DRAFT INSTREAM FLOW RECOMMENDATION March 13, 2014 Version

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 increase to existing instream flow water rights on Soldier Creek, located in Water Division 6.

Location and Land Status. Soldier Creek originates approximately eleven miles northeast of Douglas Pass and flows into Cathedral Creek. This recommendation covers a reach that starts at the confluence of Right Fork Solider Creek and Middle Fork Soldier Creek and extends downstream to the confluence with Cathedral Creek. This stream reach covers a distance of approximately 3.2 miles. The BLM manages approximately 1.3 miles of this stream reach, while 1.9miles are in private ownership.

Existing Instream Flow Water Rights. In 1985, the Colorado Water Conservation Board appropriated instream flow water rights on Soldier Creek as follows:

> Confluence of Right Fork and Middle Fork to confluence with Cathedral Creek – 1.5 cfs
> January 1 to December 31

Biological Summary. Soldier Creek is a cold-water, moderate gradient stream. It flows through a canyon with a valley floor approximately one-fourth mile in width. The stream cuts through alluvial deposits in the narrow valley and is not confined by bedrock in most locations. The stream generally has medium-sized substrate, consisting of gravels, cobbles, and small boulders. While riffle habitat is abundant, parts of the stream lack extensive pool habitat.

Fisheries surveys have revealed a self-sustaining population of native cutthroat trout. The BLM is considering implementation of a project to create better habitat connectivity between this stream and other streams in the watershed that support native cutthroat trout. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The riparian community is generally comprised of willow species, cattails, rushes, and sedges. In general, the riparian community is in good condition, and provides adequate shading and cover for fish habitat.

R2Cross Analysis. The BLM collected the following R2Cross data from Soldier Creek:

Cross Section Date	Discharge Rate	Top Width	Winter Flow Recommendation (meets 2 of 3 hydraulic criteria)	Summer Flow Recommendation (meets 3 of 3 hydraulic criteria)
07/27/2009 #1	0.82 cfs	11.30 feet	0.82 cfs	2.82 cfs
07/27/2009 #2	0.80 cfs	14.10 feet	1.52 cfs	1.79 cfs
		Averages:	1.17 cfs	2.30 cfs

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

> 2.3 cubic feet per second is recommended for the snowmelt runoff period from May 1 through September 15. Protecting 2.3 cubic feet per second will require an increase of 0.8 cfs to the existing instream flow water right. This recommendation is driven by the average depth criteria. This creek experiences consistently low flows during late summer and fall, so it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff flows and monsoon-related flows are available.
>
> The BLM recommends that the existing instream flow water right of 1.5 cfs remain unchanged for the time period between September 16 and April 30. It appears that the existing water right will meet two of three instream flow criteria used by the CWCB.

Rationale For Increase to Instream Flow Water Right. The BLM does not consider the current instream flow water right to be fully protective of the natural environment in Soldier Creek, pursuant to modern analytical procedures used by the CWCB. The current instream flow water right does not meet all three instream flow criteria during the spring and summer, which is a critical growth and spawning period for the fish population. Since the stream supports native cutthroat trout, the BLM considers a fully protective instream flow water right to be essential.

Water Availability. The BLM is not aware of any historic gage data within the East Douglas Creek watershed. The BLM does not recommend relying upon other gages that are within western Rio Blanco County because those gages measure watersheds with very different characteristics. For example, UGSG Gage 09306380 (Douglas Creek at Rangely) is located at the bottom of the very large Douglas Creek watershed, of which East Douglas Creek is a part. However, this watershed contains many square miles of low elevation terrain with low runoff per unit of area. In contrast, East Douglas Creek is located at the top of Douglas Creek watershed, with high runoff per unit of area. Historic gages in the Piceance Creek watershed to the east, such as USGS Gage 09306175 (Black Sulphur Creek), measure large watersheds with characteristics similar to the large Douglas Creek watershed. Accordingly, the BLM recommends relying upon the StreamStats package developed jointly between the U.S. Geological Survey and the CWCB for the best flow estimates.

The BLM is not aware of any decreed water rights within the proposed instream flow reach.

Relationship to Land Management Plans. This stream reach is located within BLM's "East Douglas Creek Area of Critical Environmental Concern." The BLM designated this area to protect important biologically diverse plant communities, riparian habitat, and cutthroat trout habitat. The BLM intends to continue management of this watershed for natural conditions and processes. Appropriation of increase to the existing instream flow water rights would assist BLM in long-term management of riparian values and important fishery values.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with BLM's draft recommendation in February 2014. We thank both Colorado Parks and Wildlife and the Colorado Water Conservation Board for their cooperation in this effort.

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

Sincerely,

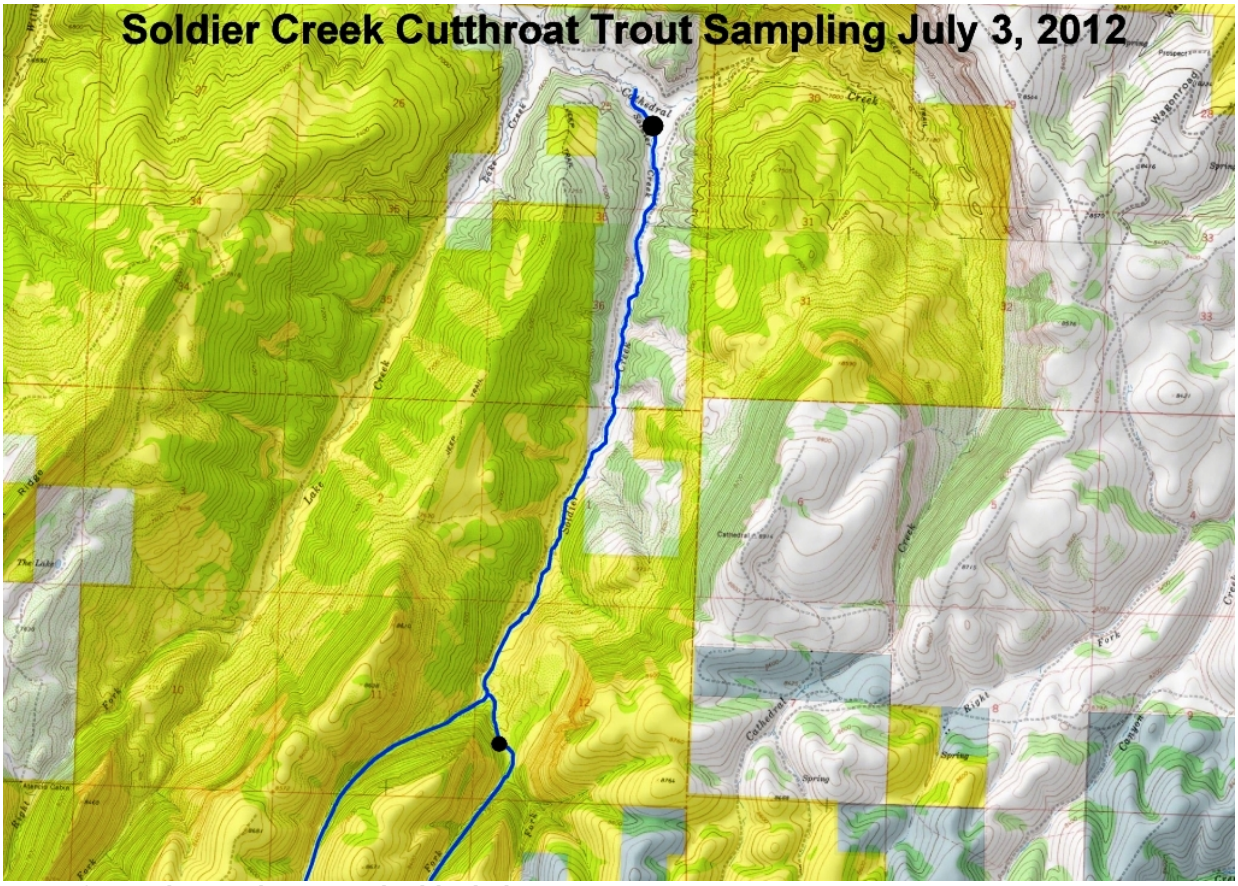
Leigh Espy
Deputy State Director
Resources and Fire

Cc: Kent Walter, White River FO
Bob Lange, White River FO
Ed Hollowed, White River FO

White River Field Office Stream Surveys
July 2012

Soldier Creek - Water Code #22082
Right Fork Soldier Creek – Water Code #23513
Middle Fork Soldier Creek – Water Code #23511

Soldier Creek, Middle Fork Soldier Creek, and Right Fork Soldier Creek were sampled on July 3, 2012. Sample sites were located on BLM lands administered by the White River Field Office and on private lands owned by Nona Powell. Sample began just upstream of the confluence of Soldier Creek with Cathedral Creek and continued upstream to where the Right Fork, Middle Fork, and unnamed fork come together at the beginning of a series of beaver ponds (See Map). Sampling was conducted to determine the upper and lower distribution of cutthroat trout in the watershed, and to collect fin clips to determine genetic purity of resident fish. The stream was sampled using a backpack electroshocker. Only cutthroat trout were seen or collected. A population estimate was not completed at this time. Personnel present were Kyle Battige and his crew, Colorado Parks and Wildlife.



Map of sample area between the black dots

Soldier Creek in the middle reach representing good habitat

15 foot waterfall on the Middle Fork Soldier Creek

Discussion:

Soldier Creek contains low densities of cutthroat trout in the lower end. There was a high amount of sediment and flow was limited, given drought conditions. The stream was intermittent in spots along the lower end. Where the stream was perennial during drought conditions, fish densities increased. Perennial flow occurred about half way up from the lowest sample area, providing some pool habitat with a cobble substrate (see photo 1). The upper portion of the creek was a large series of beaver ponds up to where the stream forks at the last large beaver pond.

Right Fork Soldier Creek is spring fed and was dry about 100 meters up from the beaver pond. The unnamed eastern fork became shallow with limited flow also about 100 meters above the pond. Middle Fork Soldier Creek had good flow with large woody debris that appears to create fish movement barriers in two locations. Approximately 60 meters upstream of the large beaver pond there is a large 15 foot waterfall barrier (see photo 2). Above this are two additional natural barriers and the stream was dry on this visit approximately 0.3 miles above these barriers.

Riparian and stream habitats improve as you move upstream. Cutthroat trout collected were in good condition despite low flows and drought conditions. Springs appear to keep temperatures in the upper portions of the stream at a moderate 60 degrees. Riparian vegetation consisted of willows, red osier dogwood, scouring rush, sedges, and some riparian grasses. Houndstongue and thistle were common and abundant in areas.

- ❖ NOTE: Genetic results are in and data suggests that these fish are pure Colorado River cutthroat trout.

Recommendations:

- Complete a population estimate at a representative site on each stream
- Consider aggressive weed treatment in the drainage to limit the spread and density of houndstongue and thistle
- Determine degree/quality of connectivity between this drainage and the Lake Creek drainage to assess meta-population functionality. Consider habitat improvements to increase connectivity at the lower ends of each stream
- Meet with CPW and TU to discuss cutthroat management in this watershed given recent genetic results

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

LOCATION INFORMATION

STREAM NAME:	Soldier Creek
XS LOCATION:	At BLM-Private boundary
XS NUMBER:	1
DATE:	27-Jul-09
OBSERVERS:	R. Smith, B. Lange, P. Crowley
1/4 SEC:	SW
SECTION:	1
TWP:	4S
RANGE:	100W
PM:	Sixth
COUNTY:	Rio Blanco
WATERSHED:	White River
DIVISION:	6
DOW CODE:	22082
USGS MAP:	0
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:	0.011

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

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

STREAM NAME: Soldier Creek
XS LOCATION: At BLM-Private boundary
XS NUMBER: 1

DATA POINTS= 25

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	RS	2.00	6.99			0.00		0.00	0.00	0.0%
1	G	3.80	7.13			0.00		0.00	0.00	0.0%
		5.30	7.73	0.00	0.00	0.00		0.00	0.00	0.0%
	W	5.70	7.85	0.10	0.34	0.42	0.10	0.04	0.01	1.7%
		6.10	7.85	0.10	0.74	0.40	0.10	0.04	0.03	3.6%
		6.50	7.85	0.10	1.20	0.40	0.10	0.04	0.05	5.9%
		6.90	7.85	0.10	1.13	0.40	0.10	0.04	0.05	5.5%
		7.30	7.85	0.10	1.88	0.40	0.10	0.04	0.08	9.2%
		7.70	7.85	0.10	1.26	0.40	0.10	0.04	0.05	6.2%
		8.10	7.90	0.15	1.26	0.40	0.15	0.06	0.08	9.2%
		8.50	7.90	0.15	1.00	0.40	0.15	0.06	0.06	7.3%
		8.90	7.90	0.15	1.36	0.40	0.15	0.06	0.08	10.0%
		9.30	7.95	0.20	1.67	0.40	0.20	0.08	0.13	16.3%
		9.70	7.90	0.15	1.48	0.40	0.15	0.06	0.09	10.8%
		10.10	7.85	0.10	0.77	0.40	0.10	0.04	0.03	3.8%
		10.50	7.85	0.10	0.23	0.40	0.10	0.04	0.01	1.1%
		10.90	7.85	0.10	0.85	0.40	0.10	0.04	0.03	4.2%
		11.30	7.85	0.10	0.85	0.40	0.10	0.04	0.03	4.2%
		11.70	7.85	0.10	0.24	0.40	0.10	0.04	0.01	1.2%
		12.10	7.80	0.05	0.00	0.40	0.05	0.02	0.00	0.0%
		12.50	7.80	0.05	0.00	0.40	0.05	0.02	0.00	0.0%
		12.90	7.80	0.05	0.00	0.40	0.05	0.03	0.00	0.0%
	W	13.50	7.75			0.60		0.00	0.00	0.0%
1	G	15.30	7.21			0.00		0.00	0.00	0.0%
	LS	20.20	6.35			0.00		0.00	0.00	0.0%
	TOTALS ----------					8.24	0.2 (Max.)	0.83	0.82	100.0%

Manning's n = 0.0339
Hydraulic Radius= 0.10017903

STREAM NAME: Soldier Creek
XS LOCATION: At BLM-Private boundary
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	0.83	0.90	9.5%
7.49	0.83	3.14	280.3%
7.51	0.83	2.95	257.0%
7.53	0.83	2.76	234.0%
7.55	0.83	2.57	211.3%
7.57	0.83	2.38	188.8%
7.59	0.83	2.20	166.7%
7.61	0.83	2.02	144.8%
7.63	0.83	1.84	123.2%
7.65	0.83	1.67	101.9%
7.67	0.83	1.49	80.9%
7.69	0.83	1.32	60.1%
7.70	0.83	1.24	49.9%
7.71	0.83	1.15	39.7%
7.72	0.83	1.07	29.5%
7.73	0.83	0.99	19.5%
7.74	0.83	0.90	9.5%
7.75	0.83	0.82	-0.4%
7.76	0.83	0.74	-10.2%
7.77	0.83	0.66	-19.7%
7.78	0.83	0.58	-29.1%
7.79	0.83	0.51	-38.4%
7.81	0.83	0.37	-55.3%
7.83	0.83	0.24	-70.6%
7.85	0.83	0.12	-85.5%
7.87	0.83	0.08	-90.9%
7.89	0.83	0.04	-95.5%
7.91	0.83	0.01	-98.4%
7.93	0.83	0.00	-99.6%
7.95	0.83	0.00	-100.0%
7.97	0.83	0.00	-100.0%
7.99	0.83	0.00	-100.0%

WATERLINE AT ZERO
AREA ERROR = 7.750

STREAM NAME: Soldier Creek
XS LOCATION: At BLM-Private boundary
XS NUMBER: 1

Constant Manning's n

STAGING TABLE

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

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	7.21	11.30	0.54	0.74	6.07	11.51	100.0%	0.53	18.25	3.01
	7.25	11.07	0.51	0.70	5.63	11.27	97.9%	0.50	16.32	2.90
	7.30	10.78	0.47	0.65	5.08	10.96	95.2%	0.46	14.02	2.76
	7.35	10.49	0.43	0.60	4.55	10.65	92.5%	0.43	11.89	2.61
	7.40	10.19	0.40	0.55	4.04	10.34	89.8%	0.39	9.92	2.46
	7.45	9.90	0.36	0.50	3.53	10.04	87.2%	0.35	8.11	2.30
	7.50	9.61	0.32	0.45	3.05	9.73	84.5%	0.31	6.46	2.12
	7.55	9.32	0.28	0.40	2.57	9.42	81.8%	0.27	4.98	1.94
	7.60	9.03	0.23	0.35	2.11	9.11	79.1%	0.23	3.67	1.74
	7.65	8.74	0.19	0.30	1.67	8.80	76.4%	0.19	2.54	1.52
	7.70	8.44	0.15	0.25	1.24	8.49	73.8%	0.15	1.58	1.28
WL	7.75	8.14	0.10	0.20	0.82	8.17	71.0%	0.10	0.82	1.00
	7.80	6.57	0.07	0.15	0.44	6.59	57.3%	0.07	0.33	0.75
	7.85	2.41	0.05	0.10	0.12	2.42	21.0%	0.05	0.08	0.63
	7.90	0.81	0.03	0.05	0.02	0.81	7.1%	0.03	0.01	0.40
	7.95	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Soldier Creek
XS LOCATION: At BLM-Private boundary
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.82	cfs
CALCULATED FLOW (Qc)=	0.82	cfs
(Qm-Qc)/Qm * 100 =	-0.5	%
MEASURED WATERLINE (WLm)=	7.74	ft
CALCULATED WATERLINE (WLc)=	7.75	ft
(WLm-WLc)/WLm * 100 =	-0.1	%
MAX MEASURED DEPTH (Dm)=	0.20	ft
MAX CALCULATED DEPTH (Dc)=	0.20	ft
(Dm-Dc)/Dm * 100	-0.2	%
MEAN VELOCITY=	1.00	ft/sec
MANNING'S N=	0.034	
SLOPE=	0.011	ft/ft
.4 * Qm =	0.3	cfs
2.5 * Qm=	2.0	cfs

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

FLOW (CFS)	PERIOD
___________________	___________________
___________________	___________________
___________________	___________________
___________________	___________________

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

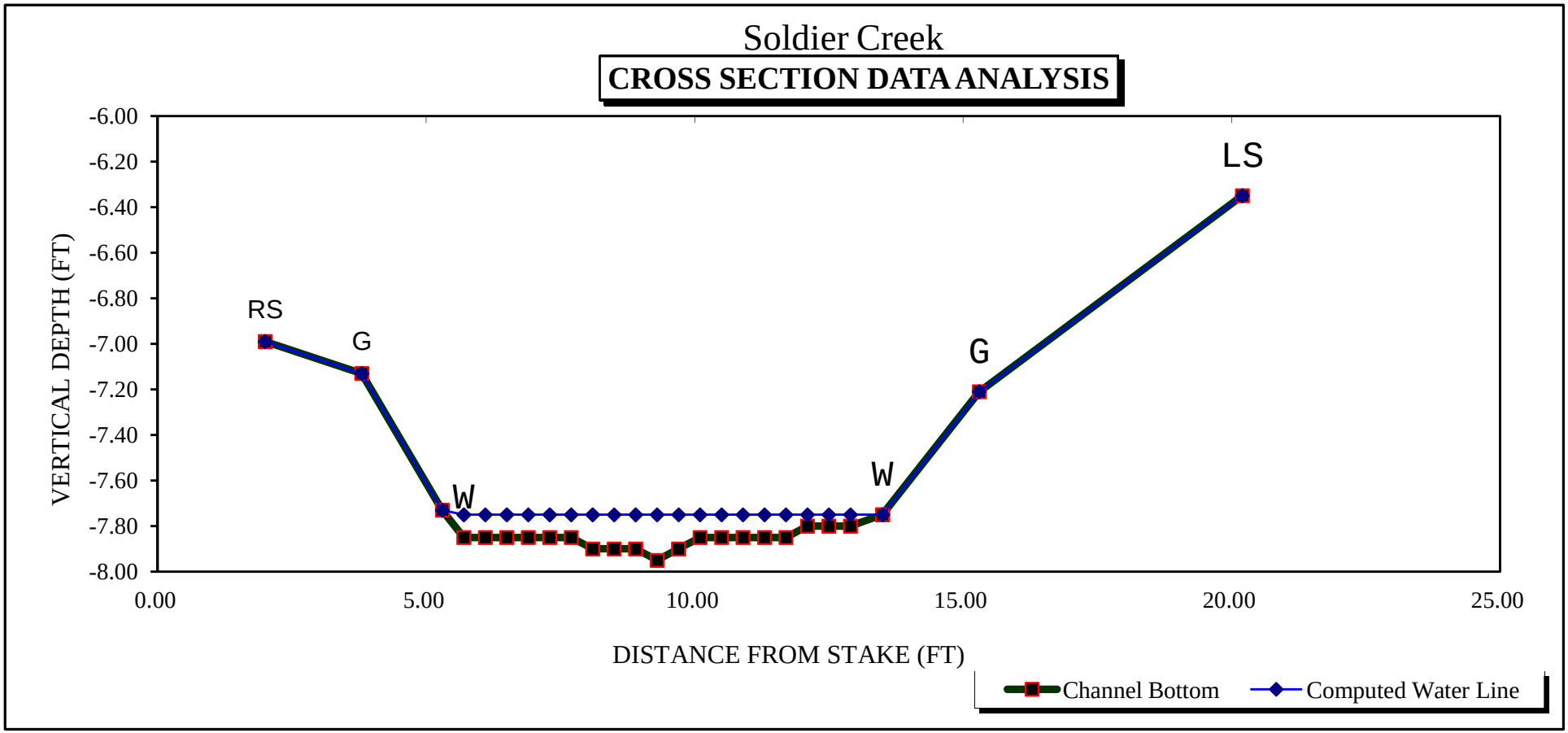
RECOMMENDATION BY: ……………………………………………… AGENCY……………………………………………… DATE:………………………

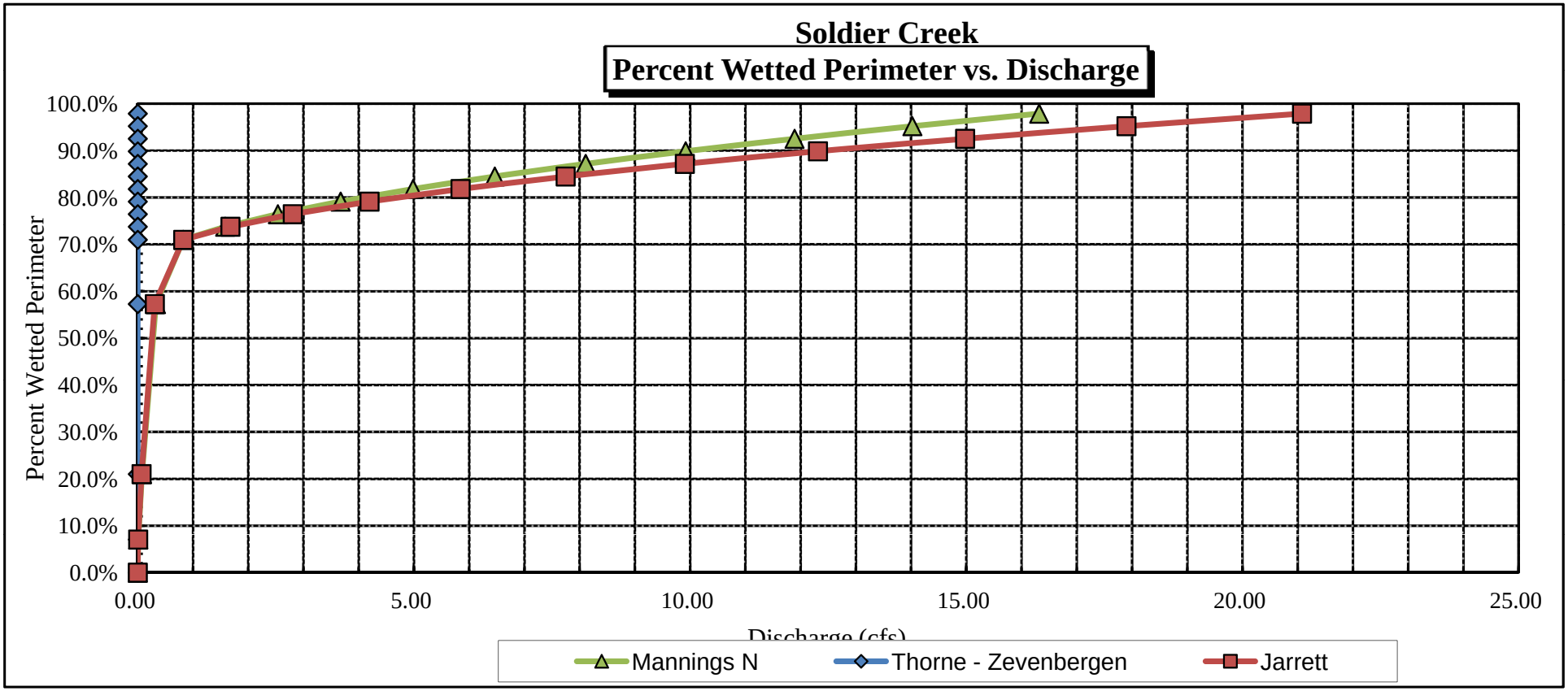
CWCB REVIEW BY: ……………………………………………………………………………………………… DATE:………………………

