United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215-7093
www.blm.gov/co

TAKE PRIDE IN AMERICA

MAR 7 2012

In Reply Refer To:
7250 (CO-932)

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 of the existing instream flow water right on Pole Creek, located in Water Division 1. In 1986, the Colorado Water Conservation Board appropriated an instream flow water right for 0.5 cubic feet per second year-round on the entire length of this creek.

Location and Land Status: Pole Creek is located within the Laramie River watershed. It is tributary to Johnson Creek approximately one-half mile south of the Colorado-Wyoming border. This recommendation covers the stream reach beginning at the headwaters (106° 7' 57.3" W, 40° 55' 8.88" N) and extending downstream to the confluence with Johnson Creek, a distance of approximately 7.3 miles. Approximately 2.8 miles of this stream reach are managed by the BLM, and 4.0 miles are managed by the U.S. Forest Service. Approximately 0.39 miles are under private ownership.

Biological Summary: Pole Creek is a cold-water stream with moderate gradient, functional floodplains, and active beaver dams. The stream is heavily influenced by extensive beaver dams, but there is sufficient riffle and spawning habitat to support fish populations. Fish surveys show that Pole Creek supports naturally reproducing populations of brook trout and longnose sucker. Intensive macroinvertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly and caddisfly. The riparian and wetland community occupies most of the floodplain area and is comprised primarily of willows, alders, rushes, and sedges.

R2Cross Analysis: The BLM collected the following R2Cross data from Pole 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)
08/03/2010 #1	1.18 cfs	8.34 feet	0.89 cfs	2.09 cfs
07/13/2011 #1	3.21 cfs	8.77 feet	Out of range	1.48 cfs
		Averages:	0.89 cfs	1.74 cfs

The 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.

> An increase of 1.25 cubic feet per second is recommended for snowmelt runoff period, from May 1 through August 15. The enlargement will bring the total instream flow rate up to 1.75 cfs for this time period. This recommendation is driven by the average velocity criteria. It is important to maintain adequate velocity in the riffles in this creek, because the creek has limited riffle habitat available for spawning because of the extensive beaver activity.
>
> An increase of 0.8 cubic feet per second is recommended during late summer and early fall, from August 16 to October 31. The increase will bring the total instream flow rate up to 1.3 cfs for this time period. This recommendation has been reduced because of water availability concerns, but the flow rate will still meet both the wetted perimeter and average depth criteria.
>
> An increase of 0.25 cfs is recommended during the winter period from November 1 to April 30. This recommendation has been slightly reduced to respond to water availability concerns. However, this flow rate will still provide an average velocity of 0.65 feet per second, 70% wetted perimeter, and 0.18 feet average depth. The BLM believes that this flow rate should provide sufficient velocity and depth to prevent icing of all physical habitat within the stream.

Water Availability: For water availability analysis, the BLM recommends analysis of U.S. Geological Survey stream gage 06657500 (Laramie River near Glendevey, CO). This gage has a long period of record between 1904 and 1982, and the State of Colorado has continued to operate the gage from 1982 to the present. This gage is located in a different part of the Laramie River watershed than Pole Creek. However, this gage should provide an excellent indication of the volume of runoff to be expected per acre within this watershed, along with an indication of the timing and distribution of that runoff. When utilizing this gage, it should be understood that the gage may have been affected by icing during the winter.

The BLM is not aware of any decreed water rights that operate within the recommended stream reach.

Rationale for Increase of Instream Flow Water Right: The BLM does not consider the current instream flow water right to be protective of the natural environment in Pole Creek. In the cross-sections analyzed by the BLM, a flow rate of 0.5 cfs does even meet the instream flow criteria for a typical winter-period instream flow water right. If the current 0.5 cfs protected flow rate were to be maintained for extended periods during the summer, the BLM would anticipate significant stress on the fish community, in the form of high stream temperatures and very limited riffle habitat. BLM deliberately surveyed a rifle with a narrow top width, and the 0.5 flow rate appears to be inadequate even in the narrowest riffles that are typical in this stream.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with BLM's draft recommendation in February 2011. 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, Water Rights Specialist at (303) 239-3940.

Sincerely,

for Leigh D. Espy
Deputy State Director, Resources and Fire

cc: Dave Stout, Kremmling FO
Paula Belcher, Kremmling FO

DRAFT INSTREAM FLOW RECOMMENDATION

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 enlargement of the existing instream flow water right on Pole Creek, located in Water Division 1. In 1986, the Colorado Water Conservation Board appropriated an instream flow water right for 0.5 cubic feet per second on the entire length of this creek.

Location and Land Status. Pole Creek is located within the Laramie River watershed. It is tributary to Johnson Creek approximately one-half mile south of the Colorado-Wyoming border. This recommendation covers the stream reach beginning at the headwaters (106° 7' 57.3" W, 40° 55' 8.88" N) and extending downstream to the confluence with Johnson Creek, a distance of approximately 7.3 miles. Approximately 2.8 miles of this stream reach are managed by the BLM, and 4.0 miles are managed by the U.S. Forest Service. Approximately 0.39 miles are under private ownership.

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07/13/2011 #1	3.21 cfs	8.77 feet	Out of range	1.48 cfs
		Averages:	0.89 cfs	1.74 cfs

BLM's analysis of this data, coordinated with the Division of Wildlife, indicates that the following flows are needed to protect the fishery and natural environment to a reasonable degree. (Note: final flow recommendations may change, based upon summer 2011 field work.)

An enlargement of 1.25 cubic feet per second is recommended for snowmelt

runoff period, from April 1 through July 15. The enlargement will bring the total instream flow rate up to 1.75 cfs for this time period. This recommendation is driven by the average velocity criteria. It is important to maintain adequate velocity in the riffles in this creek, because the creek has limited riffle habitat available for spawning because of the extensive beaver activity.

An enlargement of 0.4 cubic feet per second is recommended during the remainder of the year, from July 16 to March 31. The enlargement will bring the total instream flow rate up to 0.9 cfs for this time period. This recommendation is driven by the average depth criteria. During winter, this flow rate should provide sufficient velocity and depth to prevent icing of all physical habitat within the stream.

Water Availability. For water availability analysis, BLM recommends analysis of U.S. Geological Survey stream gage 06657500 (Laramie River near Glendevey, CO). This gage has a long period of record between 1904 and 1982, and the State of Colorado has continued to operate the gage from 1982 to the present. This gage is located in a different part of the Laramie River watershed than Pole Creek. However, this gage should provide an excellent indication of the volume of runoff to be expected per acre within this watershed, along with an indication of the timing and distribution of that runoff. When utilizing this gage, it should be understood that the gage may have been affected by icing during the winter.

BLM is not aware of any decreed water rights that operate within the recommended stream reach.

Rationale for Enlargement of Instream Flow Water Right. BLM does not consider the current instream flow water right to be protective of the natural environment in Pole Creek. In the cross-sections analyzed by BLM, a flow rate of 0.5 cfs does even meet the instream flow criteria for a typical winter-period instream flow water right. If the current 0.5 cfs protected flow rate were to be maintained for extended periods during the summer, BLM would anticipate significant stress on fish community, in the form of high stream temperatures and very limited riffle habitat. BLM deliberately surveyed a rifle with a narrow top width, and the 0.5 flow rate appears to be inadequate even in the narrowest riffles that are typical in this stream.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with BLM's draft recommendation in February 2011. 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 at 303-239-3940.

Sincerely,

Leigh Espy

Deputy State Director
Resources and Fire

Cc: Dave Stout, Kremmling FO
Paula Belcher, Kremmling FO

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME: Pole Creek						CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: 1,000 ft. upstream from confluence with Johnson Creek						
DATE: 7-13-11	OBSERVERS: R. Smith, P. Belcher					
LEGAL DESCRIPTION	¼ SECTION: SE	SECTION: 20	TOWNSHIP: 12 N/S	RANGE: 77 E/W	PM: 6th	
COUNTY: Larimer	WATERSHED: Laramie River	WATER DIVISION: 1	DOW WATER CODE: 11863			
MAP(S): USGS:			GPS 411154	Zone 13		
USFS:			4535139			

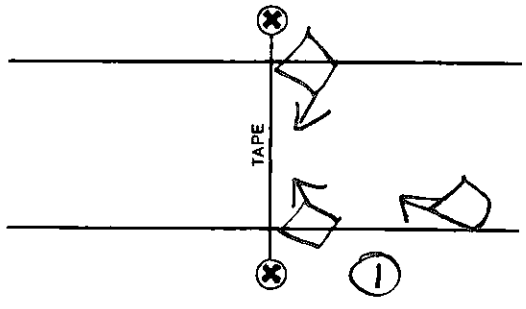
SUPPLEMENTAL DATA

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: gravels to 4" 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	9.95 / 9.98
② WS Upstream	29.4	9.50
③ WS Downstream	25.3	10.04
SLOPE	0.54/54.7 =	

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

Ph = 7.79
Conductivity = 85 µs
Temp = 15.4° C
Salinity = .1 ppt

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Pole Creek | CROSS-SECTION NO.: 1 | DATE: 7-13-11 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: 10:05 am

Features (Stake (S) Grassline (G) Waterline (W) Rock (R))	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
LS	0.0		7.35								
	1.5		6.52								
G	2.9		9.10								
W	3.1	.15	9.95	0				0		0	0
	3.4	.3	10.45	.5				.34		.15	
	3.7	.3	10.45	.5				.67		.15	
	4.0	.3	10.45	.5				.69		.15	
	4.3	.3	10.45	.5				.69		.15	
	4.6	.3	10.45	.5				.63		.15	
	4.9	.3	10.45	.5				1.25		.15	
	5.2	.3	10.50	.55				1.42		.165	
	5.5	.3	10.45	.5				1.60		.15	
	5.8	.3	10.50	.55				1.77		.165	
	6.1	.3	10.55	.6				1.81		.18	
	6.4	.3	10.45	.5				1.47		.15	
	6.7	.3	10.45	.5				2.2		.15	
	7.0	.3	10.30	.4				2.4		.12	
	7.3	.3	10.30	.4				2.03		.12	
	7.6	.3	10.25	.3				1.61		.09	
	7.9	.3	10.25	.3				1.34		.09	
	8.2	.3	10.2	.25				1.01		.075	
	8.5	.3	10.15	.2				0.77		.06	
	8.8	.3	10.1	.15				0.20		0.03	
	9.1	.25	10.05	.1				0		0	
W	9.3	.1	9.95	0				0			0
	10.6		9.35								
G	12.1		9.00							5	
RS	13.0		8.80								
	1.2	6.2									
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:	Pole Creek
XS LOCATION:	1000 ft up fr conf w/ Johnson Creek
XS NUMBER:	1
DATE:	13-Jul-11
OBSERVERS:	R.Smith, P. Belcher
1/4 SEC:	SE
SECTION:	20
TWP:	12N
RANGE:	77W
PM:	Sixth
COUNTY:	Larimer
WATERSHED:	Laramie River
DIVISION:	1
DOW CODE:	11863
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:	0.01

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

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

STREAM NAME: Pole Creek
XS LOCATION: 1000 ft up fr conf w/ Johnson Creek
XS NUMBER: 1

DATA POINTS= 28

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	LS	0.00	7.35			0.00		0.00	0.00	0.0%
		1.50	6.52			0.00		0.00	0.00	0.0%
1	G	2.90	9.10			0.00		0.00	0.00	0.0%
	W	3.10	9.95	0.00	0.00	0.00		0.00	0.00	0.0%
		3.40	10.45	0.50	0.34	0.58	0.50	0.15	0.05	1.6%
		3.70	10.45	0.50	0.67	0.30	0.50	0.15	0.10	3.1%
		4.00	10.45	0.50	0.69	0.30	0.50	0.15	0.10	3.2%
		4.30	10.45	0.50	0.69	0.30	0.50	0.15	0.10	3.2%
		4.60	10.45	0.50	0.63	0.30	0.50	0.15	0.09	2.9%
		4.90	10.45	0.50	1.25	0.30	0.50	0.15	0.19	5.8%
		5.20	10.50	0.55	1.42	0.30	0.55	0.17	0.23	7.3%
		5.50	10.45	0.50	1.60	0.30	0.50	0.15	0.24	7.5%
		5.80	10.50	0.55	1.77	0.30	0.55	0.17	0.29	9.1%
		6.10	10.55	0.60	1.81	0.30	0.60	0.18	0.33	10.1%
		6.40	10.45	0.50	1.47	0.32	0.50	0.15	0.22	6.9%
		6.70	10.45	0.50	2.20	0.30	0.50	0.15	0.33	10.3%
		7.00	10.30	0.40	2.40	0.34	0.40	0.12	0.29	9.0%
		7.30	10.30	0.40	2.03	0.30	0.40	0.12	0.24	7.6%
		7.60	10.25	0.30	1.61	0.30	0.30	0.09	0.14	4.5%
		7.90	10.25	0.30	1.34	0.30	0.30	0.09	0.12	3.8%
		8.20	10.20	0.25	1.01	0.30	0.25	0.08	0.08	2.4%
		8.50	10.15	0.20	0.77	0.30	0.20	0.06	0.05	1.4%
		8.80	10.10	0.15	0.20	0.30	0.15	0.05	0.01	0.3%
		9.10	10.05	0.10	0.00	0.30	0.10	0.03	0.00	0.0%
	W	9.30	9.95	0.00	0.00	0.22		0.00	0.00	0.0%
		10.60	9.35			0.00		0.00	0.00	0.0%
1	G	12.10	9.00			0.00		0.00	0.00	0.0%
	RS	13.00	8.80			0.00		0.00	0.00	0.0%
	TOTALS ----------					6.60	0.6 (Max.)	2.49	3.21	100.0%

Manning's n = 0.0600
Hydraulic Radius= 0.3767673

STREAM NAME: Pole Creek
XS LOCATION: 1000 ft up fr conf w/ Johnson Creek
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	2.49	2.46	-1.2%
9.70	2.49	4.08	64.2%
9.72	2.49	3.94	58.7%
9.74	2.49	3.81	53.3%
9.76	2.49	3.68	47.9%
9.78	2.49	3.54	42.6%
9.80	2.49	3.41	37.3%
9.82	2.49	3.28	32.0%
9.84	2.49	3.15	26.8%
9.86	2.49	3.02	21.6%
9.88	2.49	2.89	16.5%
9.90	2.49	2.77	11.4%
9.91	2.49	2.70	8.9%
9.92	2.49	2.64	6.3%
9.93	2.49	2.58	3.8%
9.94	2.49	2.52	1.3%
9.95	2.49	2.46	-1.2%
9.96	2.49	2.39	-3.7%
9.97	2.49	2.33	-6.2%
9.98	2.49	2.27	-8.6%
9.99	2.49	2.21	-11.1%
10.00	2.49	2.15	-13.6%
10.02	2.49	2.03	-18.4%
10.04	2.49	1.91	-23.2%
10.06	2.49	1.79	-28.0%
10.08	2.49	1.67	-32.7%
10.10	2.49	1.56	-37.3%
10.12	2.49	1.45	-41.7%
10.14	2.49	1.34	-46.1%
10.16	2.49	1.23	-50.3%
10.18	2.49	1.13	-54.5%
10.20	2.49	1.03	-58.5%

WATERLINE AT ZERO
AREA ERROR = 9.945

STREAM NAME: Pole Creek
XS LOCATION: 1000 ft up fr conf w/ Johnson Creek
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	9.10	8.77	0.99	1.45	8.66	10.00	100.0%	0.87	19.49	2.25
	9.15	8.57	0.96	1.40	8.27	9.76	97.5%	0.85	18.34	2.22
	9.20	8.34	0.94	1.35	7.84	9.48	94.8%	0.83	17.12	2.18
	9.25	8.12	0.92	1.30	7.43	9.21	92.1%	0.81	15.96	2.15
	9.30	7.89	0.89	1.25	7.03	8.94	89.4%	0.79	14.85	2.11
	9.35	7.66	0.87	1.20	6.64	8.67	86.7%	0.77	13.78	2.07
	9.40	7.53	0.83	1.15	6.26	8.49	84.9%	0.74	12.67	2.02
	9.45	7.41	0.79	1.10	5.89	8.32	83.2%	0.71	11.59	1.97
	9.50	7.29	0.76	1.05	5.52	8.15	81.5%	0.68	10.56	1.91
	9.55	7.17	0.72	1.00	5.16	7.98	79.8%	0.65	9.57	1.85
	9.60	7.05	0.68	0.95	4.81	7.81	78.1%	0.62	8.62	1.79
	9.65	6.93	0.64	0.90	4.46	7.64	76.4%	0.58	7.71	1.73
	9.70	6.81	0.60	0.85	4.11	7.47	74.6%	0.55	6.85	1.66
	9.75	6.69	0.56	0.80	3.78	7.29	72.9%	0.52	6.03	1.60
	9.80	6.57	0.52	0.75	3.44	7.12	71.2%	0.48	5.25	1.53
	9.85	6.45	0.48	0.70	3.12	6.95	69.5%	0.45	4.53	1.45
	9.90	6.33	0.44	0.65	2.80	6.78	67.8%	0.41	3.84	1.37
WL	9.95	6.21	0.40	0.60	2.48	6.61	66.1%	0.38	3.21	1.29
	10.00	6.08	0.36	0.55	2.18	6.44	64.4%	0.34	2.62	1.20
	10.05	5.95	0.32	0.50	1.88	6.27	62.7%	0.30	2.08	1.11
	10.10	5.64	0.28	0.45	1.59	5.93	59.3%	0.27	1.63	1.03
	10.15	5.31	0.25	0.40	1.31	5.57	55.7%	0.24	1.24	0.95
	10.20	4.98	0.21	0.35	1.06	5.20	52.0%	0.20	0.90	0.86
	10.25	4.65	0.18	0.30	0.81	4.84	48.4%	0.17	0.61	0.75
	10.30	4.02	0.15	0.25	0.60	4.18	41.8%	0.14	0.41	0.68
	10.35	3.57	0.12	0.20	0.42	3.69	36.9%	0.11	0.24	0.58
	10.40	3.44	0.07	0.15	0.24	3.52	35.2%	0.07	0.10	0.42
	10.45	3.31	0.02	0.10	0.08	3.35	33.5%	0.02	0.02	0.20
	10.50	0.55	0.02	0.05	0.01	0.57	5.7%	0.02	0.00	0.21
	10.55	0.04	0.00	0.00	0.00	0.04	0.4%	0.00	0.00	0.04

STREAM NAME: Pole Creek
XS LOCATION: 1000 ft up fr conf w/ Johnson Creek
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	3.21	cfs
CALCULATED FLOW (Qc)=	3.21	cfs
(Qm-Qc)/Qm * 100 =	0.2	%
MEASURED WATERLINE (WLm)=	9.95	ft
CALCULATED WATERLINE (WLc)=	9.95	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.60	ft
MAX CALCULATED DEPTH (Dc)=	0.60	ft
(Dm-Dc)/Dm * 100	-0.8	%
MEAN VELOCITY=	1.29	ft/sec
MANNING'S N=	0.060	
SLOPE=	0.01	ft/ft
.4 * Qm =	1.3	cfs
2.5 * Qm=	8.0	cfs

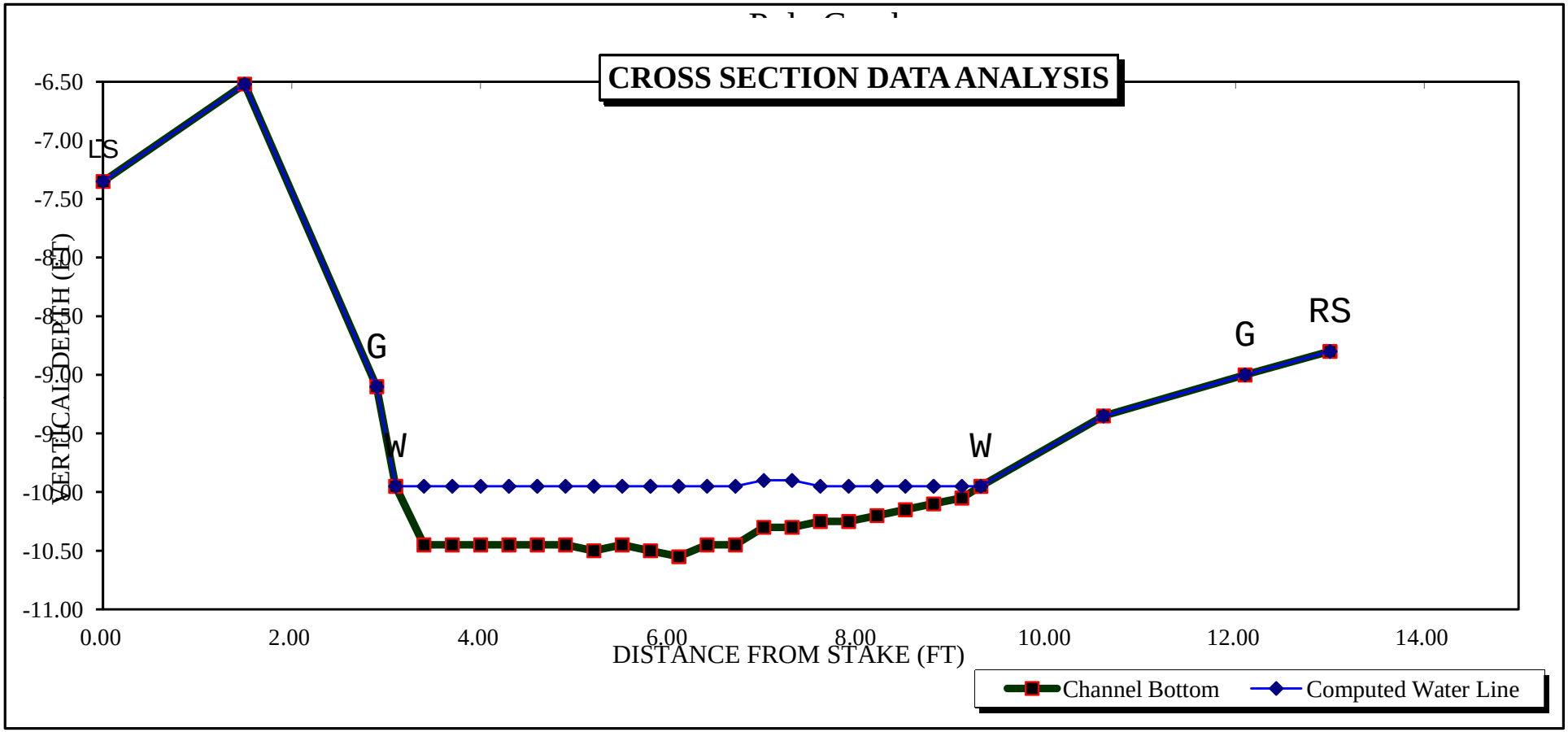
RECOMMENDED INSTREAM FLOW:
=============================

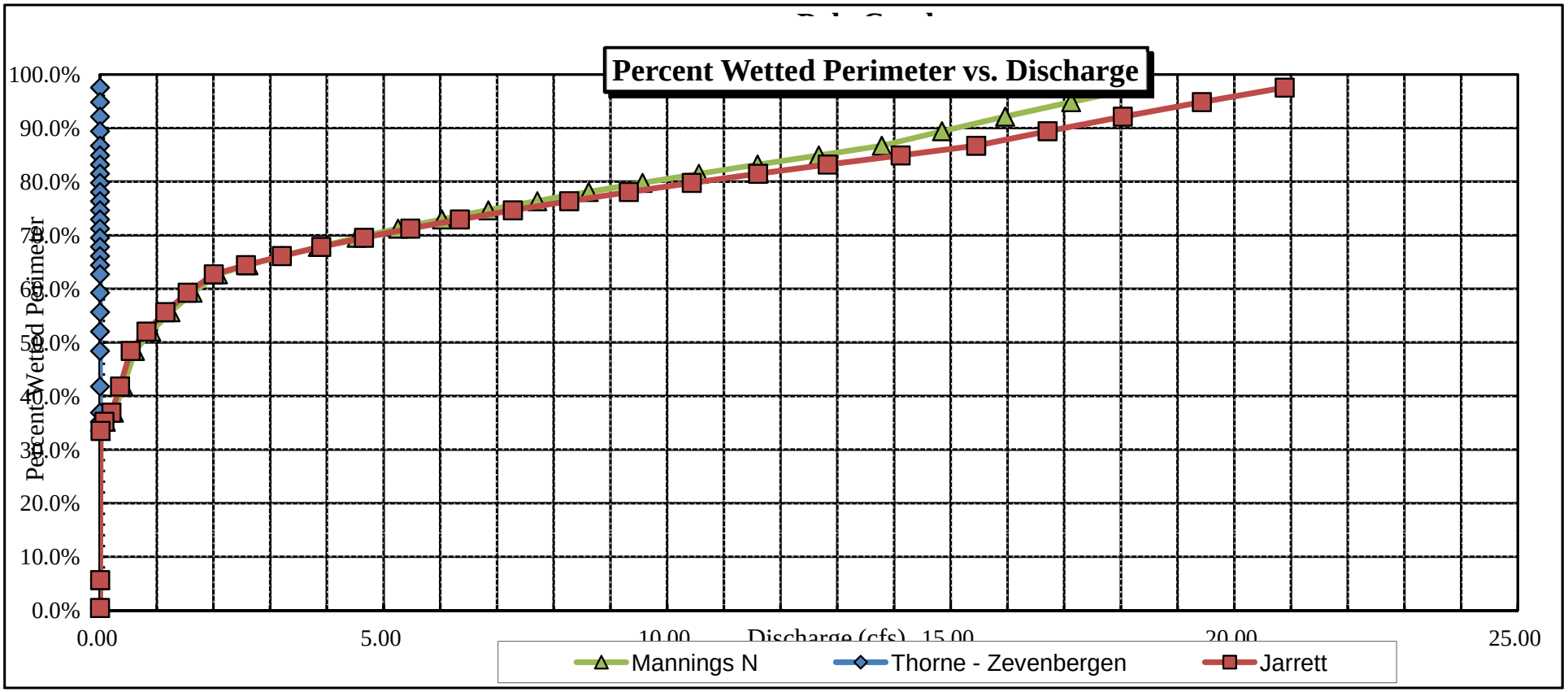
FLOW (CFS)	PERIOD
===========	========
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

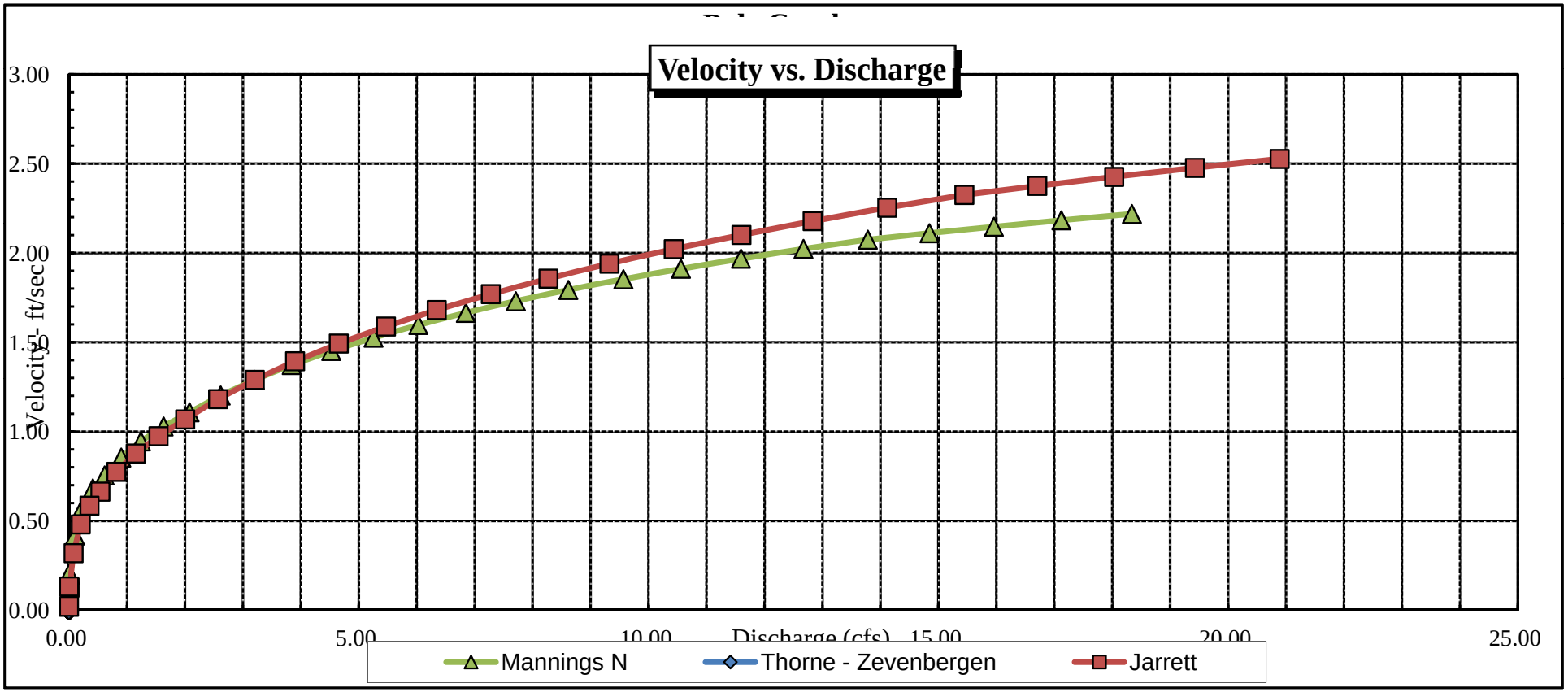
RATIONALE FOR RECOMMENDATION:
=============================

