COLORADO
Parks and Wildlife
Department of Natural Resources

Water Resources Section
6060 Broadway
Denver, CO 80216

January 16, 2019

Ms. Linda Bassi, Chief
Stream and Lake Protection Section
Colorado Water Conservation Board
1313 Sherman Street, Suite 721
Denver CO 80203

Subject: Instream Flow Recommendations for Streams in Water Division 6, Rio Blanco and Garfield Counties; North Fork White River, Marvine Creek, and West Marvine Creek, to be Presented at the January 28-29, 2019 CWCB Meeting

Dear Ms. Bassi:

The information contained in and referred to in this letter forms the scientific and biological basis for instream flow (ISF) recommendations for Marvine Creek, West Marvine Creek, and three reaches of the North Fork of the White River in Water Division 6. These flow recommendations will be presented for consideration by the Colorado Water Conservation Board (CWCB or Board) at their January 2019 regular meeting. The field investigations relating to these ISF recommendations were conducted by Colorado Parks and Wildlife (CPW) personnel in 2018. These stream reaches were first presented to interested parties at the ISF Workshop in January 2017. It is the CPW staff's opinion that the information contained in this letter is sufficient for the CWCB's staff to recommend ISF appropriations to the Board on the above referenced water bodies and to specifically address the findings required in Rule 5(i) of the Instream Flow Program Rules.

The State of Colorado's Instream Flow (ISF) Program was created in 1973 when the Colorado General Assembly passed Senate Bill 97 which called for the recognition of "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3) C.R.S.). This statute vests the Board with the exclusive authority to appropriate and acquire instream flow and natural lake level water rights. In order to encourage other entities to participate in Colorado's ISF Program, the statute directs the Board to request instream flow recommendations from other state and federal agencies. CPW is recommending these segments of the North Fork of the White River, Marvine Creek, and West Marvine Creek to the Board for inclusion into the ISF Program. We believe that these segments should be

considered for inclusion into the ISF Program because they each have a natural environment that can be preserved to a reasonable degree with an instream flow water right.

CPW participates in the ISF Program and develops instream flow recommendations for the Board's consideration in an effort to address CPW's legislative declarations "... that the wildlife and their environment are to be protected, preserved, enhanced, and managed for the use, benefit, and enjoyment of the people of this state and its visitors ... and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities" (See §33-1-101 (1) C.R.S.), and "... that the natural, scenic, scientific, and outdoor recreation areas ... protected, preserved, enhanced and managed for the use, benefit, and enjoyment of the people of this state and (its) visitors ... and that, to carry out such program and policy, there shall be a continuous operation of acquisition, development, and management of ... lands, waters, and facilities." (See §33-10-101 (1) C.R.S.).

In addition to these broad statutory guidelines, CPW's current strategic planning document (CPW Strategic Plan, 2015) explains current agency goals to, "[c]onserve wildlife and habitat to ensure healthy sustainable populations and ecosystems." In order to, "protect and enhance water resources for fish and wildlife populations," by pursuing, "partnerships and agreements to enhance instream flows, protect reservoir levels, and influence water management activities," and to, "[a]dvocate for water quality and quantities to conserve aquatic resources." In addition to the CPW strategic plan, the agency's fish and wildlife conservation activities are also directed by the State Wildlife Action Plan (2002, Revised 2015). The goals and priorities from these documents direct CPW to advocate for the preservation of the state's fish and wildlife resources and natural environment, and therefore link CPW's mission to the goals and priorities of CWCB's ISF/NLL Program.

Recommended Segments

As shown in Figure 1, CPW is proposing ISF recommendations for three reaches of North Fork White River – from the outlet of Trapper's Lake to confluence with Skinny Fish Creek, from the confluence with Skinny Fish Creek to the confluence with Big Fish Creek, and from the confluence with Big Fish Creek to the confluence with Ripple Creek. The North Fork White River below Ripple Creek has an existing decreed ISF water right of 70 cfs year-round (W-3704, 1978).

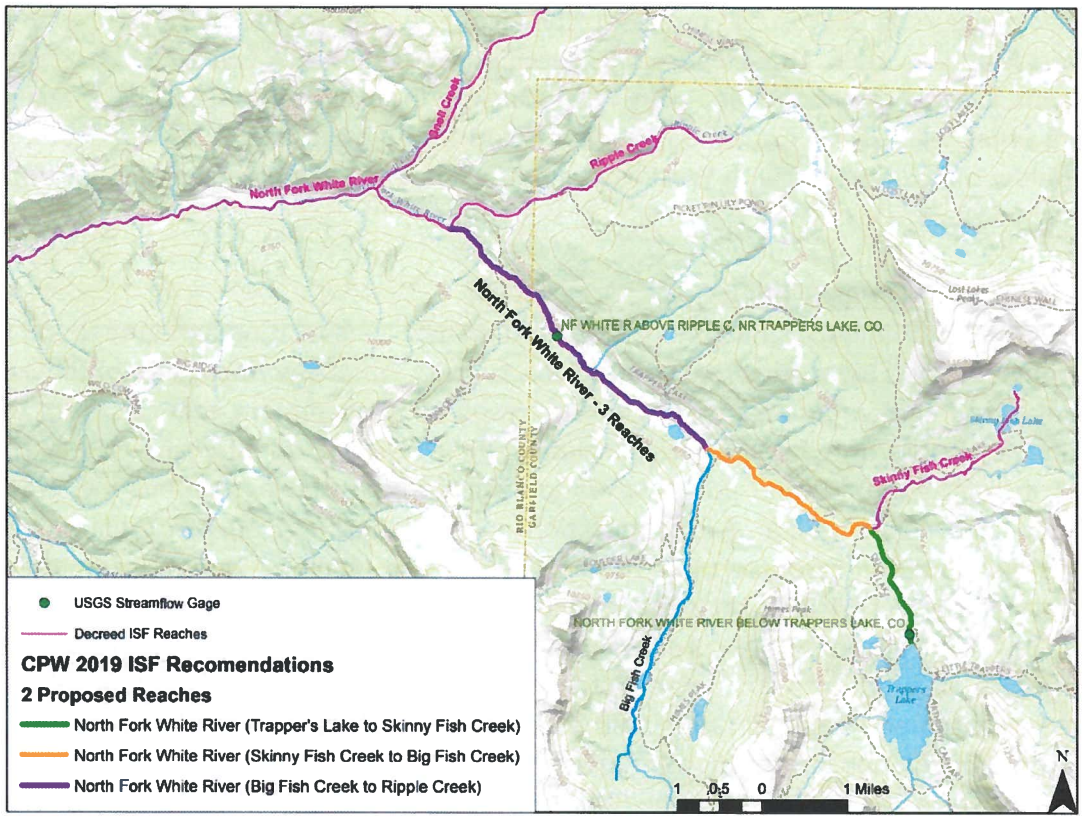


Figure 1. Vicinity map for CPW 2019 ISF Recommendations on North Fork of the White River

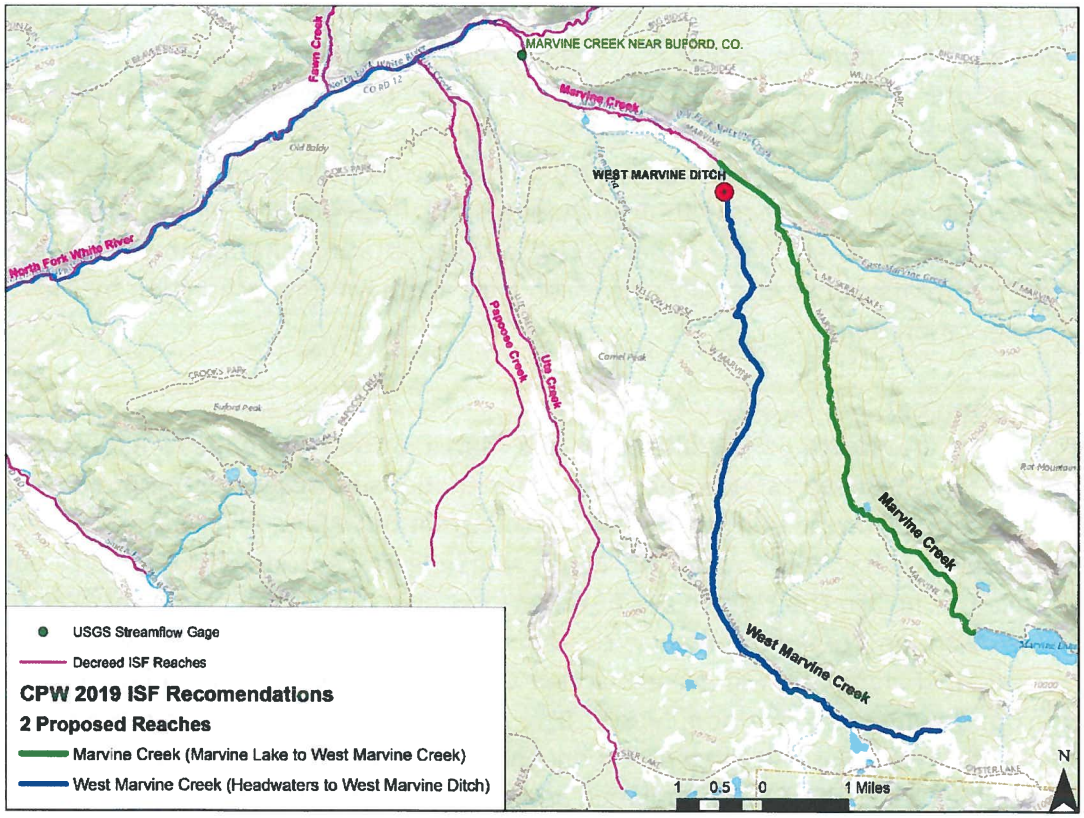


Figure 2. Vicinity map for CPW 2019 ISF Recommendation on in the Marvine Creek Basin

As shown in Figure 2, CPW is also proposing ISF recommendations on reaches of Marvine Creek and West Marvine Creek. The proposed ISF reach on Marvine Creek will extend from the outlet of Marvine Lake to the confluence with West Marvine Creek. The proposed ISF reach on West Marvine Creek will extend from the headwaters to the West Marvine Ditch headgate. Marvine Creek below the confluence with West Marvine Creek has an existing decreed ISF water right of 40 cfs (W-3652,1977).

Colorado Cutthroat Conservation Goals

In 2001, CPW entered into a multi-state and multi-agency conservation agreement and strategy concerning Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*). Colorado's partners in this plan and agreement include the natural resource management agencies from Utah and Wyoming, a number of federal agencies including the USFS, USFWS, BLM and NPS, and the Ute Indian Tribe of the Uintah and Ouray Reservation. This conservation agreement and strategy was developed in order to encourage cooperation and collaboration on conservation measures among various natural resource management agencies to minimize threats to Colorado River cutthroat trout (CRCT) that might result in actions under the Endangered Species Act of 1973. Essentially, the parties to the overall plan agreed that in order to prevent listing of the subspecies, and to reach desired recovery goals without hindering further development of our state resources, continued implementation of the conservation strategy was necessary. The stated goal of the conservation strategy is as follows:

> *"To assure the long-term viability of CRCT throughout their historic range, areas that currently support CRCT will be maintained, while other areas will be managed for increased abundance. New populations will be established where ecologically and economically feasible, while the genetic diversity of the species is maintained. The cooperators envision a future where threats to wild CRCT are either eliminated or reduced to the greatest extent possible."* (CRCT Conservation Team 2006)

One of the main threats to Colorado River cutthroat trout conservation is the depletion of streamflow that results in degradation of habitat and the overall health of the subspecies. Another major threat to cutthroat fisheries is the fragmentation of habitat. CPW believes that both of these threats can be partially addressed with instream flow protection by the Colorado Water Conservation Board.

Natural Environment

As stated above, the North Fork White River and Marvine Creek were identified by CPW at the January 2017 CWCB ISF workshop. These recommendations represent a continuation of efforts by CPW to secure ISF protection for important streams in the White River basin. CPW's interest in these segments is based on historic CPW fish sampling and stocking efforts which confirmed the presence of CRCT in the North Fork of the White River, Marvine Creek, and West Marvine Creek. West Marvine Creek in particular contains a population of CRCT that was very recently stocked. The CRCT population in West Marvine Creek is an important population, as they are isolated from downstream fish populations by a physical barrier, the dry stream channel that exists below the West Marvine Ditch diversion, and are limited to the habitat conditions existing in West Marvine Creek. This CRCT population and others in the North Fork White River basin may become more critical to CRCT conservation efforts in the future.

While CRCT is the main species of concern in this basin, other native species, namely mountain whitefish, would benefit from the conservation efforts for the CRCT. In addition to the native species present in the North Fork White River and Marvine Creek, these reaches support a diverse sport fishery of brook and rainbow trout.

A key component to habitat protection is flow protection. Flow reduction can impact habitat availability and quality, can cause water quality and temperature issues, and can reduce overall population and habitat connectivity. The hydrology of the North Fork White River will likely continue to provide a high annual peak flow for spring spawning species (since minimal water uses presently occur in the basins above the potential ISF segments), but protection of baseflows is an important component of ISF protection. Overwintering adult habitat for CRCT is often a limiting factor for these fish populations. These reaches of the North Fork White River, Marvine Creek, and West Marvine Creek provide good habitat for various life stages of fish. In summary, there is a flow-dependent natural environment that can be preserved to a reasonable degree with instream flow water rights on the proposed reaches.

Flows Necessary to Preserve the Natural Environment

In 2016 and 2017, CPW initiated ISF investigation in the White River basin in an effort to fill in protection gaps and address range-wide needs of CRCT in the White River basin. In 2018, CPW and CWCB staff collected stream cross-section data at sites within the identified reaches of the North Fork White River, Marvine Creek, and West Marvine Creek. Initial biological instream flow recommendations were developed utilizing the standard application of the R2CROSS methodology (Espegren 1996). R2CROSS uses field data that has been collected in a riffle stream habitat types; riffles are the limiting habitat type in streams during low flow events. The field data includes a survey of stream channel geometry, a longitudinal slope of the water surface, and a streamflow measurement at the designated cross-section. After processing this data with R2CROSS, winter and summer flow recommendations were developed utilizing the typical R2CROSS criteria described in Nehring (1979) and Espergren (1996); the R2CROSS hydraulic criteria of interest are average depth, average velocity, and wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types will also maintain aquatic habitat in pools and runs for most life stages of fish and aquatic invertebrates (Nehring 1979).

When flows meeting two and three of the hydraulic criteria fall out of the range for accuracy of applying Manning's equation (40 to 250 percent), the Thorne and Zevenbergen (T&Z) subroutine in R2CROSS is relied upon. The Thorne and Zevenbergen method uses several hydraulic equations depending on relative roughness to calculate velocity within the R2CROSS staging table. This subroutine relies on user-supplied D84 particle size from pebble count data collected at each cross-section location.

Two cross-section data sets were collected on each reach identified above. The field data sheets and resulting R2CROSS outputs are attached. The results of the R2CROSS analysis for each of the five reaches are summarized on the attached Fact Sheets.

R2CROSS biological recommendations are further refined with a preliminary water availability analysis. Average daily gage data from the gages in the North Fork White River and Marvine Creek basins confirm that water appears to be available for an ISF appropriation, and water that is available can be used to preserve the natural environment to a reasonable degree on all five reaches. Final detailed water availability analyses will be performed by CWCB staff and presented in the Executive Summaries provided to the Board prior to the January 2019 meeting.

The R2CROSS-generated and water availability-refined flow recommendations for the reaches discussed above are:

- West Marvine Creek:
  - 4.6 cfs (4/1 to 10/31)
  - 2.9 cfs (11/1 to 3/31)
- Marvine Creek:
  - 13.1 cfs (4/1 to 10/31)
  - 5.9 cfs (11/1 to 3/31)
- North Fork White River (outlet of Trapper's Lake to Skinny Fish Creek):
  - 3.5 cfs (4/1 to 10/31)
  - 2.0 cfs (11/1 to 3/31)
- North Fork White River (Skinny Fish Creek to Big Fish Creek)
  - 34 cfs (5/1 to 10/31)
  - 7.8 cfs (11/1 to 4/30)
- North Fork White River (Big Fish Creek to Ripple Creek):
  - 74 cfs (5/1 to 9/15)
  - 60 cfs (9/16 to 11/15)
  - 23 cfs (11/16 to 4/30)

As stated above, the purpose of this letter is to formally transmit these ISF recommendations from CPW to CWCB for the Board's consideration for the 2019 appropriation year. Please refer to the attached Fact Sheets and supporting documentation for additional information. If CWCB staff has any further questions or needs clarification regarding these flow recommendations, please contact us.

CPW personnel will be present at the January 2019 CWCB meeting to answer any questions that the Board might have regarding these flow recommendations. We appreciate your consideration.

Sincerely,

Katie Birch
CPW Instream Flow Program Coordinator

Attachments (as stated)

FACT SHEET

West Marvine Creek

In Water Division 6, Rio Blanco County

West Marvine Creek from its headwaters to the West Marvine Ditch headgate.

Upper Terminus: The headwaters at a point located at 13S 295929.96 4422407.10 UTM.

Lower Terminus: The West Marvine Ditch headgate located at 13T 291578.55 4432396.94 UTM.

Approximate Length: 9 miles

ISF Recommendation: 4.6 cfs (4/1 to 10/31)
2.9 cfs (11/1 to 3/31)

Natural Environment:
The recommended reach of West Marvine Creek is a first order stream. The stream channel is primarily a single thread channel flowing through a variety of valley types with both forested cover and open lands (meadows and pasture lands). Throughout this reach of West Marvine Creek there is an abundance of pool, riffle, and glide habitat types. There is significant large wood in the stream which contributes to side channel and pool habitat. Substrate generally ranges from large boulders to small cobble. Historic CPW fishery surveys indicate presence of Colorado River cutthroat trout (CRCT) and brook trout. CRCT is prioritized as a Tier 1 species in the 2015 State Wildlife Action Plan, meaning the species has the highest conservation priority in the state. CRCT is classified as a state "species of special concern" and "sensitive" by the US Forest Service (USFS) and Bureau of Land Management (BLM). West Marvine Creek contains a conservation population of CRCT that was stocked in 2013. The CRCT population in West Marvine Creek is an important population, as they are isolated from downstream fish populations by a physical barrier, the dry stream channel that exists below the West Marvine Ditch diversion, and are limited to the habitat existing in West Marvine Creek.

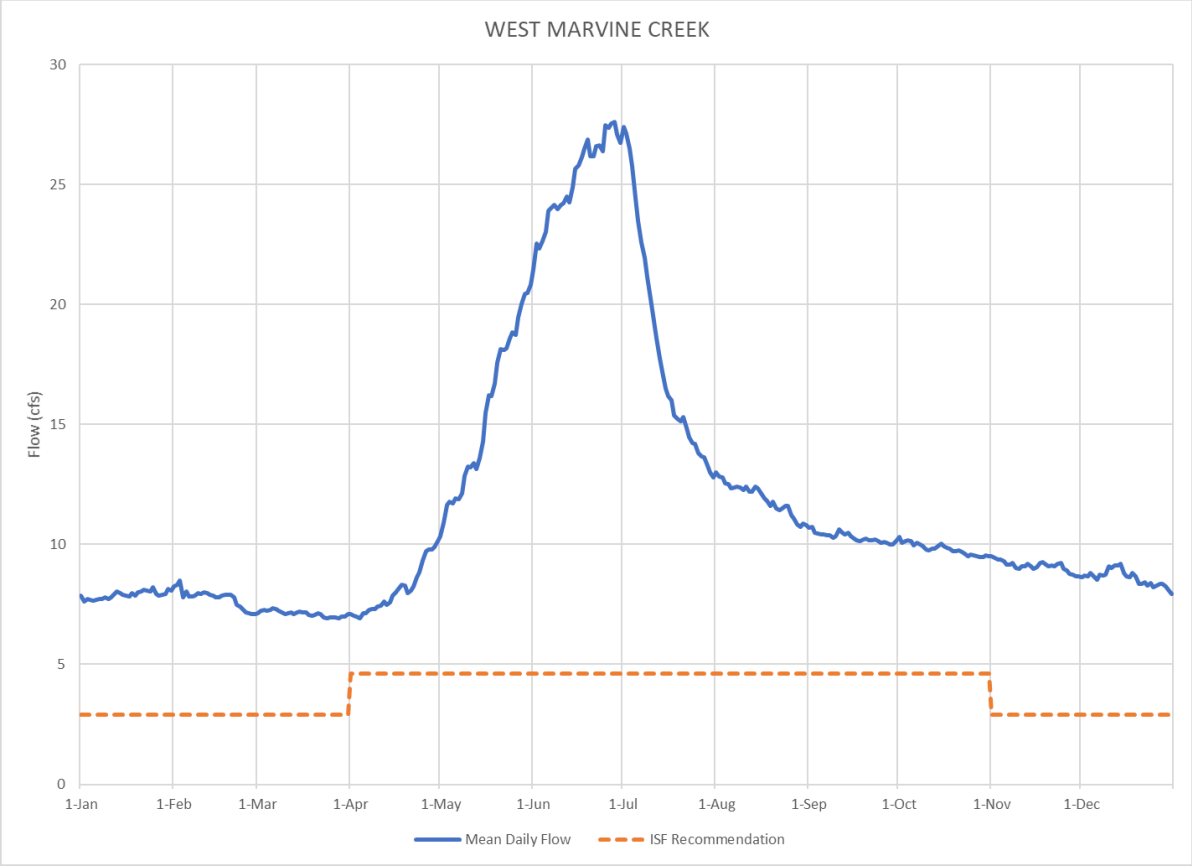
R2CROSS Results:
In 2018, CPW and CWCB personnel collected R2CROSS data at two sites within the proposed ISF segment. The results of R2CROSS modeling are summarized in the following table:

	Entity	Date Measured	Q measured	40%-250%	Hydraulic Equation	Flow Meeting Two Criteria	Flow Meeting Three Criteria
1	CPW	9/13/2018	1.4 cfs	0.6-3.6 cfs	Mannings	2.6 cfs	2.8 cfs
2	CPW	9/13/2018	1.4 cfs	0.6-3.6 cfs	T&Z[1]	3.1 cfs	6.3 cfs
				Mean		**2.9 cfs**	**4.6 cfs**

1= Flow recommendation falls outside the range of accuracy for R2CROSS's use of the Manning's equation (40%-250%); Thorne and Zevenbergen (T&Z) equations and a user-supplied D84 were then utilized.

Preliminary Water Availability:

CPW conducted preliminary water availability analysis for West Marvine Creek using the USGS stream gage, Marvine Creek near Buford, CO (09302500), which has a period of record between 1972 and 1984. Mean daily flow at this gage was distributed pro-rata to the proposed ISF reach based on contributing drainage basin area. Division of Water Resources (DWR) data indicates one major water right on West Marvine Creek – West Marvine Ditch (discussed below). The mean daily flow data from this gage was used to create a representative hydrograph for this segment (shown below). Based on this data, there appears to be ample water available for the proposed ISF recommendation.



West Marvine Ditch (structure ID:4301003) is an irrigation water right. Diversion records indicate that the ditch diverts approximately 3.44 cfs year-round. In September 2018, CPW and CWCB staff observed the ditch taking all of the flow in the creek. This ditch diversion likely sweeps the stream at all times except during spring runoff. Because of this and the seniority of the ditch, the ditch headgate was selected as the lower terminus of the instream flow reach on West Marvine Creek.

Conclusion:

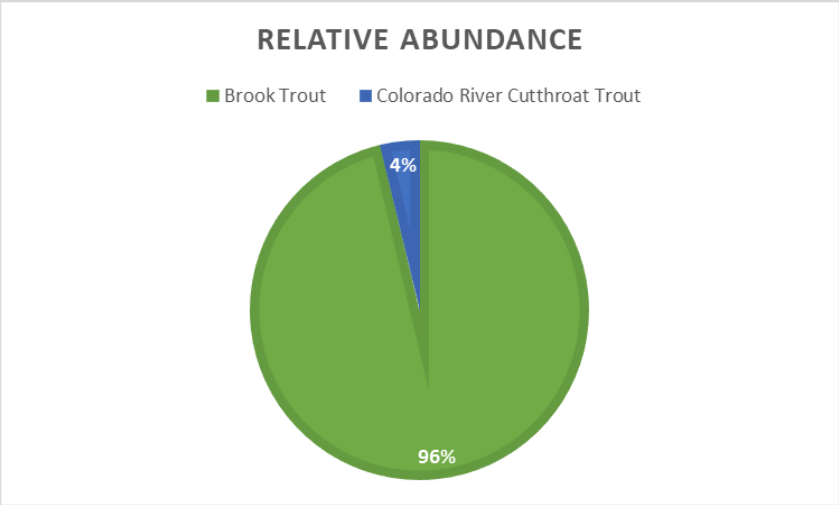
CPW recommends the following R2CROSS-based instream flow rates on West Marvine Creek; we believe that these flows are sufficient to preserve the natural environment to a reasonable degree:

- 4.6 cfs (4/1 to 10/31)
- 2.9 cfs (11/1 to 3/31)

West Marvine Creek

CPW Historic Sampling at West Marvine

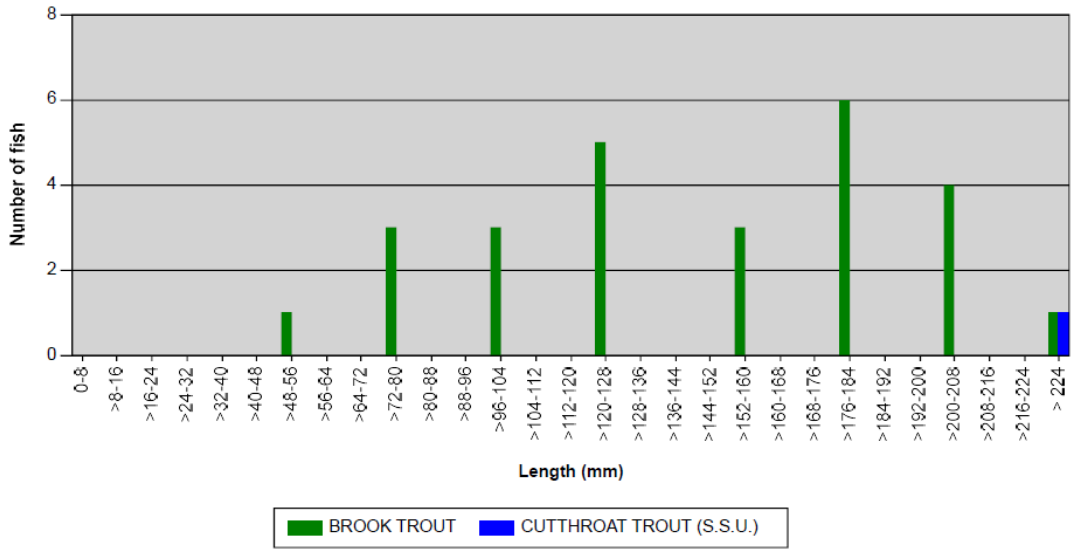
27 fish were observed during the last sampling effort in 1981. Additionally, CPW records indicate Colorado River Cutthroat Trout were stocked in 2013.



Length/Frequency

Water 21117 Marvine Creek, West — Date 8/4/1981
Station WR0858 JUST ABV CONFLUENCE W/ MARVINE CK #1

Drainage White River		UtmX	UtmY	Elevation 2403 m
		Length 30 m	Width	Area
Surveyors TROUT				
Gear EF	Effort	Metric		Protocol PRESENCE/ABSENCE



COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: West Marvine					CROSS-SECTION NO.:
CROSS-SECTION LOCATION: abv Headgate					
2 Riffles + Q Section @ Headgate					
DATE: 9/13/18	OBSERVERS: KB JS JL				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY:	WATERSHED: White R		WATER DIVISION: 5/6		DOW WATER CODE:
MAP(S):	USGS:				
	USFS:				

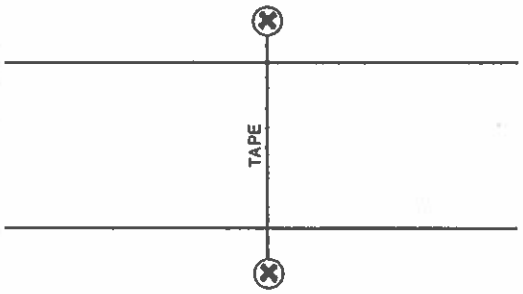
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES (NO)	METER TYPE: Marsh McB			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: ____ lbs/foot	TAPE TENSION: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: See PC data Sht	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: 5 ea perch		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	Back
⊗ Tape @ Stake RB	0.0	
① WS @ Tape LB/RB	0.0	See
② WS Upstream		
③ WS Downstream		
SLOPE		

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
(5)		(5)	(5)

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:
Diptera, Caddis (2 sp), Stnl,

COMMENTS

DISCHARGE/CROSS SECTION NOTES

STREAM NAME:	CROSS-SECTION NO:	DATE:	SHEET ___ OF ___

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

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft) Vert	Total Vertical Depth From Tape/Inst (ft) d	Water Depth (ft) #1
S	0	2.3	Reference	
	1.3	2.55		
GL	2.8	2.95		
	3.6	4.20		
	4.8	4.20		
WL	6.4	4.54	0	
	7	4.65	0.05	
	.5	4.60	0.05	
	8	4.75	0.05	
		4.85	0.20	
	9	4.95	0.30	
		4.95	0.25	
	10	4.85	0.20	
		5.00	0.35	
	11	505	0.40	
		490	0.25	
	12	4.90	0.30	
		5.00	0.40	
	13	5.00	0.40	
		4.90	0.20	
	14	4.70	0.20	
		4.60	0.10	
WL	15.3	4.48	0	
	17.8	3.85		
GL	19.4	3.00		
S	26.5	2.20		
		$S' = \frac{.91 - .14}{13.5} = \frac{.77}{13.5}$		
			3 Pt Ck	
S GL	0	5.85		
	1.8	6.20		
	3.5	6.50		
WL	5.0	6.81	0	
	6	7.10	.25	
	7	7.10	.2	
	8	7.05	.2	
	9	7.00	.2	
	10	6.95	.15	
	11	6.95	.15	
R	12	6.75	0	
TOTALS:				

Depth of Observation (ft)	Revolutions Dist	Time (sec)	Velocity (ft/sec) At Point d	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
	7.5		0			
	8		0.05	0.02		
			0.05	0.01		
	9		0.10	1.02		
			0.15	0.59		
	10		0.20	0.54		
			0.30	1.04		
	11		0.35	0.85		
			0.25	0.86		
	12		0.40	0.60		
			0.30	1.47		
	13		0.25	1.47		
			0.30	1.07		
	14		0.25	0.78		
			0.20	0.38		
	15		0.15	0.21		
			0.10	0.05		
	16		0.20	0.15		
			0.15	0.11		
	17		0			
						Q = 1.424

Feature	Dist	Vert	d
R	13	6.70	0
	14	7.05	.25
	15	7.00	.25
R	16	6.45	0
	17	6.75	0
	18	700	.25
	19	7.00	.20
	20	6.85	.05
	21	6.80	.05
	22	6.95	.15
WL	22.8	6.78	0
	23.8	6.60	
	24.6	6.20	
SGL	26	5.80	
		$S' = \frac{1.45 - .67}{28} = \frac{.78}{28}$	

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:	West Marvine
XS LOCATION:	Abv Headgate
XS NUMBER:	2 - Upper
DATE:	13-Sep-18
OBSERVERS:	Birch, Skinner, Landers
1/4 SEC:	Lat: 40.016153
SECTION:	Long: -107.442182
TWP:	0
RANGE:	0
PM:	0
COUNTY:	Rio Blanco
WATERSHED:	White
DIVISION:	6
DOW CODE:	21117
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

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

TAPE WT:	0.0106
TENSION:	99999

CHANNEL PROFILE DATA

SLOPE:	0.02785714

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

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

STREAM NAME: West Marvine
XS LOCATION: Abv Headgate
XS NUMBER: 2 - Upper

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
1	S/GL	0.00	5.85			0.00		0.00	0.00	0.0%
		1.80	6.20			0.00		0.00	0.00	0.0%
		3.50	6.50			0.00		0.00	0.00	0.0%
	WL	5.00	6.81	0.00	0.00	0.00		0.00	0.00	0.0%
		6.00	7.10	0.25	0.61	1.04	0.25	0.25	0.15	10.7%
		7.00	7.10	0.20	0.61	1.00	0.20	0.20	0.12	8.6%
		8.00	7.05	0.20	0.61	1.00	0.20	0.20	0.12	8.6%
		9.00	7.00	0.20	0.61	1.00	0.20	0.20	0.12	8.6%
		10.00	6.95	0.15	0.61	1.00	0.15	0.15	0.09	6.4%
		11.00	6.95	0.15	0.61	1.00	0.15	0.15	0.09	6.4%
	Rock	12.00	6.75	0.00	0.61	1.02		0.00	0.00	0.0%
	Rock	13.00	6.70	0.00	0.61	0.00		0.00	0.00	0.0%
		14.00	7.05	0.25	0.61	1.06	0.25	0.25	0.15	10.7%
		15.00	7.00	0.25	0.61	1.00	0.25	0.25	0.15	10.7%
	Rock	16.00	6.45	0.00	0.61	1.14		0.00	0.00	0.0%
		17.00	6.75	0.00	0.61	0.00		0.00	0.00	0.0%
		18.00	7.00	0.25	0.61	1.03	0.25	0.25	0.15	10.7%
		19.00	7.00	0.20	0.61	1.00	0.20	0.20	0.12	8.6%
		20.00	6.85	0.05	0.61	1.01	0.05	0.05	0.03	2.1%
		21.00	6.80	0.05	0.61	1.00	0.05	0.05	0.03	2.1%
		22.00	6.95	0.15	0.61	1.01	0.15	0.14	0.08	5.8%
	WL	22.80	6.78	0.00	0.00	0.82		0.00	0.00	0.0%
		23.80	6.60			0.00		0.00	0.00	0.0%
		24.60	6.20			0.00		0.00	0.00	0.0%
1	S/GL	26.00	5.80			0.00		0.00	0.00	0.0%
	TOTALS ----------					16.14	0.25 (Max.)	2.34	1.42	100.0%

Manning's n = 0.1121
Hydraulic Radius= 0.14468043

STREAM NAME: West Marvine
XS LOCATION: Abv Headgate
XS NUMBER: 2 - Upper

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	2.34	2.32	-0.8%
6.55	2.34	6.71	187.5%
6.57	2.34	6.32	170.7%
6.59	2.34	5.93	154.1%
6.61	2.34	5.55	137.8%
6.63	2.34	5.18	121.6%
6.65	2.34	4.81	105.8%
6.67	2.34	4.44	90.2%
6.69	2.34	4.08	74.9%
6.71	2.34	3.73	59.9%
6.73	2.34	3.39	45.4%
6.75	2.34	3.07	31.6%
6.76	2.34	2.92	24.9%
6.77	2.34	2.76	18.3%
6.78	2.34	2.61	11.9%
6.79	2.34	2.46	5.5%
6.80	2.34	2.32	-0.8%
6.81	2.34	2.17	-6.9%
6.82	2.34	2.03	-12.8%
6.83	2.34	1.90	-18.6%
6.84	2.34	1.77	-24.1%
6.85	2.34	1.65	-29.4%
6.87	2.34	1.41	-39.5%
6.89	2.34	1.19	-49.0%
6.91	2.34	0.98	-57.9%
6.93	2.34	0.79	-66.2%
6.95	2.34	0.61	-73.8%
6.97	2.34	0.46	-80.2%
6.99	2.34	0.33	-85.8%
7.01	2.34	0.22	-90.4%
7.03	2.34	0.15	-93.7%
7.05	2.34	0.09	-96.1%

WATERLINE AT ZERO
AREA ERROR = 6.794

STREAM NAME: West Marvine
XS LOCATION: Abv Headgate
XS NUMBER: 2 - Upper

Thorne-Zevenbergen D84 Correction Applied
User Supplied D84 = 0.36

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

Velocity based on test of R/D84>1

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.85	25.83	0.88	1.25	22.61	26.46	100.0%	0.85	111.80	4.94
	5.89	25.45	0.84	1.21	21.49	26.07	98.5%	0.82	102.58	4.77
	5.94	25.01	0.81	1.16	20.22	25.63	96.9%	0.79	92.54	4.58
	5.99	24.58	0.77	1.11	18.98	25.18	95.2%	0.75	83.02	4.37
	6.04	24.15	0.74	1.06	17.77	24.74	93.5%	0.72	74.02	4.17
	6.09	23.72	0.70	1.01	16.57	24.30	91.8%	0.68	65.53	3.95
	6.14	23.29	0.66	0.96	15.39	23.85	90.1%	0.65	57.56	3.74
	6.19	22.85	0.62	0.91	14.24	23.41	88.5%	0.61	50.09	3.52
	6.24	22.46	0.58	0.86	13.11	23.00	86.9%	0.57	43.06	3.28
	6.29	22.08	0.54	0.81	11.99	22.60	85.4%	0.53	36.53	3.05
	6.34	21.70	0.50	0.76	10.90	22.20	83.9%	0.49	30.52	2.80
	6.39	21.31	0.46	0.71	9.83	21.80	82.4%	0.45	25.02	2.55
	6.44	20.93	0.42	0.66	8.77	21.40	80.9%	0.41	20.05	2.29
	6.49	20.32	0.38	0.61	7.74	20.76	78.5%	0.37	15.80	2.04
	6.54	19.72	0.34	0.56	6.74	20.12	76.0%	0.33	12.58	1.87
	6.59	19.12	0.30	0.51	5.77	19.48	73.6%	0.30	9.20	1.60
	6.64	18.36	0.26	0.46	4.83	18.70	70.7%	0.26	6.55	1.36
	6.69	17.59	0.22	0.41	3.93	17.89	67.6%	0.22	4.46	1.14
	6.74	15.81	0.20	0.36	3.09	16.07	60.7%	0.19	3.07	0.99
WL	6.79	14.53	0.16	0.31	2.33	14.75	55.7%	0.16	1.93	0.83
	6.84	12.24	0.14	0.26	1.66	12.42	46.9%	0.13	1.17	0.71
	6.89	10.40	0.11	0.21	1.10	10.53	39.8%	0.10	0.63	0.57
	6.94	8.65	0.07	0.16	0.62	8.72	32.9%	0.07	0.27	0.44
	6.99	5.73	0.05	0.11	0.28	5.76	21.8%	0.05	0.09	0.32
	7.04	2.46	0.04	0.06	0.09	2.47	9.3%	0.04	0.02	0.17
	7.09	1.15	0.01	0.01	0.01	1.15	4.3%	0.01	0.00	0.12

STREAM NAME: West Marvine
XS LOCATION: Abv Headgate
XS NUMBER: 2 - Upper

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.42	cfs
CALCULATED FLOW (Qc)=	1.51	cfs
(Qm-Qc)/Qm * 100 =	-6.2	%
MEASURED WATERLINE (WLm)=	6.80	ft
CALCULATED WATERLINE (WLc)=	6.79	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.25	ft
MAX CALCULATED DEPTH (Dc)=	0.31	ft
(Dm-Dc)/Dm * 100	-22.5	%
MEAN VELOCITY=	0.65	ft/sec
MANNING'S N=	0.112	
SLOPE=	0.02785714	ft/ft
.4 * Qm =	0.6	cfs
2.5 * Qm=	3.6	cfs

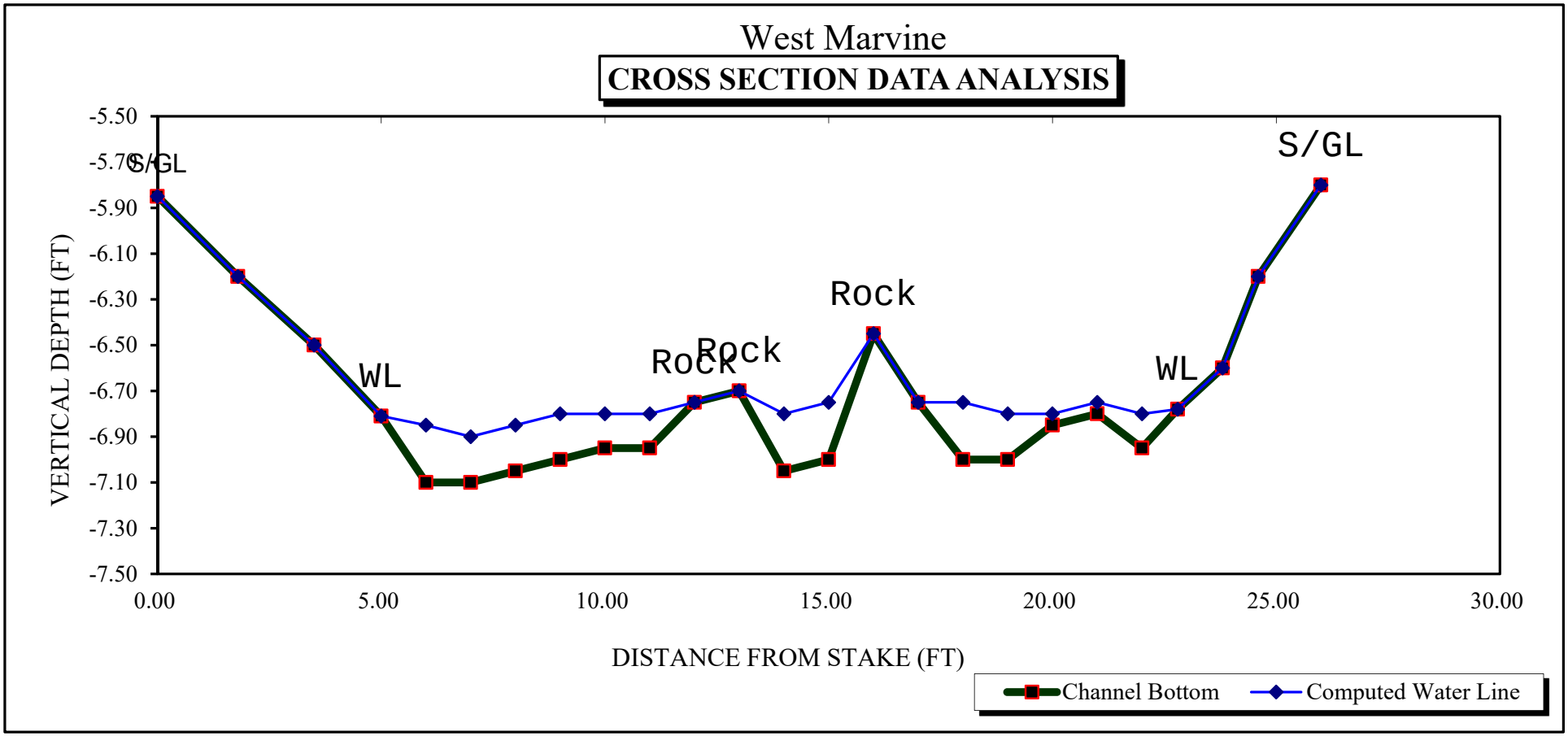
RECOMMENDED INSTREAM FLOW:
==========

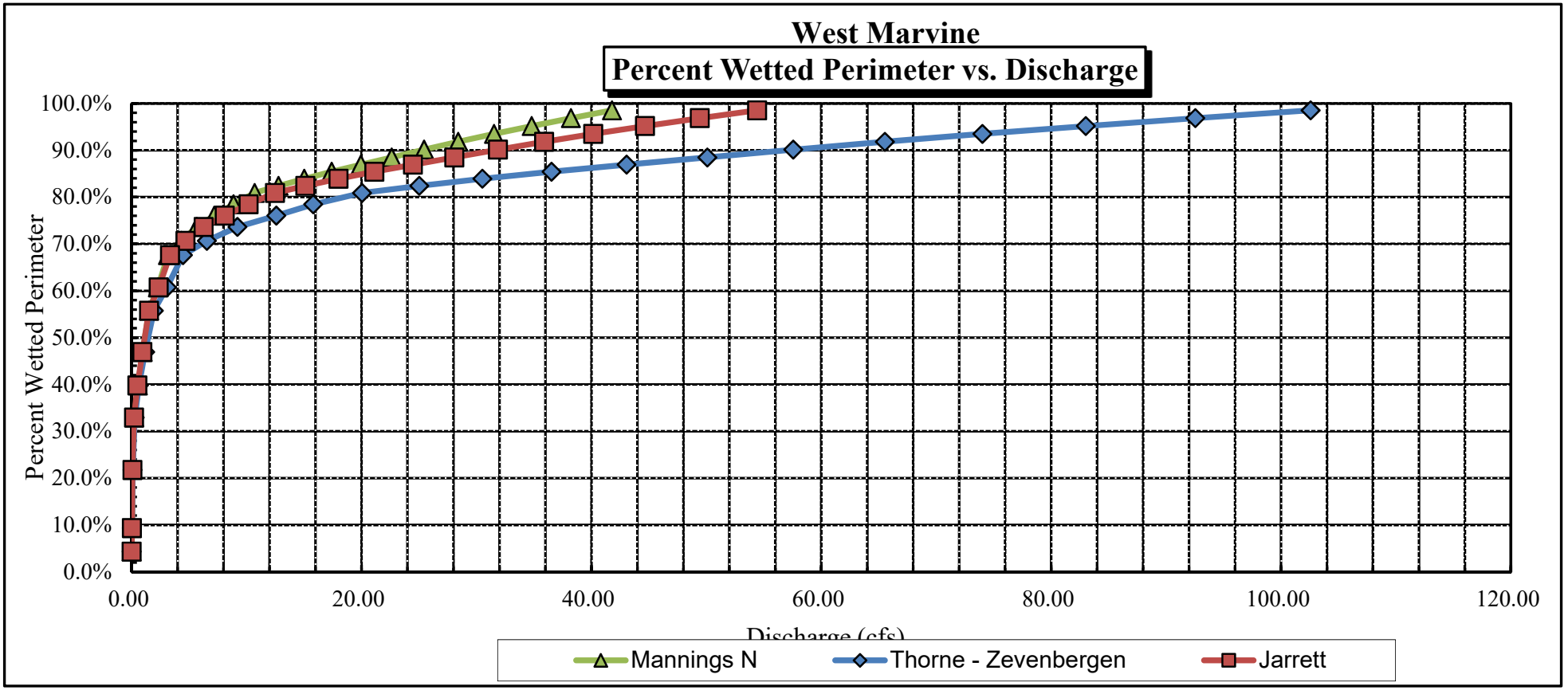
FLOW (CFS)	PERIOD
==========	========
_____	_____
_____	_____
_____	_____
_____	_____

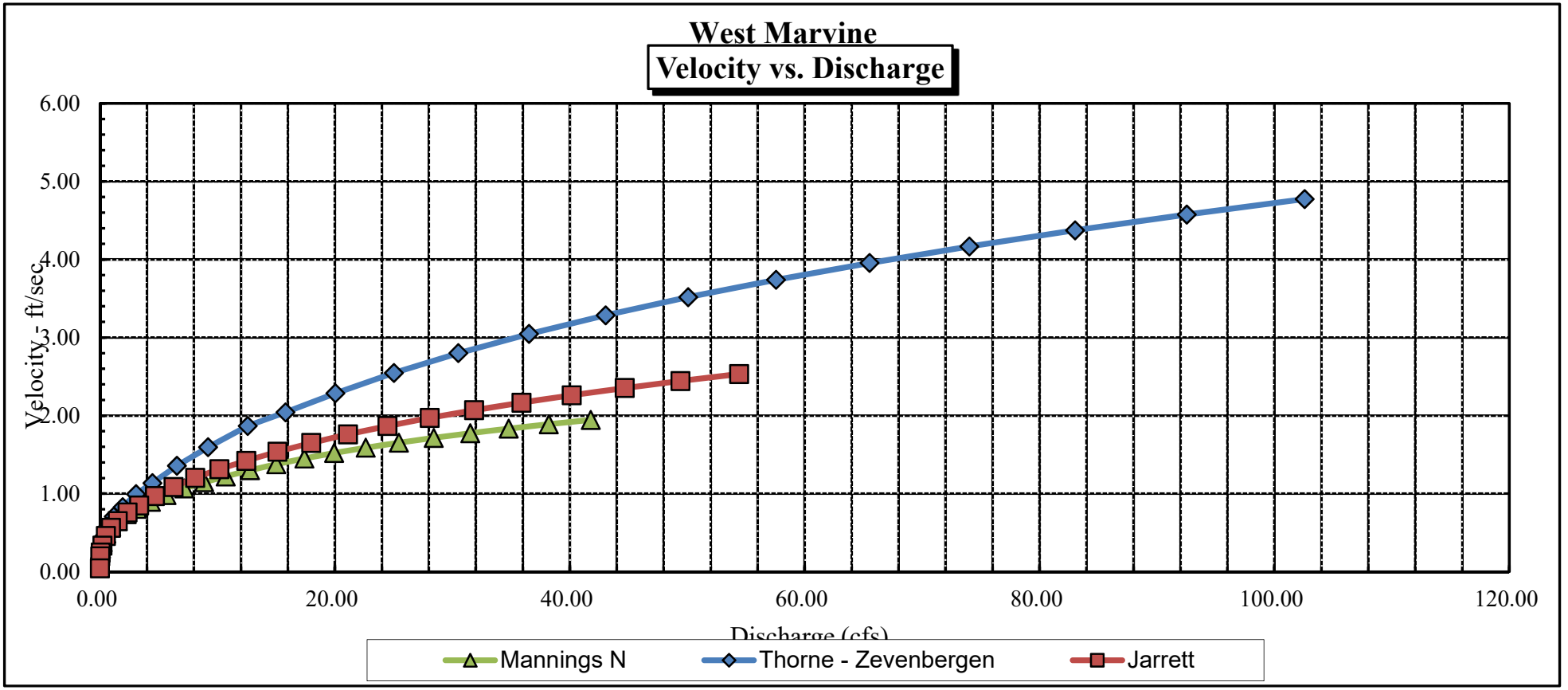
RATIONALE FOR RECOMMENDATION:
==========

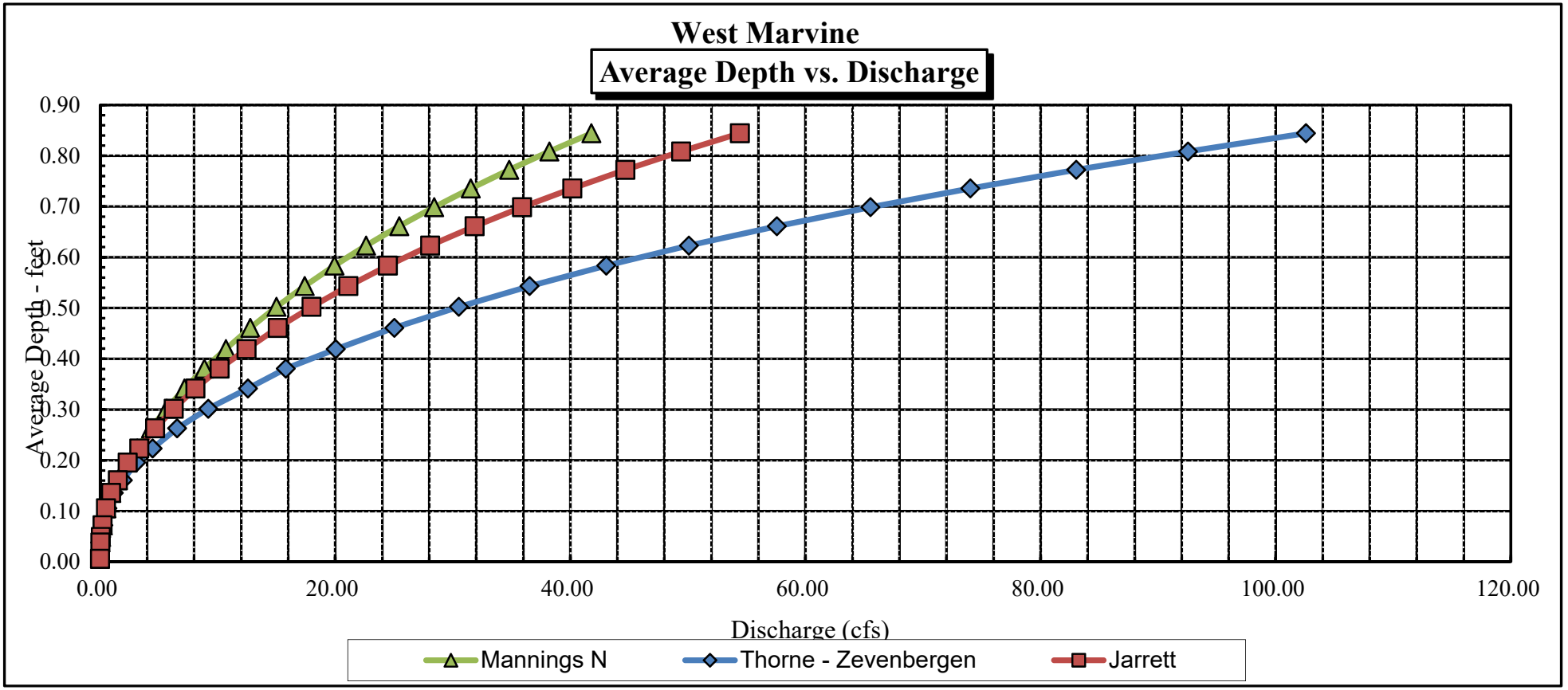
RECOMMENDATION BY: …….. AGENCY…….. DATE:……

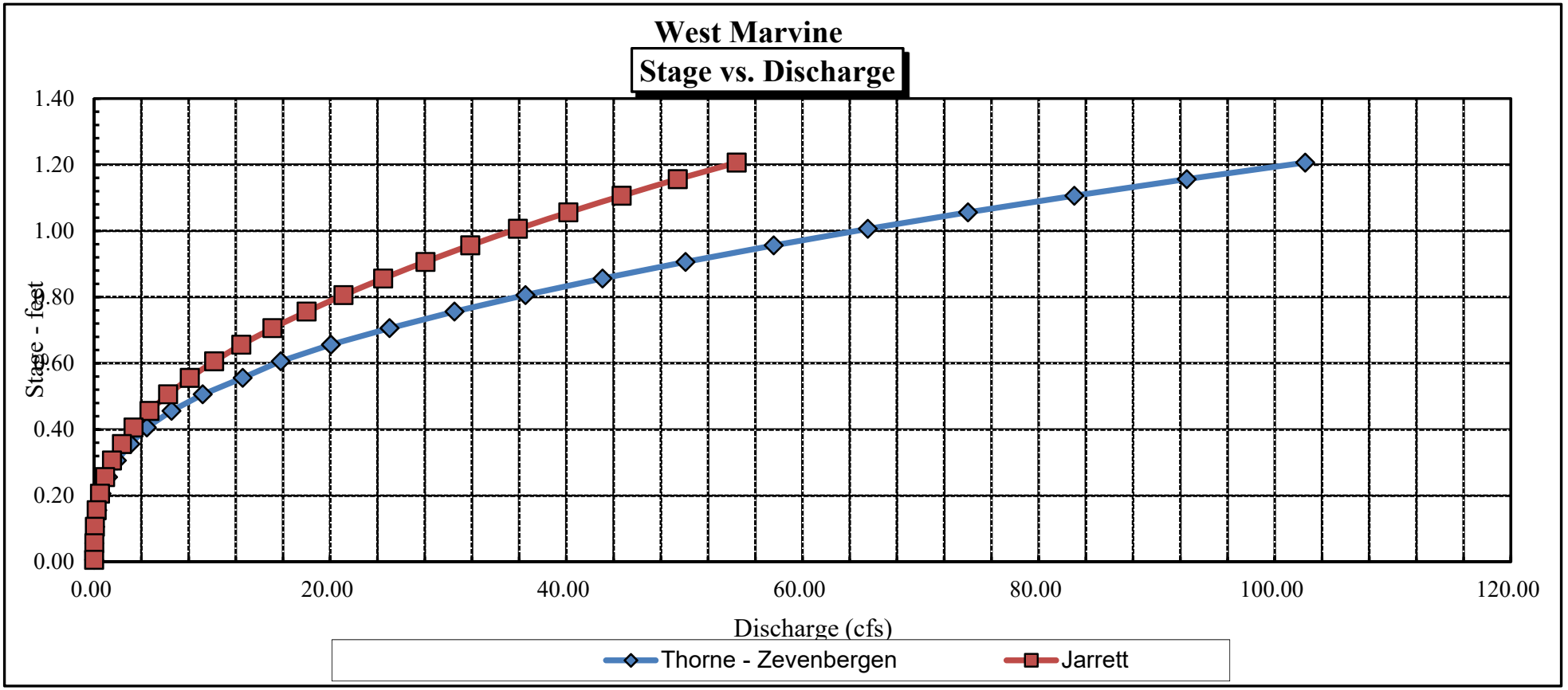
CWCB REVIEW BY: …….. DATE:……


West Marvine
CROSS SECTION DATA ANALYSIS
-5.50
-5.70
-5.90
-6.10
-6.30
-6.50
-6.70
-6.90
-7.10
-7.30
-7.50
VERTICAL DEPTH (FT)
S/GL
WL
Rock
Rock
Rock
WL
S/GL
0.00
5.00
10.00
15.00
20.00
25.00
30.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


West Marvine
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
60.00
80.00
100.00
120.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


West Marvine
Velocity vs. Discharge
Velocity - ft/sec
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


West Marvine
Average Depth vs. Discharge
Average Depth - feet
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


West Marvine
Stage vs. Discharge
Stage - feet
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
100.00
120.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

Data Input & Proofing

STREAM NAME:	West Marvine
XS LOCATION:	Abv Headgate
XS NUMBER:	2 - Upper
DATE:	9/13/2018
OBSERVERS:	Birch, Skinner, Landers
1/4 SEC:	Lat: 40.016153
SECTION:	Long: -107.442182
TWP:	
RANGE:	
PM:	
COUNTY:	Rio Blanco
WATERSHED:	White
DIVISION:	6
DOW CODE:	21117
USGS MAP:	
USFS MAP:	
	Level and Rod Survey
TAPE WT:	0.0106 lbs / ft
TENSION:	99999 lbs
SLOPE:	0.027857143 ft / ft

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

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

Total Data Points = 25

GL=1	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	Tape to Water
1	S/GL	0.00	5.85			0.00	0.00	0.00
		1.80	6.20			0.00	0.00	0.00
		3.50	6.50			0.00	0.00	0.00
	WL	5.00	6.81	0.00	0.00	0.00	0.00	0.00
		6.00	7.10	0.25	0.61	0.25	0.15	6.85
		7.00	7.10	0.20	0.61	0.20	0.12	6.90
		8.00	7.05	0.20	0.61	0.20	0.12	6.85
		9.00	7.00	0.20	0.61	0.20	0.12	6.80
		10.00	6.95	0.15	0.61	0.15	0.09	6.80
		11.00	6.95	0.15	0.61	0.15	0.09	6.80
	Rock	12.00	6.75	0.00	0.61	0.00	0.00	0.00
	Rock	13.00	6.70	0.00	0.61	0.00	0.00	0.00
		14.00	7.05	0.25	0.61	0.25	0.15	6.80
		15.00	7.00	0.25	0.61	0.25	0.15	6.75
	Rock	16.00	6.45	0.00	0.61	0.00	0.00	0.00
		17.00	6.75	0.00	0.61	0.00	0.00	0.00
		18.00	7.00	0.25	0.61	0.25	0.15	6.75
		19.00	7.00	0.20	0.61	0.20	0.12	6.80
		20.00	6.85	0.05	0.61	0.05	0.03	6.80
		21.00	6.80	0.05	0.61	0.05	0.03	6.75
		22.00	6.95	0.15	0.61	0.14	0.08	6.80
	WL	22.80	6.78	0.00	0.00	0.00	0.00	0.00
		23.80	6.60			0.00	0.00	0.00
		24.60	6.20			0.00	0.00	0.00
1	S/GL	26.00	5.80			0.00	0.00	0.00
					Totals	2.34	1.42	

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

LOCATION INFORMATION

STREAM NAME:	West Marvine
XS LOCATION:	Abv Headgate
XS NUMBER:	1 - Lower
DATE:	13-Sep-18
OBSERVERS:	Birch, Skinner, Landers
1/4 SEC:	Lat: 40.016153
SECTION:	Long: -107.442182
TWP:	0
RANGE:	0
PM:	0
COUNTY:	Rio Blanco
WATERSHED:	White
DIVISION:	6
DOW CODE:	21117
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

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

TAPE WT:	0.0106
TENSION:	99999

CHANNEL PROFILE DATA

SLOPE:	0.05703704

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

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

STREAM NAME: West Marvine
XS LOCATION: Abv Headgate
XS NUMBER: 1 - Lower

DATA POINTS= 26

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	S	0.00	2.30			0.00		0.00	0.00	0.0%
		1.30	2.55			0.00		0.00	0.00	0.0%
1	GL	2.80	2.95			0.00		0.00	0.00	0.0%
		3.60	4.20			0.00		0.00	0.00	0.0%
		4.80	4.20			0.00		0.00	0.00	0.0%
	WL	6.40	4.54	0.00	0.00	0.00		0.00	0.00	0.0%
		7.00	4.65	0.05	0.76	0.61	0.05	0.03	0.02	1.5%
		7.50	4.60	0.05	0.76	0.50	0.05	0.03	0.02	1.3%
		8.00	4.75	0.05	0.76	0.52	0.05	0.03	0.02	1.3%
		8.50	4.85	0.20	0.76	0.51	0.20	0.10	0.08	5.4%
		9.00	4.95	0.30	0.76	0.51	0.30	0.15	0.11	8.0%
		9.50	4.95	0.25	0.76	0.50	0.25	0.13	0.10	6.7%
		10.00	4.85	0.20	0.76	0.51	0.20	0.10	0.08	5.4%
		10.50	5.00	0.35	0.76	0.52	0.35	0.18	0.13	9.4%
		11.00	5.05	0.40	0.76	0.50	0.40	0.20	0.15	10.7%
		11.50	4.90	0.25	0.76	0.52	0.25	0.13	0.10	6.7%
		12.00	4.90	0.30	0.76	0.50	0.30	0.15	0.11	8.0%
		12.50	5.00	0.40	0.76	0.51	0.40	0.20	0.15	10.7%
		13.00	5.00	0.40	0.76	0.50	0.40	0.20	0.15	10.7%
		13.50	4.90	0.20	0.76	0.51	0.20	0.10	0.08	5.4%
		14.00	4.70	0.20	0.76	0.54	0.20	0.10	0.08	5.4%
		14.50	4.60	0.10	0.76	0.51	0.10	0.07	0.05	3.5%
	WL	15.30	4.48	0.00	0.00	0.81		0.00	0.00	0.0%
		17.80	3.85			0.00		0.00	0.00	0.0%
1	GL	19.40	3.00			0.00		0.00	0.00	0.0%
	S	26.50	2.20			0.00		0.00	0.00	0.0%
	TOTALS ----------					9.09	0.4 (Max.)	1.87	1.42	100.0%

Manning's n = 0.1621
Hydraulic Radius= 0.20549275

STREAM NAME: West Marvine
XS LOCATION: Abv Headgate
XS NUMBER: 1 - Lower

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	1.87	2.77	48.2%
4.26	1.87	5.27	182.1%
4.28	1.87	5.05	170.3%
4.30	1.87	4.83	158.7%
4.32	1.87	4.62	147.3%
4.34	1.87	4.41	136.1%
4.36	1.87	4.20	125.0%
4.38	1.87	4.00	114.2%
4.40	1.87	3.80	103.5%
4.42	1.87	3.60	93.0%
4.44	1.87	3.41	82.7%
4.46	1.87	3.22	72.6%
4.47	1.87	3.13	67.6%
4.48	1.87	3.04	62.7%
4.49	1.87	2.95	57.8%
4.50	1.87	2.86	53.0%
4.51	1.87	2.77	48.2%
4.52	1.87	2.68	43.5%
4.53	1.87	2.59	38.9%
4.54	1.87	2.51	34.3%
4.55	1.87	2.42	29.8%
4.56	1.87	2.34	25.3%
4.58	1.87	2.18	16.6%
4.60	1.87	2.02	8.1%
4.62	1.87	1.87	0.1%
4.64	1.87	1.73	-7.5%
4.66	1.87	1.60	-14.6%
4.68	1.87	1.47	-21.5%
4.70	1.87	1.34	-28.2%
4.72	1.87	1.22	-34.7%
4.74	1.87	1.10	-41.1%
4.76	1.87	0.98	-47.4%

WATERLINE AT ZERO
AREA ERROR = 4.620

STREAM NAME: West Marvine
XS LOCATION: Abv Headgate
XS NUMBER: 1 - Lower

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	3.00	16.57	1.44	2.05	23.89	17.74	100.0%	1.35	63.79	2.67
	3.62	15.00	0.94	1.43	14.10	15.68	88.4%	0.90	28.76	2.04
	3.67	14.88	0.90	1.38	13.35	15.51	87.5%	0.86	26.45	1.98
	3.72	14.75	0.85	1.33	12.61	15.35	86.5%	0.82	24.22	1.92
	3.77	14.63	0.81	1.28	11.87	15.18	85.6%	0.78	22.07	1.86
	3.82	14.50	0.77	1.23	11.15	15.02	84.7%	0.74	20.01	1.80
	3.87	14.33	0.73	1.18	10.43	14.81	83.5%	0.70	18.06	1.73
	3.92	14.10	0.69	1.13	9.71	14.55	82.0%	0.67	16.25	1.67
	3.97	13.87	0.65	1.08	9.02	14.28	80.5%	0.63	14.53	1.61
	4.02	13.64	0.61	1.03	8.33	14.02	79.0%	0.59	12.89	1.55
	4.07	13.41	0.57	0.98	7.65	13.75	77.5%	0.56	11.33	1.48
	4.12	13.18	0.53	0.93	6.99	13.49	76.1%	0.52	9.87	1.41
	4.17	12.95	0.49	0.88	6.33	13.23	74.6%	0.48	8.49	1.34
	4.22	11.44	0.50	0.83	5.72	11.69	65.9%	0.49	7.77	1.36
	4.27	11.00	0.47	0.78	5.16	11.24	63.4%	0.46	6.71	1.30
	4.32	10.57	0.44	0.73	4.62	10.80	60.9%	0.43	5.74	1.24
	4.37	10.14	0.40	0.68	4.10	10.35	58.4%	0.40	4.84	1.18
	4.42	9.70	0.37	0.63	3.60	9.91	55.9%	0.36	4.02	1.12
	4.47	9.27	0.34	0.58	3.13	9.46	53.4%	0.33	3.28	1.05
	4.52	8.73	0.31	0.53	2.68	8.91	50.2%	0.30	2.63	0.98
	4.57	8.13	0.28	0.48	2.26	8.31	46.9%	0.27	2.07	0.92
WL	4.62	7.29	0.26	0.43	1.87	7.46	42.0%	0.25	1.62	0.87
	4.67	6.42	0.24	0.38	1.53	6.56	37.0%	0.23	1.27	0.83
	4.72	6.05	0.20	0.33	1.22	6.18	34.9%	0.20	0.90	0.74
	4.77	5.72	0.16	0.28	0.92	5.84	32.9%	0.16	0.59	0.64
	4.82	5.35	0.12	0.23	0.65	5.45	30.7%	0.12	0.34	0.53
	4.87	4.81	0.08	0.18	0.39	4.89	27.6%	0.08	0.16	0.41
	4.92	3.30	0.06	0.13	0.18	3.35	18.9%	0.05	0.06	0.31
	4.97	1.66	0.04	0.08	0.06	1.69	9.5%	0.03	0.01	0.23
	5.02	0.40	0.01	0.03	0.01	0.40	2.3%	0.01	0.00	0.13

STREAM NAME: West Marvine
XS LOCATION: Abv Headgate
XS NUMBER: 1 - Lower

SUMMARY SHEET

MEASURED FLOW (Qm)=	1.42	cfs
CALCULATED FLOW (Qc)=	1.62	cfs
(Qm-Qc)/Qm * 100 =	-14.1	%
MEASURED WATERLINE (WLm)=	4.51	ft
CALCULATED WATERLINE (WLc)=	4.62	ft
(WLm-WLc)/WLm * 100 =	-2.4	%
MAX MEASURED DEPTH (Dm)=	0.40	ft
MAX CALCULATED DEPTH (Dc)=	0.43	ft
(Dm-Dc)/Dm * 100	-7.5	%
MEAN VELOCITY=	0.87	ft/sec
MANNING'S N=	0.162	
SLOPE=	0.05703704	ft/ft
.4 * Qm =	0.6	cfs
2.5 * Qm=	3.6	cfs

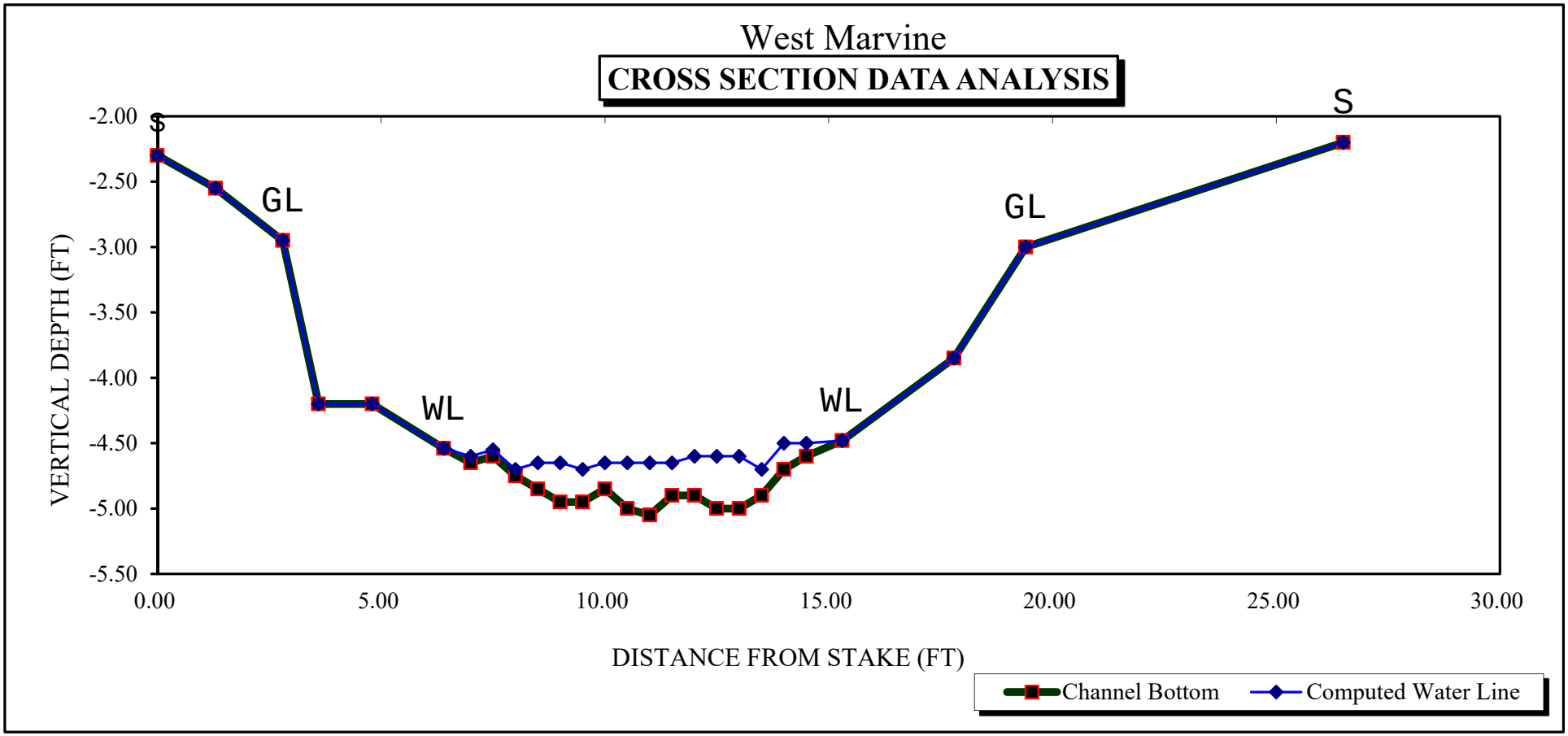
RECOMMENDED INSTREAM FLOW:
==========

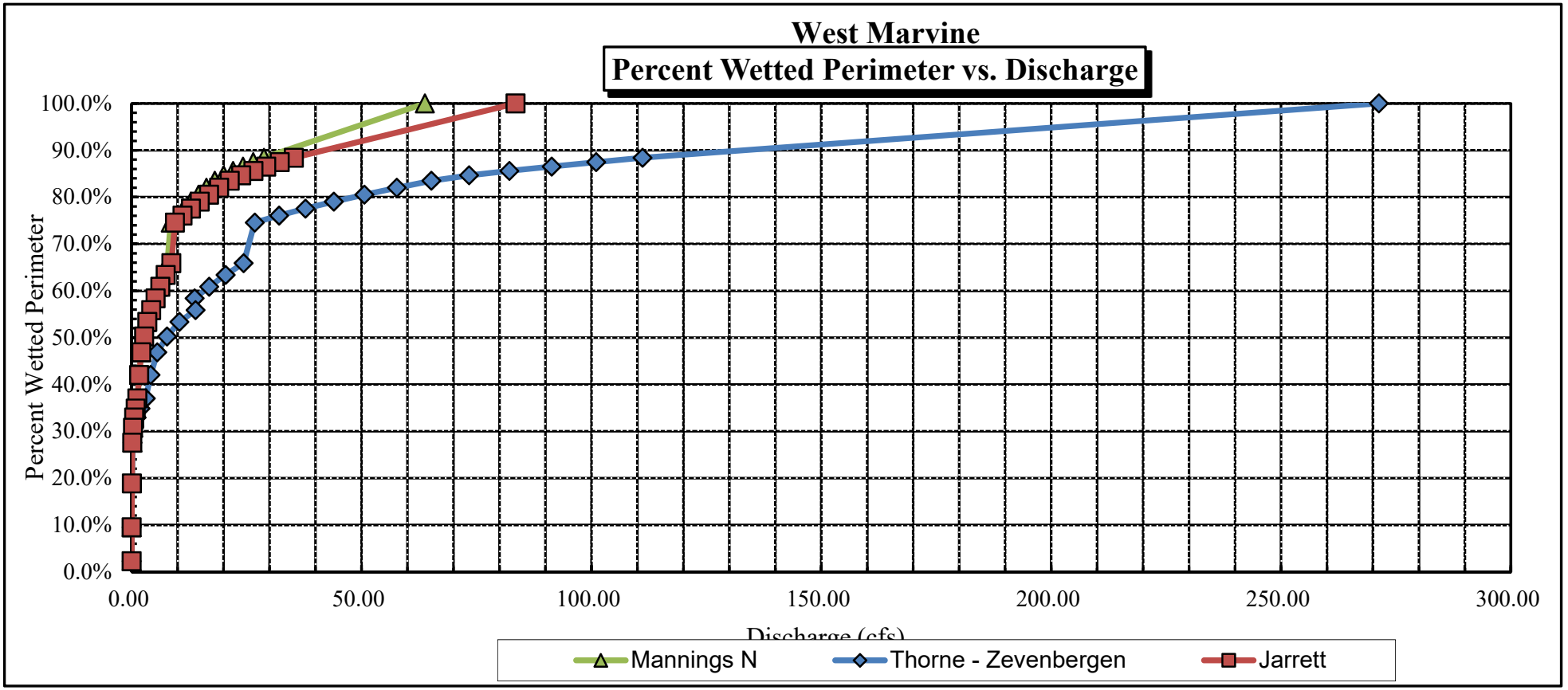
FLOW (CFS)	PERIOD
==========	========
_____	_____
_____	_____
_____	_____
_____	_____

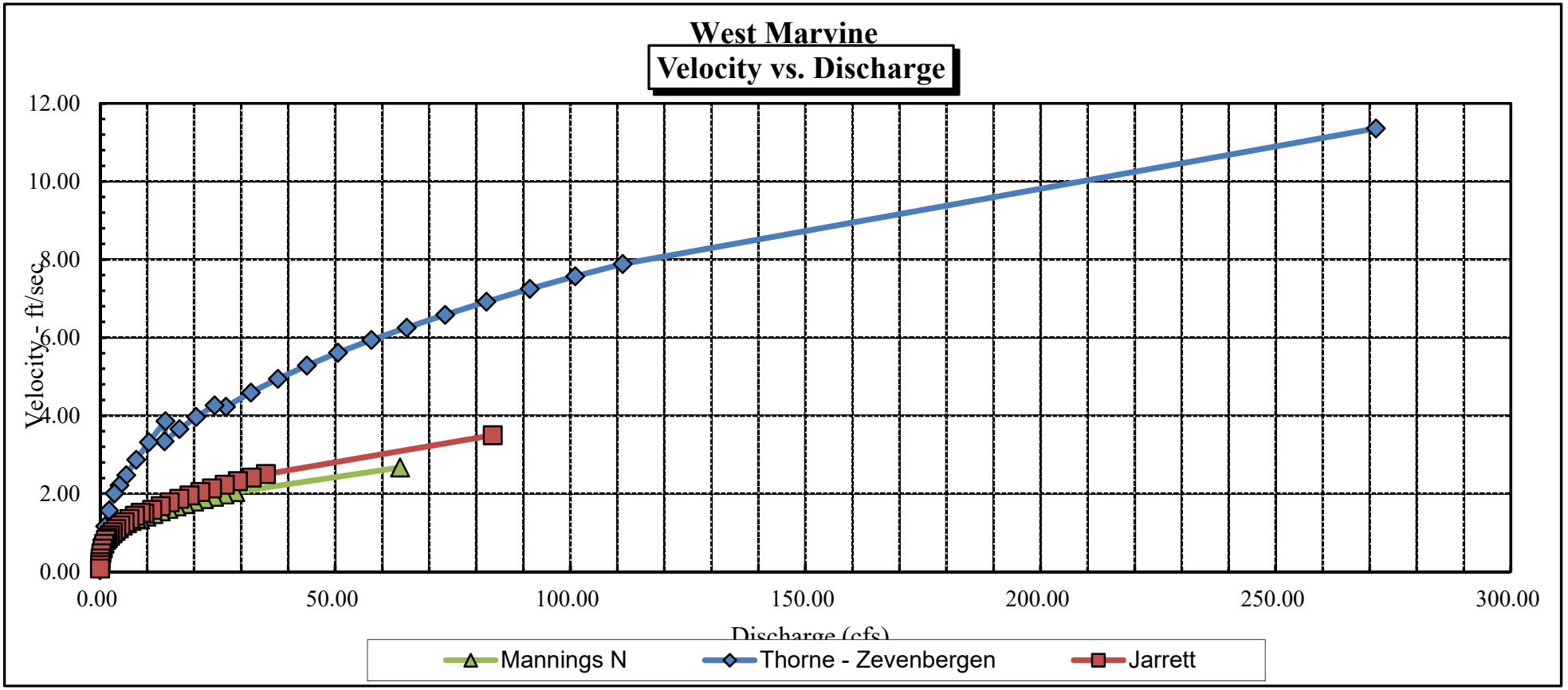
RATIONALE FOR RECOMMENDATION:
==========

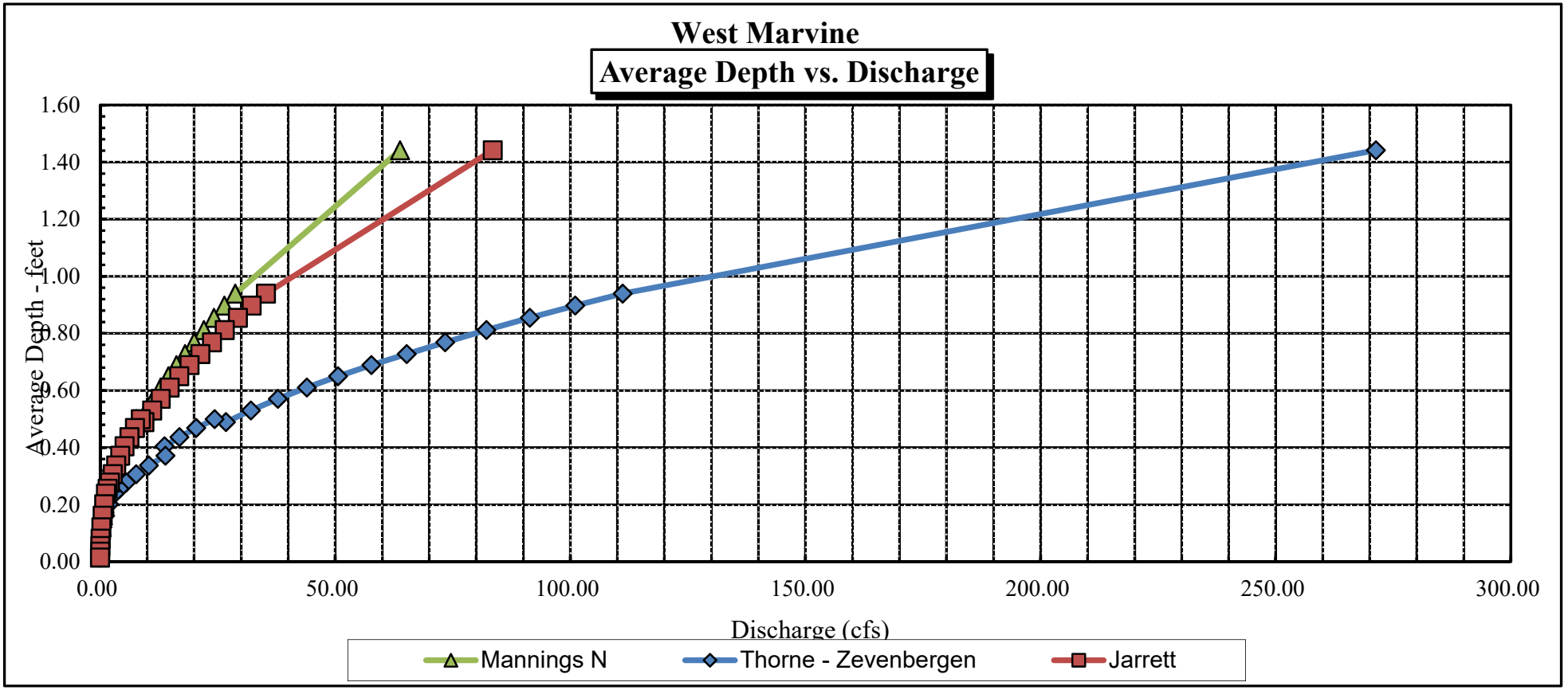
RECOMMENDATION BY: …….. AGENCY…….. DATE:……

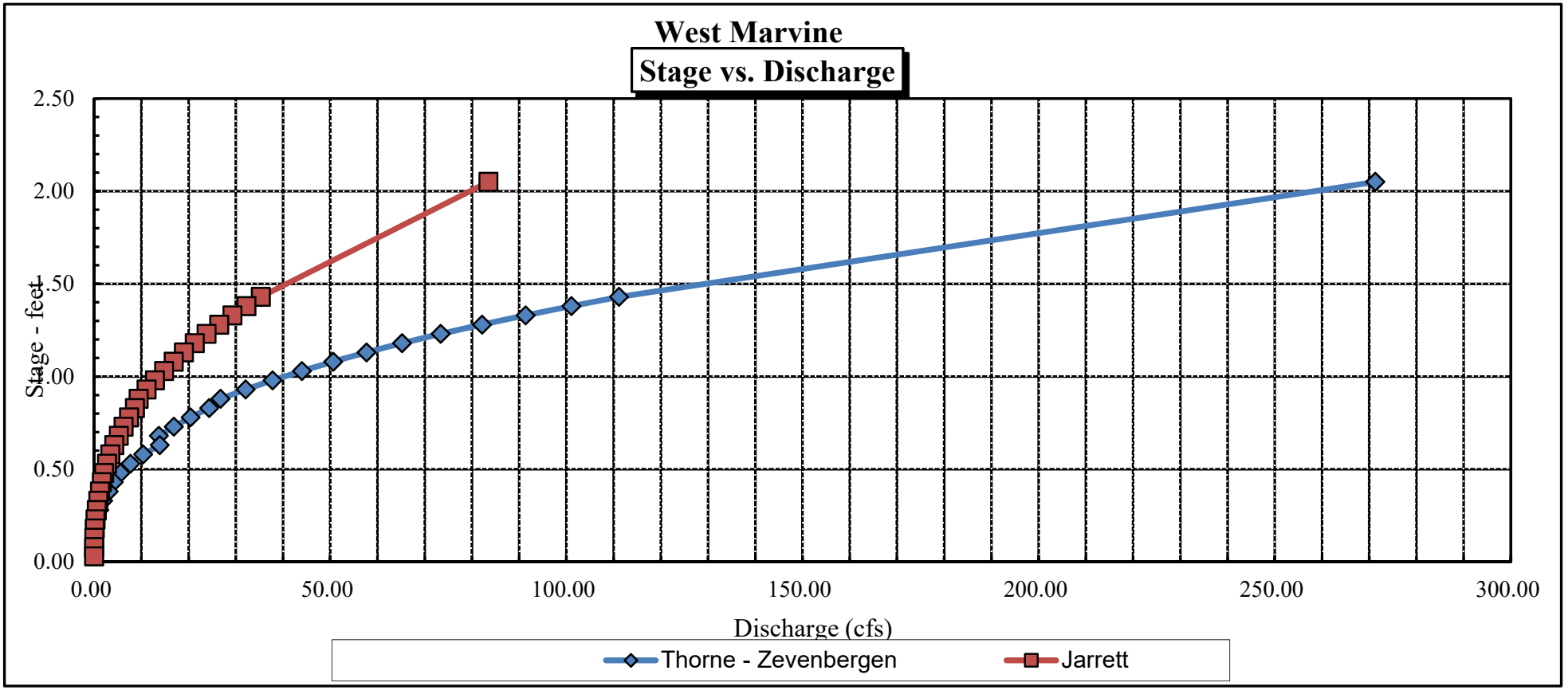
CWCB REVIEW BY: …….. DATE:……


West Marvine
CROSS SECTION DATA ANALYSIS
S
S
GL
GL
WL
WL
-2.00
-2.50
-3.00
-3.50
-4.00
-4.50
-5.00
-5.50
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


West Marvine
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
50.00
100.00
150.00
200.00
250.00
300.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


West Marvine
Velocity vs. Discharge
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Velocity - ft/sec
0.00
50.00
100.00
150.00
200.00
250.00
300.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


West Marvine
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
50.00
100.00
150.00
200.00
250.00
300.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


West Marvine
Stage vs. Discharge
2.50
2.00
1.50
1.00
0.50
0.00
Stage - feet
0.00
50.00
100.00
150.00
200.00
250.00
300.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

Data Input & Proofing

STREAM NAME:	West Marvine
XS LOCATION:	Abv Headgate
XS NUMBER:	1 - Lower
DATE:	9/13/2018
OBSERVERS:	Birch, Skinner, Landers
1/4 SEC:	Lat: 40.016153
SECTION:	Long: -107.442182
TWP:	
RANGE:	
PM:	
COUNTY:	Rio Blanco
WATERSHED:	White
DIVISION:	6
DOW CODE:	21117
USGS MAP:	
USFS MAP:	
	Level and Rod Survey
TAPE WT:	0.0106 lbs / ft
TENSION:	99999 lbs
SLOPE:	0.057037037 ft / ft

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

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

Total Data Points = 26

GL=1	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	Tape to Water
	S	0.00	2.30			0.00	0.00	0.00
		1.30	2.55			0.00	0.00	0.00
1	GL	2.80	2.95			0.00	0.00	0.00
		3.60	4.20			0.00	0.00	0.00
		4.80	4.20			0.00	0.00	0.00
	WL	6.40	4.54	0.00	0.00	0.00	0.00	0.00
		7.00	4.65	0.05	0.76	0.03	0.02	4.60
		7.50	4.60	0.05	0.76	0.03	0.02	4.55
		8.00	4.75	0.05	0.76	0.03	0.02	4.70
		8.50	4.85	0.20	0.76	0.10	0.08	4.65
		9.00	4.95	0.30	0.76	0.15	0.11	4.65
		9.50	4.95	0.25	0.76	0.13	0.10	4.70
		10.00	4.85	0.20	0.76	0.10	0.08	4.65
		10.50	5.00	0.35	0.76	0.18	0.13	4.65
		11.00	5.05	0.40	0.76	0.20	0.15	4.65
		11.50	4.90	0.25	0.76	0.13	0.10	4.65
		12.00	4.90	0.30	0.76	0.15	0.11	4.60
		12.50	5.00	0.40	0.76	0.20	0.15	4.60
		13.00	5.00	0.40	0.76	0.20	0.15	4.60
		13.50	4.90	0.20	0.76	0.10	0.08	4.70
		14.00	4.70	0.20	0.76	0.10	0.08	4.50
		14.50	4.60	0.10	0.76	0.07	0.05	4.50
	WL	15.30	4.48	0.00	0.00	0.00	0.00	0.00
		17.80	3.85			0.00	0.00	0.00
1	GL	19.40	3.00			0.00	0.00	0.00
	S	26.50	2.20			0.00	0.00	0.00
					Totals	1.87	1.42	

Page 1 of 2	State of Colorado	Meas. No.: ØØ1
YYYY: 2017	**Colorado Water Conservation Board**	Division: 6
MM-DD: 06-28	ADV Discharge Measurement Notes	District: 43

Station Name:	WMVCAHDG		
	West Marvine	River / Creek / Canal / Ditch	
At / Near / Above / Below	Headgate/Ditch WMVCØØ1		
Latitude:	40.01552052°	Longitude:	-107.44187783°
Party:	Jack Landers / Brian Epstein		

Conditions

Weather:	Partly cloudy		
Wind Spd / Dir:	Calm	Water Temp:	
X-Sec Desc:	Beginning of straight section immediately d/s of confl 2 channels		
Flow Conds:	slightly turbulent, riffle		
Control Desc.:	N/A		

Measurement Rated: Excellent (2%) / Good (5%) / Fair (8%) / Poor (>8%) [based on the above conditions]

Water Level Reading

Time	Staff Gage	Pressure Trans.	Time	Staff Gage	Pressure Trans.
N/A					

Pressure Transducer Download			
File Name:	N/A	Weighted MGH	
Time:		GH Corr.	
		Correct MGH	

Discharge Measurement

Manufacturer:	SonTek	Model:	FlowTracker	S/N:	P2354 / P2355
Firmware:	3.9	Software:	2.20		
Diag Test File:	Yes or No	Raw Data File:	WMVCAHDG.ØØ1		
Meas Type:	Wading / Boat / Bridge / Cableway			Method:	0.6
	N/A	ft. or mi / upstream or downstream of gage			
Start Edge:	4.3 ft	End Edge:	16.5	Total Width:	12.2
Start Time:	17:49	End Time:	18:18		
Discharge:	8.01	Unsertainty:	3.2%	# Stations:	25
Mean v:	1.631	Width	12.2	Mean d:	0.40
Max v:	2.719	Area:	4.91	Max d:	0.60
Mean SNR:	37.6	σv:	0.084	Mean Temp:	56.3°F

Meas. By:	Brian Epstein	Notes By:	Jack Landers
Processed By:		Reviewed By:	BJE

Remarks: West Marvine Creek   Party: Brian Epstein (1/day) Jack Landes

16:52 (iPhone Trimble Hunt GPS) WMVC001 ditch headgate
16:54 Pic 977 (Lumix DMC-TS2) from channel center looking at ditch headgate and picture right West Marvine Creek
16:55 Pic 978 from WMVC001 looking upstream
16:56 Pic 979 from WMVC001 looking down ditch
16:56 Pic 980 from WMVC001 looking down stream West Marvine Creek
17:12 Pic 981 from LEW, looking upstream, ~ 975' upstream of WMVC001, typical section of creek observed, plunge-pool
18:05 Pic 984 from center of channel, looking upstream, ~300ft downstream of WMVC001 Hdgt, vegetation disturbed by high water (lower left + upper right of pic)
40.016477, -107.412179 Jack's phone
18:10 Pic 986 Fish in center of picture, no white on fins, likely a cutthroat
18:24 Pic 989 Cross-section looking upstream, measurement taken in lower half of photo

JEL

~~Walk along ditch from boundary of private and did not observe a measuring device,~~ Measuring device 50ft downstream of Private boundary

18:38 Pic 990 Columbine near West Marvine Cr

18:39 Pic 991 Parshall Flume 50ft downstream of private fence line condition = good

Discharge Measurement Summary

Date Generated: Mon Dec 18 2017

File Information

File Name	WMVCAHGD.001.WAD
Start Date and Time	2017/06/28 17:49:32

Site Details

Site Name	W MARVINE C AB DITCH
Operator(s)	BRIAN EPSTEIN

System Information

Sensor Type	FlowTracker
Serial #	P2355
CPU Firmware Version	3.9
Software Ver	2.30
Mounting Correction	0.0%

Units (Metric Units)

Distance	m
Velocity	m/s
Area	m^2
Discharge	m^3/s

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.3%	4.0%
Velocity	1.4%	7.8%
Width	0.1%	0.1%
Method	1.7%	-
# Stations	2.0%	-
Overall	**3.2%**	**8.8%**

Summary

Averaging Int.	40	# Stations	25
Start Edge	REW	Total Width	3.719
Mean SNR	37.6 dB	Total Area	0.456
Mean Temp	13.51 °C	Mean Depth	0.123
Disch. Equation	Mid-Section	Mean Velocity	0.4970
		Total Discharge	**0.2267**

Measurement Results

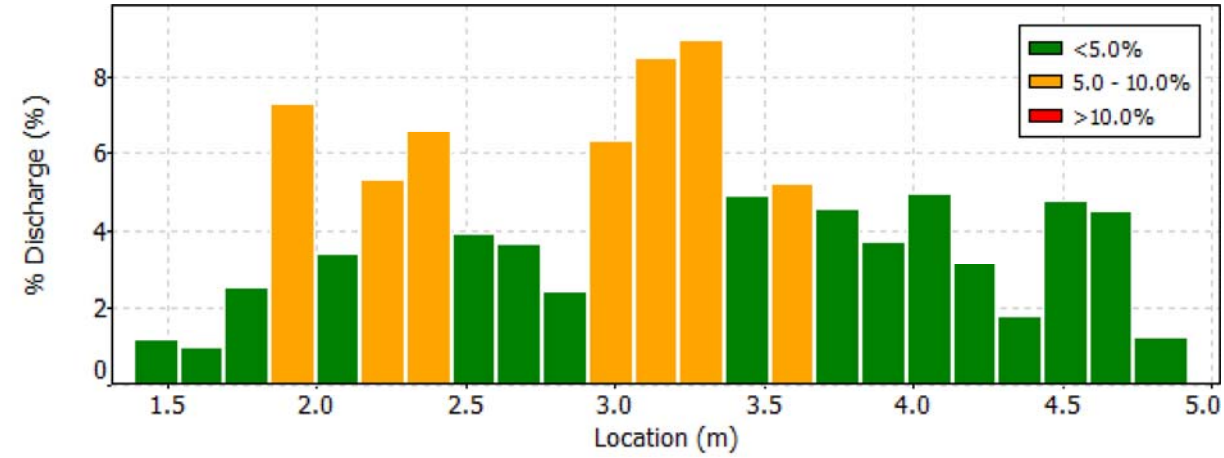
St	Clock	Loc	Method	Depth	%Dep	MeasD	Vel	CorrFact	MeanV	Area	Flow	%Q
0	17:49	1.31	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0
1	17:49	1.46	0.6	0.061	0.6	0.024	0.2795	1.00	0.2795	0.009	0.0026	1.1
2	17:50	1.62	0.6	0.061	0.6	0.024	0.2388	1.00	0.2388	0.009	0.0022	1.0
3	17:51	1.77	0.6	0.101	0.6	0.040	0.3763	1.00	0.3763	0.015	0.0058	2.5
4	17:54	1.92	0.6	0.131	0.6	0.052	0.8289	1.00	0.8289	0.020	0.0166	7.3
5	*17:56*	*2.07*	*0.6*	*0.183*	*0.6*	*0.073*	*0.2781*	*1.00*	*0.2781*	*0.028*	*0.0078*	*3.4*
6	17:57	2.23	0.6	0.107	0.6	0.043	0.7453	1.00	0.7453	0.016	0.0121	5.3
7	17:58	2.38	0.6	0.168	0.6	0.067	0.5867	1.00	0.5867	0.026	0.0150	6.6
8	17:59	2.53	0.6	0.152	0.6	0.061	0.3849	1.00	0.3849	0.023	0.0089	3.9
9	*18:00*	*2.68*	*0.6*	*0.122*	*0.6*	*0.049*	*0.4451*	*1.00*	*0.4451*	*0.019*	*0.0083*	*3.6*
10	18:01	2.83	0.6	0.091	0.6	0.037	0.3941	1.00	0.3941	0.014	0.0055	2.4
11	18:02	2.99	0.6	0.168	0.6	0.067	0.5605	1.00	0.5605	0.026	0.0143	6.3
12	*18:03*	*3.14*	*0.6*	*0.183*	*0.6*	*0.073*	*0.6917*	*1.00*	*0.6917*	*0.028*	*0.0193*	*8.5*
13	18:04	3.29	0.6	0.183	0.6	0.073	0.7316	1.00	0.7316	0.028	0.0204	9.0
14	*18:05*	*3.44*	*0.6*	*0.152*	*0.6*	*0.061*	*0.4811*	*1.00*	*0.4811*	*0.023*	*0.0112*	*4.9*
15	*18:06*	*3.60*	*0.6*	*0.152*	*0.6*	*0.061*	*0.5133*	*1.00*	*0.5133*	*0.023*	*0.0119*	*5.3*
16	*18:07*	*3.75*	*0.6*	*0.168*	*0.6*	*0.067*	*0.4034*	*1.00*	*0.4034*	*0.026*	*0.0103*	*4.5*
17	*18:08*	*3.90*	*0.6*	*0.183*	*0.6*	*0.073*	*0.3027*	*1.00*	*0.3027*	*0.028*	*0.0084*	*3.7*
18	*18:09*	*4.05*	*0.6*	*0.107*	*0.6*	*0.043*	*0.6906*	*1.00*	*0.6906*	*0.016*	*0.0112*	*5.0*
19	*18:11*	*4.21*	*0.6*	*0.091*	*0.6*	*0.037*	*0.5112*	*1.00*	*0.5112*	*0.014*	*0.0071*	*3.1*
20	*18:13*	*4.36*	*0.6*	*0.101*	*0.6*	*0.040*	*0.2690*	*1.00*	*0.2690*	*0.015*	*0.0041*	*1.8*
21	18:14	4.51	0.6	0.122	0.6	0.049	0.5819	1.00	0.5819	0.019	0.0108	4.8
22	18:15	4.66	0.6	0.116	0.6	0.046	0.5760	1.00	0.5760	0.018	0.0102	4.5
23	18:16	4.82	0.6	0.076	0.6	0.030	0.1952	1.00	0.1952	0.014	0.0027	1.2
24	18:16	5.03	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0

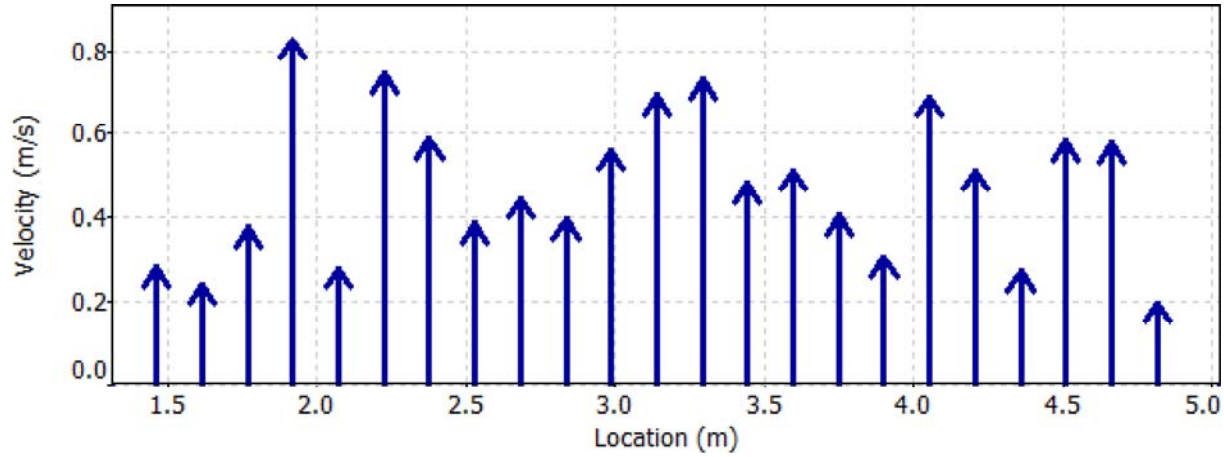
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

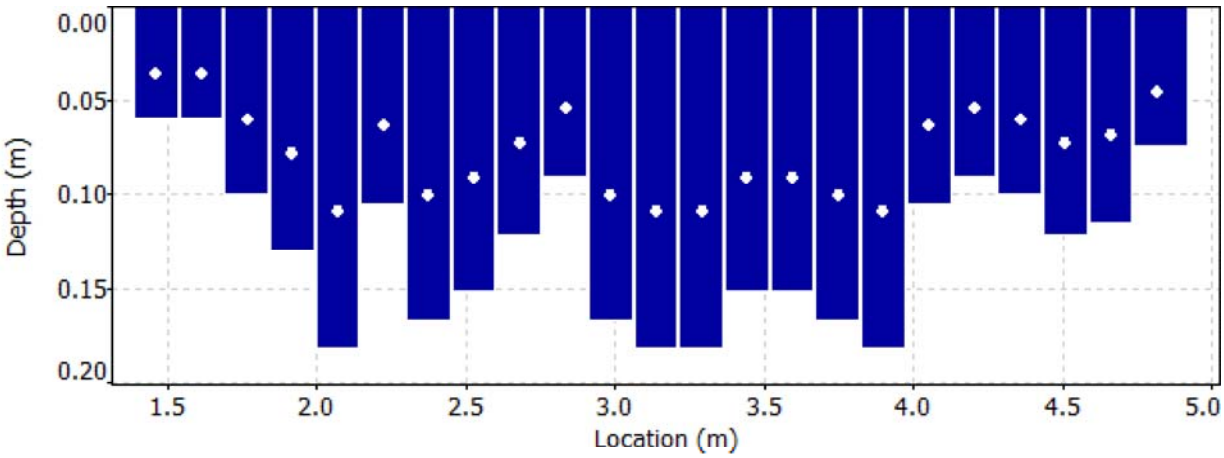
Discharge Measurement Summary

Date Generated: Mon Dec 18 2017

File Information		Site Details	
File Name	WMVCAHGD.001.WAD	Site Name	W MARVINE C AB DITCH
Start Date and Time	2017/06/28 17:49:32	Operator(s)	BRIAN EPSTEIN







Discharge Measurement Summary

Date Generated: Mon Dec 18 2017

File Information

File Name	WMVCAHGD.001.WAD
Start Date and Time	2017/06/28 17:49:32

Site Details

Site Name	W MARVINE C AB DITCH
Operator(s)	BRIAN EPSTEIN

Quality Control

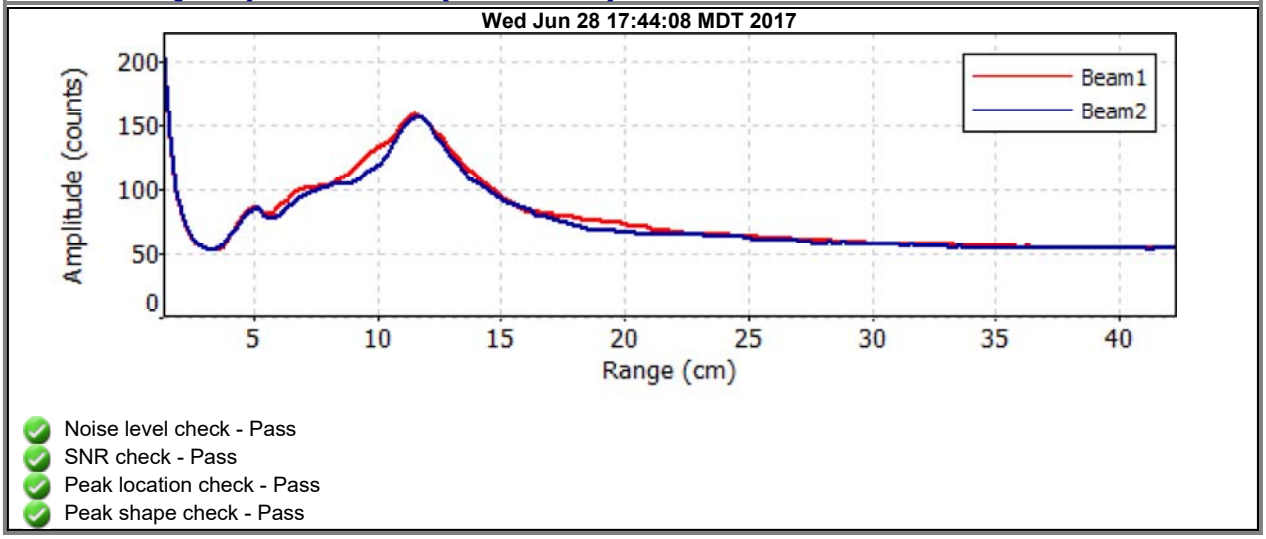
St	Loc	%Dep	Message
5	2.07	0.6	High standard error: 0.041
9	2.68	0.6	High standard error: 0.034
12	3.14	0.6	High angle: -20
14	3.44	0.6	High angle: -23
		0.6	High standard error: 0.035
15	3.60	0.6	High angle: -20
		0.6	High standard error: 0.048
16	3.75	0.6	High standard error: 0.041
17	3.90	0.6	High angle: -33
		0.6	High standard error: 0.044
18	4.05	0.6	High angle: -27
19	4.21	0.6	High standard error: 0.030
20	4.36	0.6	High standard error: 0.031

Discharge Measurement Summary

Date Generated: Mon Dec 18 2017

File Information		Site Details	
File Name	WMVCAHGD.001.WAD	Site Name	W MARVINE C AB DITCH
Start Date and Time	2017/06/28 17:49:32	Operator(s)	BRIAN EPSTEIN

Automatic Quality Control Test (BeamCheck)



- Noise level check - Pass
- SNR check - Pass
- Peak location check - Pass
- Peak shape check - Pass

West Marvine Creek, at West Marvine Ditch headgate.

West Marvine Creek, dry channel below West Marvine Ditch headgate.

West Marvine Creek, Cross Section 1, looking upstream.

West Marvine Creek, Cross Section 1, looking downstream.

West Marvine Creek, Cross Section 1, looking upstream.

West Marvine Creek, Cross Section 2, looking upstream.

West Marvine Creek, Cross Section 2, looking downstream.

West Marvine Creek, Cross Section 2, looking across from left bank.