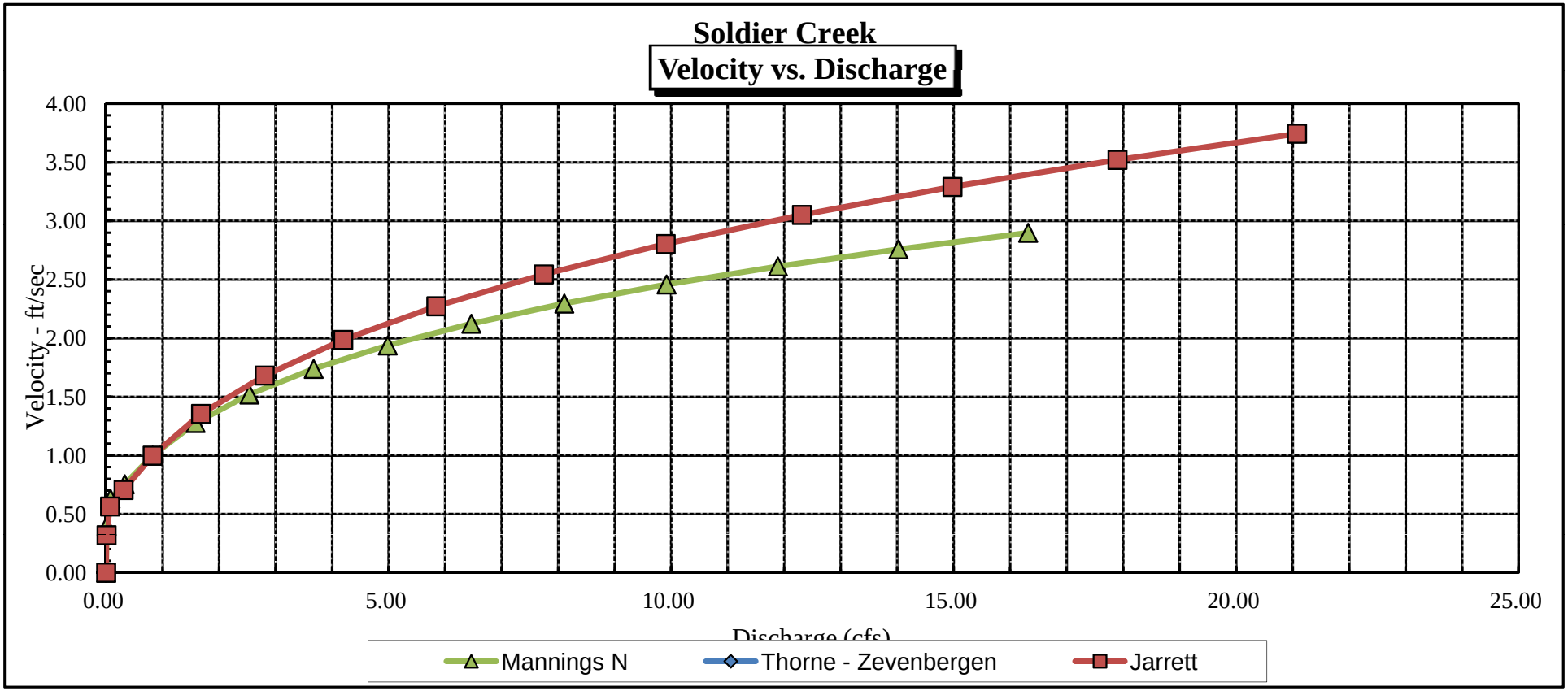
STREAM NAME: Soldier Creek
XS LOCATION: At BLM-Private boundary
XS NUMBER: 1 Jarrett Variable Manning's n Correction Applied

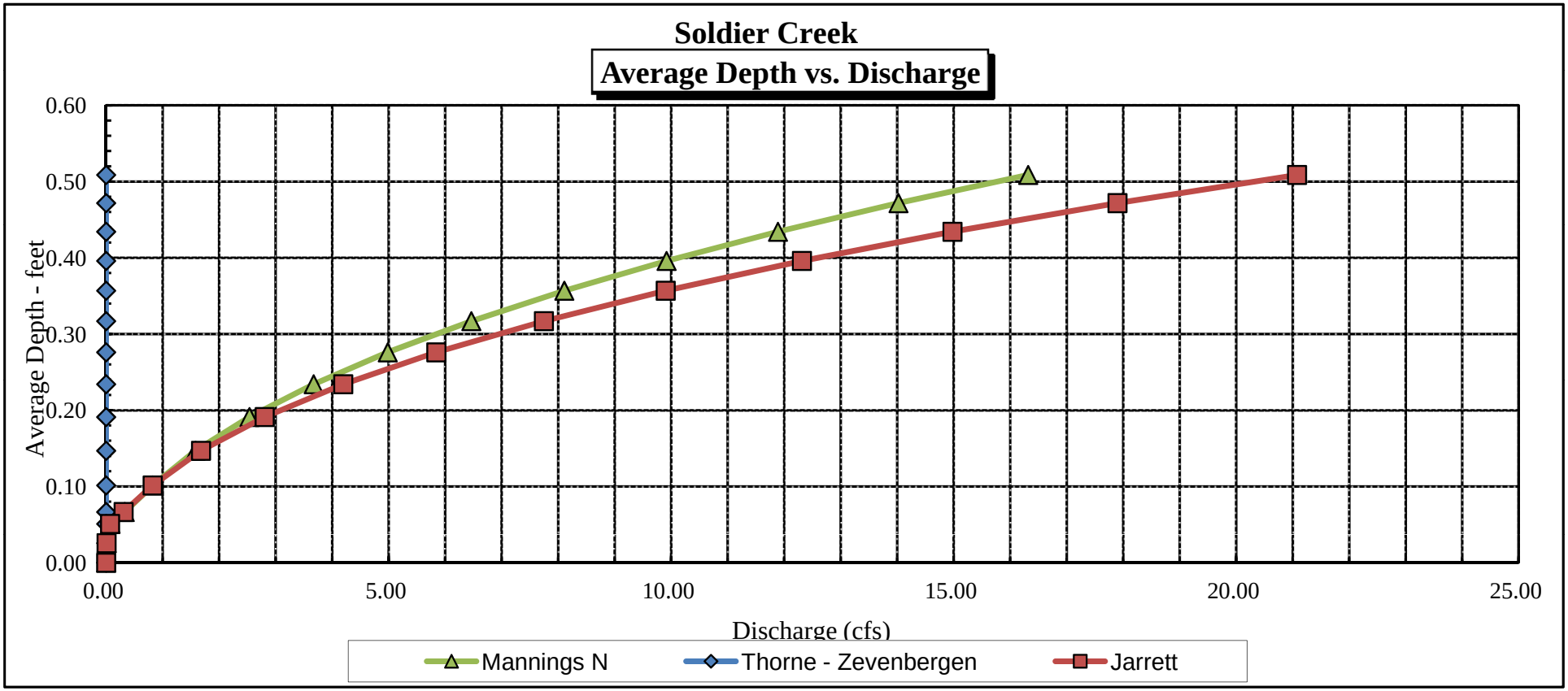
GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

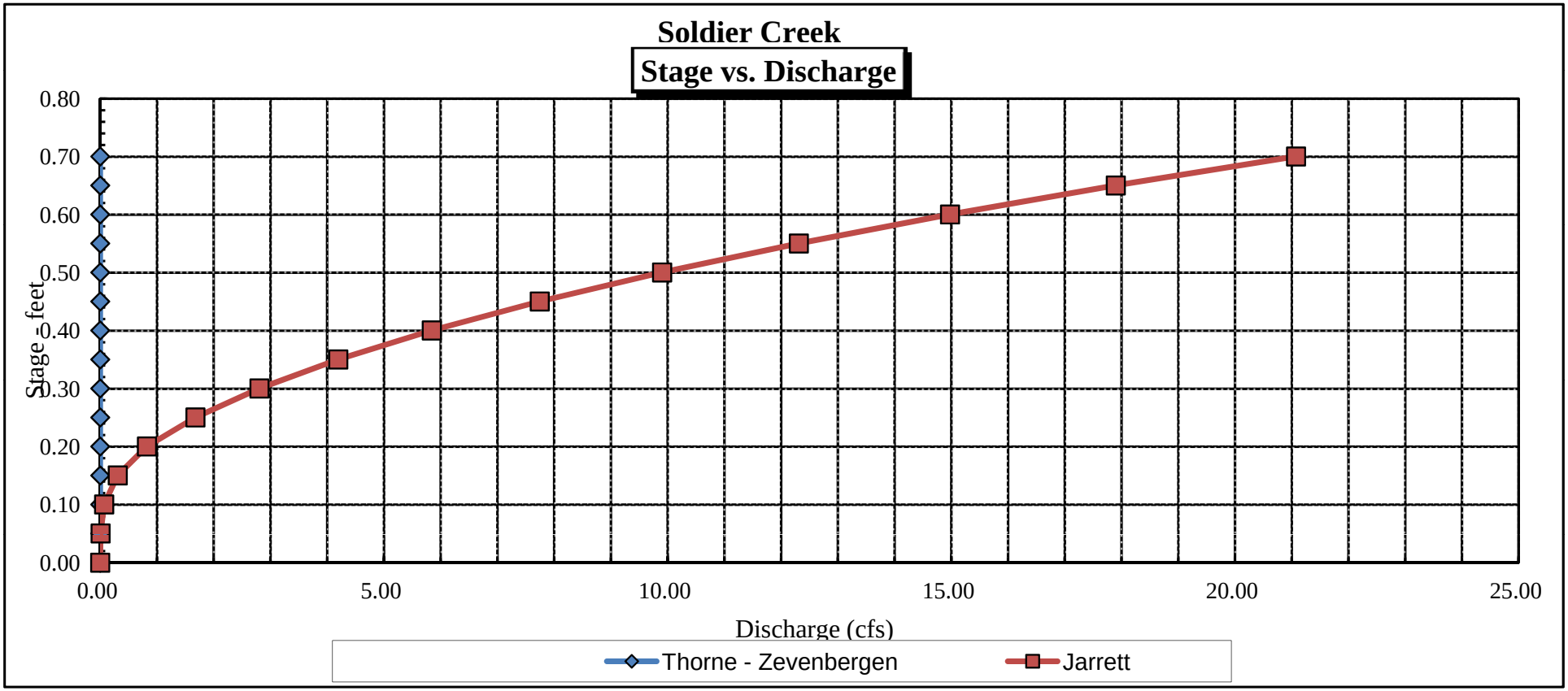
	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	7.21	11.30	0.54	0.74	6.07	11.51	100.0%	0.53	23.78	3.92
	7.25	11.07	0.51	0.70	5.63	11.27	97.9%	0.50	21.08	3.74
	7.30	10.78	0.47	0.65	5.08	10.96	95.2%	0.46	17.90	3.52
	7.35	10.49	0.43	0.60	4.55	10.65	92.5%	0.43	14.98	3.29
	7.40	10.19	0.40	0.55	4.04	10.34	89.8%	0.39	12.31	3.05
	7.45	9.90	0.36	0.50	3.53	10.04	87.2%	0.35	9.90	2.80
	7.50	9.61	0.32	0.45	3.05	9.73	84.5%	0.31	7.75	2.54
	7.55	9.32	0.28	0.40	2.57	9.42	81.8%	0.27	5.84	2.27
	7.60	9.03	0.23	0.35	2.11	9.11	79.1%	0.23	4.20	1.99
	7.65	8.74	0.19	0.30	1.67	8.80	76.4%	0.19	2.81	1.68
	7.70	8.44	0.15	0.25	1.24	8.49	73.8%	0.15	1.68	1.35
WL	7.75	8.14	0.10	0.20	0.82	8.17	71.0%	0.10	0.82	1.00
	7.80	6.57	0.07	0.15	0.44	6.59	57.3%	0.07	0.31	0.70
	7.85	2.41	0.05	0.10	0.12	2.42	21.0%	0.05	0.07	0.56
	7.90	0.81	0.03	0.05	0.02	0.81	7.1%	0.03	0.01	0.32
	7.95	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!