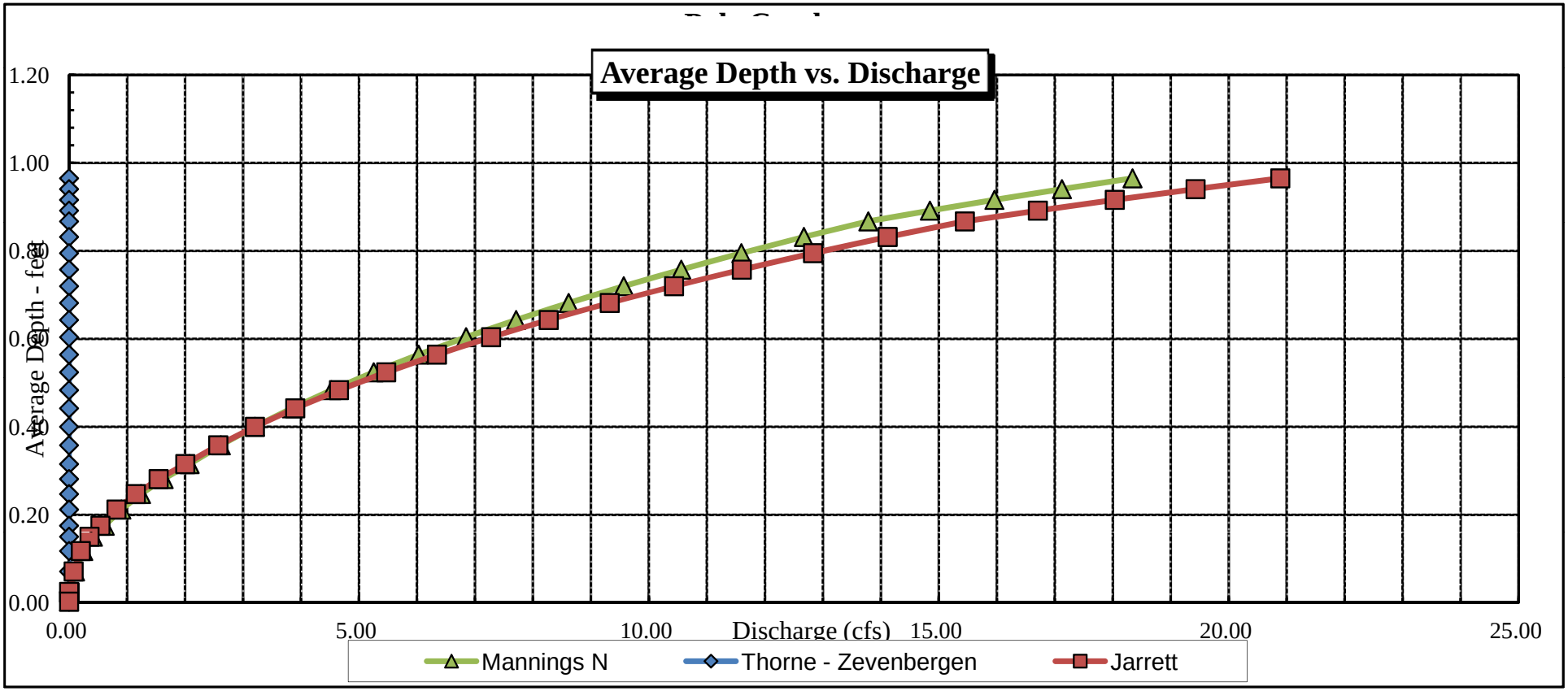
RECOMMENDATION BY: ……………………..……….……............................... AGENCY..……………………….....…….....…....…....... DATE:......…...…......……………

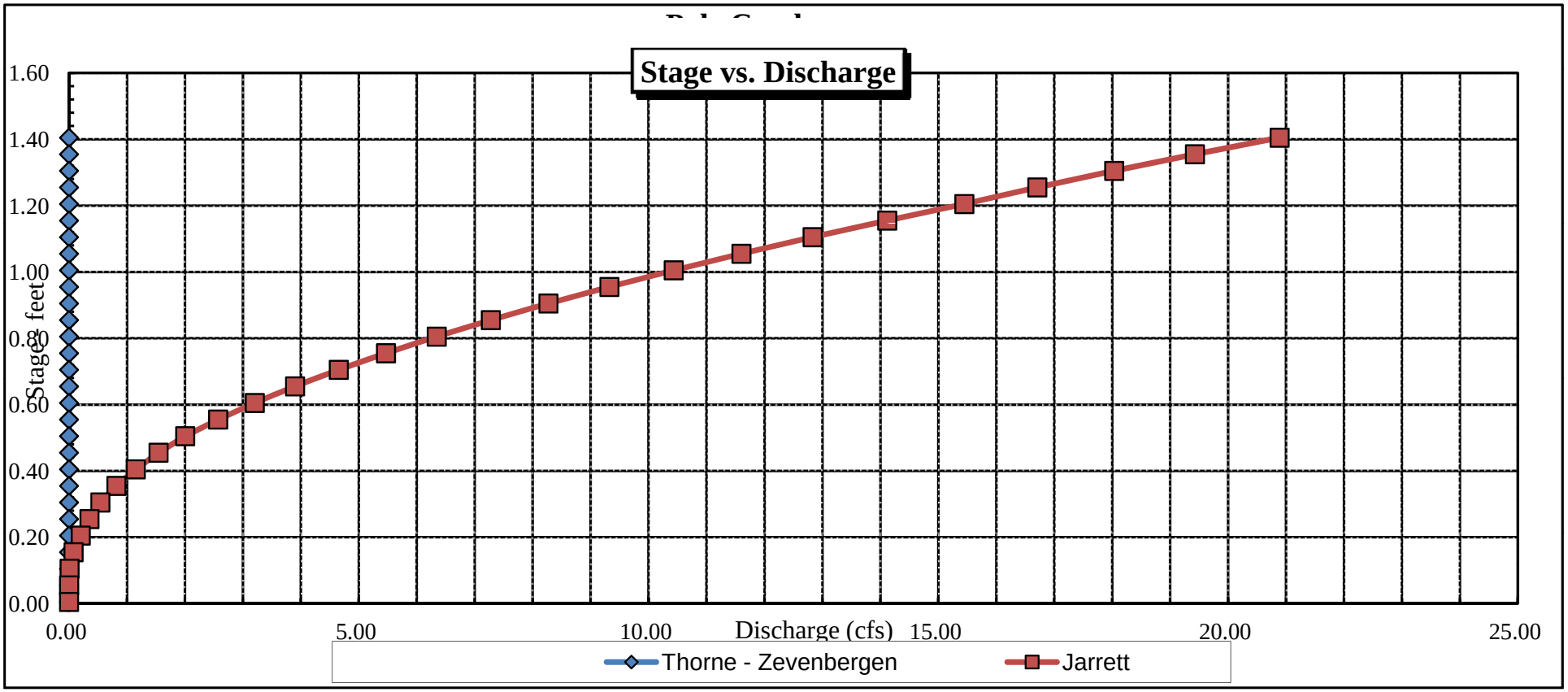
CWCB REVIEW BY: ..……………………………....…………………………………………………...…............. DATE:.................…………….....…


CROSS SECTION DATA ANALYSIS
-6.50
-7.00
-7.50
-8.00
-8.50
-9.00
-9.50
-10.00
-10.50
-11.00
VERTICAL DEPTH (FT)
LS
G
W
W
G
RS
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Percent Wetted Perimeter vs. Discharge
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
Discharge (cfs)
15.00
20.00
25.00
Mannings N
Thorne - Zevenbergen
Jarrett


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


Average Depth vs. Discharge
Average Depth - feet
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
5.00
10.00
Discharge (cfs)
15.00
20.00
25.00
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Stage, feet
0.00
5.00
10.00
15.00
20.00
25.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

DRAFT INSTREAM FLOW RECOMMENDATION

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 enlargement of the existing instream flow water right on Pole Creek, located in Water Division 1. In 1986, the Colorado Water Conservation Board appropriated an instream flow water right for 0.5 cubic feet per second on the entire length of this creek.

Location and Land Status. Pole Creek is located within the Laramie River watershed. It is tributary to Johnson Creek approximately one-half mile south of the Colorado-Wyoming border. This recommendation covers the stream reach beginning at the headwaters (106° 7' 57.3" W, 40° 55' 8.88" N) and extending downstream to the confluence with Johnson Creek, a distance of approximately 7.3 miles. Approximately 2.8 miles of this stream reach are managed by the BLM, and 4.0 miles are managed by the U.S. Forest Service. Approximately 0.39 miles are under private ownership.

Biological Summary. Pole Creek is a cold-water stream with moderate gradient, functional floodplains, and active beaver dams. The stream is heavily influenced by extensive beaver dams, but there is sufficient riffle and spawning habitat to support fish populations. Fish surveys show that Pole Creek supports naturally reproducing populations of brook trout and longnose sucker. Intensive macroinvertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly and caddisfly. The riparian and wetland community occupies most of the floodplain area and is comprised primarily of willows, alders, rushes, and sedges.

R2Cross Analysis. BLM collected the following R2Cross data from Pole 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)
08/03/2010 #1	1.18 cfs	8.34 feet	0.89 cfs	2.09 cfs
Summer 2011 survey planned				
		Averages:	0.89 cfs	2.09 cfs

BLM's analysis of this data, coordinated with the Division of Wildlife, indicates that the following flows are needed to protect the fishery and natural environment to a reasonable degree. (Note: final flow recommendations may change, based upon summer 2011 field work.)

An enlargement of 1.5 cubic feet per second is recommended for snowmelt runoff period, from April 1 through July 15. The enlargement will bring the total instream flow rate up to 2.0 cfs for this time period. This recommendation is driven by the average velocity criteria. It is important to maintain adequate velocity in the riffles in this creek, because the creek has limited riffle habitat available for spawning because of the extensive beaver activity.

An enlargement of 0.5 cubic feet per second is recommended during the remainder of the year, from July 16 to March 31. The enlargement will bring the total instream flow rate up to 1.0 cfs for this time period. This recommendation is driven by the average depth criteria. During winter, this flow rate should provide sufficient velocity and depth to prevent icing of all physical habitat within the stream.

Water Availability. For water availability analysis, BLM recommends analysis of U.S. Geological Survey stream gage 06657500 (Laramie River near Glendevey, CO). This gage has a long period of record between 1904 and 1982, and the State of Colorado has continued to operate the gage from 1982 to the present. This gage is located in a different part of the Laramie River watershed than Pole Creek. However, this gage should provide an excellent indication of the volume of runoff to be expected per acre within this watershed, along with an indication of the timing and distribution of that runoff. When utilizing this gage, it should be understood that the gage may have been affected by icing during the winter.

BLM is not aware of any decreed water rights that operate within the recommended stream reach.

Rationale for Enlargement of Instream Flow Water Right. BLM does not consider the current instream flow water right to be protective of the natural environment in Pole Creek. In the cross-sections analyzed by BLM, a flow rate of 0.5 cfs does even meet the instream flow criteria for a typical winter-period instream flow water right. If the current 0.5 cfs protected flow rate were to be maintained for extended periods during the summer, BLM would anticipate significant stress on fish community, in the form of high stream temperatures and very limited riffle habitat. BLM deliberately surveyed a rifle with a narrow top width, and the 0.5 flow rate appears to be inadequate even in the narrowest riffles that are typical in this stream.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with BLM's draft recommendation in February 2011. 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 at 303-239-3940.

Sincerely,

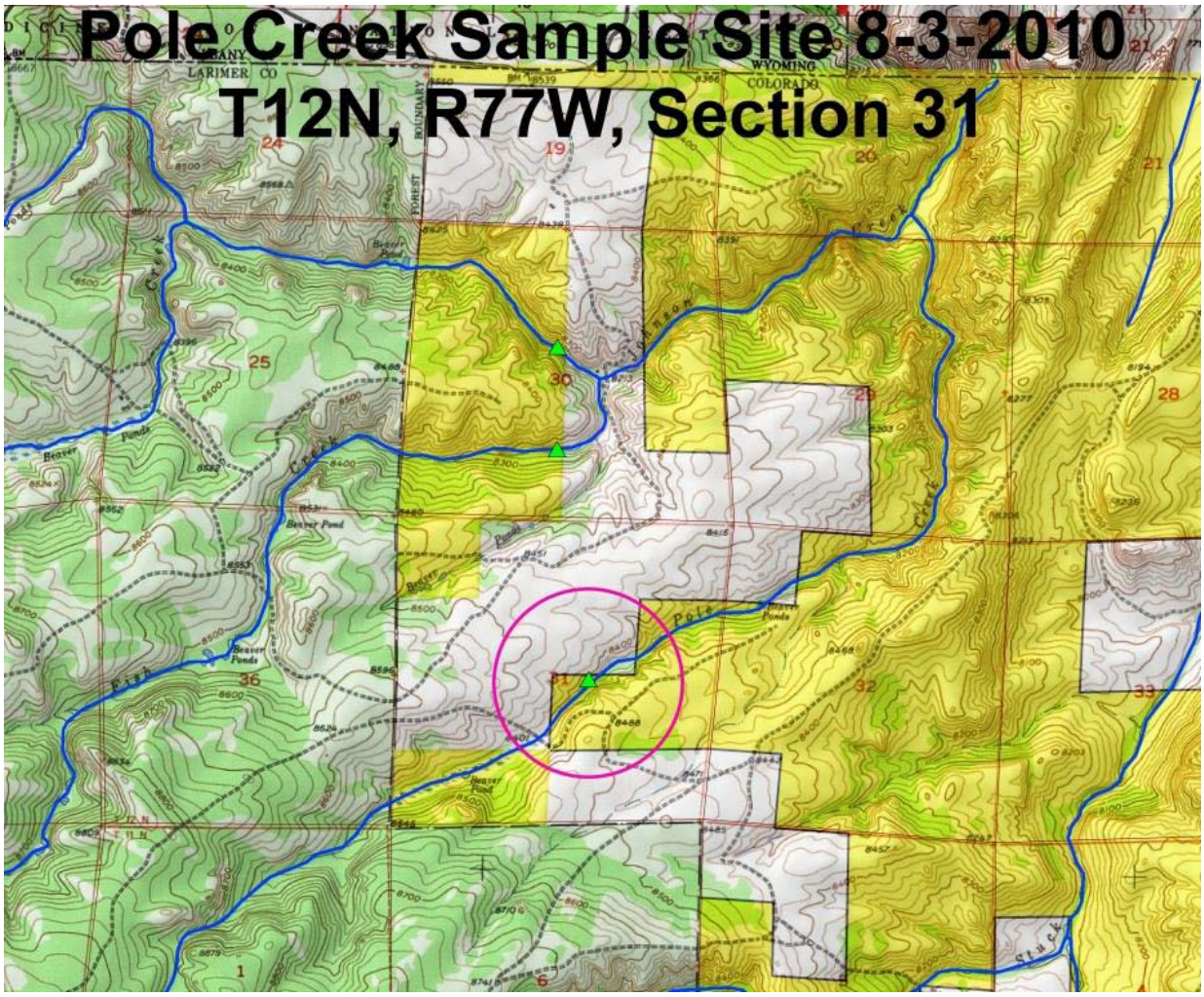
Leigh Espy
Deputy State Director
Resources and Fire

Cc: Dave Stout, Kremmling FO
Paula Belcher, Kremmling FO

Kremmling Field Office Stream Surveys
August 2010

Pole Creek - Water Code #11863

Pole Creek, located northwest of Hohnholz Lakes State Wildlife Area on BLM lands managed by the Kremmling Field Office, was sampled on August 3, 2010. Pole Creek is tributary to Johnson Creek and then the Laramie River. Sampling was done in support of the instream flow program. A two-pass removal population estimate was not completed as the stream was primarily a series of beaver ponds. Brook trout were the only fish collected or seen. Sampling was conducted via one backpack electro-shocker and a 100 foot station located between beaver ponds was sampled. Personnel present were Tom Fresques, Fish Biologist, and Gregor Dekleva and Kristy Wallner, Biological Technicians, BLM.



Pole Creek

Pole Creek

Brook trout

STREAM SURVEY FISH SAMPLING FORM

WATER _Pole Creek_____ H2O CODE __11863_____ DATE _8/3/2010_

GEAR __Backpack Shocker__ EFFORT _____ STATION # _1_____ PASS # _1_____

CREW _Fresques, Wallner, Dekleva__DRAINAGE Laramie River_ LOCATION GPS___

Pass	species	length	weight		Pass	species	length	weight
1	BRK	158	38					
1	BRK	140	42					
1	BRK	115	28					
1	BRK	60						
1	BRK	51						
1	BRK	61						

GPS Location:

Notes: Stream Width __44_ ft. Sample Reach __100__ ft.
Conductivity: ~100 ms Electroshocker settings

Discussion:

Pole Creek was flowing at a rate of approximately 1.2 cfs and primarily consisted of a series of beaver ponds with small riffle habitats in between. The stream appeared to be a Rosgen C channel type. Riparian vegetation consisted of thick willow carrs, sedge, alder, *poa*, tufted hairgrass, redtop, horsetail, and thistle. The riparian area was approximately 175 feet wide. Based on limited visual observation, the stream contained dragon fly larvae, midges, mosquitos larvae, caddis flies, and mayflies.

Brook trout of varying age classes was the only species collected or seen. Conductivity was very low (approximately 100 ms) which made shocking difficult as voltage was high and fish response was fair.

Recommendations:

- This stream would benefit from an enlargement of the current instream water right. The present instream flow water right of 0.5 cfs would appear to seriously limit habitat availability during the critical parts of the summer growing season.
- . Periodically monitor to ensure that stream habitats remain in good condition.
- Consider treating the thistle in the riparian area

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Pole Creek						CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: Approx. 0.5 mile downstream from BLM road crossing						
DATE: 8-3-10	OBSERVERS: R. Smith, P. Belcher					
LEGAL DESCRIPTION	¼ SECTION: NW SE	SECTION: 31	TOWNSHIP: 12 (N) S	RANGE: 77 E (W)	PM: 6th	
COUNTY: Larimer	WATERSHED: Laramie R.	WATER DIVISION: 1	DOW WATER CODE: 11863			
MAP(S): USGS:			GPS: 409289			
USFS:			4535619			

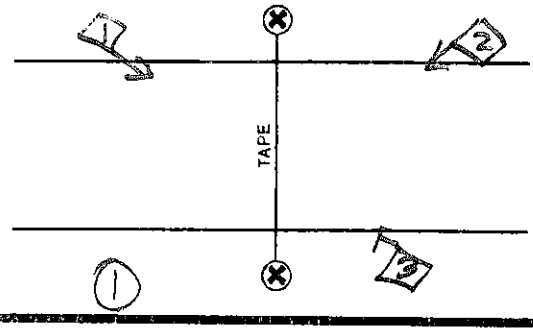
SUPPLEMENTAL DATA

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" cobble	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: 5		

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	7.00 / 7.00
(2) WS Upstream	11.0	6.74
(3) WS Downstream	4.7	7.02
SLOPE	0.28 / 15.7 = .018	

SKETCH



LEGEND.
Stake (X)
Station (1)
Photo (1)
Direction of Flow

AQUATIC SAMPLING SUMMARY

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

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

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

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

mayfly, caddisfly, midge

COMMENTS

pH = 8.1 TDS = 120 Temp = 22.°C

Stream channel has very high number of beaver ponds.

Willow riparian community.

FED 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Pole Creek | CROSS-SECTION NO.: 1 | DATE: 8.3.10 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: 3:30 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)
LS	0.0		5.52								
G	0.7		6.28								
W	1.8		7.00								
	2.1		7.10	.10				0.71			
	2.4		7.15	.15	-			0.53			
	2.7		7.10	.10				0.85			
	3.0		7.30	.30				0.64			
	3.3		7.30	.30				1.05			
	3.7		7.20	.20				1.10			
R	4.0		7.15	.15				1.27	-		
	4.3		7.20	.20				0.49			
	4.6		7.15	.15				0.47			
	4.9		7.10	.10				1.26			
R	5.2		7.25	.25				1.28	-		
	5.5		7.35	.35				0.65			
	5.8		7.40	.40				0.78			
	6.1		7.30	.30				0.82			
	6.4		7.40	.40				1.32	-		
	6.7		7.50	.50				0.74			
	7.0		7.40	.40				0.51			
	7.3		7.20	.20				0.44			
	7.6		7.20	.20				0.47			
W	8.0		7.00								
G	8.5		6.34								
RS	10.0		5.22								
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:	Pole Creek
XS LOCATION:	Approx. 0.5 d/s fr BLM road crossing
XS NUMBER:	1
DATE:	3-Aug-10
OBSERVERS:	R. Smith, P. Belcher
1/4 SEC:	NW SE
SECTION:	31
TWP:	12N
RANGE:	77W
PM:	6th
COUNTY:	Larimer
WATERSHED:	Laramie River
DIVISION:	1
DOW CODE:	11863
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

TAPE WT:	0.0106
TENSION:	99999

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

CHANNEL PROFILE DATA

SLOPE:	0.018

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

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

STREAM NAME: Pole Creek
XS LOCATION: Approx. 0.5 d/s fr BLM road crossing
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
	LS	0.00	5.52			0.00		0.00	0.00	0.0%
1	G	0.70	6.28			0.00		0.00	0.00	0.0%
	W	1.80	7.00	0.00	0.00	0.00		0.00	0.00	0.0%
		2.10	7.10	0.10	0.71	0.32	0.10	0.03	0.02	1.8%
		2.40	7.15	0.15	0.53	0.30	0.15	0.05	0.02	2.0%
		2.70	7.10	0.10	0.85	0.30	0.10	0.03	0.03	2.2%
		3.00	7.30	0.30	0.64	0.36	0.30	0.09	0.06	4.9%
		3.30	7.30	0.30	1.05	0.30	0.30	0.11	0.11	9.3%
		3.70	7.20	0.20	1.10	0.41	0.20	0.07	0.08	6.5%
		4.00	7.15	0.15	1.27	0.30	0.15	0.05	0.06	4.8%
		4.30	7.20	0.20	0.49	0.30	0.20	0.06	0.03	2.5%
		4.60	7.15	0.15	0.47	0.30	0.15	0.05	0.02	1.8%
		4.90	7.10	0.10	1.26	0.30	0.10	0.03	0.04	3.2%
		5.20	7.25	0.25	1.28	0.34	0.25	0.08	0.10	8.1%
		5.50	7.35	0.35	0.65	0.32	0.35	0.11	0.07	5.8%
		5.80	7.40	0.40	0.78	0.30	0.40	0.12	0.09	7.9%
		6.10	7.30	0.30	0.82	0.32	0.30	0.09	0.07	6.2%
		6.40	7.40	0.40	1.32	0.32	0.40	0.12	0.16	13.4%
		6.70	7.50	0.50	0.74	0.32	0.50	0.15	0.11	9.4%
		7.00	7.40	0.40	0.51	0.32	0.40	0.12	0.06	5.2%
		7.30	7.20	0.20	0.44	0.36	0.20	0.06	0.03	2.2%
		7.60	7.20	0.20	0.47	0.30	0.20	0.07	0.03	2.8%
	W	8.00	7.00	0.00	0.00	0.45		0.00	0.00	0.0%
1	G	8.50	6.34			0.00		0.00	0.00	0.0%
	RS	10.00	5.22			0.00		0.00	0.00	0.0%
	TOTALS ----------					6.54	0.5 (Max.)	1.46	1.18	100.0%

Manning's n = 0.0906
Hydraulic Radius= 0.22316044

STREAM NAME: Pole Creek
XS LOCATION: Approx. 0.5 d/s fr BLM road crossing
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.46	1.46	0.0%
6.75	1.46	3.08	111.1%
6.77	1.46	2.95	101.8%
6.79	1.46	2.81	92.6%
6.81	1.46	2.68	83.5%
6.83	1.46	2.55	74.5%
6.85	1.46	2.42	65.5%
6.87	1.46	2.29	56.5%
6.89	1.46	2.16	47.7%
6.91	1.46	2.03	38.9%
6.93	1.46	1.90	30.1%
6.95	1.46	1.77	21.4%
6.96	1.46	1.71	17.1%
6.97	1.46	1.65	12.8%
6.98	1.46	1.58	8.5%
6.99	1.46	1.52	4.3%
7.00	1.46	1.46	0.0%
7.01	1.46	1.40	-4.2%
7.02	1.46	1.34	-8.4%
7.03	1.46	1.28	-12.6%
7.04	1.46	1.22	-16.7%
7.05	1.46	1.16	-20.8%
7.07	1.46	1.04	-28.9%
7.09	1.46	0.92	-36.8%
7.11	1.46	0.81	-44.6%
7.13	1.46	0.70	-51.7%
7.15	1.46	0.61	-58.3%
7.17	1.46	0.52	-64.1%
7.19	1.46	0.45	-69.4%
7.21	1.46	0.38	-73.8%
7.23	1.46	0.33	-77.7%
7.25	1.46	0.27	-81.4%

WATERLINE AT ZERO
AREA ERROR = 7.000

STREAM NAME: Pole Creek
XS LOCATION: Approx. 0.5 d/s fr BLM road crossing
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	6.34	7.71	0.78	1.16	6.05	8.58	100.0%	0.71	10.56	1.74
	6.35	7.69	0.78	1.15	5.97	8.54	99.6%	0.70	10.36	1.73
	6.40	7.57	0.74	1.10	5.59	8.39	97.8%	0.67	9.39	1.68
	6.45	7.46	0.70	1.05	5.22	8.24	96.0%	0.63	8.47	1.62
	6.50	7.34	0.66	1.00	4.85	8.08	94.3%	0.60	7.59	1.57
	6.55	7.23	0.62	0.95	4.48	7.93	92.5%	0.57	6.74	1.51
	6.60	7.11	0.58	0.90	4.12	7.77	90.7%	0.53	5.95	1.44
	6.65	7.00	0.54	0.85	3.77	7.62	88.9%	0.49	5.19	1.38
	6.70	6.89	0.50	0.80	3.42	7.47	87.1%	0.46	4.48	1.31
	6.75	6.77	0.46	0.75	3.08	7.31	85.3%	0.42	3.81	1.24
	6.80	6.66	0.41	0.70	2.75	7.16	83.5%	0.38	3.19	1.16
	6.85	6.54	0.37	0.65	2.42	7.00	81.7%	0.34	2.62	1.08
	6.90	6.43	0.33	0.60	2.09	6.85	79.9%	0.31	2.09	1.00
	6.95	6.31	0.28	0.55	1.77	6.70	78.1%	0.26	1.61	0.91
WL	7.00	6.20	0.24	0.50	1.46	6.54	76.3%	0.22	1.18	0.81
	7.05	5.95	0.19	0.45	1.16	6.27	73.1%	0.18	0.82	0.71
	7.10	5.70	0.15	0.40	0.87	6.00	70.0%	0.14	0.52	0.61
	7.15	4.53	0.13	0.35	0.61	4.78	55.7%	0.13	0.34	0.56
	7.20	3.05	0.14	0.30	0.41	3.25	37.9%	0.13	0.23	0.56
	7.25	2.60	0.10	0.25	0.27	2.75	32.1%	0.10	0.13	0.47
	7.30	1.80	0.09	0.20	0.15	1.91	22.2%	0.08	0.06	0.41
	7.35	1.28	0.06	0.15	0.08	1.34	15.7%	0.06	0.03	0.33
	7.40	0.60	0.05	0.10	0.03	0.63	7.4%	0.05	0.01	0.29
	7.45	0.30	0.03	0.05	0.01	0.32	3.7%	0.02	0.00	0.18
	7.50	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Pole Creek
XS LOCATION: Approx. 0.5 d/s fr BLM road crossing
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.18	cfs
CALCULATED FLOW (Qc)=	1.18	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	7.00	ft
CALCULATED WATERLINE (WLc)=	7.00	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.50	ft
MAX CALCULATED DEPTH (Dc)=	0.50	ft
(Dm-Dc)/Dm * 100	0.0	%
MEAN VELOCITY=	0.81	ft/sec
MANNING'S N=	0.091	
SLOPE=	0.018	ft/ft
.4 * Qm =	0.5	cfs
2.5 * Qm=	3.0	cfs

RECOMMENDED INSTREAM FLOW:
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FLOW (CFS)	PERIOD
===========	========
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

RATIONALE FOR RECOMMENDATION:
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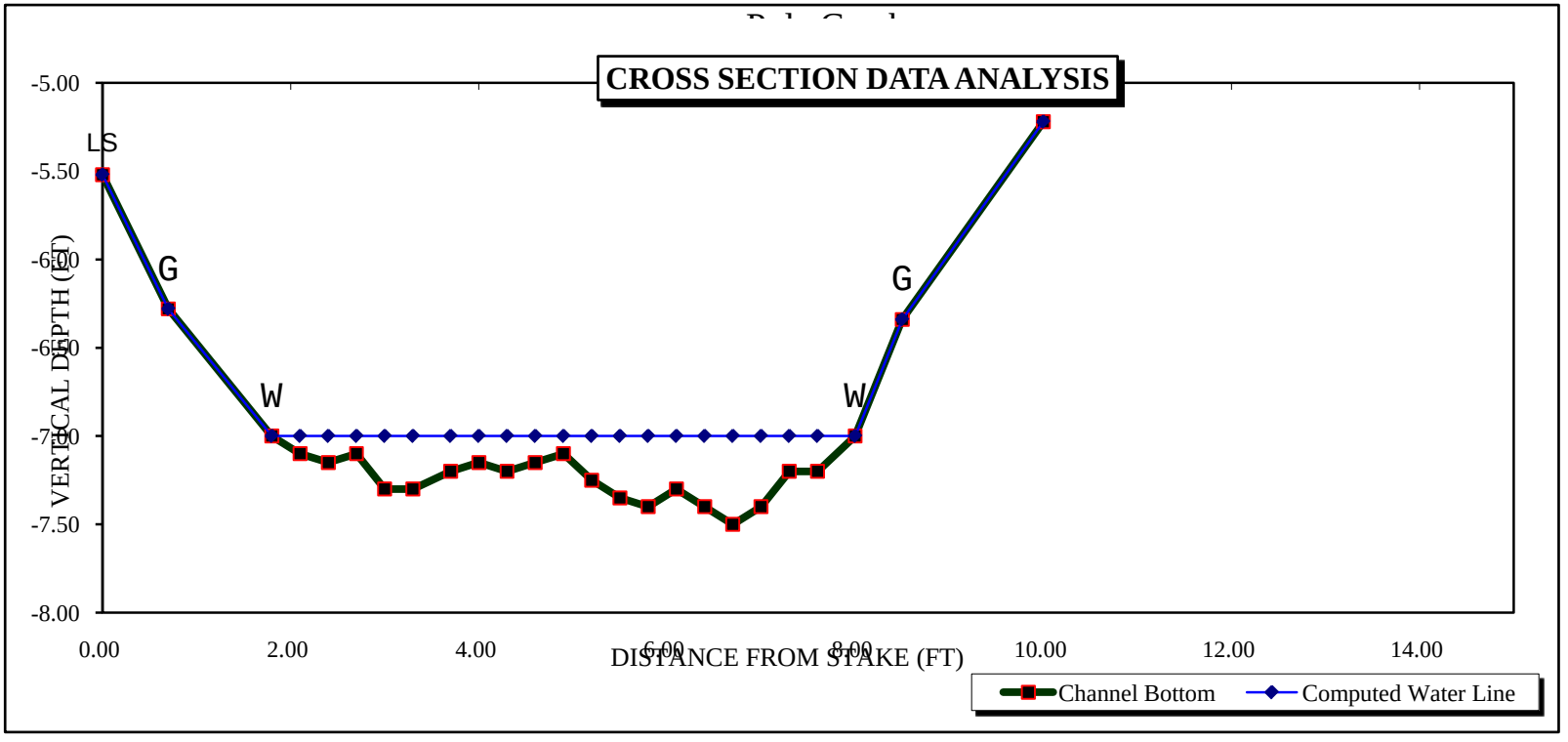
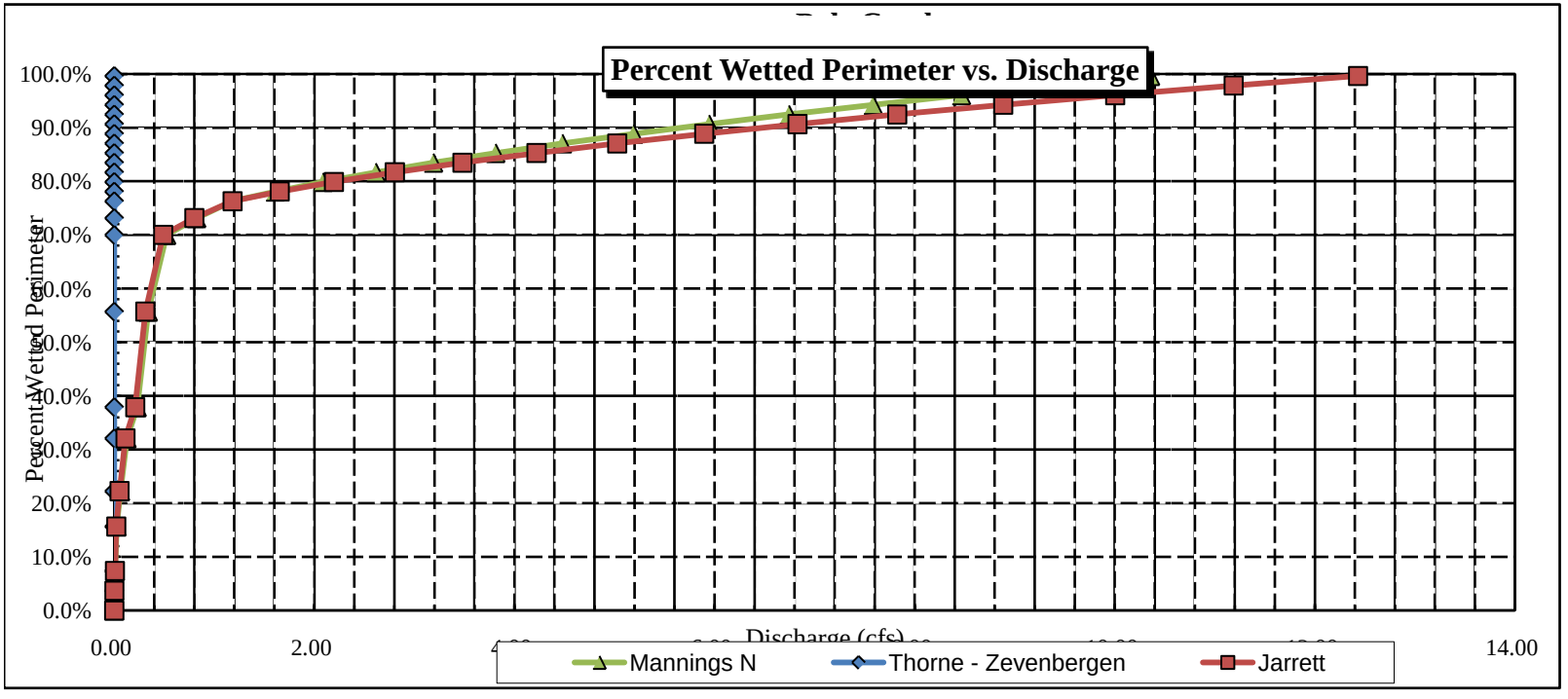
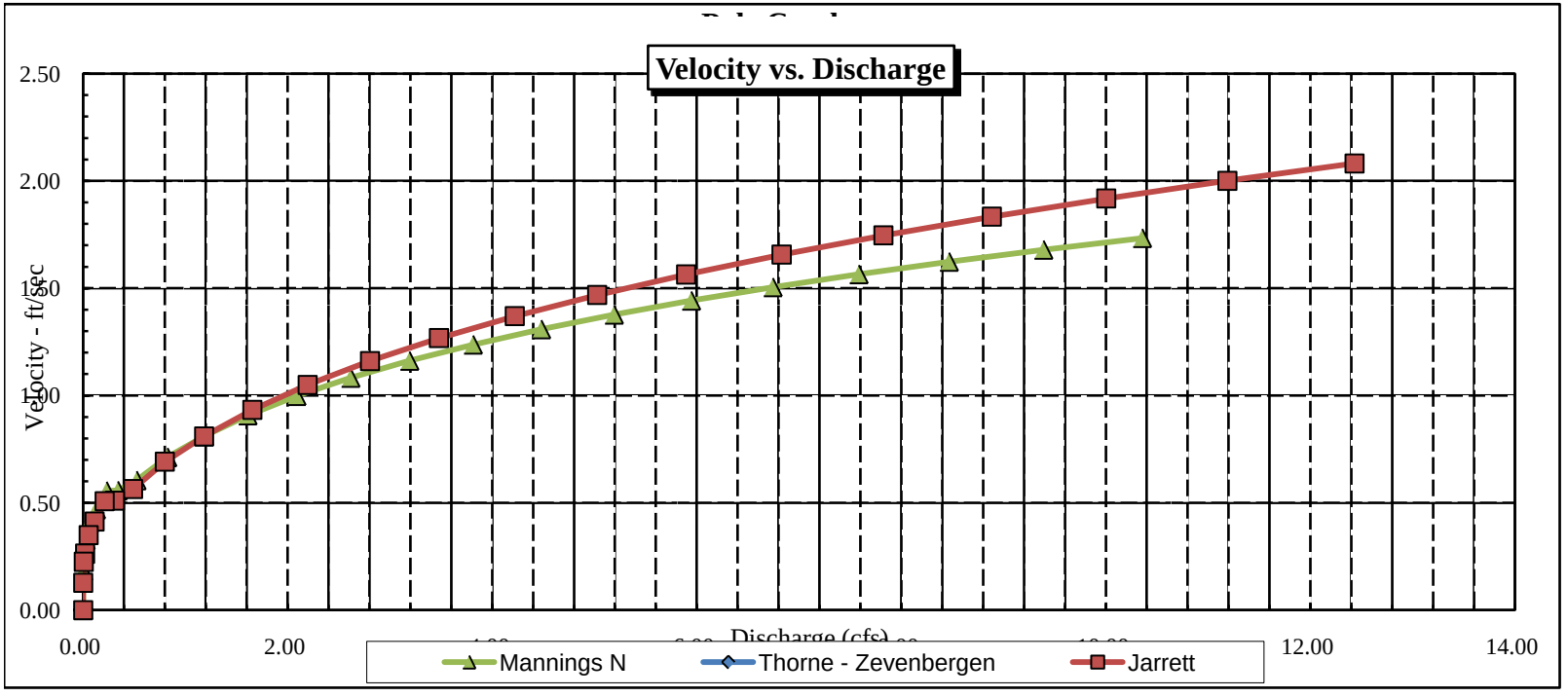
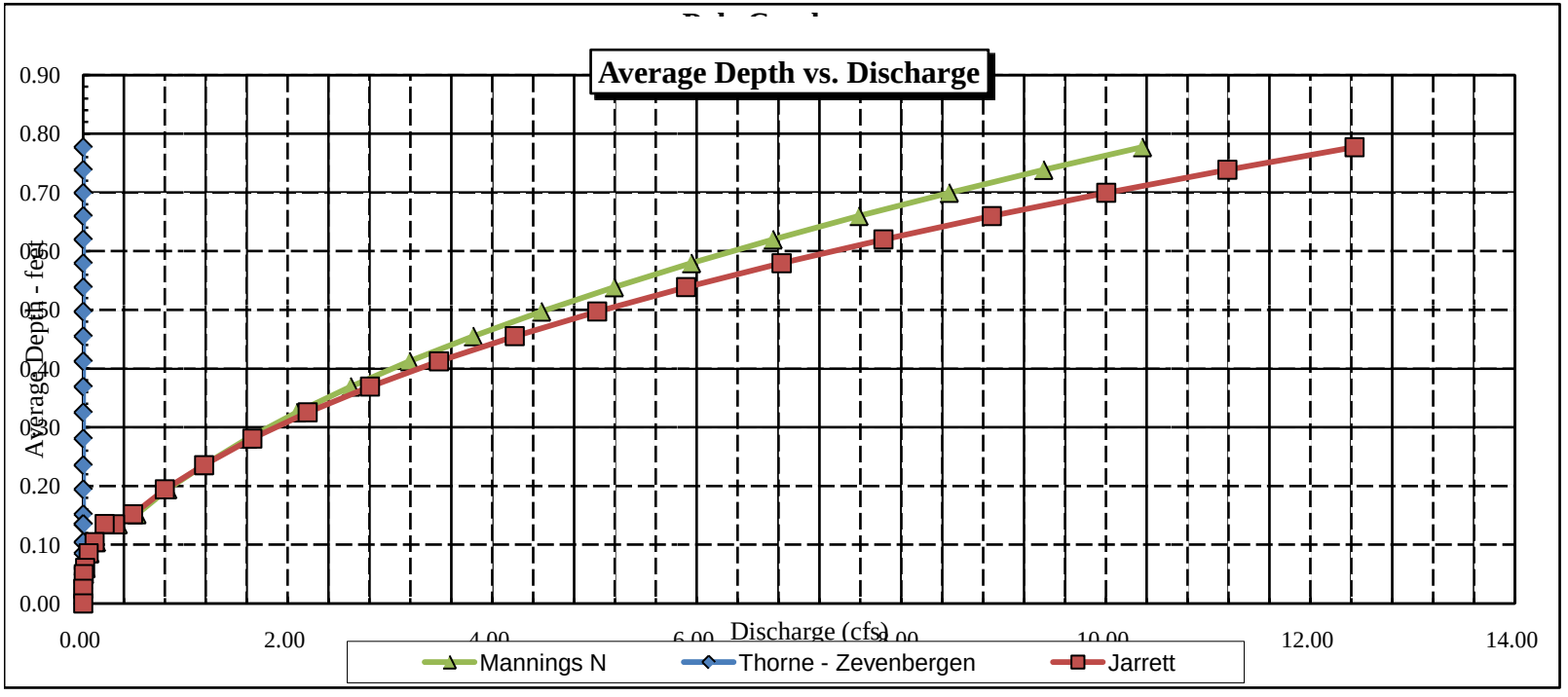
RECOMMENDATION BY: ………………...………..……............................... AGENCY..………………………......……...…...…….…...... DATE:.......…..…......……………

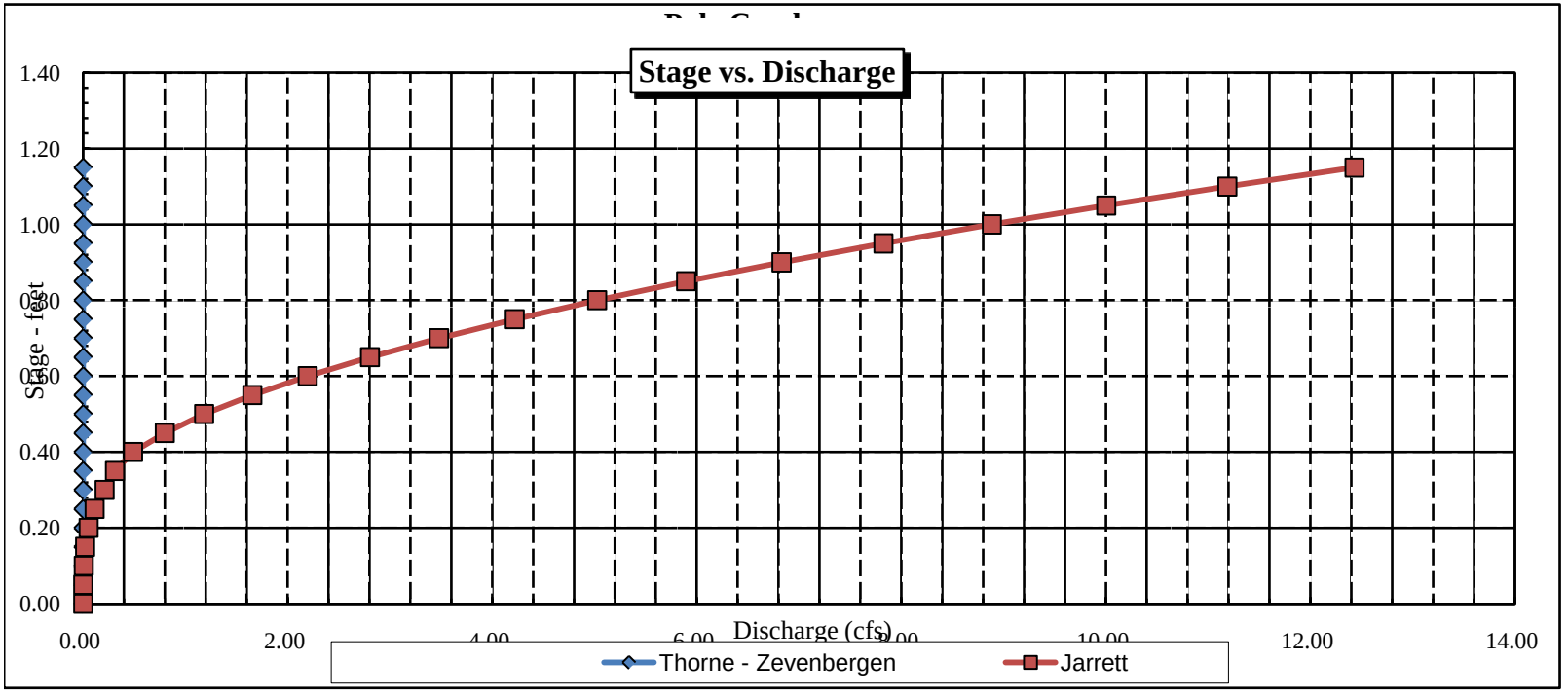
CWCB REVIEW BY: ..……………………………....……………………………………………………...…............. DATE:.................…………….....


CROSS SECTION DATA ANALYSIS
-5.00
-5.50
-6.00
-6.50
-7.00
-7.50
-8.00
VERTICAL DEPTH (FT)
LS
G
W
W
G
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Percent Wetted Perimeter vs. Discharge
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
14.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
2.50
2.00
1.50
1.00
0.50
0.00
Velocity - ft/sec
0.00
2.00
12.00
14.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
Average Depth - feet
0.90
0.80
0.70
0.60
0.40
0.30
0.20
0.10
0.00
0.00
2.00
12.00
14.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
Stage - feet
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett