11	0.37	1.19
	6.99	2.51	0.07	0.18	0.18	2.64	36.6%	0.07	0.16	0.87
	7.04	1.34	0.06	0.13	0.08	1.42	19.8%	0.06	0.06	0.78
	7.09	0.70	0.05	0.08	0.04	0.75	10.4%	0.05	0.03	0.72
	7.14	0.45	0.02	0.03	0.01	0.46	6.4%	0.02	0.00	0.37

Mule Creek
250 ft. upstream from headgate
2

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.28 cfs
CALCULATED FLOW (Qc)=	1.37 cfs
(Qm-Qc)/Qm * 100 =	-6.8 %

MEASURED WATERLINE (W _m)=	6.83 ft
CALCULATED WATERLINE (W _c)=	6.79 ft
(W _m -W _c)/W _m * 100 =	0.6 %

MAX MEASURED DEPTH (Dm)=	0.35 ft
MAX CALCULATED DEPTH (Dc)=	0.38 ft
(Dm-Dc)/Dm * 100	-7.9 %

MEAN VELOCITY=	1.80 ft/sec
MANNING'S N=	0.042
SLOPE=	0.0213 ft/ft

.4 * Qm =	0.5 cfs
2.5 * Qm =	3.2 cfs

RECOMMENDED INSTREAM FLOW:

FLOW (CFS)					
PERIOD					

RATIONALE FOR RECOMMENDATION:

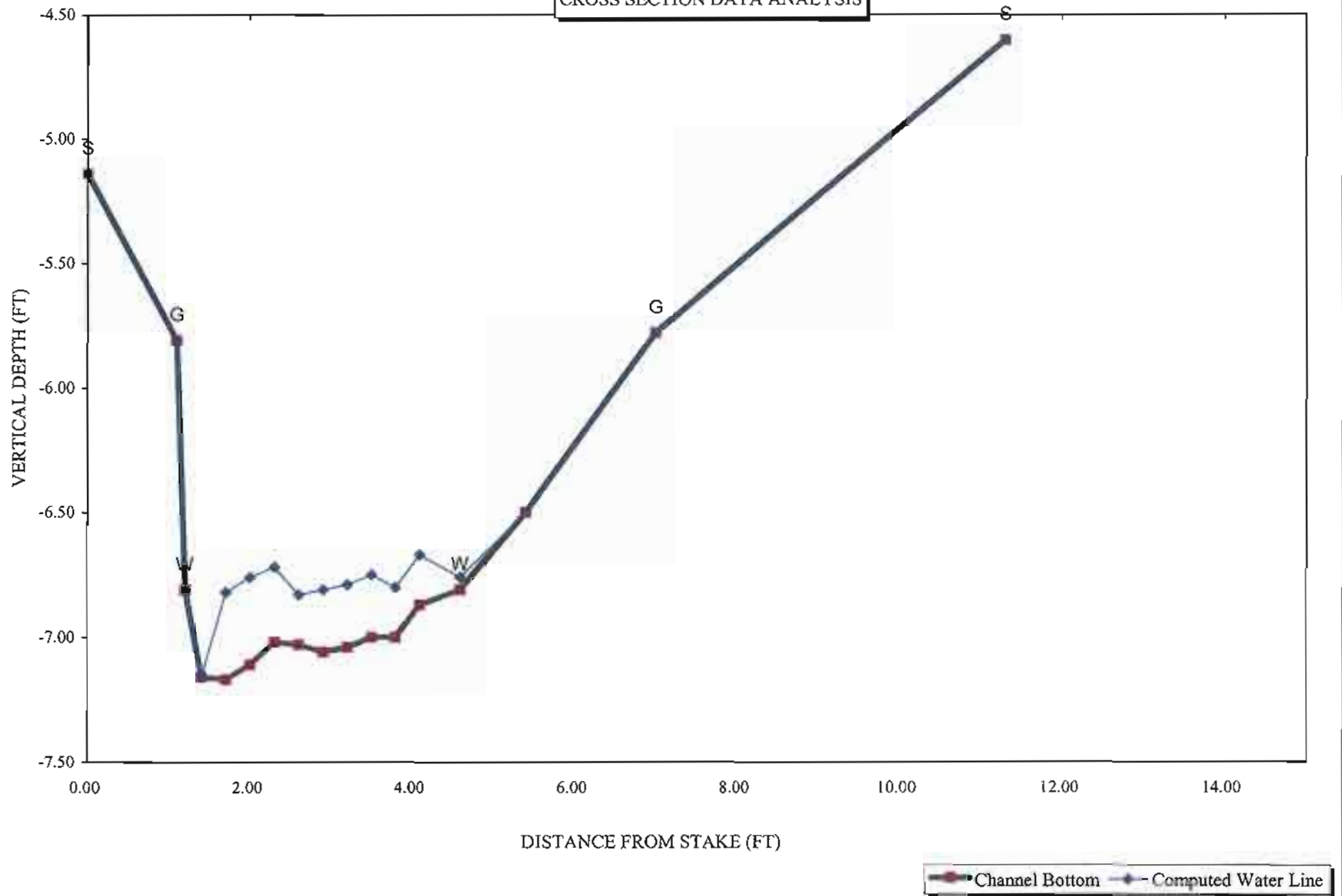
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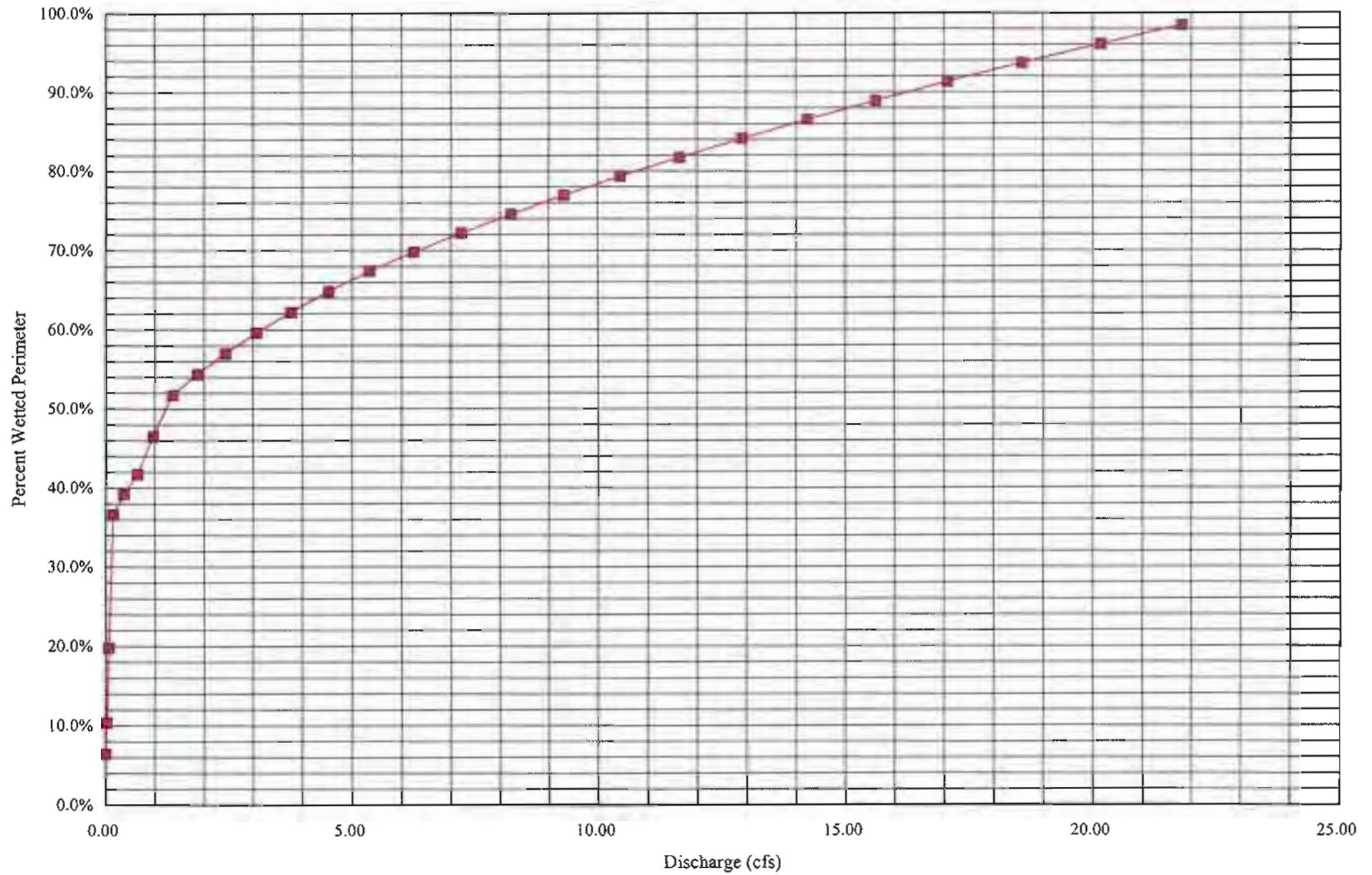
CVCB REVIEW BY: _____ DATE: _____

Mule Creek

CROSS SECTION DATA ANALYSIS



Percent Wetted Perimeter vs. Discharge



Kremmling Field Office Stream Surveys

October 2006

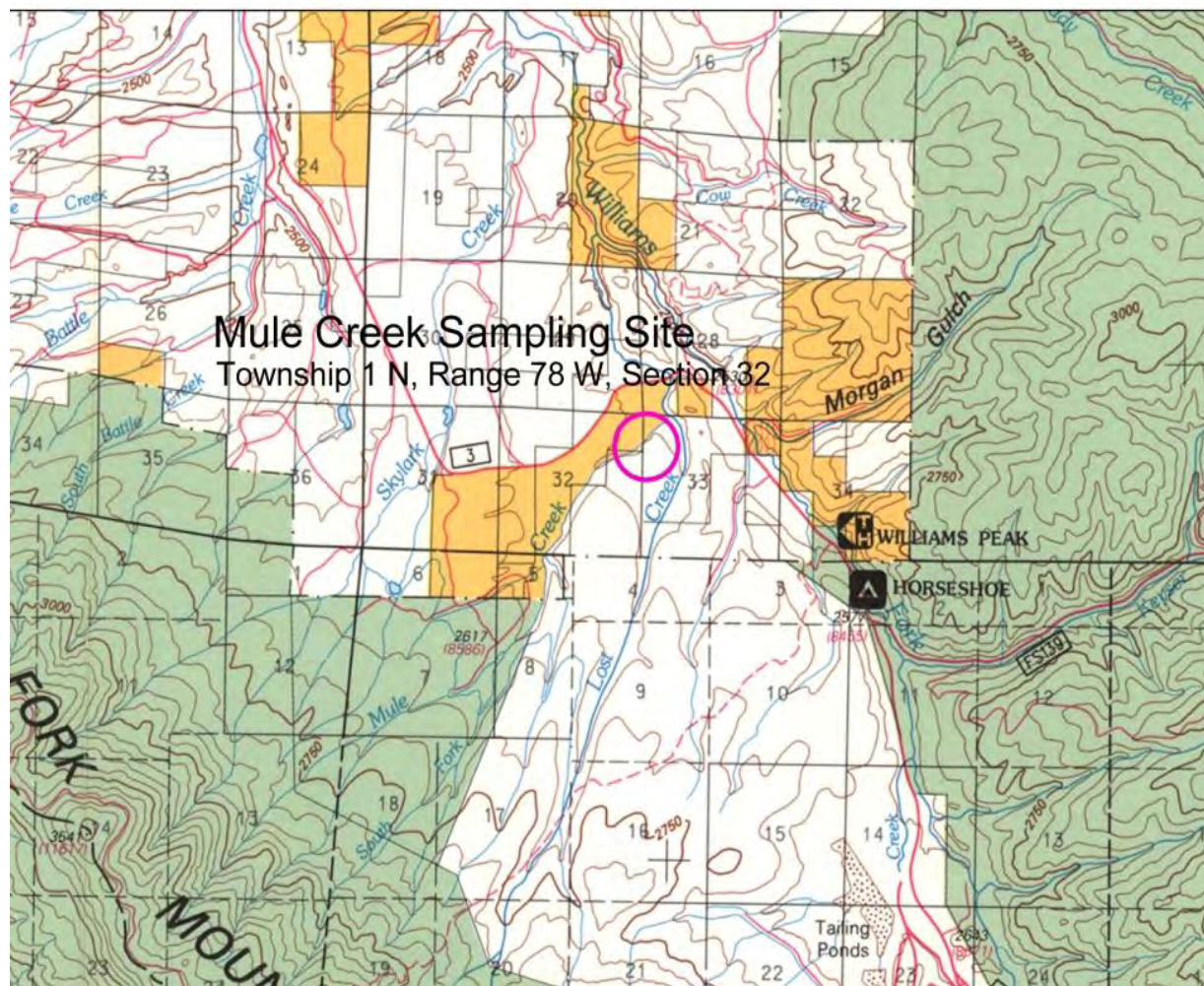
Mule Creek - Water Code #23438

Mule Creek, located southeast Kremmling, CO and located on BLM lands managed by the Kremmling Field Office was sampled on October 12, 2006. Mule Creek is tributary to Lost Creek which is tributary to the Williams Fork 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 125 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, and all fish were brook trout. See the data sheet below for size class distributions.







FISH SAMPLING FORM

WATER Mule Creek CODE 23438 DATE 10-12-06

GEAR backpack shocker EFFORT 100-125 ft STATION # PASS #
(mm)

species	length	weight	mark		species	length	weight	mark
BRK	168							
BRK	114							
BRK	83							
BRK	193							
BRK	87							
BRK	155							
BRK	176							
BRK	158							
BRK	87							
BRK	80							
BRK	142							
BRK	106							
BRK	186							
BRK	89							
BRK	165							
BRK	163							
BRK	182							
BRK	128							
BRK	68							
BRK	79							
BRK	77							
BRK	135							

GPS Location:

Notes (water temp, etc.):

22 total fish, all brook trout (*Salvelinus fontinalis*)

2+ age classes













