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

JAN 7 20[illegible]

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 instream flow water rights on Grace Creek, located in Water Division 1.

Location and Land Status: Grace Creek is tributary to the Laramie River approximately three miles south of the Colorado-Wyoming border. This recommendation covers the stream reach beginning at the confluence of the North Fork and South Fork of Grace Creek and extending downstream to the headgate of the Grace Creek Ditch, a distance of approximately 2.5 miles. The entire stream reach is located on public lands, with approximately 1.0 miles managed by the U.S. Forest Service and 1.5 miles managed by the BLM.

Biological Summary: Grace Creek is a cold-water stream with moderate gradient, functional floodplains, and active beaver dams. The stream has a good mix of riffle, run, and deep pool habitats. Fish surveys show that Grace Creek supports naturally reproducing brown trout and longnose sucker populations. Intensive macroinvertebrate surveys have not been conducted, but spot samples have revealed primarily caddisfly and midge larvae, with small population of stonefly and mayfly.

The riparian community occupies most of the floodplain area and is comprised primarily of willows, spruce, and sedges. The healthy riparian community has resulted in normal width-to-depth ratios, sinuosity, and bank stability.

R2Cross Analysis: BLM collected the following R2Cross data from Grace 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)
08/02/2010 #1	10.36 cfs	26.00 feet	Out of range	5.87 cfs
08/02/2010 #2	10.27 cfs	24.80 feet	4.16 cfs	5.10 cfs
		Averages:	4.16 cfs	5.49 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.

> 5.5 cubic feet per second is recommended for the snowmelt runoff period, from May 1 through August 15. This recommendation is driven by the average depth criteria. It is important to maintain adequate depth in the riffles in this creek, because the riffles tend to be wide and shallow. The typical riffles are shallow due to high snowmelt runoff flows and their location on finer materials, rather than bedrock.
>
> 3.6 cubic feet per second is recommended for late summer and early fall, from August 16 to October 31. This recommendation is driven by the wetted perimeter criteria, as would be expected in a stream with shallow, wide riffles. It is important to wet as much of the channel as possible during this time period, because macroinvertebrates and fish are still actively completing life cycles before the winter freeze.
>
> 2.0 cfs is recommended for the cold temperature period from November 1 to April 30. This recommendation has been reduced due to limited water availability, but this flow still provides 1.15 feet per second average velocity, 40% wetted perimeter, and 0.17 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 Grace 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.

Relationship to Land Management Plans: The BLM considers the creeks it manages on the west side of the Laramie River watershed to be in very good condition. The streams possess largely intact natural hydrology. Grazing management has been significantly improved during the last 20 years. Impacts from roads, timber management, and other surface disturbances are very light. The BLM believes it is important to protect flow rates on these creeks and prevent hydrologic stresses, because these creeks will experience other stresses within the watershed as the pine beetle epidemic changes the vegetation community.

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

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		Averages:	4.16 cfs	5.49 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.

5.5 cubic feet per second is recommended for the higher temperature period, from

April 1 through October 31. This recommendation is driven by the average depth criteria. It is important to maintain adequate depth in the riffles in this creek, because the riffles tend to be wide and shallow. The typical riffles are shallow due to high snowmelt runoff flows and their location on finer materials, rather than bedrock.

4.15 cubic feet per second is recommended for the remainder of the year, from November 1 to March 31. This recommendation is driven by the wetted perimeter criteria, as would be expected in a stream with shallow, wide riffles. 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 Grace 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.

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

Sincerely,

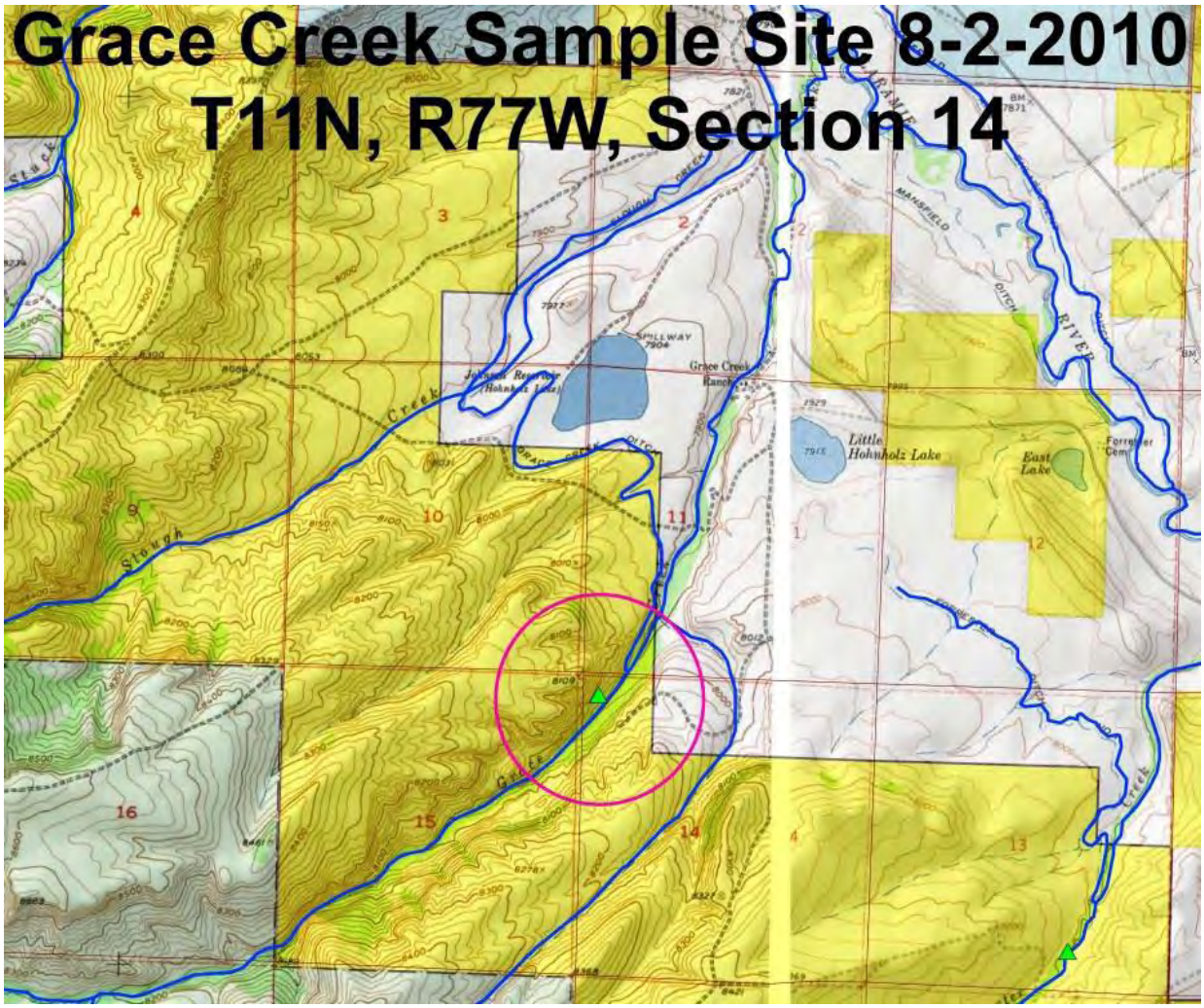
Leigh Espy
Deputy State Director
Resources and Fire

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

Kremmling Field Office Stream Surveys
August 2010

Grace Creek - Water Code #11053

Grace Creek, located south of Hohnholz Lakes State Wildlife Area on BLM lands managed by the Kremmling Field Office, was sampled on August 2, 2010. Grace Creek is tributary to the Laramie River. Sampling was done is support of the instream flow program and a two pass removal population estimate was completed. Brown trout and longnose suckers were collected. Sampling was conducted via two backpack electro-shockers and a 325-foot station was sampled. Personnel present were Tom Fresques, Fish Biologist, and Gregor Dekleva and Kristy Wallner, Biological Technicians.



Grace Creek

Grace Creek

Brown Trout

Longnose Sucker

STREAM SURVEY FISH SAMPLING FORM

WATER _Grace Creek_____ H2O CODE __11053_____ DATE _8/2/2010_

GEAR __Backpack Shocker__ EFFORT _____ STATION # _1_____ PASS # _1_____

CREW _Fresques, Wallner, Dekleva, Johnson__DRAINAGE Laramie River_ LOCATION GPS___

Pass	species	length	weight		Pass	species	length	weight
1	LOC	126	30		2	LNS	123	28
1	LOC	205	93		2	LNS	180	63
1	LOC	252	161		2	LNS	152	48
1	LOC	269	213		2	LNS	127	26
1	LOC	212	102		2	LNS	126	25
1	LOC	179	73		2	LNS	116	23
1	LOC	113	23		2	LOC	126	37
1	LNS	207	93		2	LOC	103	20
1	LNS	113	22		2	LOC	245	162
1	LNS	185	73		2	LOC	271	299
1	LNS	134	31					

GPS Location:

Notes: Stream Width __15.4_ ft. Sample Reach __325__ ft.
Conductivity: ~100 ms Electroshocker settings

Discussion:

Grace Creek was flowing at a rate approximately 10 cfs and had a good mix of riffle, run, and deep pool habitats. The stream appeared to be a Rosgen C channel type. Riparian vegetation was abundant and consisted of thick willows, sedge, mare's tail, redtop, tufted hairgrass, spruce, poa, and thistle. The riparian area was approximately 150 feet wide. The stream contained primarily caddis flies and midge larvae with a few stoneflies and mayflies.

Brown trout and longnose suckers of several age classes were collected. Fish density seemed a bit low given the habitat quality. However, conductivity was very low (approximately 100 ms) which made shocking difficult as voltage was high and fish response was poor to fair.

Recommendations:

- This stream would benefit from an instream flow recommendation. This stream represents a significant fisheries resource on BLM lands with a large channel, consistent flow rate, and habitat complexity.

- Periodically monitor to ensure that stream habitats remain in good condition.

- Consider treating the thistle in portions of the riparian area.

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME: Grace Creek						CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: 1/4 mile upstream from Grace Creek Ditch headgate						
DATE: 8-2-10	OBSERVERS: R. Smith, T. Allai, T. Transdrom					
LEGAL DESCRIPTION	¼ SECTION: NE NE	SECTION: 15	TOWNSHIP: 11 (N) S	RANGE: 77 E (W)	PM: 6th	
COUNTY: Larimer	WATERSHED: Laramie R.	WATER DIVISION: 1	DOW WATER CODE: 11053			
MAP(S): USGS: GPS: 414658						
USFS: 4531260						

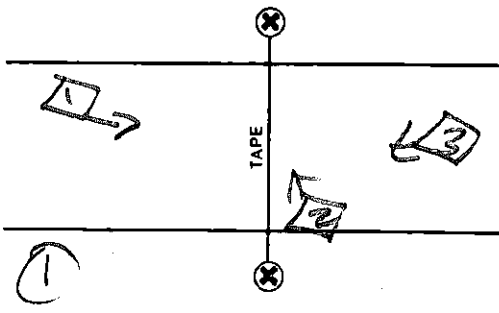
SUPPLEMENTAL DATA

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: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: gravel to 6" cobble		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	5.18 / 5.18
② WS Upstream	24.4'	5.72
③ WS Downstream	34.7'	6.08
SLOPE	0.36/59.1 = .006	

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
see report																	

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:
mayfly, caddisfly, stonefly

COMMENTS

Willow - cottonwood riparian
Ph: 7.6 TDS: 100 Temp: 18°C

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Grace Creek	CROSS-SECTION NO.: 1	DATE: 8-2-10	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: ____ ft	TIME: 1:15

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)
LS	0.0		1.20								
G	0.9		3.84								
	2.0	-	4.60								
W	2.7		5.18								
	3.4		5.70	.50				1.20			
	4.1		5.60	.40				0.77			
	4.8		5.55	.35				1.74			
	5.5		5.60	.40				1.44			
	6.2		5.70	.50				1.64			
	6.9		5.70	.50				2.16			
	7.6		5.70	.50				1.77			
	8.3		5.60	.40				1.61			
	9.0		5.60	.40				1.40			
	9.7		5.75	.55				1.62			
	10.4		5.60	.40				2.43			
	11.1		5.60	.40				2.13			
	11.8		5.55	.35				2.27			
	12.5		5.55	.35				2.39			
	13.2		5.50	.30				2.19			
	13.9		5.55	.35				1.69			
	14.6		5.55	.35				1.36			
	15.3		5.50	.30				1.74			
	16.0		5.50	.30				2.43			
	16.7		5.50	.30				2.10			
	17.4		5.45	.25				1.81			
	18.1		5.40	.20				1.09			
	18.9		5.30	.10				.97			
	19.5		5.25	.05				.0			
W	19.8		5.18								
	22.4		4.67								
G	26.9		3.84								
RS	29.0		2.51								
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:	Grace Creek
XS LOCATION:	1/4 mile u/s fr Grace Ck. Ditch headg.
XS NUMBER:	1
DATE:	2-Aug-10
OBSERVERS:	R. Smith, T. Allai
1/4 SEC:	NE NE
SECTION:	15
TWP:	11N
RANGE:	77W
PM:	6th
COUNTY:	Larimer
WATERSHED:	Laramie
DIVISION:	1
DOW CODE:	11053
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:	0.006

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

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

STREAM NAME: Grace Creek
XS LOCATION: 1/4 mile u/s fr Grace Ck. Ditch headg.
XS NUMBER: 1

DATA POINTS= 32

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	1.20			0.00		0.00	0.00	0.0%
1	G	0.90	3.84			0.00		0.00	0.00	0.0%
		2.00	4.60			0.00		0.00	0.00	0.0%
	W	2.70	5.18	0.00	0.00	0.00		0.00	0.00	0.0%
		3.40	5.70	0.50	1.20	0.87	0.50	0.35	0.42	4.1%
		4.10	5.60	0.40	0.77	0.71	0.40	0.28	0.22	2.1%
		4.80	5.55	0.35	1.74	0.70	0.35	0.25	0.43	4.1%
		5.50	5.60	0.40	1.44	0.70	0.40	0.28	0.40	3.9%
		6.20	5.70	0.50	1.64	0.71	0.50	0.35	0.57	5.5%
		6.90	5.70	0.50	2.16	0.70	0.50	0.35	0.76	7.3%
		7.60	5.70	0.50	1.77	0.70	0.50	0.35	0.62	6.0%
		8.30	5.60	0.40	1.61	0.71	0.40	0.28	0.45	4.4%
		9.00	5.60	0.40	1.40	0.70	0.40	0.28	0.39	3.8%
		9.70	5.75	0.55	1.62	0.72	0.55	0.39	0.62	6.0%
		10.40	5.60	0.40	2.43	0.72	0.40	0.28	0.68	6.6%
		11.10	5.60	0.40	2.13	0.70	0.40	0.28	0.60	5.8%
		11.80	5.55	0.35	2.27	0.70	0.35	0.25	0.56	5.4%
		12.50	5.55	0.35	2.39	0.70	0.35	0.25	0.59	5.7%
		13.20	5.50	0.30	2.19	0.70	0.30	0.21	0.46	4.4%
		13.90	5.55	0.35	1.69	0.70	0.35	0.25	0.41	4.0%
		14.60	5.55	0.35	1.36	0.70	0.35	0.25	0.33	3.2%
		15.30	5.50	0.30	1.74	0.70	0.30	0.21	0.37	3.5%
		16.00	5.50	0.30	2.43	0.70	0.30	0.21	0.51	4.9%
		16.70	5.50	0.30	2.10	0.70	0.30	0.21	0.44	4.3%
		17.40	5.45	0.25	1.81	0.70	0.25	0.18	0.32	3.1%
		18.10	5.40	0.20	1.09	0.70	0.20	0.14	0.15	1.5%
		18.80	5.30	0.10	0.97	0.71	0.10	0.07	0.07	0.7%
		19.50	5.25	0.05	0.00	0.70	0.05	0.03	0.00	0.0%
	W	19.80	5.18	0.00	0.00	0.31		0.00	0.00	0.0%
		22.40	4.62			0.00		0.00	0.00	0.0%
1	G	26.90	3.84			0.00		0.00	0.00	0.0%
	RS	29.00	2.51			0.00		0.00	0.00	0.0%
	TOTALS ----------					17.36	0.55 (Max.)	5.94	10.36	100.0%

Manning's n = 0.0323
Hydraulic Radius= 0.34223829

STREAM NAME: Grace Creek
XS LOCATION: 1/4 mile u/s fr Grace Ck. Ditch headg.
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	5.94	6.27	5.6%
4.93	5.94	10.73	80.6%
4.95	5.94	10.36	74.4%
4.97	5.94	9.99	68.2%
4.99	5.94	9.63	62.1%
5.01	5.94	9.26	56.0%
5.03	5.94	8.90	49.9%
5.05	5.94	8.54	43.8%
5.07	5.94	8.19	37.9%
5.09	5.94	7.83	31.9%
5.11	5.94	7.48	26.0%
5.13	5.94	7.13	20.1%
5.14	5.94	6.96	17.2%
5.15	5.94	6.79	14.3%
5.16	5.94	6.62	11.4%
5.17	5.94	6.44	8.5%
5.18	5.94	6.27	5.6%
5.19	5.94	6.10	2.7%
5.20	5.94	5.93	-0.1%
5.21	5.94	5.76	-3.0%
5.22	5.94	5.59	-5.8%
5.23	5.94	5.42	-8.7%
5.25	5.94	5.09	-14.3%
5.27	5.94	4.76	-19.9%
5.29	5.94	4.43	-25.4%
5.31	5.94	4.11	-30.7%
5.33	5.94	3.80	-36.1%
5.35	5.94	3.49	-41.3%
5.37	5.94	3.18	-46.5%
5.39	5.94	2.87	-51.6%
5.41	5.94	2.57	-56.7%
5.43	5.94	2.27	-61.7%

WATERLINE AT ZERO
AREA ERROR = 5.199

STREAM NAME: Grace Creek
XS LOCATION: 1/4 mile u/s fr Grace Ck. Ditch headg.
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	3.84	26.00	1.34	1.91	34.85	26.83	100.0%	1.30	147.91	4.24
	4.20	23.41	1.11	1.55	25.97	24.09	89.8%	1.08	97.33	3.75
	4.25	23.04	1.08	1.50	24.81	23.71	88.4%	1.05	91.15	3.67
	4.30	22.68	1.04	1.45	23.67	23.33	87.0%	1.01	85.17	3.60
	4.35	22.32	1.01	1.40	22.54	22.95	85.5%	0.98	79.40	3.52
	4.40	21.96	0.98	1.35	21.43	22.57	84.1%	0.95	73.82	3.44
	4.45	21.60	0.94	1.30	20.34	22.19	82.7%	0.92	68.45	3.36
	4.50	21.24	0.91	1.25	19.27	21.81	81.3%	0.88	63.28	3.28
	4.55	20.88	0.87	1.20	18.22	21.43	79.9%	0.85	58.30	3.20
	4.60	20.52	0.84	1.15	17.18	21.05	78.4%	0.82	53.52	3.11
	4.65	20.20	0.80	1.10	16.17	20.71	77.2%	0.78	48.87	3.02
	4.70	19.91	0.76	1.05	15.16	20.39	76.0%	0.74	44.37	2.93
	4.75	19.62	0.72	1.00	14.18	20.08	74.8%	0.71	40.07	2.83
	4.80	19.33	0.68	0.95	13.20	19.76	73.7%	0.67	35.97	2.72
	4.85	19.03	0.64	0.90	12.24	19.44	72.5%	0.63	32.07	2.62
	4.90	18.74	0.60	0.85	11.30	19.13	71.3%	0.59	28.36	2.51
	4.95	18.45	0.56	0.80	10.37	18.81	70.1%	0.55	24.85	2.40
	5.00	18.16	0.52	0.75	9.45	18.50	68.9%	0.51	21.55	2.28
	5.05	17.86	0.48	0.70	8.55	18.18	67.8%	0.47	18.45	2.16
	5.10	17.57	0.44	0.65	7.67	17.86	66.6%	0.43	15.55	2.03
	5.15	17.28	0.39	0.60	6.80	17.55	65.4%	0.39	12.87	1.89
WL	5.20	16.99	0.35	0.55	5.94	17.24	64.3%	0.34	10.41	1.75
	5.25	16.71	0.30	0.50	5.10	16.94	63.1%	0.30	8.16	1.60
	5.30	15.94	0.27	0.45	4.28	16.15	60.2%	0.27	6.30	1.47
	5.35	15.53	0.23	0.40	3.49	15.71	58.6%	0.22	4.57	1.31
	5.40	15.11	0.18	0.35	2.73	15.28	56.9%	0.18	3.08	1.13
	5.45	14.34	0.14	0.30	1.99	14.49	54.0%	0.14	1.89	0.95
	5.50	12.19	0.11	0.25	1.29	12.32	45.9%	0.11	1.03	0.79
	5.55	8.62	0.09	0.20	0.74	8.73	32.5%	0.08	0.51	0.69
	5.60	5.05	0.07	0.15	0.36	5.14	19.1%	0.07	0.22	0.61
	5.65	3.47	0.04	0.10	0.15	3.52	13.1%	0.04	0.06	0.43
	5.70	0.47	0.03	0.05	0.01	0.48	1.8%	0.03	0.00	0.31
	5.75	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Grace Creek
XS LOCATION: 1/4 mile u/s fr Grace Ck. Ditch headg.
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	10.36	cfs
CALCULATED FLOW (Qc)=	10.41	cfs
(Qm-Qc)/Qm * 100 =	-0.5	%
MEASURED WATERLINE (WLm)=	5.18	ft
CALCULATED WATERLINE (WLc)=	5.20	ft
(WLm-WLc)/WLm * 100 =	-0.4	%
MAX MEASURED DEPTH (Dm)=	0.55	ft
MAX CALCULATED DEPTH (Dc)=	0.55	ft
(Dm-Dc)/Dm * 100	-0.1	%
MEAN VELOCITY=	1.75	ft/sec
MANNING'S N=	0.032	
SLOPE=	0.006	ft/ft
.4 * Qm =	4.1	cfs
2.5 * Qm=	25.9	cfs

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

FLOW (CFS)	PERIOD
==========	========
_____	_____
_____	_____
_____	_____
_____	_____

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

_____
_____
_____
_____
_____
_____
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_____
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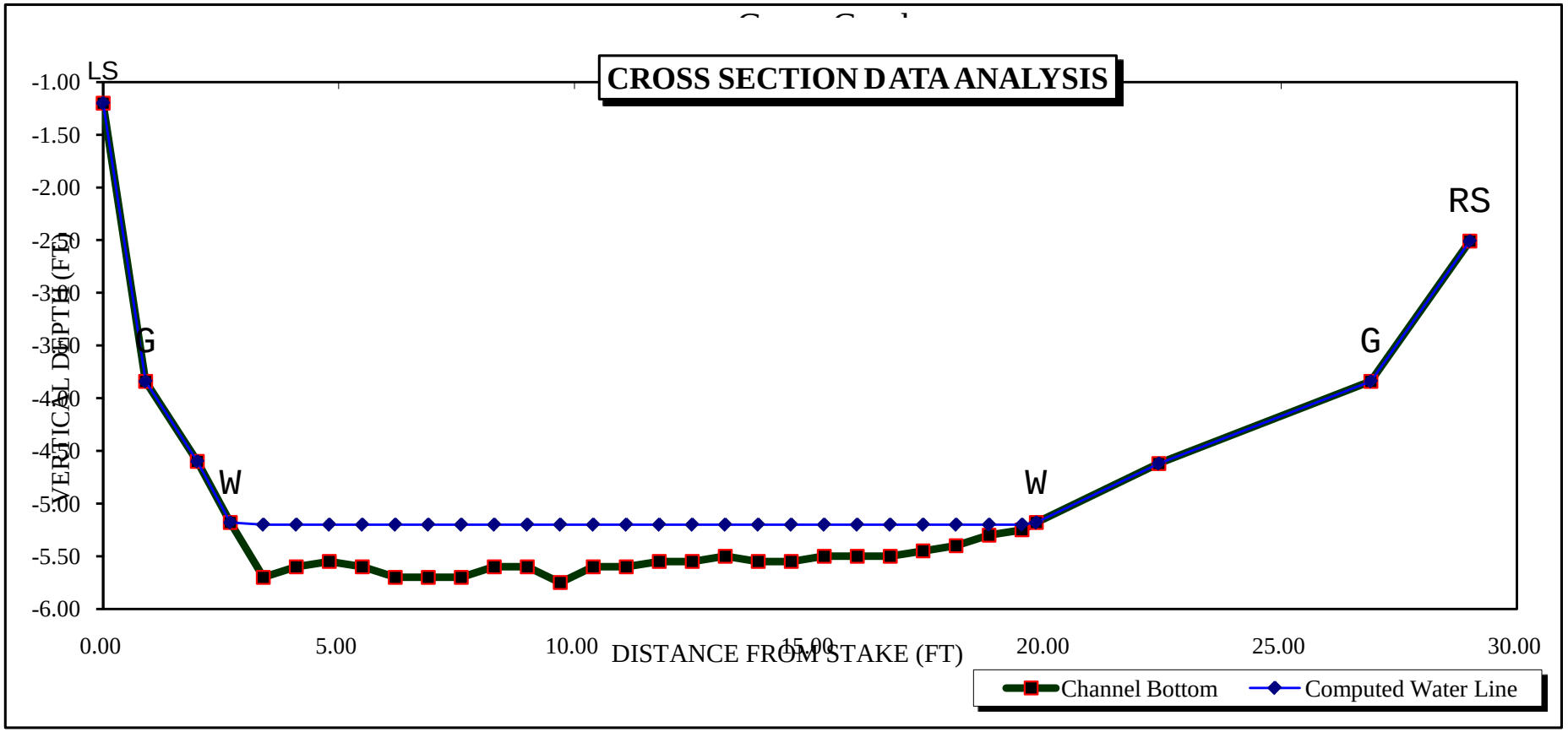
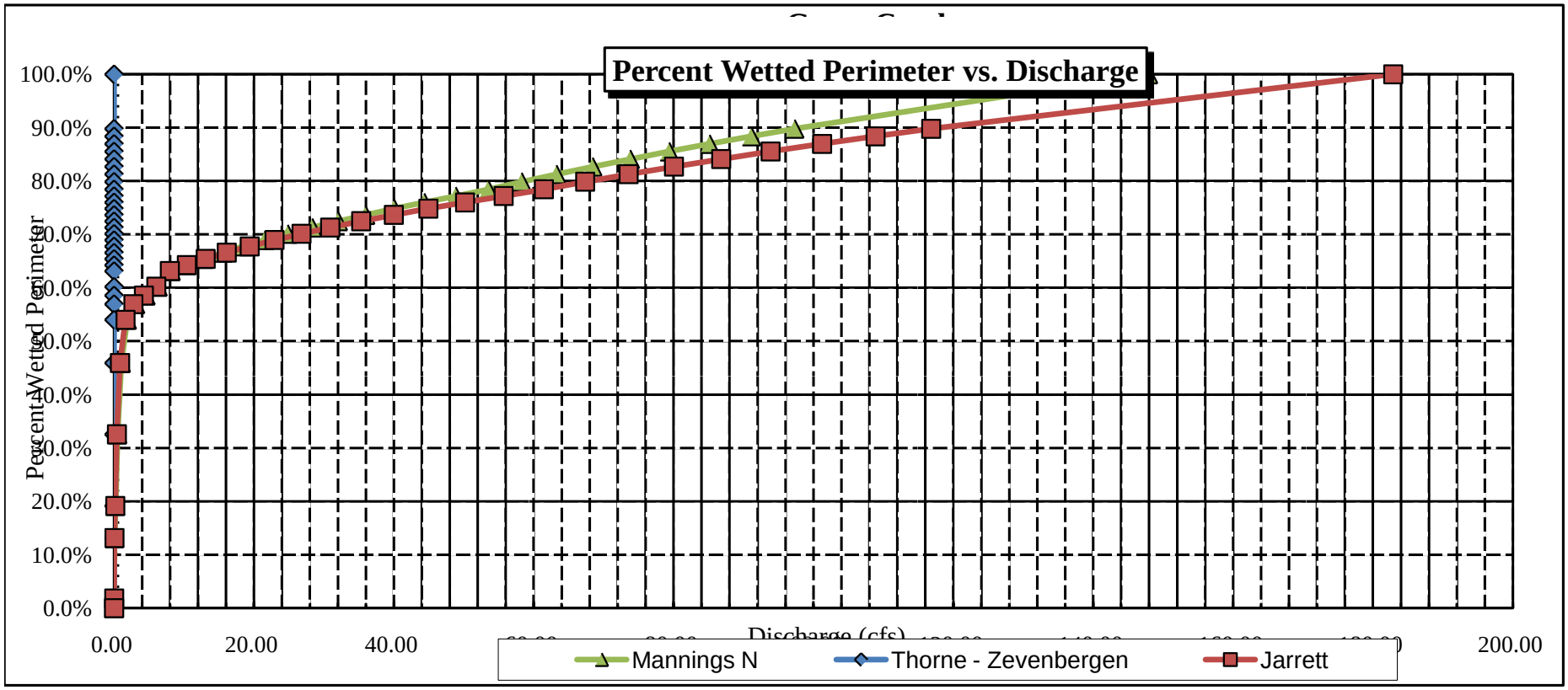
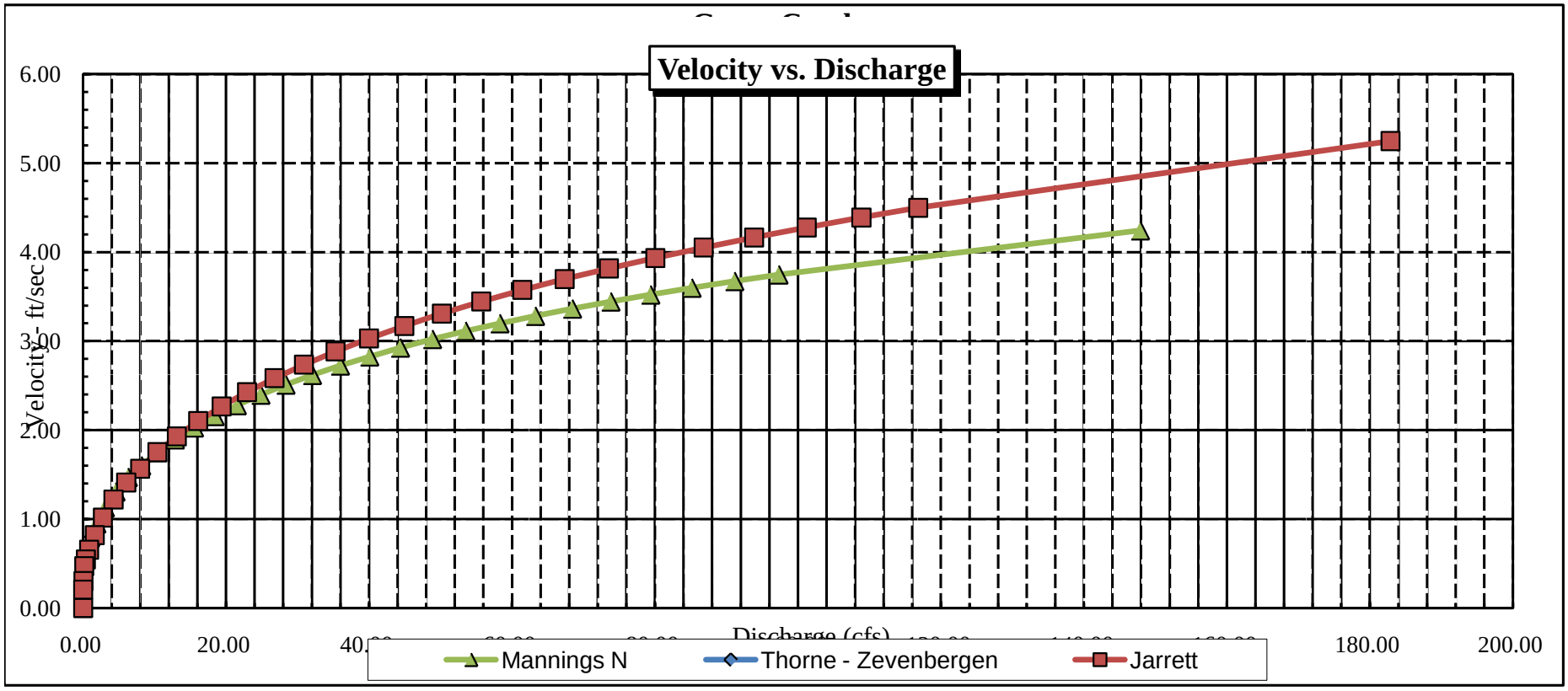
_____

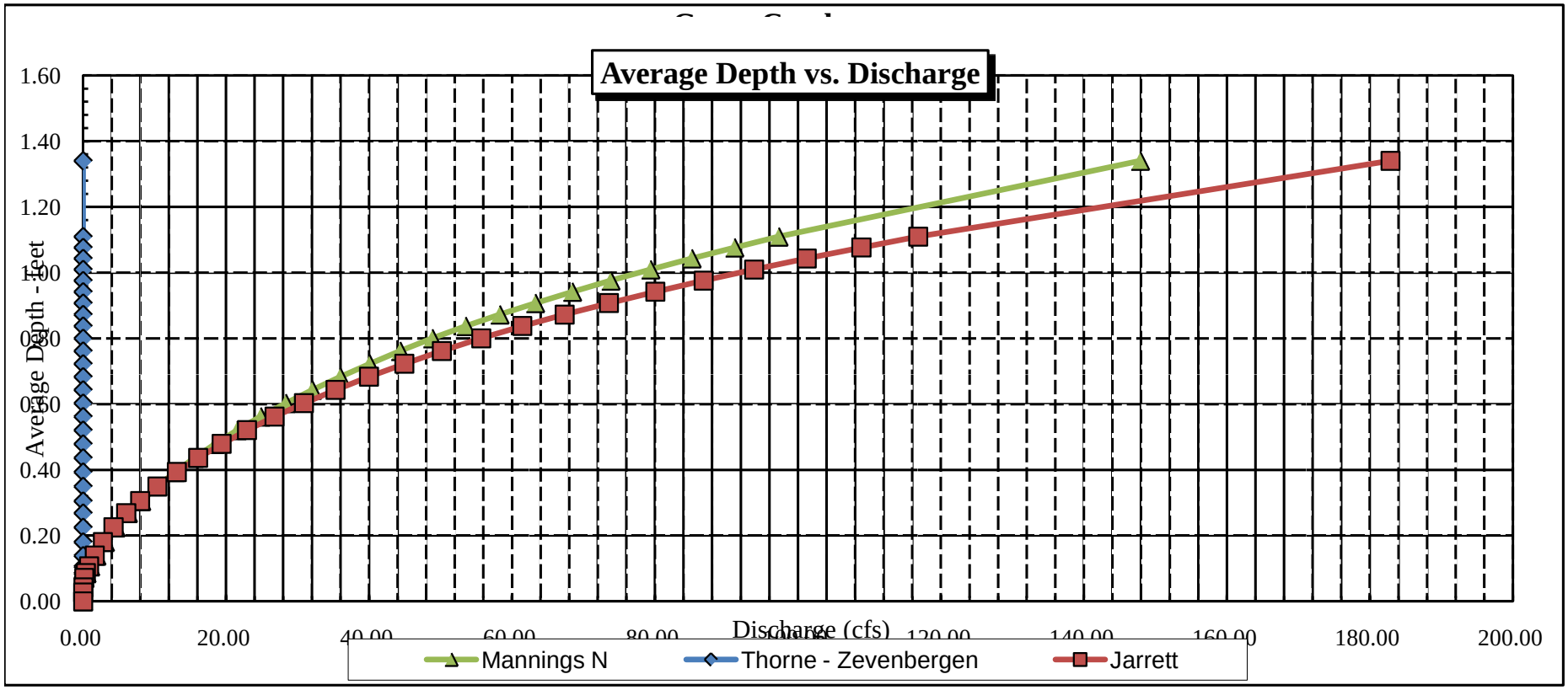
RECOMMENDATION BY: ..... AGENCY..... DATE:.....

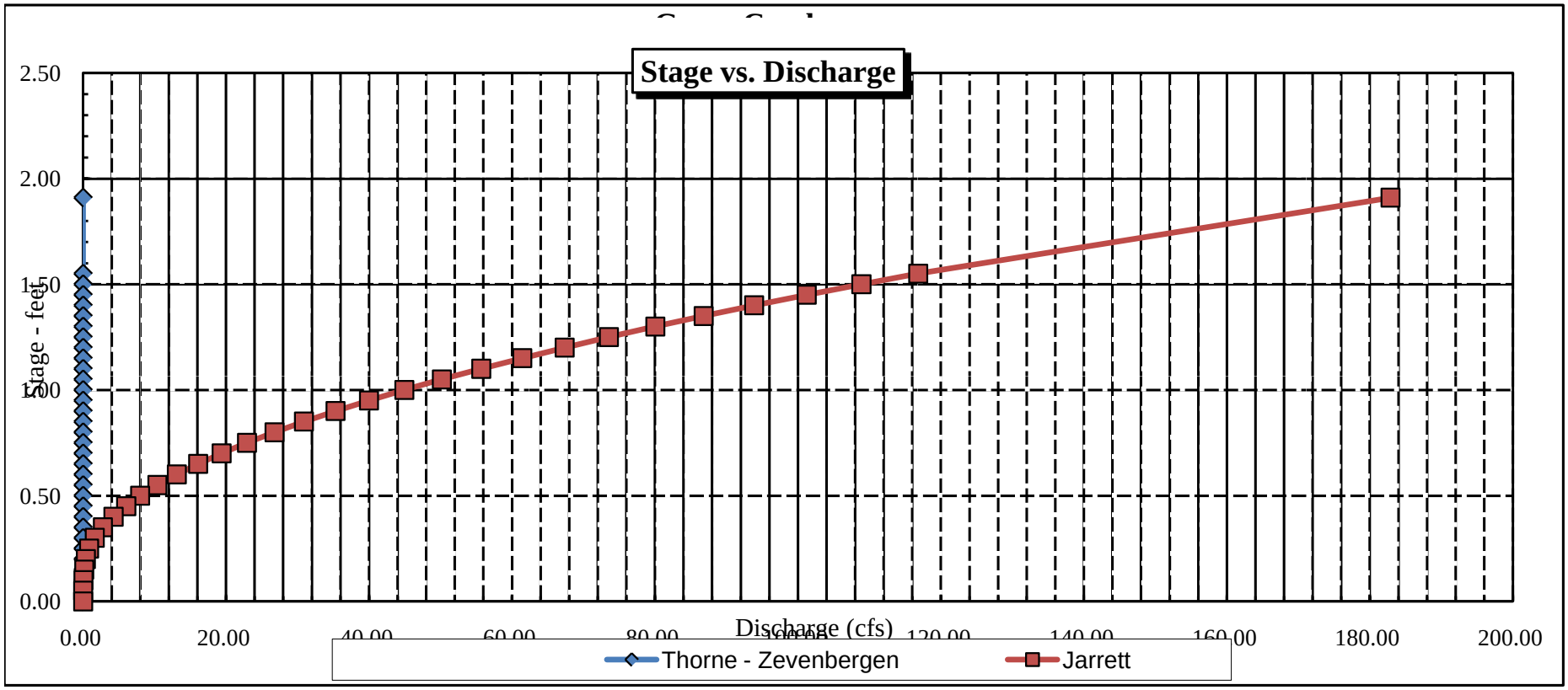
CWCB REVIEW BY: ..... DATE:.....


CROSS SECTION DATA ANALYSIS
LS
G
W
W
G
RS
-1.00
-1.50
-2.00
-5.00
-5.50
-6.00
0.00
5.00
10.00
15.00
20.00
25.00
30.00
VERTICAL DEPTH (FT)
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
20.00
40.00
200.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Velocity - ft/sec
0.00
20.00
180.00
200.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
Average Depth - feet
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
20.00
40.00
60.00
80.00
120.00
140.00
160.00
180.00
200.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
2.50
2.00
1.50
1.00
0.50
0.00
Stage - feet
0.00
20.00
40.00
60.00
80.00
120.00
140.00
160.00
180.00
200.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME: Grace Creek						CROSS-SECTION NO.: 2
CROSS-SECTION LOCATION: 1/3 mile upstream from Grace Ck. ditch headgate						
DATE: 8-2-10	OBSERVERS: R. Smith, T. Allai					
LEGAL DESCRIPTION	¼ SECTION: NE NE	SECTION: 15	TOWNSHIP: 11 (N)/S	RANGE: 77 E/(W)	PM: 6th	
COUNTY: Larimer	WATERSHED: Laramie R.	WATER DIVISION: 1	DOW WATER CODE: 11053			
MAP(S): USGS:						
USFS:						

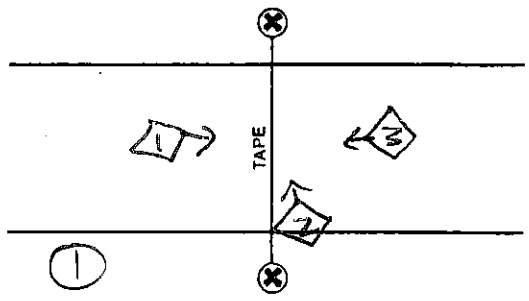
SUPPLEMENTAL DATA

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: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: gravel to 6" cobble	PHOTOGRAPHS TAKEN (YES)/NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
(X) Tape @ Stake LB	0.0	surveyed
(X) Tape @ Stake RB	0.0	surveyed
(1) WS @ Tape LB/RB	0.0	5.18 / 5.22
(2) WS Upstream	42.4	4.98
(3) WS Downstream	37.4	5.44
SLOPE	0.46/79.8 = .006	

SKETCH



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, stonefly

COMMENTS

TDS: 100 Ph: 7.6 Temp: 18°C

Willow - cottonwood riparian

FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Grace Creek | CROSS-SECTION NO.: 2 | DATE: 8-2-10 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: 2:15 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		1.58								
	0.7		2.74								
G	1.2		4.11								
W	1.25		5.18								
	2.0		5.7	.50	-			2.05			
	2.7		5.7	.50				1.94			
	3.4		5.7	.50				2.64			
	4.1		5.8	.60				2.1			
	4.8		5.75	.55				2.33			
	5.5		5.75	.55				2.30			
	6.2		5.70	.50				2.27			
	6.9		5.65	.45				1.82			
	7.6		5.70	.50				2.44			
	8.3		5.65	.45				.84			
	9.0		5.65	.45				2.09			
	9.7		5.55	.35				1.62			
	10.4		5.50	.30				1.64			
	11.1		5.55	.25				1.60			
	11.8		5.40	.20				.95			
	12.5		5.30	.10				.59			
	13.2		5.50	.30				1.15			
	13.9		5.50	.30				1.35			
	14.6		5.50	.30				1.51			
	15.3		5.40	.20				.54			
	16.0		5.2	0				0			
	16.7		5.2	0				0			
	17.4		5.25	.05				0			
	18.1		5.2	0				0			
W	18.2		5.22								
	21.2		4.84								
G	26.0		4.20								
	27.1		3.78								
RS	27.9		3.13								
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:	Grace Creek
XS LOCATION:	1/3 mile u/s fr Grace Ck. Ditch headg.
XS NUMBER:	2
DATE:	2-Aug-10
OBSERVERS:	R. Smith, T. Allai
1/4 SEC:	NE NE
SECTION:	15
TWP:	11N
RANGE:	77W
PM:	6th
COUNTY:	Larimer
WATERSHED:	Laramie River
DIVISION:	1
DOW CODE:	11053
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:	0.006

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

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

STREAM NAME: Grace Creek
XS LOCATION: 1/3 mile u/s fr Grace Ck. Ditch headg.
XS NUMBER: 2

DATA POINTS= 33

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	1.58			0.00		0.00	0.00	0.0%
	0.70	2.74			0.00		0.00	0.00	0.0%
1 G	1.20	4.11			0.00		0.00	0.00	0.0%
W	1.25	5.18	0.00	0.00	0.00		0.00	0.00	0.0%
	2.00	5.70	0.50	2.05	0.91	0.50	0.36	0.74	7.2%
	2.70	5.70	0.50	1.94	0.70	0.50	0.35	0.68	6.6%
	3.40	5.70	0.50	2.64	0.70	0.50	0.35	0.92	9.0%
	4.10	5.80	0.60	2.10	0.71	0.60	0.42	0.88	8.6%
	4.80	5.75	0.55	2.33	0.70	0.55	0.39	0.90	8.7%
	5.50	5.75	0.55	2.30	0.70	0.55	0.39	0.89	8.6%
	6.20	5.70	0.50	2.27	0.70	0.50	0.35	0.79	7.7%
	6.90	5.65	0.45	1.82	0.70	0.45	0.32	0.57	5.6%
	7.60	5.70	0.50	2.44	0.70	0.50	0.35	0.85	8.3%
	8.30	5.65	0.45	0.84	0.70	0.45	0.32	0.26	2.6%
	9.00	5.65	0.45	2.09	0.70	0.45	0.32	0.66	6.4%
	9.70	5.55	0.35	1.62	0.71	0.35	0.25	0.40	3.9%
	10.40	5.50	0.30	1.64	0.70	0.30	0.21	0.34	3.4%
	11.10	5.55	0.25	1.60	0.70	0.25	0.18	0.28	2.7%
	11.80	5.40	0.20	0.95	0.72	0.20	0.14	0.13	1.3%
	12.50	5.30	0.10	0.59	0.71	0.10	0.07	0.04	0.4%
	13.20	5.50	0.30	1.15	0.73	0.30	0.21	0.24	2.4%
	13.90	5.50	0.30	1.35	0.70	0.30	0.21	0.28	2.8%
	14.60	5.50	0.30	1.51	0.70	0.30	0.21	0.32	3.1%
	15.30	5.40	0.20	0.54	0.71	0.20	0.14	0.08	0.7%
	16.00	5.20	0.00	0.00	0.73		0.00	0.00	0.0%
	16.70	5.20	0.00	0.00	0.00		0.00	0.00	0.0%
	17.40	5.25	0.05	0.00	0.70	0.05	0.04	0.00	0.0%
	18.10	5.20	0.00	0.00	0.70		0.00	0.00	0.0%
W	18.20	5.22	0.00	0.00	0.00		0.00	0.00	0.0%
	21.20	4.84			0.00		0.00	0.00	0.0%
1 G	26.00	4.20			0.00		0.00	0.00	0.0%
	27.10	3.78			0.00		0.00	0.00	0.0%
RS	27.90	3.13			0.00		0.00	0.00	0.0%
TOTALS ----------					16.43	0.6 (Max.)	5.54	10.27	100.0%

Manning's n = 0.0301
Hydraulic Radius= 0.33736026

STREAM NAME: Grace Creek
XS LOCATION: 1/3 mile u/s fr Grace Ck. Ditch headg.
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	5.54	5.61	1.2%
4.95	5.54	10.13	82.8%
4.97	5.54	9.75	76.0%
4.99	5.54	9.38	69.1%
5.01	5.54	9.00	62.4%
5.03	5.54	8.63	55.7%
5.05	5.54	8.26	49.1%
5.07	5.54	7.90	42.5%
5.09	5.54	7.54	36.0%
5.11	5.54	7.18	29.5%
5.13	5.54	6.82	23.1%
5.15	5.54	6.47	16.8%
5.16	5.54	6.30	13.6%
5.17	5.54	6.12	10.5%
5.18	5.54	5.95	7.4%
5.19	5.54	5.78	4.3%
5.20	5.54	5.61	1.2%
5.21	5.54	5.45	-1.7%
5.22	5.54	5.29	-4.6%
5.23	5.54	5.14	-7.3%
5.24	5.54	4.99	-10.0%
5.25	5.54	4.84	-12.7%
5.27	5.54	4.55	-17.9%
5.29	5.54	4.27	-23.0%
5.31	5.54	3.98	-28.2%
5.33	5.54	3.70	-33.2%
5.35	5.54	3.43	-38.1%
5.37	5.54	3.16	-42.9%
5.39	5.54	2.90	-47.6%
5.41	5.54	2.65	-52.2%
5.43	5.54	2.40	-56.6%
5.45	5.54	2.16	-61.0%

WATERLINE AT ZERO
AREA ERROR = 5.204

STREAM NAME: Grace Creek
XS LOCATION: 1/3 mile u/s fr Grace Ck. Ditch headg.
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	4.20	24.80	1.07	1.60	26.60	26.08	100.0%	1.02	103.08	3.87
	4.20	24.77	1.07	1.60	26.50	26.04	99.9%	1.02	102.52	3.87
	4.25	24.39	1.04	1.55	25.28	25.62	98.2%	0.99	95.78	3.79
	4.30	24.01	1.00	1.50	24.07	25.19	96.6%	0.96	89.25	3.71
	4.35	23.63	0.97	1.45	22.87	24.76	94.9%	0.92	82.96	3.63
	4.40	23.26	0.93	1.40	21.70	24.33	93.3%	0.89	76.88	3.54
	4.45	22.88	0.90	1.35	20.55	23.90	91.7%	0.86	71.03	3.46
	4.50	22.50	0.86	1.30	19.41	23.47	90.0%	0.83	65.40	3.37
	4.55	22.12	0.83	1.25	18.30	23.05	88.4%	0.79	59.99	3.28
	4.60	21.75	0.79	1.20	17.20	22.62	86.7%	0.76	54.80	3.19
	4.65	21.37	0.75	1.15	16.12	22.19	85.1%	0.73	49.83	3.09
	4.70	20.99	0.72	1.10	15.06	21.76	83.4%	0.69	45.07	2.99
	4.75	20.61	0.68	1.05	14.02	21.33	81.8%	0.66	40.54	2.89
	4.80	20.24	0.64	1.00	13.00	20.90	80.2%	0.62	36.23	2.79
	4.85	19.85	0.60	0.95	12.00	20.47	78.5%	0.59	32.14	2.68
	4.90	19.46	0.57	0.90	11.02	20.02	76.8%	0.55	28.29	2.57
	4.95	19.06	0.53	0.85	10.06	19.57	75.1%	0.51	24.66	2.45
	5.00	18.66	0.49	0.80	9.11	19.13	73.3%	0.48	21.25	2.33
	5.05	18.27	0.45	0.75	8.19	18.68	71.6%	0.44	18.07	2.21
	5.10	17.87	0.41	0.70	7.29	18.23	69.9%	0.40	15.11	2.07
	5.15	17.47	0.37	0.65	6.40	17.78	68.2%	0.36	12.39	1.93
WL	5.20	16.19	0.34	0.60	5.54	16.47	63.1%	0.34	10.25	1.85
	5.25	14.45	0.33	0.55	4.78	14.70	56.4%	0.33	8.65	1.81
	5.30	14.16	0.29	0.50	4.07	14.39	55.2%	0.28	6.69	1.65
	5.35	13.39	0.25	0.45	3.38	13.58	52.1%	0.25	5.10	1.51
	5.40	12.62	0.22	0.40	2.73	12.77	49.0%	0.21	3.72	1.37
	5.45	11.79	0.18	0.35	2.12	11.91	45.7%	0.18	2.56	1.21
	5.50	9.48	0.16	0.30	1.55	9.58	36.7%	0.16	1.77	1.14
	5.55	7.88	0.14	0.25	1.12	7.95	30.5%	0.14	1.16	1.04
	5.60	7.46	0.10	0.20	0.74	7.51	28.8%	0.10	0.60	0.81
	5.65	6.20	0.06	0.15	0.38	6.23	23.9%	0.06	0.22	0.59
	5.70	2.71	0.05	0.10	0.13	2.73	10.4%	0.05	0.06	0.50
	5.75	0.96	0.02	0.05	0.02	0.97	3.7%	0.02	0.01	0.31

STREAM NAME: Grace Creek
XS LOCATION: 1/3 mile u/s fr Grace Ck. Ditch headg.
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	10.27	cfs
CALCULATED FLOW (Qc)=	10.25	cfs
(Qm-Qc)/Qm * 100 =	0.2	%
MEASURED WATERLINE (WLm)=	5.20	ft
CALCULATED WATERLINE (WLc)=	5.20	ft
(WLm-WLc)/WLm * 100 =	-0.1	%
MAX MEASURED DEPTH (Dm)=	0.60	ft
MAX CALCULATED DEPTH (Dc)=	0.60	ft
(Dm-Dc)/Dm * 100	0.7	%
MEAN VELOCITY=	1.85	ft/sec
MANNING'S N=	0.030	
SLOPE=	0.006	ft/ft
.4 * Qm =	4.1	cfs
2.5 * Qm=	25.7	cfs

RECOMMENDED INSTREAM FLOW:
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FLOW (CFS)	PERIOD
___________	___________
___________	___________
___________	___________
___________	___________

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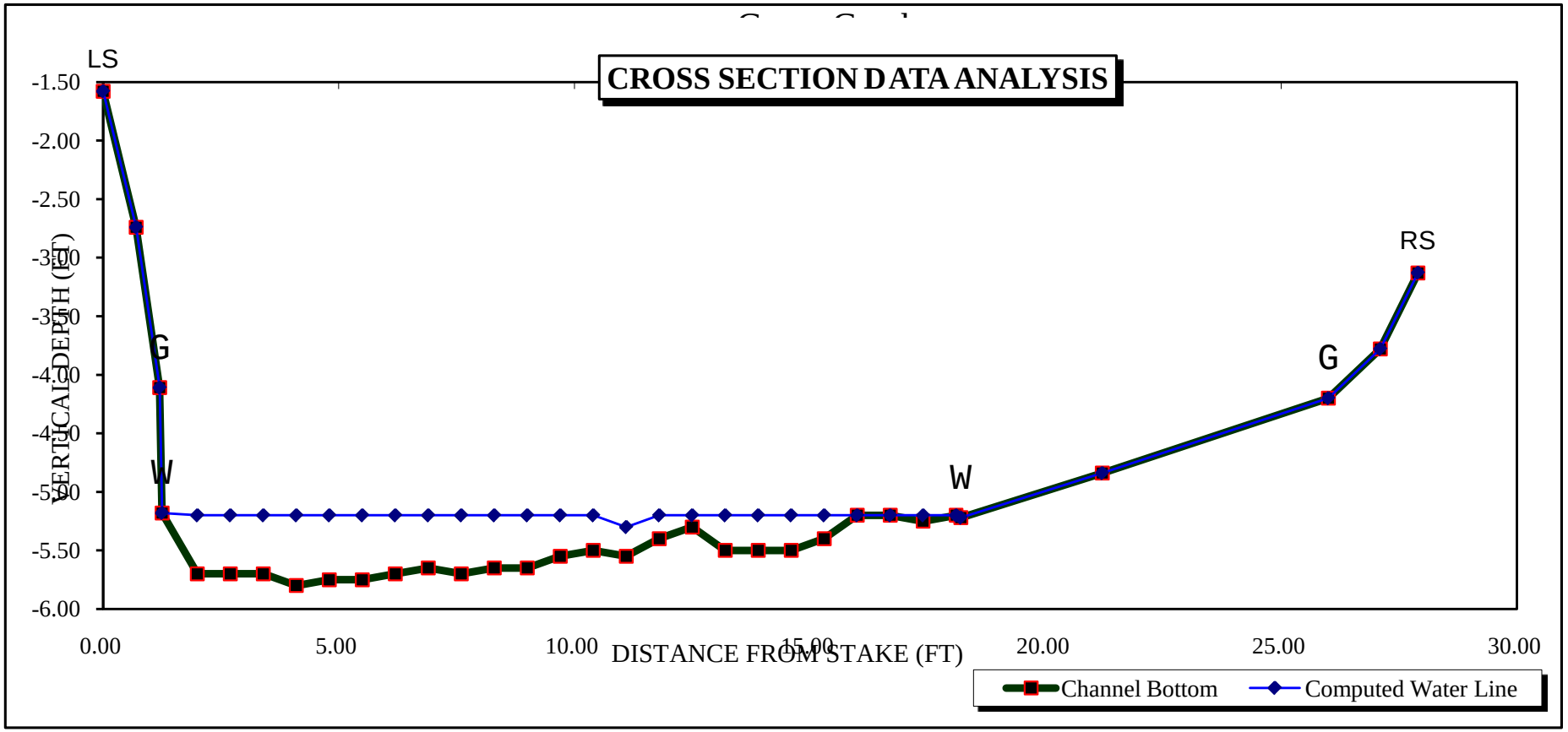
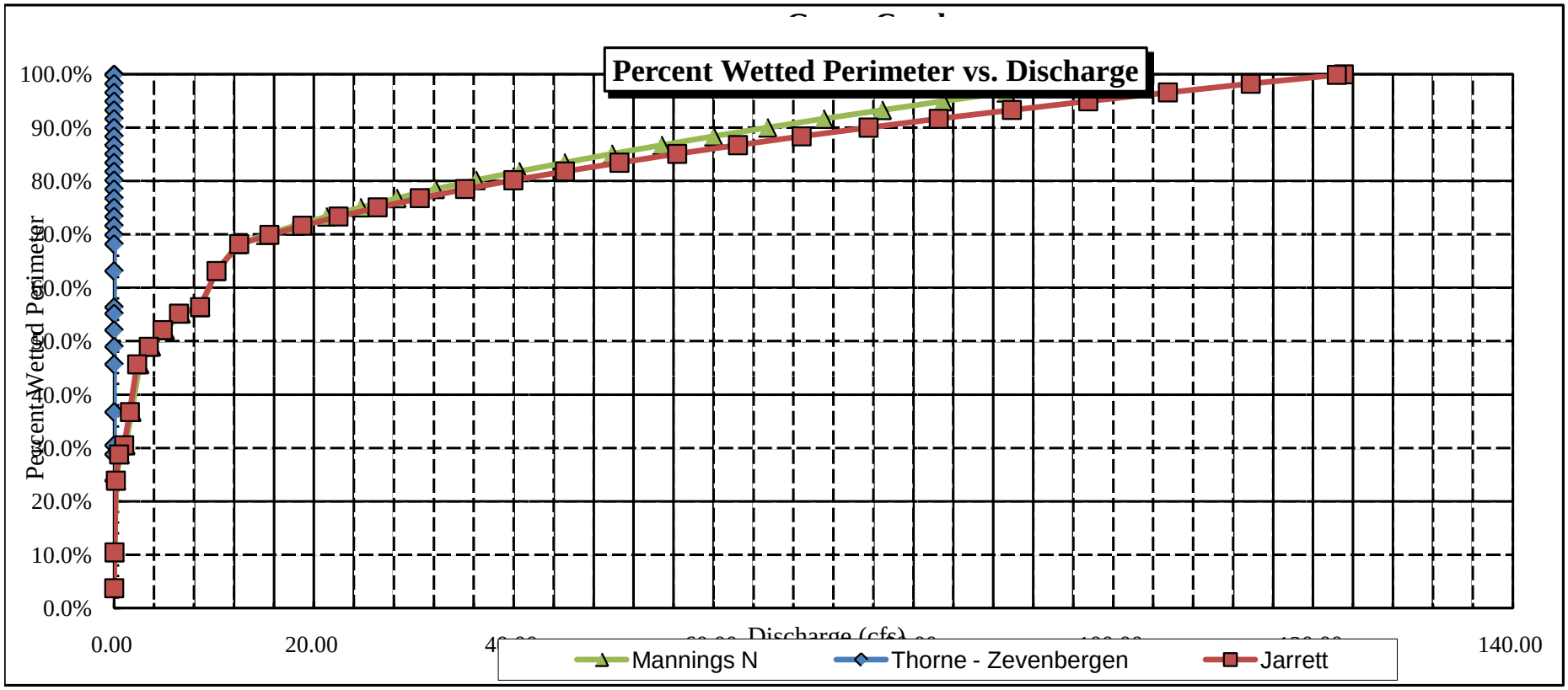
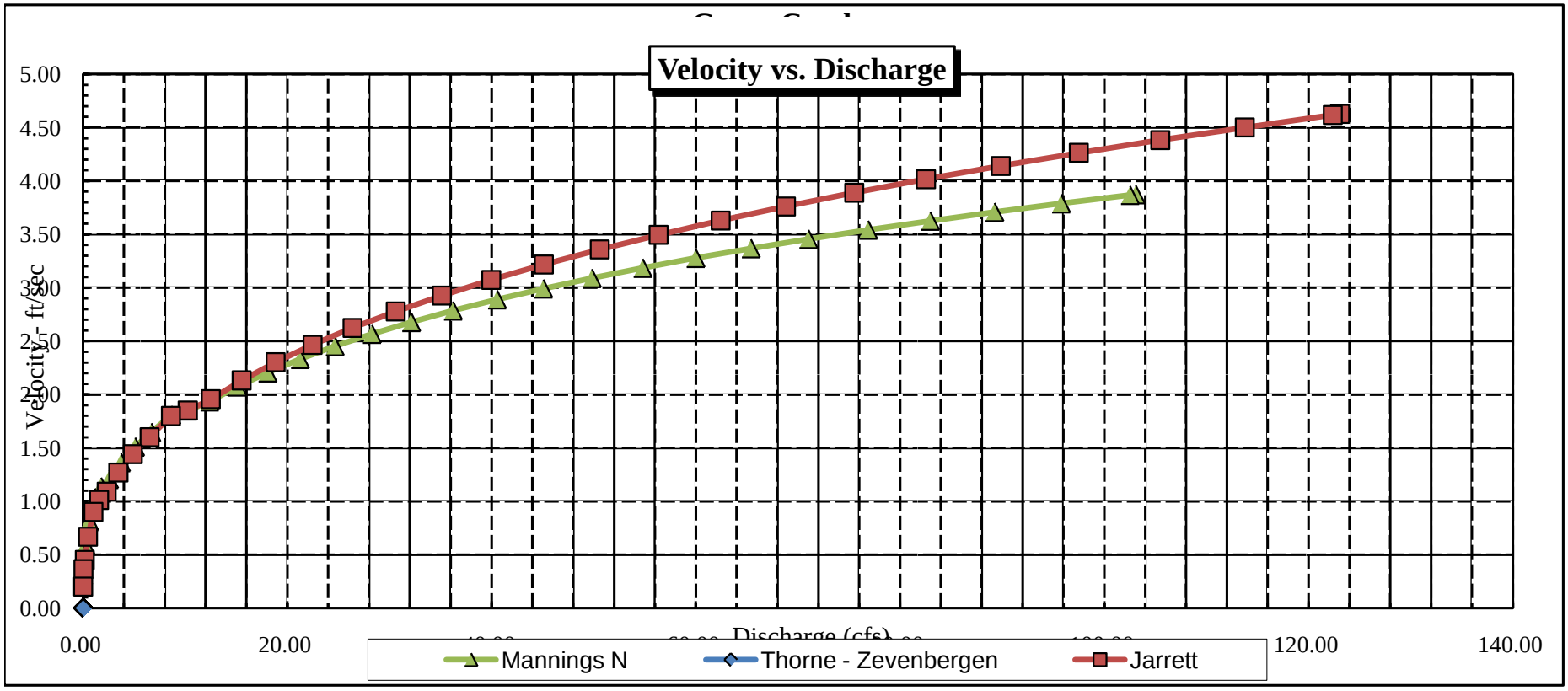
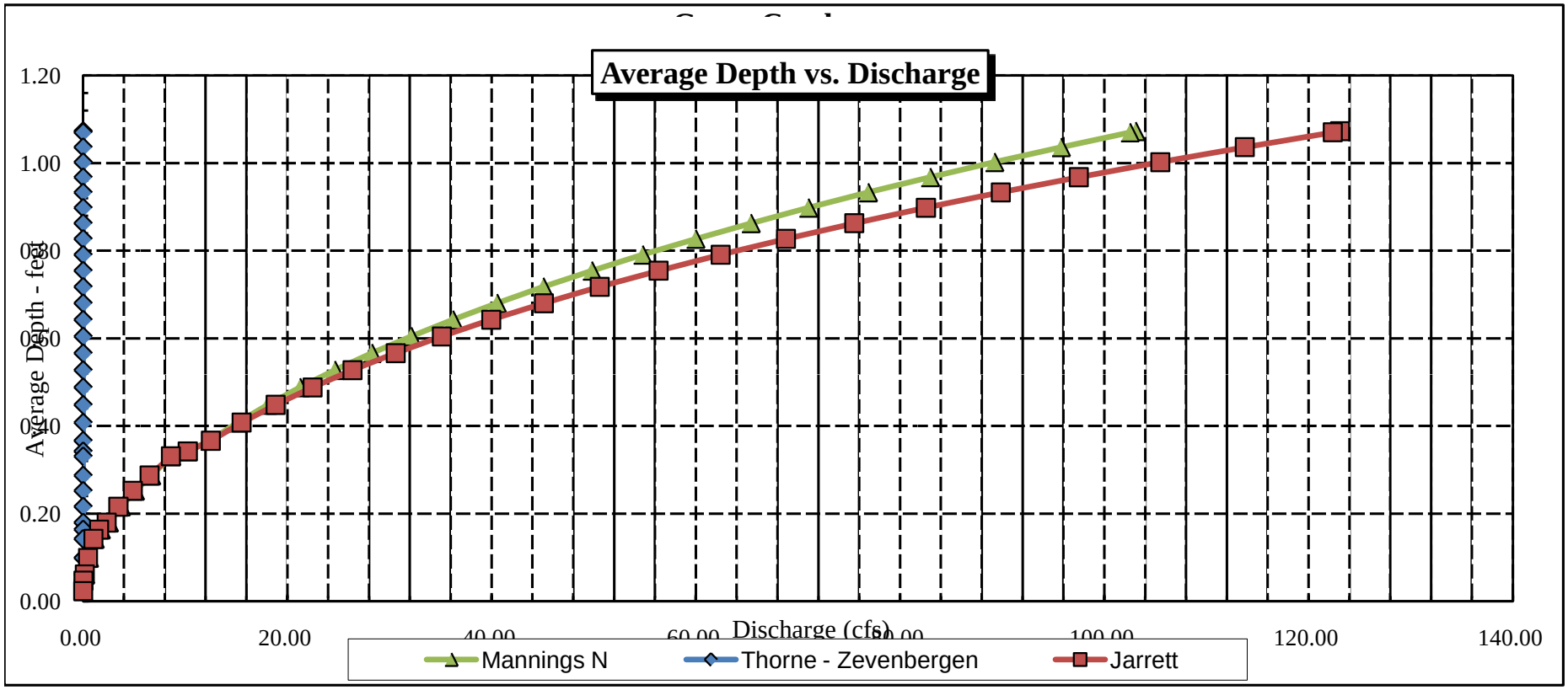
RECOMMENDATION BY: ………………………………………………… AGENCY………………………………………………… DATE:………………………………

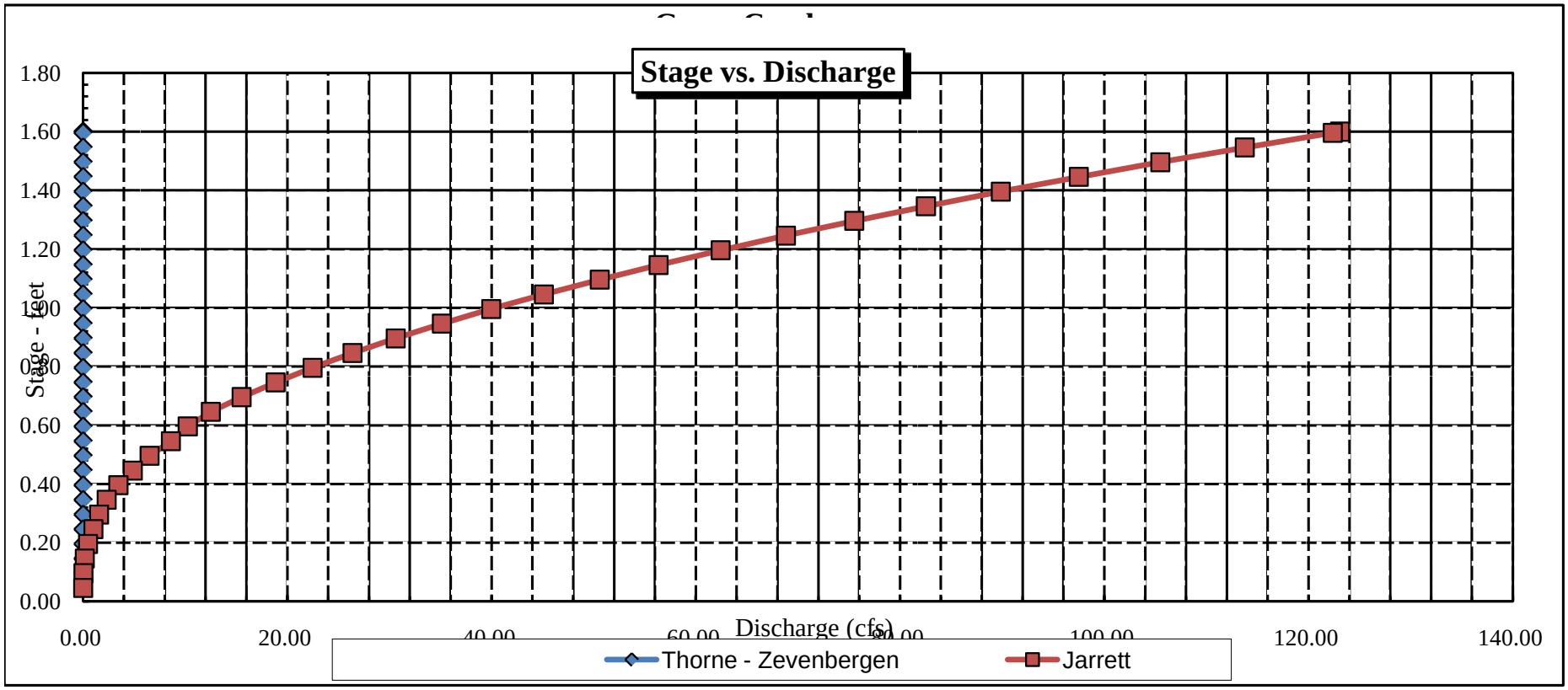
CWCB REVIEW BY: ……………………………………………………………………………………………………… DATE:………………………………


CROSS SECTION DATA ANALYSIS
LS
G
W
W
G
RS
-1.50
-2.00
-2.50
-3.00
-3.50
-4.00
-4.50
-5.00
-5.50
-6.00
VERTICAL DEPTH (FT)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
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
20.00
140.00
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Velocity, ft/sec
0.00
20.00
120.00
140.00
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
20.00
40.00
60.00
80.00
100.00
120.00
140.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Stage - feet
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett