February 5, 2024

Mr. Robert Viehl
Colorado Water Conservation Board
1313 Sherman Street
Denver, CO 80203

Dear Mr. Viehl,

High Country Conservation Advocates (HCCA) and the National Park Service (NPS) are submitting this preliminary instream flow recommendation for Red Creek, located in Gunnison County, Water Division 4.

HCCA protects the health and natural beauty of the land, rivers, and wildlife in and around Gunnison County. Many of HCCA's members live and work in Gunnison County and enjoy the outdoor opportunities and quality of life available in the headwaters of the Colorado Rockies. HCCA has a long history of protecting waters in the Upper Gunnison Basin and of partnering with federal agencies and other non-profits to support a number of instream flow proposals in our region.

The National Park Service preserves unimpaired the natural and cultural resources of the parks in perpetuity, and provides for the enjoyment of those resources to this–and future-generations. The Curecanti National Recreation Area Foundation Document (2013) identifies both riparian habitats and aquatic resources as core resources for protection both in the park and in the surrounding, connected landscape. The mainstem of Red Creek is partially within the park—where it is directly protected—and upstream of the park—where the NPS seeks to protect water and habitat quality through cooperative conservation. Colorado Parks and Wildlife assisted with the fieldwork to collect R2Cross data. This proposal is an example of cooperative conservation.

The headwaters of Red Creek originate in the West Elk Wilderness on land managed by the United States Forest Service. Red Creek has been designated an outstanding waters by the State of Colorado, sustains a fishery, and provides important riparian habitat for a broad range of wildlife species. Enclosed you will find a preliminary instream flow proposal. If you have any questions regarding this recommendation, please feel free to contact High Country Conservation Advocates at Office@hccacb.org or Brinnen Carter, Brinnen_Carter@nps.gov.

Sincerely,

Julie Nania
Water Director
High Country Conservation Advocates

Brinnen Carter
Brinnen Carter
Integrated Resource Manager
Curecanti NRA/Black Canyon NP

Enclosure: Preliminary Instream Flow Proposal for Red Creek.

ENCLOSURE - INSTREAM FLOW RECOMMENDATIONS FOR RED CREEK

Below is a description of the proposed instream flow. Additional details can be found in Attachments A-E.

Location

Red Creek is located in Gunnison County, Water Division 4. The headwaters of Red Creek originate in a small basin located in the West Elk Wilderness. Red Creek flows south into Blue Mesa Reservoir, a reservoir on the Gunnison River located west of the City of Gunnison. The Red Creek Watershed is about 14.3 square miles and is on the West Elk Peak SW and Carpenter Ridge United States Geological Survey quad maps (Attachment A).

The stream segment identified for the proposed instream flow appropriation is approximately 6.7 miles long from its headwaters to the confluence with Blue Mesa Reservoir.

Table 1. Land Status in the Red Creek Watershed.

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			Private (%)	Public (%)
Headwaters	Confluence with Blue Mesa Reservoir	6.7	Riparian Corridor[2] 0%	Riparian Corridor 100%
			Watershed Composition 0%	Watershed Composition 100%

1. The public land in the Red Creek watershed is managed by the National Park Service, Bureau of Land Management and Colorado Parks and Wildlife.

The Red Creek Watershed is 100 percent public land managed by the National Park Service (NPS), Bureau of Land Management (BLM), and Colorado Parks and Wildlife (CPW). This instream flow proposal aligns with the NPS goals and mission in managing Curecanti NRA. As stated in the Curecanti NRA Final Resource Protection Study / Environmental Impact Statement (2008), the NPS will continue to work with neighboring landowners, assisted by conservation partners, to utilize cooperative conservation efforts that could maintain and/or improve resources such as animal habitat and water quality throughout the area; would better ensure the preservation of the area's spectacular natural scenery; and would enhance the enjoyment and recreational opportunities for residents and visitors alike.

Existing Instream Flow Rights

Red Creek has an existing year-round instream flow water right of 1.5 cfs (4-84CW379) with an appropriation date of 05/04/1984. This instream flow extends 6.7 miles, from the confluence of East and West Red Creek to the terminus where Red Creek enters Blue Mesa.

In addition to the instream flow on the mainstem of Red Creek, there is also an instream flow on West Red Creek of 1 cfs (4-84CW380). This instream flow right has the same priority date as the mainstem of Red Creek (05/04/1984) and extends 5 miles from the headwaters to the confluence of West Red Creek and East Red Creek (also the headwaters of Red Creek mainstem). Both of these instream flows are flat-rate, year-round instream flows that do not reflect the annual variability in the hydrograph.

Water Availability

Physical Availability

There is not a gage on Red Creek. Proponents relied on initial modeling results from Streamstats to provide an estimate of the basin's hydrology. Streamstats models a June mean flow of 41.2 cfs and a December mean flow of 1.63 cfs. Please see the Streamstats attachment for complete modeling results (Attachment B).

Legal Availability

There is one spring right and one diversion decreed on Red Creek, the Carpenter Ditch. The Carpenter Ditch is decreed for 4.5 cfs with a priority date of 6/10/1914. However, the comments maintained by the Division of Water Resources (DWR) note that the ditch may need to be abandoned (CA1635) and this ditch appears to be no longer operational. During development of this proposal the proponents reached out to our local water commissioner to discuss this right. He noted that this is a historical structure that is no longer in operation. Please see the attached Water Rights Summary for more information (Attachment C).

Biological Summary

The headwaters of Red Creek form in the West Elk Wilderness area. The upper portion of Red Creek within the West Elk Wilderness area has been designated as an outstanding water by the State of Colorado.

In 1979 CPW sampled Red Creek and found brook trout present. In 1986 CPW sampled and also noted the presence of brown trout and rainbow trout. In 2016 sampling below the confluence of West and East Red Creek demonstrated the presence of brook trout.

While conducting R2Cross assessments, we saw numerous macroinvertebrates, a crawdad and a small fish (unknown species). Please see the attached CPW data demonstrating the Red Creek fish community (Attachment D).

Photo 1. Red Creek Crawdad 8/10/2022.

Photo 2. Red Creek Macroinvertebrates 8/10/2022.

The NPS manages the lower half mile of stream before the creek enters Blue Mesa Reservoir as part of Curecanti National Recreation Area (NRA). As part of the foundational document for Curecanti NRA the aquatic resources are identified as Fundamental Resources essential to the purpose of the park and maintaining its significance. The NPS has been monitoring the aquatic macroinvertebrate community in Red Creek going back to 2013. Red Creek has shown consistently high index scores and no impairment, as seen in Table 2.

Table 2. Red Creek Aquatic Macroinvertebrate Sampling Results

Model Method: CO Ecological Data Application System Multimetric Index - Transition

Collection Date	Fixed Count	MMI Score	Condition Result
2013-08-29	96	79.4	Not impaired
2014-09-02	204	72.2	Not impaired
2016-08-11	6	41	Inconclusive
2017-08-15	60	53.9	Not impaired
2018-09-06	51	55	Not impaired
2020-09-10	300	65.1	Not impaired
2022-09-14	300	61.2	Not impaired

Preliminary R2Cross Analysis

CPW completed the initial interpretation of output from the R2Cross model to develop a preliminary instream flow recommendation that will protect the Red Creek natural environment to a reasonable degree.

An R2Cross field survey was completed at one location on August 10, 2022. Measured streamflow was extremely low (0.3 cfs), so results from this dataset were not used in the final flow recommendations.

NPS, CPW, and HCCA collected two additional cross-sectional data in 2023 after the reconnaissance-level investigation in 2022. Two additional cross-sections were collected on June 12, 2023 under more suitable flow conditions (7.5 cfs). These data were used to create the preliminary instream flow recommendations for Red Creek (Table 2). The R2Cross output and field forms are attached for review (Attachment E).

A summer flow rate of 4.0 cfs (2.5 cfs enlargement) and a winter flow rate of 2.0 cfs (0.5 cfs enlargement) are recommended based on the results of the two 2023 cross-sections (Table 2).

Initially, the proposed dates for the winter ISF rate are November 1 to March 31. The proposed dates for the summer ISF rate are April 1 to October 31. The dates may be revised based upon additional review of physical and legal water availability.

Table 3. R2Cross analysis summary and preliminary instream flow recommendations.

Cross Section (Date)	Measured Discharge (cfs)	Bankfull Top Width (ft)	Winter Flow Recommendation [1] (cfs)	Summer Flow Recommendation[2] (cfs)
Red Creek #2 (6-12-2023)	7.46 cfs	14.2 ft	2.71 cfs	2.86 cfs
Red Creek #3 (6-12-2023)	7.46 cfs	15.5 ft	1.31 cfs	5.13 cfs
Preliminary Proposed ISF Rates:			**2.0 cfs**	**4.0 cfs**

1) The proposed dates for the winter flow rate are November 1 through March 31. .
2) The proposed dates for the summer flow recommendation are April 1 through October 31.

Photographs

Photo 3. Cross Section 1 Red Creek: right bank to left bank view (6-12-2023).

Photo 4. Cross Section 1 Red Creek: downstream (6-12-2023).

Photo 5. Cross Section 1 Red Creek: upstream (6-12-2023).

Photo 6. Cross Section 2 Red Creek: upstream (6-12-2023).

Photo 7. Cross Section 2 Red Creek: Left bank to right bank/upstream (6-12-2023).

Photo 8. Cross Section 2 Red Creek: Downstream (6-12-2023).

Relationship to Existing State Policy

HCCA and NPS are proposing this instream flow to the CWCB in furtherance of the State of Colorado's policy "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." C.R.S. 33-1-101(1).

Attachments

A – USGS Topographic Quadrangle Maps
B – Streamstats
C – Water Rights Summary
D – CPW Fisheries Data
E – R2Cross

Attachment A- USGS Quad Maps

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

CARPENTER RIDGE QUADRANGLE
COLORADO - GUNNISON COUNTY
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid, Universal Transverse Mercator, Zone 13S

This map is not to be used for navigation

Revisions and further information concerning this map may be addressed to the Director, U.S. Geological Survey, Reston, Virginia 20192

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard.

ROAD CLASSIFICATION

Interstate Route | US Route | State Route

QUADRANGLE LOCATION

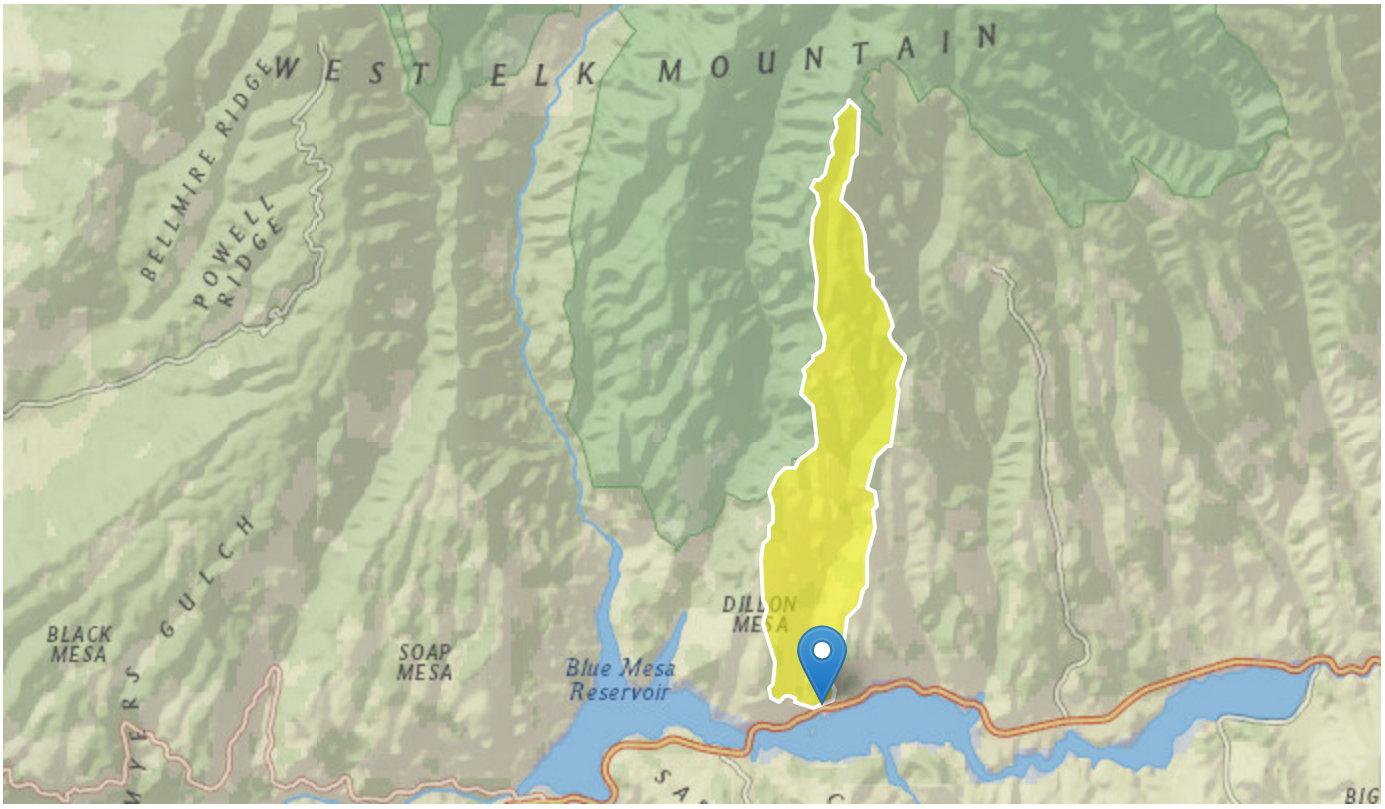
1 Little Soda Park
2 West Pa Peak SW
3 Marshall Mountain
4 Sapinero
5 Cimarron
6 Potter Draw
7 Gunnison
8 Montrose

CARPENTER RIDGE, CO
2022

Attachment B- Streamstats

StreamStats Report

Region ID: CO
Workspace ID: CO20240126180807589000
Clicked Point (Latitude, Longitude): 38.47728, -107.22952
Time: 2024-01-26 11:08:32 -0700



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	34	percent
DRNAREA	Area that drains to a point on a stream	14.3	square miles
ELEV	Mean Basin Elevation	9322	feet
PRECIP	Mean Annual Precipitation	19.4	inches

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Mountain Region Peak Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	14.3	square miles	1	1060
BSLDEM10M	Mean Basin Slope from 10m DEM	34	percent	7.6	60.2
PRECIP	Mean Annual Precipitation	19.4	inches	18	47

Peak-Flow Statistics Flow Report [Mountain Region Peak Flow]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
50-percent AEP flood	65.4	ft^3/s	49
20-percent AEP flood	102	ft^3/s	44
10-percent AEP flood	128	ft^3/s	41
4-percent AEP flood	161	ft^3/s	40
2-percent AEP flood	199	ft^3/s	39
1-percent AEP flood	229	ft^3/s	36
0.5-percent AEP flood	256	ft^3/s	36
0.2-percent AEP flood	311	ft^3/s	33

Peak-Flow Statistics Citations

Capesius, J.P., and Stephens, V. C.,2009, Regional Regression Equations for Estimation of Natural Streamflow Statistics in Colorado: U. S. Geological Survey Scientific Investigations Report 2009-5136, 32 p. (http://pubs.usgs.gov/sir/2009/5136/)

Flow-Duration Statistics

Flow-Duration Statistics Parameters [Mountain Region Flow Duration]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	14.3	square miles	1	1060
PRECIP	Mean Annual Precipitation	19.4	inches	18	47

Flow-Duration Statistics Flow Report [Mountain Region Flow Duration]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
10 Percent Duration	17.7	ft^3/s	45
25 Percent Duration	5.27	ft^3/s	55
50 Percent Duration	2.3	ft^3/s	55
75 Percent Duration	1.32	ft^3/s	64
90 Percent Duration	0.722	ft^3/s	85

Flow-Duration Statistics Citations

Capesius, J.P., and Stephens, V. C.,2009, Regional Regression Equations for Estimation of Natural Streamflow Statistics in Colorado: U. S. Geological Survey Scientific Investigations Report 2009-5136, 32 p. (http://pubs.usgs.gov/sir/2009/5136/)

Annual Flow Statistics

Annual Flow Statistics Parameters [Mountain Region Mean Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	14.3	square miles	1	1060

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
PRECIP	Mean Annual Precipitation	19.4	inches	18	47

Annual Flow Statistics Flow Report [Mountain Region Mean Flow]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Mean Annual Flow	8.11	ft^3/s	33

Annual Flow Statistics Citations

Capesius, J.P., and Stephens, V. C.,2009, Regional Regression Equations for Estimation of Natural Streamflow Statistics in Colorado: U. S. Geological Survey Scientific Investigations Report 2009-5136, 32 p. (http://pubs.usgs.gov/sir/2009/5136/)

Monthly Flow Statistics

Monthly Flow Statistics Parameters [Mountain Region Mean Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	14.3	square miles	1	1060
PRECIP	Mean Annual Precipitation	19.4	inches	18	47

Monthly Flow Statistics Flow Report [Mountain Region Mean Flow]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
January Mean Flow	1.44	ft^3/s	50
February Mean Flow	1.38	ft^3/s	51
March Mean Flow	1.53	ft^3/s	49
April Mean Flow	3.01	ft^3/s	44

Statistic	Value	Unit	ASEp
May Mean Flow	21.9	ft^3/s	46
June Mean Flow	41.2	ft^3/s	46
July Mean Flow	11	ft^3/s	76
August Mean Flow	5.15	ft^3/s	80
September Mean Flow	3.18	ft^3/s	59
October Mean Flow	2.4	ft^3/s	45
November Mean Flow	1.93	ft^3/s	46
December Mean Flow	1.63	ft^3/s	47

Monthly Flow Statistics Citations

Capesius, J.P., and Stephens, V. C.,2009, Regional Regression Equations for Estimation of Natural Streamflow Statistics in Colorado: U. S. Geological Survey Scientific Investigations Report 2009-5136, 32 p. (http://pubs.usgs.gov/sir/2009/5136/)

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

USGS Software Disclaimer: This software has been approved for release by the U.S. Geological Survey (USGS). Although the software has been subjected to rigorous review, the USGS reserves the right to update the software as needed pursuant to further analysis and review. No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the software and related material nor shall the fact of release constitute any such warranty. Furthermore, the software is released on condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from its authorized or unauthorized use.

USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.19.3
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

Attachment C- Water Rights Summary

There are three decreed water rights in the Red Creek watershed. The first is a spring right (WDID 5907305) referred to as RC8. This spring right is held by the USFS and has a 1905 priority date.

The second decreed right is a 4.5 cfs diversion rate for the Carpenter Ditch (WDID 5900795). The structure notes record this structure may need to be abandoned (2006/2007). There are no active diversion records associated with the DWR files. However, the appropriation date for the ditch is 6/10/1914 making this a pre-Colorado River Compact water right. A conversation with the local water commissioner confirmed that this is a historical structure. A copy of the CDSS diversion structure information for the Carpenter Ditch is included below.

The final water right identified in the basin is a historical structure only, the Red Creek Ditch (WDID 5901075).

COLORADO
Division of Water Resources
Department of Natural Resources

Structure Summary Report

Structure Name:	CARPENTER DITCH (5900795)	Associated Permits:	
Structure Type:	DITCH	Water Source Type:	Tributary
CIU Code:	Active structure but diversion records are not maintained (U)	Water Source:	GUNNISON RIVER [00201748] @ Stream Mile: 131.45

Physical Location

Feature Type	Dist N/S	Dist E/W	Q10	Q40	Q160	Sec	Township	Range	PM	UTMx	UTMy	Latitude	Longitude	Location Accuracy
Point of Diversion			NE	NW	NW	30	49.0 N	3.0 W	N	304925.5	4261665.7	38.482004	-107.236472	Spotted from quarters

Division: 4 District: 59

County: GUNNISON

Designated Basin:

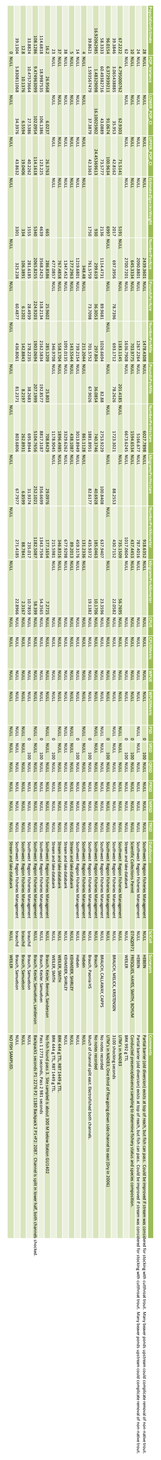
Management District:

Water Rights - Net Amounts

Adj Date	Appro Date	Priority Admin No	Order No	Priority No	Associated Case Numbers	Net Absolute	Net Conditional	Net APEX Absolute	Net APEX Conditional	Decreed Units	Seasonal Limits	Comments
10/25/1921	6/10/1914	23536.00000	0	210	CA1635	4.5000	0.0000	0.0000	0.0000	C	No	SOURCE RED CREEK P137

Atachment D- CPW Fisheries Data

County	Stream	Survey Purpose	Survey Type	Survey Date	Survey Length	Survey Area	Survey Area Type	Number Pass	Electro Seconds	Habitat Length	Habitat Width	Habitat Area	Habitat Area Type	Habitat Type	Habitat Gradient	Habitat Canopy	Habitat Cover	Habitat Comments	Species	Species Common Name	Species Status	Species Origin	Count	Length 1	Weight 1	Length 2	Weight 2	Length 3	Weight 3	Length 4	Weight 4	Length 5	Weight 5	Length 6	Weight 6	Length 7	Weight 7	Length 8	Weight 8	Length 9	Weight 9	Length 10	Weight 10	Length 11	Weight 11	Length 12	Weight 12	Length 13	Weight 13	Length 14	Weight 14	Length 15	Weight 15	Length 16	Weight 16	Length 17	Weight 17	Length 18	Weight 18	Length 19	Weight 19	Length 20	Weight 20	Length 21	Weight 21	Length 22	Weight 22	Length 23	Weight 23	Length 24	Weight 24	Length 25	Weight 25	Length 26	Weight 26
Gunnison	Dan Beach	9/17/1991 0:00	NULL	PRESENCEABSENCE	NOT LISTED	NULL	NULL	NULL	100	0.018939	0.03048	5	0.01147842	0.004645152	52	680	NULL	NULL	NULL	NULL	1	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Counts	28	0.938461538	130	21	53.85	28	NULL	NULL	NULL	NULL	NULL	NULL	580	0	7	NULL	NULL	NULL	NULL	NULL	NULL	82.86	38 - 136	NULL	28	90.75	25 - 229	NULL																									
Gunnison	Dan Beach	9/17/1991 0:00	NULL	PRESENCEABSENCE	NOT LISTED	NULL	NULL	NULL	100	0.018939	0.03048	5	0.01147842	0.004645152	52	680	NULL	NULL	NULL	NULL	1	PASS	181	RBT	SALMONIDAE	RAINBOW TROUT	Oncorhynchus mykiss	Counts	24	0.461538462	200	23	46.15	24	NULL	NULL	NULL	NULL	NULL	NULL	100	0	1	NULL	NULL	NULL	NULL	NULL	NULL	100	100 - 100	NULL	24	112.17	25 - 203	NULL																									
Gunnison	Dan Beach	7/20/2007 0:00	NULL	PRESENCEABSENCE	NOT LISTED	NULL	NULL	NULL	75	0.014205	0.02286	9	0.015495867	0.006270955	10	382	NULL	NULL	NULL	NULL	1	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Counts	10	1	130	2	100	10	NULL	NULL	NULL	NULL	NULL	NULL	382	0	8	NULL	NULL	NULL	NULL	NULL	NULL	47.75	29 - 100	NULL	10	151.1	114 - 207	NULL																									
Gunnison	Dan Beach	8/17/1979 0:00	Standard Survey or Population Estimate	PRESENCEABSENCE	BPEF	NULL	NULL	NULL	200	0.037879	0.06096	5	0.02295684	0.009290304	62	872	0	0	0	0 NULL	2	Nats	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Counts	62	1	130	47	100	62	NULL	NULL	NULL	NULL	NULL	NULL	872	0	15	NULL	NULL	NULL	NULL	NULL	NULL	58.13	18 - 188	NULL	62	109.9	51 - 254	NULL																									
Gunnison	Dan Beach	9/13/2007 0:00	NULL	TWO-PASS REMOVAL	NOT LISTED	NULL	NULL	2 NULL	300	0.056818	0.09144	0 NULL	NULL	NULL	65	593	0	0	0	0	2	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Saber Lacram	65	1	130	56	100	55	10	NULL	NULL	NULL	NULL	NULL	703	9	5	617	86	NULL	NULL	NULL	NULL	69.89	30 - 88	121.2	65	78.92	42 - 146		0.8182																							
Gunnison	Dan Beach	9/11/2008 0:00	NULL	TWO-PASS REMOVAL	ST	NULL	NULL	2 NULL	300	0.056818	0.09144	8.2	0.054473826	0.022854148	38	96	2	NULL	NULL	NULL	2	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Saber Lacram	38	1	130	36	100	32	6	NULL	NULL	NULL	NULL	NULL	513	2	0	481	72	NULL	NULL	NULL	NULL	48	33 - 63	110.58	38	104.58	49 - 168		0.8125																							
Gunnison	Dan Beach	9/11/2008 0:00	NULL	TWO-PASS REMOVAL	NOT LISTED	NULL	NULL	2 NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	0	0	0	0	2	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Saber Lacram	49	1	130	40	100	35	14	NULL	NULL	NULL	NULL	NULL	887.5	10	0	712.5	165	NULL	NULL	NULL	NULL	43.15	21 - 67	101.66	49	110.49	47 - 191		0.6																							
Gunnison	Dan Beach	9/11/2008 0:00	NULL	TWO-PASS REMOVAL	NOT LISTED	NULL	NULL	2 NULL	300	0.056818	0.09144	8.2	0.054473826	0.022854148	16	333	NULL	NULL	NULL	NULL	2	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	3-Pass Eschmeier	16	1	130	8	100	10	5	1	0 NULL	NULL	NULL	NULL	333	8	0	245.5	206.5	21.5	NULL	NULL	NULL	41.63	22 - 79	139.62	16	124.13	54 - 160		0.823373456																							
Gunnison	Dan Beach	9/11/2009 0:00	NULL	TWO-PASS REMOVAL	ST	NULL	NULL	2 NULL	300	0.056818	0.09144	7.6	0.05134155	0.021181893	39	644	2	NULL	NULL	NULL	2	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Saber Lacram	39	1	130	24	100	34	5	NULL	NULL	NULL	NULL	NULL	952	15	0	883	69	NULL	NULL	NULL	NULL	42.93	23 - 121	154.11	39	119.92	47 - 214		0.8129																							
Gunnison	Dan Beach	9/17/1991 0:00	NULL	PRESENCEABSENCE	BPEF	NULL	NULL	NULL	100	0.018939	0.03048	5	0.01147842	0.004645152	18	220	NULL	NULL	NULL	NULL	1	PASS	123	LOC	SALMONIDAE	BROWN TROUT	Salmo trutta	Counts	14	0.777777778	120	12	77.78	14	NULL	NULL	NULL	NULL	NULL	NULL	182	0	2	NULL	NULL	NULL	NULL	NULL	NULL	91	91 - 91	NULL	14	78.07	51 - 203	NULL																									
Gunnison	Dan Beach	9/17/1991 0:00	NULL	PRESENCEABSENCE	BPEF	NULL	NULL	NULL	100	0.018939	0.03048	5	0.01147842	0.004645152	18	220	NULL	NULL	NULL	NULL	1	PASS	123	LOC	SALMONIDAE	BROWN TROUT	Salmo trutta	Counts	14	0.777777778	120	12	77.78	14	NULL	NULL	NULL	NULL	NULL	NULL	182	0	2	NULL	NULL	NULL	NULL	NULL	NULL	91	91 - 91	NULL	14	78.07	51 - 203	NULL																									
Gunnison	Dan Beach	8/21/1986 0:00	Standard Survey or Population Estimate	PRESENCEABSENCE	BPEF	NULL	NULL	NULL	183.9	0.03483	0.056053	6.68	0.038203176	0.011412693	43	145	NULL	NULL	NULL	NULL	1	PASS	123	LOC	SALMONIDAE	BROWN TROUT	Salmo trutta	Counts	5	0.10637907	120	5	11.63	5	NULL	NULL	NULL	NULL	NULL	NULL	NULL	0	0	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	5	74	70 - 80	NULL																									
Gunnison	Dan Beach	8/20/1979 0:00	Standard Survey or Population Estimate	PRESENCEABSENCE	BPEF	NULL	NULL	NULL	183.9	0.03483	0.056053	6.68	0.038203176	0.011412693	43	145	NULL	NULL	NULL	NULL	1	PASS	123	LOC	SALMONIDAE	BROWN TROUT	Salmo trutta	Brown x Brook (male)	5	0.10637907	120	5	11.63	5	NULL	NULL	NULL	NULL	NULL	NULL	145	0	1	NULL	NULL	NULL	NULL	NULL	NULL	145	145 - 145	NULL	5	104.2	90 - 120	NULL																									
Gunnison	Dan Beach	8/20/1979 0:00	Standard Survey or Population Estimate	PRESENCEABSENCE	BPEF	NULL	NULL	NULL	150	0.066288	0.10668	6	0.040209564	0.015509638	60	967	NULL	NULL	NULL	NULL	1	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Counts	37	0.616666667	130	37	61.67	37	NULL	NULL	NULL	NULL	NULL	NULL	329	0	5	NULL	NULL	NULL	NULL	NULL	NULL	65.8	28 - 82	NULL	37	93.49	52 - 178	NULL																									
Gunnison	Dan Beach	8/20/1979 0:00	Standard Survey or Population Estimate	PRESENCEABSENCE	BPEF	NULL	NULL	NULL	150	0.066288	0.10668	6	0.040209564	0.015509638	60	967	NULL	NULL	NULL	NULL	1	PASS	181	RBT	SALMONIDAE	RAINBOW TROUT	Oncorhynchus mykiss	Counts	22	0.383333333	200	18	38.33	22	NULL	NULL	NULL	NULL	NULL	NULL	639	0	5	NULL	NULL	NULL	NULL	NULL	NULL	127.8	100 - 196	NULL	23	171.04	127 - 254	NULL																									
Gunnison	Dan Beach	9/15/2016 0:00	Species Presence, Community Composition and Relative Abundance	TWO-PASS REMOVAL	BPEF	NULL		2 NULL	300	0.056818	0.09144	8.2	0.054473826	0.022854148	13	271	NULL	NULL	NULL	NULL	2	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Saber Lacram	13	1	130	7	100	9	4	NULL	NULL	NULL	NULL	NULL	366	6	0	277	89	NULL	NULL	NULL	NULL	45.17	28 - 59	113.29	13	124	56 - 167		0.5556																							
Gunnison	Dan Beach	9/20/2016 0:00	Species Presence, Community Composition and Relative Abundance	Backpack EP	NULL			2 NULL	280	0.05303	0.085344	5	0.032139576	0.013006426	108	960	NULL	NULL	NULL	NULL	2	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Saber Lacram	108	1	130	87	100	87	21	NULL	NULL	NULL	NULL	NULL	1455	21	0	1254	201	NULL	NULL	NULL	NULL	45.71	19 - 130	93.96	108	93.41	55 - 225		0.7586																							
Gunnison	Dan Beach	9/15/2016 0:00	Species Presence, Community Composition and Relative Abundance	TWO-PASS REMOVAL	BPEF	NULL		2 NULL	300	0.056818	0.09144	7.6	0.05134155	0.021181893	104	994	NULL	NULL	NULL	NULL	2	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Saber Lacram	104	1	130	83	100	87	17	NULL	NULL	NULL	NULL	NULL	1590	21	0	1340	250	NULL	NULL	NULL	NULL	47.33	24 - 80	108.49	104	104.73	43 - 195		0.8696																							
Gunnison	Dan Beach	8/29/2017 0:00	Standard Survey or Population Estimate	TWO-PASS REMOVAL	BPEF	NULL		2 NULL	473	0.089583	0.14417	11.08	0.120313125	0.046868997	79	1881	NULL	NULL	NULL	NULL	2	PASS	24	BRK	SALMONIDAE	BROOK TROUT	Salvelinus fontinalis	Saber Lacram	31	0.392405063	130	8	39.24	24	7	NULL	NULL	NULL	NULL	NULL	1376	23	0	1116	260	NULL	NULL	NULL	NULL	57.33	26 - 152	86.63	31	151.61	62 - 240		0.7083																							
Gunnison	Dan Beach	8/29/2017 0:00	Standard Survey or Population Estimate	TWO-PASS REMOVAL	BPEF	NULL		2 NULL	473	0.089583	0.14417	11.08	0.120313125	0.046868997	79	1881	NULL	NULL	NULL	NULL	2	PASS	123	LOC	SALMONIDAE	BROWN TROUT	Salmo trutta	Saber Lacram	11	0.139240506	120	1	13.92	8	3	NULL	NULL	NULL	NULL	NULL	358	10	0	260	98	NULL	NULL	NULL	NULL	34.4	24 - 54	87.2	11	149	114 - 178		0.025																							
Gunnison	Dan Beach	8/29/2017 0:00	Standard Survey or Population Estimate	TWO-PASS REMOVAL	BPEF	NULL		2 NULL	473	0.089583	0.14417	11.08	0.120313125	0.046868997	79	1881	NULL	NULL	NULL	NULL	2	PASS	181	RBT	SALMONIDAE	RAINBOW TROUT	Oncorhynchus mykiss	Saber Lacram	37	0.46835443	200	35	46.84	30	7	NULL	NULL	NULL	NULL	NULL	1074	2	0	838	236	NULL	NULL	NULL	NULL	101.5	96 - 107	87.89	37	134.08	48 - 217		0.7667																							
Gunnison	Dan Beach	8/21/1977 0:00	Standard Survey or Population Estimate	PRESENCEABSENCE	BPEF	NULL	NULL	NULL	150	0.026400	0.04572	4	0.009663156	0.003813174	0 NULL	1 NULL	NULL	NULL	NULL	NULL	1	PASS	NULL	AKK	NULL	No Fish Caught	NULL	Counts	0 NULL	NULL	NULL	0 NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	0	0	0 NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

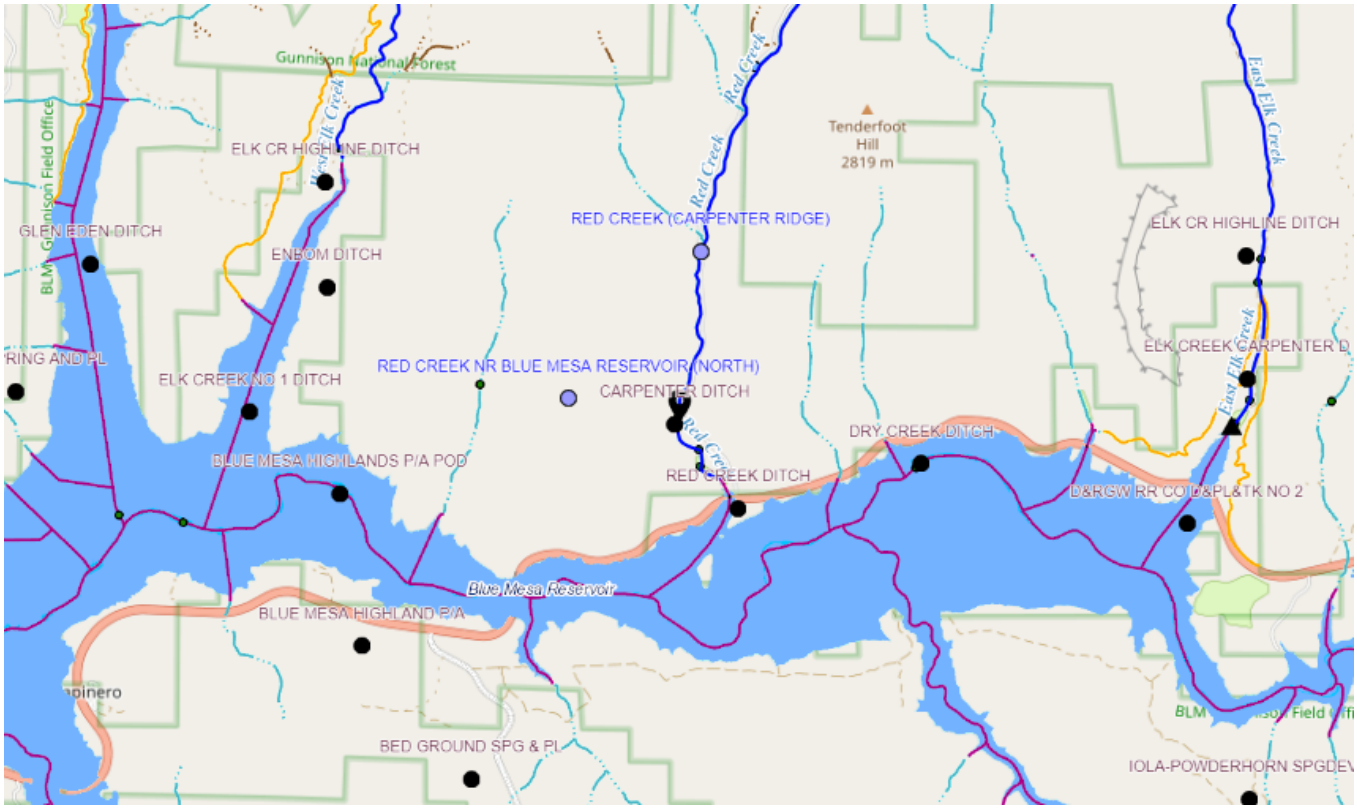


Attachment E- R2Cross

R2Cross RESULTS

Stream Name: Red Creek
Stream Locations: Upstream of Curecanti NRA campground
Fieldwork Date: 06/12/2023
Cross-section: 3
Observers: KB JN
Coordinate System: UTM Zone 13
X (easting): 305061
Y (northing): 4262036
Date Processed: 01/10/2024
Slope: 0.0214
Discharge: Entered Value: 7.46 (cfs)
Computation method: Ferguson VPE
R2Cross data filename: Red_Creek_XS3_6-12-2023_Q=7.457 cfs.xlsx
R2Cross version: 2.0.2

LOCATION



ANALYSIS RESULTS

Habitat Criteria Results

Bankfull top width (ft) = 15.47

	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	0.2
Percent Wetted Perimeter (%)	50.0	1.31
Mean Velocity (ft/s)	1.0	5.13

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	4.95	15.47	0.54	1.21	8.33	15.92	100.0	0.52	0.12	1.14	9.49
	4.98	14.38	0.54	1.18	7.83	14.81	93.05	0.53	0.12	1.16	9.06
	5.03	13.64	0.52	1.13	7.14	14.05	88.3	0.51	0.13	1.09	7.79
	5.08	12.06	0.54	1.08	6.5	12.45	78.19	0.52	0.12	1.13	7.37
	5.13	11.32	0.52	1.03	5.92	11.68	73.39	0.51	0.13	1.09	6.43
Waterline	5.18	10.59	0.51	0.98	5.37	10.94	68.74	0.49	0.13	1.04	5.58
	5.23	10.14	0.48	0.93	4.85	10.48	65.81	0.46	0.14	0.96	4.64
	5.28	9.2	0.47	0.88	4.36	9.53	59.88	0.46	0.14	0.94	4.11
	5.33	8.51	0.46	0.83	3.93	8.82	55.43	0.45	0.14	0.9	3.55
	5.38	8.33	0.42	0.78	3.51	8.61	54.11	0.41	0.15	0.79	2.78
	5.43	8.11	0.38	0.73	3.09	8.37	52.61	0.37	0.16	0.69	2.14
	5.48	7.89	0.34	0.68	2.69	8.12	51.03	0.33	0.18	0.59	1.59
	5.53	7.65	0.3	0.63	2.31	7.86	49.38	0.29	0.2	0.49	1.14
	5.58	7.23	0.27	0.58	1.93	7.43	46.66	0.26	0.21	0.41	0.8
	5.63	6.37	0.25	0.53	1.59	6.54	41.1	0.24	0.23	0.37	0.59
	5.68	5.11	0.26	0.48	1.31	5.26	33.04	0.25	0.22	0.39	0.5
	5.73	4.38	0.25	0.43	1.08	4.51	28.32	0.24	0.23	0.36	0.39
	5.78	3.9	0.22	0.38	0.87	4.01	25.19	0.22	0.25	0.32	0.27
	5.83	3.54	0.19	0.33	0.68	3.63	22.79	0.19	0.28	0.26	0.18
	5.88	3.21	0.16	0.28	0.52	3.28	20.6	0.16	0.32	0.2	0.1
	5.93	2.87	0.13	0.23	0.36	2.92	18.36	0.12	0.39	0.14	0.05
	5.98	2.1	0.11	0.18	0.24	2.14	13.46	0.11	0.43	0.12	0.03
	6.03	1.7	0.09	0.13	0.15	1.73	10.85	0.08	0.54	0.08	0.01
	6.08	1.29	0.06	0.08	0.07	1.3	8.18	0.05	0.78	0.04	0.0
	6.13	0.85	0.02	0.03	0.02	0.86	5.38	0.02	1.84	0.01	0.0

	6.14	0.65	0.01	0.01	0.01	0.66	4.13	0.01	2.74	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) =	7.46	(cfs)
Calculated Flow (Qc) =	6.51	(cfs)
(Qm-Qc)/Qm * 100 =	12.71%	
Measured Waterline (WLm) =	5.31	(ft)
Calculated Waterline (WLc) =	5.18	(ft)
(WLm-WLc)/WLm * 100 =	2.38%	
Max Measured Depth (Dm) =	1.15	(ft)
Max Calculated Depth (Dc) =	0.98	(ft)
(Dm-Dc)/Dm * 100 =	15.08%	
Mean Velocity =	1.21	(ft/s)
Manning's n =	0.112	
0.4 * Qm =	2.98	(cfs)
2.5 * Qm =	18.64	(cfs)

FIELD DATA

Feature	Station (ft)	Rod Height (ft)	Water depth (ft)	Velocity (ft/s)
	0	4.15		
	1	4.5		
	1.4	4.6		
	1.8	4.65		
	2	4.75		
Bankfull	2.2	4.9		
	2.6	4.94		
	3	4.97		
	3.4	5		
	3.8	4.95		
	4.2	4.99		
	4.4	5.04		
	4.8	5.07		
	5.2	5.2		
	5.6	5.25		
Waterline	6.8	5.31	0	
	7	5.4	0.14	
	7.4	5.53	0.28	
	7.8	5.59	0.32	
	8.2	5.7	0.46	
	8.6	5.68	0.44	
	9	5.93	0.74	
	9.4	6.04	0.9	
	9.8	6.13	1.1	
	10.2	6.16	1.15	
	10.6	6.16	1.1	
	11	6.05	0.98	
	11.4	5.96	0.88	
	11.8	5.95	0.88	
	12.2	5.87	0.8	

	12.6	5.79	0.66
	13	5.75	0.6
	13.4	5.65	0.5
	13.8	5.64	0.45
	14.2	5.6	0.4
	14.6	5.69	0.38
	15	5.58	0.3
Waterline	15.4	5.31	0
	15.8	5.16	
	16.2	5.15	
	17	5.03	
	18	5.1	
Bankfull	18.2	4.95	
	20.8	4.01	

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	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	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	0	0
0	0	0	0	0
0.22	0.14	0.04	0.06	0.78
0.42	0.28	0.11	0.16	2.09
0.4	0.32	0.13	0.18	2.38
0.41	0.46	0.18	0.26	3.43
0.4	0.44	0.18	0.24	3.28
0.47	0.74	0.3	0.41	5.51
0.41	0.9	0.36	0.5	6.7
0.41	1.1	0.44	0.61	8.19
0.4	1.15	0.46	0.64	8.57
0.4	1.1	0.44	0.61	8.19
0.41	0.98	0.39	0.54	7.3
0.41	0.88	0.35	0.49	6.55
0.4	0.88	0.35	0.49	6.55
0.41	0.8	0.32	0.44	5.96

0.41	0.66	0.26	0.37	4.92
0.4	0.6	0.24	0.33	4.47
0.41	0.5	0.2	0.28	3.72
0.4	0.45	0.18	0.25	3.35
0.4	0.4	0.16	0.22	2.98
0.41	0.38	0.15	0.21	2.83
0.41	0.3	0.12	0.17	2.23
0.48	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	0	0	0
0	0	0	0	0

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.