Stream: Huerfano River

Executive Summary

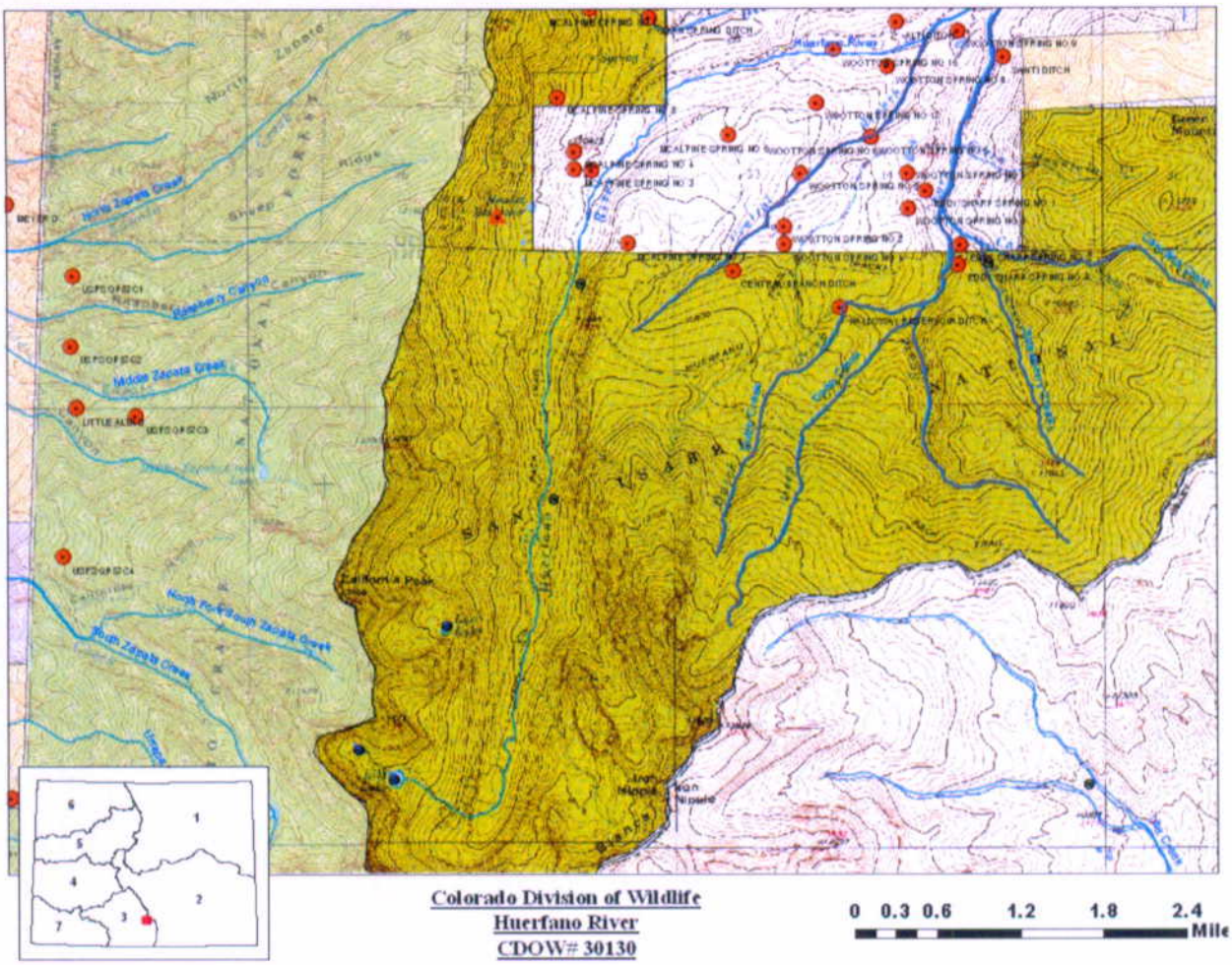
Water Division: 2
Water District: 79
CDOW#: 30130

Segment: LILY LAKE TO CENTRAL BRANCH HUERFANO RIVER

Upper Terminus: LILY LAKE
Latitude: 37° 35' 40"N Longitude: 105° 29' 22"W

Lower Terminus: CENTRAL BRANCH HUERFANO RIVER
Latitude: 37 40' 15"N Longitude: 105° 25' 16"W

Counties: Huerfano County
Length: 8.2 miles
USGS Quad(s): Mosca Pass.
ISF Appropriation: 4.10 cfs (May 1 – October 31)
2.70 cfs (November 1 – April 30)



The information contained in this report and the associated instream flow file folder forms the basis for the instream flow recommendation to be considered by the Colorado Water Conservation Board (Board). It is the Colorado Division of Wildlife (CDOW) staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5(i).

The State of Colorado's Instream Flow Program (ISFP) 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 Board 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 ISFP, the statute directs the Board to request instream flow recommendations from other state and federal agencies. The CDOW recommended this segment of Huerfano River to the Board for inclusion into the ISFP. Huerfano River is being considered for inclusion into the ISFP because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

The CDOW is forwarding this instream flow recommendation to the Board to meet Colorado's policy "… that the wildlife and their environment are to be protected, preserved, enhanced, and

managed for the use, benefit, and enjoyment of the people of this state and its visitors ... and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities" (See §33-1-101 (1) C.R.S.). The CDOW Strategic Plan states "[h]ealthy aquatic environments are essential to maintain healthy and viable fisheries, and critical for self-sustaining populations. The [CDOW] desires to protect and enhance the quality and quantity of aquatic habitats."

This segment of the Huerfano River is approximately 8.2 miles long. It begins on the north side of Blanca Peak at an elevation of approximately 12,250 feet and terminates at the confluence with the Central Branch of the Huerfano River at an elevation of approximately 9,200 feet. Of the 8.2 mile segment addressed by this report, approximately 60% of the segment, or 5 miles, is located on public lands. Huerfano River is located within Huerfano County. The total drainage area of this segment of the Huerfano River is approximately 11 square miles. Huerfano River generally flows in a northeasterly direction.

The subject of this report is a segment of the Huerfano River beginning at the outlet of Lily Lake and extending downstream to confluence with the Central Branch of Huerfano Creek. The proposed segment is located near the Town of Redwing. The recommendation for this segment is discussed below.

Instream Flow Recommendation(s)

The CDOW is recommending up to 4.1 cfs, summer, and 2.7 cfs, winter, based on their data collection efforts. This recommendation is based on the physical and biological data collected to date and does not incorporate any water availability constraints.

- 4.1 cubic feet per second is recommended is required to maintain the three principal hydraulic criteria of average depth, average velocity and percent wetted perimeter;
- 2.7 cubic feet per second is required to maintain two of the three principal hydraulic criteria.

The modeling results from this survey effort are within the confidence interval produced by the R2CROSS model (see Table 1).

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
LILY LAKE	C. B. HUERFANO RIVER	8.2	40	60

Biological and Field Survey Data

The CDOW, in 2007, collected stream cross-section information, natural environment data, and other data needed to quantify the instream flow needs for this reach of Huerfano River. Huerfano River is classified as a small stream (between 9 to 19 feet wide) and surveys indicate the stream environment of Huerfano River supports populations of brook trout (*Salvelinus*

fontinalis) and brown trout (*Salmo trutta*). These species inhabit cold water streams and lakes with adequate stream spawning habitat present in the fall of the year.

Field Survey Data

CDOW 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. Appendix B contains copies of field data collected for this proposed segment.

Biological Flow Recommendation

The BOARD 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, one data set was collected with the results shown in Table 1 below. Table 1 shows who collected the data (Party), the date the data was collected, 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: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
DOW	8/22/2007	2.6	6.5 – 1.0	4.1	2.7

DOW = Division of Wildlife

Biologic Flow Recommendation

The summer flow recommendation, which met 3 of 3 criteria and was within the accuracy range of the R2CROSS model is 4.1 cfs (See Table 1). The winter flow recommendation, which met 2 of 3 criteria and is within the accuracy range of the R2CROSS model range is 2.7 cfs (See Table 1).

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

LOCATION INFORMATION

STREAM NAME:	Huerfano River
XS LOCATION:	NF LANDS - 37 38' 30" 105 28' 12"
XS NUMBER:	082107-X3
DATE:	21-Aug-07
OBSERVERS:	Uppendahl
1/4 SEC:	0
SECTION:	0
TWP:	0
RANGE:	0
PM:	0
COUNTY:	HUERFANO
WATERSHED:	HUERFANO RIVER
DIVISION:	2
DOW CODE:	0
USGS MAP:	MOSCA PASS
USFS MAP:	0

SUPPLEMENTAL DATA

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

CHANNEL PROFILE DATA

SLOPE:	0.02058824

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

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

STREAM NAME: Huerfano River
XS LOCATION: NF LANDS - 37 38' 30" 105 28' 12"
XS NUMBER: 082107-X3

DATA POINTS= 37

VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
TS	0.00	5.95			0.00		0.00	0.00	0.0%
BS	0.01	6.28			0.00		0.00	0.00	0.0%
	1.00	6.40			0.00		0.00	0.00	0.0%
	2.00	6.80			0.00		0.00	0.00	0.0%
	2.50	6.85			0.00		0.00	0.00	0.0%
1 GL	3.00	7.00			0.00		0.00	0.00	0.0%
	3.50	7.35			0.00		0.00	0.00	0.0%
	4.00	7.75			0.00		0.00	0.00	0.0%
WL	4.30	8.00	0.00	0.00	0.00		0.00	0.00	0.0%
	5.00	8.25	0.25	0.49	0.74	0.25	0.21	0.10	4.0%
	6.00	8.15	0.15	0.89	1.00	0.15	0.15	0.13	5.1%
	7.00	8.20	0.20	1.30	1.00	0.20	0.15	0.20	7.5%
	7.50	8.20	0.20	1.87	0.50	0.20	0.10	0.19	7.2%
	8.00	8.25	0.25	2.01	0.50	0.25	0.13	0.25	9.6%
	8.50	8.30	0.30	2.03	0.50	0.30	0.15	0.30	11.7%
	9.00	8.20	0.20	1.57	0.51	0.20	0.15	0.24	9.0%
BR	10.00	8.20	0.20	0.16	1.00	0.20	0.20	0.03	1.2%
	11.00	8.20	0.20	1.30	1.00	0.20	0.15	0.20	7.5%
	11.50	8.15	0.15	0.90	0.50	0.15	0.08	0.07	2.6%
	12.00	8.20	0.20	1.19	0.50	0.20	0.15	0.18	6.8%
	13.00	8.15	0.15	1.03	1.00	0.15	0.15	0.15	5.9%
	14.00	8.10	0.10	0.45	1.00	0.10	0.10	0.05	1.7%
	15.00	8.10	0.10	1.03	1.00	0.10	0.10	0.10	4.0%
	16.00	8.10	0.10	0.65	1.00	0.10	0.08	0.05	1.9%
	16.50	8.20	0.20	0.50	0.51	0.20	0.10	0.05	1.9%
	17.00	8.15	0.15	1.29	0.50	0.15	0.11	0.15	5.6%
	18.00	8.20	0.20	0.63	1.00	0.20	0.20	0.13	4.8%
	19.00	8.05	0.05	0.05	1.01	0.05	0.05	0.00	0.1%
	20.00	8.10	0.10	0.45	1.00	0.10	0.10	0.05	1.7%
	21.00	8.05	0.05	0.10	1.00	0.05	0.03	0.00	0.1%
WL	21.30	8.00	0.00	0.00	0.30		0.00	0.00	0.0%
	21.50	7.85			0.00		0.00	0.00	0.0%
	22.00	7.65			0.00		0.00	0.00	0.0%
1 GL	23.00	7.05			0.00		0.00	0.00	0.0%
	26.00	7.05			0.00		0.00	0.00	0.0%
BS	27.30	6.55			0.00		0.00	0.00	0.0%
TS	27.31	6.05			0.00		0.00	0.00	0.0%
TOTALS ----------					17.10	0.3 (Max.)	2.63	2.61	100.0%

Manning's n = 0.0618
Hydraulic Radius= 0.153916903

STREAM NAME: Huerfano River
XS LOCATION: NF LANDS - 37 38' 30" 105 28' 12"
XS NUMBER: 082107-X3

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	2.63	2.63	0.0%
7.75	2.63	6.97	164.7%
7.77	2.63	6.61	151.2%
7.79	2.63	6.26	137.8%
7.81	2.63	5.91	124.5%
7.83	2.63	5.56	111.2%
7.85	2.63	5.21	98.0%
7.87	2.63	4.86	84.8%
7.89	2.63	4.52	71.6%
7.91	2.63	4.17	58.5%
7.93	2.63	3.83	45.4%
7.95	2.63	3.49	32.4%
7.96	2.63	3.31	25.9%
7.97	2.63	3.14	19.4%
7.98	2.63	2.97	12.9%
7.99	2.63	2.80	6.5%
8.00	2.63	2.63	0.0%
8.01	2.63	2.46	-6.4%
8.02	2.63	2.29	-12.8%
8.03	2.63	2.13	-19.2%
8.04	2.63	1.96	-25.6%
8.05	2.63	1.79	-31.9%
8.07	2.63	1.47	-44.1%
8.09	2.63	1.17	-55.5%
8.11	2.63	0.91	-65.5%
8.13	2.63	0.68	-74.2%
8.15	2.63	0.47	-82.3%
8.17	2.63	0.28	-89.3%
8.19	2.63	0.14	-94.6%
8.21	2.63	0.07	-97.3%
8.23	2.63	0.04	-98.5%
8.25	2.63	0.02	-99.3%

WATERLINE AT ZERO
AREA ERROR = 8.000

STREAM NAME: Huerfano River
XS LOCATION: NF LANDS - 37 38' 30" 105 28' 12"
XS NUMBER: 082107-X3

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	7.05	19.93	1.01	1.25	20.17	20.61	100.0%	0.98	68.55	3.40
	7.05	19.93	1.01	1.25	20.17	20.61	100.0%	0.98	68.55	3.40
	7.10	19.77	0.97	1.20	19.18	20.43	99.1%	0.94	63.40	3.31
	7.15	19.62	0.93	1.15	18.19	20.24	98.2%	0.90	58.42	3.21
	7.20	19.46	0.88	1.10	17.21	20.06	97.3%	0.86	53.61	3.11
	7.25	19.31	0.84	1.05	16.25	19.87	96.4%	0.82	48.97	3.01
	7.30	19.15	0.80	1.00	15.28	19.69	95.5%	0.78	44.51	2.91
	7.35	19.00	0.75	0.95	14.33	19.51	94.6%	0.73	40.23	2.81
	7.40	18.85	0.71	0.90	13.38	19.33	93.8%	0.69	36.12	2.70
	7.45	18.71	0.67	0.85	12.44	19.15	92.9%	0.65	32.19	2.59
	7.50	18.56	0.62	0.80	11.51	18.97	92.1%	0.61	28.45	2.47
	7.55	18.42	0.57	0.75	10.59	18.80	91.2%	0.56	24.90	2.35
	7.60	18.27	0.53	0.70	9.67	18.62	90.3%	0.52	21.55	2.23
	7.65	18.12	0.48	0.65	8.76	18.44	89.5%	0.48	18.39	2.10
	7.70	17.94	0.44	0.60	7.86	18.23	88.4%	0.43	15.47	1.97
	7.75	17.75	0.39	0.55	6.97	18.01	87.4%	0.39	12.75	1.83
	7.80	17.56	0.35	0.50	6.08	17.80	86.4%	0.34	10.26	1.69
	7.85	17.38	0.30	0.45	5.21	17.59	85.3%	0.30	7.99	1.53
	7.90	17.25	0.25	0.40	4.35	17.43	84.5%	0.25	5.94	1.37
	7.95	17.13	0.20	0.35	3.49	17.26	83.8%	0.20	4.14	1.19
WL	8.00	17.00	0.15	0.30	2.63	17.10	83.0%	0.15	2.61	0.99
	8.05	16.56	0.11	0.25	1.79	16.65	80.8%	0.11	1.40	0.78
	8.10	12.09	0.08	0.20	1.03	12.16	59.0%	0.08	0.68	0.66
	8.15	10.36	0.04	0.15	0.47	10.42	50.6%	0.04	0.20	0.43
	8.20	2.14	0.04	0.10	0.09	2.17	10.5%	0.04	0.04	0.42
	8.25	0.75	0.02	0.05	0.02	0.76	3.7%	0.02	0.01	0.29

3/3 = 4.1

2/3 = 2.7

STREAM NAME: Huerfano River
XS LOCATION: NF LANDS - 37 38' 30" 105 28' 12"
XS NUMBER: 082107-X3

SUMMARY SHEET

MEASURED FLOW (Qm)=	2.61	cfs
CALCULATED FLOW (Qc)=	2.61	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	8.00	ft
CALCULATED WATERLINE (WLc)=	8.00	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	0.0	%
MEAN VELOCITY=	0.99	ft/sec
MANNING'S N=	0.062	
SLOPE=	0.02058824	ft/ft
.4 * Qm =	1.0	cfs
2.5 * Qm=	6.5	cfs

RECOMMENDED INSTREAM FLOW:

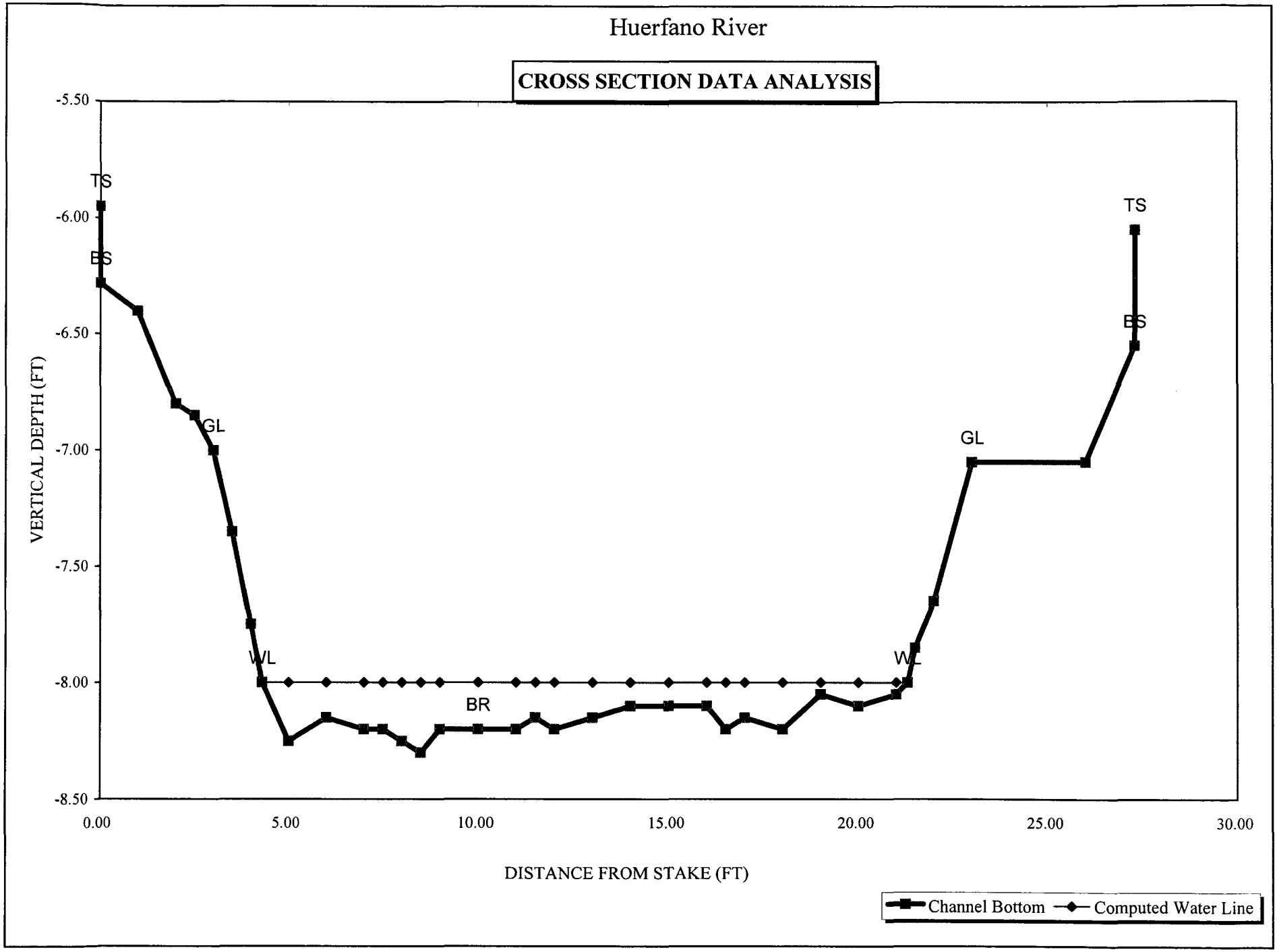
FLOW (CFS)	PERIOD

RATIONALE FOR RECOMMENDATION:

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

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

Huerfano River



Data Input & Proofing

STREAM NAME: Huerfano River
XS LOCATION: NF LANDS - 37 38' 30" 105 28' 12"
XS NUMBER: 082107-X3
DATE: 8/21/2007
OBSERVERS: Uppendahl

1/4 SEC:
SECTION:
TWP:
RANGE:
PM:

COUNTY: HUERFANO
WATERSHED: HUERFANO RIVER
DIVISION: 2
DOW CODE:
USGS MAP: MOSCA PASS
USFS MAP:

Level and Rod Survey

TAPE WT: 0.0106 lbs / ft
TENSION: 99999 lbs

SLOPE: 0.020588235 ft / ft

CHECKED BY:.....DATE.....

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

Total Data Points = 37

GL=1	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	Tape to Water
	TS	0.00	5.95			0.00	0.00	0.00
	BS	0.01	6.28			0.00	0.00	0.00
		1.00	6.40			0.00	0.00	0.00
		2.00	6.80			0.00	0.00	0.00
		2.50	6.85			0.00	0.00	0.00
1	GL	3.00	7.00			0.00	0.00	0.00
		3.50	7.35			0.00	0.00	0.00
		4.00	7.75			0.00	0.00	0.00
	WL	4.30	8.00	0.00	0.00	0.00	0.00	0.00
		5.00	8.25	0.25	0.49	0.21	0.10	8.00
		6.00	8.15	0.15	0.89	0.15	0.13	8.00
		7.00	8.20	0.20	1.30	0.15	0.20	8.00
		7.50	8.20	0.20	1.87	0.10	0.19	8.00
		8.00	8.25	0.25	2.01	0.13	0.25	8.00
		8.50	8.30	0.30	2.03	0.15	0.30	8.00
		9.00	8.20	0.20	1.57	0.15	0.24	8.00
	BR	10.00	8.20	0.20	0.16	0.20	0.03	8.00
		11.00	8.20	0.20	1.30	0.15	0.20	8.00
		11.50	8.15	0.15	0.90	0.08	0.07	8.00
		12.00	8.20	0.20	1.19	0.15	0.18	8.00
		13.00	8.15	0.15	1.03	0.15	0.15	8.00
		14.00	8.10	0.10	0.45	0.10	0.05	8.00
		15.00	8.10	0.10	1.03	0.10	0.10	8.00
		16.00	8.10	0.10	0.65	0.08	0.05	8.00
		16.50	8.20	0.20	0.50	0.10	0.05	8.00
		17.00	8.15	0.15	1.29	0.11	0.15	8.00
		18.00	8.20	0.20	0.63	0.20	0.13	8.00
		19.00	8.05	0.05	0.05	0.05	0.00	8.00
		20.00	8.10	0.10	0.45	0.10	0.05	8.00
		21.00	8.05	0.05	0.10	0.03	0.00	8.00
	WL	21.30	8.00	0.00	0.00	0.00	0.00	0.00
		21.50	7.85			0.00	0.00	0.00
		22.00	7.65			0.00	0.00	0.00
1	GL	23.00	7.05			0.00	0.00	0.00
		26.00	7.05			0.00	0.00	0.00
	BS	27.30	6.55			0.00	0.00	0.00
	TS	27.31	6.05			0.00	0.00	0.00
					Totals	2.63	2.61	

STREAM NAME: Huerfano River
XS LOCATION: NF LANDS - 37 38' 30" 105 28' 12"
XS NUMBER: 082107-X3

Thorne-Zevenbergen D84 Correction Applied
Estimated D84 = 0.11

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

Velocity based on test of R/D84>1

	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	7.05	19.93	1.01	1.25	20.17	20.61	100.0%	0.98	136.00	6.74
	7.05	19.93	1.01	1.25	20.17	20.61	100.0%	0.98	136.00	6.74
	7.10	19.77	0.97	1.20	19.18	20.43	99.1%	0.94	125.11	6.52
	7.15	19.62	0.93	1.15	18.19	20.24	98.2%	0.90	114.62	6.30
	7.20	19.46	0.88	1.10	17.21	20.06	97.3%	0.86	104.54	6.07
	7.25	19.31	0.84	1.05	16.25	19.87	96.4%	0.82	94.86	5.84
	7.30	19.15	0.80	1.00	15.28	19.69	95.5%	0.78	85.60	5.60
	7.35	19.00	0.75	0.95	14.33	19.51	94.6%	0.73	76.75	5.36
	7.40	18.85	0.71	0.90	13.38	19.33	93.8%	0.69	68.30	5.10
	7.45	18.71	0.67	0.85	12.44	19.15	92.9%	0.65	60.28	4.84
	7.50	18.56	0.62	0.80	11.51	18.97	92.1%	0.61	52.70	4.58
	7.55	18.42	0.57	0.75	10.59	18.80	91.2%	0.56	45.57	4.30
	7.60	18.27	0.53	0.70	9.67	18.62	90.3%	0.52	38.88	4.02
	7.65	18.12	0.48	0.65	8.76	18.44	89.5%	0.48	32.66	3.73
	7.70	17.94	0.44	0.60	7.86	18.23	88.4%	0.43	26.97	3.43
	7.75	17.75	0.39	0.55	6.97	18.01	87.4%	0.39	21.76	3.12
	7.80	17.56	0.35	0.50	6.08	17.80	86.4%	0.34	17.04	2.80
	7.85	17.38	0.30	0.45	5.21	17.59	85.3%	0.30	12.84	2.46
	7.90	17.25	0.25	0.40	4.35	17.43	84.5%	0.25	9.15	2.10
	7.95	17.13	0.20	0.35	3.49	17.26	83.8%	0.20	6.01	1.73
WL	8.00	17.00	0.15	0.30	2.63	17.10	83.0%	0.15	3.48	1.32
	8.05	16.56	0.11	0.25	1.79	16.65	80.8%	0.11	1.20	0.67
	8.10	12.09	0.08	0.20	1.03	12.16	59.0%	0.08	0.58	0.57
	8.15	10.36	0.04	0.15	0.47	10.42	50.6%	0.04	0.17	0.37
	8.20	2.14	0.04	0.10	0.09	2.17	10.5%	0.04	0.03	0.30
	8.25	0.75	0.02	0.05	0.02	0.76	3.7%	0.02	0.00	0.13

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Huerfano River on N.F. Lands					CROSS-SECTION NO.:
CROSS-SECTION LOCATION: u/s of Habitat imp structures 0.5 miles above FS boundary Z 37 38 30 105 28 12					
DATE: 8/21/07	OBSERVERS: Appendix				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY: Huerfano	WATERSHED: Huerfano		WATER DIVISION: 2		DOW WATER CODE:
MAP(S):	USGS:				
	USFS:				

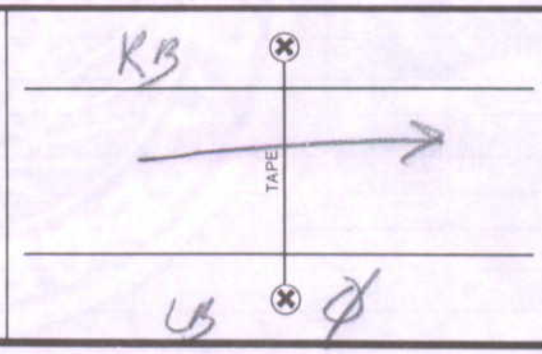
SUPPLEMENTAL DATA

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

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	5.95
⊗ Tape @ Stake RB	0.0	6.05
① WS @ Tape LB/RB	0.0	8.0 / 8.0
② WS Upstream	32.0'	7.39
③ WS Downstream	53.0'	9.14
SLOPE	1.75/85	

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:

COMMENTS

Water Temp 6°C

RW07-6536 F

WQ samples taken RW07-6538 NF

FORM #ISF FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Huerfano River on NF	CROSS-SECTION NO.: #3	DATE: 8/21/07	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: ____ ft	TIME: 17:00

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 Obser-vation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
TS	~~0~~	~~0~~	5.95								
BS	~~0~~		6.28								
	1		6.40								
	2		6.80								
	~~2.5~~		6.85								
GL	3		7.00								
	3.5		7.35								
	4		7.75								
SWL	4.3		8.00	~~0~~				~~0~~			
	5			.25				.49			
	6			.15				.89			
	7			.20				1.30			
	7.5			.20				1.87			
	8			.25				2.01			
	8.5			.30				2.03			
	9			.20				1.57			
BR	10			.20				.16			
	11			.20				1.30			
	11.5			.15				.90			
	12			.20				1.19			
	13			.15				1.03			
	14			.10				.45			
	15			.10				1.03			
	16			.10				.65			
	16.5			.20				.50			
	17			.15				1.29			
	18			.20				.63			
	19			.05				.05			
	20			.10				.43			
	21			~~.05~~				.10			
SWL	21.3		8.00	~~0~~				~~0~~			
	21.5		7.85								
	22.0		7.65								
GL	23.0		7.05								
	26		7.05								
BS	27.3		6.55								
TS	27.3		6.05								
TOTALS:											2.61

End of Measurement	Time:	Gage Reading: ____ ft	CALCULATIONS PERFORMED BY:	CALCULATIONS CHECKED BY:

HUERFANO RIVER

NATIONAL FOREST LANDS

37 38' 30" & 105 28' 12"

Stream: Huerfano River

Executive Summary

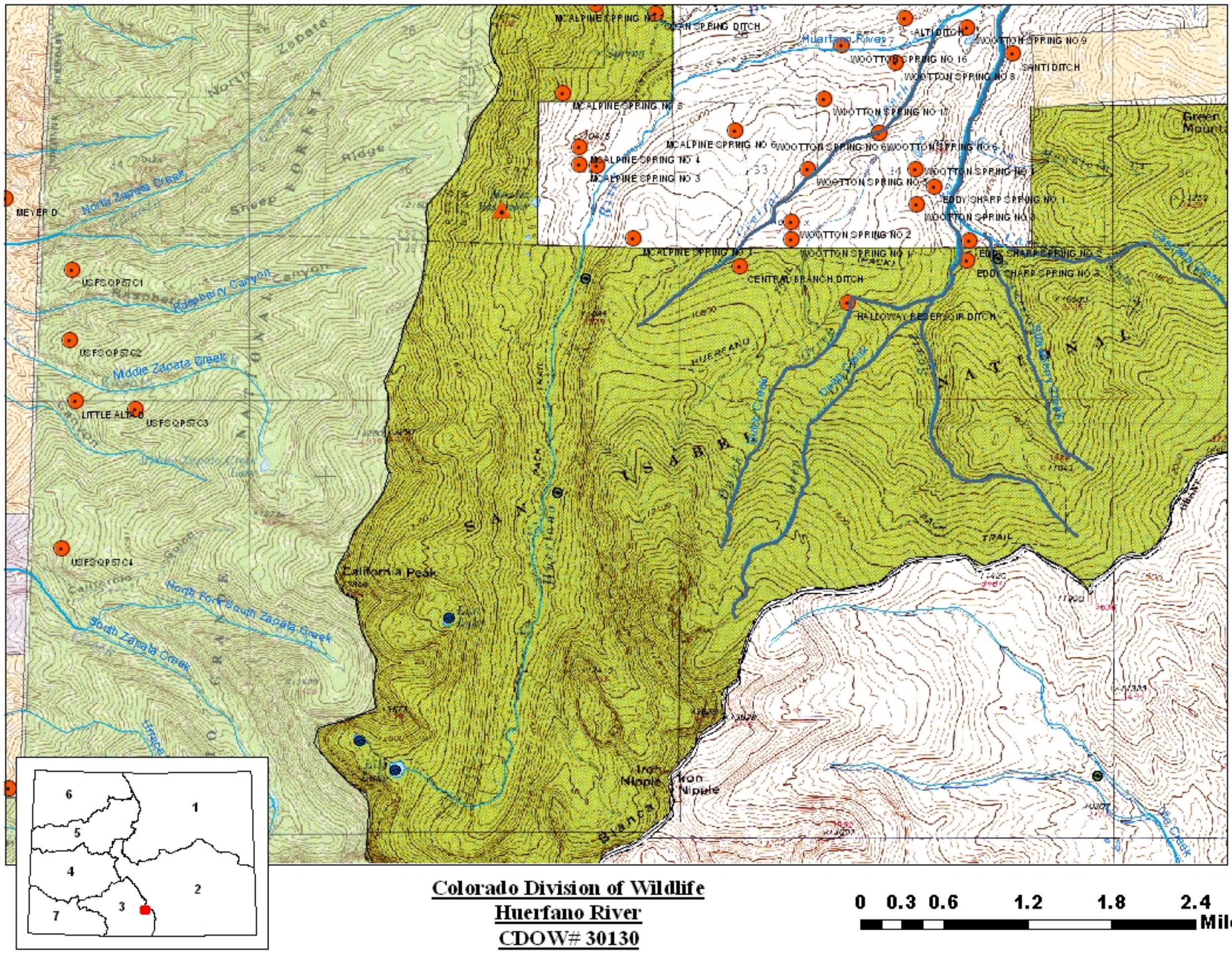
Water Division: 2
Water District: 79
CDOW#: 30130

Segment: LILY LAKE TO CENTRAL BRANCH HUERFANO RIVER

Upper Terminus: LILY LAKE
Latitude: 37º 35’ 40”N Longitude: 105º 29’ 22"W

Lower Terminus: CENTRAL BRANCH HUERFANO RIVER
Latitude: 37 40’ 15”N Longitude: 105º 25’ 16"W

Counties: Huerfano County
Length: 8.2 miles
USGS Quad(s): Mosca Pass.
ISF Appropriation: 4.10 cfs (May 1 – August 31)
2.50 cfs (September 1 - October 31)*
1.50 cfs (November 1 – March 31)
2.70 cfs (April 1 – April 30)



The information contained in this report and the associated instream flow file folder forms the basis for the instream flow recommendation to be considered by the Colorado Water Conservation Board (Board). It is the Colorado Division of Wildlife (CDOW) staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5(i).

The State of Colorado's Instream Flow Program (ISFP) 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 Board 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 ISFP, the statute directs the Board to request instream flow recommendations from other state and federal agencies. The CDOW recommended this segment of Huerfano River to the Board for inclusion into the ISFP. Huerfano River is being considered for inclusion into the ISFP because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

The CDOW is forwarding this instream flow recommendation to the Board to meet Colorado's policy "… that the wildlife and their environment are to be protected, preserved, enhanced, and

managed for the use, benefit, and enjoyment of the people of this state and its visitors … and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities" (See §33-1-101 (1) C.R.S.). The CDOW Strategic Plan states "[h]ealthy aquatic environments are essential to maintain healthy and viable fisheries, and critical for self-sustaining populations. The [CDOW] desires to protect and enhance the quality and quantity of aquatic habitats."

This segment of the Huerfano River is approximately 8.2 miles long. It begins on the north side of Blanca Peak at an elevation of approximately 12,250 feet and terminates at the confluence with the Central Branch of the Huerfano River at an elevation of approximately 9,200 feet. Of the 8.2 mile segment addressed by this report, approximately 60% of the segment, or 5 miles, is located on public lands. Huerfano River is located within Huerfano County. The total drainage area of this segment of the Huerfano River is approximately 11 square miles. Huerfano River generally flows in an northeasterly direction.

The subject of this report is a segment of the Huerfano River beginning at the outlet of Lily Lake and extending downstream to confluence with the Central Branch of Huerfano Creek. The proposed segment is located near the Town of Redwing. The recommendation for this segment is discussed below.

Instream Flow Recommendation(s)

The CDOW is recommending up to 4.1 cfs, summer, and 2.7 cfs, winter, based on their data collection efforts. This recommendation is based on the physical and biological data collected to date and does not incorporate any water availability constraints.

- 4.1 cubic feet per second is recommended is required to maintain the three principal hydraulic criteria of average depth, average velocity and percent wetted perimeter;
- 2.7 cubic feet per second is required to maintain two of the three principal hydraulic criteria.

The modeling results from this survey effort are within the confidence interval produced by the R2CROSS model (see Table 1).

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
LILY LAKE	C. B. HUERFANO RIVER	8.2	40	60

Biological and Field Survey Data

The CDOW, in 2007, collected stream cross-section information, natural environment data, and other data needed to quantify the instream flow needs for this reach of Huerfano River. Huerfano River is classified as a small stream (between 9 to 19 feet wide) and surveys indicate the stream environment of Huerfano River supports populations of brook trout (*Salvelinus*

fontinalis) and brown trout (*Salmo trutta*). These species inhabit cold water streams and lakes with adequate stream spawning habitat present in the fall of the year.

Field Survey Data

CDOW 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. Appendix B contains copies of field data collected for this proposed segment.

Biological Flow Recommendation

The BOARD 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, one data set was collected with the results shown in Table 1 below. Table 1 shows who collected the data (Party), the date the data was collected, 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: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
DOW	8/22/2007	2.6	6.5 – 1.0	4.1	2.7

DOW = Division of Wildlife

Biologic Flow Recommendation

The summer flow recommendation, which met 3 of 3 criteria and was within the accuracy range of the R2CROSS model is 4.1 cfs (See Table 1). The winter flow recommendation, which met 2 of 3 criteria and is within the accuracy range of the R2CROSS model range is 2.7 cfs (See Table 1).

Hydrologic Data

The CDOW staff conducted a preliminary evaluation of the stream hydrology to determine if water was physically available for an instream flow appropriation. The hydrograph below was derived from data collected by the USGS stream gage for the Huerfano River near Redwing, CO (#07111000), which has a drainage area of 73 square miles (See Gage Summary in Appendix C).

The total drainage area upstream of this ISF segment of Huerfano River is 11 square miles. The period of record for the Huerfano River gage was 1923 to 1985, the period of record used by staff in their analysis was 1923 to 1985, or 59 years of record. Table 2 below displays the estimated flow of Huerfano River in cfs at the lower terminus of the instream flow reach in terms of a percentage of exceedence.

Table 2: Estimated Stream Flow for Huerfano River

Exceedences	January	February	March	April	May	June	July	August	September	October	November	December
1%	2.86	2.71	3.77	12.36	37.87	38.17	25.32	21.70	13.61	6.48	4.67	3.62
5%	2.41	2.26	3.01	8.66	27.52	28.93	17.78	12.36	8.74	4.82	3.77	2.71
10%	2.11	2.26	2.71	6.33	21.56	25.32	14.32	9.49	6.63	4.37	3.32	2.41
20%	1.96	1.96	2.56	4.37	14.32	19.89	10.85	7.38	4.82	3.47	2.71	2.26
50%	1.51	1.51	1.81	2.71	7.84	10.85	6.33	4.52	3.01	2.56	2.11	1.66
80%	1.20	1.28	1.43	1.96	4.22	5.73	3.32	3.01	2.11	1.96	1.51	1.30
90%	0.98	1.05	1.21	1.66	3.16	4.10	2.56	2.26	1.66	1.66	1.39	1.13
95%	0.75	0.99	1.11	1.48	2.71	3.47	2.11	1.81	1.31	1.44	1.25	0.96
99%	0.66	0.75	0.86	1.28	1.81	2.41	1.28	1.30	0.98	0.99	1.05	0.80

Table 2 shows that the summer flow recommendation of 4.1 cfs is available at least 50% of the time from May through August. The winter flow recommendation of 2.7 cfs is available at least 50% of the time in April. Based on this water availability analysis, the fall/winter recommendation was further reduced to 2.5 cfs for the months of September through October and 1.5 cfs November through March. After incorporating the above water availability constraints, the original instream flow recommendation was modified to the following:

- 4.10 cubic feet per second is recommended from May 1 through August 31;
- 2.50 cubic feet per second is recommended from September 1 through October 31;
- 1.50 feet per second is recommended from November 1 through March 31;
- 2.70 cubic feet per second is recommended from April 1 through April 30.

However, if additional water is determined to be available in further investigations, the CDOW would recommend appropriating the additional water up to the recommended flow amounts to preserve the natural environment to a reasonable degree.

Precipitation Data

CDOW staff identified 4 local precipitation data sets located near the Huerfano River Drainage: Gardner (3222), Redwing 1 WSW (6977), Sheep Mountain (7572) and Blanco Station (BLA01) (see Precipitation Data in Appendix C).

Existing Water Right Information

CDOW staff has analyzed the water rights tabulation and will consult with the Division Engineer's Office (DEO) to identify any potential water availability problems due to existing diversions. Records indicate that there are no surface water rights within this reach of Huerfano River.