COLORADO
Parks and Wildlife
Department of Natural Resources

Aquatic Wildlife Section
6060 Broadway
Denver, CO 80216

January 7, 2026

Rob Viehl, Section Chief
Stream and Lake Protection Section
Colorado Water Conservation Board
1313 Sherman Street, 7th Floor
Denver, CO 80203

Re: Instream Flow Recommendations for Streams in Water Division 2, Custer County;
Cottonwood Creek, to be presented at the January 2026 CWCB Meeting

Dear Mr. Viehl:

The information contained within and referred to in this letter forms the scientific and biological basis for an instream flow (ISF) recommendation on Cottonwood Creek in Water Division 2. Cottonwood Creek is a headwaters stream that flows east out of the Sangre de Cristo Mountains towards the town of Westcliffe. Cottonwood Creek supports a population of cutthroat trout referred to as "Hayden Creek cutthroat." Hayden Creek cutthroat trout are a lineage of cutthroat trout with unique genetic markers dating back to early samples collected in the Arkansas Basin. Conservation of this subspecies of cutthroat is important to CPW, which is why field investigations to quantify an ISF recommendation were initiated in 2019. Field investigations were completed in 2025. This ISF recommendation was first presented to interested parties at the ISF Workshop in 2020. CPW and CWCB staff conducted outreach to the Custer County Commissioners in January 2026. It is CPW staff's opinion that the information contained in this letter is sufficient for the CWCB's staff to recommend an ISF appropriation to the Board on Cottonwood Creek as it specifically addresses the findings required in Rule 5(i) of the Instream Flow Program Rules.

CPW participates in the ISF Program and develops ISF recommendations for the Board's consideration in an effort to address CPW's legislative directives "… 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" [§33-1-101 (1) C.R.S.], and "… that the natural, scenic, scientific, and outdoor recreation areas … 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 acquisition, development, and management of … lands, waters, and facilities." [§33-10-101 (1) C.R.S.].

In addition to these broad statutory guidelines, CPW's strategic planning document (CPW Strategic Plan, 2015) explains the agency's current 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 informed by the State Wildlife Action Plan (SWAP 2015, Revised 2025). The aforementioned documents direct CPW to advocate for the preservation of the state's fish and wildlife resources and natural environment, thereby linking CPW's mission to the goals and priorities of CWCB's Instream Flow and Natural Lake Level Program.

Recommended Segments & Land Status

CPW is recommending an ISF water right on Cottonwood Creek from its headwaters (13S 446587.20 4210367.96) to the USFS boundary (13S 451493.06 4213216.70). The reach is approximately 4.1 miles in length and is entirely located on USFS lands, managed as part of the Sangre de Cristo Wilderness.

Natural Environment and Biological Summary

Cottonwood Creek is a first-order tributary of Alvarado Creek, although its surface water is physically disconnected. The headwaters of Cottonwood Creek originate at 13,000 feet in the Sangre de Cristo Range between Comanche Peak and Fluted Peak. Cottonwood Creek flows easterly towards the town of Westcliffe. Once Cottonwood Creek hits the valley floor west of Westcliffe, it goes subsurface. The watershed is approximately 2.7 square miles in size and is densely forested. Hydrology of the creek is driven by snowmelt runoff with perennial baseflows through the recommended reach. Mean annual precipitation in the basin is 34 inches. Cottonwood Creek is a steep, cascading stream with coarse substrate that ranges from small gravel to large cobble. Large substrate like small boulders and large woody debris in the channel provide moderately sized pools that provide good habitat for small fish. There are small pockets of gravel that provide the resident fish population with spawning habitat. Large woody debris and overhead cover is abundant.

CPW is working to establish Hayden Creek cutthroat in Cottonwood Creek. Hayden Creek cutthroat are a unique lineage of cutthroat trout that have genetic markers which date back to early samples collected in the Arkansas Basin. As part of the recovery strategy, CPW actively stocked Hayden Creek cutthroat trout in Cottonwood Creek for the three consecutive years between 2019 through 2021. Since then, CPW has observed good survival rates among stocked fish, indicating favorable habitat conditions that support a self-sustaining population of cutthroat trout. Establishing new populations of Hayden Creek cutthroat trout and

protecting the habitat where these populations reside are critical steps to the successful recovery of the subspecies. Yellowfin cutthroat trout, which were native to the Arkansas Basin, are considered extinct; therefore, the Hayden Creek cutthroat is the closest analog to a native Arkansas River Basin cutthroat trout. They are also considered Tier 1 Species of Greatest Conservation Need (SGCN) according to CPW's State Wildlife Action Plan.

R2Cross Background

Initial biological instream flow rates were developed using the R2Cross methodology (CWCB, 2024[1]). R2Cross uses field data that has been collected in a riffle habitat type. Riffles are often the limiting habitat features in streams during low flow events, so maintaining specific hydraulic conditions across riffle habitat types will also maintain aquatic habitat in pools and runs for most life stages of fish and macroinvertebrates (Nehring, 1979[2]). The R2Cross model uses field data, including a survey of cross-sectional channel geometry, a longitudinal slope of the water surface, and a flow measurement as input to a single transect hydraulic model. R2Cross uses Ferguson's Variable-Power Equation (Ferguson, 2007[3]) to model a stage-discharge relationship and compute corresponding hydraulic parameters of average depth, average velocity, and percent wetted perimeter over modeled stages. Maintaining these three hydraulic parameters at specified levels should ensure conditions that allow movement of fish longitudinally across riffles and adequate depths, velocities, and oxygenation for production of macroinvertebrates and development of trout eggs. Baseflow recommendations are typically developed based on the flows that meet two of three hydraulic criteria and summer flow recommendations are based on hydraulic criteria that meet three of three hydraulic criteria (as described in Nehring 1979 and CWCB 2024).

In 2025, Jay Skinner with Western Resource Advocates was hired to assist CPW and CWCB in collecting R2Cross data. Jay Skinner is a retired CPW ISF Program Coordinator with extensive R2Crosss experience. Mr. Skinner and CWCB staff collected five cross-section data sets on Cottonwood Creek. The results of the R2Cross analysis are summarized below.

	Bankfull Top Width	Date Measured	Flow measured	Flow Meeting Two Criteria	Flow Meeting Three Criteria
1	11.9'	6/10/2025	10.7 cfs	0.91 cfs	4.07 cfs
2	21.5'	6/10/2025	10.7 cfs	4.80 cfs	13.97 cfs
3	13.5'	6/10/2025	10.7 cfs	0.39 cfs	5.86 cfs

[1]Colorado Water Conservation Board, 2024, R2Cross field manual. https://dnrweblink.state.co.us/cwcbsearch/0/edoc/224685/R2Cross%20Field%20Manual%202024.pdf
[2]Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.
[3] Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

4	15.4'	6/10/2025	10.7 cfs	1.38 cfs	1.95 cfs
5	13.6'	6/10/2025	10.7 cfs	0.34 cfs	5.51 cfs
		Recommended Biological Flow Rates		**1.6 cfs**	**6.3 cfs**

The biological flow recommendation during the baseflow period is 1.6 cfs. This flow rate will provide sufficient wetted perimeter and depth criteria across all surveyed riffle cross-sections. The biological flow recommendation during the high flow period is 6.3 cfs, which will maintain average depth of at least 0.2 feet, at least 50 percent wetted perimeter of the stream channel, and average velocity of 1.0 feet per second (fps).

In order to make a preliminary determination whether water is available for the R2Cross-based flow recommendations and to determine the appropriate seasonal transition dates, CPW examined basic hydrologic data and water rights information for Cottonwood Creek. Cottonwood Creek does not have any gage data, so CWCB staff used a neighboring gage (USGS 7094900 "Middle Taylor Creek near Westcliffe, CO") which was operational between 1974 and 1985). Median hydrology was prorated based on a weighted area-precipitation factor. CPW is not aware of any active water rights within the reach, although there are a number of active diversions downstream of the proposed ISF reach.

Final Flow Recommendations:

CPW's analysis indicates that the following flows are needed to protect the natural environment to a reasonable degree. Based on median hydrology analyzed by CWCB staff, there are slight modifications to the biological flow recommendations due to water availability during the fall and baseflow periods. Therefore, CPW's refined flow recommendations are the following:

- Spring Flow Recommendation (April 16 through May 16): **1.0 cfs**
  - This flow rate will maintain sufficient depth and wetted perimeter criteria, and high velocities (less than 1.0 fps). This will support movement of cutthroat trout as they transition from overwintering conditions as snowmelt begins. The inclusion of this early spring flow target also recognizes that earlier spring runoff may become a reality in a changing climate.
- Summer Flow Recommendation (May 17 through July 10): **6.3 cfs**
  - This flow rate will maintain adequate depth, velocity, and wetted perimeter criteria during spring runoff, its receding limb, and early summer. This flow rate supports beneficial feeding and spawning conditions for cutthroat trout as they mature and grow. Cutthroat trout exhibit increased activity during the summer, resulting in heightened metabolic activity. This flow rate provides sufficient aquatic habitat which is beneficial for both fish and macroinvertebrates.

  - Late Summer Flow Recommendation (July 11 through August 31): **1.7 cfs**

- This flow rate will support sufficient depth and wetted perimeter, as well as moderately high velocities (less than 1.0 fps). Most trout growth occurs during summer when longer days and warmer water temperatures facilitate growth. Late summer is a crucial period for cutthroat trout, making increased aquatic habitat availability beneficial for fish and macroinvertebrates from late July through August.

- Fall Flow Recommendation (September 1 through November 30): **0.75 cfs**

  - This flow rate has been reduced due to water availability constraints but will support adequate wetted perimeter and habitat availability in deep habitat features like glides and pools.

- Winter Baseflow Recommendation (December 1 through April 15): **0.4 cfs**

  - This flow rate has been reduced due to water availability constraints, but will still support adequate habitat availability and will provide sufficient areas of holding habitat in pools and glides to support overwintering fish.

The purpose of this letter is to formally transmit this ISF recommendation to CWCB for the Board's consideration. Based on CPW's opinion, there is a flow-dependent natural environment in Cottonwood Creek that can be preserved to a reasonable degree with an ISF water right in the recommended rates. Please refer to attachments which include; R2Cross field forms, R2Cross output, fish survey information, and photographs at each cross section location.

CPW personnel will be available at the January 2026 CWCB meeting to answer any questions that the Board might have regarding these flow recommendations. We appreciate your consideration.

Sincerely,

Katie Birch
Digitally signed by Katie Birch
Date: 2026.01.07 13:16:02
-07'00'

Katie Birch, CPW Instream Flow Program Coordinator

#1

Dist	Elev	d	Dist	Elev	d
S O	2.30				
BF 0.7	3.85				
1.9	4.75				
4	5.10				
WL 4.3	5.40	0			
5	5.75	.3			
6	5.85	.45			
7	6.00	.6			
8	6.30	1.0			
9	6.35	1.05			
10	6.40	1.1			
11	6.00	.7			
12	5.9	.7			
13	5.75	.45			
14	5.55	.2			
WL 14.2	5.32	0			
14.7	5.2				
BFS 15.3	5.00				

	Elev	drop
U/S	5.25	5.5
DS	5.37	3.3

$$\frac{0.12}{8.8} =$$

WL   5.32 / 5.40

#2

Dist	Elev	d	Dist	Elev	d
SBM 25	6.99				
23	8.15				
WL 21	8.15	0			
20	8.40	0.25			
19	9.05	.85			
18	9.30	1.20			
17	9.25	1.10			
16	9.15	1.0			
15	9.15	1.0			
14	9.30	1.15			
13	9.25	1.1			
12	9.35	1.2			
11	9.10	0.95			
10	8.8	0.65			
9	8.45	.25			
WL 8.2	8.20	0			
7	8.10				
5	7.50				
BM 3	6.80				
S 0	5.6				

	Elev	Dist
U/S	7.99	11.9
D/S	8.26	↑

$$S \sim \frac{0.27}{12.9} =$$

WL 8.15 / 8.20

#3

Dist	Elev	depth
S 19.3	10.35	
BP 17.5	10.70	
WL 17.2	12.05	0
16	12.60	0.7
15	12.85	0.9
14	13.25	1.25
13	13.00	1.00
12	12.7	0.7
11	12.6	0.6
10	12.6	0.6
9	12.65	0.7
8	12.80	0.9
7	12.33	0.4
WL 6.5	11.93	0
BP 4	10.9	
S 0	9.15	

	Elev	Dist
U/S	12.03	6
D/S	12.25	2

$$S = \frac{0.22}{8} =$$

W/L 11.93 / 12.05

#4

Dist	Elev	d	Dist	Elev	d
S 0	5.40		15	7.70	.05
BF 1.6	6.60			7.65	.45
1.9	6.70		16	7.40	.4
5.2	6.60			7.65	.4
WL 5.9	7.18	0	WL 16.3	7.22	0
6.5	7.65	0.35	BF 17.3	6.05	
7	7.50	.1	S 18.3	5.80	
.5	7.45	.2			
8	7.45	.05			
	7.45	.05			
9	8.00	0.7			
	8.05	0.65			
10	7.90	0.55			
	7.90	0.6			
11	7.80	.55			
	7.75	.5			
12	7.75	.55			
	7.85	.65			
13	7.85	.6			
	7.75	.5			
14	7.70	.5			
	7.70	.5			

	Elev	Dist
U/S	7.06	8.9
D/S	7.53	2.6

$$S = \frac{0.44}{11.5} =$$

WL 7.18 / 7.22

Cottonwo... THE RI...
CcK DV? 6/10/25 culvert W...

#6

Dist	Elev	d	Dist	Elev	d
S 17.1	2.25				
BF 16	2.8				
14	3.15				
WL 12.0	3.46	0			
12	4.15	.65			
11	4.25	.85			
10	4.15	.7			
9	4.2	.75			
8	4.40	1.0			
7	4.40	1.0			
6	4.5	1.1			
5	4.35	.9			
4	4.05	.7			
3	3.45	.4			
WL 2.7	3.38	0			
BF 1.8	1.85				

	Elev	Dist
U/S	3.01	13
D/S	3.35	3.2

$$S = \frac{0.34}{16.2} =$$

WL — 3.38 / 3.46

R2Cross RESULTS

Stream Name: Cottonwood Ck
Stream Locations: At Rainbow Trail
Fieldwork Date: 06/10/2025
Cross-section: 1
Observers: WRA CWCB
Coordinate System: UTM Zone 13
X (easting): 449776.5
Y (northing): 4212761.91
Date Processed: 12/09/2025
Slope: 0.0136
Discharge: Entered Value: 10.69 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: Cottonwood Ck 2025 1.xlsx
R2Cross version: 2.0.4

LOCATION

R2Cross RESULTS: Cottonwood Ck - 06/10/2025 XS 1, Analysis Method: [Ferguson VPE]
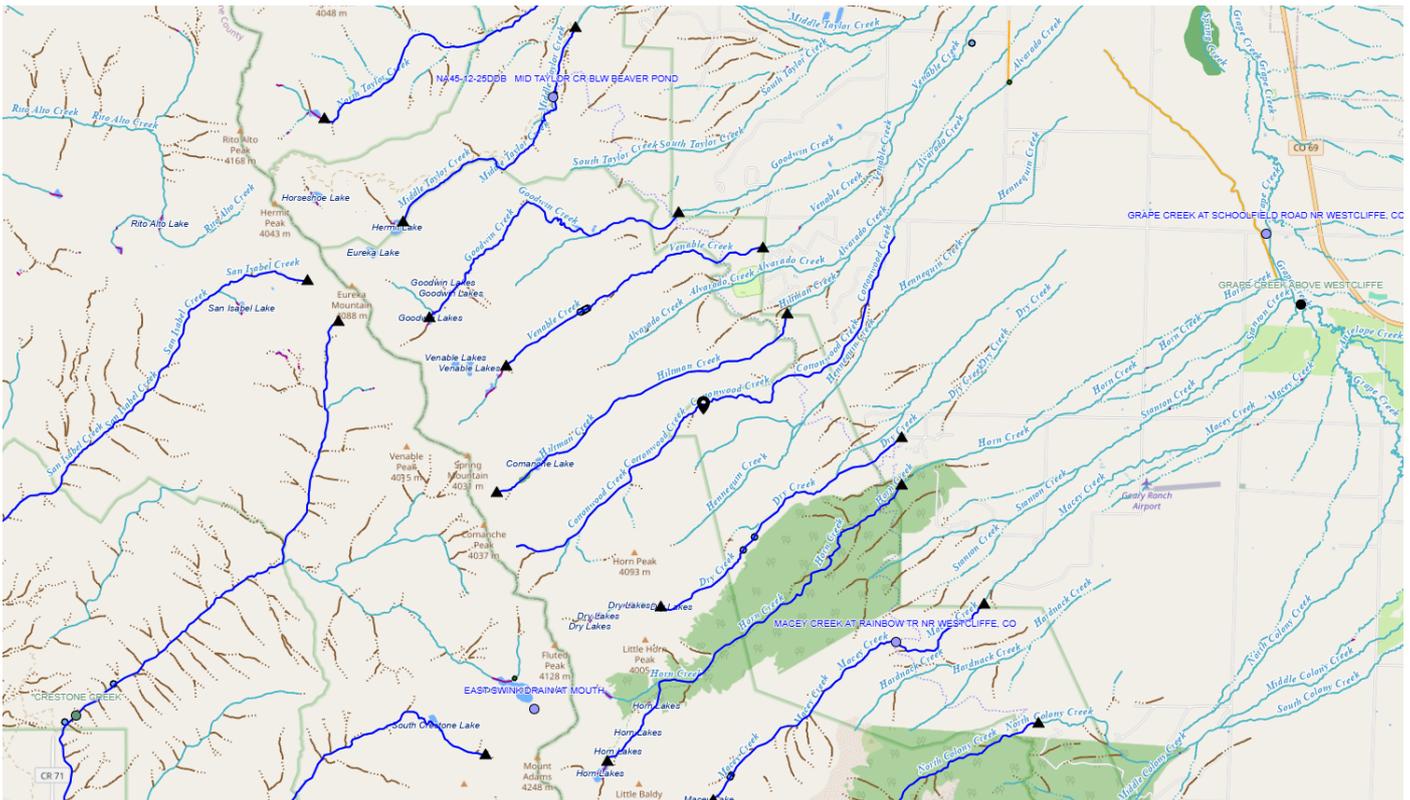
ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 11.9

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	0.22
Percent Wetted Perimeter (%)	50.0	0.91
Mean Velocity (ft/s)	1.0	4.07

STAGING TABLE

Feature	Distance to Water (ft)	Top Width (ft)	Mean Depth (ft)	Maximum Depth (ft)	Area (sq ft)	Wetted Perimeter (ft)	Percent Wetted Perimeter	Hydraulic Radius (ft)	Manning's n	Mean Velocity (ft/s)	Discharge (cfs)
Bankfull	5.0	11.9	0.83	1.4	9.94	12.45	100.0	0.8	0.07	2.28	22.63
	5.03	11.58	0.83	1.37	9.58	12.13	97.42	0.79	0.07	2.25	21.55
	5.08	11.06	0.82	1.32	9.02	11.6	93.13	0.78	0.07	2.2	19.88
	5.13	10.68	0.79	1.27	8.48	11.2	89.96	0.76	0.07	2.13	18.04
	5.18	10.41	0.76	1.22	7.95	10.9	87.54	0.73	0.07	2.03	16.14
	5.23	10.22	0.73	1.17	7.43	10.68	85.76	0.7	0.07	1.91	14.21
	5.28	10.09	0.69	1.12	6.93	10.51	84.42	0.66	0.07	1.78	12.33
Waterline	5.33	9.96	0.64	1.07	6.42	10.35	83.12	0.62	0.08	1.65	10.57
	5.38	9.87	0.6	1.02	5.93	10.21	82.02	0.58	0.08	1.5	8.92
	5.43	9.74	0.56	0.97	5.44	10.05	80.72	0.54	0.08	1.37	7.44
	5.48	9.6	0.52	0.92	4.95	9.87	79.29	0.5	0.09	1.24	6.12
	5.53	9.46	0.47	0.87	4.48	9.69	77.86	0.46	0.09	1.1	4.94
	5.58	9.19	0.44	0.82	4.01	9.4	75.52	0.43	0.1	0.99	3.96
	5.63	8.84	0.4	0.77	3.56	9.04	72.57	0.39	0.11	0.88	3.14
	5.68	8.49	0.37	0.72	3.13	8.67	69.63	0.36	0.11	0.78	2.44
	5.73	8.14	0.33	0.67	2.71	8.3	66.68	0.33	0.12	0.68	1.83
	5.78	7.5	0.31	0.62	2.32	7.65	61.46	0.3	0.13	0.61	1.41
	5.83	6.67	0.29	0.57	1.96	6.81	54.71	0.29	0.13	0.56	1.11
	5.88	5.93	0.28	0.52	1.65	6.07	48.77	0.27	0.14	0.52	0.86
	5.93	5.17	0.27	0.47	1.37	5.3	42.56	0.26	0.15	0.48	0.66
	5.98	4.33	0.26	0.42	1.13	4.46	35.81	0.25	0.15	0.47	0.53
	6.03	3.82	0.24	0.37	0.93	3.94	31.63	0.24	0.16	0.42	0.4
	6.08	3.53	0.21	0.32	0.75	3.63	29.15	0.21	0.17	0.35	0.26
	6.13	3.24	0.18	0.27	0.58	3.32	26.67	0.17	0.2	0.27	0.16
	6.18	2.95	0.14	0.22	0.42	3.01	24.19	0.14	0.24	0.2	0.08

R2Cross RESULTS: Cottonwood Ck - 06/10/2025 XS 1, Analysis Method: [Ferguson VPE]

6.23	2.66	0.11	0.17	0.28	2.7	21.72	0.11	0.3	0.13	0.04
6.28	2.37	0.07	0.12	0.16	2.4	19.24	0.07	0.44	0.06	0.01
6.33	1.57	0.03	0.07	0.06	1.59	12.77	0.03	0.76	0.02	0.0
6.38	0.45	0.01	0.02	0.0	0.45	3.65	0.01	2.14	0.0	0.0
6.38	0.34	0.01	0.01	0.0	0.34	2.74	0.01	2.72	0.0	0.0

This Manning's roughness coefficient was calculated based on velocity estimates from the Ferguson VPE method

MODEL SUMMARY

Measured Flow (Qm) =	10.69	(cfs)
Calculated Flow (Qc) =	10.63	(cfs)
(Qm-Qc)/Qm * 100 =	0.56%	
Measured Waterline (WLm) =	5.36	(ft)
Calculated Waterline (WLc) =	5.33	(ft)
(WLm-WLc)/WLm * 100 =	0.56%	
Max Measured Depth (Dm) =	1.1	(ft)
Max Calculated Depth (Dc) =	1.07	(ft)
(Dm-Dc)/Dm * 100 =	2.73%	
Mean Velocity =	1.65	(ft/s)
Manning's n =	0.076	
0.4 * Qm =	4.28	(cfs)
2.5 * Qm =	26.73	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	2.3		
Bankfull	0.7	3.85		
	1.9	4.75		
	4	5.1		
Waterline	4.3	5.4	0	
	5	5.75	0.3	
	6	5.85	0.45	
	7	6	0.6	
	8	6.3	1	
	9	6.35	1.05	
	10	6.4	1.1	
	11	6	0.7	
	12	5.9	0.7	
	13	5.75	0.45	
	14	5.55	0.2	
Waterline	14.2	5.32	0	
	14.4	5.2		
Bankfull	15.3	5		

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.78	0.3	0.26	0.42	3.97
1	0.45	0.45	0.75	7
1.01	0.6	0.6	1	9.34
1.04	1	1	1.66	15.56
1	1.05	1.05	1.75	16.34
1	1.1	1.1	1.83	17.12
1.08	0.7	0.7	1.16	10.89
1	0.7	0.7	1.16	10.89
1.01	0.45	0.45	0.75	7
1.02	0.2	0.12	0.2	1.87
0.3	0	0	0	0
0	0	0	0	0
0	0	0	0	0

R2Cross RESULTS: Cottonwood Ck - 06/10/2025 XS 1, Analysis Method: [Ferguson VPE]

DISCLAIMER

"The Colorado Water Conservation Board makes no representations about the use of the software contained in the R2Cross platform for any purpose besides that for which it was designed. To the maximum extent permitted by applicable law, all information, modeling results, and software are provided "as is" without warranty or condition of any kind, including all implied warranties or conditions of merchantability, or fitness for a particular purpose. The user assumes all responsibility for the accuracy and suitability of this program for a specific application. In no event shall the Colorado Water Conservation Board or any state agency, official or employee be liable for any direct, indirect, punitive, incidental, special, consequential damages or any damages whatsoever including, without limitation, damages for loss of use, data, profits, or savings arising from the implementation, reliance on, or use of or inability to use the R2Cross platform.

R2Cross RESULTS

Stream Name: Cottonwood Ck
Stream Locations: At Rainbow Trail
Fieldwork Date: 06/10/2025
Cross-section: 2
Observers: WRS1A CWCB
Coordinate System: UTM Zone 13
X (easting): 449776.5
Y (northing): 4212761.91
Date Processed: 12/08/2025
Slope: 0.021
Discharge: Entered Value: 10.7 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: Cottonwood Ck 2025 2.xlsx
R2Cross version: 2.0.4

LOCATION

R2Cross RESULTS: Cottonwood Ck - 06/10/2025 XS 2, Analysis Method: [Ferguson VPE]
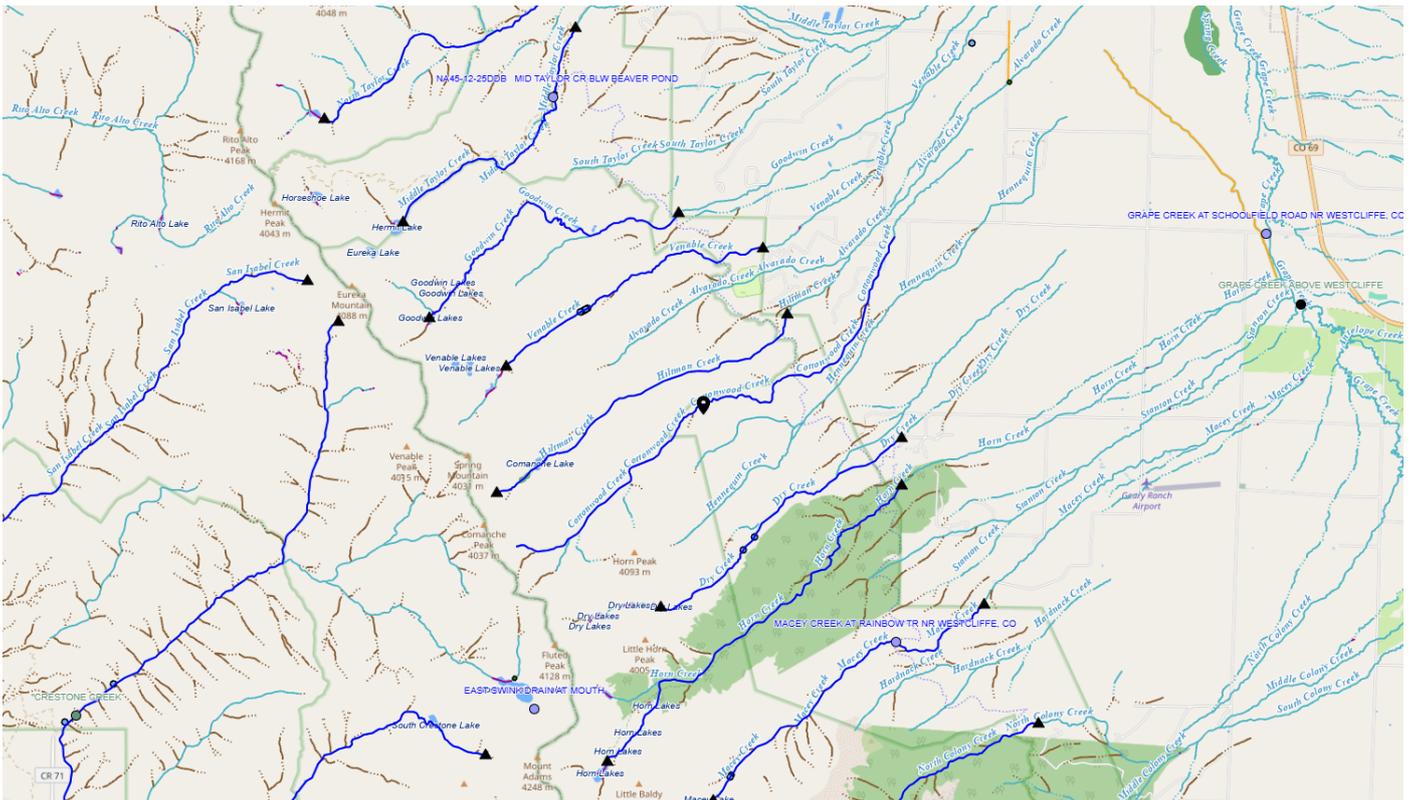
ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 21.46

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.215	0.25
Percent Wetted Perimeter (%)	50.0	4.8
Mean Velocity (ft/s)	1.0	13.97

STAGING TABLE

Feature	Distance to Water (ft)	Top Width (ft)	Mean Depth (ft)	Maximum Depth (ft)	Area (sq ft)	Wetted Perimeter (ft)	Percent Wetted Perimeter	Hydraulic Radius (ft)	Manning's n	Mean Velocity (ft/s)	Discharge (cfs)
Bankfull	6.99	21.46	1.51	2.36	32.45	22.4	100.0	1.45	0.12	2.32	75.21
	7.01	21.38	1.5	2.34	32.11	22.32	99.64	1.44	0.12	2.29	73.69
	7.06	21.15	1.47	2.29	31.05	22.07	98.52	1.41	0.12	2.22	69.06
	7.11	20.93	1.43	2.24	29.99	21.82	97.4	1.37	0.12	2.15	64.61
	7.16	20.7	1.4	2.19	28.95	21.57	96.28	1.34	0.13	2.08	60.32
	7.21	20.47	1.36	2.14	27.92	21.31	95.16	1.31	0.13	2.01	56.21
	7.26	20.24	1.33	2.09	26.91	21.06	94.04	1.28	0.13	1.94	52.27
	7.31	20.01	1.29	2.04	25.9	20.81	92.92	1.24	0.13	1.87	48.49
	7.36	19.78	1.26	1.99	24.91	20.56	91.8	1.21	0.14	1.8	44.88
	7.41	19.55	1.22	1.94	23.92	20.31	90.68	1.18	0.14	1.73	41.43
	7.46	19.32	1.19	1.89	22.95	20.06	89.56	1.14	0.14	1.66	38.14
	7.51	19.09	1.15	1.84	21.99	19.81	88.42	1.11	0.15	1.59	35.01
	7.56	18.84	1.12	1.79	21.04	19.53	87.2	1.08	0.15	1.52	32.09
	7.61	18.58	1.08	1.74	20.11	19.26	85.98	1.04	0.15	1.46	29.32
	7.66	18.33	1.05	1.69	19.18	18.98	84.76	1.01	0.16	1.39	26.69
	7.71	18.08	1.01	1.64	18.27	18.71	83.54	0.98	0.16	1.32	24.2
	7.76	17.83	0.97	1.59	17.38	18.44	82.31	0.94	0.16	1.26	21.86
	7.81	17.57	0.94	1.54	16.49	18.16	81.09	0.91	0.17	1.19	19.66
	7.86	17.32	0.9	1.49	15.62	17.89	79.87	0.87	0.17	1.13	17.59
	7.91	17.07	0.86	1.44	14.76	17.62	78.65	0.84	0.18	1.06	15.66
	7.96	16.81	0.83	1.39	13.91	17.34	77.43	0.8	0.19	1.0	13.86
	8.01	16.56	0.79	1.34	13.08	17.07	76.21	0.77	0.19	0.93	12.18
	8.06	16.31	0.75	1.29	12.26	16.8	74.98	0.73	0.2	0.87	10.63
	8.11	16.0	0.72	1.24	11.45	16.47	73.53	0.69	0.21	0.81	9.25
Waterline	8.16	13.3	0.8	1.19	10.68	13.76	61.42	0.78	0.19	0.95	10.13

R2Cross RESULTS: Cottonwood Ck - 06/10/2025 XS 2, Analysis Method: [Ferguson VPE]

8.21	12.56	0.8	1.14	10.03	13.0	58.04	0.77	0.19	0.94	9.44
8.26	12.2	0.77	1.09	9.41	12.63	56.37	0.75	0.2	0.89	8.42
8.31	11.84	0.74	1.04	8.81	12.25	54.7	0.72	0.2	0.85	7.48
8.36	11.48	0.72	0.99	8.23	11.88	53.03	0.69	0.21	0.8	6.61
8.41	11.13	0.69	0.94	7.66	11.52	51.42	0.67	0.22	0.76	5.81
8.46	10.9	0.65	0.89	7.11	11.26	50.27	0.63	0.23	0.7	4.99
8.51	10.68	0.62	0.84	6.57	11.02	49.19	0.6	0.24	0.65	4.24
8.56	10.46	0.58	0.79	6.04	10.77	48.1	0.56	0.25	0.59	3.56
8.61	10.24	0.54	0.74	5.53	10.53	47.02	0.52	0.26	0.53	2.95
8.66	10.02	0.5	0.69	5.02	10.29	45.93	0.49	0.28	0.48	2.41
8.71	9.8	0.46	0.64	4.53	10.05	44.85	0.45	0.3	0.43	1.93
8.76	9.58	0.42	0.59	4.04	9.8	43.76	0.41	0.32	0.37	1.51
8.81	9.36	0.38	0.54	3.57	9.56	42.66	0.37	0.35	0.32	1.15
8.86	9.11	0.34	0.49	3.11	9.29	41.48	0.33	0.38	0.27	0.85
8.91	8.87	0.3	0.44	2.66	9.02	40.29	0.29	0.42	0.23	0.6
8.96	8.62	0.26	0.39	2.22	8.76	39.11	0.25	0.48	0.18	0.4
9.01	8.38	0.21	0.34	1.79	8.49	37.92	0.21	0.55	0.14	0.25
9.06	8.12	0.17	0.29	1.38	8.21	36.67	0.17	0.67	0.1	0.14
9.11	7.75	0.13	0.24	0.98	7.83	34.96	0.13	0.85	0.06	0.06
9.16	6.25	0.1	0.19	0.61	6.32	28.2	0.1	1.06	0.04	0.03
9.21	5.02	0.07	0.14	0.33	5.07	22.62	0.07	1.47	0.02	0.01
9.26	3.55	0.03	0.09	0.11	3.57	15.96	0.03	2.73	0.01	0.0
9.31	0.62	0.02	0.04	0.01	0.62	2.79	0.02	3.67	0.0	0.0
9.34	0.21	0.01	0.02	0.0	0.21	0.95	0.01	9.01	0.0	0.0

This Manning's roughness coefficient was calculated based on velocity estimates from the Ferguson VPE method

MODEL SUMMARY

Measured Flow (Qm) =	10.7	(cfs)
Calculated Flow (Qc) =	10.44	(cfs)
(Qm-Qc)/Qm * 100 =	2.46%	
Measured Waterline (WLm) =	8.18	(ft)
Calculated Waterline (WLc) =	8.16	(ft)
(WLm-WLc)/WLm * 100 =	0.23%	
Max Measured Depth (Dm) =	1.2	(ft)
Max Calculated Depth (Dc) =	1.19	(ft)
(Dm-Dc)/Dm * 100 =	0.50%	
Mean Velocity =	0.98	(ft/s)
Manning's n =	0.186	
0.4 * Qm =	4.28	(cfs)
2.5 * Qm =	26.75	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	5.6		
Bankfull	3	6.8		
	5	7.5		
	7	8.1		
Waterline	8.2	8.2	0	
	9	8.45	0.25	
	10	8.8	0.65	
	11	9.1	0.95	
	12	9.35	1.2	
	13	9.25	1.1	
	14	9.3	1.15	
	15	9.15	1	
	16	9.15	1	
	17	9.25	1.1	
	18	9.3	1.2	
	19	9.05	0.85	
	20	8.4	0.25	
Waterline	21	8.15	0	
	23	8.15		
Bankfull	25	6.99		

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.84	0.25	0.23	0.23	2.11
1.06	0.65	0.65	0.65	6.09
1.04	0.95	0.95	0.95	8.9
1.03	1.2	1.2	1.2	11.24
1	1.1	1.1	1.1	10.3
1	1.15	1.15	1.15	10.77
1.01	1	1	1	9.37
1	1	1	1	9.37
1	1.1	1.1	1.1	10.3
1	1.2	1.2	1.2	11.24
1.03	0.85	0.85	0.85	7.96
1.19	0.25	0.25	0.25	2.34
1.03	0	0	0	0
0	0	0	0	0
0	0	0	0	0

R2Cross RESULTS: Cottonwood Ck - 06/10/2025 XS 2, Analysis Method: [Ferguson VPE]

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R2Cross RESULTS

Stream Name: Cottonwood Ck
Stream Locations: At Rainbow Trail
Fieldwork Date: 06/10/2025
Cross-section: 3
Observers: WRA CWCB
Coordinate System: UTM Zone 13
X (easting): 449776.5
Y (northing): 4212761.91
Date Processed: 12/09/2025
Slope: 0.0275
Discharge: Entered Value: 10.69 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: Cottonwood Ck 2025 3.xlsx
R2Cross version: 2.0.4

LOCATION
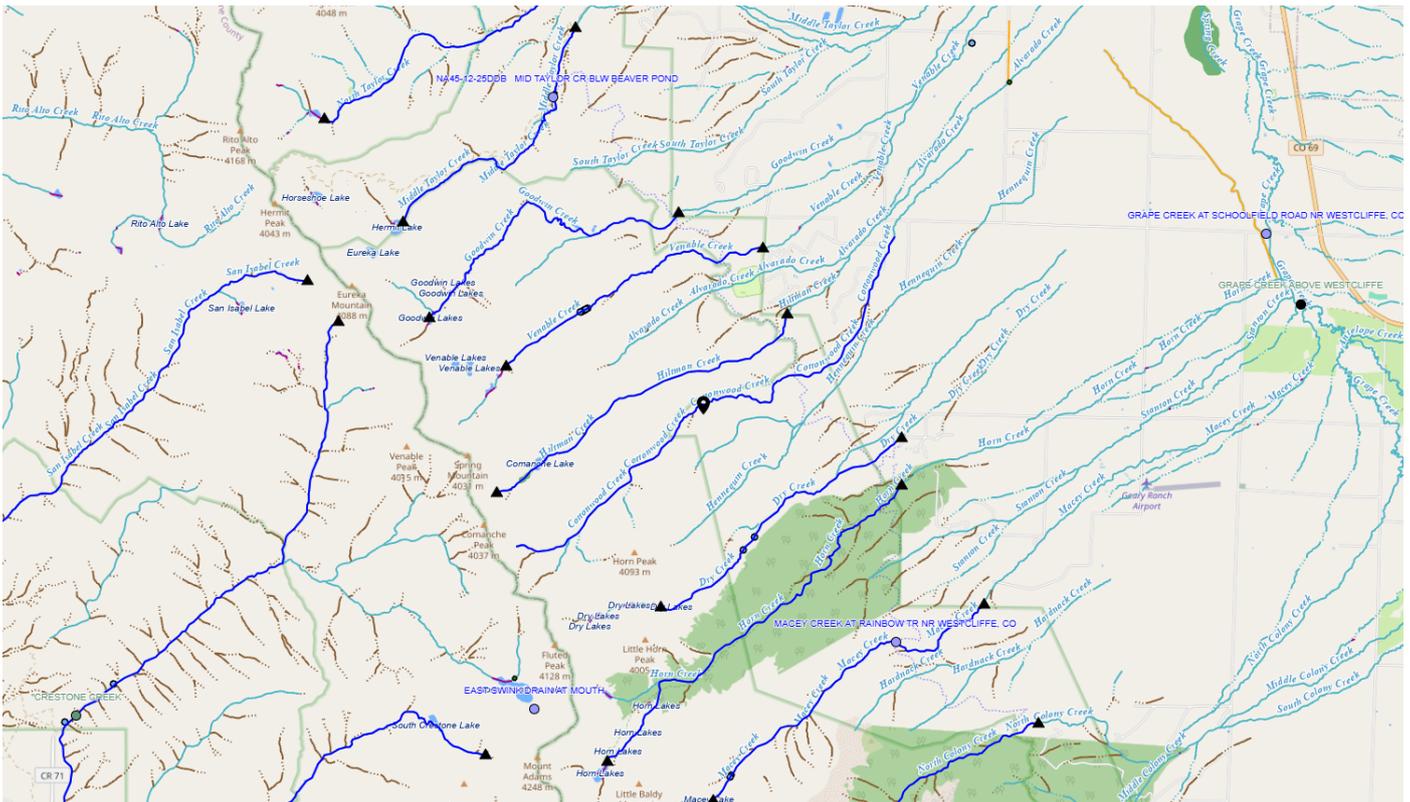
ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 13.46

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	0.1
Percent Wetted Perimeter (%)	50.0	0.39
Mean Velocity (ft/s)	1.0	5.86

STAGING TABLE

Feature	Distance to Water (ft)	Top Width (ft)	Mean Depth (ft)	Maximum Depth (ft)	Area (sq ft)	Wetted Perimeter (ft)	Percent Wetted Perimeter	Hydraulic Radius (ft)	Manning's n	Mean Velocity (ft/s)	Discharge (cfs)
Bankfull	10.9	13.46	1.53	2.35	20.59	15.15	100.0	1.36	0.08	3.57	73.45
	10.92	13.41	1.52	2.33	20.34	15.08	99.55	1.35	0.09	3.53	71.8
	10.97	13.27	1.48	2.28	19.67	14.9	98.34	1.32	0.09	3.43	67.53
	11.02	13.14	1.45	2.23	19.01	14.72	97.14	1.29	0.09	3.34	63.4
	11.07	13.01	1.41	2.18	18.36	14.54	95.93	1.26	0.09	3.24	59.41
	11.12	12.88	1.38	2.13	17.71	14.35	94.73	1.23	0.09	3.14	55.56
	11.17	12.74	1.34	2.08	17.07	14.17	93.52	1.2	0.09	3.04	51.85
	11.22	12.61	1.3	2.03	16.43	13.99	92.32	1.17	0.09	2.94	48.28
	11.27	12.48	1.27	1.98	15.81	13.81	91.12	1.14	0.1	2.84	44.85
	11.32	12.35	1.23	1.93	15.19	13.62	89.91	1.11	0.1	2.74	41.55
	11.37	12.21	1.19	1.88	14.57	13.44	88.71	1.08	0.1	2.63	38.39
	11.42	12.08	1.16	1.83	13.96	13.26	87.5	1.05	0.1	2.53	35.37
	11.47	11.95	1.12	1.78	13.36	13.08	86.3	1.02	0.1	2.43	32.47
	11.52	11.82	1.08	1.73	12.77	12.89	85.09	0.99	0.11	2.33	29.72
	11.57	11.68	1.04	1.68	12.18	12.71	83.89	0.96	0.11	2.22	27.09
	11.62	11.55	1.0	1.63	11.6	12.53	82.69	0.93	0.11	2.12	24.59
	11.67	11.42	0.97	1.58	11.03	12.35	81.48	0.89	0.11	2.02	22.23
	11.72	11.29	0.93	1.53	10.46	12.16	80.28	0.86	0.12	1.91	19.99
	11.77	11.15	0.89	1.48	9.9	11.98	79.07	0.83	0.12	1.81	17.89
	11.82	11.02	0.85	1.43	9.34	11.8	77.87	0.79	0.12	1.7	15.91
	11.87	10.89	0.81	1.38	8.8	11.62	76.66	0.76	0.13	1.6	14.05
	11.92	10.76	0.77	1.33	8.26	11.43	75.46	0.72	0.13	1.49	12.32
Waterline	11.97	10.67	0.72	1.28	7.72	11.29	74.53	0.68	0.14	1.38	10.66
	12.02	10.6	0.68	1.23	7.19	11.16	73.68	0.64	0.15	1.27	9.11
	12.07	10.49	0.63	1.18	6.66	11.01	72.66	0.6	0.15	1.16	7.71

12.12	10.32	0.59	1.13	6.14	10.81	71.35	0.57	0.16	1.06	6.49
12.17	10.16	0.55	1.08	5.63	10.61	70.05	0.53	0.17	0.96	5.38
12.22	9.99	0.51	1.03	5.12	10.42	68.74	0.49	0.18	0.86	4.4
12.27	9.82	0.47	0.98	4.63	10.22	67.44	0.45	0.19	0.76	3.52
12.32	9.65	0.43	0.93	4.14	10.02	66.13	0.41	0.21	0.66	2.75
12.37	9.46	0.39	0.88	3.66	9.81	64.72	0.37	0.22	0.57	2.1
12.42	9.24	0.35	0.83	3.2	9.56	63.12	0.33	0.24	0.49	1.55
12.47	9.02	0.3	0.78	2.74	9.32	61.52	0.29	0.27	0.4	1.1
12.52	8.8	0.26	0.73	2.29	9.08	59.93	0.25	0.31	0.32	0.74
12.57	8.58	0.22	0.68	1.86	8.84	58.33	0.21	0.36	0.24	0.45
12.62	6.76	0.22	0.63	1.46	7.0	46.18	0.21	0.36	0.24	0.35
12.67	5.2	0.22	0.58	1.17	5.42	35.74	0.22	0.35	0.25	0.29
12.72	4.18	0.22	0.53	0.93	4.37	28.85	0.21	0.35	0.25	0.23
12.77	3.37	0.22	0.48	0.74	3.53	23.32	0.21	0.36	0.24	0.18
12.82	2.73	0.22	0.43	0.59	2.87	18.92	0.21	0.36	0.24	0.14
12.87	2.39	0.2	0.38	0.47	2.51	16.59	0.19	0.4	0.2	0.09
12.92	2.1	0.17	0.33	0.35	2.2	14.55	0.16	0.45	0.16	0.06
12.97	1.81	0.14	0.28	0.26	1.9	12.51	0.14	0.51	0.13	0.03
13.02	1.5	0.12	0.23	0.17	1.58	10.4	0.11	0.61	0.09	0.02
13.07	1.18	0.09	0.18	0.11	1.23	8.15	0.09	0.74	0.06	0.01
13.12	0.85	0.07	0.13	0.06	0.89	5.9	0.06	0.97	0.04	0.0
13.17	0.53	0.04	0.08	0.02	0.55	3.65	0.04	1.45	0.02	0.0
13.22	0.2	0.02	0.03	0.0	0.21	1.4	0.01	3.23	0.0	0.0
13.23	0.1	0.01	0.02	0.0	0.1	0.67	0.01	5.93	0.0	0.0

This Manning's roughness coefficient was calculated based on velocity estimates from the Ferguson VPE method

MODEL SUMMARY

Measured Flow (Qm) =	10.69	(cfs)
Calculated Flow (Qc) =	10.68	(cfs)
(Qm-Qc)/Qm * 100 =	0.14%	
Measured Waterline (WLm) =	11.99	(ft)
Calculated Waterline (WLc) =	11.97	(ft)
(WLm-WLc)/WLm * 100 =	0.18%	
Max Measured Depth (Dm) =	1.25	(ft)
Max Calculated Depth (Dc) =	1.28	(ft)
(Dm-Dc)/Dm * 100 =	-2.49%	
Mean Velocity =	1.38	(ft/s)
Manning's n =	0.138	
0.4 * Qm =	4.28	(cfs)
2.5 * Qm =	26.73	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	9.15		
Bankfull	4	10.9		
Waterline	6.5	11.93	0	
	7	12.35	0.4	
	8	12.8	0.9	
	9	12.65	0.7	
	10	12.6	0.6	
	11	12.6	0.6	
	12	12.7	0.7	
	13	13	1	
	14	13.25	1.25	
	15	12.85	0.9	
	16	12.6	0.7	
Waterline	17.2	12.05	0	
Bankfull	17.5	10.7		
	19.3	10.35		

COMPUTED FROM MEASURED FIELD DATA

| Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.65	0.4	0.3	0.42	3.89
1.1	0.9	0.9	1.25	11.66
1.01	0.7	0.7	0.97	9.07
1	0.6	0.6	0.83	7.77
1	0.6	0.6	0.83	7.77
1	0.7	0.7	0.97	9.07
1.04	1	1	1.38	12.95
1.03	1.25	1.25	1.73	16.19
1.08	0.9	0.9	1.25	11.66
1.03	0.7	0.77	1.07	9.97
1.32	0	0	0	0
0	0	0	0	0
0	0	0	0	0

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R2Cross RESULTS

Stream Name: Cottonwood Ck
Stream Locations: Ab Rainbow Trail
Fieldwork Date: 06/10/2025
Cross-section: 4
Observers: WRA CWCB
Coordinate System: UTM Zone 13
X (easting): 449776.5
Y (northing): 4212761.91
Date Processed: 12/09/2025
Slope: 0.038
Discharge: Entered Value: 10.69 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: Cottonwood Ck 2025 4.xlsx
R2Cross version: 2.0.4

LOCATION

R2Cross RESULTS: Cottonwood Ck - 06/10/2025 XS 4, Analysis Method: [Ferguson VPE]
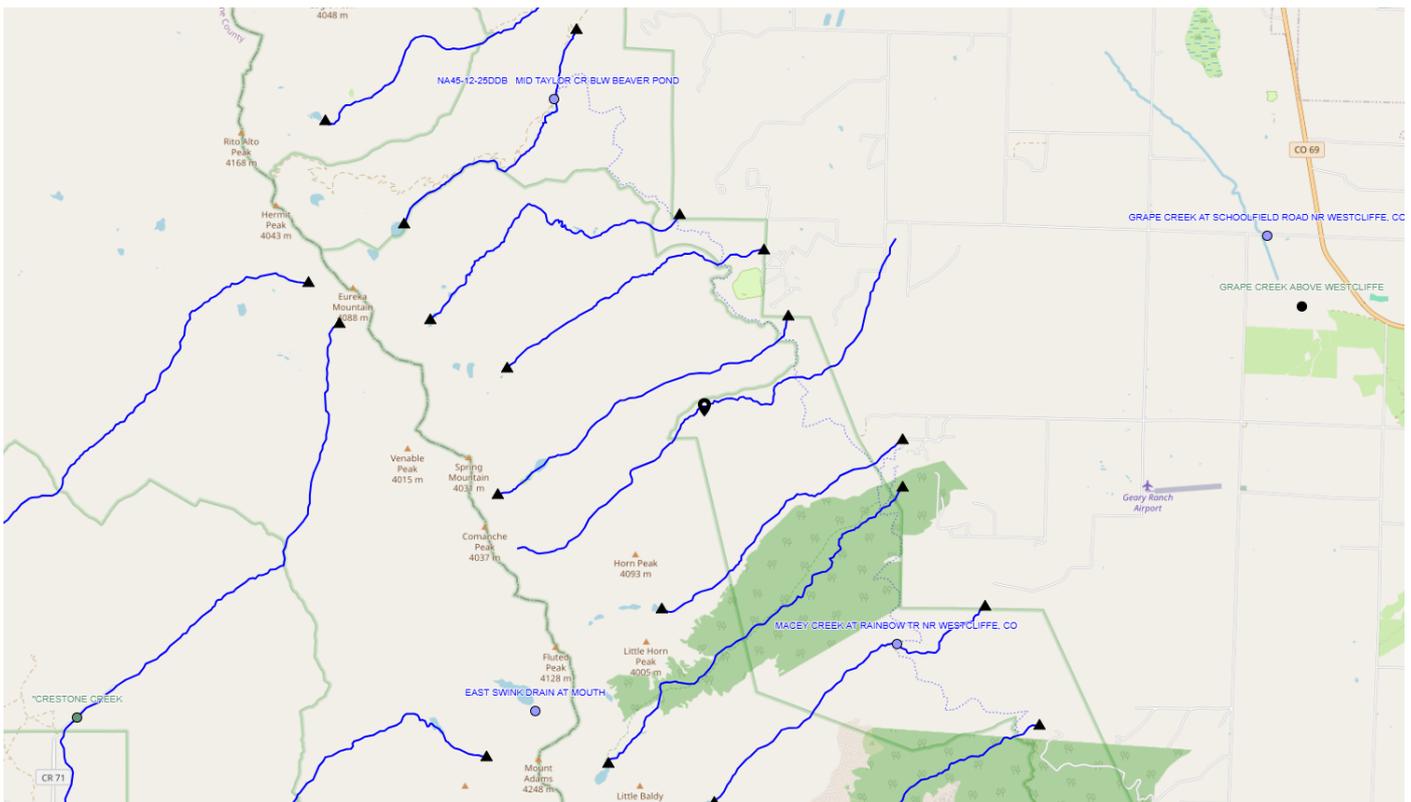
ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 15.42

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	1.38
Percent Wetted Perimeter (%)	50.0	1.3
Mean Velocity (ft/s)	1.0	1.95

STAGING TABLE

Feature	Distance to Water (ft)	Top Width (ft)	Mean Depth (ft)	Maximum Depth (ft)	Area (sq ft)	Wetted Perimeter (ft)	Percent Wetted Perimeter	Hydraulic Radius (ft)	Manning's n	Mean Velocity (ft/s)	Discharge (cfs)
Bankfull	6.6	15.42	0.8	1.45	12.36	16.79	100.0	0.74	0.05	4.87	60.19
	6.62	14.6	0.82	1.43	12.04	15.95	94.97	0.75	0.05	5.01	60.27
	6.67	12.71	0.89	1.38	11.35	14.01	83.4	0.81	0.05	5.42	61.54
	6.72	11.61	0.93	1.33	10.76	12.85	76.51	0.84	0.05	5.61	60.39
	6.77	11.52	0.88	1.28	10.18	12.71	75.71	0.8	0.05	5.35	54.42
	6.82	11.44	0.84	1.23	9.6	12.58	74.91	0.76	0.05	5.07	48.72
	6.87	11.35	0.8	1.18	9.03	12.45	74.1	0.73	0.05	4.79	43.31
	6.92	11.26	0.75	1.13	8.47	12.31	73.3	0.69	0.05	4.51	38.18
	6.97	11.18	0.71	1.08	7.91	12.18	72.5	0.65	0.05	4.22	33.34
	7.02	11.09	0.66	1.03	7.35	12.04	71.7	0.61	0.05	3.92	28.81
	7.07	11.01	0.62	0.98	6.8	11.91	70.9	0.57	0.06	3.62	24.58
	7.12	10.92	0.57	0.93	6.25	11.77	70.1	0.53	0.06	3.31	20.68
	7.17	10.83	0.53	0.88	5.71	11.64	69.3	0.49	0.06	3.0	17.09
	7.22	10.75	0.48	0.83	5.17	11.5	68.48	0.45	0.06	2.68	13.85
Waterline	7.27	10.66	0.43	0.78	4.63	11.37	67.67	0.41	0.07	2.36	10.94
	7.32	10.57	0.39	0.73	4.1	11.23	66.86	0.37	0.07	2.04	8.38
	7.37	10.48	0.34	0.68	3.58	11.09	66.05	0.32	0.08	1.73	6.17
	7.42	10.4	0.29	0.63	3.05	10.96	65.24	0.28	0.09	1.41	4.32
	7.47	9.07	0.28	0.58	2.56	9.57	57.0	0.27	0.09	1.34	3.42
	7.52	8.59	0.25	0.53	2.12	9.01	53.64	0.24	0.1	1.12	2.37
	7.57	8.29	0.2	0.48	1.7	8.63	51.39	0.2	0.11	0.87	1.47
	7.62	7.55	0.17	0.43	1.3	7.82	46.54	0.17	0.13	0.68	0.88
	7.67	6.58	0.14	0.38	0.95	6.79	40.41	0.14	0.15	0.53	0.5
	7.72	5.04	0.13	0.33	0.65	5.22	31.06	0.13	0.16	0.45	0.29
	7.77	3.77	0.11	0.28	0.43	3.93	23.37	0.11	0.18	0.37	0.16

7.82	2.84	0.09	0.23	0.27	2.95	17.58	0.09	0.21	0.28	0.07
7.87	1.76	0.09	0.18	0.15	1.84	10.97	0.08	0.23	0.24	0.04
7.92	1.0	0.08	0.13	0.08	1.05	6.28	0.08	0.24	0.22	0.02
7.97	0.79	0.05	0.08	0.04	0.81	4.84	0.05	0.37	0.1	0.0
8.02	0.38	0.01	0.03	0.01	0.38	2.28	0.01	0.99	0.02	0.0
8.04	0.2	0.01	0.02	0.0	0.2	1.21	0.01	1.67	0.01	0.0

This Manning's roughness coefficient was calculated based on velocity estimates from the Ferguson VPE method

MODEL SUMMARY

Measured Flow (Qm) =	10.69	(cfs)
Calculated Flow (Qc) =	10.82	(cfs)
(Qm-Qc)/Qm * 100 =	-1.20%	
Measured Waterline (WLm) =	7.2	(ft)
Calculated Waterline (WLc) =	7.27	(ft)
(WLm-WLc)/WLm * 100 =	-1.00%	
Max Measured Depth (Dm) =	0.7	(ft)
Max Calculated Depth (Dc) =	0.78	(ft)
(Dm-Dc)/Dm * 100 =	-11.18%	
Mean Velocity =	2.34	(ft/s)
Manning's n =	0.068	
0.4 * Qm =	4.28	(cfs)
2.5 * Qm =	26.73	(cfs)

R2Cross RESULTS: Cottonwood Ck - 06/10/2025 XS 4, Analysis Method: [Ferguson VPE]

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	5.4		
Bankfull	1.6	6.6		
	1.9	6.7		
	5.2	6.6		
Waterline	5.9	7.18	0	
	6.5	7.65	0.35	
	7	7.5	0.1	
	7.5	7.45	0.2	
	8	7.45	0.05	
	8.5	7.45	0.05	
	9	8	0.7	
	9.5	8.05	0.65	
	10	7.9	0.55	
	10.5	7.9	0.6	
	11	7.8	0.55	
	11.5	7.75	0.5	
	12	7.75	0.55	
	12.5	7.85	0.65	
	13	7.85	0.6	
	13.5	7.75	0.5	
	14	7.7	0.5	
	14.5	7.7	0.5	
	15	7.7	0.5	
	15.5	7.65	0.45	
	16	7.6	0.4	
	16.5	7.65	0.4	
Waterline	16.7	7.22	0	
Bankfull	17.3	6.05		
	18.5	5.8		

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.76	0.35	0.19	0.44	4.16
0.52	0.1	0.05	0.12	1.08
0.5	0.2	0.1	0.23	2.16
0.5	0.05	0.03	0.06	0.54
0.5	0.05	0.03	0.06	0.54
0.74	0.7	0.35	0.81	7.55
0.5	0.65	0.33	0.75	7.02
0.52	0.55	0.28	0.63	5.94
0.5	0.6	0.3	0.69	6.48
0.51	0.55	0.28	0.63	5.94
0.5	0.5	0.25	0.58	5.4
0.5	0.55	0.28	0.63	5.94
0.51	0.65	0.33	0.75	7.02
0.5	0.6	0.3	0.69	6.48
0.51	0.5	0.25	0.58	5.4
0.5	0.5	0.25	0.58	5.4
0.5	0.5	0.25	0.58	5.4
0.5	0.5	0.25	0.58	5.4
0.5	0.45	0.23	0.52	4.86
0.5	0.4	0.2	0.46	4.32
0.5	0.4	0.14	0.32	3.02
0.47	0	0	0	0
0	0	0	0	0
0	0	0	0	0

R2Cross RESULTS: Cottonwood Ck - 06/10/2025 XS 4, Analysis Method: [Ferguson VPE]

DISCLAIMER

"The Colorado Water Conservation Board makes no representations about the use of the software contained in the R2Cross platform for any purpose besides that for which it was designed. To the maximum extent permitted by applicable law, all information, modeling results, and software are provided "as is" without warranty or condition of any kind, including all implied warranties or conditions of merchantability, or fitness for a particular purpose. The user assumes all responsibility for the accuracy and suitability of this program for a specific application. In no event shall the Colorado Water Conservation Board or any state agency, official or employee be liable for any direct, indirect, punitive, incidental, special, consequential damages or any damages whatsoever including, without limitation, damages for loss of use, data, profits, or savings arising from the implementation, reliance on, or use of or inability to use the R2Cross platform.

R2Cross RESULTS

Stream Name: Cottonwood Ck
Stream Locations: Ab Rainbow Trail
Fieldwork Date: 06/10/2025
Cross-section: 5
Observers: WRA CWCB
Coordinate System: UTM Zone 13
X (easting): 449776.5
Y (northing): 4212761.91
Date Processed: 12/08/2025
Slope: 0.021
Discharge: Entered Value: 10.7 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: Cottonwood Ck 2025 5.xlsx
R2Cross version: 2.0.4

LOCATION

R2Cross RESULTS: Cottonwood Ck - 06/10/2025 XS 5, Analysis Method: [Ferguson VPE]
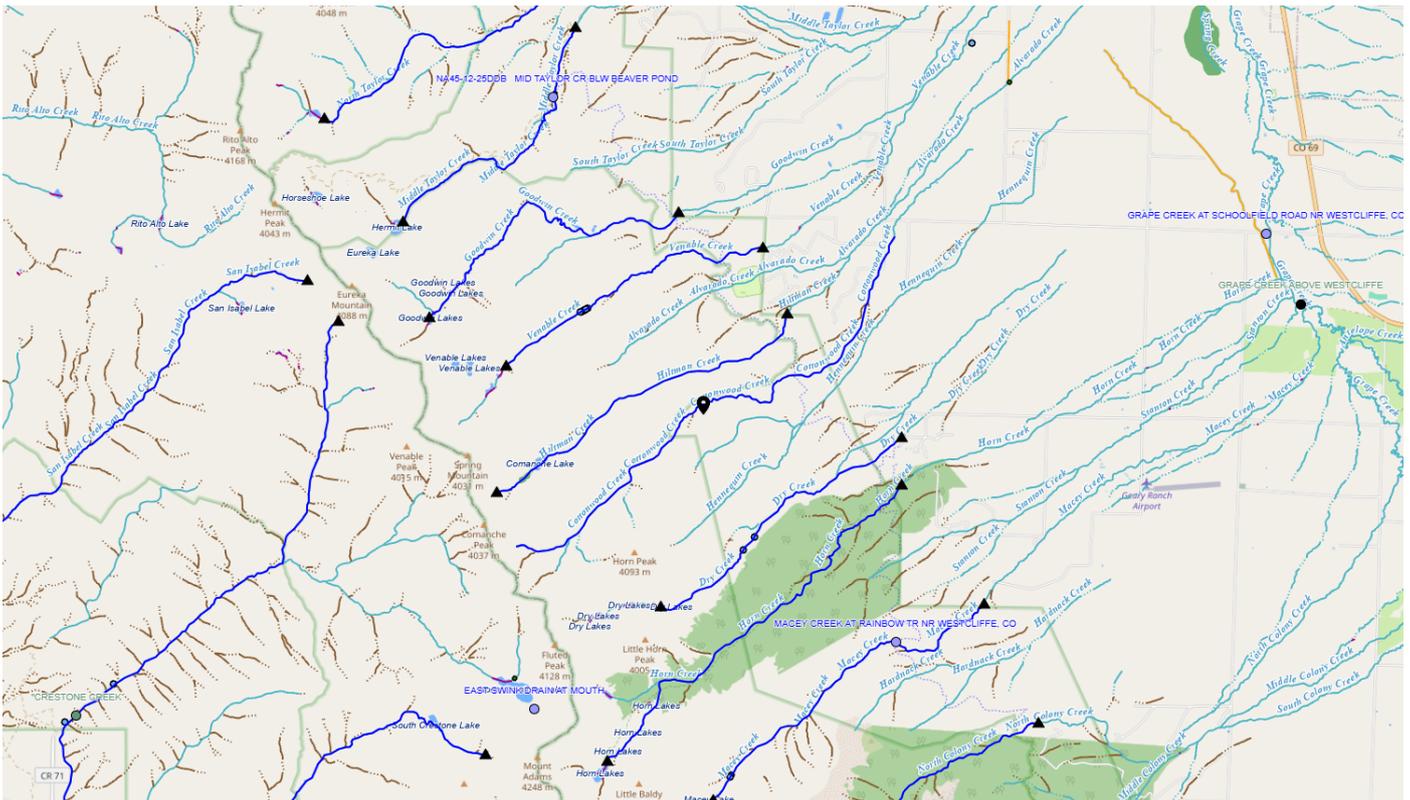
ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 13.64

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	0.34
Percent Wetted Perimeter (%)	50.0	0.18
Mean Velocity (ft/s)	1.0	5.51

STAGING TABLE

Feature	Distance to Water (ft)	Top Width (ft)	Mean Depth (ft)	Maximum Depth (ft)	Area (sq ft)	Wetted Perimeter (ft)	Percent Wetted Perimeter	Hydraulic Radius (ft)	Manning's n	Mean Velocity (ft/s)	Discharge (cfs)
Bankfull	2.8	13.64	1.1	1.7	14.94	14.56	100.0	1.03	0.1	2.29	34.18
	2.82	13.53	1.09	1.68	14.69	14.44	99.12	1.02	0.1	2.26	33.25
	2.87	13.21	1.06	1.63	14.03	14.09	96.73	1.0	0.1	2.2	30.79
	2.92	12.9	1.04	1.58	13.37	13.74	94.34	0.97	0.1	2.13	28.47
	2.97	12.58	1.01	1.53	12.74	13.39	91.95	0.95	0.1	2.06	26.26
	3.02	12.27	0.99	1.48	12.12	13.04	89.56	0.93	0.1	2.0	24.18
	3.07	11.95	0.96	1.43	11.51	12.7	87.17	0.91	0.1	1.93	22.22
	3.12	11.63	0.94	1.38	10.92	12.35	84.78	0.88	0.11	1.87	20.37
	3.17	11.35	0.91	1.33	10.35	12.03	82.62	0.86	0.11	1.79	18.56
	3.22	11.13	0.88	1.28	9.78	11.78	80.85	0.83	0.11	1.71	16.73
	3.27	10.91	0.85	1.23	9.23	11.52	79.08	0.8	0.11	1.63	15.02
	3.32	10.68	0.81	1.18	8.69	11.26	77.31	0.77	0.12	1.54	13.41
	3.37	10.46	0.78	1.13	8.16	11.0	75.54	0.74	0.12	1.46	11.91
Waterline	3.42	10.1	0.76	1.08	7.65	10.62	72.92	0.72	0.12	1.4	10.7
	3.47	9.76	0.73	1.03	7.15	10.27	70.48	0.7	0.13	1.34	9.55
	3.52	9.62	0.69	0.98	6.67	10.09	69.29	0.66	0.13	1.24	8.26
	3.57	9.48	0.65	0.93	6.19	9.92	68.1	0.62	0.14	1.14	7.07
	3.62	9.34	0.61	0.88	5.72	9.74	66.9	0.59	0.14	1.05	5.98
	3.67	9.19	0.57	0.83	5.26	9.57	65.71	0.55	0.15	0.95	4.99
	3.72	9.05	0.53	0.78	4.8	9.4	64.52	0.51	0.16	0.86	4.11
	3.77	8.91	0.49	0.73	4.35	9.22	63.33	0.47	0.17	0.76	3.32
	3.82	8.77	0.45	0.68	3.91	9.05	62.13	0.43	0.18	0.67	2.62
	3.87	8.63	0.4	0.63	3.48	8.88	60.94	0.39	0.2	0.58	2.02
	3.92	8.49	0.36	0.58	3.05	8.7	59.75	0.35	0.22	0.49	1.5
	3.97	8.35	0.31	0.53	2.63	8.53	58.55	0.31	0.24	0.41	1.07

4.02	8.21	0.27	0.48	2.21	8.35	57.36	0.27	0.27	0.33	0.72
4.07	8.03	0.23	0.43	1.81	8.15	55.97	0.22	0.32	0.25	0.45
4.12	7.81	0.18	0.38	1.41	7.9	54.25	0.18	0.38	0.18	0.26
4.17	6.87	0.15	0.33	1.03	6.94	47.68	0.15	0.44	0.14	0.14
4.22	4.98	0.15	0.28	0.74	5.04	34.58	0.15	0.44	0.14	0.1
4.27	3.93	0.13	0.23	0.52	3.97	27.27	0.13	0.48	0.12	0.06
4.32	3.51	0.1	0.18	0.34	3.54	24.32	0.1	0.63	0.07	0.02
4.37	3.04	0.06	0.13	0.17	3.05	20.97	0.06	0.97	0.03	0.01
4.42	1.36	0.04	0.08	0.06	1.37	9.41	0.04	1.29	0.02	0.0
4.47	0.53	0.02	0.03	0.01	0.53	3.65	0.02	2.84	0.0	0.0
4.49	0.25	0.01	0.01	0.0	0.25	1.73	0.01	5.3	0.0	0.0

This Manning's roughness coefficient was calculated based on velocity estimates from the Ferguson VPE method

MODEL SUMMARY

Measured Flow (Qm) =	10.7	(cfs)
Calculated Flow (Qc) =	10.7	(cfs)
(Qm-Qc)/Qm * 100 =	-0.01%	
Measured Waterline (WLm) =	3.42	(ft)
Calculated Waterline (WLc) =	3.42	(ft)
(WLm-WLc)/WLm * 100 =	0.05%	
Max Measured Depth (Dm) =	1.1	(ft)
Max Calculated Depth (Dc) =	1.08	(ft)
(Dm-Dc)/Dm * 100 =	1.67%	
Mean Velocity =	1.4	(ft/s)
Manning's n =	0.124	
0.4 * Qm =	4.28	(cfs)
2.5 * Qm =	26.75	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	1.85		
Bankfull	1.8	1.85		
Waterline	2.7	3.38	0	
	3	3.45	0.1	
	4	4.05	0.7	
	5	4.35	0.9	
	6	4.5	1.1	
	7	4.4	1	
	8	4.4	1	
	9	4.2	0.75	
	10	4.15	0.7	
	11	4.25	0.85	
	12	4.15	0.65	
Waterline	12.8	3.46	0	
	14	3.15		
Bankfull	16	2.8		
	17.1	2.25		

COMPUTED FROM MEASURED FIELD DATA

Wetted Perimeter (ft)	Water Depth (ft)	Area (ft^2)	Discharge (cfs)	Percent Discharge
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0.31	0.1	0.07	0.09	0.85
1.17	0.7	0.7	0.98	9.15
1.04	0.9	0.9	1.26	11.76
1.01	1.1	1.1	1.54	14.38
1	1	1	1.4	13.07
1	1	1	1.4	13.07
1.02	0.75	0.75	1.05	9.8
1	0.7	0.7	0.98	9.15
1	0.85	0.85	1.19	11.11
1	0.65	0.58	0.82	7.65
1.06	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

DISCLAIMER

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General Site Field Visit Data Report   *(Filters: Name begins with Cottonwood Creek; Division = 2;)*

Type		Div	Name	CWCB Case Number	Segment ID	Visit Date	Location Description	Watershed Name
Stream		2	Cottonwood Creek		21/2/A-002	6/10/2025	R2Cross locations	Arkansas Headwaters

	Remarks	Date	Remark			
		10/06/25 13:37	Assisted in collecting R2Cross data, discharge measurements, and observing the natural environment.			
	GPS Log	No GPS Log records for this visit.				
	Photo Log	No Photo Log records for this visit.				