Soldier Creek
CROSS SECTION DATA ANALYSIS
-6.00
-6.20
-6.40
-6.60
-6.80
-7.00
-7.20
-7.40
-7.60
-7.80
-8.00
VERTICAL DEPTH (FT)
RS
G
W
W
G
LS
0.00
5.00
10.00
15.00
20.00
25.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Soldier Creek
Percent Wetted Perimeter vs. Discharge
Percent Wetted Perimeter
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
5.00
10.00
15.00
20.00
25.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Soldier Creek
Velocity vs. Discharge
Velocity - ft/sec
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
5.00
10.00
15.00
20.00
25.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Soldier Creek
Average Depth vs. Discharge
Average Depth - feet
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
5.00
10.00
15.00
20.00
25.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Soldier Creek
Stage vs. Discharge
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Stage - feet
0.00
5.00
10.00
15.00
20.00
25.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Solder Creek | CROSS-SECTION NO.: 1

CROSS-SECTION LOCATION: at BLM - private boundary

DATE: 7-27-09 | OBSERVERS: R. Smith, B. Lango, P Crowley

LEGAL DESCRIPTION | ¼ SECTION: SW | SECTION: 1 | TOWNSHIP: 4 N(S) | RANGE: 100E(W) | PM: 6th

COUNTY: Rio Blanco | WATERSHED: White River | WATER DIVISION: 6 | DOW WATER CODE: 02082

MAP(S): USGS: 6900 ft, GPS 12S 0708492 4400731

USFS:

SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES) NO | METER TYPE: M-M

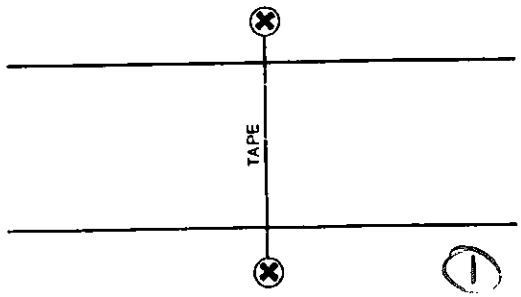
METER NUMBER: | DATE RATED: | CALIB/SPIN: ____ sec | TAPE WEIGHT: surveyed ____ lbs/foot | TAPE TENSION: surveyed ____ lbs

CHANNEL BED MATERIAL SIZE RANGE: gravel to 6" cobbles | 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	8.0	7.67
③ WS Downstream	33.0	8.15
SLOPE	0.48/41.0 =	

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, stonefly

COMMENTS

TDS = 710 ms
pH = 8.4
Temp = 21°

FORM #ISS FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Soldier Creek | CROSS-SECTION NO.: 1 | DATE: 7-27-09 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: 3:05 pm

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	2.0		6.99								
G	3.8		7.13								
W	5.3		7.73								
	5.7		7.85	.10				.34			
	6.1		7.85	.10				.74			
(6.9)	6.5	7.85	7.85	.10	<.10			1.20	<1.13		
	7.3		7.85	.10				1.88			
	7.7		7.85	.10				1.26			
	8.1		7.90	.15				1.26			
	8.5		7.90	.15				1.00			
	8.9		7.90	.15				1.36			
	9.3		7.95	.20				1.67			
	9.7		7.90	.15				1.48			
	10.1		7.85	.10				.77			
	10.5		7.85	.10				.23			
	10.9		7.85	.10				.85			
	11.3		7.85	.10				.85			
	11.7		7.85	.10				.24			
	12.1		7.80	.05				0			
	12.5		7.80	.05				0			
	12.9		7.80	.05				0			
W	13.5		7.75								
G	15.3		7.21								
LS	20.2		6.35								
TOTALS:											

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

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

LOCATION INFORMATION

STREAM NAME:	Soldier Creek
XS LOCATION:	At BLM-Private boundary
XS NUMBER:	2
DATE:	27-Jul-09
OBSERVERS:	R. Smith, B. Lange, P. Crowley
1/4 SEC:	SW
SECTION:	1
TWP:	4S
RANGE:	100W
PM:	Sixth
COUNTY:	Rio Blanco
WATERSHED:	White River
DIVISION:	6
DOW CODE:	22082
USGS MAP:	0
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:	0.008

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

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

STREAM NAME: Soldier Creek
XS LOCATION: At BLM-Private boundary
XS NUMBER: 2

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
	LS	2.00	4.31			0.00		0.00	0.00	0.0%
1	G	3.00	5.06			0.00		0.00	0.00	0.0%
	W	5.00	5.59	0.00	0.00	0.00		0.00	0.00	0.0%
		5.10	5.70	0.10	0.06	0.15	0.10	0.03	0.00	0.2%
		5.50	5.80	0.20	0.24	0.41	0.20	0.08	0.02	2.4%
		5.90	5.80	0.20	0.96	0.40	0.20	0.08	0.08	9.6%
		6.30	5.80	0.20	1.43	0.40	0.20	0.08	0.11	14.3%
		6.70	5.75	0.15	0.70	0.40	0.15	0.06	0.04	5.2%
		7.10	5.80	0.20	1.20	0.40	0.20	0.08	0.10	12.0%
		7.50	5.80	0.20	0.97	0.40	0.20	0.08	0.08	9.7%
		7.90	5.80	0.20	0.85	0.40	0.20	0.08	0.07	8.5%
		8.30	5.80	0.20	0.57	0.40	0.20	0.08	0.05	5.7%
		8.70	5.80	0.20	1.02	0.40	0.20	0.08	0.08	10.2%
		9.10	5.75	0.15	0.52	0.40	0.15	0.06	0.03	3.9%
		9.50	5.75	0.15	0.08	0.40	0.15	0.06	0.00	0.6%
		9.90	5.75	0.15	0.58	0.40	0.15	0.06	0.03	4.3%
		10.30	5.75	0.15	1.23	0.40	0.15	0.06	0.07	9.2%
		10.70	5.65	0.05	0.97	0.41	0.05	0.02	0.02	2.4%
		11.10	5.65	0.05	0.76	0.40	0.05	0.02	0.02	1.9%
		11.50	5.65	0.05	0.00	0.40	0.05	0.02	0.00	0.0%
		11.90	5.60	0.00	0.00	0.40		0.00	0.00	0.0%
	W	12.20	5.58			0.00		0.00	0.00	0.0%
1	G	17.30	5.04			0.00		0.00	0.00	0.0%
	RS	20.30	4.39			0.00		0.00	0.00	0.0%
	TOTALS ----------					6.99	0.2 (Max.)	1.03	0.80	100.0%

Manning's n = 0.0473
Hydraulic Radius= 0.14672762

STREAM NAME: Soldier Creek
XS LOCATION: At BLM-Private boundary
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.03	1.06	3.3%
5.35	1.03	3.23	215.3%
5.37	1.03	3.03	195.3%
5.39	1.03	2.83	175.9%
5.41	1.03	2.63	157.0%
5.43	1.03	2.45	138.7%
5.45	1.03	2.26	120.8%
5.47	1.03	2.09	103.5%
5.49	1.03	1.91	86.6%
5.51	1.03	1.75	70.3%
5.53	1.03	1.58	54.5%
5.55	1.03	1.43	39.2%
5.56	1.03	1.35	31.8%
5.57	1.03	1.28	24.5%
5.58	1.03	1.20	17.3%
5.59	1.03	1.13	10.2%
5.60	1.03	1.06	3.3%
5.61	1.03	0.99	-3.4%
5.62	1.03	0.92	-10.0%
5.63	1.03	0.86	-16.6%
5.64	1.03	0.79	-23.0%
5.65	1.03	0.72	-29.4%
5.67	1.03	0.61	-40.8%
5.69	1.03	0.50	-51.6%
5.71	1.03	0.39	-62.1%
5.73	1.03	0.28	-72.4%
5.75	1.03	0.18	-82.4%
5.77	1.03	0.10	-90.1%
5.79	1.03	0.04	-96.2%
5.81	1.03	0.00	-100.0%
5.83	1.03	0.00	-100.0%
5.85	1.03	0.00	-100.0%

WATERLINE AT ZERO
AREA ERROR = 5.600

STREAM NAME: Soldier Creek
XS LOCATION: At BLM-Private boundary
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	5.06	14.11	0.48	0.74	6.72	14.29	100.0%	0.47	11.42	1.70
	5.10	13.58	0.45	0.70	6.16	13.76	96.3%	0.45	10.15	1.65
	5.15	12.92	0.43	0.65	5.50	13.09	91.6%	0.42	8.68	1.58
	5.20	12.26	0.40	0.60	4.87	12.42	86.9%	0.39	7.34	1.51
	5.25	11.60	0.37	0.55	4.27	11.75	82.2%	0.36	6.13	1.43
	5.30	10.94	0.34	0.50	3.71	11.08	77.5%	0.33	5.03	1.36
	5.35	10.28	0.31	0.45	3.18	10.41	72.8%	0.31	4.06	1.28
	5.40	9.62	0.28	0.40	2.68	9.74	68.1%	0.28	3.19	1.19
	5.45	8.96	0.25	0.35	2.22	9.07	63.4%	0.24	2.44	1.10
	5.50	8.30	0.22	0.30	1.79	8.40	58.8%	0.21	1.79	1.00
	5.55	7.63	0.18	0.25	1.39	7.73	54.1%	0.18	1.24	0.90
WL	5.60	6.89	0.15	0.20	1.02	6.97	48.8%	0.15	0.80	0.78
	5.65	5.65	0.12	0.15	0.69	5.70	39.9%	0.12	0.48	0.69
	5.70	5.40	0.08	0.10	0.42	5.43	38.0%	0.08	0.21	0.51
	5.75	3.80	0.04	0.05	0.16	3.82	26.7%	0.04	0.05	0.33
	5.80	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Soldier Creek
XS LOCATION: At BLM-Private boundary
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	0.80	cfs	RECOMMENDED INSTREAM FLOW:	
CALCULATED FLOW (Qc)=	0.80	cfs	============================	
(Qm-Qc)/Qm * 100 =	-0.1	%		
			FLOW (CFS)	PERIOD
MEASURED WATERLINE (WLm)=	5.60	ft	===========	========
CALCULATED WATERLINE (WLc)=	5.60	ft		
(WLm-WLc)/WLm * 100 =	-0.1	%	____________________	____________________
MAX MEASURED DEPTH (Dm)=	0.20	ft	____________________	____________________
MAX CALCULATED DEPTH (Dc)=	0.20	ft		
(Dm-Dc)/Dm * 100	0.0	%	____________________	____________________
MEAN VELOCITY=	0.78	ft/sec	____________________	____________________
MANNING'S N=	0.047			
SLOPE=	0.008	ft/ft		
.4 * Qm =	0.3	cfs		
2.5 * Qm=	2.0	cfs		

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

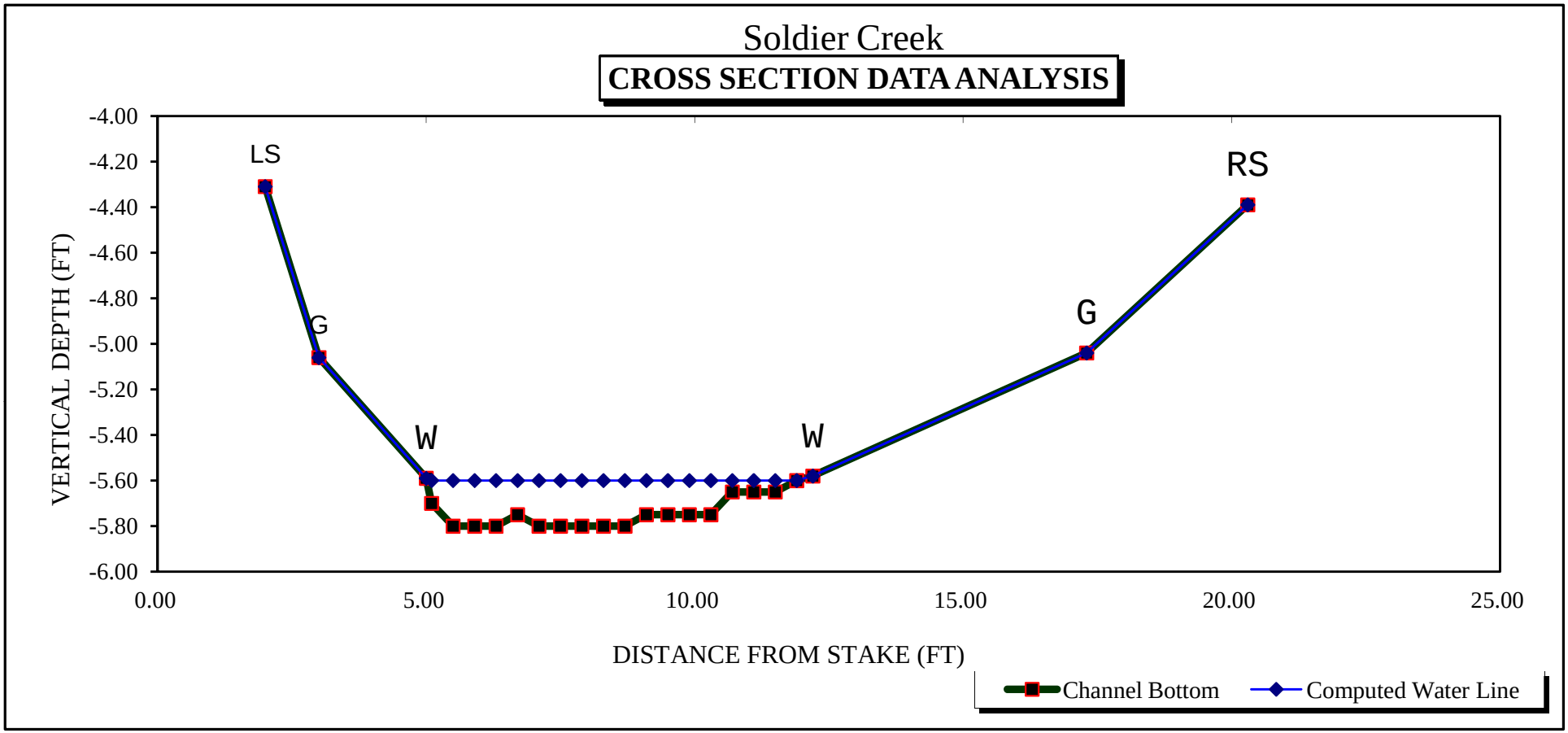
RECOMMENDATION BY: …………………...………..……............................... AGENCY...……………………......……....…....……....... DATE:.......…...….......……………

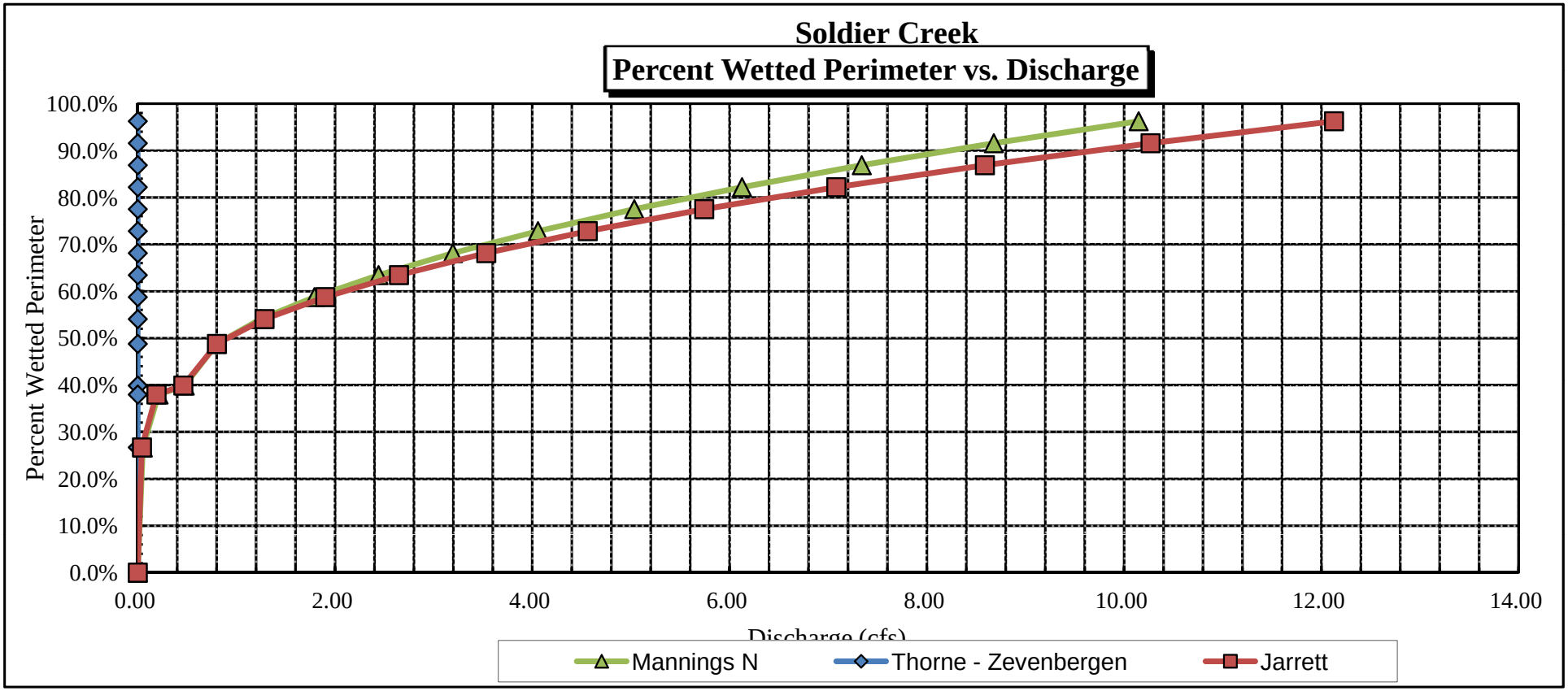
CWCB REVIEW BY: ..……………………………....…………………………………………………….......................................…............. DATE:..................…………….....…

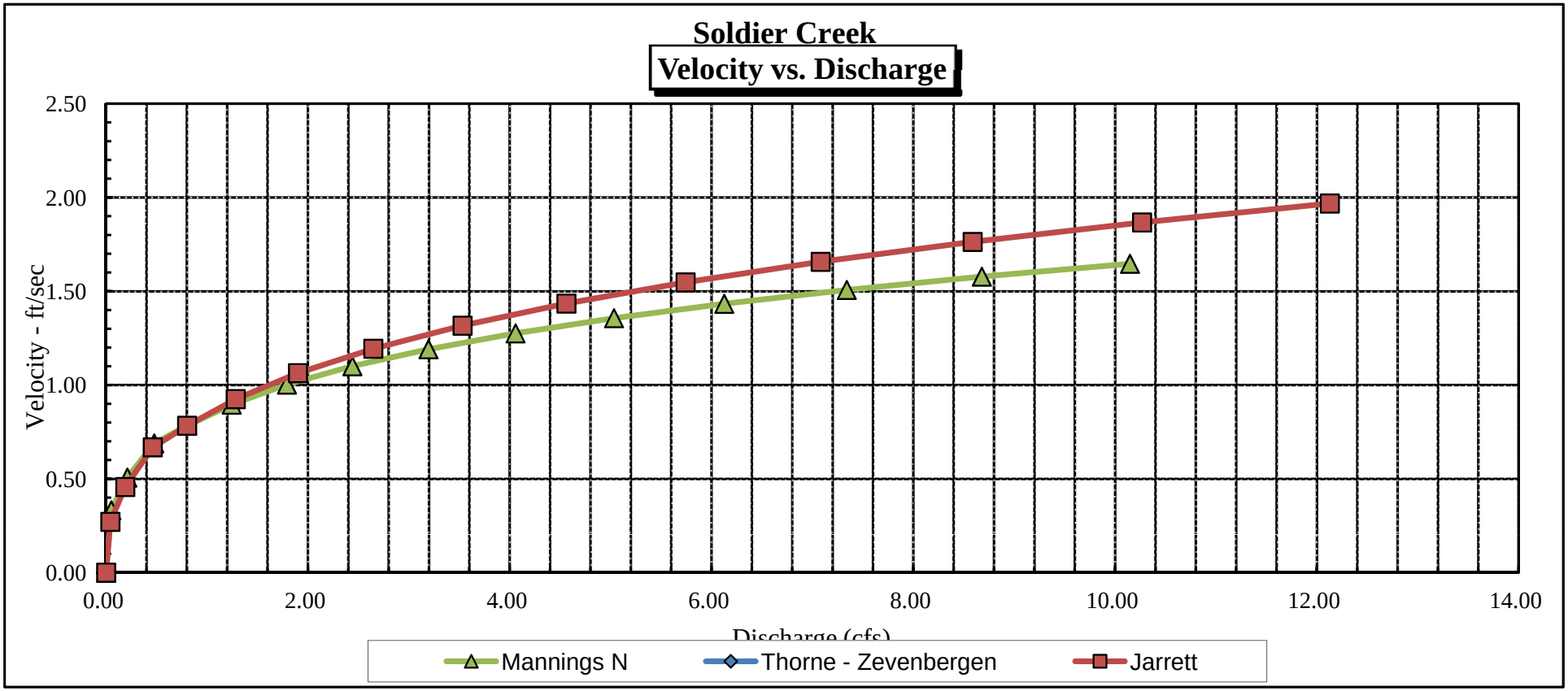
STREAM NAME: Soldier Creek
XS LOCATION: At BLM-Private boundary
XS NUMBER: 2 Jarrett Variable Manning's n Correction Applied

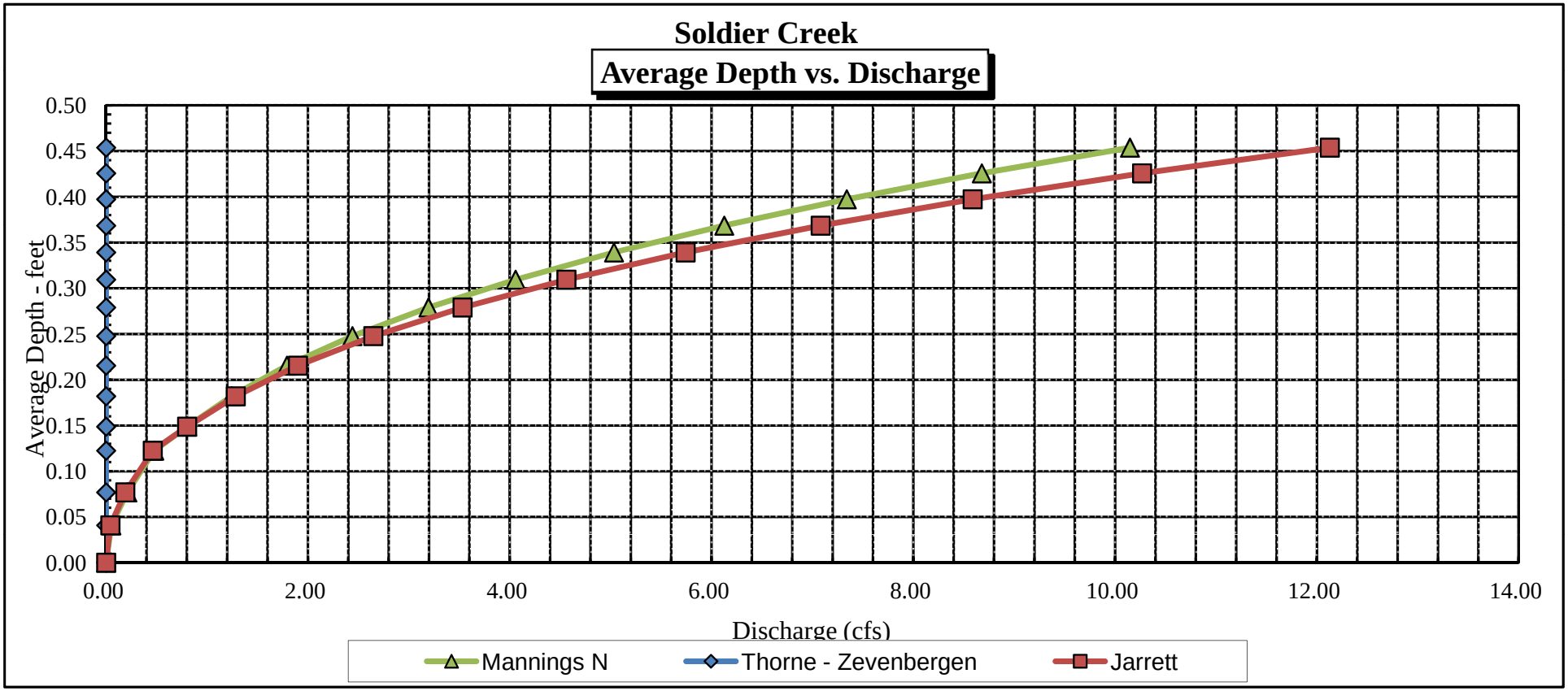
GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

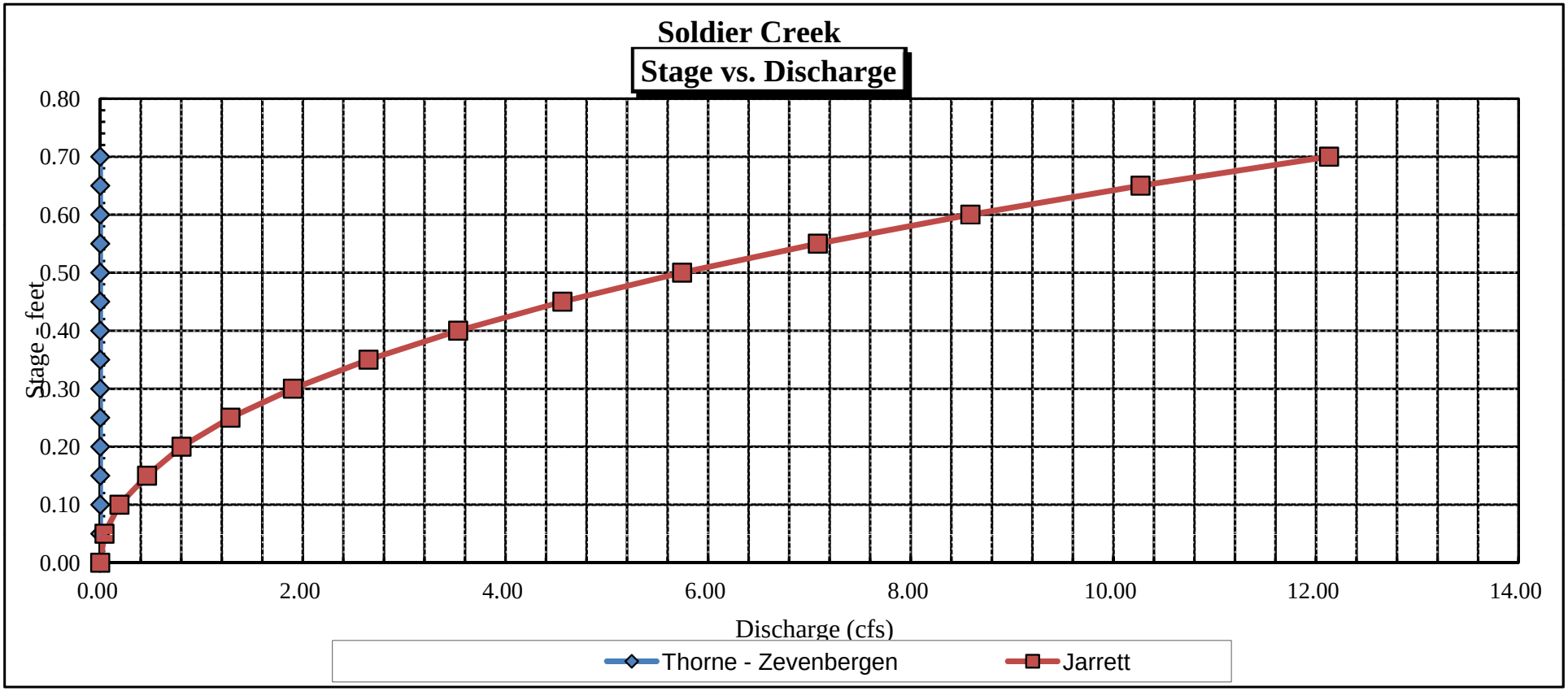
	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.06	14.11	0.48	0.74	6.72	14.29	100.0%	0.47	13.75	2.05
	5.10	13.58	0.45	0.70	6.16	13.76	96.3%	0.45	12.13	1.97
	5.15	12.92	0.43	0.65	5.50	13.09	91.6%	0.42	10.27	1.87
	5.20	12.26	0.40	0.60	4.87	12.42	86.9%	0.39	8.59	1.76
	5.25	11.60	0.37	0.55	4.27	11.75	82.2%	0.36	7.08	1.66
	5.30	10.94	0.34	0.50	3.71	11.08	77.5%	0.33	5.74	1.55
	5.35	10.28	0.31	0.45	3.18	10.41	72.8%	0.31	4.56	1.43
	5.40	9.62	0.28	0.40	2.68	9.74	68.1%	0.28	3.53	1.32
	5.45	8.96	0.25	0.35	2.22	9.07	63.4%	0.24	2.65	1.19
	5.50	8.30	0.22	0.30	1.79	8.40	58.8%	0.21	1.90	1.06
	5.55	7.63	0.18	0.25	1.39	7.73	54.1%	0.18	1.28	0.93
WL	5.60	6.89	0.15	0.20	1.02	6.97	48.8%	0.15	0.80	0.78
	5.65	5.65	0.12	0.15	0.69	5.70	39.9%	0.12	0.46	0.67
	5.70	5.40	0.08	0.10	0.42	5.43	38.0%	0.08	0.19	0.46
	5.75	3.80	0.04	0.05	0.16	3.82	26.7%	0.04	0.04	0.27
	5.80	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!


Soldier Creek
CROSS SECTION DATA ANALYSIS
-4.00
-4.20
-4.40
-4.60
-4.80
-5.00
-5.20
-5.40
-5.60
-5.80
-6.00
VERTICAL DEPTH (FT)
LS
G
W
W
G
RS
0.00
5.00
10.00
15.00
20.00
25.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Soldier Creek
Percent Wetted Perimeter vs. Discharge
Percent Wetted Perimeter
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Soldier Creek
Velocity vs. Discharge
Velocity - ft/sec
2.50
2.00
1.50
1.00
0.50
0.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Soldier Creek
Average Depth vs. Discharge
Average Depth - feet
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Soldier Creek
Stage vs. Discharge
Stage - feet
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Soldier Creek						CROSS-SECTION NO.: 2	
CROSS-SECTION LOCATION: at BLM - private boundary							
DATE: 7-27-09	OBSERVERS: R. Smith, B. Lange, P. Crowley						
LEGAL DESCRIPTION	¼ SECTION: SW	SECTION: 1	TOWNSHIP: 4 N(S)	RANGE: 100 E(W)	PM: 6th		
COUNTY: Rio Blanco	WATERSHED: White River		WATER DIVISION: 6		DOW WATER CODE: 22087		
MAP(S):	USGS:						
	USFS:						

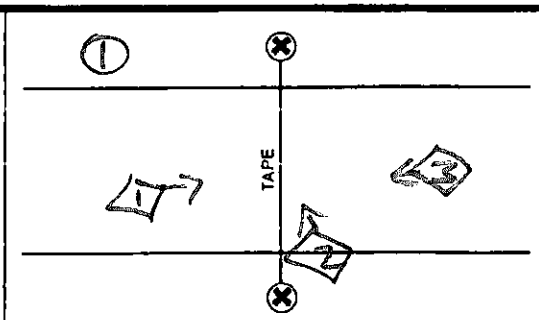
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / NO	METER TYPE: M-M			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: surveyed ____ lbs/foot	TAPE TENSION: surveyed ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: gravel to 6" cobbles	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	5.59/5.58
② WS Upstream	19.0'	5.50
③ WS Downstream	20.0'	5.84
SLOPE	0.34 / 39.0' = 0.008	

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, stonefly

COMMENTS

TDS = 710 ms
PH = 8.4
Temp = 21°C

FORM #ISF ED-1 RE

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Soldier Creek | CROSS-SECTION NO.: 2 | DATE: 7-27-09 | SHEET 1 OF 1

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: 3:45

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
LS	2.0		4.31								
G	3.0		5.06								
W	5.0		5.59								
	5.1		5.70	.10				.06			
	5.5		5.80	.20				.24			
	5.9		5.80	.20				.96			
	6.3		5.80	.20				1.43			
	6.7		5.75	.15				.70			
	7.1		5.80	.20				1.20			
	7.5		5.80	.20				.97			
	7.9		5.80	.20				.85			
	8.3		5.80	.20				.57			
	8.7		5.80	.20				1.02			
	9.1		5.75	.15				.52			
	9.5		5.75	.15				.08			
	9.9		5.75	.15				.58			
	10.3		5.75	.15				1.23			
	10.7		5.65	.05				.97			
	11.1		5.65	.05				.76			
	11.5		5.65	.05				Ø			
	11.9		5.60	Ø				Ø			
W	12.2		5.58								
G	17.3		5.04								
RS	20.3		4.39								
TOTALS:											

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