United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215-7210
www.co.blm.gov

DEC 18 2013

In Reply Refer To:
7250 (CO-930)

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 Shell Creek, located in Water Division 1.

Location and Land Status. Shell Creek originates on Bull Mountain near the Colorado-Wyoming border, approximately 25 miles south of Laramie, Wyoming. This recommendation covers the stream reach beginning at the headwaters of Shell Creek and extends downstream to the lowest BLM boundary, a distance of approximately 5.1 miles. Of this distance, the BLM manages 3.6 miles and private owners manage 1.5 miles.

Biological Summary. Shell Creek is a cold-water, high gradient stream in a narrow, forested canyon. The stream is confined by bedrock and has variable substrate, ranging from gravels to boulders up to 1-foot in diameter. The stream has a good mix of riffle, run, and deep pool habitats to support a salmonid fishery.

Fishery surveys revealed a self-sustaining brook trout fishery. Even though Shell Creek is a small stream, the fish population survived the 2002-2003 drought, indicating that base flows are sufficient to support the trout fishery through all types of climate conditions. However, fish surveys noted only one age class of fish, so reproduction in the stream may be limited in some types of hydrologic conditions. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The riparian community along Shell Creek is in good condition, and provides adequate cover and shading for the fish population. In the upper elevations of the creek, the riparian community is comprised of Engelmann spruce, alder, willow, sedges and rushes. At lower elevations, the riparian community also includes cottonwood and birch.

R2Cross Analysis. The BLM collected the following R2Cross data from Shell 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)
07/13/2011 #1	1.25 cfs	5.45 feet	0.95 cfs	1.14 cfs
07/13/2011 #2	1.35 cfs	10.25 feet	1.13 cfs	1.19 cfs
		Averages:	1.04 cfs	1.17 cfs

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

> 1.1 cubic feet per second is recommended for the warm weather period, from April 1 through October 31. This recommendation is driven by the average depth criteria. Because of its small size and steep gradient, this creek possesses limited physical habitat suitable for fish. Accordingly, it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff flows are available. This flow rate is capable of preventing excessively water high water temperatures.
>
> 1.0 cubic feet per second is recommended for cold weather period, from November 1 to March 31. This recommendation is driven by the average velocity criteria. This flow rate should prevent pools from freezing and protect overwintering fish.

Water Availability. There is no readily available gage data for this creek or for any of the adjacent watersheds. The BLM recommends using the StreamStats package developed jointly between the U.S. Geological Survey (USGS) and the Colorado Water Conservation Board (CWCB). The BLM's experience is that for applications in this area, this package is very reliable in terms of estimating average monthly flow rates that can be expected.

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

Relationship to Land Management Plans. The BLM's inventories of conditions in the Shell Creek watershed indicate that it is in largely natural condition. The public lands in the Shell Creek watershed are managed primarily for forestry, livestock grazing, and recreation, with a network of gravel roads and two track roads to facilitate these management objectives. The BLM intends to continue management for these activities, with an emphasis on maintaining and improving riparian conditions and addressing the tree mortality caused by pine beetles. Appropriation of an instream flow water right would assist the BLM in long-term management of outstanding 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 2012. We thank both Colorado Parks and Wildlife and the CWCB 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,

Leigh D. Espy
Deputy State Director, Resources and Fire

cc: Jim Cagney, NW District
Stephanie Odell, 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 instream flow water rights on Shell Creek, located in Water Division 6.

Location and Land Status. Shell Creek originates on Bull Mountain near the Colorado-Wyoming border, approximately 25 miles south of Laramie, Wyoming. This recommendation covers the stream reach beginning at the headwaters of Shell Creek and extends downstream to the headgate of the Shell Creek Ditch, a distance of approximately 5.8 miles. Of this distance, BLM manages 3.6 miles and private owners manage 2.2 miles.

Biological Summary. Shell Creek is a cold-water, high gradient stream in a narrow, forested canyon. The stream is confined by bedrock and has variable substrate, ranging from gravels to boulders up to 1-foot in diameter. The stream has a good mix of riffle, run, and deep pool habitats to support a salmonid fishery.

Fishery surveys revealed a self-sustaining brook trout fishery. Even though Shell Creek is a small stream, the fish population survived the 2002-2003 drought, indicating that base flows are sufficient to support the trout fishery through all types of climate conditions. However, fish surveys noted only one age class of fish, so reproduction in the stream may be limited in some types of hydrologic conditions. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The riparian community along Shell Creek is good condition, and provides adequate cover and shading for the fish population. In the upper elevations of the creek, the riparian community is comprised of blue spruce, alder, willow, sedges, and rushes. At lower elevations, the riparian community also includes cottonwood and birch.

R2Cross Analysis. BLM collected the following R2Cross data from Shell 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)
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07/13/2011 #2	1.35 cfs	10.25 feet	1.13 cfs	1.19 cfs
		Averages:	1.04 cfs	1.17 cfs

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

> 1.15 cubic feet per second is recommended for the warm weather period, from April 1 through October 31. This recommendation is driven by the average depth criteria. Because of its small size and steep gradient, this creek possesses limited physical habitat suitable for fish. Accordingly, it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff flows are available. This flow rate is capable of preventing excessively water high water temperatures.
>
> 1.0 cubic feet per second is recommended for cold weather period, from November 1 to March 31. This recommendation is driven by the average velocity criteria. This flow rate should prevent pools from freezing and protect overwintering fish.

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

Relationship to Land Management Plans. BLM's inventories of conditions in the Shell Creek watershed indicate that it is in largely natural condition. The public lands in the Shell Creek watershed are managed primarily for forestry, livestock grazing, and recreation, with a network of gravel roads and two track roads to facilitate these management objectives. BLM intends to continue management for these activities, with an emphasis on maintaining and improving riparian conditions and addressing the tree mortality caused by pine beetles. Appropriation of an instream flow water right would assist the BLM in long-term management of outstanding 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 2012. 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,

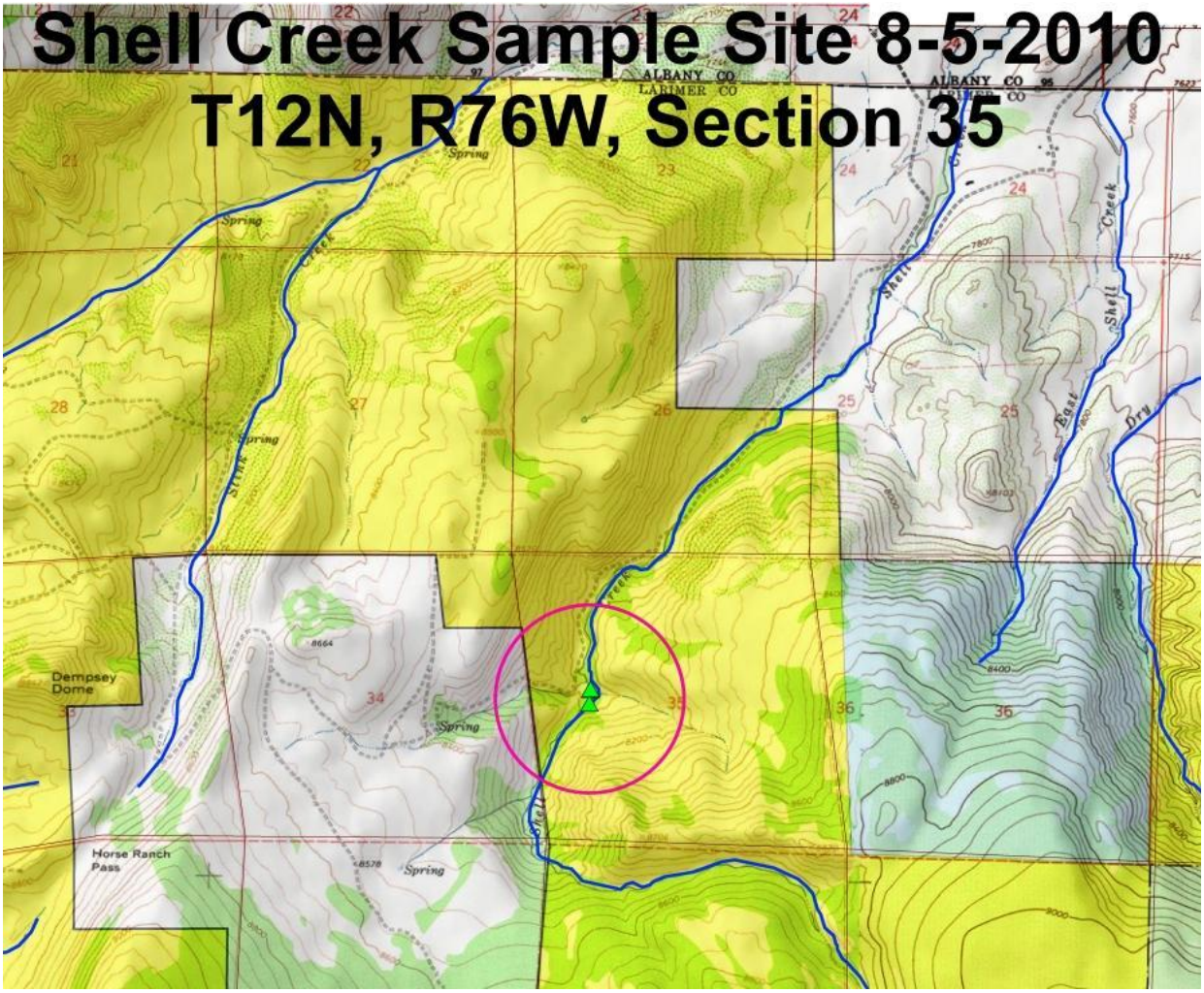
Leigh Espy
Deputy State Director
Resources and Fire

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

Kremmling Field Office Stream Surveys
August 2010

Shell Creek - Water Code #13754

Shell Creek, located northeast of Hohnholz Lakes State Wildlife Area on BLM lands managed by the Kremmling Field Office was sampled on August 5, 2010. Shell Creek is a tributary to the Laramie River in Wyoming. Sampling was done in support of the instream flow program. A two-pass removal population estimate was not completed due to the very low fish density and thick, impenetrable stream cover/vegetation. Three large brook trout were the only fish seen or collected. Sampling was conducted via two backpack electro-shockers and approximately 250 feet of stream was sampled. Personnel present were Tom Fresques, Fish Biologist, and Gregor Dekleva and Kristy Wallner, Biological Technicians.



Shell Creek

Shell Creek

Brook trout

STREAM SURVEY FISH SAMPLING FORM

WATER _Shell Creek_____ H2O CODE __13754_____ DATE _8/5/2010_

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	311	400					
1	BRK	306	410					
1	BRK	279	254					

GPS Location:

Notes: Stream Width __5.6_ ft. Sample Reach __250__ft.
Conductivity: ~300 ms Electroshocker settings

Discussion:

Shell Creek was flowing at a rate of approximately 4.0 cfs and had a good mix of riffle, run, and pool habitats. The stream appeared to be a Rosgen B channel type. Riparian vegetation consisted of an overstory of cottonwood trees, thick willows, alder, birch, sedge, rush, redtop, *poa*, aspen, and thistle. The riparian area was approximately 100 feet wide. Based on limited visual observation, the stream contained midges, caddis flies, stoneflies, and mayflies.

Three large brook trout were collected. These fish were the only fish collected or seen. No age class diversity was noted and the stream appears to have far fewer fish then the habitat appears capable of supporting. Based on verbal communication, streamflows are known to get pretty low in late summer. Conductivity was low (approximately 300 ms).

Recommendations:

- This stream would benefit from an enlargement of the instream flow water right. The present instream flow water right of 1.0 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 thistle along the creek

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

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

CROSS-SECTION LOCATION: 500 ft upstream from Bull Mtn. Road

DATE: 7-13-11 | OBSERVERS: R. Smith, P Belcher, J. Wilk

LEGAL DESCRIPTION | ¼ SECTION: NW | SECTION: 12 | TOWNSHIP: 12 (N)/S | RANGE: 75 E/(W) | PM: 6th

COUNTY: Larimer | WATERSHED: Laramie River | WATER DIVISION: 1 | DOW WATER CODE: 13754

MAP(S): USGS: Zone 13 0426838

USFS: 4532662

SUPPLEMENTAL DATA

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

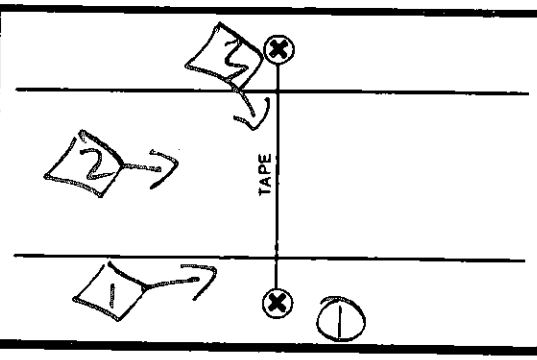
METER NUMBER: | DATE RATED: | CALIB/SPIN. ____ sec | TAPE WEIGHT: surveyed ____ lbs/foot | TAPE TENSION: surveyed ____ lbs

CHANNEL BED MATERIAL SIZE RANGE: gravel to 6" cobbles | PHOTOGRAPHS TAKEN: (YES)/NO | NUMBER OF PHOTOGRAPHS: 5

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	7.75/7.70
② WS Upstream	19.5	7.40
③ WS Downstream	19.0	8.22
SLOPE	0.82/38.5 = .021	

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

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

mayfly, caddis fly, stonefly

COMMENTS

Temp = 14.3°

Cond. = 49.1 µs

Ph = 7.53

Salinity = 0.2 ppt

FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Shell 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: 1:25 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		6.10								
G	1.1		6.58								
	1.3	1.35	7.00	7.15 .0				Ø			Ø
W	1.4	.15	7.90	.15				.83		.023	0.016
	1.7	.3	7.95	.20				1.01		.06	0.061
	2.0	.3	8.05	.30				1.40		.09	0.126
	2.3	.3	7.95	.25				1.15		.075	0.086
	2.6	.3	8.05	.3				1.43		.09	0.129
	2.9	.3	8.05	.3				1.29		.09	0.116
	3.2	.3	8.00	.3				1.50		.09	0.135
	3.5	.3	8.00	.3				1.47		.09	0.132
	3.8	.3	7.95	.25				1.43		.075	0.107
	4.1	.3	7.85	.15				1.31		.045	0.059
	4.4	.3	7.85	.15				1.12		.045	
	4.7	.3	7.80	.10				0.88		.03	
	5.0	.3	7.80	.10				0.74		.03	
	5.3	.3	7.90	.20				1.00		.06	0.06
	5.6	.3	7.90	.20				1.10		.06	
	5.9	.3	7.90	.20				0.83		.06	
	6.2	.35	8.00	.30				0.05			
W	6.6	.2	7.70	Ø							
G	6.7		6.90								
	7.4		6.00								
RS	9.5		5.20								
	5.2	5.2									
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:	Shell Creek
XS LOCATION:	500 ft upstream from Bull Mtn Road
XS NUMBER:	1
DATE:	13-Jul-11
OBSERVERS:	R. Smith, P. Belcher, J. Wilk
1/4 SEC:	NW
SECTION:	12
TWP:	12N
RANGE:	75W
PM:	Sixth
COUNTY:	Larimer
WATERSHED:	Laramie River
DIVISION:	1
DOW CODE:	13754
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:	0.0021

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

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

STREAM NAME: Shell Creek
XS LOCATION: 500 ft upstream from Bull Mtn Road
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	6.10			0.00		0.00	0.00	0.0%
1 G	1.10	6.58			0.00		0.00	0.00	0.0%
	1.30	7.00			0.00		0.00	0.00	0.0%
W	1.35	7.75	0.00	0.00	0.00		0.00	0.00	0.0%
	1.40	7.90	0.15	0.83	0.16	0.15	0.03	0.02	1.7%
	1.70	7.95	0.20	1.01	0.30	0.20	0.06	0.06	4.8%
	2.00	8.05	0.30	1.40	0.32	0.30	0.09	0.13	10.1%
	2.30	7.95	0.25	1.15	0.32	0.25	0.08	0.09	6.9%
	2.60	8.05	0.30	1.43	0.32	0.30	0.09	0.13	10.3%
	2.90	8.05	0.30	1.29	0.30	0.30	0.09	0.12	9.3%
	3.20	8.00	0.30	1.50	0.30	0.30	0.09	0.14	10.8%
	3.50	8.00	0.30	1.47	0.30	0.30	0.09	0.13	10.6%
	3.80	7.95	0.25	1.43	0.30	0.25	0.08	0.11	8.6%
	4.10	7.85	0.15	1.31	0.32	0.15	0.05	0.06	4.7%
	4.40	7.85	0.15	1.12	0.30	0.15	0.05	0.05	4.0%
	4.70	7.80	0.10	0.88	0.30	0.10	0.03	0.03	2.1%
	5.00	7.80	0.10	0.74	0.30	0.10	0.03	0.02	1.8%
	5.30	7.90	0.20	1.00	0.32	0.20	0.06	0.06	4.8%
	5.60	7.90	0.20	1.10	0.30	0.20	0.06	0.07	5.3%
	5.90	7.90	0.20	0.83	0.30	0.20	0.06	0.05	4.0%
	6.20	8.00	0.30	0.05	0.32	0.30	0.11	0.01	0.4%
W	6.60	7.70	0.00	0.00	0.50		0.00	0.00	0.0%
1 G	6.70	6.90			0.00		0.00	0.00	0.0%
	7.40	6.00			0.00		0.00	0.00	0.0%
RS	9.50	5.20			0.00		0.00	0.00	0.0%
TOTALS ----------					5.57	0.3 (Max.)	1.12	1.25	100.0%

Manning's n = 0.0209
Hydraulic Radius= 0.20122817

STREAM NAME: Shell Creek
XS LOCATION: 500 ft upstream from Bull Mtn Road
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.12	1.06	-5.4%
7.48	1.12	2.38	112.1%
7.50	1.12	2.27	102.7%
7.52	1.12	2.17	93.2%
7.54	1.12	2.06	83.8%
7.56	1.12	1.96	74.4%
7.58	1.12	1.85	64.9%
7.60	1.12	1.74	55.5%
7.62	1.12	1.64	46.1%
7.64	1.12	1.53	36.7%
7.66	1.12	1.43	27.4%
7.68	1.12	1.32	18.0%
7.69	1.12	1.27	13.3%
7.70	1.12	1.22	8.6%
7.71	1.12	1.17	3.9%
7.72	1.12	1.11	-0.8%
7.73	1.12	1.06	-5.4%
7.74	1.12	1.01	-10.1%
7.75	1.12	0.96	-14.7%
7.76	1.12	0.90	-19.3%
7.77	1.12	0.85	-23.9%
7.78	1.12	0.80	-28.5%
7.80	1.12	0.70	-37.7%
7.82	1.12	0.60	-46.3%
7.84	1.12	0.51	-54.3%
7.86	1.12	0.43	-61.9%
7.88	1.12	0.35	-68.8%
7.90	1.12	0.28	-75.4%
7.92	1.12	0.21	-80.9%
7.94	1.12	0.16	-85.6%
7.96	1.12	0.11	-89.8%
7.98	1.12	0.07	-93.4%

WATERLINE AT ZERO
AREA ERROR = 7.713

STREAM NAME: Shell Creek
XS LOCATION: 500 ft upstream from Bull Mtn Road
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	6.90	5.45	1.00	1.15	5.46	7.24	100.0%	0.75	14.71	2.70
	6.91	5.44	0.99	1.14	5.38	7.21	99.6%	0.75	14.42	2.68
	6.96	5.41	0.95	1.09	5.11	7.11	98.1%	0.72	13.36	2.61
	7.01	5.38	0.90	1.04	4.84	7.00	96.7%	0.69	12.33	2.55
	7.06	5.38	0.85	0.99	4.57	6.90	95.3%	0.66	11.32	2.47
	7.11	5.37	0.80	0.94	4.31	6.80	93.9%	0.63	10.33	2.40
	7.16	5.36	0.75	0.89	4.04	6.70	92.5%	0.60	9.38	2.32
	7.21	5.35	0.71	0.84	3.77	6.60	91.2%	0.57	8.45	2.24
	7.26	5.34	0.66	0.79	3.50	6.50	89.8%	0.54	7.55	2.16
	7.31	5.33	0.61	0.74	3.24	6.40	88.4%	0.51	6.69	2.07
	7.36	5.32	0.56	0.69	2.97	6.30	87.0%	0.47	5.86	1.97
	7.41	5.31	0.51	0.64	2.70	6.20	85.6%	0.44	5.06	1.87
	7.46	5.30	0.46	0.59	2.44	6.10	84.2%	0.40	4.31	1.77
	7.51	5.29	0.41	0.54	2.18	6.00	82.8%	0.36	3.60	1.66
	7.56	5.28	0.36	0.49	1.91	5.90	81.4%	0.32	2.93	1.54
	7.61	5.27	0.31	0.44	1.65	5.80	80.1%	0.28	2.32	1.41
	7.66	5.26	0.26	0.39	1.38	5.70	78.7%	0.24	1.75	1.27
WL	7.71	5.23	0.21	0.34	1.12	5.59	77.2%	0.20	1.25	1.12
	7.76	5.16	0.17	0.29	0.86	5.45	75.3%	0.16	0.82	0.95
	7.81	4.66	0.13	0.24	0.61	4.89	67.6%	0.12	0.50	0.81
	7.86	3.86	0.10	0.19	0.39	4.03	55.7%	0.10	0.27	0.69
	7.91	2.81	0.08	0.14	0.22	2.91	40.2%	0.08	0.13	0.58
	7.96	2.06	0.05	0.09	0.10	2.13	29.4%	0.05	0.04	0.41
	8.01	0.85	0.02	0.04	0.02	0.87	12.0%	0.02	0.01	0.27

STREAM NAME: Shell Creek
XS LOCATION: 500 ft upstream from Bull Mtn Road
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.25	cfs
CALCULATED FLOW (Qc)=	1.25	cfs
(Qm-Qc)/Qm * 100 =	0.2	%
MEASURED WATERLINE (WLm)=	7.73	ft
CALCULATED WATERLINE (WLc)=	7.71	ft
(WLm-WLc)/WLm * 100 =	0.2	%
MAX MEASURED DEPTH (Dm)=	0.30	ft
MAX CALCULATED DEPTH (Dc)=	0.34	ft
(Dm-Dc)/Dm * 100	-12.2	%
MEAN VELOCITY=	1.12	ft/sec
MANNING'S N=	0.021	
SLOPE=	0.0021	ft/ft
.4 * Qm =	0.5	cfs
2.5 * Qm=	3.1	cfs

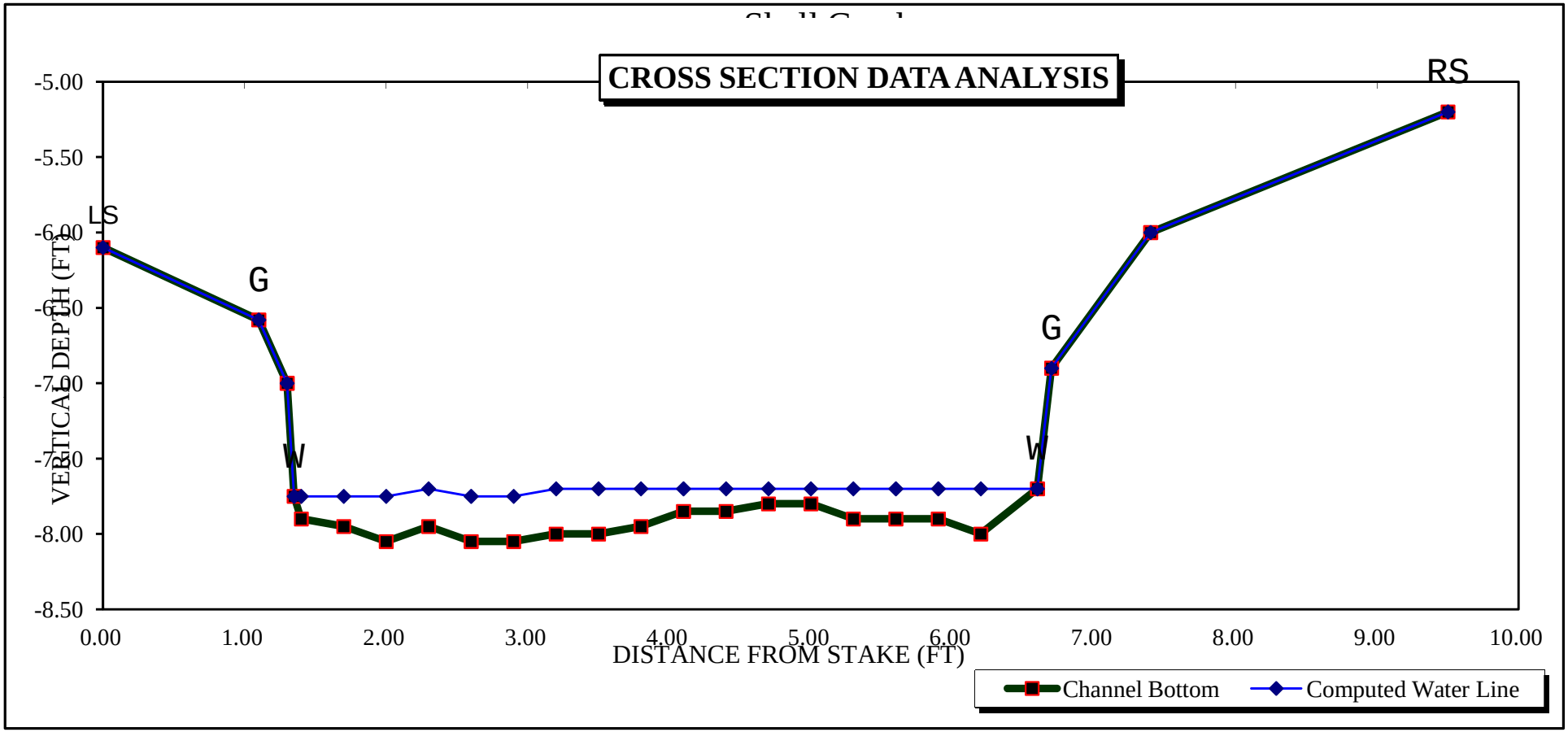
RECOMMENDED INSTREAM FLOW:
============================

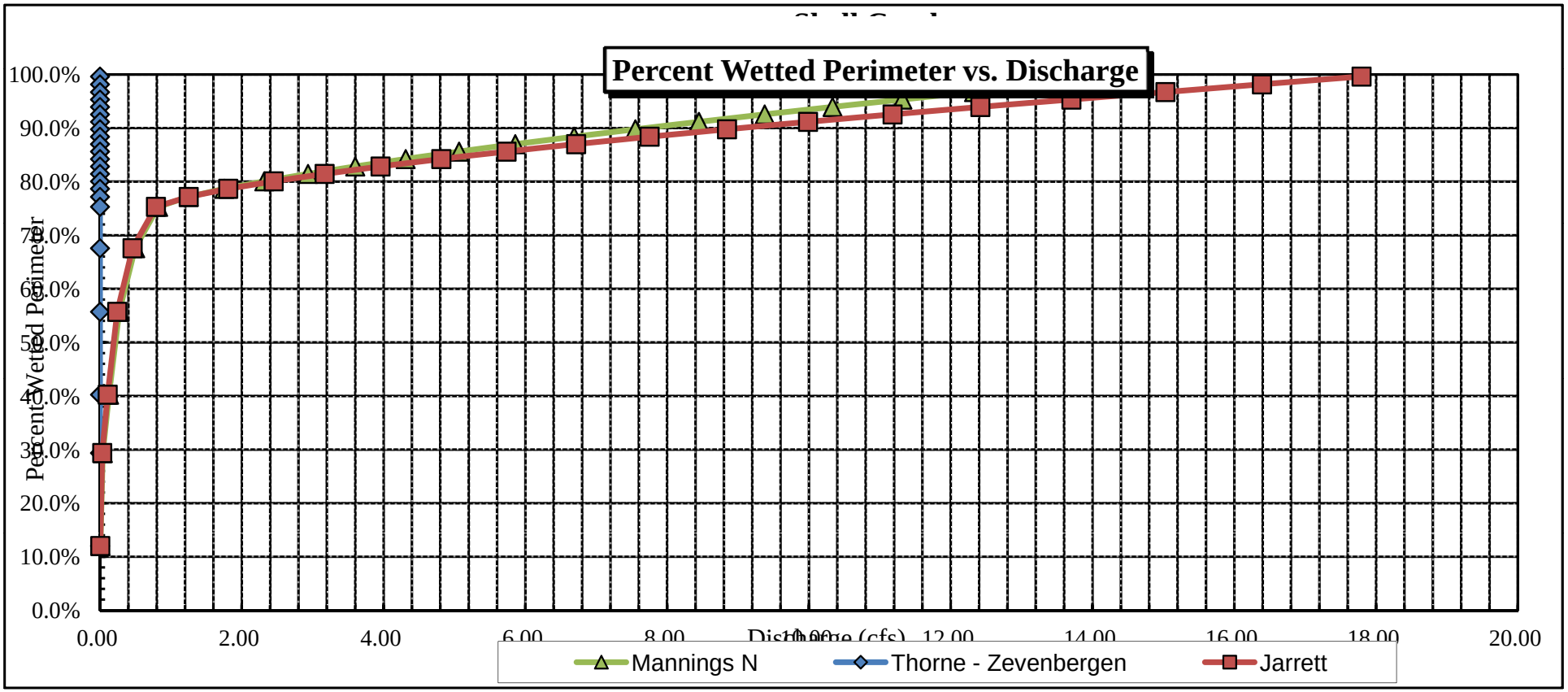
FLOW (CFS)	PERIOD
___________________	___________________
___________________	___________________
___________________	___________________
___________________	___________________

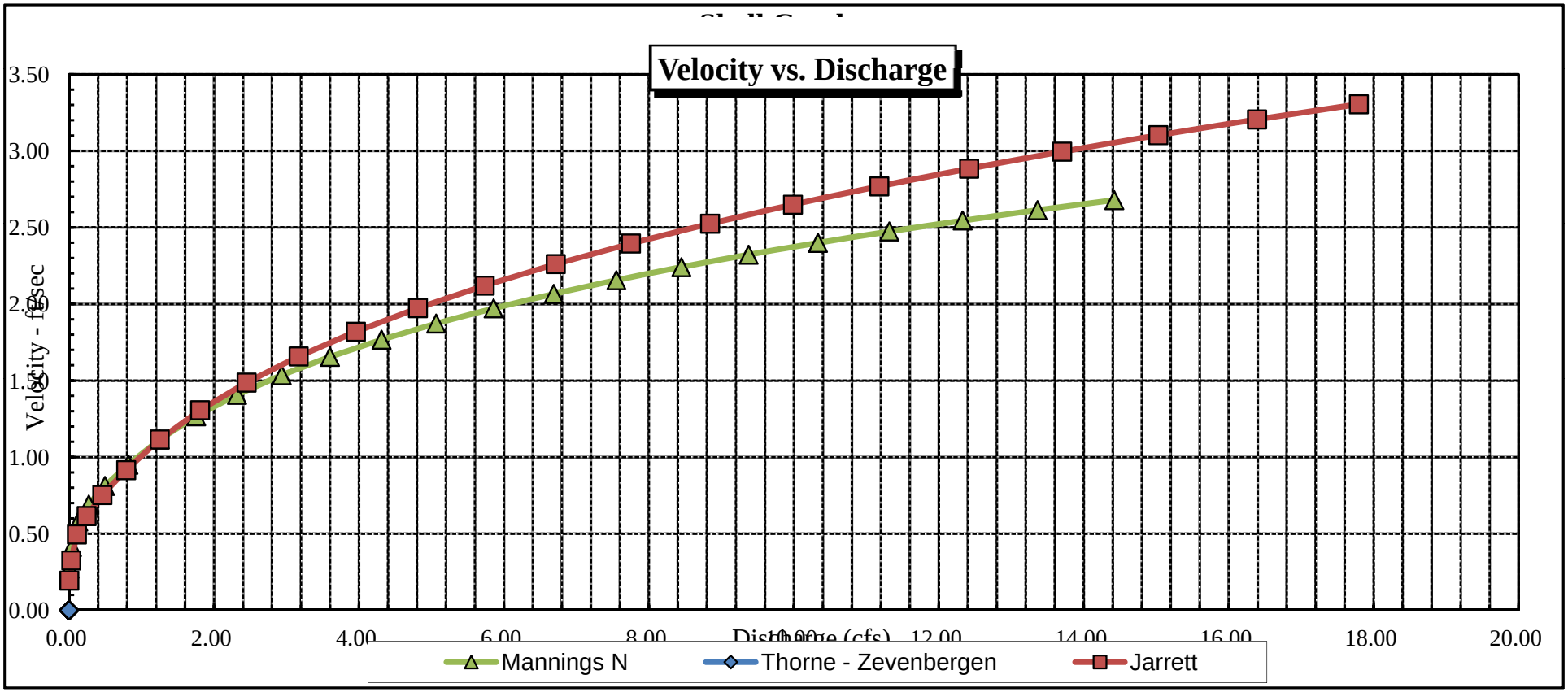
RATIONALE FOR RECOMMENDATION:
============================

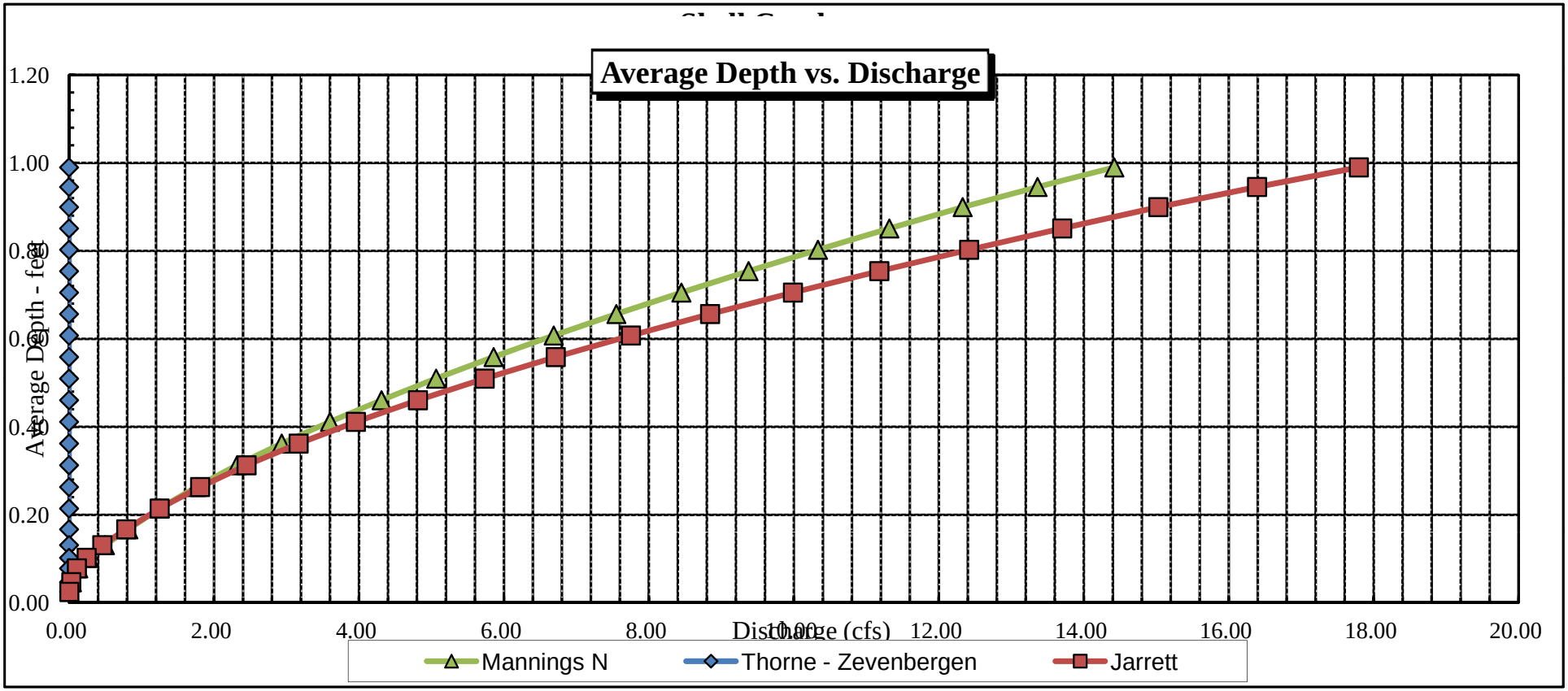
RECOMMENDATION BY: ……………………..………..……............................... AGENCY..……………………….....……...…...……....... DATE:.......…...…......……………

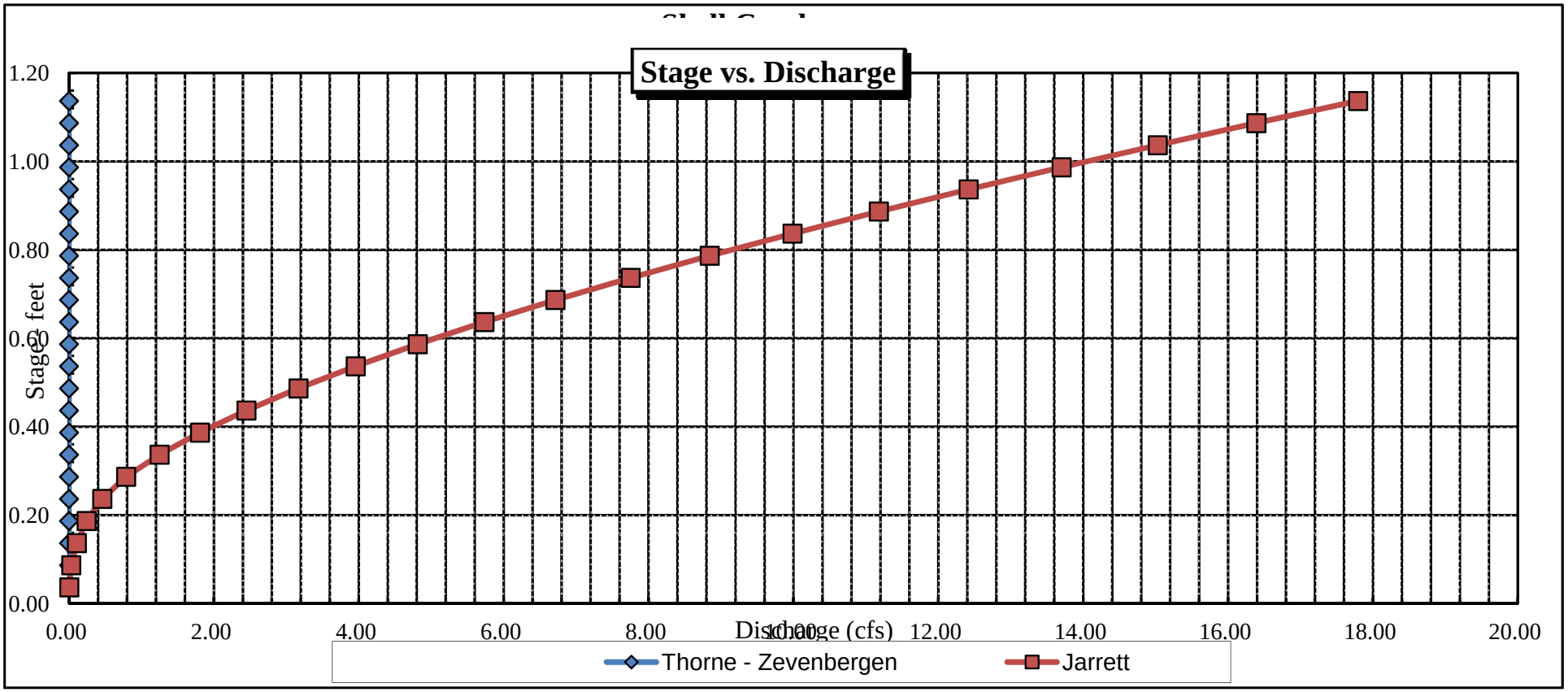
CWCB REVIEW BY: ..…………………………....………………………………………………...…............. DATE:.................…………….…


CROSS SECTION DATA ANALYSIS
RS
LS
G
W
G
W
-5.00
-5.50
-6.00
-6.50
-7.00
-7.50
-8.00
-8.50
VERTICAL DEPTH (FT)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
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
4.00
6.00
8.00
12.00
14.00
16.00
18.00
20.00
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
Velocity - ft/sec
3.50
3.00
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
16.00
18.00
20.00
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
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Stage, feet
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME: Shell Creek						CROSS-SECTION NO.: 2
CROSS-SECTION LOCATION: Approx. 400 ft. upstream from Bull Mtn. Road						
DATE: 7-13-11	OBSERVERS: R. Smith, P. Belcher, J. Wilk					
LEGAL DESCRIPTION	¼ SECTION: NW	SECTION: 12	TOWNSHIP: 12 (N/S)	RANGE: 75 (E/W)	PM: 6th	
COUNTY: Larimer	WATERSHED: Laramie River	WATER DIVISION: 1	DOW WATER CODE: 13754			
MAP(S): USGS:						
USFS:						

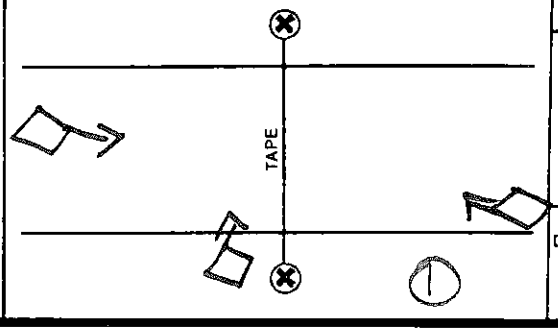
SUPPLEMENTAL DATA

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: gravels to 1-foot boulders	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	7.70 / 7.70
② WS Upstream	6.4	7.60
③ WS Downstream	18.5	7.90
SLOPE	0.30 / 24.9 = .012	

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

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

COMMENTS

Temp = 14.30 C
Cond = 49.1 us
pH = 7.53
Salinity = 0.2 ppt
Alder - Willow riparian

FD 1-85

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Shell Creek | CROSS-SECTION NO.: 2 | DATE: 7-13-11 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) | LEFT / RIGHT | Gage Reading: _____ ft | TIME: 2:10 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	0.0		3.52								
G	2.1		6.87								
W	2.5		7.70								
	2.8		7.85	0.1				0.81			
	3.1		7.85	0.15				1.09			
	3.4		7.90	0.2				1.15			
	3.7		7.95	0.25				0.38			
	4.0		7.90	0.20				1.00			
	4.3		8.00	0.30				0.40			
	4.6		8.05	0.35				0.92			
	4.9		7.95	0.25				0.89			
	5.2		7.90	0.20				0.49			
	5.5		8.00	0.30				1.11			
	5.8		8.00	0.30				1.42			
	6.1		8.00	0.30				0.87			
	6.4		8.00	0.30				1.46			
	6.7		8.00	0.35				1.80			
	7.0		7.95	0.25				1.34			
	7.3		7.90	0.20				1.16			
	7.6		7.85	0.15				1.57			
	7.9		7.80	0.10				0.72			
	8.2		7.75	0.05				Ø			
W	8.3		7.70								
G	12.4		6.98								
LS	14.0		6.92								
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:	Shell Creek
XS LOCATION:	Approx. 400 ft upstream fr Bull Mtn Rd
XS NUMBER:	2
DATE:	13-Jul-11
OBSERVERS:	R. Smith, P. Belcher, J. Wilk
1/4 SEC:	NW
SECTION:	12
TWP:	12N
RANGE:	75W
PM:	Sixth
COUNTY:	Larimer
WATERSHED:	Laramie
DIVISION:	1
DOW CODE:	13754
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:	0.012

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

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

STREAM NAME: Shell Creek
XS LOCATION: Approx. 400 ft upstream fr Bull Mtn Rd
XS NUMBER: 2

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	0.00	3.52			0.00		0.00	0.00	0.0%
1	G	2.10	6.87			0.00		0.00	0.00	0.0%
	W	2.50	7.70	0.00	0.00	0.00		0.00	0.00	0.0%
		2.80	7.85	0.10	0.81	0.34	0.10	0.03	0.02	1.8%
		3.10	7.85	0.15	1.09	0.30	0.15	0.05	0.05	3.6%
		3.40	7.90	0.20	1.15	0.30	0.20	0.06	0.07	5.1%
		3.70	7.95	0.25	0.38	0.30	0.25	0.08	0.03	2.1%
		4.00	7.90	0.20	1.00	0.30	0.20	0.06	0.06	4.4%
		4.30	8.00	0.30	0.40	0.32	0.30	0.09	0.04	2.7%
		4.60	8.05	0.35	0.92	0.30	0.35	0.11	0.10	7.2%
		4.90	7.95	0.25	0.89	0.32	0.25	0.08	0.07	5.0%
		5.20	7.90	0.20	0.49	0.30	0.20	0.06	0.03	2.2%
		5.50	8.00	0.30	1.11	0.32	0.30	0.09	0.10	7.4%
		5.80	8.00	0.30	1.42	0.30	0.30	0.09	0.13	9.5%
		6.10	8.00	0.30	0.87	0.30	0.30	0.09	0.08	5.8%
		6.40	8.00	0.30	1.46	0.30	0.30	0.09	0.13	9.7%
		6.70	8.00	0.35	1.80	0.30	0.35	0.11	0.19	14.0%
		7.00	7.95	0.25	1.34	0.30	0.25	0.08	0.10	7.5%
		7.30	7.90	0.20	1.16	0.30	0.20	0.06	0.07	5.2%
		7.60	7.85	0.15	1.57	0.30	0.15	0.05	0.07	5.2%
		7.90	7.80	0.10	0.72	0.30	0.10	0.03	0.02	1.6%
		8.20	7.75	0.05	0.00	0.30	0.05	0.01	0.00	0.0%
	W	8.30	7.70	0.00		0.11		0.00	0.00	0.0%
1	G	12.40	6.98			0.00		0.00	0.00	0.0%
	LS	14.00	6.92			0.00		0.00	0.00	0.0%
	TOTALS ----------					5.94	0.35 (Max.)	1.29	1.35	100.0%

Manning's n = 0.0559
Hydraulic Radius= 0.21642914

STREAM NAME: Shell Creek
XS LOCATION: Approx. 400 ft upstream fr Bull Mtn Rd
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.29	1.29	0.0%
7.45	1.29	2.93	127.9%
7.47	1.29	2.78	116.5%
7.49	1.29	2.64	105.4%
7.51	1.29	2.50	94.4%
7.53	1.29	2.36	83.7%
7.55	1.29	2.22	73.1%
7.57	1.29	2.09	62.7%
7.59	1.29	1.96	52.6%
7.61	1.29	1.83	42.6%
7.63	1.29	1.71	32.8%
7.65	1.29	1.58	23.2%
7.66	1.29	1.52	18.4%
7.67	1.29	1.46	13.8%
7.68	1.29	1.40	9.1%
7.69	1.29	1.34	4.5%
7.70	1.29	1.29	0.0%
7.71	1.29	1.23	-4.5%
7.72	1.29	1.17	-9.0%
7.73	1.29	1.11	-13.4%
7.74	1.29	1.06	-17.8%
7.75	1.29	1.00	-22.2%
7.77	1.29	0.89	-30.8%
7.79	1.29	0.78	-39.1%
7.81	1.29	0.68	-47.2%
7.83	1.29	0.58	-55.1%
7.85	1.29	0.48	-62.6%
7.87	1.29	0.39	-69.5%
7.89	1.29	0.31	-75.9%
7.91	1.29	0.23	-81.9%
7.93	1.29	0.17	-87.0%
7.95	1.29	0.11	-91.2%

WATERLINE AT ZERO
AREA ERROR = 7.700

STREAM NAME: Shell Creek
XS LOCATION: Approx. 400 ft upstream fr Bull Mtn Rd
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	6.98	10.25	0.69	1.07	7.06	10.90	100.0%	0.65	15.39	2.18
	7.00	10.12	0.68	1.05	6.86	10.76	98.7%	0.64	14.78	2.16
	7.05	9.81	0.65	1.00	6.36	10.42	95.6%	0.61	13.32	2.09
	7.10	9.51	0.62	0.95	5.88	10.07	92.4%	0.58	11.94	2.03
	7.15	9.20	0.59	0.90	5.41	9.73	89.3%	0.56	10.65	1.97
	7.20	8.89	0.56	0.85	4.96	9.38	86.1%	0.53	9.43	1.90
	7.25	8.58	0.53	0.80	4.52	9.04	82.9%	0.50	8.29	1.83
	7.30	8.27	0.50	0.75	4.10	8.69	79.8%	0.47	7.23	1.76
	7.35	7.96	0.46	0.70	3.69	8.35	76.6%	0.44	6.24	1.69
	7.40	7.65	0.43	0.65	3.30	8.00	73.4%	0.41	5.33	1.61
	7.45	7.34	0.40	0.60	2.93	7.66	70.3%	0.38	4.49	1.53
	7.50	7.04	0.37	0.55	2.57	7.32	67.1%	0.35	3.72	1.45
	7.55	6.73	0.33	0.50	2.22	6.97	64.0%	0.32	3.02	1.36
	7.60	6.42	0.30	0.45	1.90	6.63	60.8%	0.29	2.40	1.26
	7.65	6.11	0.26	0.40	1.58	6.28	57.6%	0.25	1.84	1.16
WL	7.70	5.80	0.22	0.35	1.28	5.94	54.5%	0.22	1.35	1.05
	7.75	5.60	0.18	0.30	1.00	5.71	52.4%	0.18	0.91	0.91
	7.80	5.20	0.14	0.25	0.73	5.30	48.6%	0.14	0.57	0.78
	7.85	4.50	0.11	0.20	0.48	4.58	42.0%	0.10	0.31	0.65
	7.90	3.90	0.07	0.15	0.27	3.97	36.5%	0.07	0.13	0.48
	7.95	2.40	0.05	0.10	0.11	2.44	22.4%	0.05	0.04	0.37
	8.00	0.45	0.03	0.05	0.01	0.46	4.2%	0.02	0.00	0.24

STREAM NAME: Shell Creek
XS LOCATION: Approx. 400 ft upstream fr Bull Mtn Rd
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.35	cfs
CALCULATED FLOW (Qc)=	1.35	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	7.70	ft
CALCULATED WATERLINE (WLc)=	7.70	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.35	ft
MAX CALCULATED DEPTH (Dc)=	0.35	ft
(Dm-Dc)/Dm * 100	0.0	%
MEAN VELOCITY=	1.05	ft/sec
MANNING'S N=	0.056	
SLOPE=	0.012	ft/ft
.4 * Qm =	0.5	cfs
2.5 * Qm=	3.4	cfs

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

FLOW (CFS)	PERIOD
___________	___________
___________	___________
___________	___________
___________	___________

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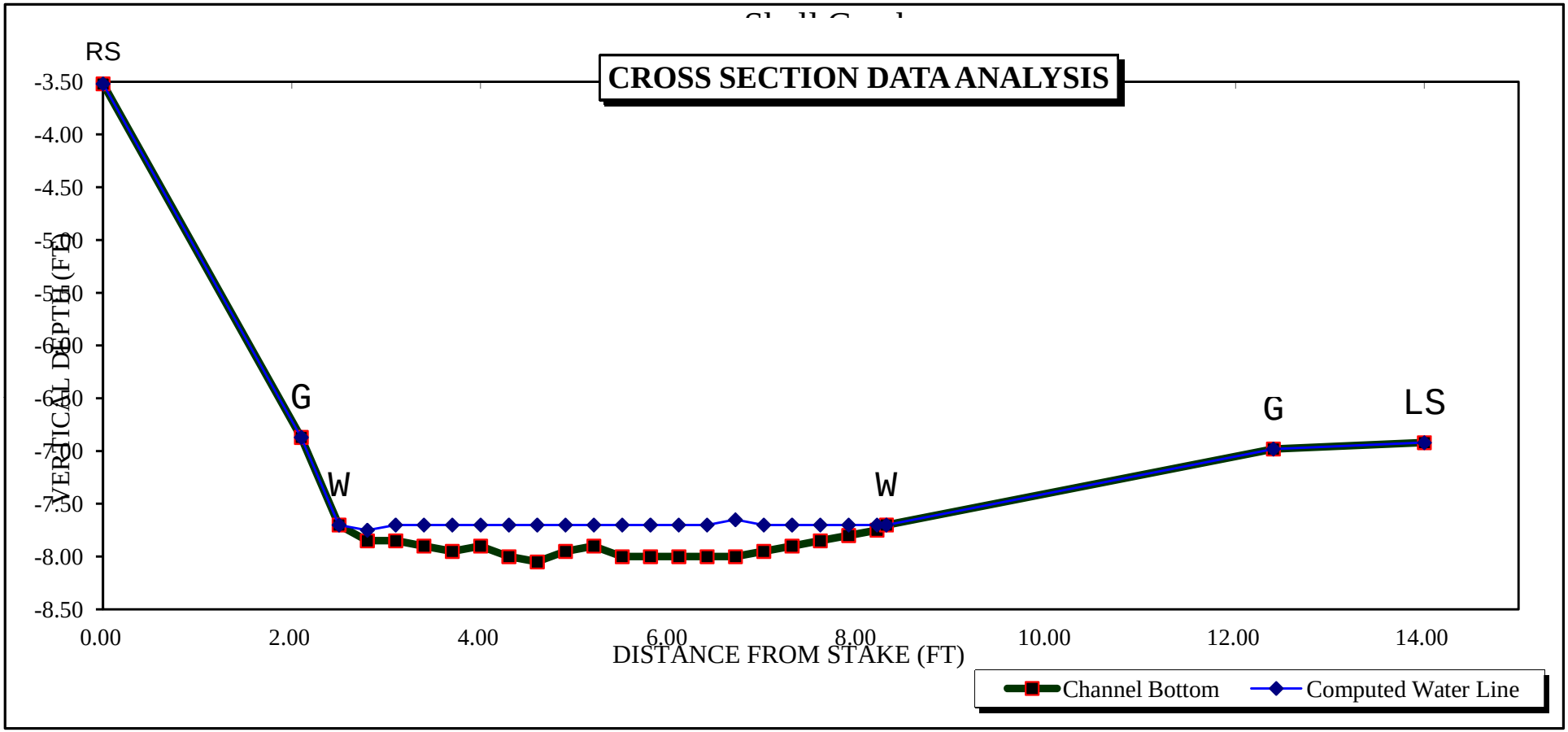
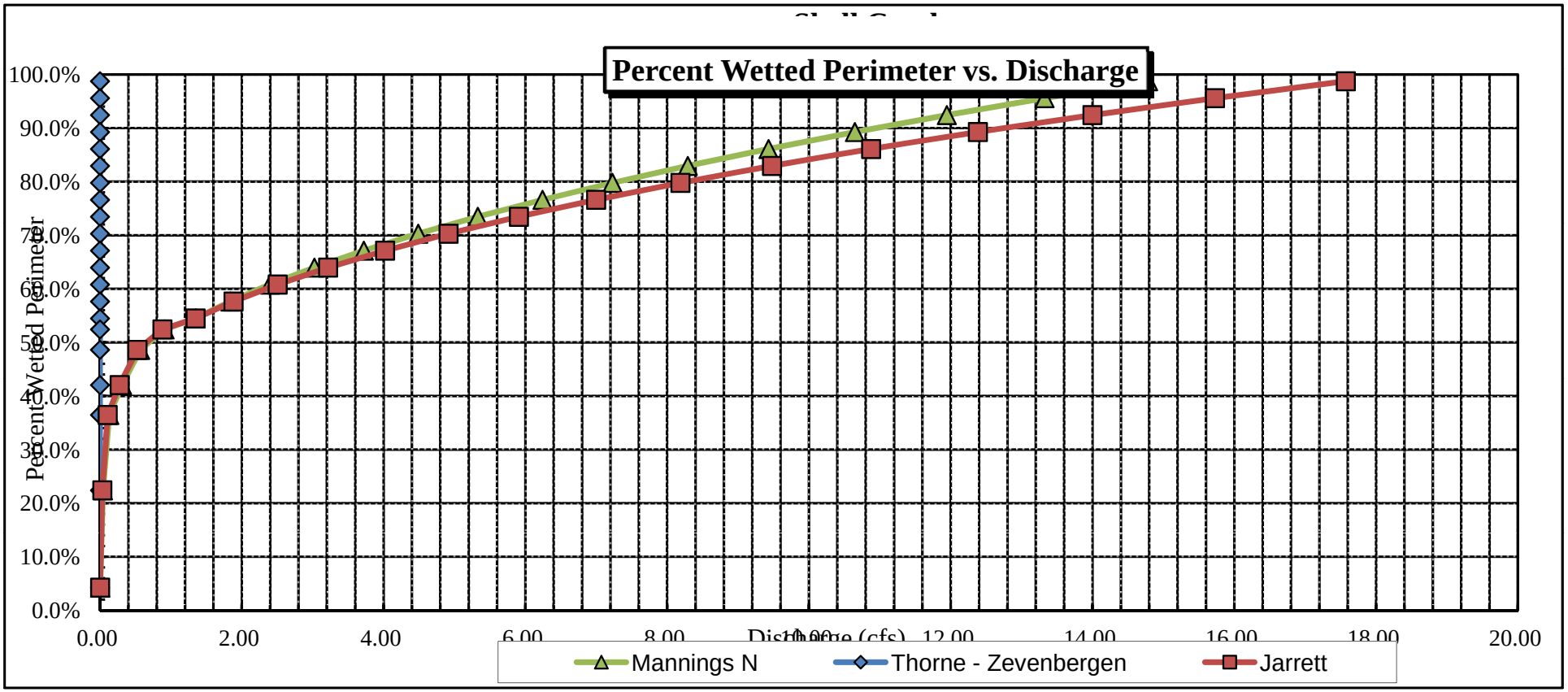
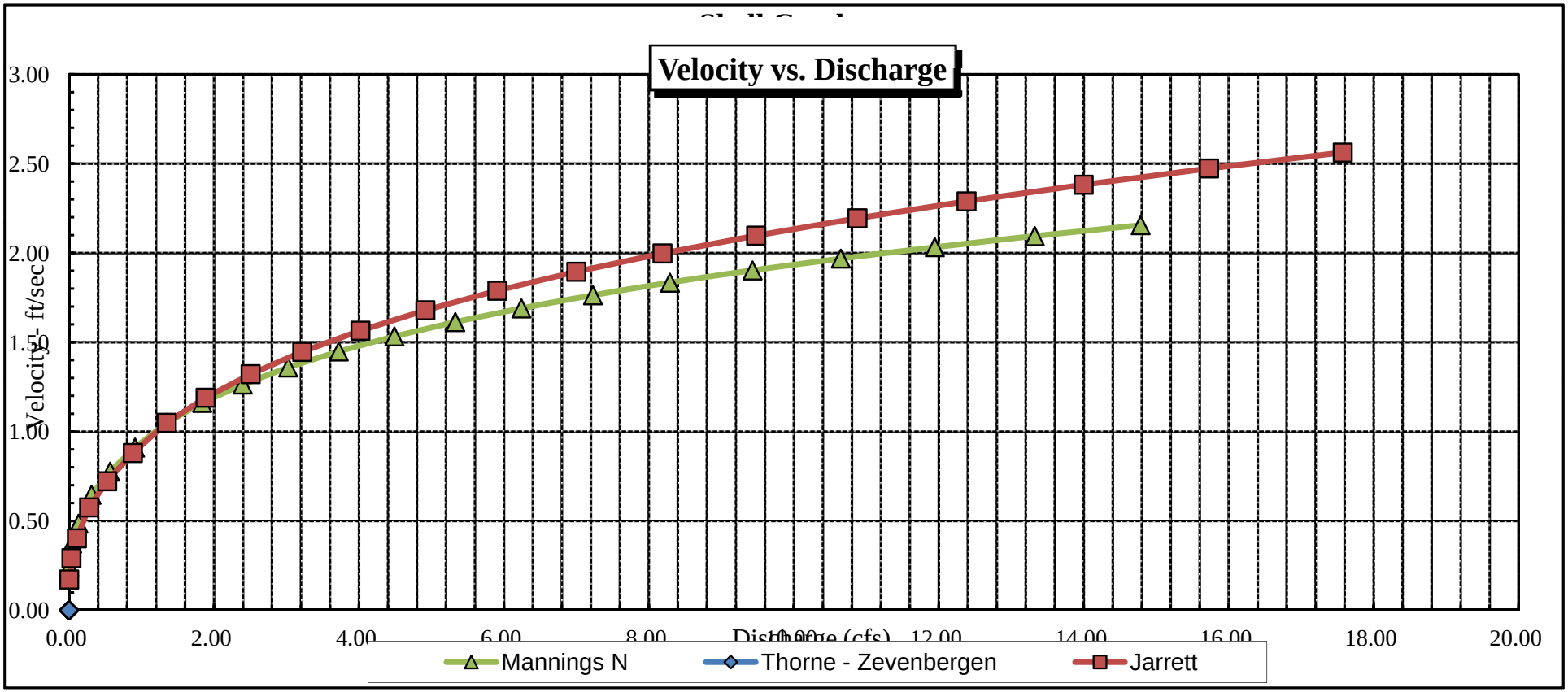
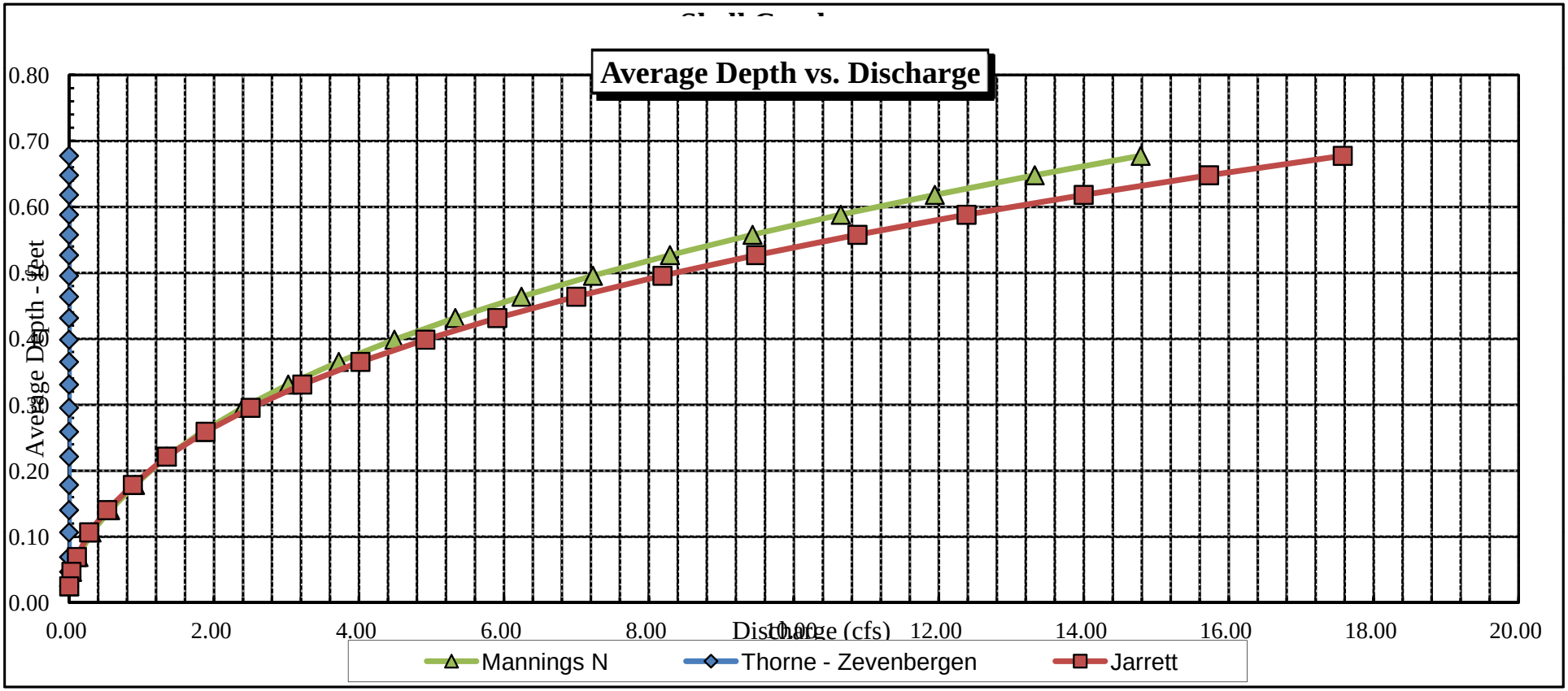
RECOMMENDATION BY: ………………………………………… AGENCY………………………………………… DATE:……………………

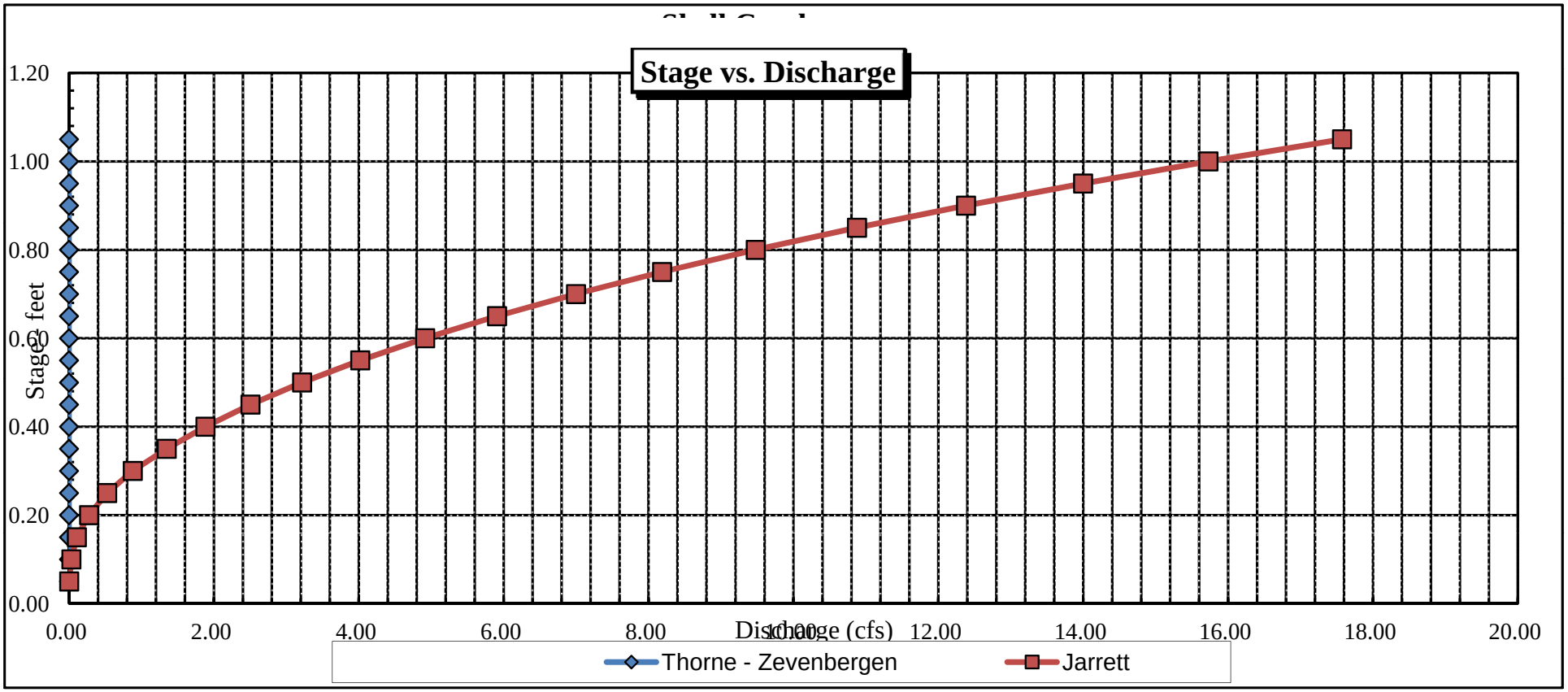
CWCB REVIEW BY: ……………………………………………………………………………………… DATE:……………………


CROSS SECTION DATA ANALYSIS
RS
G
W
W
G
LS
-3.50
-4.00
-4.50
-5.00
-5.50
-6.00
-6.50
-7.00
-7.50
-8.00
-8.50
VERTICAL DEPTH (FT)
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
4.00
6.00
8.00
12.00
14.00
16.00
18.00
20.00
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
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
Average Depth - 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
16.00
18.00
20.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Stage, feet
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett