COLORADO
Colorado Water Conservation Board
Department of Natural Resources

1313 Sherman Street, Room 718
Denver, CO 80203

P (303) 866-3441
F (303) 866-4474

Jared Polis, Governor

Dan Gibbs, DNR Executive Director

Rebecca Mitchell, CWCB Director

**TO:** Colorado Water Conservation Board Members

**FROM:** Robert Viehl, Chief
Brandy Logan, Water Resource Specialist
Stream and Lake Protection Section

**DATE:** January 24, 2023

**AGENDA ITEM:** 19 a. Request to Form Intent to Appropriate Instream Flow and Natural Lake Level Water Rights in Water Divisions 1, 4, 5, and 6

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## Staff Recommendation

Staff recommends that, pursuant to ISF Rule 5d., the Board declare its intent to appropriate an instream flow (ISF) water right on each stream segment listed in Table 1, and a natural lake level (NLL) water right on the lake listed in Table 2, and direct staff to publicly notice the Board's declaration of its intent to appropriate.

**Table 1. ISF Water Rights**

| Div | Stream | Watershed | County | Length (miles) | Upper Terminus | Lower Terminus | Flow Rate cfs/ Timing |
|---|---|---|---|---|---|---|---|
| 1 | Herman Gulch *(Increase)* | Clear | Clear Creek | 3.64 | headwaters | confluence Clear Creek | 0.4 (04/01 - 04/30)<br>4 (05/01 - 07/31)<br>0.7 (08/01 - 8/31) |
| 4 | Cameron Creek | East-Taylor | Gunnison | 3.36 | headwaters | confluence Lottis Creek | 1.1 (04/01 - 09/30)<br>0.64 (10/01 - 10/31)<br>0.5 (11/01 - 03/31) |
| 4 | Cross Creek | East-Taylor | Gunnison | 2.48 | headwaters | confluence Lottis Creek | 0.72 (04/01 - 04/30)<br>1.4 (05/01 - 07/31)<br>0.85 (08/01 - 08/31)<br>0.63 (09/01 - 09/30)<br>0.27 (10/01 - 03/31) |
| 4 | Curecanti Creek *(Increase)* | Upper Gunnison | Gunnison | 9.90 | headwaters | confluence Commissary Gulch | 0.5 (03/01 - 03/31)<br>8.5 (04/01 - 07/15)<br>1.5 (07/16 - 7/31) |
| 4 | Curecanti Creek *(Increase)* | Upper Gunnison | Gunnison | 10.1 | confluence Commissary Gulch | confluence Morrow Point Reservoir | 3 (03/01 - 03/31)<br>11.8 (04/01 - 07/15)<br>4.8 (07/16 - 07/31)<br>0.4 (08/01 - 09/30)<br>1.4 (10/01 - 11/30)<br>0.6 (12/01 - 02/28) |
| 4 | Kelly Creek | San Miguel | Montrose | 1.59 | headwaters | confluence Red Canyon | 1.2 (04/01 - 04/30)<br>2.6 (05/01 - 05/31)<br>2.7 (06/01 - 06/30)<br>1.2 (07/01 - 07/31)<br>0.45 (08/01 - 10/31)<br>0.2 (11/01 - 03/31) |
| 4 | Monitor Creek | Lower Gunnison | Montrose | 9.44 | confluence Little Monitor Creek | confluence Potter Creek | 4.6 (04/01 - 05/31)<br>3.6 (06/01 - 06/30) |

| Div | Stream | Watershed | County | Length (miles) | Upper Terminus | Lower Terminus | Flow Rate cfs/ Timing |
|---|---|---|---|---|---|---|---|
| 4 | Red Canyon Creek | San Miguel | Montrose | 3.20 | headwaters | confluence Big A Creek | 5 (04/01 - 04/30)<br>6.2 (05/01 - 07/31)<br>3 (08/01 - 09/30)<br>2.3 (10/01 - 10/31)<br>1 (11/01 - 03/31) |
| 4 | Van Boxel Creek *(Increase)* | Upper Gunnison | Gunnison | 7.75 | headwaters | confluence Little Cimarron Rover | 2.5 (04/01 - 04/30)<br>7.8 (05/01 - 06/30)<br>7.1(07/01 - 07/31)<br>1.5 (08/01 - 08/31)<br>0.4 (09/01 - 09/30) |
| 4 | West Steuben Creek | Upper Gunnison | Gunnison | 5.39 | headwaters | confluence Steuben Creek | 2.2 (04/01 - 04/30)<br>4.5 (05/01 - 07/31)<br>1.5 (08/01 - 09/30)<br>1.1 (10/01 - 11/30)<br>0.8 (12/01 - 03/31) |
| 6 | Piceance Creek | Piceance-Yellow | Garfield, Rio Blanco | 6.93 | headwaters | confluence unnamed tributary | 0.2 (07/01 - 02/29)<br>0.8 (03/01 - 03/31)<br>1.5 (04/01 - 04/30)<br>1.4 (05/01 - 05/31)<br>0.8 (06/01 - 06/31) |
| 6 | Piceance Creek | Piceance-Yellow | Rio Blanco | 3.67 | confluence unnamed tributary | Piceance Ditch headgate | 0.4 (07/01 - 02/29)<br>1.5 (03/01 - 03/31)<br>2.9 (04/01 - 05/31)<br>1.5 (06/01 - 06/30) |

Table 2. NLL Water Right

| Div | Lake | Watershed | County | Location (Center-point) (NAD 1983 Zone 13 North) | Surface Elevation (feet) | Volume (acre-feet) |
|---|---|---|---|---|---|---|
| 5 | Hack Lake | Colorado Headwaters | Garfield | UTM-East: 316816.32<br>UTM-North: 4409994.98 | 9,875 | 8.92 |

## Introduction

This memo provides an overview of the technical analyses performed by the recommending entities and CWCB staff on ISF and NLL recommendations in Water Divisions 1, 4, 5, and 6. This work was conducted to provide the Board with sufficient information to declare its intent to appropriate ISF and NLL water rights in accordance with the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program (ISF Rules). The Board was also provided with an executive summary for each recommended stream segment and lake. The executive summaries contain the technical basis for each appropriation along with appendices of the supporting scientific data.

In addition, the scientific data and technical analyses performed by the recommending entity are accessible on the Board's website at:
https://cwcb.colorado.gov/2023-isf-recommendations

## Natural Environment Studies

The Bureau of Land Management, Colorado Parks and Wildlife, and High Country Conservation Advocates documented the natural environment on their respective recommendations and found natural environments that can be preserved. To evaluate instream flow requirements, the recommending entities collected hydraulic data and performed R2Cross modeling on all segments. Staff reviewed each proposed ISF segment to ensure that the dataset is complete,

and proper methods and procedures were followed. Staff also conducted site visits to each recommendation. CWCB staff worked with the recommending entities to develop final recommendations for the flow rates of water necessary to preserve the natural environment to a reasonable degree.

**Water Availability Studies**

To determine the amount of water physically available for the recommended streams, staff analyzed available streamflow gage records, available streamflow models, and/or utilized appropriate standard methods to develop a hydrograph showing median daily or mean monthly flows for each stream flow recommendation. In addition, staff analyzed the water rights tabulation for each stream to identify any potential water availability problems. To determine water availability for the lakes, staff reviewed hydrology, and analyzed maps and aerial photos to assess the long-term persistence of the lake. Based on these analyses, staff determined that water is available for appropriation on each stream segment listed in Table 1 and the lake listed in Table 2 to preserve the natural environment to a reasonable degree.

On some of these streams, CWCB staff suggested modifications to the R2Cross biological flow recommendation due to water availability limitations. For these streams, staff met with the recommending entities to review the water availability analyses and discuss whether the modified recommendation would preserve the natural environment to a reasonable degree. After reviewing staff's hydrology and the original R2Cross results, and evaluating flow needs of the natural environment, the recommending entities concluded that the proposed modified recommendations would preserve the natural environment to a reasonable degree on each stream segment.

**Stakeholder Outreach**

Staff provided public notice of the recommendations in both March and November of 2022 to the ISF subscription mailing list, posted public notices in local newspapers, gave presentations to County Commissioners, and contacted landowners adjacent to the proposed ISF reaches via phone or mail. In addition, staff contacted water commissioners, water right holders, and others when possible to further discuss the recommendations. Detailed information on stakeholder outreach is contained in the attached executive summary for each recommendation.

**Instream Flow Rule 5d.**

Rule 5d. provides that the Board may declare its intent to appropriate ISF water rights after reviewing staff's recommendations for the proposed appropriations. Rule 5d. also sets forth actions that staff must take after the Board declares its intent that initiate the public notice and comment procedure for the ISF appropriations. Specifically:

5d. Board's Intent to Appropriate. Notice of the Board's potential action to declare its intent to appropriate shall be given in the January Board meeting agenda and the Board will take public comment regarding its intent to appropriate at the January meeting.

(1) After reviewing Staff's ISF recommendations for proposed ISF appropriations, the Board may declare its intent to appropriate specific ISF water rights. At that time, the Board shall direct the Staff to publicly notice the Board's declaration of its intent to appropriate.

(2) After the Board declares its intent to appropriate, notice shall be published in a mailing to the ISF Subscription Mailing Lists for the relevant water divisions and shall include:

(a) A description of the appropriation (e.g. stream reach, flow amounts, etc.);

(b) Availability (time and place) for review of Summary Reports and Investigations Files for each recommendation; and,

(c) Summary identification of any data, exhibits, testimony or other information in addition to the Summary Reports and Investigations Files supporting the appropriation.

(3) Published notice shall also contain the following information:

(a) The Board may change flow amounts of contested ISF appropriations based on information received during the public notice and comment period.

(b) Staff will maintain, pursuant to Rule 5e.(3), an ISF Subscription Mailing List for each water division composed of the names of all persons who have sent notice to the Board Office that they wish to be included on such list for a particular water division. Any person desiring to be on the ISF Subscription Mailing List(s) must send notice to the Board Office.

(c) Any meetings held between Staff and members of the public will be open to the public. Staff may provide Proper Notice prior to any such meetings and may provide notice to persons on the ISF Subscription Mailing List(s).

(d) Any Notice to Contest must be received at the Board office no later than March 31st, or the first business day thereafter. All Notices of Party status and Contested Hearing Participant status must be received at the Board office no later than April 30th, or the first business day thereafter.

(e) Staff will announce its Final Staff ISF Recommendation concerning contested appropriations at the September Board meeting and will send notice of the Final Staff Recommendation to all persons on the Contested Hearing Mailing List.

(f) The Board may take final action on any uncontested ISF appropriations at the May Board meeting.

(4) After the Board declares its intent to appropriate, notice of the Board's action shall be mailed within five working days to the County Commissioners of the county(ies) in which the proposed reach is located.

(5) Final action by the Board on ISF appropriations will occur no earlier than the May Board Meeting.

Attachments: Overview Map
ISF and NLL Executive Summaries

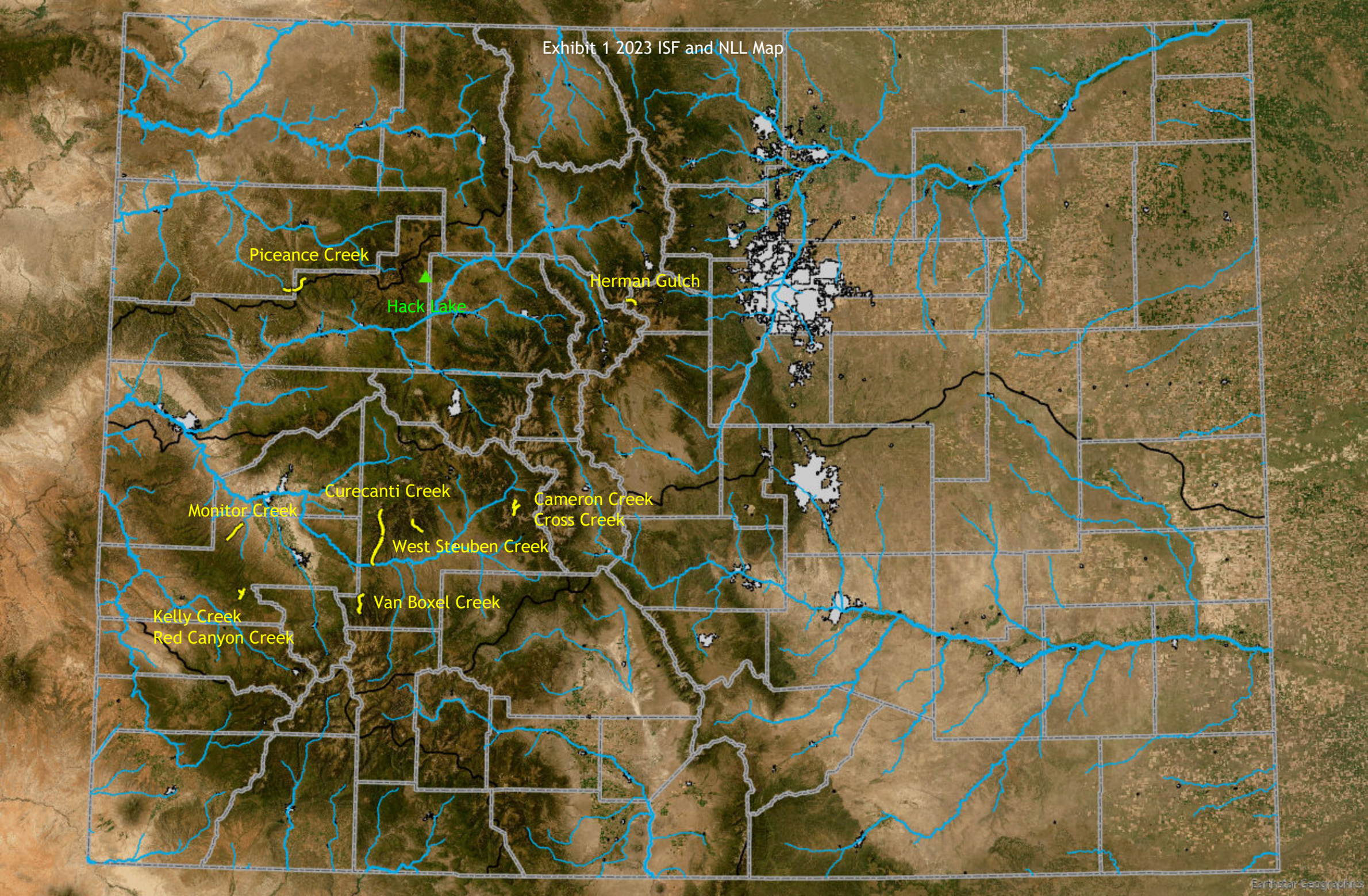
Exhibit 1 2023 ISF and NLL Map
Piceance Creek
Hack Lake
Herman Gulch
Curecanti Creek
Monitor Creek
Cameron Creek
Cross Creek
West Steuben Creek
Van Boxel Creek
Kelly Creek
Red Canyon Creek

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# January 2023 Instream Flow and Natural Lake Level Recommendations

Water Division 1

1. Herman Gulch *(Increase)* (Clear Creek County)
    a. Executive Summary
    b. Appendices

Water Division 4

2. Cameron Creek *(Increase)* (Gunnison County)
    a. Executive Summary
    b. Appendices

3. Cross Creek (Gunnison County)
    a. Executive Summary
    b. Appendices

4. Curecanti Creek (Upper) *(Increase)* (Gunnison County)
    a. Executive Summary
    b. Appendices

5. Curecanti Creek (Lower) *(Increase)* (Gunnison County)
    a. Executive Summary
    b. Appendices

6. Kelly Creek (Montrose County)
    a. Executive Summary
    b. Appendices

7. Monitor Creek (Montrose County)
    a. Executive Summary
    b. Appendices

8. Red Canyon Creek (Montrose County)
    a. Executive Summary
    b. Appendices

9. Van Boxel Creek *(Increase)* (Montrose County)
    a. Executive Summary
    b. Appendices

10. West Steuben Creek (Gunnison County)
    a. Executive Summary
    b. Appendices

Water Division 5

11. Hack Lake (Garfield County)
    a. Executive Summary
    b. Appendices

Water Division 6

12. Piceance Creek (Upper) (Garfield and Rio Blanco Counties)
    a. Executive Summary
    b. Appendices

13. Piceance Creek (Lower) (Rio Blanco County)
    a. Executive Summary
    b. Appendices

# Herman Gulch Executive Summary

**CWCB STAFF INSTREAM FLOW INCREASE RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | headwaters in the vicinity of:<br>UTM North: 4396896.47 UTM East: 422251.32 |
| LOWER TERMINUS: | confluence Clear Creek at:<br>UTM North: 4394857.42 UTM East: 426667.37 |
| WATER DIVISION: | 1 |
| WATER DISTRICT: | 7 |
| COUNTY: | Clear Creek |
| WATERSHED: | Clear |
| CWCB ID: | 21/1/A-003 |
| RECOMMENDER: | Colorado Parks and Wildlife (CPW) |
| LENGTH: | 3.64 miles |
| EXISTING INSTREAM FLOW: | 84CW0650, 2 CFS (1/1 -12/31) |
| FLOW INCREASE RECOMMENDATION: | 0.4 cfs (04/01 - 04/30)<br>4 cfs (05/01 - 07/31)<br>0.7 cfs (08/01 - 08/31) |

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**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

CPW recommended that the CWCB appropriate an increase to the existing ISF water right on Herman Gulch. Herman Gulch is located within Clear Creek County and is approximately 6.4 miles west from the town of Silver Plume (See Vicinity Map). The stream originates on the east side of Pettingell Peak at approximately 12,200 feet elevation and flows east and south, along the popular Herman Gulch trail, until it reaches the confluence with Clear Creek. The existing ISF water right on Herman Gulch was appropriated in 1984 for two cfs year-round. This ISF water right extends from the headwaters to the confluence with Clear Creek.

The proposed ISF reach extends from the headwaters downstream to the confluence with Clear Creek for a total of 3.64 miles. The entire proposed reach is located on United States Forest Service (USFS) land in the Arapaho National Forest (See Land Ownership Map). CPW is interested in an additional ISF water right to protect this stream because it contains a population of Greenback Cutthroat Trout, which is listed as a threatened species by both the state and federal government. CPW introduced Greenback Cutthroat Trout to Herman Gulch to establish a new conservation population as part of the Greenback Cuthroat Trout recovery plan (US Fish and Wildlife Service, 1998). In 2022, CPW found evidence of natural reproduction of Greenback Cutthroat Trout in Herman Gulch, making it only the second known self-sustaining population in the state.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Herman Gulch was sent to the mailing list in March 2020, March 2021, September 2021, March 2022, and November 2022. A public notice about this recommendation was also published in the Clear Creek Courant on December 22, 2022.

Staff presented information about the ISF program and this recommendation to the Clear Creek County Board of County Commissioners on October 20, 2020. In addition, staff communicated

with Water Commisioner Jason Smith via email in late December 2022 regarding existing water rights and water uses on Herman Gulch.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

Herman Gulch starts at the continental divide near Pettingell Peak. It is a first order and snowmelt driven stream with snowpack reserves generally lasting into the late summer. The top of the reach flows at a high gradient through high alpine scree fields and high alpine wetlands above treeline. It transitions to a lower gradient for a large section of the reach with stands of evergreen forest and wet meadows. The lower reach transitions again into a steep and densely evergreen forested section before flowing under Interstate 70 and into Clear Creek.

The channel is mainly single thread with substrate that ranges from medium-sized cobble to larger boulders. There are long runs, undercut banks, pocket pools, steep coarse-substrate riffles, and boulder cascades. Large woody debris and boulders form deep pools and scour pools. There is a significant amount of log jams formed by the aftermath of a large avalanche cycle in 2019.

CPW completed a reintroduction process for genetically pure Greenback Cutthroat Trout in Herman Gulch from 2016 to 2019. The Greenback Cutthroat Trout was designated Colorado's state fish in 1994. This subspecies of cutthroat trout is listed as a threatened species by both the state and federal government. A 2019 CPW fish survey found that the fishery was exclusively Greenback Cutthroat Trout and in 2022 CPW fish biologists found evidence that the population are successfully reproducing and naturally sustaining their population. The macroinvertebrate community is diverse and thriving. In the field, staff have identified mayfly caddisfly, stonefly, damselfly, blackfly, and flatworm. Taxa in the mayfly, stonefly, and caddisfly orders are considered evidence of good water quality (Hilsenhoff, 1987).

**Table 1. List of species identified in Herman Gulch.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Greenback Cutthroat Trout | *Oncorhynchus clarkii stomias* | Federal - Threatened Species<br>State - Threatened Species<br>State - Species of Greatest Conservation Need |
| aquatic fly larve | *Diptera* | None |
| black fly | *Simuliidae* | None |
| caddisfly | *Trichoptera* | None |
| damselfly | *Zygoptera* | None |
| dragonfly | *Anisoptera* | None |
| flathead mayfly | *Heptageniidae* | None |
| flatworm | *Turbellaria* | None |
| mayfly | *Ephemeroptera* | None |
| stonefly | *Plecoptera* | None |

## ISF QUANTIFICATION

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

### Quantification Methodology

CPW staff used the R2Cross method to develop the ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022) Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macro-invertebrates (Nehring, 1979). CPW staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial

recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree or withdraws the recommendation.

**Data Collection and Analysis**
CPW collected R2Cross data at three transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a summer flow of 6.0 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Herman Gulch.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 09/23/2020, 1 | 12.19 | 0.93 | N/A | 6.84 |
| 10/11/2021, 3 | 13.39 | 1.24 | N/A | 5.57 |
| 07/18/2022, 4 | 14.81 | 4.94 | N/A | 5.58 |
| | | | N/A | 6.00 |

**ISF Recommendation**
The CPW recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

An increase of 0.4 cfs is recommended from April 1 through April 30 to bring the total ISF protection to 2.4 cfs. This maintains adequate depth and wetted perimeter as fish transition from overwintering habitat to more metabolic activity as flows rise before the beginning of spring runoff.

An increase of 4.0 cfs is recommended from May 1 through July 31 to bring the total ISF protection to 6.0 cfs. This maintains adequate depth, velocity, and wetted perimeter during the summer period when fish are most active. This higher flow rate will also help remove fine sediment to maintain clean interstitial space in gravels for spawning and egg incubation.

An increase of 0.7 cfs is recommended from August 1 through August 31 to bring the total ISF protection to 2.7 cfs. This maintains adequate dpeth and wetted perimeter that allows fish to move to more stable habitat as flows begin to recede. It also may assist with higher water temperatures in late summer.

**WATER AVAILABILITY**
CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**
Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge,

etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**

The drainage basin of the proposed ISF on Herman Gulch is 3.16 square miles, with an average elevation of 11,891 feet and average annual precipitation of 32.15 inches (See the Hydrologic Features Map). There are three small springs and a well that total less than 0.07 cfs in decreed water rights. Due to small number of water uses, hydrology in this drainage basin represents essentially natural flow conditions.

**Data Collection and Analysis**

*Gage Data and CWCB Measurements*

There is not a current or historic streamflow gage on Herman Gulch. Several nearby gages were evaluated, but none appeared to be representative of Herman Gulch due to differences in drainage basin characteristics. CWCB staff visited Herman Gulch and assisted CPW in making R2Cross measurements on the proposed reach. Staff did not make any additional streamflow measurements.

*CSUFlow18*

The CSUFlow18 method provides the best available estimate of streamflow for Herman Gulch. The mean-monthly streamflow estimated using CSUFlow18 was not adjusted to account for the existing water rights which are for negligible amounts.

**Water Availability Summary**
The hydrograph (See Complete Hydrograph) shows CSUFlow18 results for mean-monthly streamflow. Staff has concluded that water is available for appropriation.

**MATERIAL INJURY**
As a new junior water right, the proposed ISF on Herman Gulch can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**

**Citations**
Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

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.

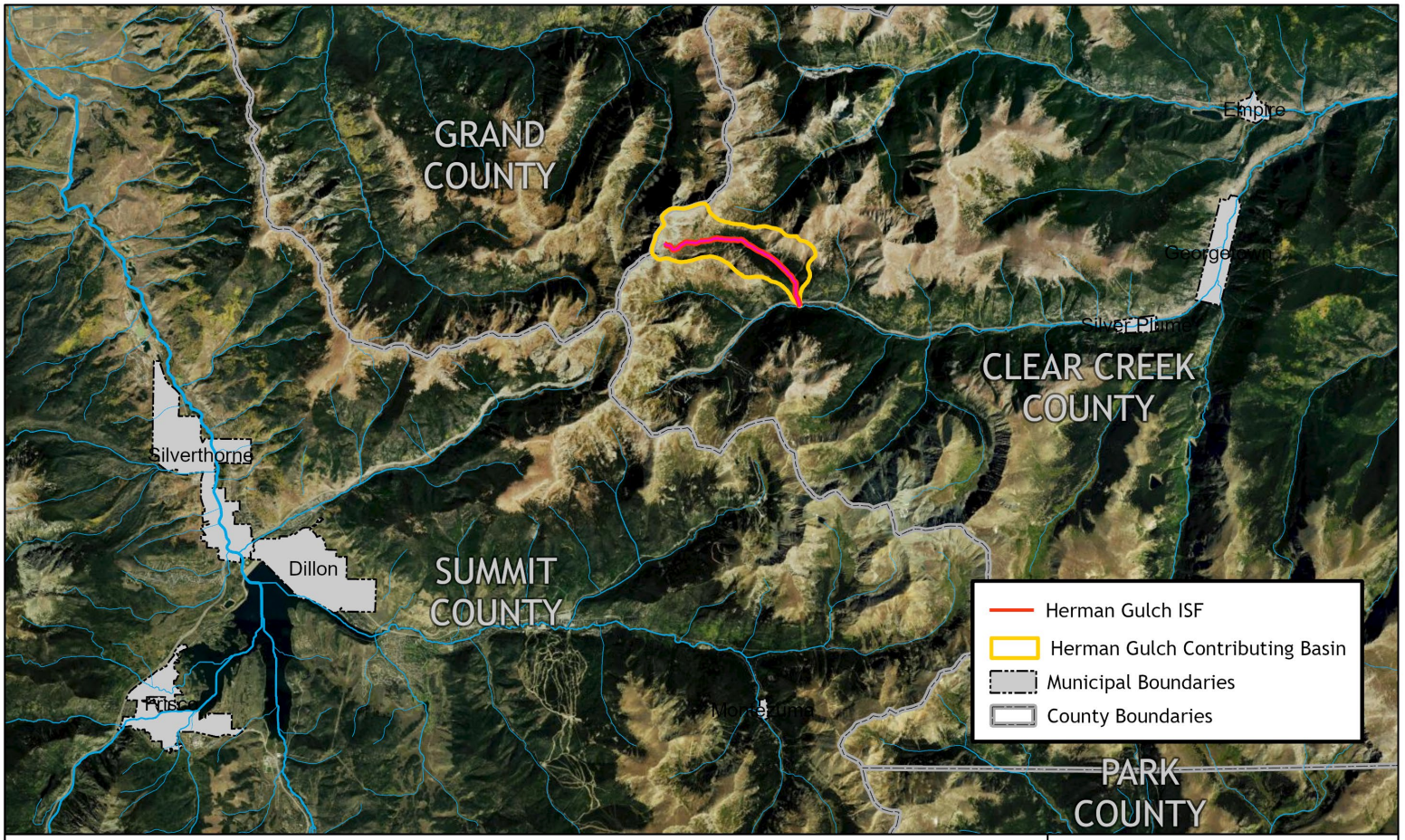
Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

U.S. Fish and Wildlife Service, 1998, Greenback cutthroat trout recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.
https://cpw.state.co.us/Documents/Research/Aquatic/CutthroatTrout/GBNRecoveryPlan.pdf

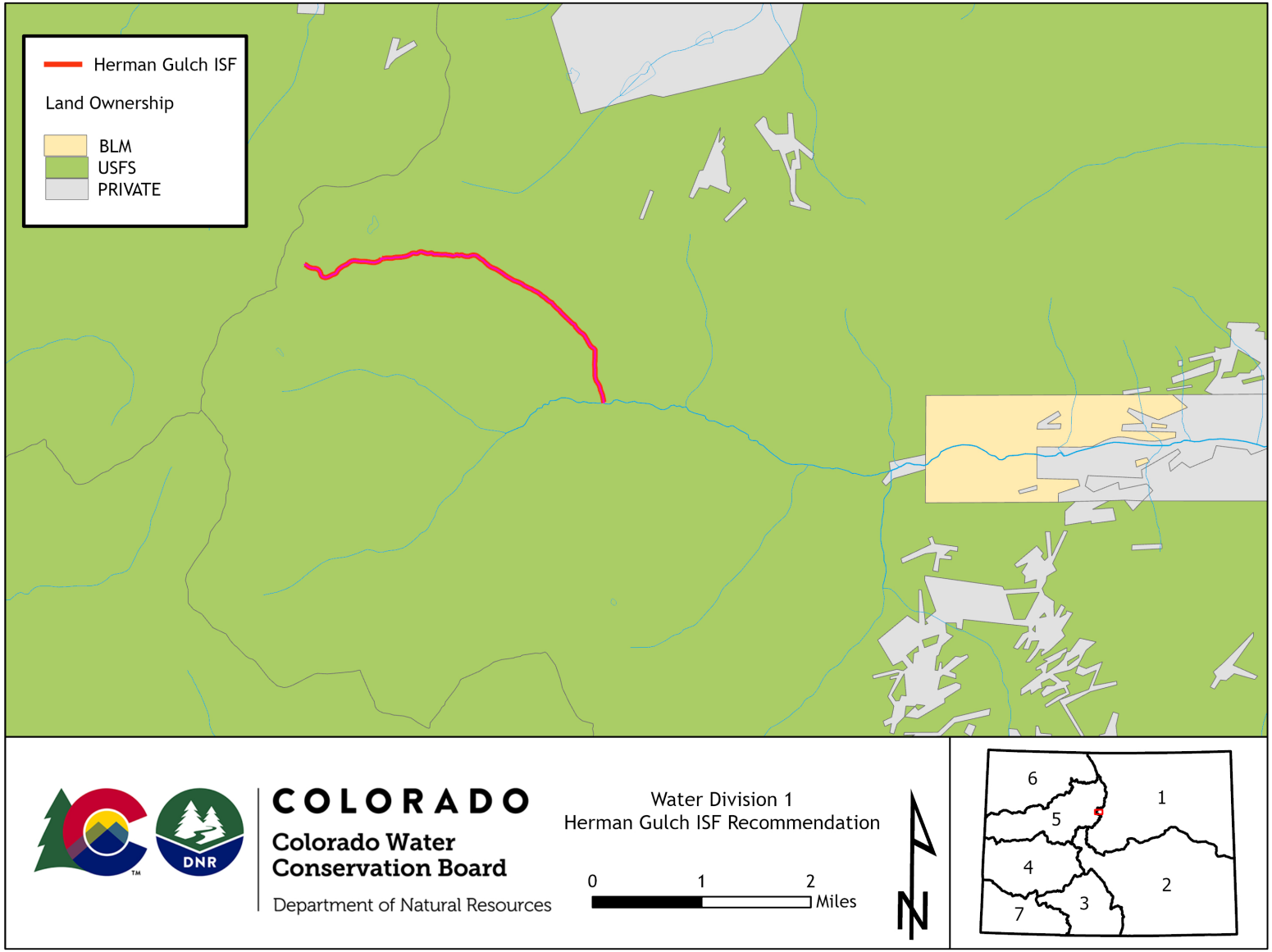
**Metadata Descriptions**
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

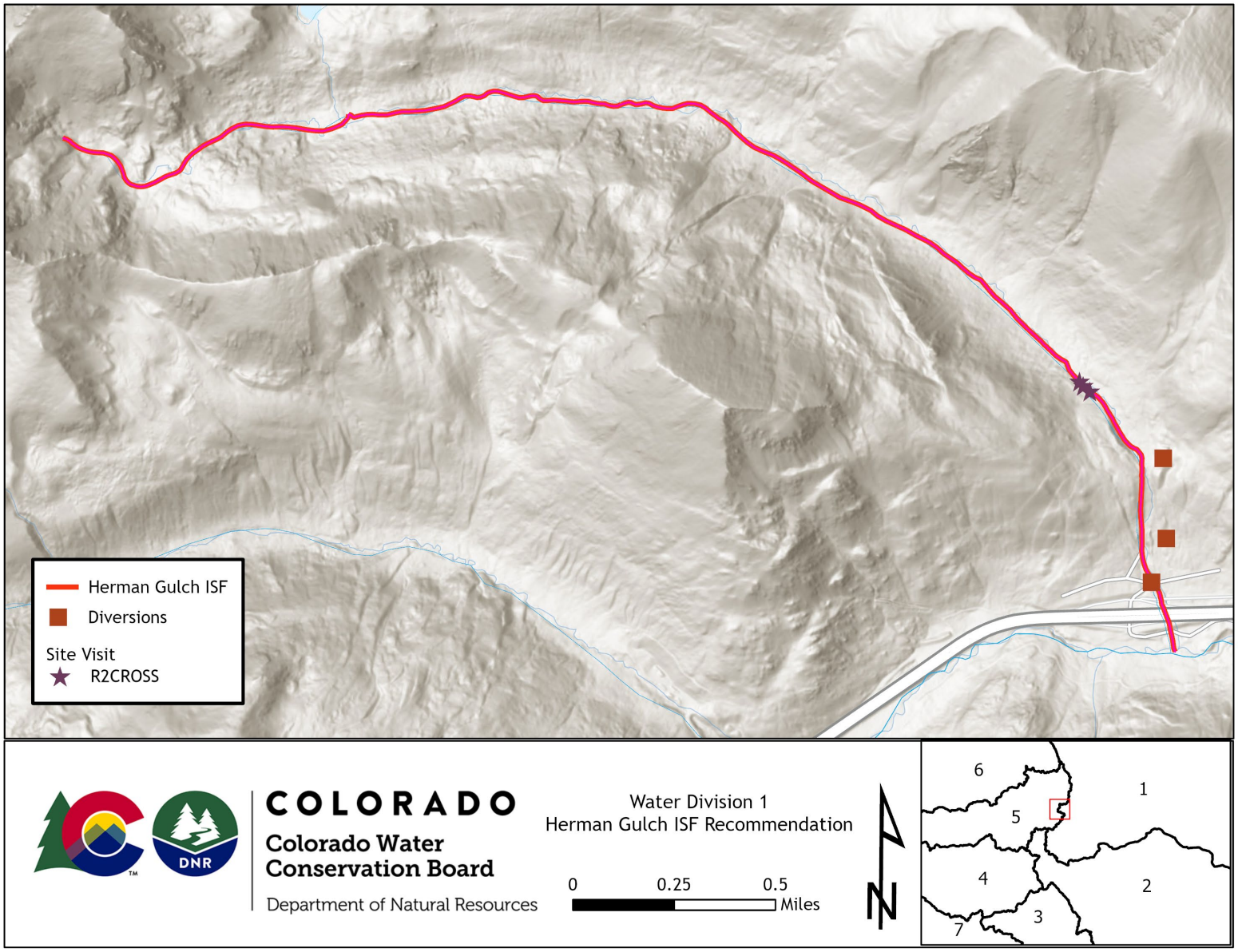
# VICINITY MAP



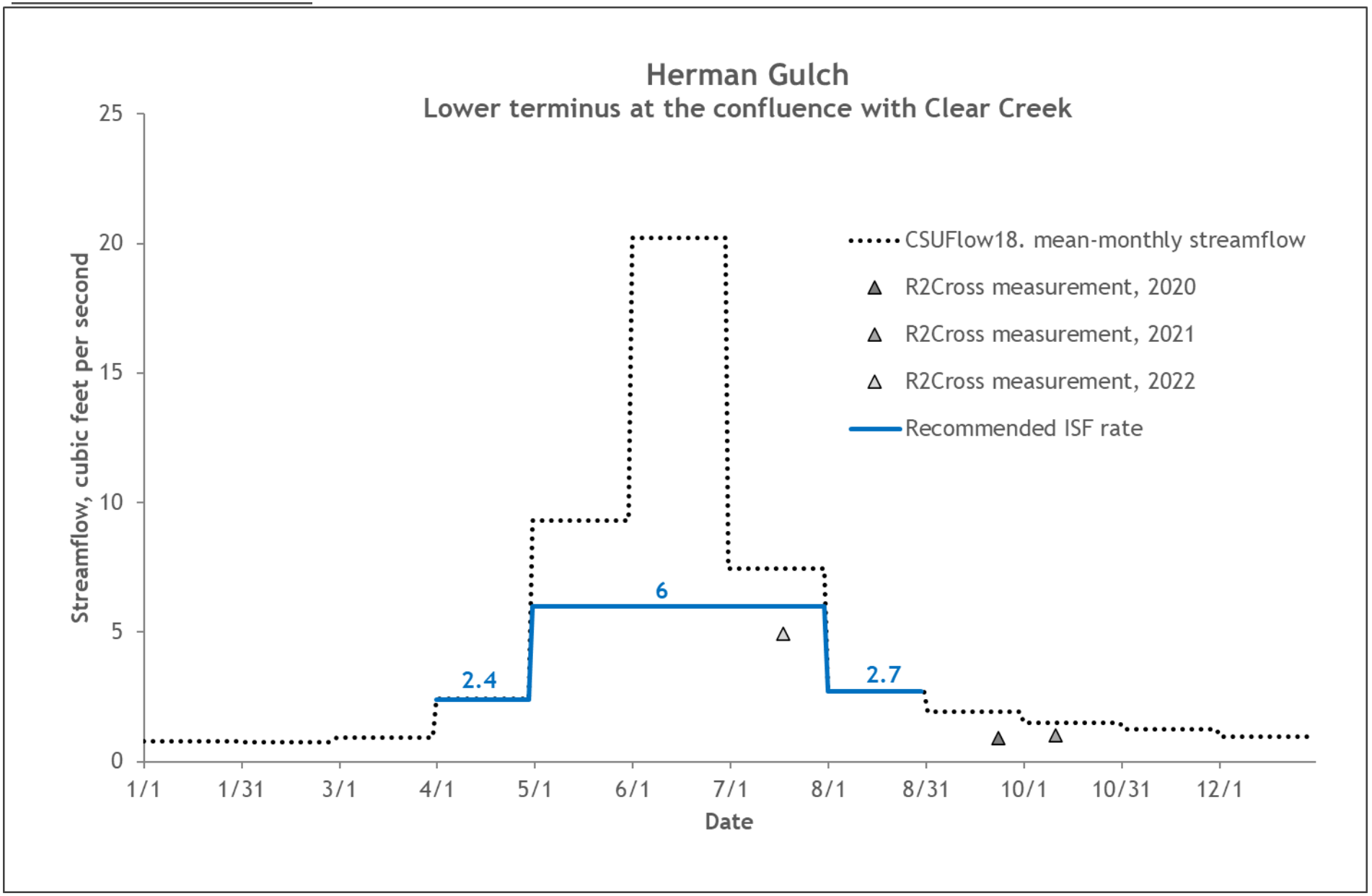
# LAND OWNERSHIP MAP



# HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



# Cameron Creek Executive Summary

**CWCB STAFF INSTREAM FLOW RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | headwaters in the vicinity of<br>UTM North: 4284643.53 UTM East: 362920.79 |
| LOWER TERMINUS: | confluence with Lottis Creek at<br>UTM North: 4289426.62 UTM East: 365596.60 |
| WATER DIVISION: | 4 |
| WATER DISTRICT: | 59 |
| COUNTY: | Gunnison |
| WATERSHED: | East-Taylor |
| CWCB ID: | 23/4/A-003 |
| RECOMMENDER: | High Country Conservation Advocates (HCCA) |
| LENGTH: | 3.69 miles |
| FLOW RECOMMENDATION: | 1.1 cfs (04/01 - 09/30)<br>0.64 cfs (10/01 - 10/31)<br>0.5 cfs (11/01 - 03/31) |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

HCCA recommended that the CWCB appropriate an ISF water right on a reach of Cameron Creek. Cameron Creek is located within Gunnison County and is approximately 15 miles northeast from the city of Almont (See Vicinity Map). The stream originates on steep slopes between Cross Mountain and Cameron Mountain at 11,600 feet elevation and flows northeast until it reaches the confluence with Lottis Creek.

The proposed reach extends from the headwaters downstream to confluence with Lottis Creek for a total of 3.69 miles. Approximately 96% of the land on the proposed reach is United States Forest Service (USFS) land within the Gunnison National Forest and approximately 4% is private land (See Land Ownership Map). HCCA is interested in protecting this stream to continue their mission to protect the health and natural beauty of the land, rivers, and wildlife in and around Gunnison County.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Cameron Creek was sent to the mailing list in March 2022 and Novemnber 2022. Staff sent letters to identified landowners adjacent to Cameron Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Crested Butte News on December 30, 2022.

Staff presented information about the ISF program and this recommendation to the Gunnison County Board of County Commissioners on September 13, 2022. In addition, staff spoke with Bob Hurford, Division Four Engineer on October 11, 2022 regarding water availability on Cameron Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each

recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

The headwaters start above treeline before flowing through the valley between Cross Mountain and Cameron Mountain and then joining Lottis Creek. Cameron Creek flows from alpine slopes into a valley consisting of alternating sections of evergreen forest and meadow. The stream curves sinuously, forming diverse habitats including large riparian wetlands, oxbow lakes and ponds. There are side channels and wet meadows, indicating good floodplain connectivity.

The stream system begins as a high gradient stream, decreasing through the valley terrain. It is a cold-water, high-elevation system. The streambed consists largely of gravel and cobble substrate with ample woody debris below treeline. Cameron Creek supports Brown Trout, and a macroinvertebrate population. CWCB staff identified caddisfly in the field. Taxa in this order are considered evidence of generally good water quality (Hilsenhoff, 1987). CWCB observed evidence of active beaver complexes.

**Table 1. List of species identified in Cameron Creek.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Brown Trout | *Salmo trutta* | None |
| caddisfly | *Trichoptera* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**

HCCA staff used the R2Cross method to develop the ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022). Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macroinvertebrates (Nehring, 1979). HCCA staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to

develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

**Data Collection and Analysis**
HCCA collected R2Cross data at two transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 0.64 cfs and a summer flow of 1.1 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Cameron Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 07/05/2021, 1 | 5.70 | 1.96 | 0.75 | 0.87 |
| 09/17/2021, 2 | 5.70 | 0.52 | 0.52 | 1.42 |
| | | | 0.64 | 1.1 |

**ISF Recommendation**
HCCA recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

1.1 cfs is recommended from April 1 to September 30. This rate meets three of three hydraulic criteria.

0.64 cfs is recommended from October 1 to October 31. This rate meets two of three hydraulic criteria.

0.5 cfs is recommended from November 1 to March 31 for baseflow conditions; this flow rate is reduced due to water availability limitations.

**WATER AVAILABILITY**
CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**
Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.
Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate

streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**

The drainage basin of the proposed ISF on Cameron Creek is 2.96 square miles, with an average elevation of 11,194 feet and average annual precipitation of 24.24 inches (See the Hydrologic Features Map). Cameron Creek is a snowmelt driven hydrologic system, with variable timing and magnitude in snowmelt runoff. There are no water diversions on-channel or within the basin.

*Water Rights Assessment*

There are no diversions on Cameron Creek. There is one privately held ISF right on Cameron Creek for 12.5 cfs from the headwaters to the confluence with Lottis Creek (case number W-1987). This privately held right is part of a larger water right for Lottis Creek and its tributaries for a net amount of 60 cfs. These water rights have an appropriation date of 1910 and beneficial uses include stock water, recreation, fish culture, wildlife procreation, and heritage preservation. Although these private ISF rights are extensive, CWCB does not monitor, enforce, or legally protect them.

**Data Collection and Analysis**

*Representative Gage Analysis*

There are no current or historic gages on Cameron Creek. Staff investigated nearby gages for similarities in basin characteristics and hydrology and for data collection histories. No gages were sufficiently similar to be used to estimate streamflow on Cameron Creek.

*Multiple Regression Model*

The CSUFlow18 regression model predicts mean-monthly flow in Cameron Creek and provides the best estimate for streamflow conditions.

CWCB staff made one streamflow measurement on the proposed reach of Cameron Creek as summarized in Table 3.

**Table 3. Summary of streamflow measurements for Cameron Creek.**

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 09/12/2022 | 0.74 | CWCB |

**Water Availability Summary**
The hydrograph shows CSUFlow18 results for mean-monthly streamflow and includes the proposed ISF rate (See Complete Hydrograph). The proposed ISF flow rate is below the mean-monthly streamflow. Staff concludes that water is available for a new appropriation on Cameron Creek.

**MATERIAL INJURY**
As a new junior water right, the proposed ISF on Cameron Creek can exist without material injury to other existing water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**

**Citations**
Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

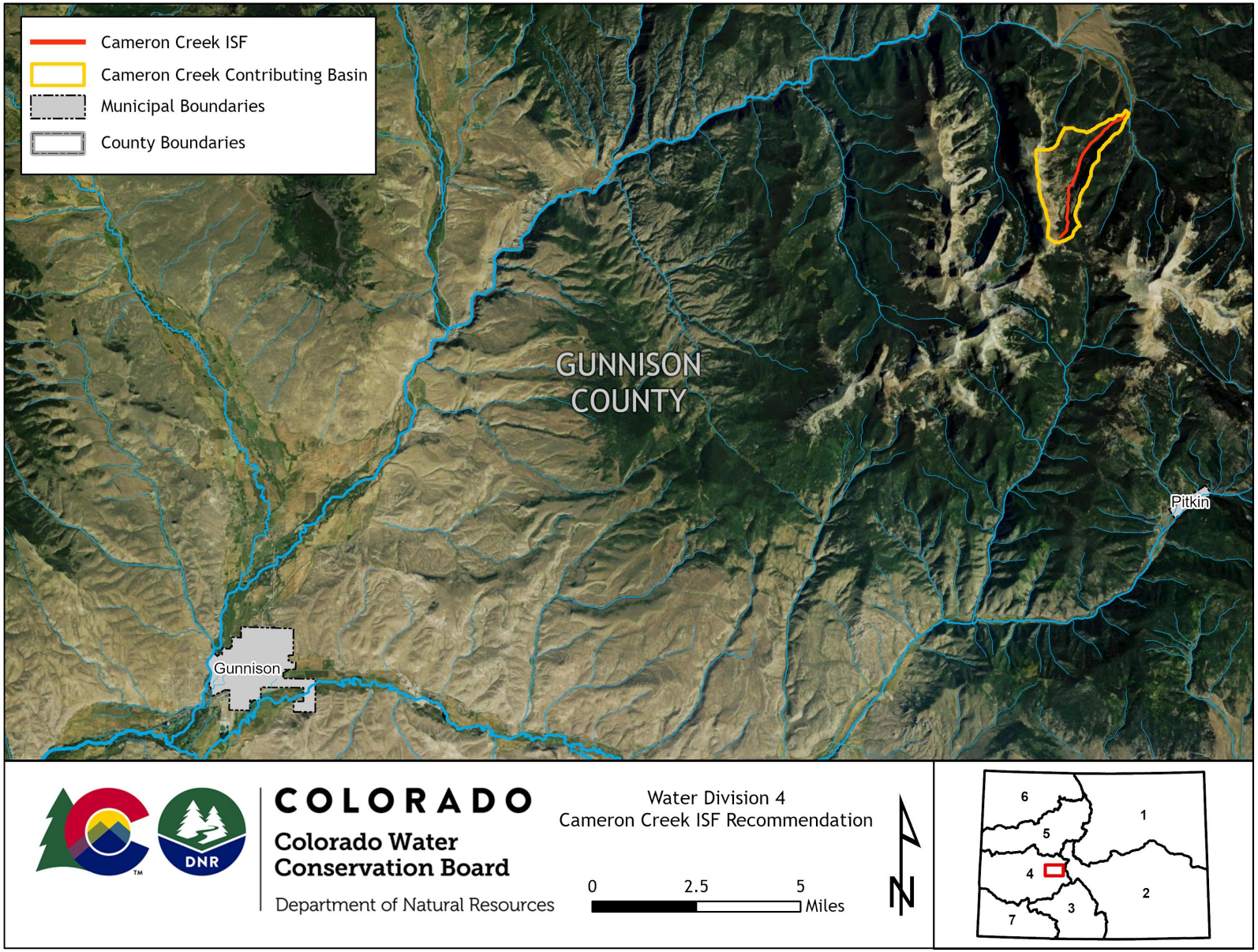
Nehring, B.R., 1979, Evaluation of instream flow methods and determination of water quantity needs for streams in the State of Colorado, Colorado Division of Wildlife.

Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

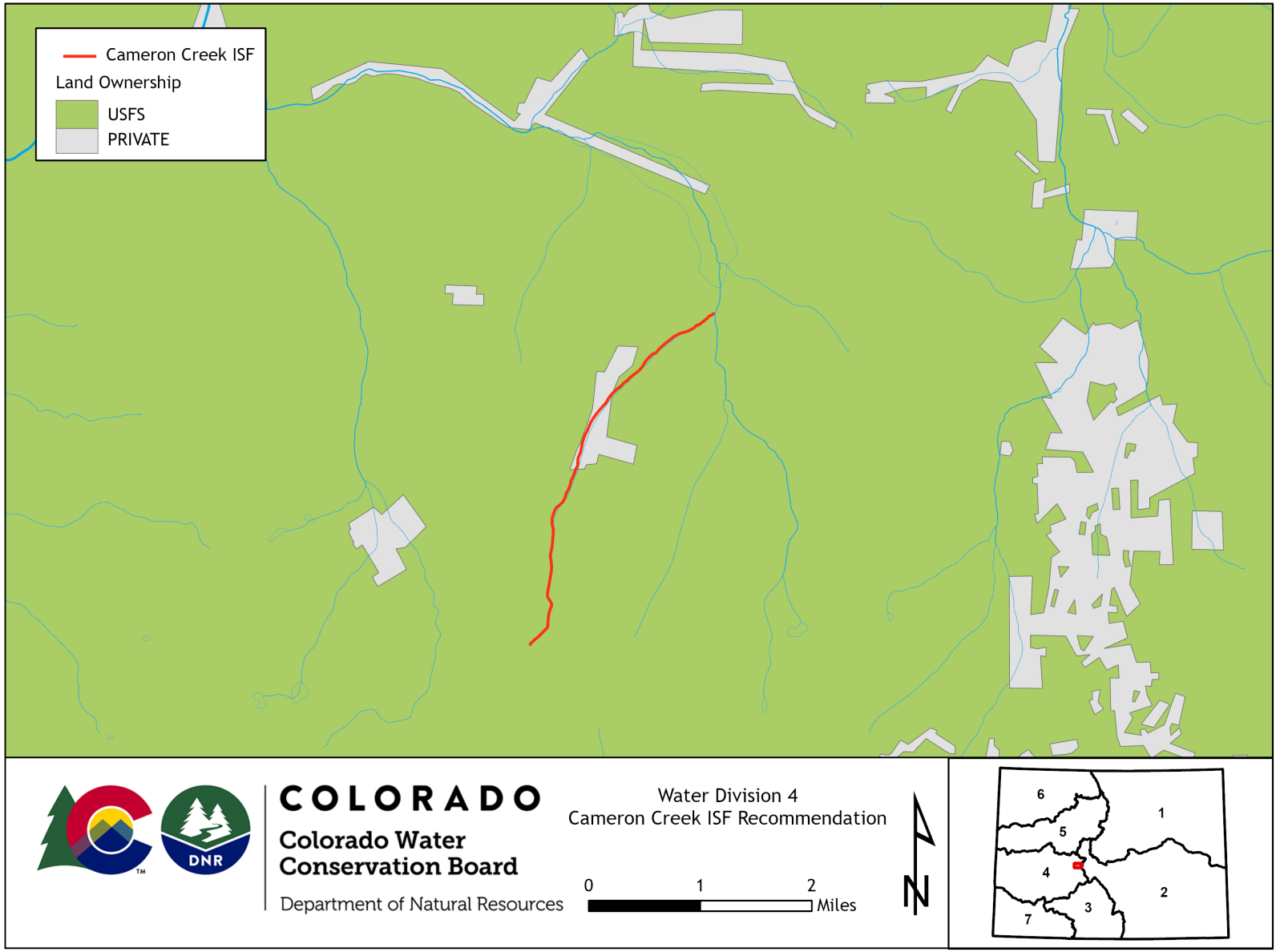
**Metadata Descriptions**
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

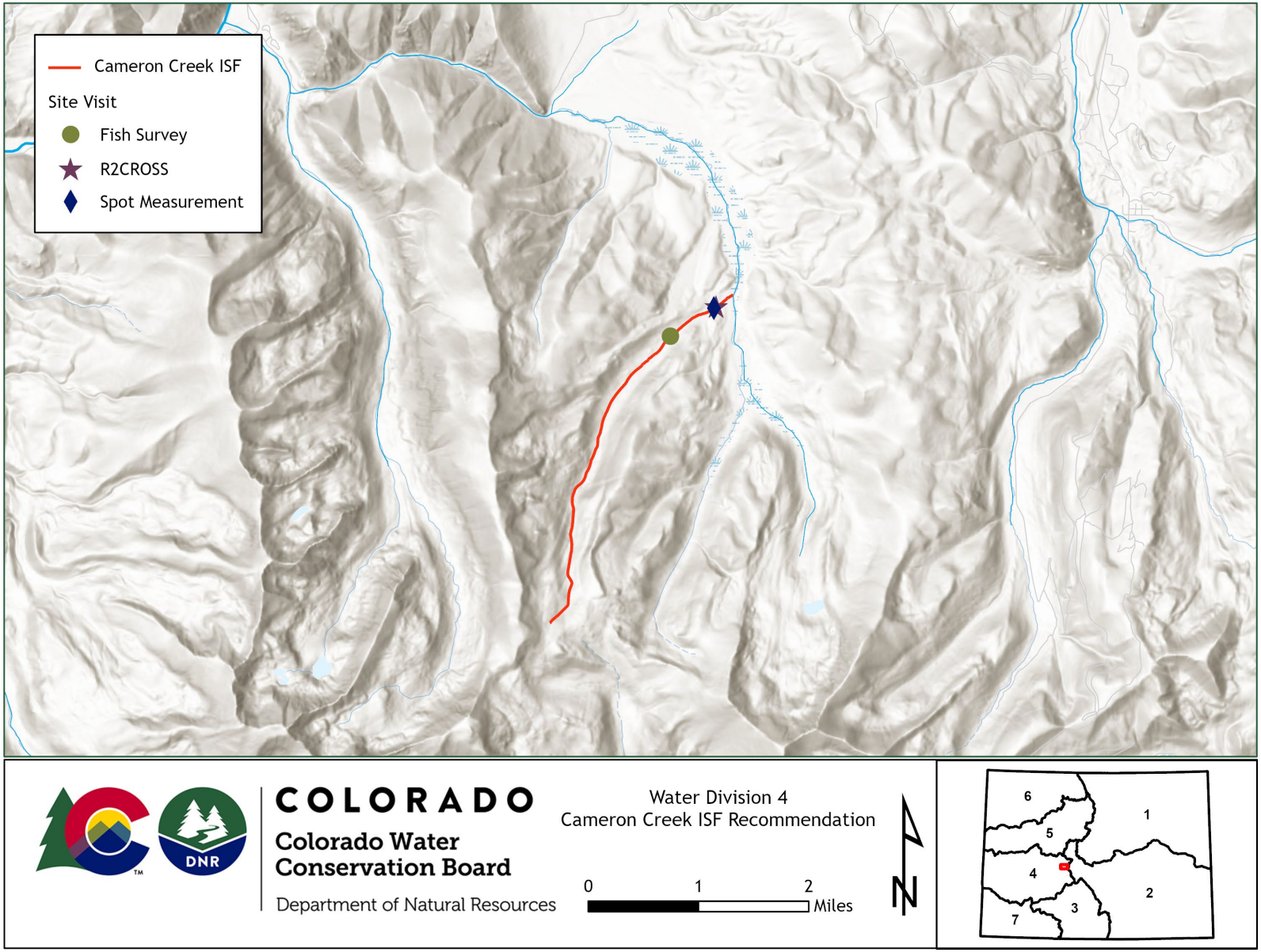
# VICINITY MAP



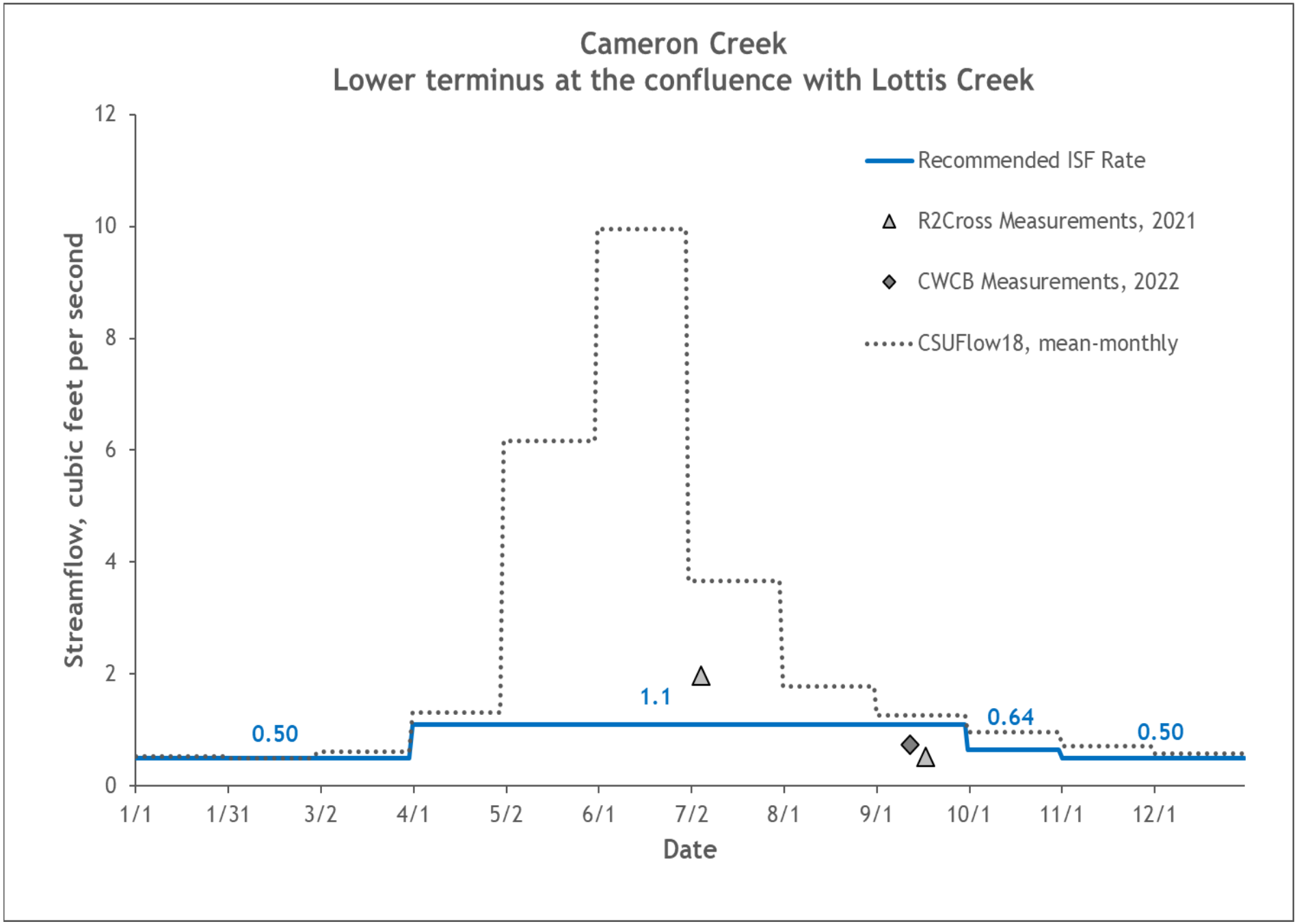
# LAND OWNERSHIP MAP



# HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



# Cross Creek Executive Summary

**CWCB STAFF INSTREAM FLOW RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | headwaters in the vicinity of<br>UTM North: 4288386.58 UTM East: 362731.96 |
| LOWER TERMINUS: | confluence Lottis Creek at<br>UTM North: 4291938.66 UTM East: 363705.61 |
| WATER DIVISION: | 4 |
| WATER DISTRICT: | 59 |
| COUNTY: | Gunnison |
| WATERSHED: | East-Taylor |
| CWCB ID: | 23/4/A-002 |
| RECOMMENDER: | High Country Conservation Advocates (HCCA) |
| LENGTH: | 2.48 miles |
| FLOW RECOMMENDATION: | 0.72 cfs (04/01 - 04/30)<br>1.4 cfs (05/01 - 07/31)<br>0.85 cfs (08/01 - 08/31)<br>0.63 cfs (09/01 - 09/30)<br>0.27 cfs (10/01 - 03/31) |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

HCCA recommended that the CWCB appropriate an ISF water right on a reach of Cross Creek. Cross Creek is located within Gunnison County and is approximately 15 miles northeast of the town of Almont (See Vicinity Map). The stream originates at an elevation of approximately 19,000 feet on the north slope of Cross Mountain and flows northeast until it reaches the confluence with Lottis Creek.

The proposed ISF reach extends from the headwaters downstream to the confluence with Lottis Creek for a total of 2.48 miles. The land on the proposed reach is 95% United State Forest Service (USFS) land in the Gunnison National Forest and 5% is private (See Land Ownership Map). HCCA is interested in protecting this stream to continue their mission to protect the health and natural beauty of the land, rivers, and wildlife in and around Gunnison County.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Cross Creek was sent to the mailing list in March 2022 and November 2022. Staff sent letters to identified landowners adjacent to Cross Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Crested Butte News on December 30, 2022.

Staff presented information about the ISF program and this recommendation to the Gunnison County Board of County Commissioners on September 13, 2022. In addition, staff communicated with Bob Hurford, Division Four Engineer on October 11, 2022 regarding water availability on Cross Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each

recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

The headwaters of Cross Creek form above treeline on the northeast slope of Cross Mountain. This cold-water, high gradient stream flows from alpine slopes into a valley consisting of alternating sections of dense evergreen forest, meadow, and wetlands. The stream system begins as a high gradient stream and slope decreases through the valley terrain as channel sinuosity increases. The streambed consists largely of gravel and cobble substrate. The stream includes riffle and pool habitat.

Cross Creek supports Brown Trout and an ample macroinvertebrate population (Table 1). CWCB Staff identified caddisfly in the field. Taxa in this order are considered evidence of good water quality (Hilsenhoff, 1987). The riparian corridor is robust and includes willow and wet meadow species. There are active and abandoned beaver ponds at several locations along the creek.

**Table 1. List of species identified in Cross Creek.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Brown Trout | *Salmo trutta* | None |
| caddisfly | *Trichoptera* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**

HCCA staff used the R2Cross method to develop the ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022). Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macro-invertebrates (Nehring, 1979). HCCA staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the

reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree or withdraws the recommendation.

**Data Collection and Analysis**
HCCA collected R2Cross data at one transect for this proposed ISF reach (Table 2). The R2Cross model results in a winter flow of 0.85 cfs and a summer flow of 1.39 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Cross Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 09/17/2021, 1 | 7.70 | 1.41 | 0.85 | 1.39 |
| | | | 0.85 | 1.39 |

**ISF Recommendation**
The HCCA recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

0.72 cfs is recommended from April 1 to April 30; this flow rate is reduced due to water availability limitations.

1.4 cfs is recommended from May 1 to July 31. This flow rate meets three of three hydraulic criteria.

0.85 cfs is recommended from August 1 to August 31; this flow rate is reduced due to water availability limitations. This flow rate meets two of three hydraulic criteria.

0.63 is recommended from September 1 to September 30; this flow rate is reduced due to water availability limitations.

0.27 cfs is recommended from October 1 to March 31; this flow rate is reduced due to water availability limitations.

**WATER AVAILABILITY**
CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**
Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). Although extensive and time-consuming investigations of all variables may be possible, staff takes a pragmatic and cost-effective approach to analyzing water availability. This

approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**

The drainage basin of the proposed ISF on Cross Creek is 1.89 square miles, with an average elevation of 10,734 feet and average annual precipitation of 24.10 inches (See the Hydrologic Features Map). Cross Creek is a snowmelt driven hydrologic system, with variable timing and magnitude in snowmelt runoff.

*Water Rights Assessment*

There are no diversions on Cross Creek. There is one privately held ISF right on Cross Creek for 5 cfs from the headwaters to the confluence with Lottis Creek (case number W-1987). This privately held right is part of a larger water right for Lottis Creek and its tributaries for a net amount of 60 cfs. The combined flows in this right have an appropriation date of 1910 and beneficial uses of stock water, recreation, fish culture, wildlife procreation, and heritage preservation. Although these private ISF rights are extensive, CWCB does not monitor, enforce, or legally protect them. Further, as this right works in kind with the proposed ISF right, no water reductions are made in consideration of this right.

**Data Collection and Analysis**

*Representative Gage Analysis*

There are no current or historic gages on Cross Creek. Staff investigated nearby gages for similarities in basin characteristics and hydrology and for data collection histories. No gages were sufficiently similar to be used to estimate streamflow on Cross Creek.

*Multiple Regression Models*
The CSUFlow18 regression model predicts mean monthly flow in Cross Creek and provides best estimate for streamflow conditions.

*Measurements*
CWCB staff made one streamflow measurement on the proposed reach of Cross Creek as summarized in Table 3.

**Table 3. Summary of streamflow measurements for Cross Creek.**

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 09/12/2022 | 0.47 | CWCB |

**Water Availability Summary**
The hydrograph shows CSUFlow18 results for mean-monthly streamflow and includes the proposed ISF rate. Staff has concluded that water is available for a new appropriation on Cross Creek.

**MATERIAL INJURY**
As a new junior water right, the proposed ISF on Cross Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**

**Citations**

Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

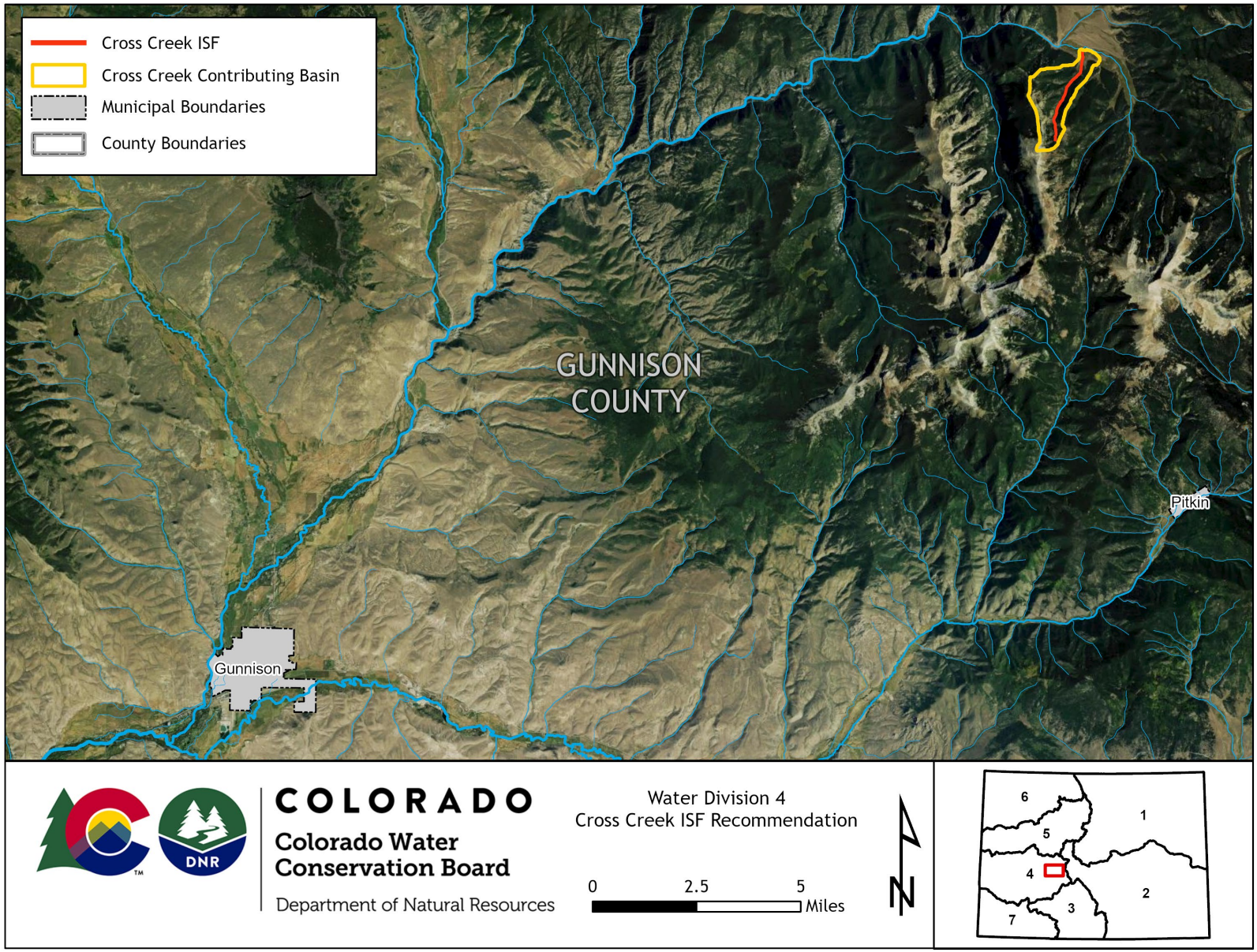
Nehring, B.R., 1979, Evaluation of instream flow methods and determination of water quantity needs for streams in the State of Colorado, Colorado Division of Wildlife.

Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

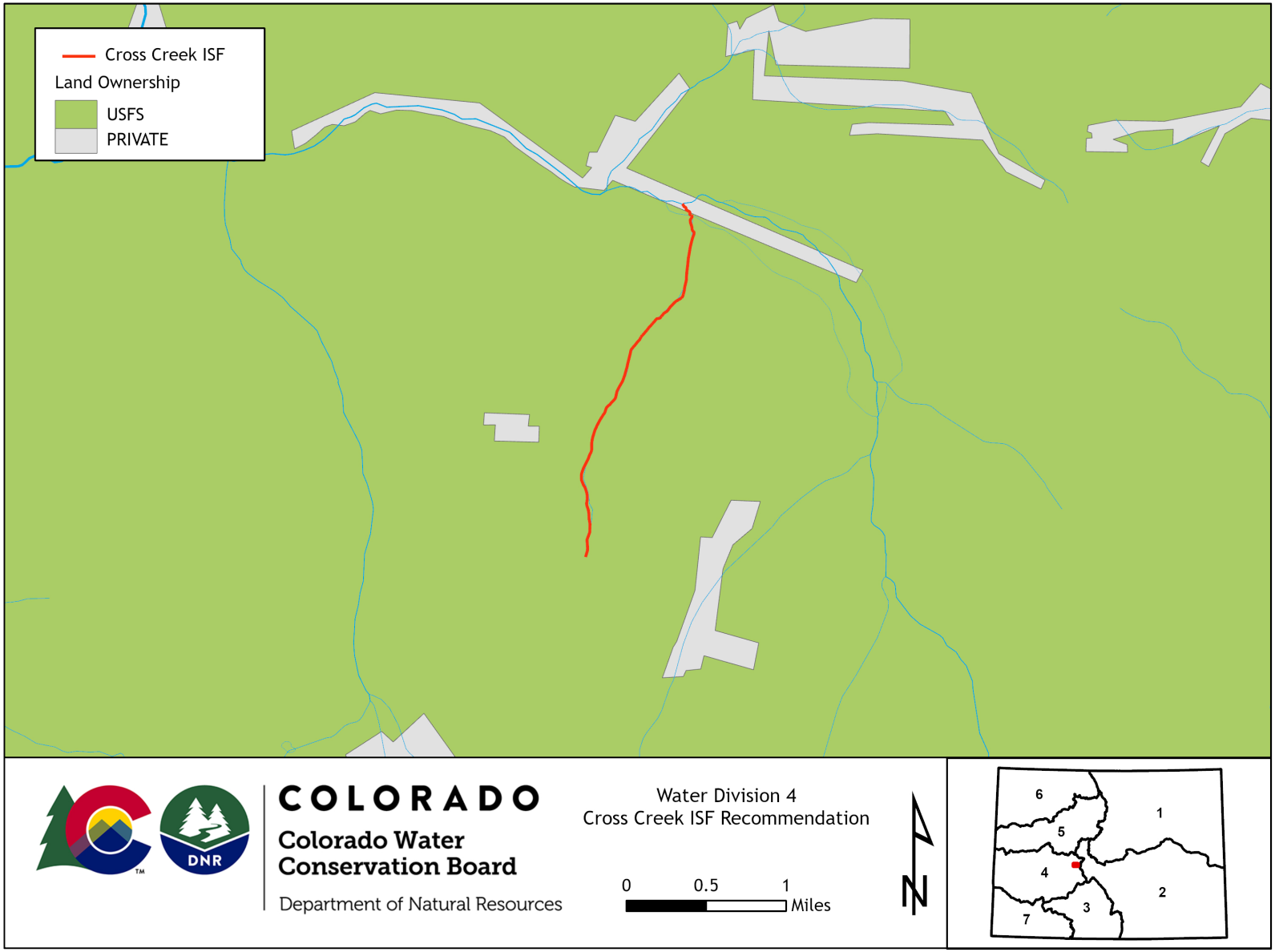
**Metadata Descriptions**
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

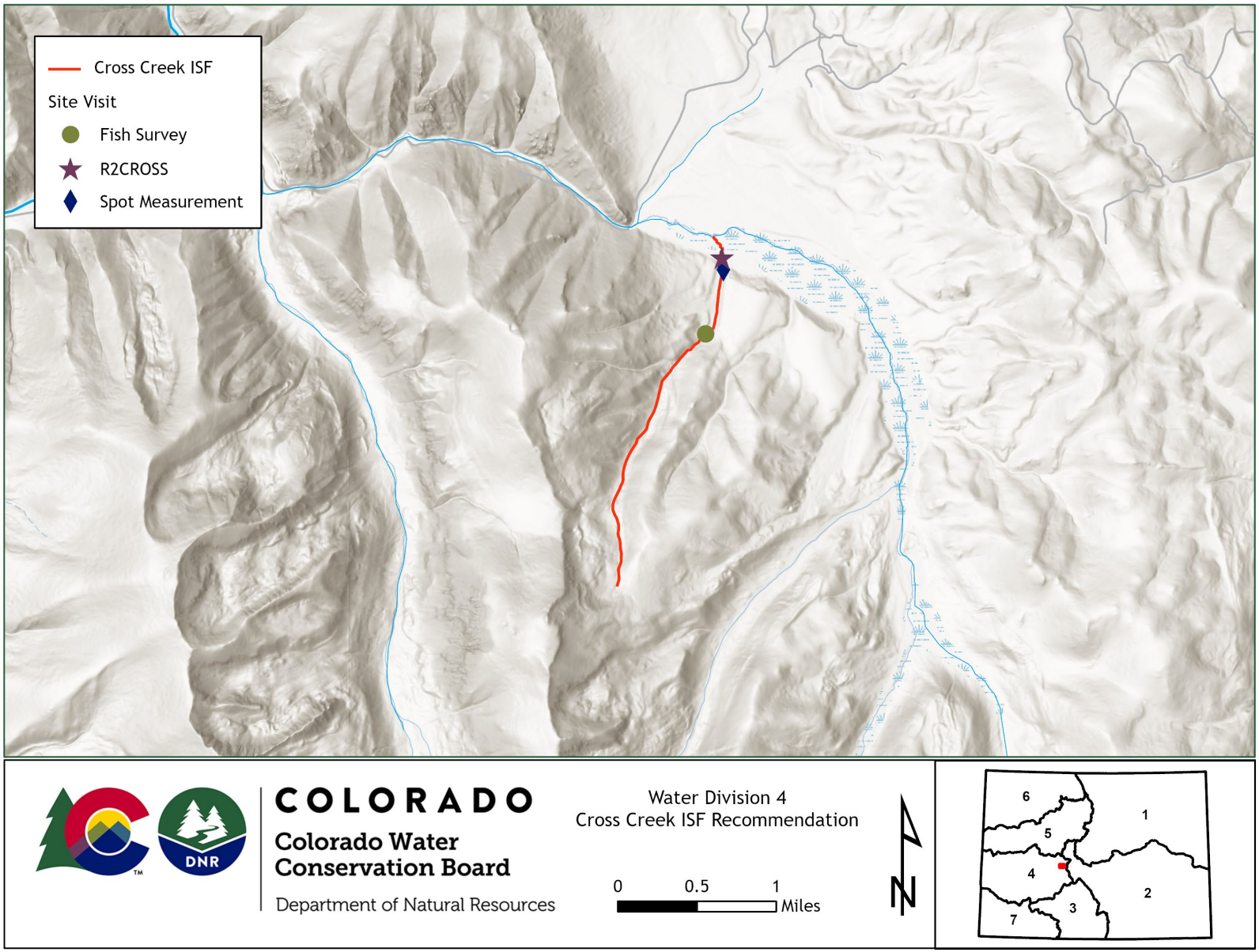
# VICINITY MAP



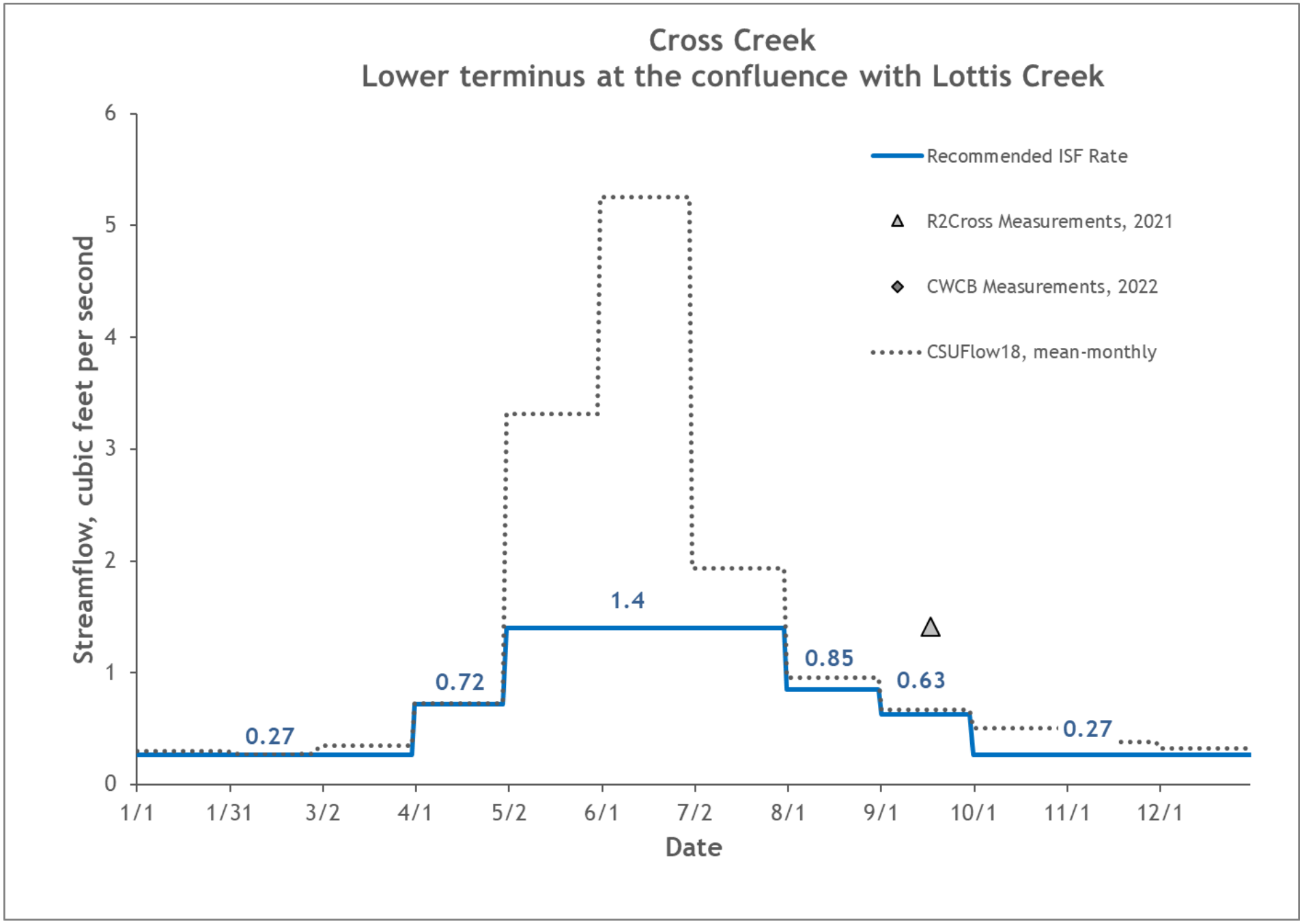
# LAND OWNERSHIP MAP



# HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



# Curecanti Creek (Upper) Executive Summary

**CWCB STAFF INSTREAM FLOW INCREASE RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | headwaters in the vicinity of<br>UTM North: 4286947.81 UTM East: 293747.09 |
| LOWER TERMINUS: | confluence with Commissary Gulch at<br>UTM North: 4272414.37 UTM East: 294045.93 |
| WATER DIVISION: | 4 |
| WATER DISTRICT: | 59 |
| COUNTY: | Gunnison |
| WATERSHED: | Upper Gunnison |
| CWCB ID: | 21/4/A-003 |
| RECOMMENDER: | Colorado Parks and Wildlife (CPW) |
| LENGTH: | 9.9 miles |
| EXISTING INSTREAM FLOW: | 84CW0390, 3 cfs (01/01 – 12/31) |
| FLOW INCREASE RECOMMENDATION: | 1.5 cfs (03/01 - 03/31)<br>8.5 cfs (04/01 - 07/15)<br>2.5 cfs (07/16 - 7/31) |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

The CPW recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Curecanti Creek. Curecanti Creek is located within Gunnison County and is approximately 21 miles east of Montrose (See Vicinity Map). The stream originates near Curecanti Pass and flows south until it reaches the confluence with the Gunnison River upstream of the Black Canyon of the Gunnison. The existing ISF water right on Curecanti Creek was appropriated in 1984 for 3 cfs year-round.

The proposed reach extends from the headwaters downstream to the confluence with Commissary Gulch for a total of 9.9 miles. The entire proposed reach is on United States Forest Service (USFS) land in the Gunnison National Forest (See Land Ownership Map). CPW is interested in protecting this stream in order to protect the natural environment.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Curecanti Creek was sent to the mailing list in March 2020, March 2021, March 2022, and November 2022. Staff sent letters to identified landowners adjacent to Curecanti Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Crested Butte News on December 30, 2022.

Staff presented information about the ISF program and this recommendation to the Gunnison County Board of County Commissioners on November 10, 2020 and September 13, 2022. In addition, staff communicated with Bob Hurford, Division Four Engineer on October 11, 2022 and November 29, 2022 regarding water availability on Curecanti Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each

recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

The headwaters of Curecanti Creek form on the southern slope of Curecanti pass in a dense alpine forest. The channel then weaves down through a wide sagebrush and conifer valley dotted with lightly grazed meadows. Beaver complexes were observed by CWCB staff. The stream has a relatively low gradient throughout the proposed reach.

Curecanti Creek has multiple side channels and varied channel morphology. The creek also appears to have good floodplain connection and a robust riparian corridor of willow and alder stands interspersed with sedge and grasses. The streambed substrate is primarily large cobbles. Channel features include: runs, plentiful pocket pools, beaver ponds, coarse substrate and traditional riffles. Shade and cover are also abundant. Significant woody debris and leafy detritus provide habitat and food for the macroinvertebrate and fish communities.

CPW has identified self-sustaining population of Brook Trout in Curecanti Creek (Table 1). CPW staff observed caddisfly, mayfly, and stonefly in the field. Taxa in these orders are considered evidence of good water quality (Hilsenhoff, 1987).

**Table 1. List of species identified in Curecanti Creek.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Brook Trout | *Salvelinus fontinalis* | None |
| black fly | *Simuliidae* | None |
| caddisfly | *Trichoptera* | None |
| mayfly | *Ephemeroptera* | None |
| beaver | *Castor canadensis* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**

CPW staff used the R2Cross method to develop the ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022). Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and

aquatic macro-invertebrates (Nehring, 1979). CPW staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

**Data Collection and Analysis**

CPW collected R2Cross data at two transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a summer flow of 11.51 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Curecanti Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 08/12/2022, 1 | 22.60 | 3.28 | NA | 8.61 |
| 08/12/2022, 2 | 37.40 | 3.28 | NA | 14.41 |
| | | | NA | 11.51 |

**ISF Recommendation**

CPW and National Park Service (NPS) observed that the single decreed instream flow rate of 3 cfs did not protect season fluctuations in flow. R2Cross data supports additional protection of flow during the summer months to meet three of three hydraulic criteria. The CPW recommends the following increased flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

An increase of 1.5 cfs is recommended for March 1 through March 31, to bring the total ISF protection to 4.5 cfs; this early spring flow initiation rate is reduced due to water availability. This rate maintains adequate depth and wetted perimeter across most riffles, which will support fish they begin to move, transitioning from overwintering habitat to more metabolic activity as temperatures rise before the beginning of spring runoff.

An increase of 8.5 cfs is recommended for April 1 through July 15 during summer, to bring the total ISF protection to 11.5 cfs; this flow rate provides complete minimum protection of three of three criteria during the summer months. This rate maintains adequate depth, velocity, and wetted perimeter during the spring and early summer periods. This flow rate supports fish passage and ideal conditions macroinvertebrate production, fish feeding, and spawning.

An increase of 2.5 cfs is recommended for July 16 through July 31 to bring the total ISF protection to 5.5 cfs; this flow rate is reduced due to water availability limitations. This rate maintains habitat with suitable depth and wetted perimeter and allows fish movement as flows recede and temperatures may be high in late July.

**WATER AVAILABILITY**

CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**

Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). Although extensive and time-consuming investigations of all variables may be possible, staff takes a pragmatic and cost-effective approach to analyzing water availability. This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**

The drainage basin of the proposed ISF on Curecanti Creek is 17.60 square miles, with an average elevation of 10,154 feet and average annual precipitation of 27.41 inches (See the Hydrologic Features Map). The upper reach of Curecanti Creek is a snowmelt-driven hydrologic system that flows through a medium to high-gradient channel in a heavily forested catchment.

*Water Rights Assessment*

There is one water right in the proposed upper reach of Curecanti Creek that alters the hydrology of the basin as well as one spring right (Table 3). The Head and Ferrier Ditch (WDID 5900944) is the only main-channel diverting ditch. The ditch is decreed for 10.5 cfs of trans-basin diversions, and is located near the headwaters of Curecanti Creek. As per the Final Revised Abandoned List in Division 4 and email communication with Bob Hurford (11/29/2022), 4.45 cfs of the senior right and the entire 2.5 cfs junior right are on the finalized abandonment list, leaving 3.55 cfs remaining in this right. Limited diversion records show the ditch operates from June through September.

**Table 3. Absolute diversion located within the proposed ISF reach on Curecanti Creek.**

| WDID | Structure Name | Decreed Flow rate, cfs | Appropriation Date |
|---|---|---|---|
| 5900944 | Head and Ferrier Ditch | 8, 2.5[1] | 1955, 1956 |
| 5907127 | S U Packer Spring | 0.001 | 1905 |

[1] Includes 6.95 cfs of flow listed for abandonment

**Data Analysis**

*Representative Gage Analysis*

There is a historic gage on Curecanti Creek below this proposed reach, Curecanti Creek near Sapinero, CO (USGS9125000). The gage collected daily streamflow records for a period of record (POR) of 27 years (1945 to 1972) and is approximately 2.5 miles above the creek's confluence with Morrow Point Reservoir. The contributing basin of the gage is 35 square miles with an average precipitation of 22.77 inches.

To assess the how the gage POR compared hydrologically to the most recent thirty year POR, staff evaluated daily precipitation records from NOAA Climate station Gunnison 3 SW (USC00053662). The climate station is located approximately 25 miles east of the gage. During operation of the historical gage, the average annual precipitation recorded was 10.55 inches. This is higher than the 30 years when average precipitation was 8.95 inches. Six years of gage record were recorded during conditions that were drier than the most recent 30-year average. Overall, the gage record reflects recent hydrologic conditions with three notably wet years that significantly increase the gage POR's average precipitation values (1957, 1959 and 1969).

Sufficient data exist to calculate upper and lower 95% confidence intervals for median streamflow and median streamflow based on the gage records. A weighted area-precipitation factor of 60% was applied the gage records to account for the difference in location between the gage and the reach. The Head and Ferrier Ditch (Table 3) was appropriated during the POR of the gage, ditch diversion is assumed to be reflected in the gage record.

CWCB staff made one streamflow measurement on the proposed reach of Curecanti Creek as summarized in Table 4.

**Table 4. Summary of streamflow measurements for Curecanti Creek.**

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 06/24/2022 | 19.03 | CWCB |

**Water Availability Summary**
The hydrograph (See Complete Hydrograph) shows the median streamflow with upper and lower range of the 95% confidence intervals recorded from USGS9125000 gage from 1945 to 1972 and the proposed ISF flow rate. Staff has concluded that water is available for an increase in ISF protection from March 1 to July 31.

**MATERIAL INJURY**
As a new junior water right, the proposed ISF on Curecanti Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**

**Citations**
Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

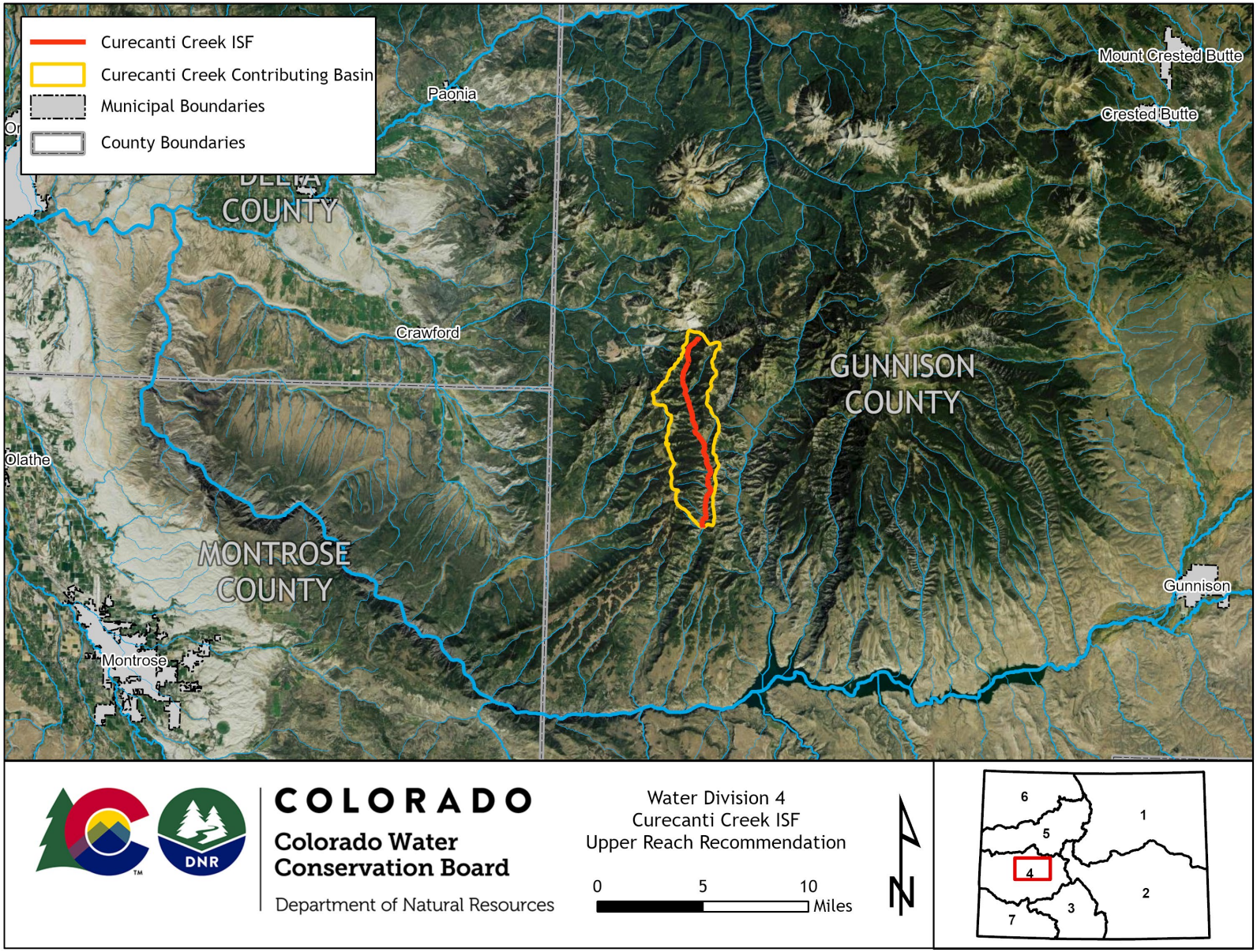
Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

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.

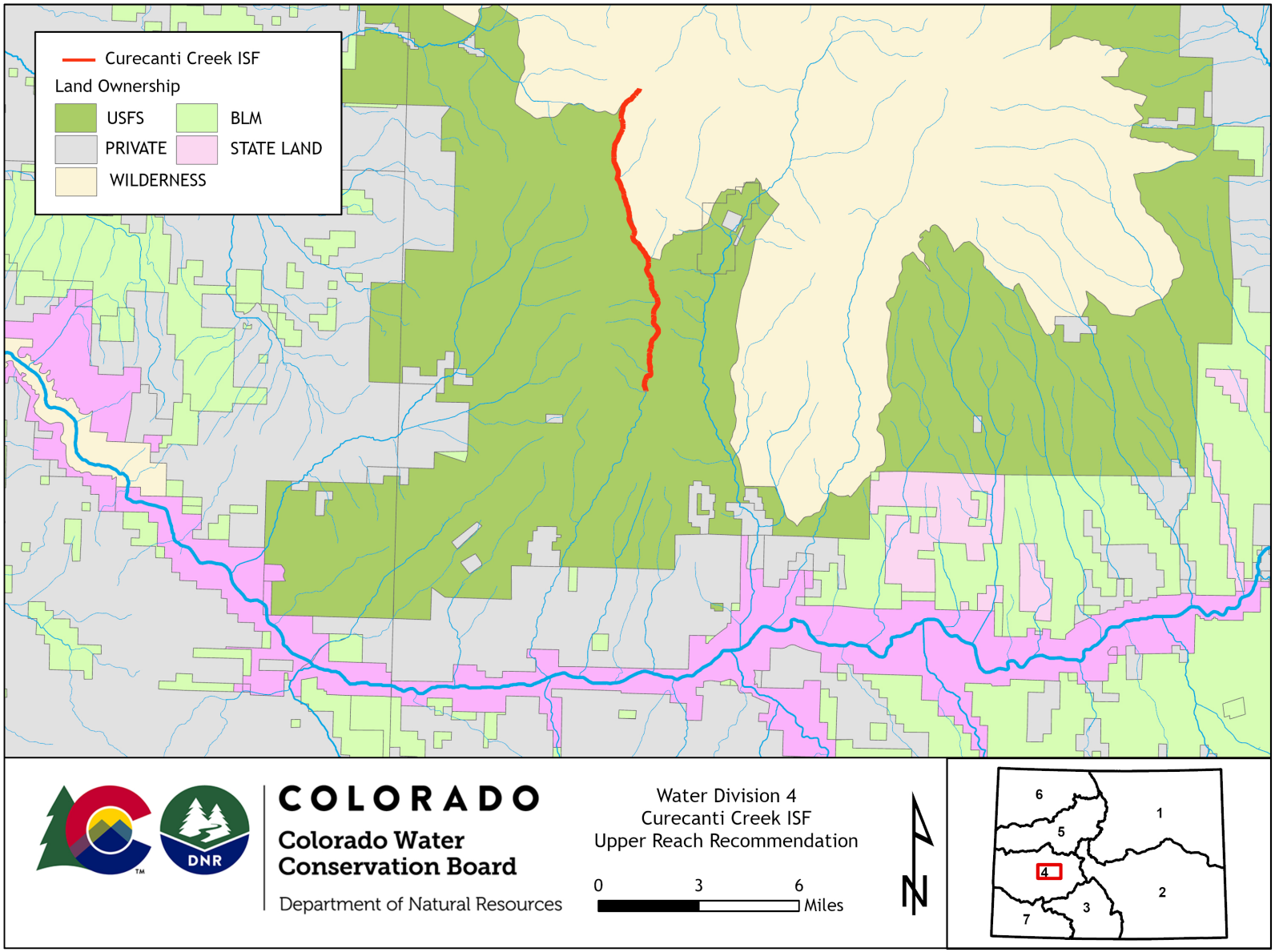
**Metadata Descriptions**
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

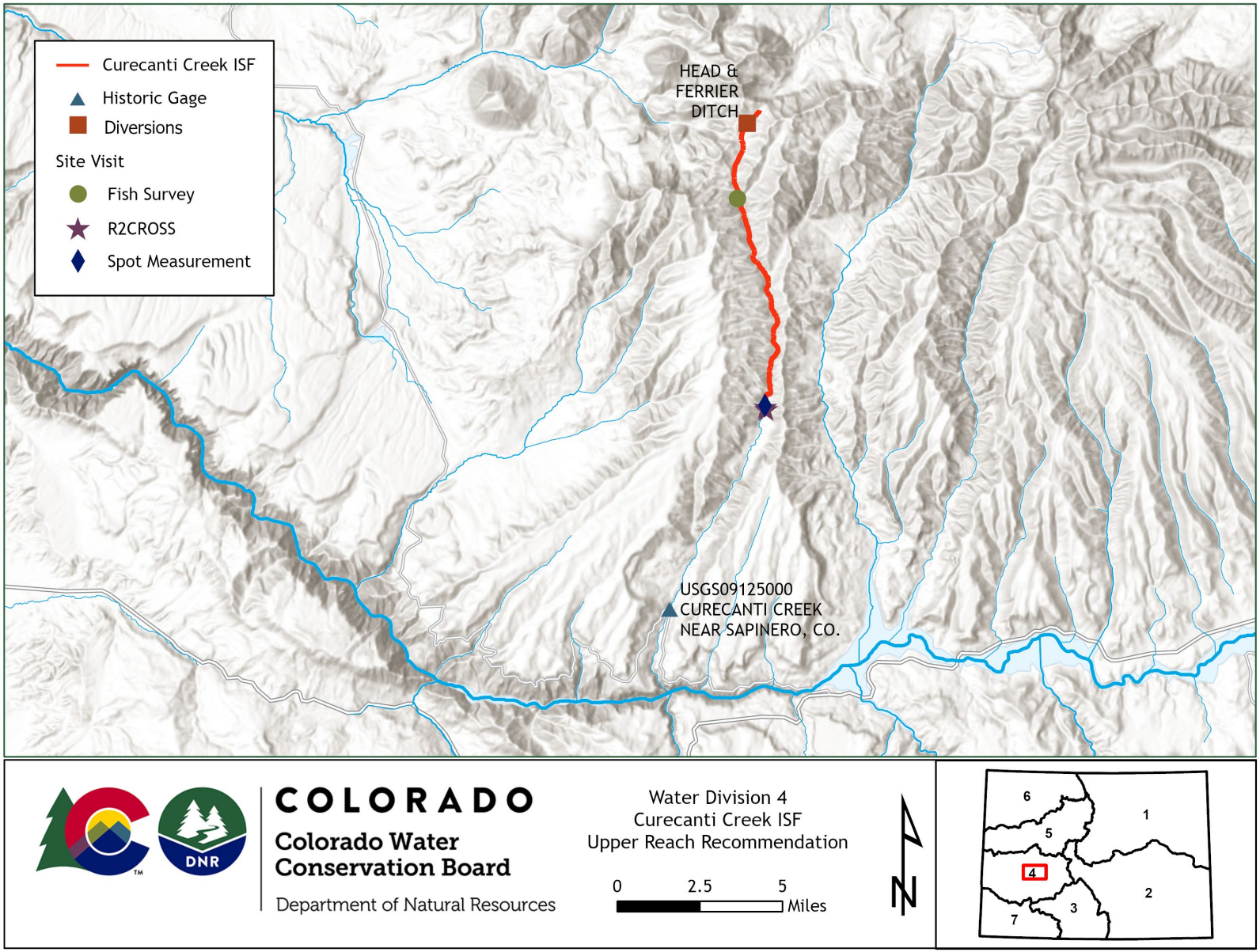
# VICINITY MAP



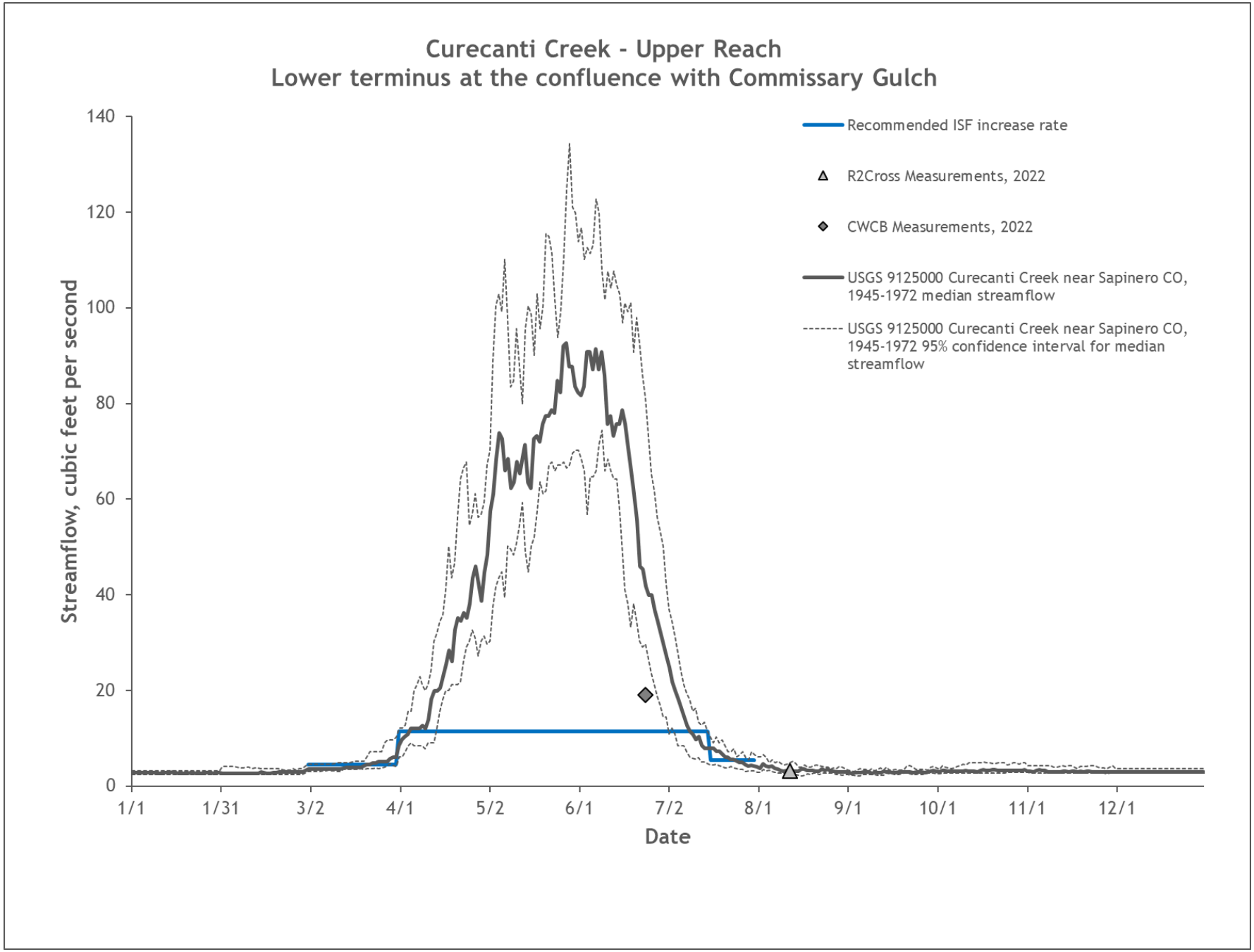
# LAND OWNERSHIP MAP



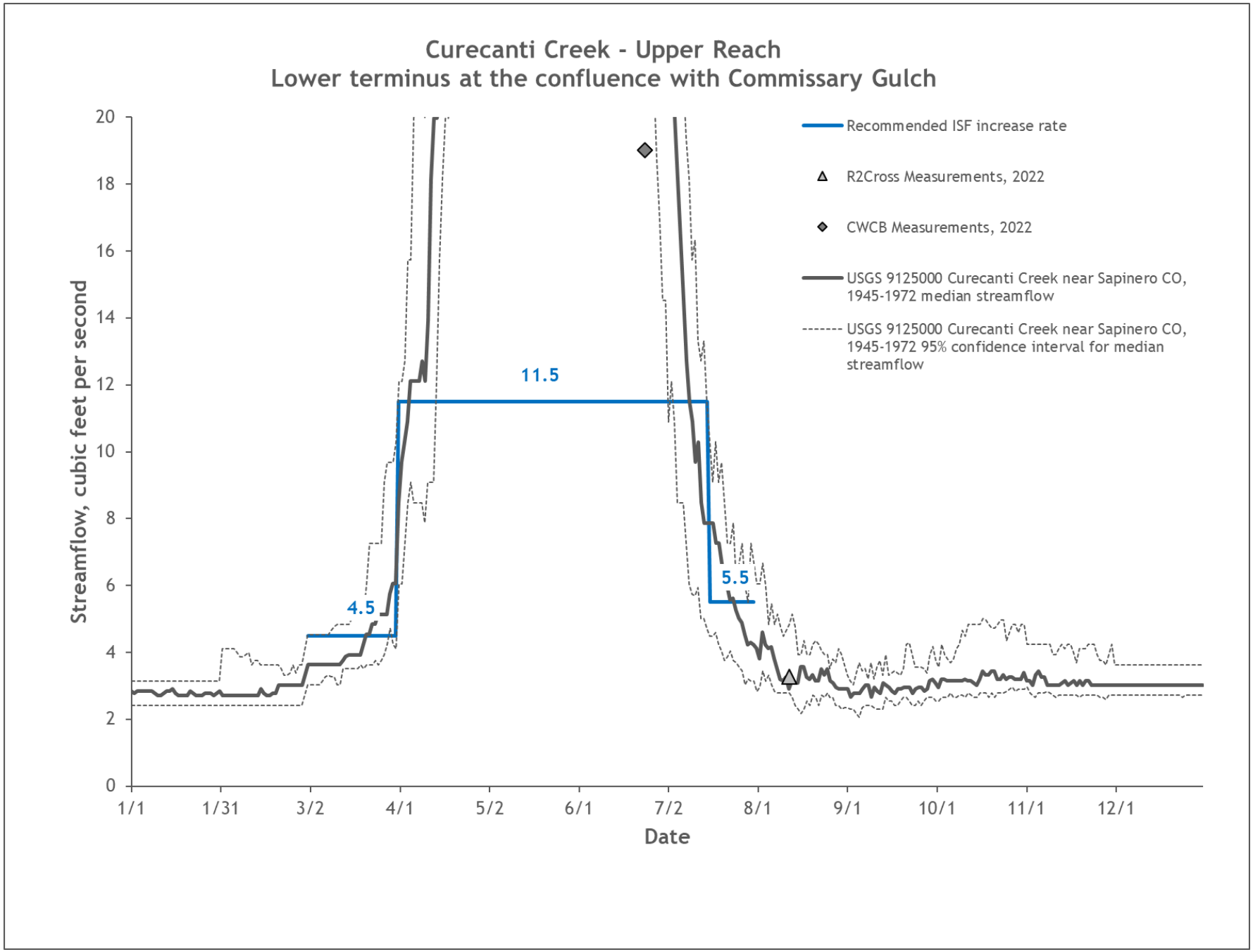
# HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAP



## DETAILED HYDROGRAPH



# Curecanti Creek (Lower) Executive Summary

**CWCB STAFF INSTREAM FLOW RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | confluence with Commissary Gulch at<br>UTM North: 4272414.37 UTM East: 294045.93 |
| LOWER TERMINUS: | conlfuence wtih Morrow Point Reservoir at<br>UTM North: 4258638.97 UTM East: 289312.65 |
| WATER DIVISION: | 4 |
| WATER DISTRICT: | 59 |
| COUNTY: | Gunnison |
| WATERSHED: | Upper Gunnison |
| CWCB ID: | 21/4/A-014 |
| RECOMMENDER: | Colorado Parks and Wildlife (CPW) |
| LENGTH: | 10.1 miles |
| EXISTING INSTREAM FLOW: | 84CW0391, 5 cfs (01/01 – 12/31) |
| FLOW INCREASE RECOMMENDATION: | 3 cfs (03/01 - 03/31)<br>11.8 cfs (04/01 - 07/15)<br>4.8 cfs (07/16 - 07/31)<br>0.4 cfs (08/01 - 09/30)<br>1.4 cfs (10/01 - 11/30)<br>0.6 cfs (12/01 - 02/28) |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

CPW recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Curecanti Creek. Curecanti Creek is located within Gunnison County and is approximately 21 miles east of the town of Montrose (See Vicinity Map). The stream originates near Curecanti Pass and flows south until it reaches the confluence with the Gunnison River upstream of the Black Canyon of the Gunnison. The existing ISF water right on Curecanti Creek was appropriated in 1984 for 5 cfs year-round.

The proposed ISF reach extends from the confluence with Commissary Gulch downstream to the confluence with Morrow Point Reservoir for a total of 10.1 miles. Approximately 59.7% of the land on the proposed reach is owned by the United States Forest Service (USFS) in the Gunnison National Forest, 10.2% is owned by the National Park Service (NPS), and 30.1% is privately owned (See Land Ownership Map). CPW is interested in protecting this stream in order to protect the natural environment.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Curecanti Creek was sent to the mailing list in November 2022, March 2022, March 2021 and March 2020. Staff sent letters to identified landowners adjacent to Curecanti Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Crested Butte News on December 30, 2022.

Staff presented information about the ISF program and this recommendation to the Gunnison County Board of County Commissioners on Spetember 13, 2022 and November 10, 2022. In addition, staff communicated with Bob Hurford, Division Four Engineer on October 11, 2022 and November 29, 2022 regarding water availability on Curecanti Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

The headwaters of Curecanti Creek gather on the southern slope of Curecanti pass amongst dense alpine forest. The channel then weaves down through a wide sagebrush and conifer valley dotted with lightly grazed meadows and active beaver complexes in the upper reach. Downstream of Colorado State Highway 92, Curecanti Creek descends sharply into a deep canyon of steep metamorphic rock walls. At the mouth of Curecanti Creek stands a towering spire, called the Curecanti Needle.

Curecanti Creek is a snowmelt driven stream and has a high gradient in this lower reach. The streambed substrate is made-up of large boulders. The boulders make up cascade drop features, large pools, back waters, and course riffles. Shade and cover are also abundant throughout the reach due to the canyon walls and pockets of alder, willow, and blue spruce. Significant woody debris and leafy detritus provide habitat and food for the macroinvertebrate and fish communities.

CPW has identified populations of Brook Trout, Colorado River Cutthroat Trout, and Rainbow Trout in this reach of Curecanti Creek (Table 1). Colorado River Cutthroat Trout are classified as a species of greatest conservation need and a species of special concern in Colorado. Black fly larvae, caddisfly, mayfly, and stonefly were identified in the field. Taxa in caddisfly, mayfly, and stonefly orders are considered evidence of good water quality (Hilsenhoff, 1987). Marmots, snakes, and frogs where also observed by staff in the area.

**Table 1. List of species identified in Curecanti Creek.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Colorado River Cutthroat Trout | *Oncorhynchus clarkii pleuriticus* | State - Species of Greatest Conservation Need<br>State - Species of Special Concern |
| Brook Trout | *Salvelinus fontinalis* | None |
| Rainbow Trout | *Oncorhynchus mykiss* | None |
| black fly | *Simuliidae* | None |
| caddisfly | *Trichoptera* | None |
| mayfly | *Ehpemeroptera* | None |
| stonefly | *Plecoptera* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**
CPW staff used the R2Cross method to develop the ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022) Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macroinvertebrates (Nehring, 1979). CPW staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

**Data Collection and Analysis**
CPW collected R2Cross data at three transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 5.6 cfs and a summer flow of 16.8 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Curecanti Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 10/06/2020, 1 | 35.80 | 2.77 | 5.04 | 19.95 |
| 08/10/2021, 2 | 36.40 | 2.26 | 6.39 | 13.46 |
| 08/10/2021, 3 | 38.80 | 2.26 | 5.44 | 16.84 |
| | | | 5.6 | 16.8 |

**ISF Recommendation and Increase Justification**
CPW and National Park Service (NPS) observed that the single decreed instream flow rate of 5 cfs did not protect seasonal fluctuations in flow. R2Cross data supports additional protection of flow during the summer months to meet three of three hydraulic criteria. Data collected in

2020 and 2021 demonstrated the need for seasonal increases. CPW recommends the following increased flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

An increase of 3.0 cfs is recommended for March 1 through March 31, to bring the total ISF protection to 8.0 cfs; this early spring flow initiation rate is reduced due to water availability. This rate maintains adequate depth and wetted perimeter across riffles, which will support fish they begin to move, transitioning from overwintering habitat to more metabolic activity as temperatures rise before the beginning of spring runoff.

A summer flow increase of 11.8 cfs is recommended for April 1 through July 15, to bring the total ISF protection to 16.8 cfs; this flow rate provides complete minimum protection of three of three criteria during the summer months. This rate maintains adequate average depth of 0.4 feet, velocity, and wetted perimeter during the spring and early summer periods. This flow rate supports fish passage and ideal conditions macroinvertebrate production, fish feeding, and spawning

An increase of 4.8 cfs is recommended for July 16 through July 31 to bring the total ISF protection to 9.8 cfs; this flow rate is reduced due to water availability limitations. This rate maintains fish habitat with adequate depth and wetted perimeter and allows fish movement as flows recede and temperatures may be high in late July.

An increase of 0.4 cfs is recommended from August 1 to September 30, to bring total ISF protection to 5.4 cfs; this flow rate is reduced due to water availability limitations but will still provide suitable habitat availability by maintaining depth and wetted perimeter in most riffles.

A fall increase of 1.4 cfs is recommended for October 1 through November 30, to bring the total ISF protection to 6.4 cfs; this flow rate is reduced due to water availability limitations and does not meet the two of three criteria for baseflow protections. This rate maintains available habitat and allows fish movement during the fall transition to overwintering conditions.

An increase of 0.6 cfs is recommended for baseflow conditions from December 1 through February 28, to bring total ISF protections to 5.6 cfs. This rate is protective by maintaining adequate habitat to support fish during the overwintering period by maintaining adequate depth and wetted perimeter in riffles, as well as habitat availability in glides and pools.

**WATER AVAILABILITY**

CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**

Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). Although extensive and time-consuming investigations of all variables may be possible, staff takes a pragmatic and cost-effective approach to analyzing water availability. This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**

The drainage basin of the proposed ISF on Curecanti Creek is 39.30 square miles, with an average elevation of 9,544 feet and average annual precipitation of 21.98 inches (See the Hydrologic Features Map). Curecanti Creek is a snowmelt driven hydrologic system, with variable timing and magnitude in snowmelt runoff. Curecanti Creek originates as a medium to high-gradient, heavily forested headwater steam and transitions over the reach to a lower gradient, gaining stream near its confluence with Morrow Point Reservoir.

*Water Rights Assessment*

There are twenty-four decreed water rights within the contributing basin of Curecanti Creek; for the purposes of this assessment, staff is not including existing or recommended ISF rights. Of these, four water rights were cancelled by the water court, according to Hydrobase documentation. Of the remaining 20 decreed water rights, three are diverting ditch rights from both main channel and tributaries, four are reservoir storage rights and thirteen are spring rights (Table 3). The Head and Ferrier Ditch (WDID 5900944) is the only main-channel diverting ditch, is decreed for 10.5 cfs of transbasin diversions, and is located near the headwaters of Curecanti Creek. As per the Final Revised Abandoned List in Division 4 and email communication with Bob Hurford (11/29/2022), 4.45 cfs of the senior right and the entire 2.5 cfs junior right are on the finalized abandonment list, leaving 3.55 cfs remaining in this right. Limited diversion records show the ditch operates from June through September.

**Table 3. Summary of decreed water rights in the Curecanti Creek Contributing Basin**

| Structure Type | # | Flow (cfs) | Volume (acre-foot) |
|---|---|---|---|
| Ditch | 3 | 17.75[1] | |
| Reservoir | 4 | | 20.3 |
| Spring | 13 | 0.453 | |

[1] Includes 6.95 cfs of flow listed for abandonment

**Data Analysis**

*Representative Gage Analysis*

There is a historic gage on Curecanti Creek within this proposed reach, Curecanti Creek near Sapinero, CO (USGS9125000). The gage collected daily streamflow records for a period of record (POR) of 27 years (1945 to 1972) and is located approximately 2.5 miles above the creek's confluence with Morrow Point Reservoir. The contributing basin of the gage is 35 square miles with an average precipitation of 22.77 inches, slightly more than the entire basin, which could be because the higher average elevation of 9674 feet.

To assess the how the gage POR compared hydrologically to the most recent thirty-year POR, staff evaluated daily precipitation records from NOAA Climate station Gunnison 3 SW (USC00053662). The climate station is located approximately 25 miles east of the gage. Average annual precipitation recorded was 10.55 inches, compared to the last 30-year average precipitation of 8.95 inches. Six years of gage record were recorded during conditions that were drier than the most recent 30-year average. Overall, the gage record reflects normal hydrologic conditions with three notably wet years that significantly increase the gage POR's average precipitation values (1957, 1959 and 1969).

Of the water rights decreed within the contributing basin of Curecanti Creek, all ditches and reservoirs were appropriated prior to the stream gage POR. No thorough records on use are available from the Division Engineer or on Hydrobase; diversion and storage are assumed to be reflected in the gage records for all but the Irving Ditch (WDID 5900961). Irving Ditch is decreed for 3.75 cfs and diverts from a tributary that joins Curecanti Creek below gage. According to Bob Hurford, this "ditch runs fast in the spring and then there is not much water supply after the runoff" (email communication, 11/29/2022**).** Three the spring rights were appropriated during or prior to the gage and POR; the remaining 10 were all appropriated in total for 0.33 cfs between 1999 and 2000. Spring rights are not all consumptive, so water availability was not reduced due to the presence of these rights.

Sufficient data exist to calculate upper and lower 95% confidence intervals for median streamflow and median streamflow based on the gage records. A weighted area-precipitation factor of 108% was applied the gage records to account for the gage's mid-reach location.

CWCB staff made one streamflow measurement on the proposed reach of Curecanti Creek as summarized in Table 4.

**Table 4. Summary of streamflow measurements for Curecanti Creek.**

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 06/24/2022 | 19.02 | CWCB |

**Water Availability Summary**
The hydrograph (See Complete Hydrograph) shows the median streamflow with upper and lower range of the 95% confidence intervals recorded from USGS9125000 gage from 1945 to 1972 and the proposed ISF flow rate. Staff has concluded that water is available for a year-round increase.

**MATERIAL INJURY**
As a new junior water right, the proposed ISF on Curecanti Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**

**Citations**
Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

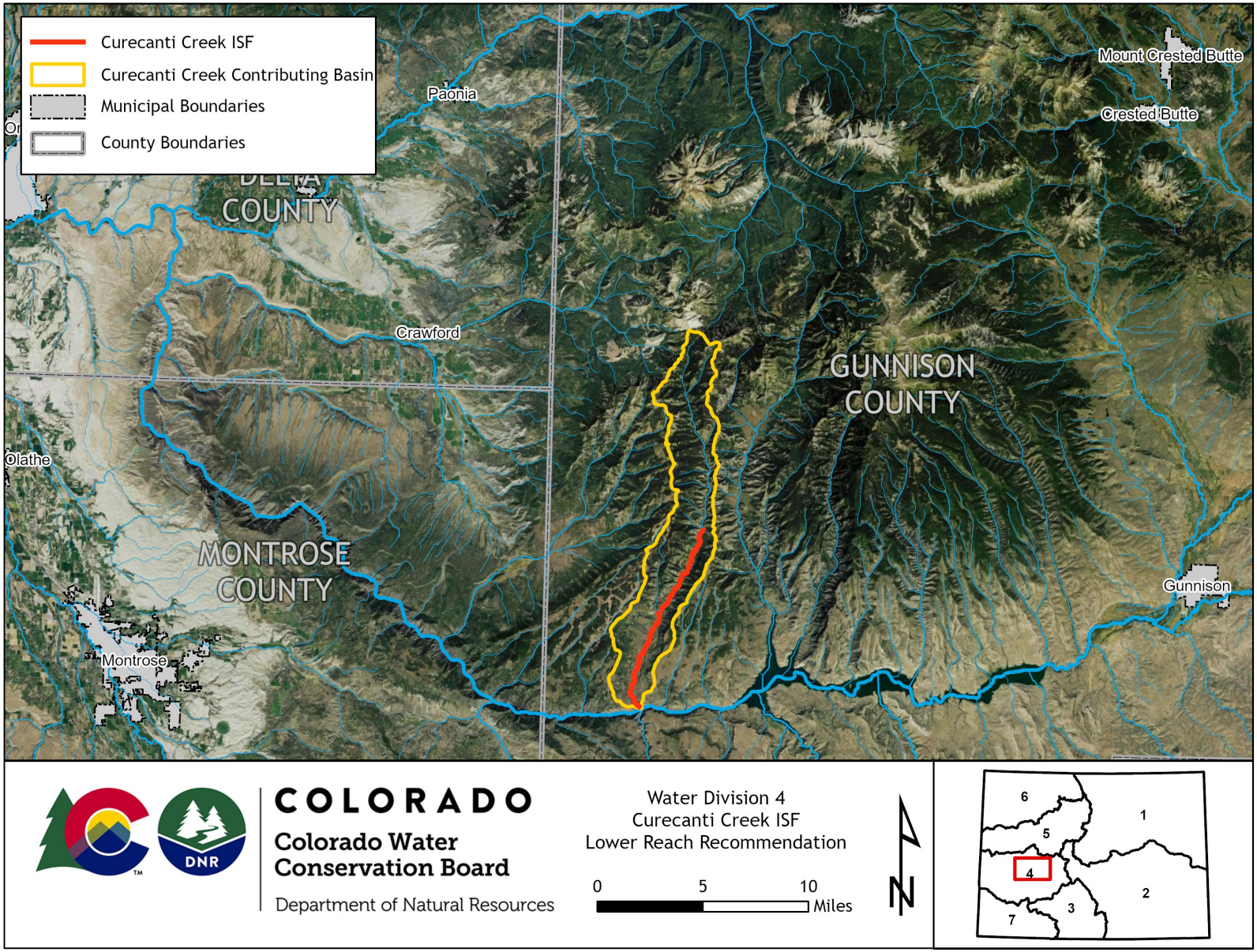
Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

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.

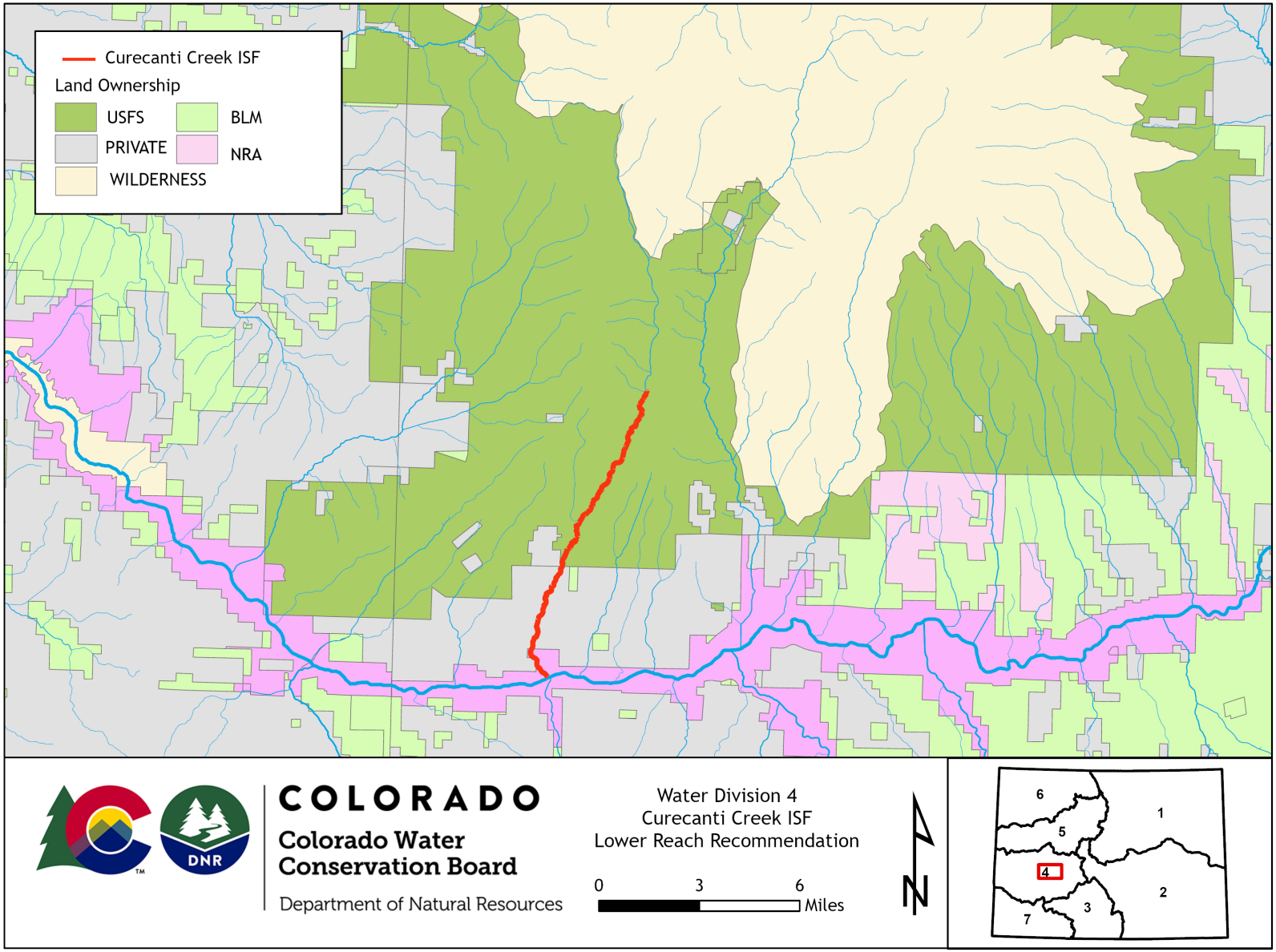
**Metadata Descriptions**
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

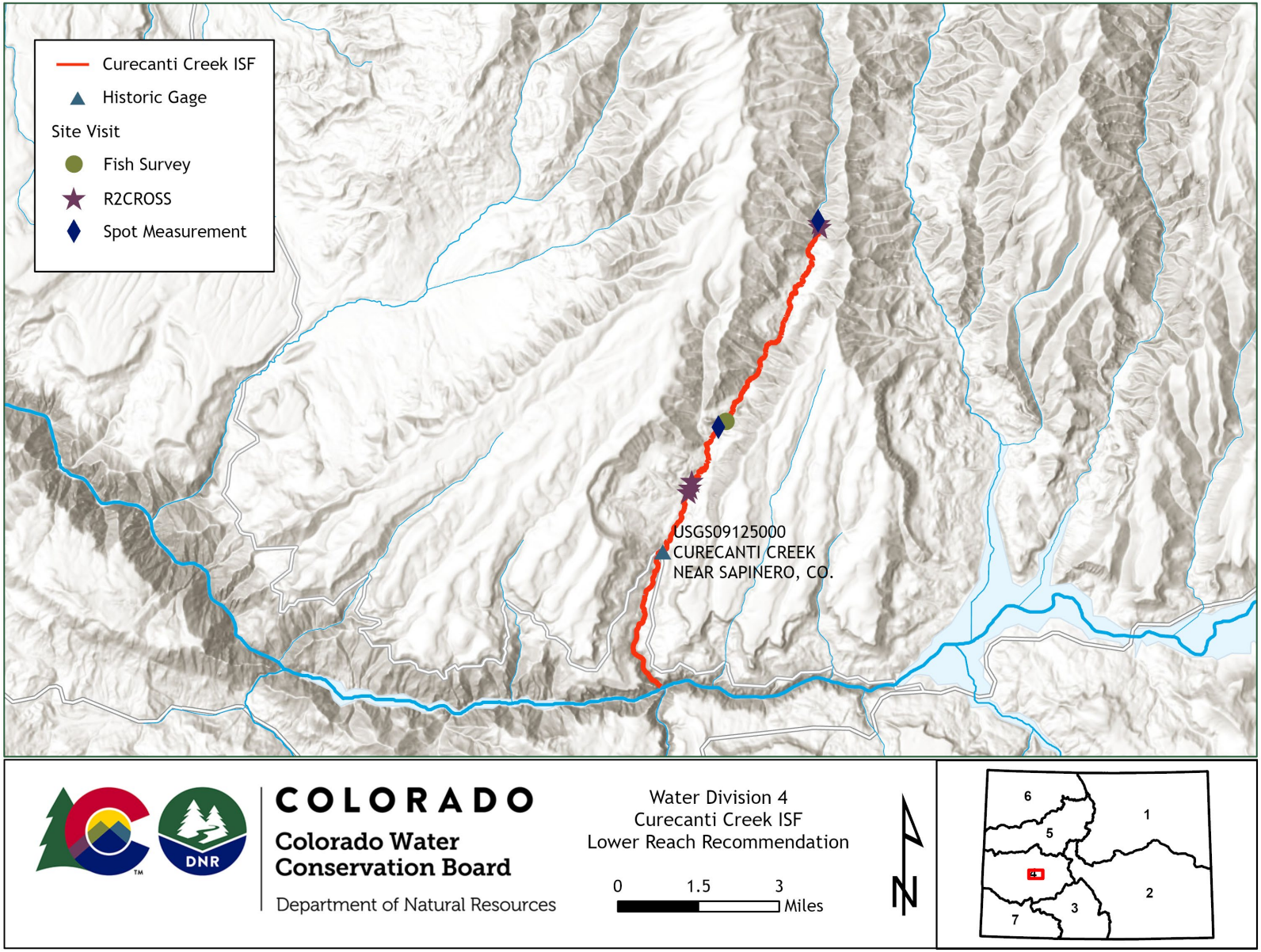
# VICINITY MAP



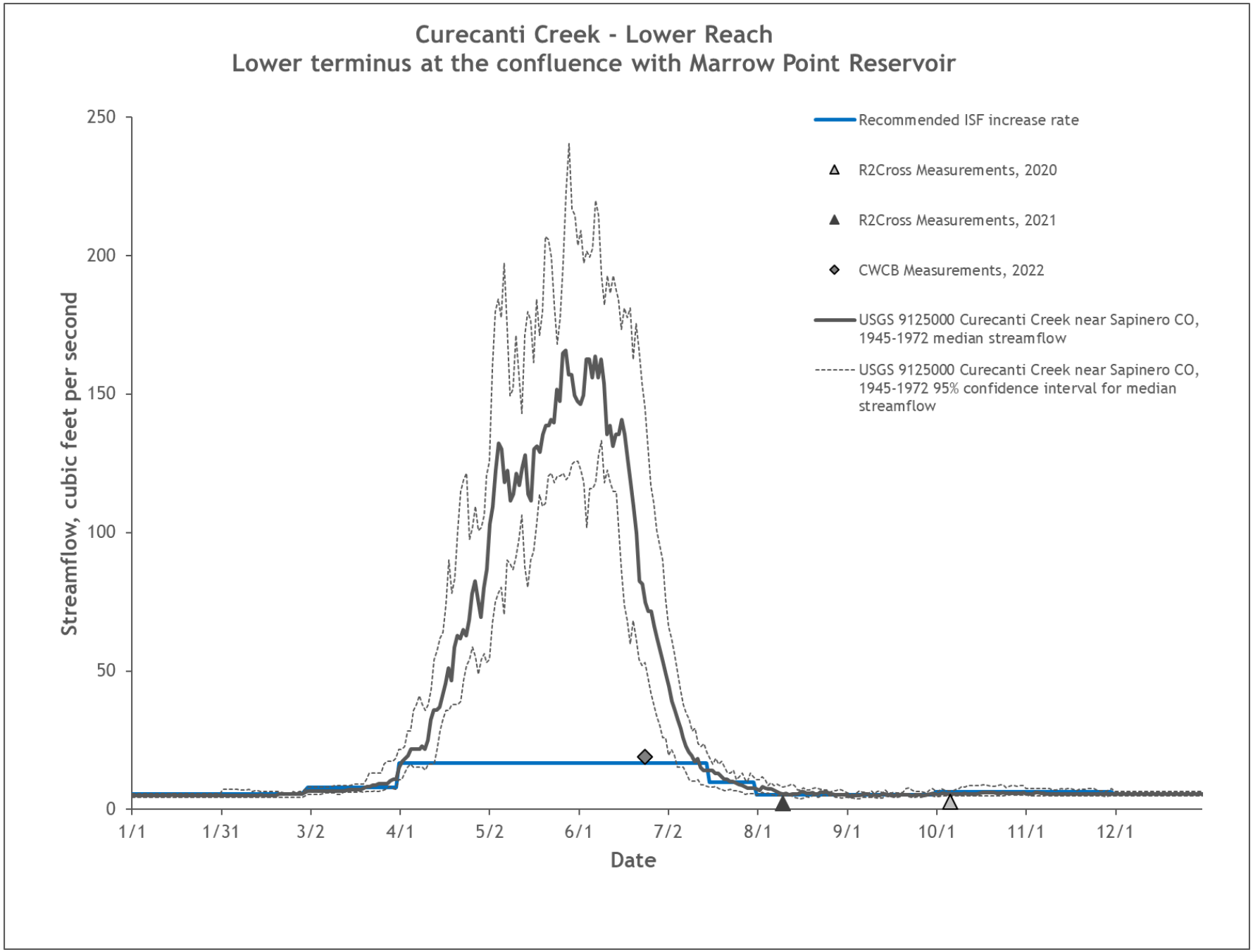
# LAND OWNERSHIP MAP



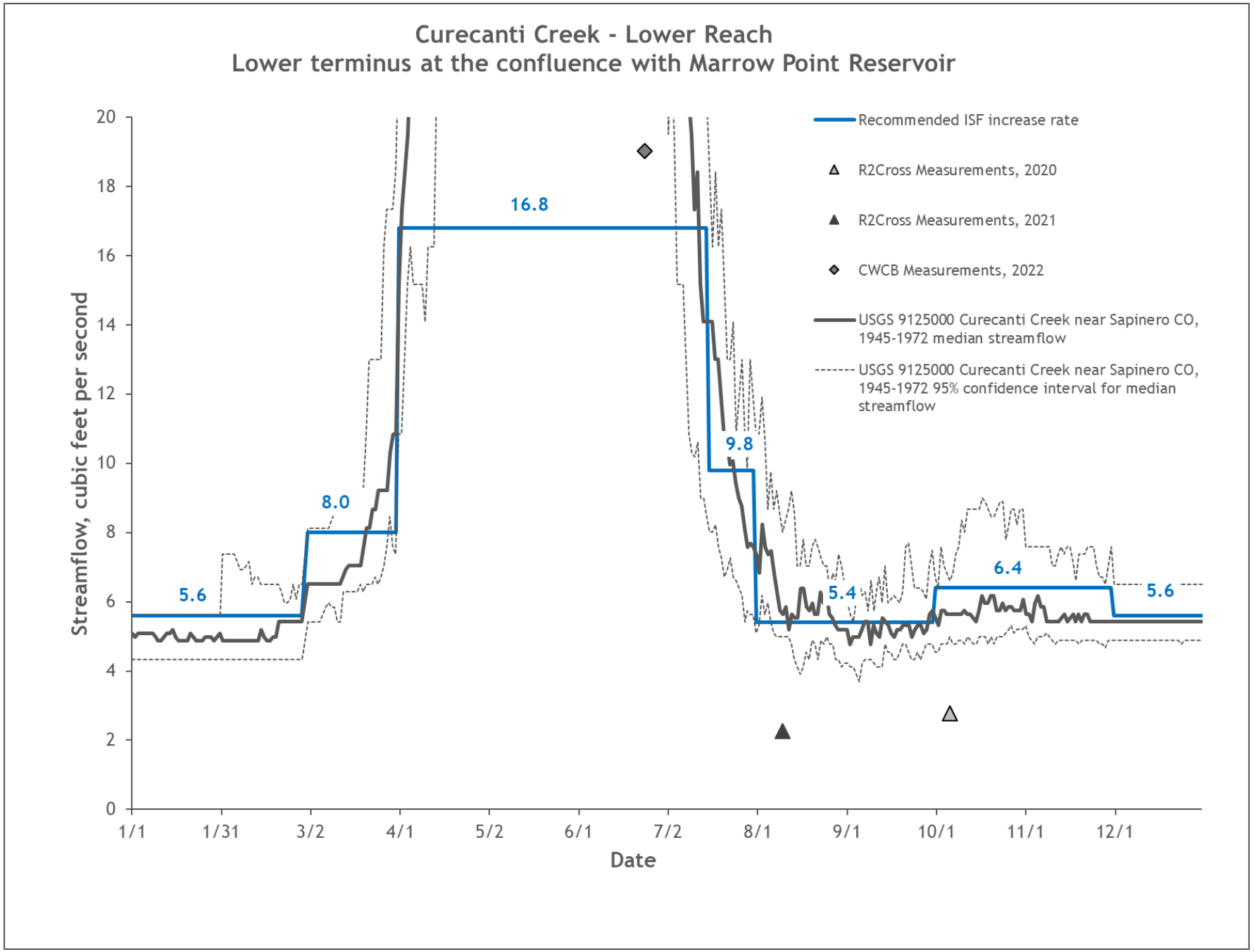
# HYDROLOGIC FEATURES MAP



## COMPLETE HYDROGRAPH



## DETAILED HYDROGRAPH



# Kelly Creek Executive Summary

**CWCB STAFF INSTREAM FLOW RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | headwaters in the vicinity of<br>UTM North: 4244823.74 UTM East: 219127.69 |
| LOWER TERMINUS: | confluence with Red Canyon Creek at<br>UTM North: 4243319.90 UTM East: 221016.68 |
| WATER DIVISION: | 4 |
| WATER DISTRICT: | 60 |
| COUNTY: | Montrose |
| WATERSHED: | San Miguel |
| CWCB ID: | 21/4/A-009 |
| RECOMMENDER: | Colorado Parks and Wildlife (CPW) |
| LENGTH: | 1.59 miles |
| FLOW RECOMMENDATION: | 1.2 cfs (04/01 - 04/30)<br>2.6 cfs (05/01 - 05/31)<br>2.7 cfs (06/01 - 06/30)<br>1.2 cfs (07/01 - 07/31)<br>0.45 cfs (08/01 - 10/31)<br>0.2 cfs (11/01 - 03/31) |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

CPW recommended that the CWCB appropriate an ISF water right on a reach of Kelly Creek. Kelly Creek is located within Montrose County and is approximately 18 miles east from the town of Nucla (See Vicinity Map). The stream originates on the Uncompahgre Plateau north of Reade Hill at approximately 9,700 feet elevation and flows in a southeasterly direction until it reaches the confluence with Red Canyon Creek.

The proposed ISF reach extends from the headwaters downstream to the confluence with Red Canyon Creek for a total of 1.59 miles. The entire proposed reach is on United States Forest Service (USFS) land within the Uncompaghre National Forest (See Land Ownership Map). CPW is interested in protecting this stream in order to protect the natural environment. In addition, CPW believes that appropriation of an ISF water right on Kelly Creek would be protective of the core conservation population of Colorado River Cutthroat Trout in Kelly Creek and Red Canyon Creek.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Kelly Creek was sent to the mailing list in March 2020, March 2021, March 2022, and November 2022. Staff sent letters to identified landowners adjacent to Kelly Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Montrose Daily Press on December 21, 2022.

Staff presented information about the ISF program and this recommendation to the Montrose County Board of County Commissioners on November 22, 2022. In addition, staff communicated with Bob Hurford, Division Four Engineer on October 11, 2022 regarding water availability on Kelly Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

Kelly Creek is a snowmelt driven, cold-water stream. It flows in a single channel through a small, steep canyon into Red Canyon, where it joins Red Canyon Creek. The Kelly Creek basin is forested with stands of aspen, blue spruce, ponderosa, and oak scrub. The understory consists of shrubs and wildflowers, including native red columbines, wild iris, and purple beardtongue. Along the streambank, the riparian community is comprised of healthy willow and alder dotted with common horsetail.

Kelly Creek's channel cascades over boulder drops and rock outcroppings, forming a series of riffle, run, and pool complexes. The streambed's substrate mainly consists of small boulders, small cobbles, large sands, and gravels. The riparian community shades the cold-water stream. Ample woody debris and detritus provide habitat and food sources for stream macroinvertebrates. The macroinvertebrate community observed in the field was diverse and included caddisfly, mayfly, aquatic beetle, diptera, broad shouldered water striders, and giant water striders. Caddisfly and mayfly orders are known to be sensitive to water quality (Hilsenhoff, 1987).

CPW identified a self-sustaining population of Colorado River Cutthroat trout (CRCT) of the Gunnison lineage in Kelly Creek. CRCT are native to the Colorado River and its tributaries and are designated as a species of special concern and species of greatest conservation need in Colorado. This population is a core conservation population of CRCT, meaning that the population is 99% pure. CPW works to secure and enhance watershed conditions in CRCT conservation populations as part of a multi-state and multi-agency conservation agreement aimed at preventing the listing of these subspecies under the Endangered Species Act.

**Table 1. List of species identified in Kelly Creek.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Colorado River Cutthroat Trout | *Oncorhynchus clarkii pleuriticus* | State - Species of Greatest Conservation Need<br>State - Species of Special Concern |
| aquatic beetle | *Coleoptera* | None |
| aquatic fly larve | *Diptera* | None |
| caddisfly | *Trichoperta* | None |
| flathead mayfly | *Heptageniidae* | None |
| mayfly | *Ephemeroptera* | None |
| water strider | *Gerridae* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB

staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**

CPW staff used the R2Cross method to develop the ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022) Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macroinvertebrates (Nehring, 1979). CPW staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

**Data Collection and Analysis**

CPW collected R2Cross data at two transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 1.14 cfs and a summer flow of 2.70 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Kelly Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 06/03/2021 | 9.92 | 0.24 | 1.32 | NA |
| 05/19/2022 | 14.34 | 1.48 | 0.96 | 2.70 |
| | | | 1.14 | 2.70 |

**ISF Recommendation**

CPW recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

1.3 cfs is recommended from April 1 to April 30; this flow rate is reduced due to water availability limitations. This early spring flow recommendation will support spawning conditions for cutthroat trout, a species that spawn during runoff and the receding limb of runoff. This flow recommendation will support sufficient water depths and wetted perimeter that allows fish to move longitudinally between pools and riffles.

2.6 cfs is recommended from May 1 through May 31; this flow rate is limited by water availability and does not fully meet protections for the three of three criteria. This spring flow recommendation will support ideal spawning conditions for cutthroat trout. This recommendation has been reduced by 0.1 cfs because of water availability constraints, but sufficient velocity of nearly 1 feet per second on average will be maintained.

2.7 cfs is recommended from June 1 to June 30 to meet three of three criteria. This rate maintains adequate depth, velocity, and wetted perimeter during the month of June when fish are active and moving throughout the creek. This flow rate will support ideal spawning conditions for cutthroat trout.

1.2 cfs is recommended from July 1 to July 31 in late summer; this flow rate is reduced due to water availability limitations. This rate maintains adequate depth and wetted perimeter and allows fish movement as flows recede after the high flow period. It provides additional refuge habitat during periods when stream and air temperatures might be high.

0.45 cfs is recommended from August 1 to October 31; this flow rate is reduced due to water availability limitations. This rate will maintain adequate wetted perimeter and available habitat as flows recede to baseflow conditions.

0.2 cfs recommended from November 1 to March 31; this flow rate is reduced due to water availability limitations. This rate will provide sufficient habitat availability in pools for fish during the overwintering period.

**WATER AVAILABILITY**

CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**

Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by

Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**

The drainage basin of the proposed ISF on Kelly Creek is 1.37 square miles, with an average elevation of 9,458 feet and average annual precipitation of 30.79 inches (See the Hydrologic Features Map). Kelly Creek is a high-gradient, confined, snowmelt driven hydrologic system, with variable timing and magnitude in snowmelt runoff.

*Water Rights Assessment*

There are current water rights within the contributing basin of Kelly Creek. Staff is aware of a historical structure that no longer exists within the reach, Kelley Creek Ditch (WDID 6000658).

**Data Analysis**

*Representative Gage Analysis*

There are no current or historic gages on Kelly Creek. Staff investigated nearby gages for similarities in basin characteristics and hydrology and for data collection histories. No gages were sufficiently similar to be used to estimate streamflow on Kelly Creek.

*Multiple Regression Model*

The CSUFlow18 regression model predicts mean-monthly flow in Kelly Creek and provides best estimate for natural streamflow conditions.

CWCB staff assisted CPW in R2Cross data collection and performed both site visits and stream measurements alongside CPW staff (Table 2).

**Water Availability Summary**

The hydrograph (See Complete Hydrograph) shows CSUFlow18 results for mean-monthly streamflow and includes the proposed ISF flow rate. Staff has concluded that water is available for appropriation.

**MATERIAL INJURY**

As a new junior water right, the proposed ISF on Kelly Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**

**Citations**

Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

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Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

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.

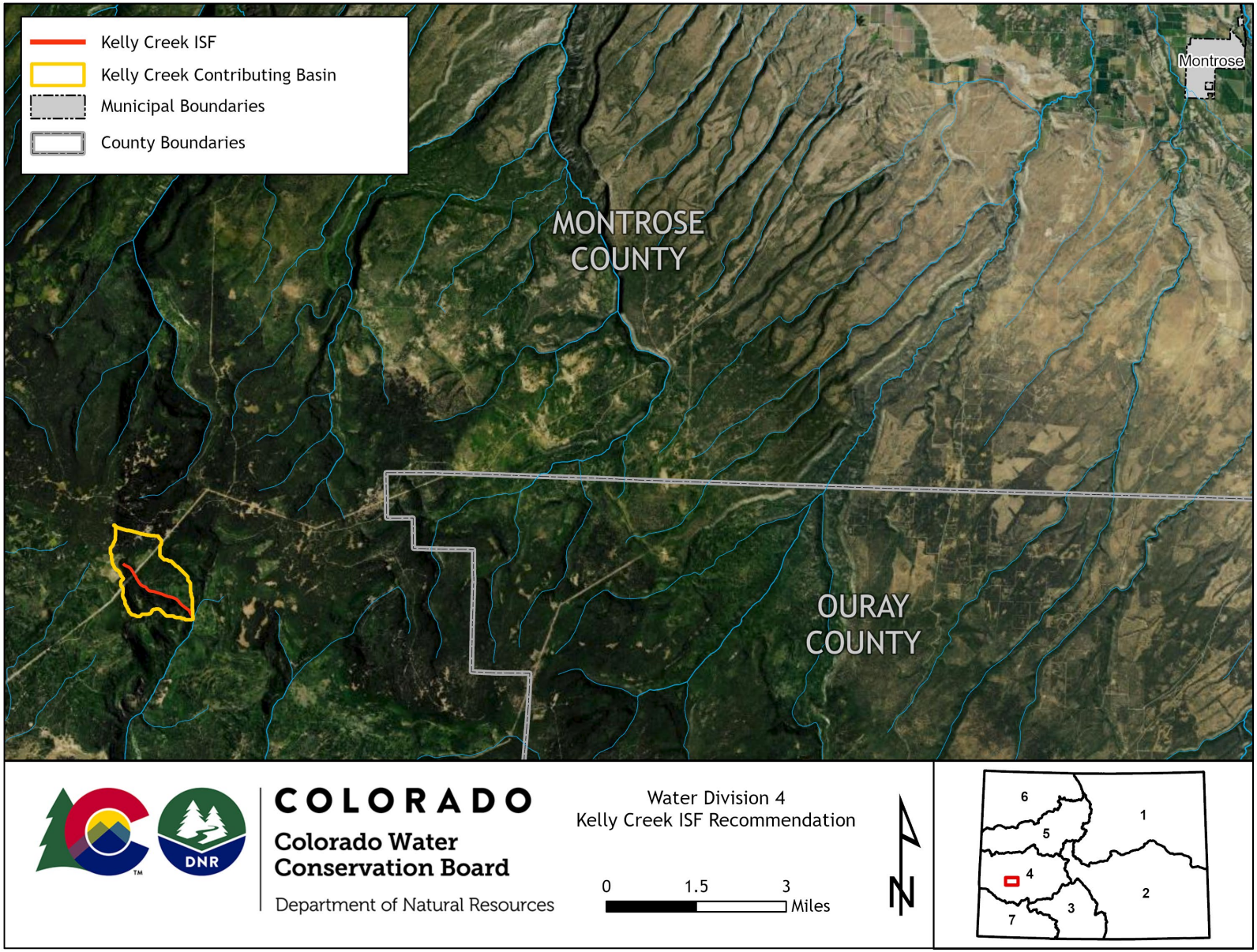
Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

**Metadata Descriptions**

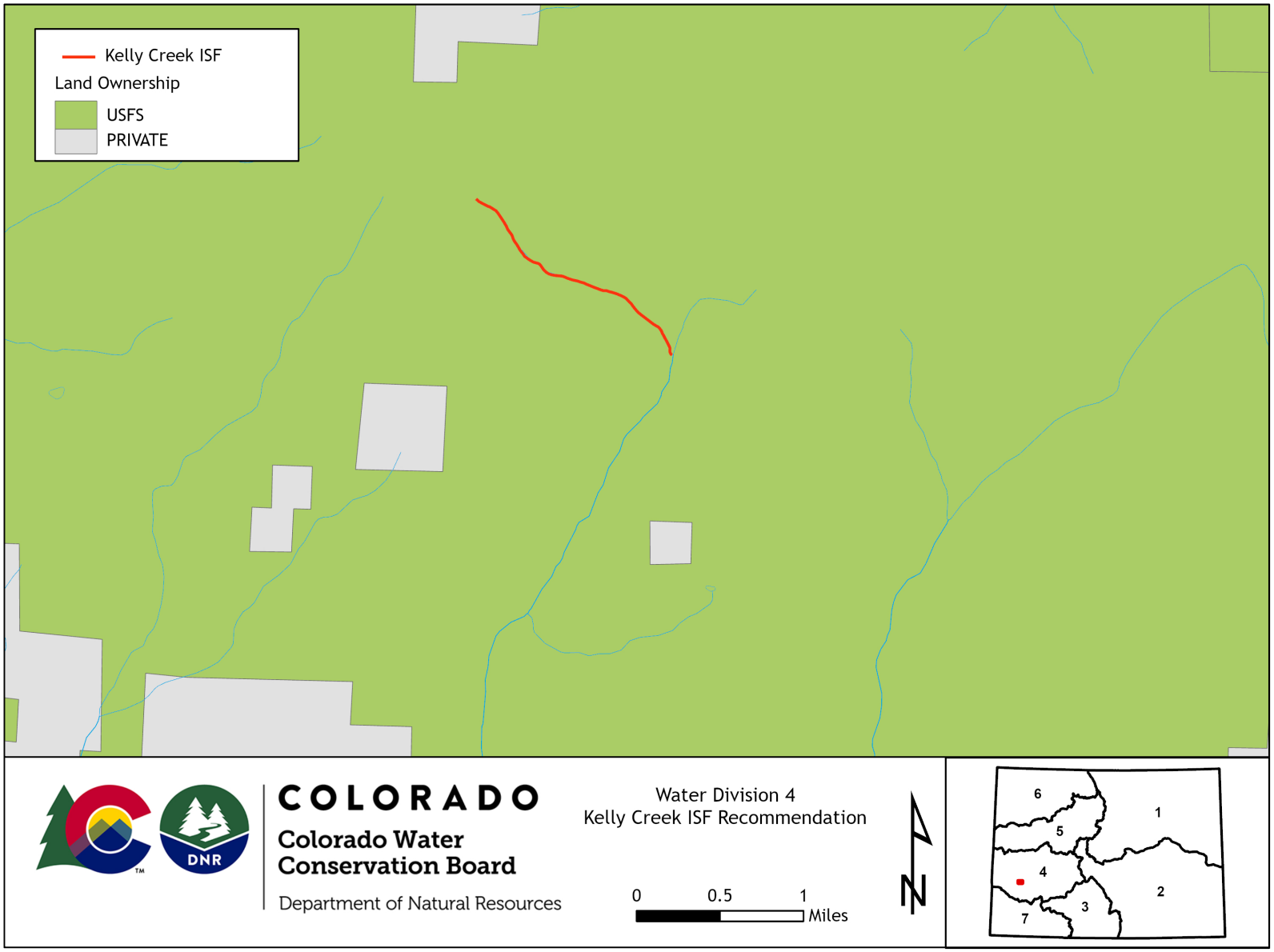
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

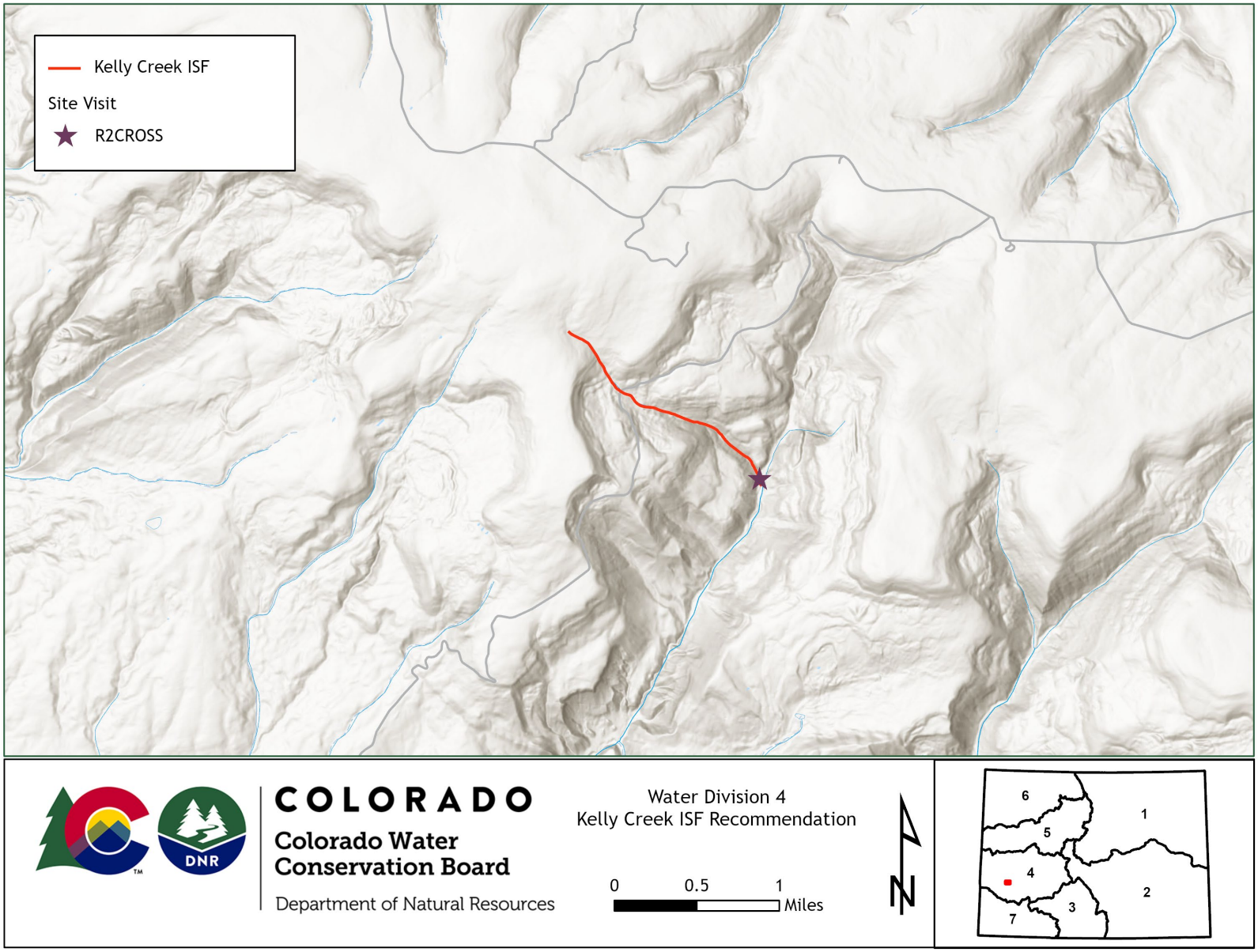
# VICINITY MAP



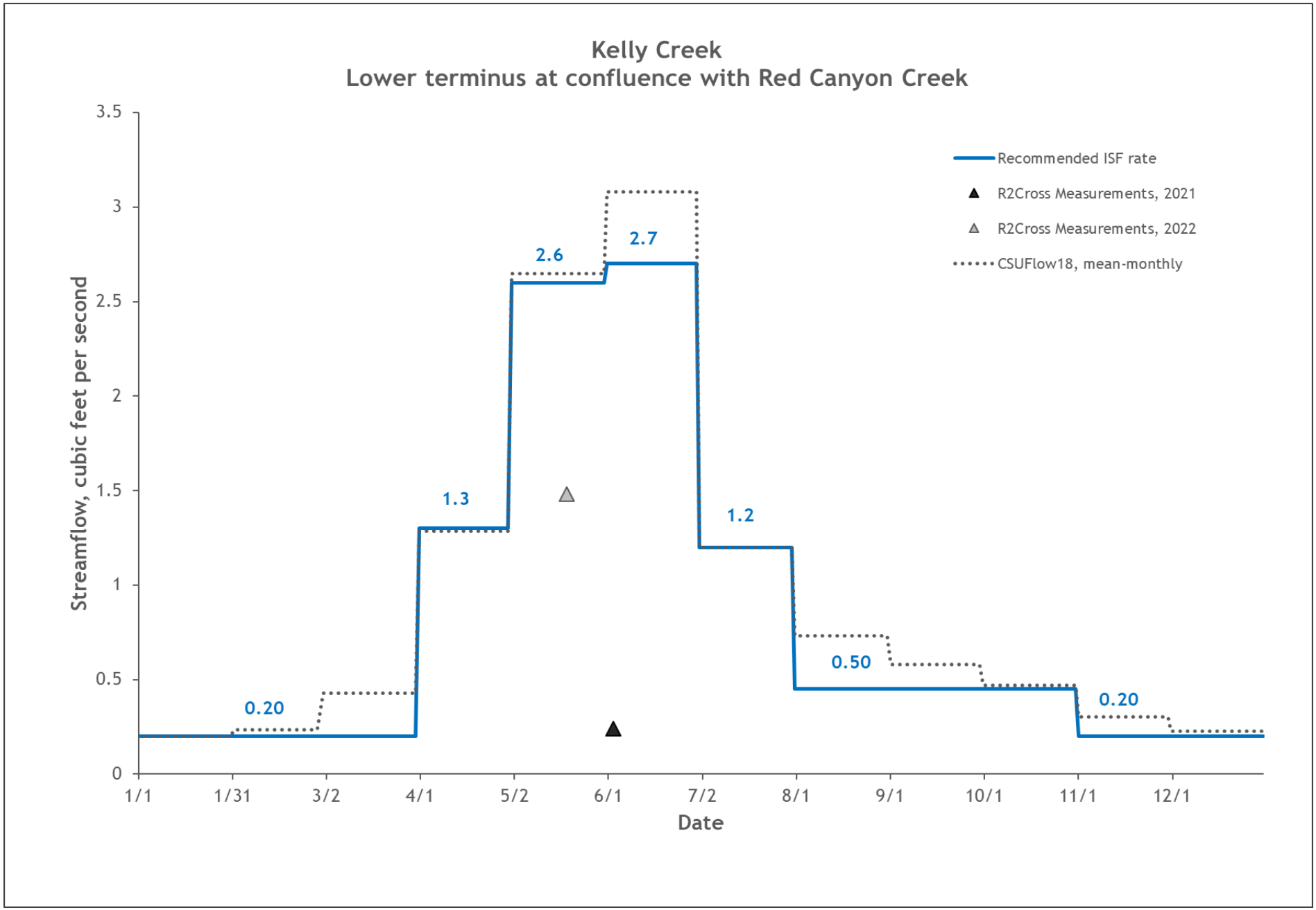
# LAND OWNERSHIP MAP



# HYDROLOGIC FEATURES MAP



## COMPLETE HYDROGRAPH



# Monitor Creek Executive Summary

**CWCB STAFF INSTREAM FLOW RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | confluence with Little Monitor Creek at<br>UTM North: 4270075.83 UTM East: 212258.00 |
| LOWER TERMINUS: | confluence Potter Creek at<br>UTM North: 4279535.32 UTM East: 220671.03 |
| WATER DIVISION: | 4 |
| WATER DISTRICT: | 40 |
| COUNTY: | Montrose |
| WATERSHED: | Lower Gunnison |
| CWCB ID: | 18/4/A-008 |
| RECOMMENDER: | Bureau of Land Management (BLM) |
| LENGTH: | 8.29 miles |
| FLOW RECOMMENDATION: | 4.6 cfs (04/01 - 05/31)<br>3.6 cfs (06/01 - 06/30) |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

BLM recommended that the CWCB appropriate an ISF water right on a reach of Monitor Creek. Monitor Creek is located within Montrose County and is approximately 24 miles west of Montrose (See Vicinity Map). The stream originates on the east side of the Uncompaghre Plateau and flows northeast until it reaches the confluence with Potter Creek, which is a tributary to Roubideau Creek and the Gunnison River.

The proposed reach extends from the confluence with Little Monitor Creek downstream to the confluence with Potter Creek for a total of 8.29 miles. The entire proposed reach is on BLM public land (See Land Ownership Map). BLM is interested in protecting this stream to assist in long-term management of riparian and aquatic habitats.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Monitor Creek was sent to the mailing list in March 2017, March 2018, March 2019, November 2019, March 2020, November 2020, March 2021, November 2021, March 2022, and November 2022. Staff sent letters to identified landowners adjacent to Monitor Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Montrose Daily Press on December 21, 2022.

Staff presented information about the ISF program and this recommendation to the Montrose County Board of County Commissioners on October 3, 2017, December 9, 2019, and November 22, 2022. In addition, staff communicated with Bob Hurford, Division Four Engineer and Luke Reschke, Lead Water Commissioner several times regarding water rights and water use practices on Monitor Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each

recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

The headwaters of Monitor Creek form on the eastern side of the Uncompaghre Plateau, just north of Divide Road and Tabeguache Basin. Monitor Creek is part of several stream systems within the Roubideau Creek watershed. The creek runs parallel to Cottonwood and Potter Creeks, separated by long narrow mesas. The steep stair-step sandstone slopes of the mesas surrounding Monitor Creek form a deepening canyon. Monitor Creek is very steep at the headwaters and decreases in gradient as the canyon deepens. The ISF reach begins at a moderate gradient in the canyon and water temperatures are generally cool.

The streambed substrate is variable, consisting of large to small boulders, cobbles, gravel, sand, and silt. The channel is mostly single-thread at low flows, with course-substrate riffles. At higher flows, the stream braids over varying levels of the floodplain. Monitor Creek has large, flashy changes in flow causing an actively moving streambed and significant overbank flows. The channel is complex and includes riffles, runs, and pools. Many of the pools are deep enough to support fish year-round, even at very low flows in dry years. Woody debris, algae, and aquatic plants provide habitat and food sources for fish and macroinvertebrates.

Monitor Creek supports Bluehead Sucker and Flannelmouth Sucker, which are identified in Colorado as state species of greatest conservation need and by the BLM as sensitive species (Table 1). Monitor Creek provides important spawning habitat for these species during runoff and nursery habitat for young native fish. Biological surveys have also found Speckled Dace, White Sucker, and Rainbow Trout.

Macroinvertebrate surveys in 2003, 2004 and 2018 found the community to be diverse and abundant. CWCB staff observed the following taxa in the field: dragonfly, damselfly, water boatmen, giant water striders, giant water bugs, aquatic diving beetles, whirligig beetles, chironomids, spinner caddisfly, crawdads, and midges. In 2018, a bioassessment was conducted under the guidelines of Colorado Public Health and Environment's (CDPHE) Aquatic Life Use Attainment Policy using Colorado's multi-metric index. The calculated score of 46.5 indicates the creek is capable of sustaining a wide variety of water biota for the region.

Amphibians were also found during the biological surveys including Woodhouse Toads and Northern Leopard Frogs, which are identified as a Colorado species of special concern and a species of greatest conservation need. Monitor Creek also supports a number of other animals including great blue heron, western whiptail, prairie rattlesnake, hummingbirds, desert bighorn sheep, black bear, mule deer, and mountain lion. The riparian community is comprised of narrowleaf cottonwood, red osier, dogwood, coyote willow, and herbaceous plants that are similar to grass.

**Table 1. List of species identified in Monitor Creek.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Bluehead Sucker | *Catostomus discobolus* | BLM – Sensitive Species<br>State - Species of Greatest Conservation Need |
| Flannelmouth Sucker | *Catostomus latipinnis* | BLM – Sensitive Species<br>State - Species of Greatest Conservation Need |
| Rainbow Trout | *Oncorhynchus mykiss* | None |
| Speckled Dace | *Rhinichthys osculus* | None |
| Northern Leopard Frog | *Rana pipiens* | State - Species of Greatest Conservation Need<br>State - Species of Special Concern |
| aquatic beetle | *Coleoptera* | None |
| aquatic fly larve | *Diptera* | None |
| back swimmer | *Nototectidae* | None |
| chironomid fly | *Chronomides* | None |
| crawdad | *decapodadecapoda* | None |
| damselfly | *Zygoptera* | None |
| dragonfly | *Anisoptera* | None |
| giant water bug | *Belostomatidae* | None |
| water boatmen | *Corixidae* | None |
| water horsetail | *Equisetum fluviatile* | None |
| water strider | *Gerridae* | None |
| whirligig beetle | *Gyrinidae* | None |
| great blue heron | *Ardea herodias* | None |
| western whiptail | *Cnemidophorus tigris* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**

BLM staff used the R2Cross method to develop the initial recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022). Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macro-invertebrates (Nehring, 1979). BLM staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree or withdraws the recommendation.

**Data Collection and Analysis**

BLM collected R2Cross data at two transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 2.44 cfs and a summer flow of 4.63 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Monitor Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 05/10/2012, 1 | 22.71 | 2.00 | 3.20 | 5.52 |
| 05/10/2012, 2 | 19.00 | 1.96 | 1.68 | 3.75 |
| | | | 2.44 | 4.63 |

**ISF Recommendation**

BLM recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

4.6 cfs is recommended from April 1 to May 31 during the peak snowmelt season. This recommendation is driven by the average velocity criteria. Monitor Creek experiences consistently low flows during late summer and fall, so it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff flows are available. Protecting this flow rate will help ensure that habitat and passage is available for native species that spawn in the creek.

3.6 cfs is recommended from June 1 to June 30 during the early summer period. This recommendation is driven by limited water availability. This flow rate meets two of three ISF

criteria. This flow rate will assist adult fish, young-of-the-year, and larvae in returning to Roubideau Creek and Gunnison River after spawning is complete.

**WATER AVAILABILITY**
CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**
Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**
The drainage basin of the proposed ISF on Monitor Creek is 30.1 square miles, with an average elevation of 7,710 feet and average annual precipitation of 19.1 inches. Hydrology throughout the Uncompahgre Plateau demonstrates a relatively early snowmelt runoff pattern that is also influenced by monsoon and late season storms.

There are a number of water uses in the basin tributary to the proposed ISF on Monitor Creek. There are seven active surface water diversions upstream from the proposed upper terminus. The sum of active surface water diversions in the Monitor Creek basin is 67.13 cfs (See the Hydrologic Features Map and Detailed map). The largest of these is the Big Monitor Ditch No 1

(WDID 4001426, 51.85 cfs, appropriated in 1918). There are also 412 acre feet in active storage rights, 0.53 cfs for a number of springs and pipelines, and 0.4 cfs for well water rights. None of these water rights are known to completely dry up Monitor Creek. In addition, there are some diversions that import or export water into the Monitor basin. The Everlasting Ditch (WDID 4001435, 27 cfs, appropriated in 1901 and 1964), which diverts from Cottonwood Creek, irrigates lands in the Monitor Creek basin and may contribute additional flow. The 25 Mesa Upper Little Monitor Ditch (WDID 4001319, 7 cfs, appropriated in 1904) diverts water from Little Monitor Creek, which is used on lands in both the Monitor Creek and Cottonwood Creek basins. Based on these water uses, hydrology is altered.

**Data Collection and Analysis**

*Gage Data*

There are no current or historic streamflow gages on Monitor Creek. No representative gages on nearby streams were identified due to a general lack of gages in the region and the high level of water use in the nearest streams with gages.

*CWCB Gage and Staff Measurements*

CWCB staff installed a temporary gage on Monitor Creek approximately 150 feet upstream from the confluence with Potter Creek. This gage operated from 6/8/2017 through present and data was processed through 6/30/2022. There are a number of data gaps in the record due to equipment failures, disruptions to gage maintenance due to COVID-19, and two high flow events that dislodged equipment. Streamflow measurements collected to maintain this gage as well as other measurements made by BLM and the USGS are shown in Table 3.

**Table 3. Summary of streamflow measurements for Monitor Creek.**

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 5/20/2003 | 12.89 | USGS |
| 5/25/2004 | 2.32 | USGS |
| 6/12/2014 | 0.84 | BLM |
| 4/8/2015 | 3.55 | BLM |
| 7/23/2015 | 0.97 | BLM |
| 5/4/2016 | 30.32 | BLM |
| 3/10/2017 | 0.28 | CWCB |
| 4/13/2017 | 32.15 | BLM |
| 4/19/2017 | 57.7 | CWCB |
| 5/22/2017 | 14.48 | BLM |
| 6/8/2017 | 1.53 | CWCB |
| 6/22/2017 | 0.37 | CWCB |

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 6/26/2017 | 0.09 | BLM |
| 7/13/2017 | 0.75 | CWCB |
| 8/24/2017 | 0.12 | CWCB |
| 3/20/2018 | 0.04 | CWCB |
| 3/21/2018 | 0.08 | CWCB |
| 4/3/2018 | 0.09 | CWCB |
| 5/10/2018 | 0.09 | CWCB |
| 7/3/2018 | 0.02 | CWCB |
| 8/22/2018 | 0.03 | CWCB |
| 4/8/2019 | 3.35 | CWCB |
| 4/11/2019 | 11.61 | CWCB |
| 5/3/2019 | 48.31 | BLM |
| 5/15/2019 | 55.13 | CWCB |
| 6/19/2019 | 5.07 | CPW |
| 7/31/2019 | 0.25 | CWCB |
| 10/17/2019 | 0.06 | CWCB |
| 3/4/2020 | 0.06 | CWCB |
| 5/13/2020 | 0.55 | CPW |
| 10/1/2020 | 0.05 | CWCB |
| 4/5/2021 | 0.02 | CWCB |
| 5/11/2021 | 0.03 | CWCB |
| 7/22/2021 | 0.04 | CWCB |
| 9/14/2021 | 0 | CWCB |
| 2/23/2022 | 0.04 | CWCB |
| 3/26/2022 | 0.02 | CPW |
| 4/28/2022 | 47.53 | CPW |
| 5/6/2022 | 23.2 | CPW |

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 6/9/2022 | 0.12 | CPW |
| 6/22/2022 | 0.08 | CWCB |

A nearby weather station was reviewed to assess how the 2017-2022 gage record compared to a longer-term record for the area. The nearest climate station with a relatively long record is at Columbine Pass (USS0008L02S, 1986 to 2022) located near the headwaters of Monitor Creek, approximately 24 miles southwest from the proposed lower terminus. Figure 1 shows cumulative snow water equivalent (SWE) totals for 2017-2022 in comparison to the 30-year average (downloaded from the Colorado River Basin Forecast Center on 12/19/2022). Peak SWE in 2018 was the lowest on record, 2020 and 2021 were below average, and 2017, 2019, and 2022 were above average. This information demonstrates a range of precipitation in the area during the CWCB gage record.

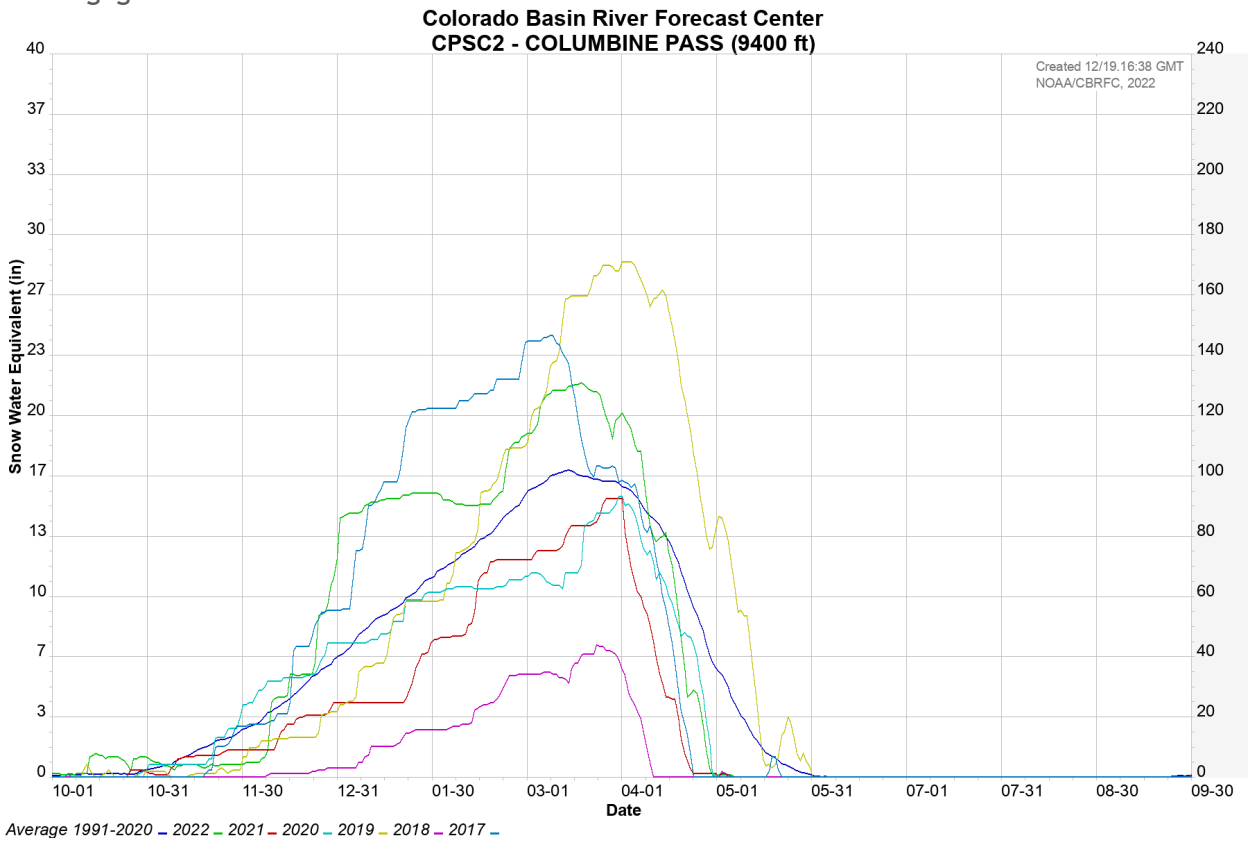



Figure 1. Cumulative SWE for 2014 to 2022 and median SWE from 1991 to 2020 downloaded from the Colorado River Basin Forecast Center on 12/19/2022.

Staff also evaluated streamflow gages to better understand potential streamflow given that persistent low soil moisture in recent years has impacted how much snowfall becomes streamflow. The Dallas Creek gage and San Miguel gages (USGS 09147000 Dallas Creek near Ridgway and USGS 0917700 San Miguel River at Uravan) were selected because they were reasonably close to the Uncompaghre Plateau. The gages are not impacted by large reservoirs;

however, they are in different basins and have significant water uses. Years with complete data (provisional or approved data, filling missing data in 2022 with the long-term average) from 1992 to 2022 was used to calculate annual water volumes and basic percentiles. Data from these gages show that 2019 was very wet (greater than 75$^{th}$ percentile); 2017 was wet or wettest (greater than the 50$^{th}$ percentile for the San Miguel River and greater than 75$^{th}$ percentile for Dallas Creek); 2018, 2020, 2021, and 2022 were in the driest category (less then 25$^{th}$ percentile). 2018 and 2020 were exceptionally dry with annual water volumes less than the 10$^{th}$ percentile. Therefore, the CWCB gage data contains a range of year types, but the majority of years in the record are likely to reflect dry or exceptionally dry conditions.

The CWCB temporary gage data also shows a wide range in streamflow between 2017 and 2022. High flows in 2017 dislodge the newly installed gage, but the gage was likely installed after the majority of snowmelt runoff. There was little to no measured streamflow in 2018 or 2021 (although some data in missing in 2021), and just a short duration peak in 2020. Streamflow was higher in 2022 and in 2019, which also dislodged the gaging equipment. Due to the short period of record at the gage and significant variability in flows between years, mean-monthly streamflow was calculated using the entire available record rather than median daily streamflow.

**Water Availability Summary**
The hydrograph (See Complete Hydrograph) shows mean-monthly streamflow calculated from the CWCB temporary gage and other spot streamflow measurements. Staff has concluded that water is available for appropriation.

**MATERIAL INJURY**
As a new junior water right, the proposed ISF on Monitor Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**

**Citations**
Colorado Department of Public Health and Environment, 2020, Aquatic life use attainment: methodology to determine to use attainment for rivers and streams. Retrieve from URL: https://www.coloradosmp.org/wp-content/uploads/2022/03/Policy-10-1-v.-2020.pdf

Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

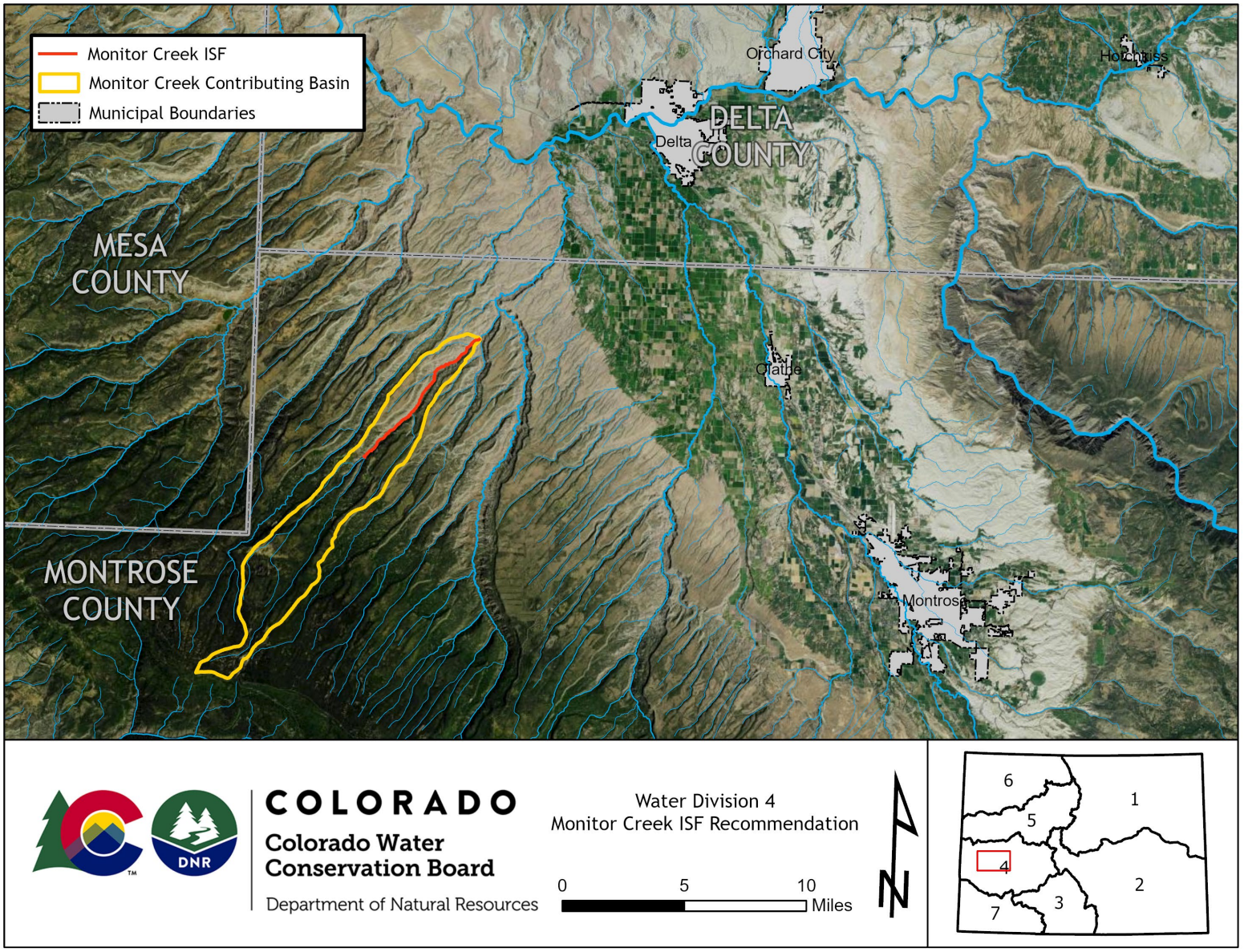
Nehring, B.R., 1979, Evaluation of instream flow methods and determination of water quantity needs for streams in the State of Colorado, Colorado Division of Wildlife.

**Metadata Descriptions**

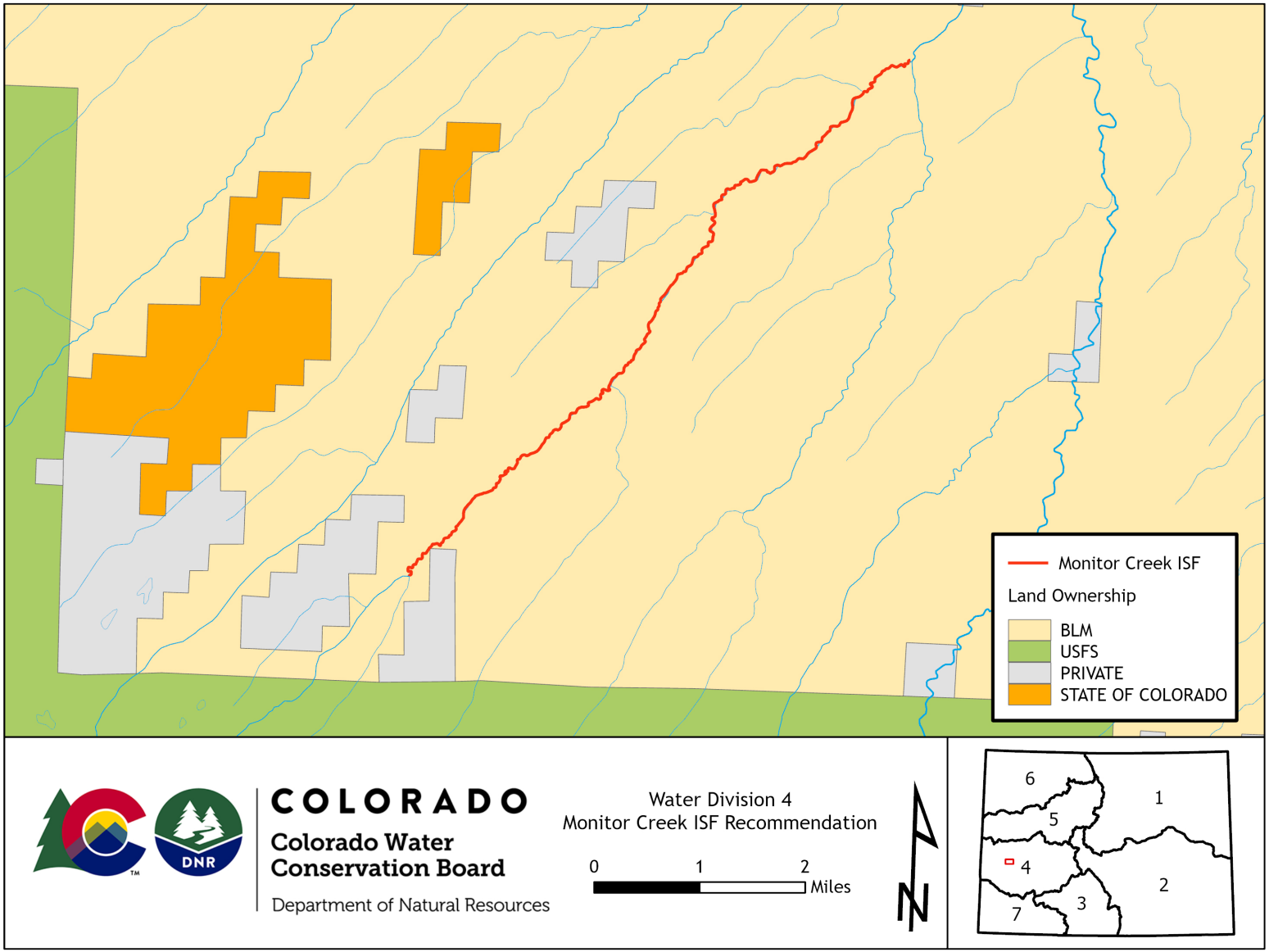
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

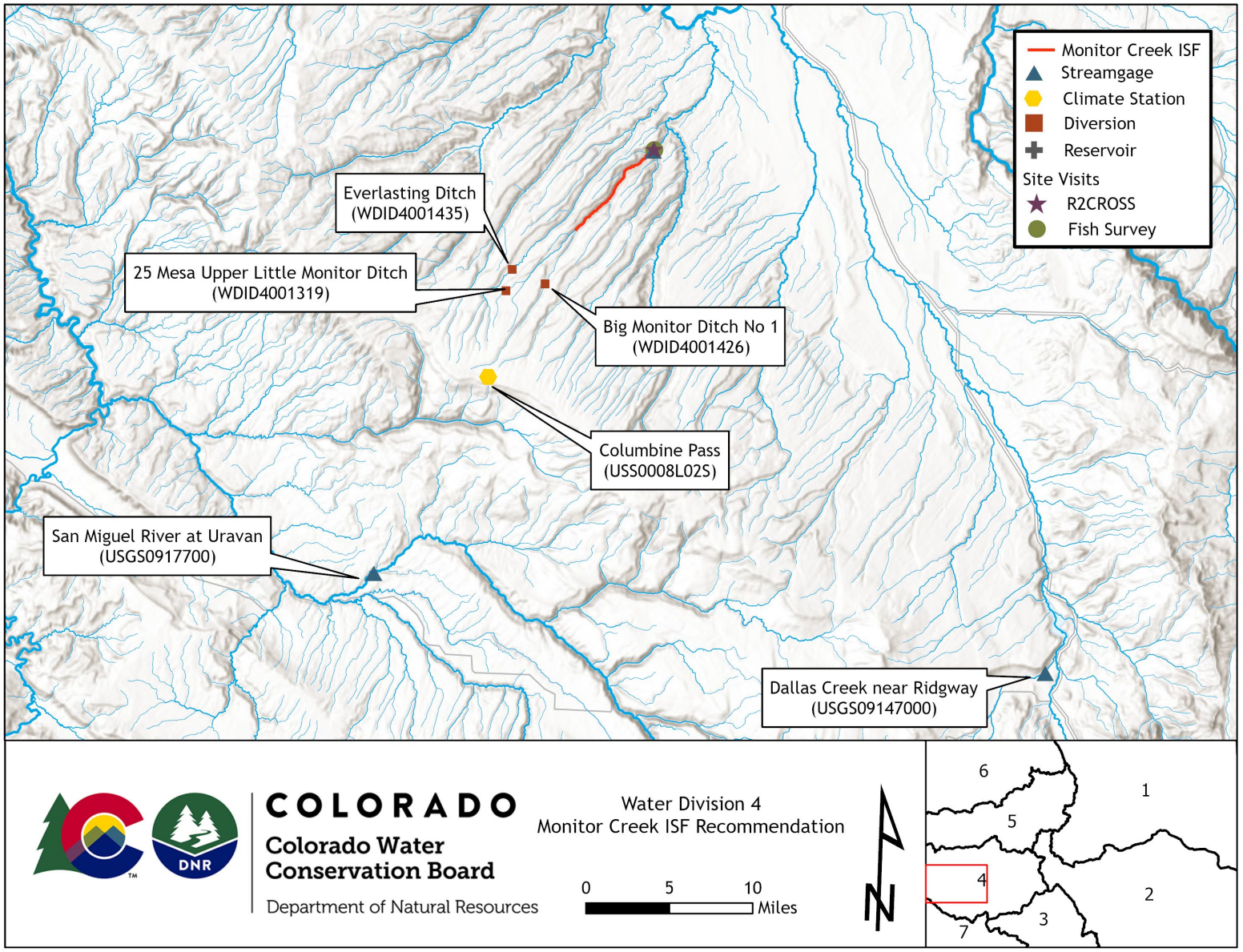
# VICINITY MAP



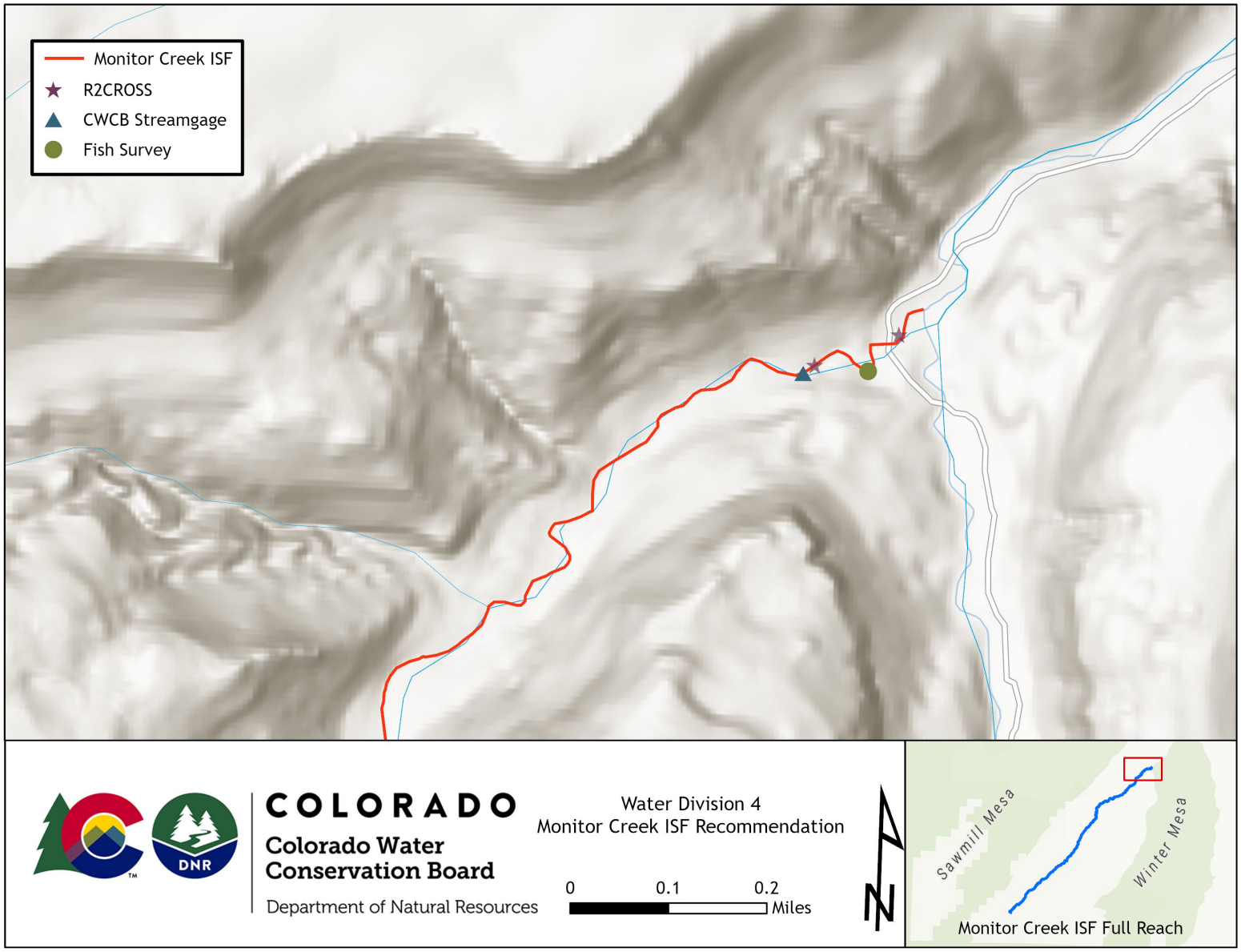
# LAND OWNERSHIP MAP



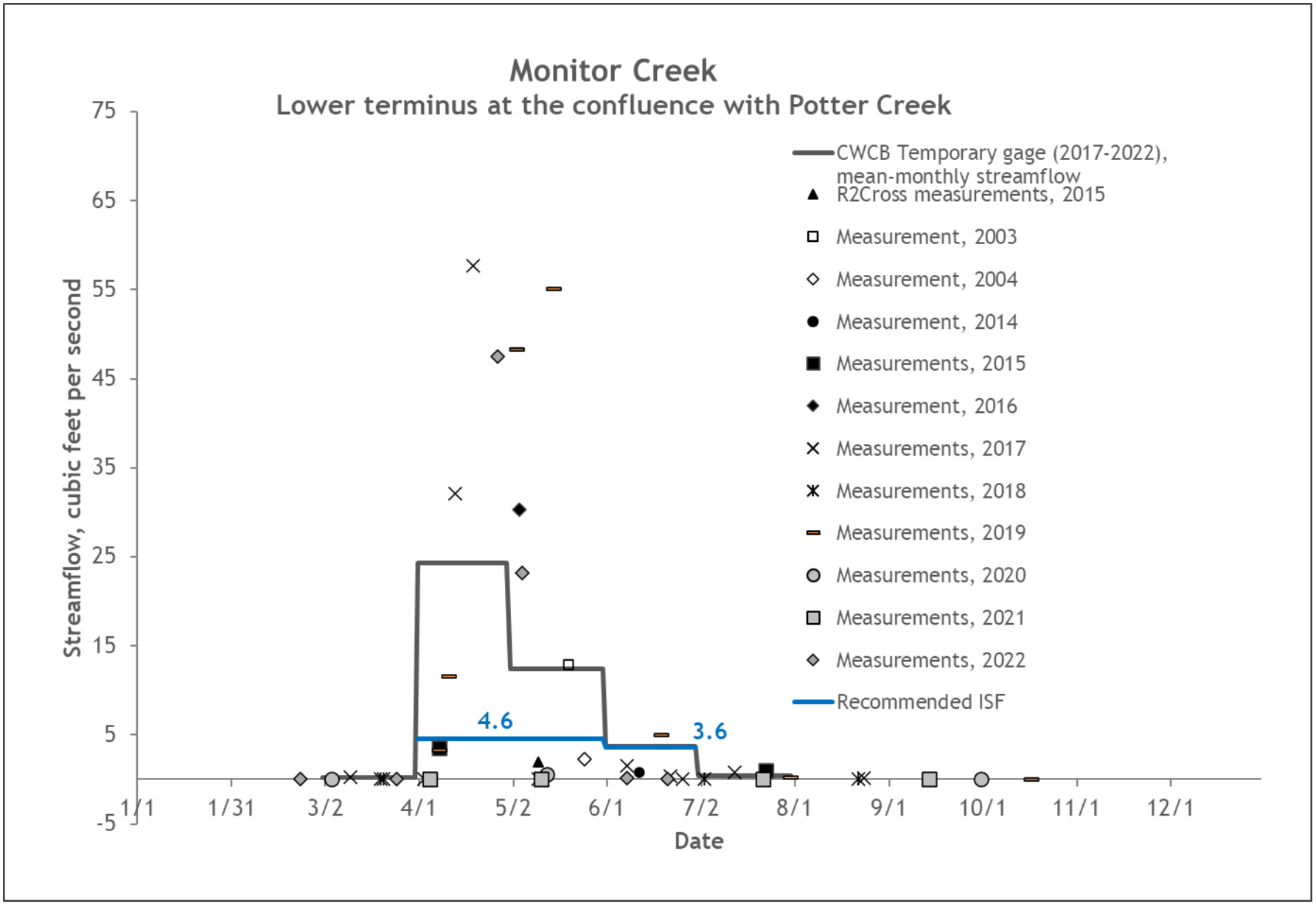
# HYDROLOGIC FEATURES MAP



# DETAILED HYDROLOGIC FEATURES DETAILS MAP



COMPLETE HYDROGRAPH



# Red Canyon Creek Executive Summary

**CWCB STAFF INSTREAM FLOW RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | headwaters in the vicinity of<br>UTM North: 4245322.94 UTM East: 221751.70 |
| LOWER TERMINUS: | confluence with Big A Creek at<br>UTM North: 4240822.17 UTM East: 219603.08 |
| WATER DIVISION: | 4 |
| WATER DISTRICT: | 60 |
| COUNTY: | Montrose |
| WATERSHED: | San Miguel |
| CWCB ID: | 21/4/A-010 |
| RECOMMENDER: | Colorado Parks and Wildlife (CPW) |
| LENGTH: | 3.2 miles |
| FLOW RECOMMENDATION: | 5 cfs (04/01 - 04/30)<br>6.2 cfs (05/01 - 07/31)<br>3 cfs (08/01 - 09/30)<br>2.3 cfs (10/01 - 10/31)<br>1 cfs (11/01 - 03/31) |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

CPW recommended that the CWCB appropriate an ISF water right on a reach of Red Canyon Creek. Red Canyon Creek is located within Montrose County and is approximately 18 miles north of the town of Nulca (See Vicinity Map). The stream originates on the Uncompaghre Plateau at the top of Red Canyon and flows south until it reaches the confluence with Horsefly Creek which is a tributary to the San Miguel River.

The proposed reach extends from the headwaters downstream to confluence with Big A Creek for a total of 3.2 miles. The entire proposed reach is on United States Forest Service (USFS) land in the Uncompaghre National Forest (See Land Ownership Map). CPW is interested in protecting this stream in order to protect the natural environment which includes a core conservation population of Colorado River Cutthroat Trout.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Red Canyon Creek was sent to the mailing list in March 2020, March 2021, March 2022, and November 2022. Staff sent letters to identified landowners adjacent to Red Canyon Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Montrose Daily Press on December 21, 2022.

Staff presented information about the ISF program and this recommendation to the Montrose County Board of County Commissioners on November 22, 2022. In addition, staff communicated with Bob Hurford, Division Four Engineer on October 11, 2022 regarding water availability on Red Canyon Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each

recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

Red Canyon Creek is a snowmelt driven, cold-water stream. It flows in a mainly single channel at a high gradient through Red Canyon. Red Canyon Creek basin is forested with stands of aspen, blue spruce, ponderosa, and oak scrub. The understory consists of shrubs and wildflowers, including native red columbines, wild iris, and purple beardtongue. Along the streambank, the riparian community is comprised of healthy willow and alder dotted with common horsetail. Large beaver dam complexes were observed in the field.

The Red Canyon Creek morphology is complex with undercut banks, coarse substrate riffles, pools, and glides. The bed substrate ranges from medium cobbles to large boulders. The riparian community shades the cold-water stream. Ample woody debris and detritus provide habitat and food sources for stream macroinvertebrates. The macroinvertebrate community observed in the field was diverse and included orders, caddisfly and mayfly, that are known to be sensitive to water quality (Hilsenhoff, 1987). A few species of caddisfly, mayfly, aquatic beetle, and diptera were observed in addition to both broad shouldered and giant water striders.

CPW identified a self-sustaining population of Colorado River Cutthroat trout (CRCT) of the Gunnison Basin lineage in Red Canyon Creek. CRCT are native to the Colorado River and its tributaries and are designated by CPW as a species of special concern and species of greatest conservation need in Colorado. This population is a core conservation population of CRCT, meaning that the population is 99% pure. CPW works to secure and enhance watershed conditions in CRCT conservation populations as part of a multi-state and multi-agency conservation agreement aimed at preventing the listing of these subspecies under the Endangered Species Act

**Table 1. List of species identified in Red Canyon Creek.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Colorado River cutthroat trout | *Oncorhynchus clarkii pleuriticus* | State - Species of Greatest Conservation Need<br>State - Species of Special Concern |
| aquatic beetle | *Coleoptera* | None |
| aquatic fly larvae | *Diptera* | None |
| caddisfly | *Trichoptera* | None |
| mayfly | *Ephemeroptera* | None |
| water strider | *Gerridae* | None |
| beaver | *Castor canadensis* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**
CPW staff used the R2Cross method to develop the ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022). Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macroinvertebrates (Nehring, 1979). CPW staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

**Data Collection and Analysis**
CPW collected R2Cross data at one transect for this proposed ISF reach (Table 2). The R2Cross model results in a winter flow of 1.45 cfs and a summer flow of 6.15 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Red Canyon Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 05/19/2022, 1 | 20.97 | 6.89 | 1.45 | 6.15 |

**ISF Recommendation**
The CPW recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

5 cfs is recommended from April 1 to April 30; this flow rate is reduced due to water availability limitations. This early season flow recommendation will support beneficial spawning conditions for cutthroat trout.

6.2 cfs is recommended from May 1 to July 31. This rate maintains adequate depth, velocity, and wetted perimeter during the summer period when fish are most active and stream

temperatures are high. This higher flow rate will support ideal spawning conditions for cutthroat trout, a species who spawn in the spring.

3.0 cfs is recommended from August 1 to September 30; this flow rate is reduced due to water availability limitations. This rate maintains available habitat, depth, and wetted perimeter, and allows fish movement as flows recede and temperatures may still be high during the late-summer.

2.3 cfs is recommended from October 1 to October 31. This flow rate is reduced due to water availability limitations. This rate maintains available habitat and allows fish movement as flows recede to baseflow conditions.

1.0 cfs from November 1 to March 31; this flow rate is reduced due to water availability limitations. This rate will provide sufficient habitat availability in pools and deep glides during the overwintering period.

**WATER AVAILABILITY**
CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**
Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95%

confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**
The drainage basin of the proposed ISF on Red Canyon Creek is 6.00 square miles, with an average elevation of 9,186 feet and average annual precipitation of 29.12 inches (See the Hydrologic Features Map). Red Canyon Creek is a high-gradient, single channel, snowmelt driven hydrologic system, with variable timing and magnitude in snowmelt runoff.

*Water Rights Assessment*
There are current water rights within the contributing basin of Red Canyon Creek. Staff is aware of a historical structure that no longer exists within the reach, Red Canyon Ditch (WDID 6001303).

**Data Collection and Analysis**
*Representative Gage Analysis*
There are no current or historic gages on Red Canyon Creek. Staff investigated nearby gages for similarities in basin characteristics and hydrology and for data collection histories. No gages were sufficiently similar to be used to estimate streamflow on Red Canyon Creek.

*Multiple Regression Models*
The CSUFlow18 regression model predicts mean-monthly flow in Red Canyon Creek and provides the best estimate for natural streamflow conditions.

**Data Collection and Analysis**
CWCB staff assisted CPW in R2Cross data collection and performed both site visit and stream measurement alongside CPW staff (Table 2).

**Water Availability Summary**
The hydrograph (See Complete Hydrograph) shows CSUFlow18 results for mean-monthly streamflow and the proposed ISF flow rate. Staff has concluded that water is available for appropriation.

**MATERIAL INJURY**
As a new junior water right, the proposed ISF on Red Canyon Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**
**Citations**
Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

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.

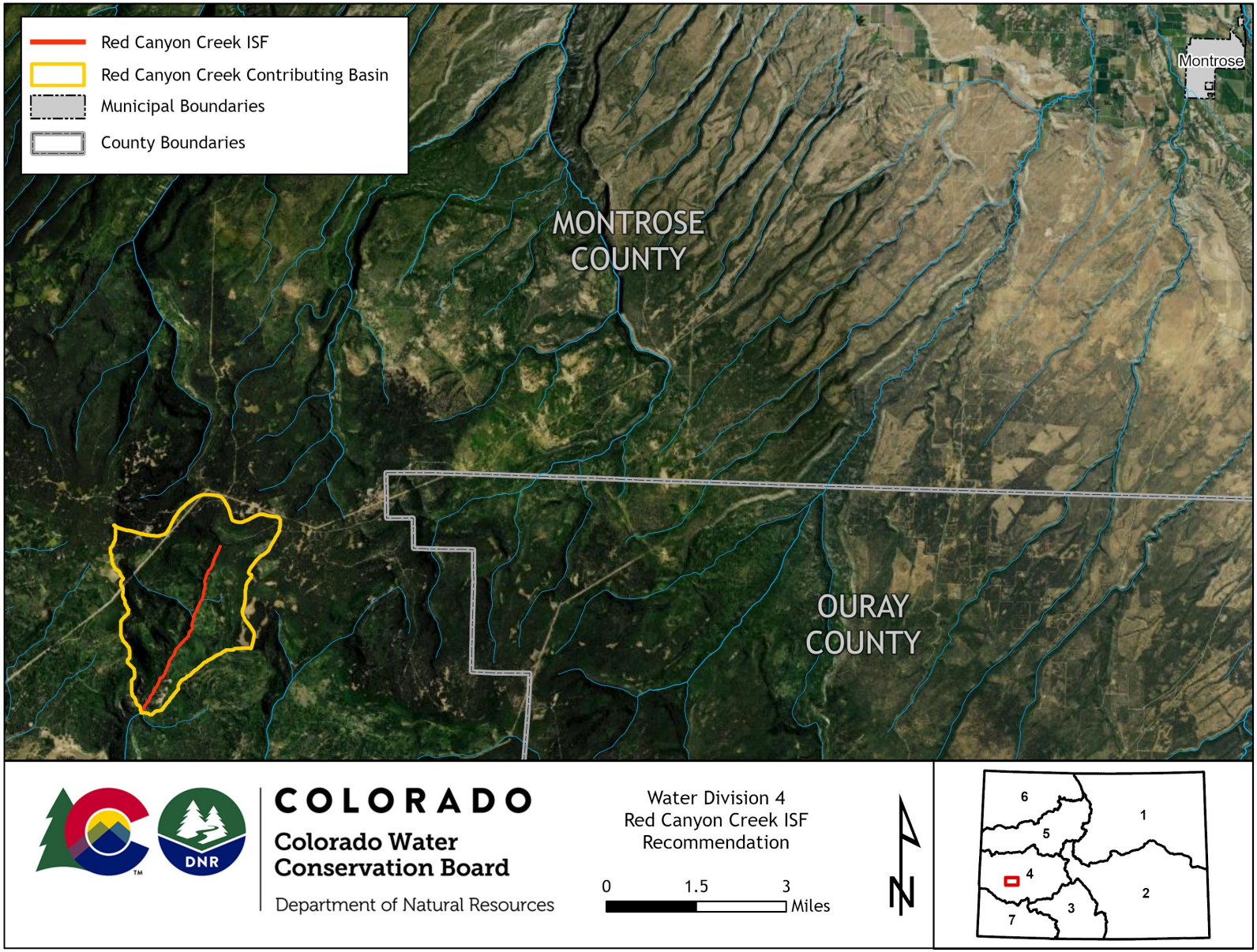
Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

**Metadata Descriptions**

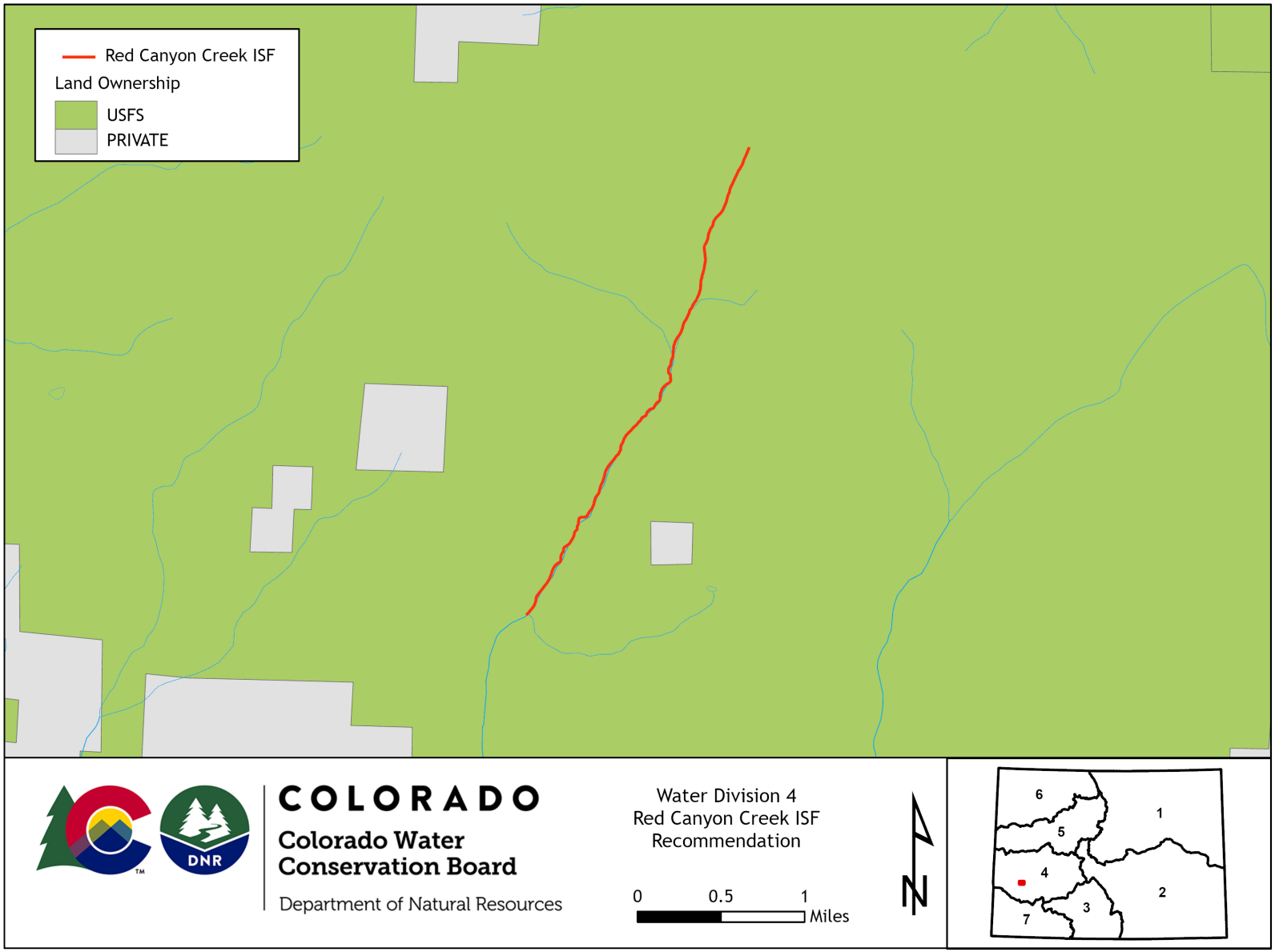
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

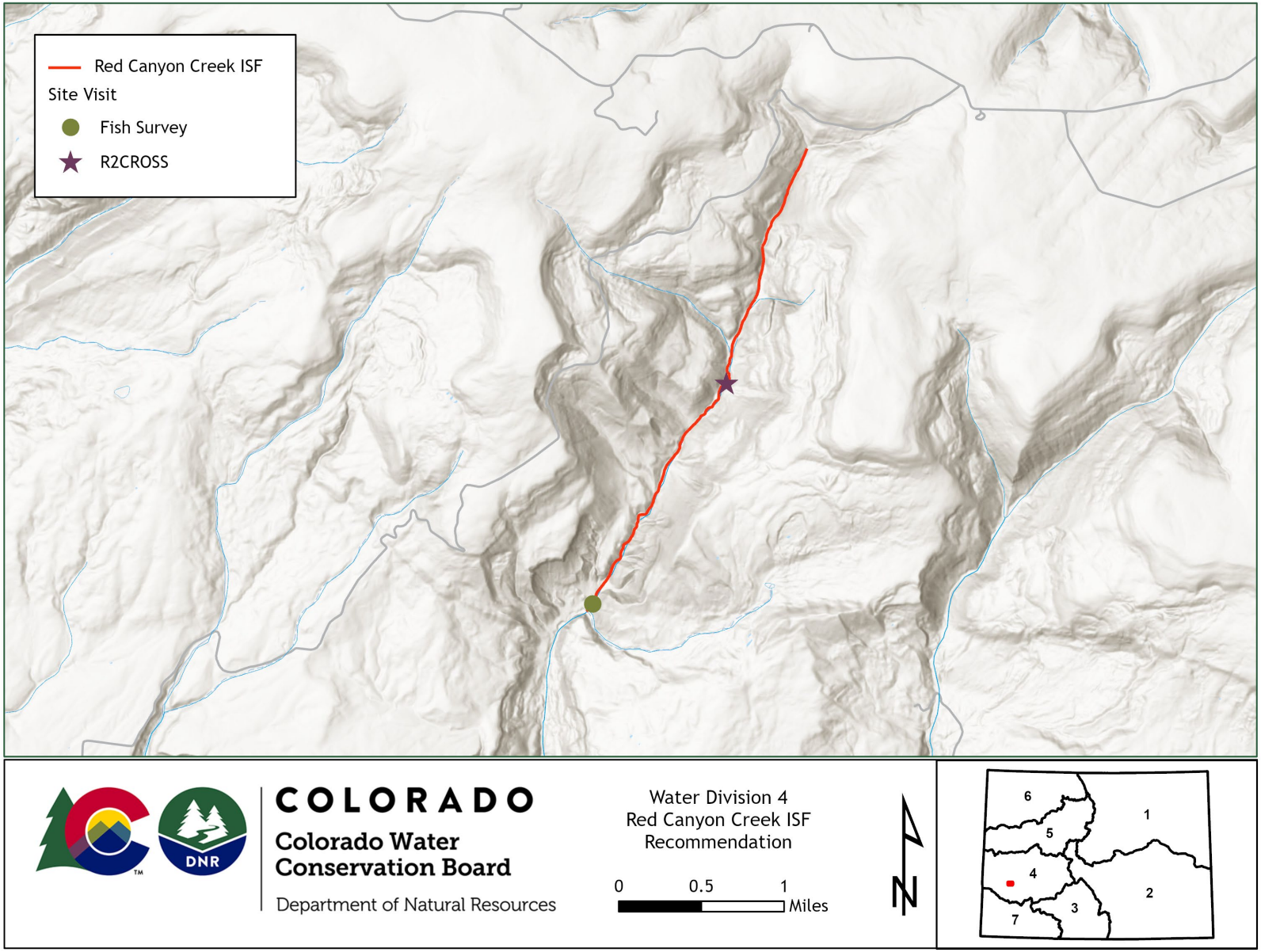
# VICINITY MAP



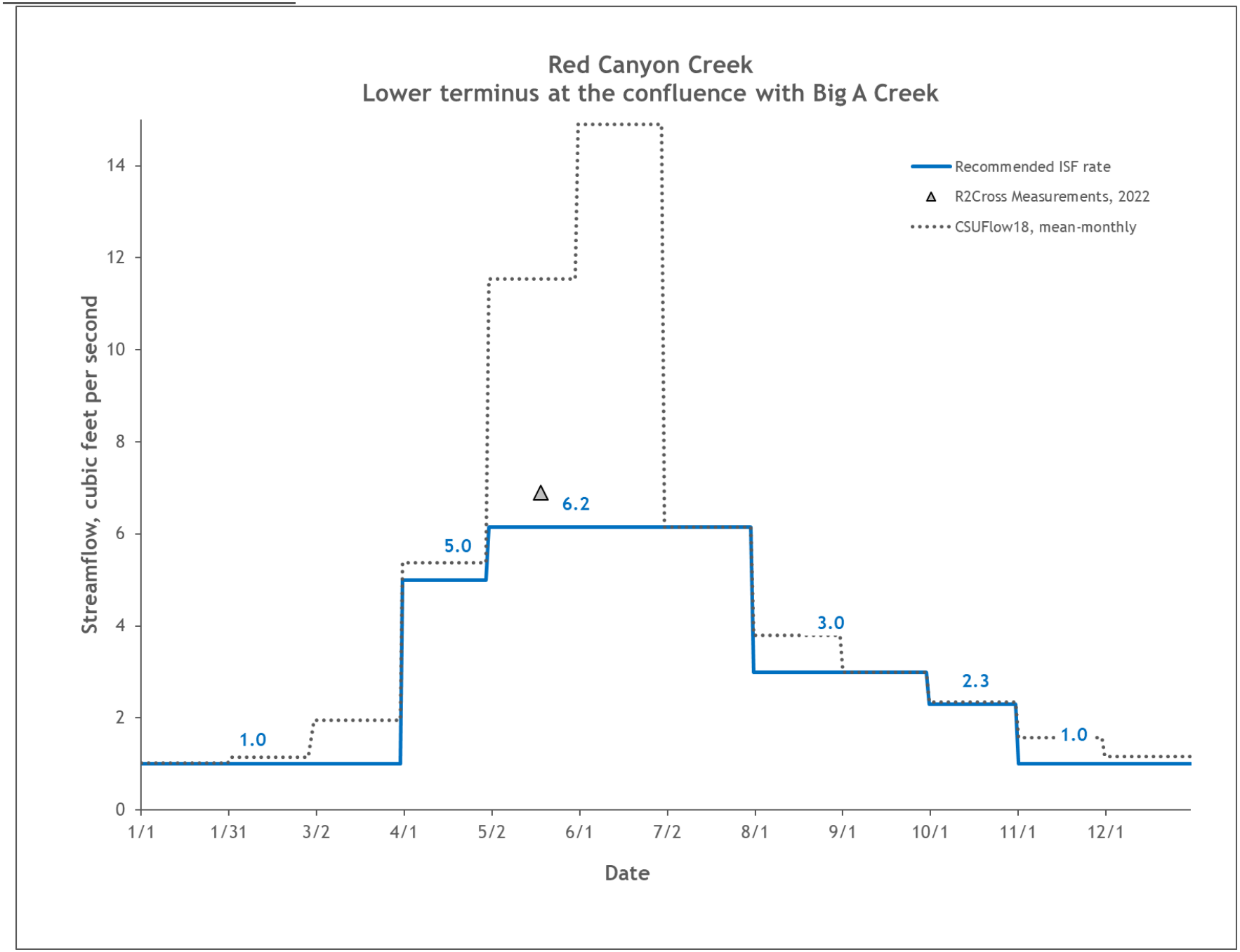
# LAND OWNERSHIP MAP



# HYDROLOGIC FEATURES MAP



## COMPLETE HYDROGRAPH



# Van Boxel Creek Executive Summary

**CWCB STAFF INSTREAM FLOW INCREASE RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | headwaters in the vicinity of<br>UTM North: 4233170.73 UTM East: 282342.59 |
| LOWER TERMINUS: | confluence with Little Cimarron River at<br>UTM North: 4242731.81 UTM East: 284132.66 |
| WATER DIVISION: | 4 |
| WATER DISTRICT: | 62 |
| COUNTY: | Gunnison |
| WATERSHED: | Upper Gunnison |
| CWCB ID: | 23/4/A-006 |
| RECOMMENDER: | Bureau of Land Management (BLM) |
| LENGTH: | 7.75 miles |
| EXISTING INSTREAM FLOW: | 4-76W2921, 2 cfs (01/01 – 12/31) |
| FLOW INCREASE RECOMMENDATION: | 2.5 cfs (04/01 - 04/30)<br>7.8 cfs (05/01 - 06/30)<br>7.1 cfs (07/01 - 07/31)<br>1.5 cfs (08/01 - 08/31)<br>0.4 cfs (09/01 - 09/30) |

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Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

BLM recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Van Boxel Creek. Van Boxel Creek is located within Gunnison County and is approximately 10 miles south of Morrow Point Reservoir (See Vicinity Map). The stream originates on High Mesa and flows north until it reaches the confluence with the Little Cimmaron River. The existing ISF water right on Van Boxel Creek was appropriated in 1976 for two cfs year-round.

The proposed reach extends from the headwaters downstream to the confluence with Little Cimarron River for a total of 7.75 miles. Approximately 49% of the land on the proposed reach is BLM public land, 31% is United States Forest Service and 20% private (See Land Ownership Map). This proposed increase assists BLM's long-term management goals protecting outstanding riparian and important fishery values.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Van Boxel Creek was sent to the mailing list in November 2022 and March 2022. Staff sent letters to identified landowners adjacent to Van Boxel Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Crested Butte News on December 30, 2022.

Staff presented information about the ISF program and this recommendation to the Gunnison County Board of County Commissioners on September 13, 2022. In addition, staff spoke with Bob Hurford, Division Four Engineer on October 11, 2022 regarding water availability on Van Boxel Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

The headwaters of Van Boxel Creek form on High Mesa in meadows at a low gradient surrounded by forest stands. The cold-water creek runs through a narrow canyon with dense evergreen forest speckled with meadows. The streambed substrate consist of small cobbles and boulders up to three feet in size. The channel is complex, sinuous and braiding, winding around many downed logs forming jams and boulders. The riparian corridor includes alder, blue spruce, river birch, willows, field horsetail, fringed willowherb, and swamp currant. The combination of large boulders and logs create frequent pools. There is limited riffle habitat because of the high gradient however, there are coarse substrate riffles within the reach. There is a significant amount of woody debris and leafy detritus.

BLM identified Brook Trout in Van Boxel Creek (Table 1). At least six caddisfly taxa, three mayfly taxa, stonefly, and giant water strider were identified in the field by CWCB staff. Taxa in the caddisfly, mayfly and stonefly orders are considered evidence of good water quality (Hilsenhoff, 1987). Multiped algae taxa and bryophytes were also observed.

**Table 1. List of species identified in Van Boxel Creek.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Brook Trout | *Salvelinus fontinalis* | None |
| caddisfly | *Trichoptera* | None |
| mayfly | *Ephemeroptera* | None |
| stonefly | *Plechoptera* | None |
| alder | *Alnus Spp.* | None |
| blue spruce | *Picea pungens* | None |
| willow | *Salix spp.* | None |
| river birch | *Betula nigra* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**

BLM staff used the R2Cross method to develop the initial ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022). Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macro-invertebrates (Nehring, 1979). BLM staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

**Data Collection and Analysis**

BLM collected R2Cross data at two transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a summer flow of 9.80 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Van Boxel Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 06/07/2021, 1 | 31.71 | 11.30 | NA | 8.01 |
| 06/07/2021, 2 | 35.16 | 11.76 | NA | 11.58 |
| | | | NA | 9.80 |

**ISF Recommendation**

The R2Cross data summarized above indicates that the current ISF water right does not provide sufficient physical habitat. This is important during the warm weather portions of the year when the fish populations are feeding, growing and spawning. The existing ISF decreed flow rate of 2 cfs only provides between 21% and 29% wetted perimeter so a significant portion of the potential habitat is not available during the warm weather season.

The BLM recommends the following increased flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

An increase of 2.5 cfs is recommended from April 1 to April 30, to bring the total ISF protection to 4.5 cfs; this flow rate is reduced due to water availability limitations. An

increase during this period is important because the fish population is starting to become more active after stream ice melts and water temperatures start rising.

An increase of 7.8 cfs is recommended from May 1 to June 30, to bring the total ISF protection to 9.8 cfs. This recommendation is driven by the wetted perimeter criteria. It is important to protect a flow rate that makes most habitat possible available to the fish population while they are completing critical life history functions during snowmelt runoff.
An increase of 7.1 cfs is recommended from July 1 to July 31, to bring the total ISF protection to 9.1 cfs; this flow rate is reduced due to water availability limitations. This is still a very active period for the fish community, but the recommended flow rate has been decreased because of water availability.

An increase of 1.5 cfs is recommended from August 1 to August 31, to bring the total ISF protection to 3.5 cfs; this flow rate is reduced due to water availability limitations. During this period, fish are feeding aggressively and gaining weight for the upcoming winter, so it is important to provide as much habitat as possible for feeding.

An increase of 0.4 cfs is recommended from September 1 to September 30, to bring the total ISF protection to 2.4 cfs; this flow rate is reduced due to water availability limitations. This flow rate will provide a transitional flow rate for the fish community between the higher flows during the warmer part of the year and low base flows during winter, allowing the population to adjust to gradually reduced physical habitat. This flow rate will also provide ample pool habitat, where the fish population resides during much of warm portion of the year.

**WATER AVAILABILITY**
CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**
Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can

provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**

The drainage basin of the proposed ISF on Van Boxel Creek is 10.20 square miles, with an average elevation of 5,132 feet and average annual precipitation of 29.24 inches (See the Hydrologic Features Map). Van Boxel Creek is a snowmelt driven hydrologic system, with variable timing and magnitude in snowmelt runoff.

*Water Rights Assessment*

There is one hydropower water right on Van Boxel Creek. The Ramsey Hydro Pipeline (WDID 6201797) is the only surface water right located within the proposed ISF reach. This water right was appropriated in 2000 for 3.0 cfs, 0.68 cfs is absolute and 2.32 cfs is conditional. The water right owner diverts 0.68 cfs from Van Boxel Creek for hydropower generation. The distance between the point of diversion to the location it returns to Van Boxel Creek is less than 200 feet (personal communication with water right owner, Stephen Ramsey, 9/22/22). According to Mr. Ramsey, this short reach of stream has flow year-round and is never dry. No adjustments were made to account for the hydropower water right due to the small length of the affected reach. Within the contributing basin of Van Boxel Creek, there are nine spring water rights with a total flow right of 0.67 cfs and one spring with an associated ditch right for 0.03 cfs.

**Data Collection and Analysis**

*Representative Gage Analysis*

There are no current or historic gages on Van Boxel Creek. Staff investigated nearby gages for similarities in basin characteristics and hydrology and for data collection histories. No gages were sufficiently similar to be used to estimate streamflow on Van Boxel Creek.

*Multiple Regression Models*

The CSUFlow18 regression model predicts mean-monthly flow in Van Boxel Creek and provides best estimate for streamflow conditions.

CWCB staff made two streamflow measurements and BLM staff made twelve additional measurements on the proposed reach of Van Boxel Creek as summarized in Table 3.

**Table 3. Summary of streamflow measurements for Van Boxel Creek.**

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 6/20/2020 | 0.70 | BLM |
| 8/5/2020 | 0.48 | BLM |
| 8/17/2020 | 0.21 | BLM |
| 10/13/2020 | 0.46 | BLM |
| 6/27/2021 | 11.97 | BLM |
| 7/29/2021 | 0.48 | BLM |
| 5/1/2022 | 3.47 | BLM |
| 5/6/2022 | 4.67 | BLM |
| 5/22/2022 | 17.48 | BLM |
| 5/26/2022 | 16.17 | BLM |
| 6/16/2022 | 4.03 | BLM |
| 9/13/2022 | 1.32 | BLM |
| 09/30/2022 | 0.49 | CWCB |
| 09/30/2022 | 1.00 | CWCB |

**Water Availability Summary**
The hydrograph shows CSUFlow18 results for mean-monthly streamflow and includes the proposed ISF rate (See Complete Hydrograph). Staff has concluded that water is available for an increase from April 1 to September 30.

**MATERIAL INJURY**
As a new junior water right, the proposed ISF increase on Van Boxel Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**

**Citations**
Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

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Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

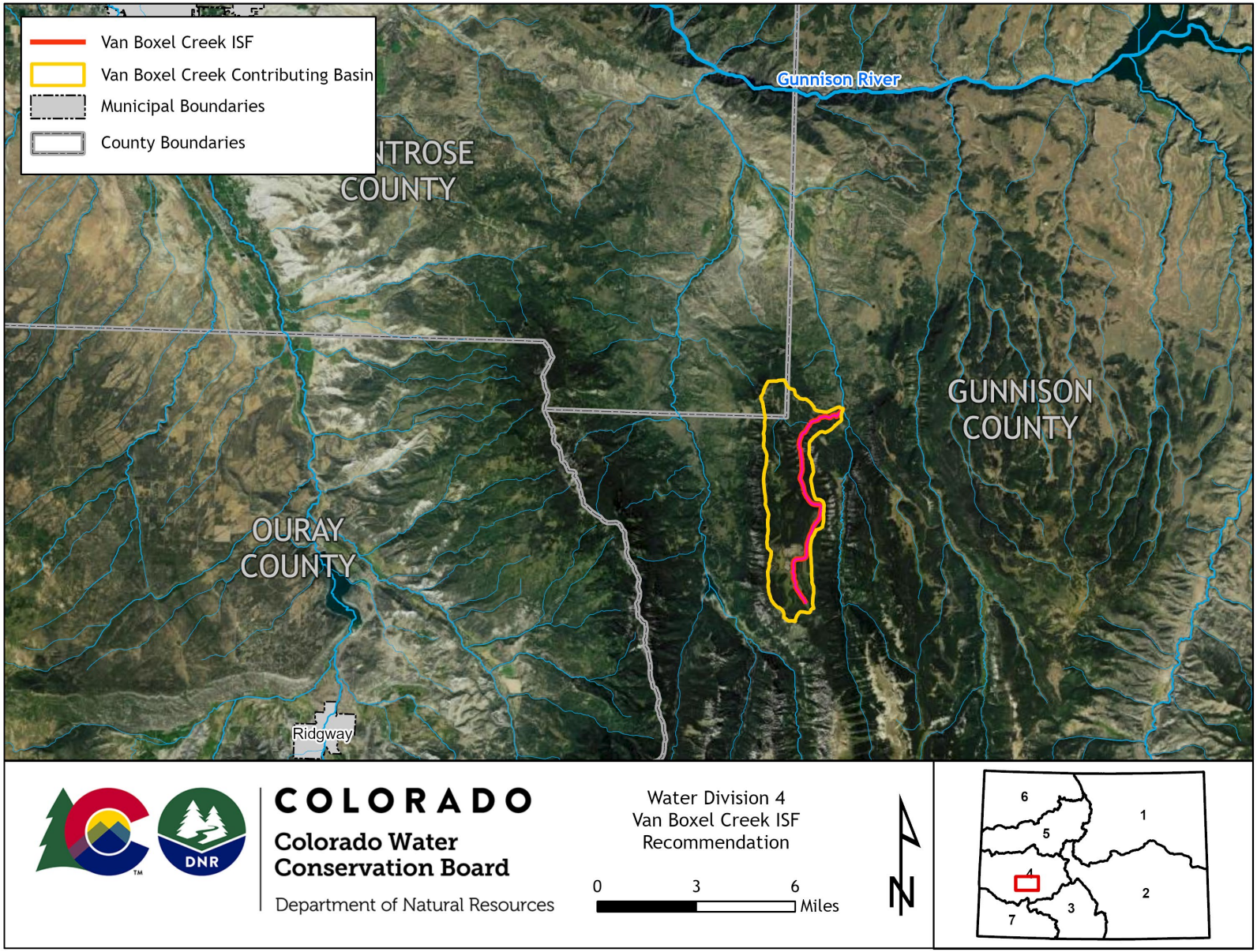
Nehring, B.R., 1979, Evaluation of instream flow methods and determination of water quantity needs for streams in the State of Colorado, Colorado Division of Wildlife.

**Metadata Descriptions**

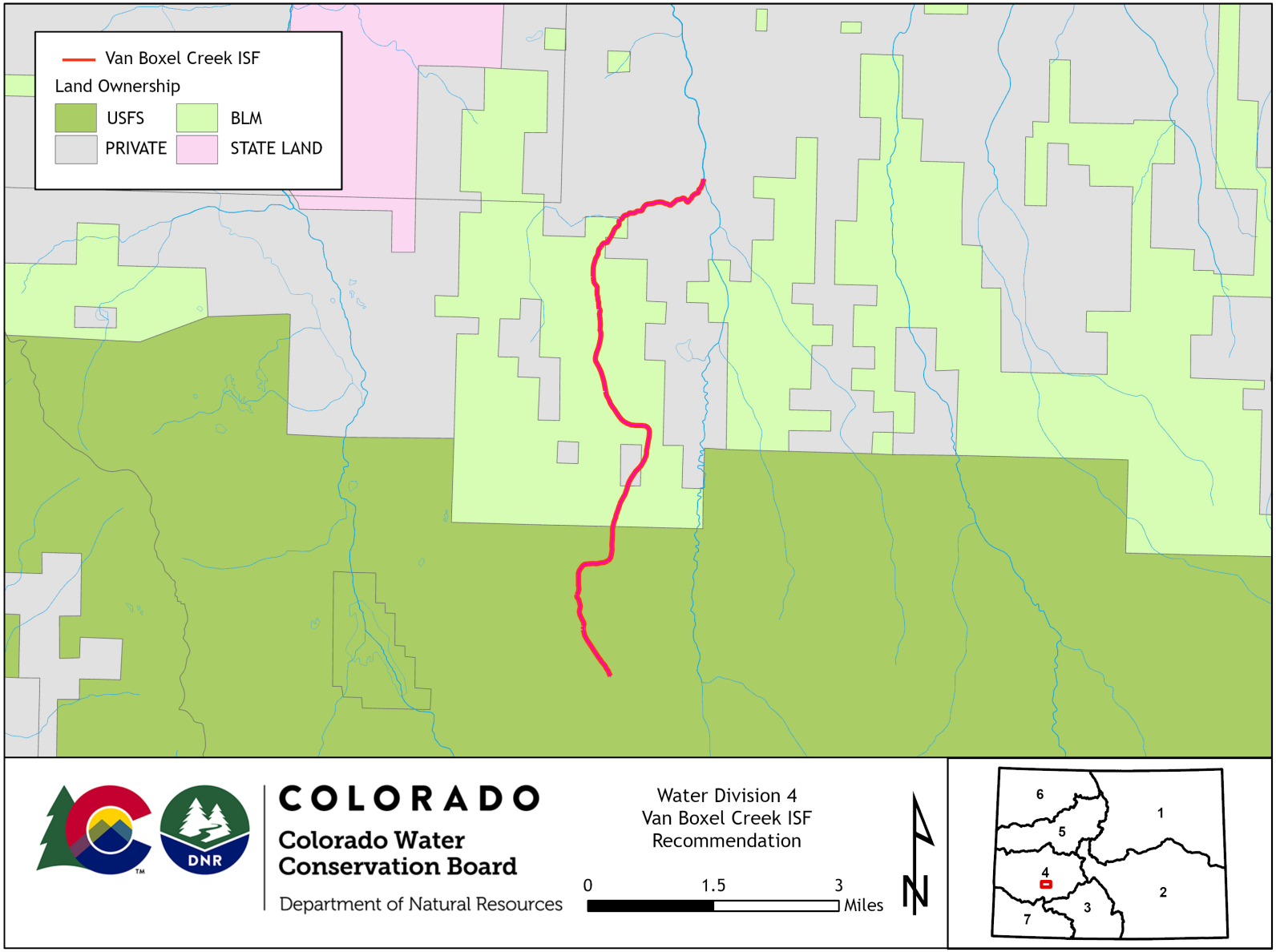
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

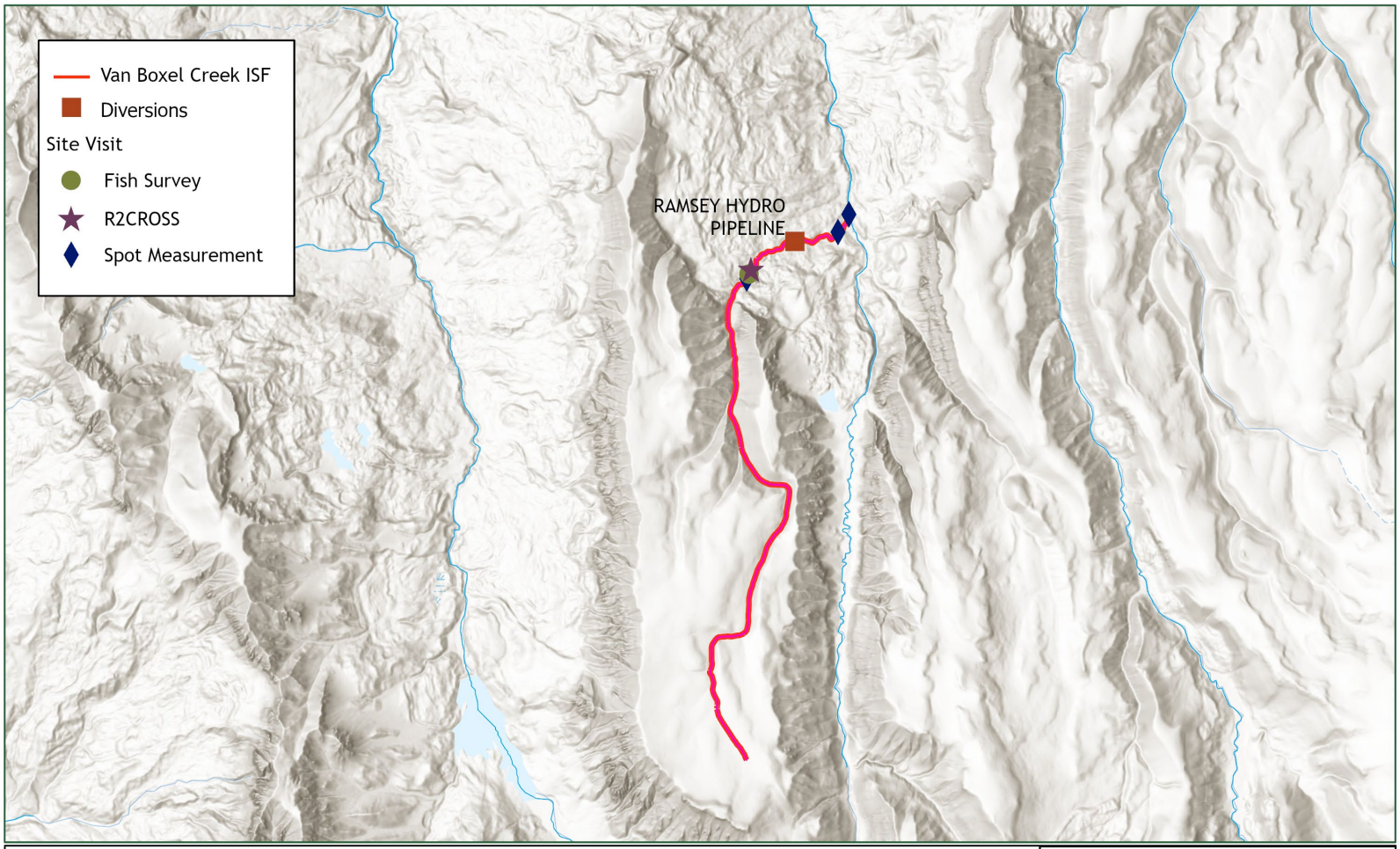
Projected Coordinate System: NAD 1983 UTM Zone 13N.

# VICINITY MAP



# LAND OWNERSHIP MAP






COLORADO

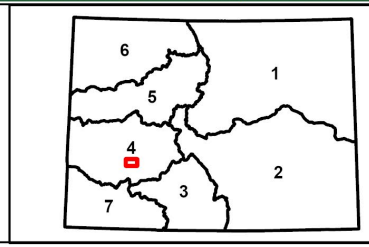
Colorado Water Conservation Board

Department of Natural Resources

Water Division 4
Van Boxel Creek ISF
Recommendation

0 1 2 Miles

N

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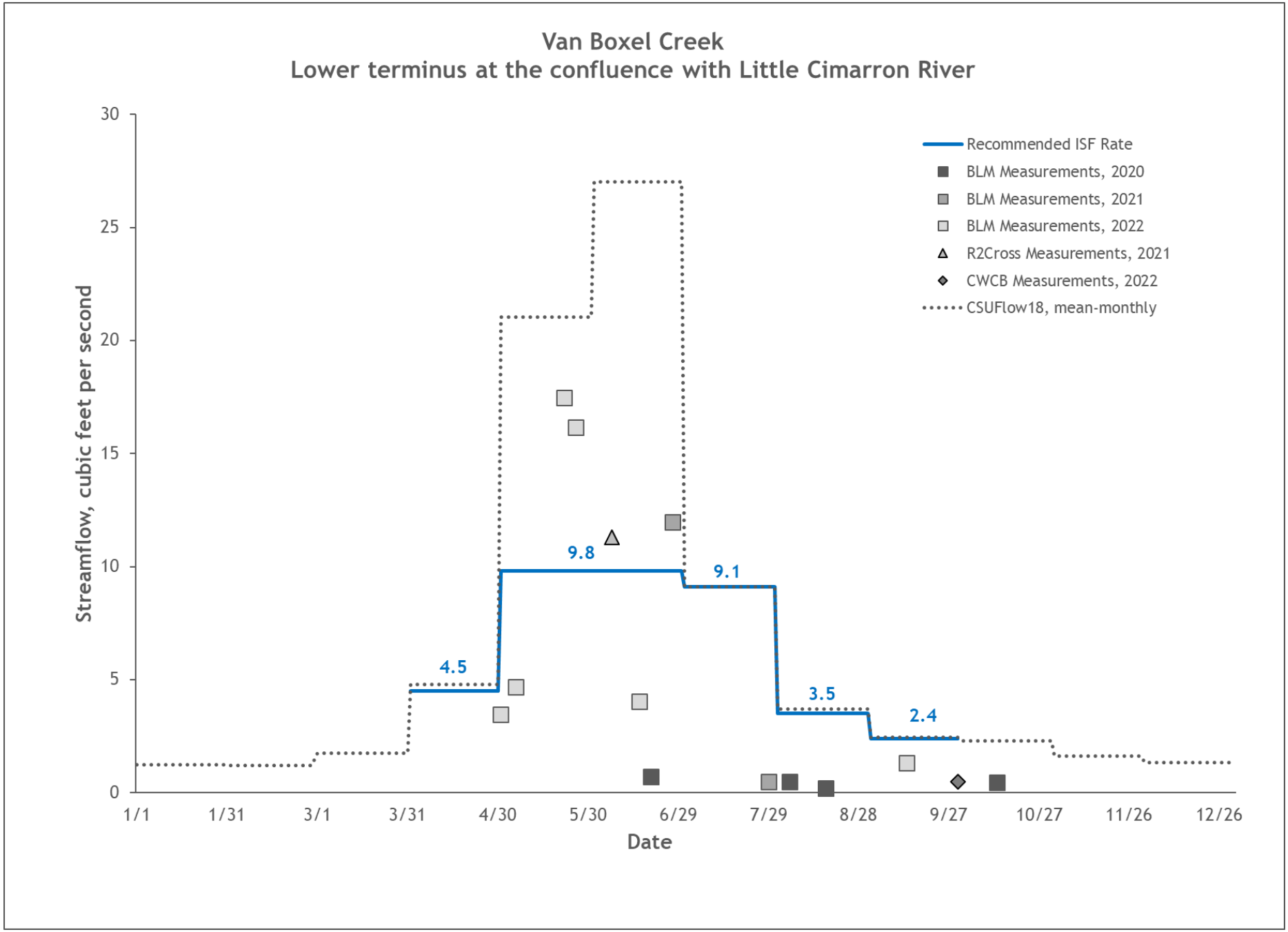

Van Boxel Creek
Lower terminus at the confluence with Little Cimarron River
Streamflow, cubic feet per second
30
25
20
15
10
5
0
1/1
1/31
3/1
3/31
4/30
5/30
6/29
7/29
8/28
9/27
10/27
11/26
12/26
Date
Recommended ISF Rate
BLM Measurements, 2020
BLM Measurements, 2021
BLM Measurements, 2022
R2Cross Measurements, 2021
CWCB Measurements, 2022
CSUFlow18, mean-monthly
4.5
9.8
9.1
3.5
2.4

# West Steuben Creek Executive Summary

**CWCB STAFF INSTREAM FLOW RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | headwaters in the vicinity of<br>UTM North: 4281796.13 UTM East: 310056.82 |
| LOWER TERMINUS: | confluence with Stueben Creek at<br>UTM North: 4275906.50 UTM East: 314936.78 |
| WATER DIVISION: | 4 |
| WATER DISTRICT: | 59 |
| COUNTY: | Gunnison |
| WATERSHED: | Upper Gunnison |
| CWCB ID: | 23/4/A-004 |
| RECOMMENDER: | Colorado Parks and Wildlife (CPW) |
| LENGTH: | 5.39 miles |
| FLOW RECOMMENDATION: | 2.2 cfs (04/01 - 04/30)<br>4.5 cfs (05/01 - 07/31)<br>1.5 cfs (08/01 - 09/30)<br>1.1 cfs (10/01 - 11/30)<br>0.8 cfs (12/01 - 03/31) |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The Information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

CPW recommended that the CWCB appropriate an ISF water right on a reach of West Steuben Creek. West Steuben Creek is located within Gunnison County and is approximately 12 miles northwest of the city of Gunnison (See Vicinity Map). The stream originates at approximately 11,400 feet near South Baldy Mountain and flows southeast until it reaches the confluence with Steuben Creek which is a tributary of the Gunnison River.

The proposed ISF reach extends from the headwaters downstream to the confluence with Stueben Creek for a total of 5.39 miles. The majority, 99.99% of the land on the proposed reach is United States Forest Service (USFS) managed as West Elk Wilderness and the remaining land is under private ownership as an inholding surrounded by Gunnison National Forest and West Elk Wilderness (See Land Ownership Map). CPW is interested in protecting this stream in order to protect the natural environemet.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on West Steuben Creek was sent to the mailing list in March 2022 and November 2022. Staff sent letters to identified landowners adjacent to West Steuben Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Crested Butte News on December 30, 2022.

Staff presented information about the ISF program and this recommendation to the Gunnison County Board of County Commissioners on September 13, 2022. In addition, staff spoke with Bob Hurford, Division Four Engineer on October 11, 2022 regarding water availability on West Steuben Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each

recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

West Steuben's headwaters gather on the northeast slopes of South Bald Mountain in a dense evergreen-forested alpine basin. The forest transitions to aspen interspersed with spruce and fir with several open meadows as the stream winds southward toward Steuben Creek. West Steuben is a first order, snowmelt-driven stream with a mostly steep gradient creating a single-thread confined channel. The section of the creek running though the alpine meadows of Baldy Basin does have a lower gradient and becomes braided in areas.

Throughout the reach, West Steuben has a dense riparian corridor consisting of alder and willow. The streambed substrate includes bedrock outcrops and large boulders with some cobbles and gravels. Bedrock control features and boulders create scour pools. There are also pocket pools, plunge pools, and undercut banks. Woody debris provides complex pool habitat and riparian shade provides fish cover. There is plenty of overwinter and resting zones for fish, including large pools and sizeable glides.

West Steuben Creek contains and self-sustaining population of Colorado Cutthroat Trout (CRCT) of the Gunnison Basin lineage. CRCT are native to the Colorado River and its tributaries and are designated by CPW as a species of special concern and species of greatest conservation need in Colorado. This population is a core conservation population of CRCT, meaning that the population is 99% pure. CPW works to secure and enhance watershed conditions in CRCT conservation populations as part of a multi-state and multi-agency conservation agreement aimed at preventing the listing of these subspecies under the Endangered Species Act.

This CRCT population in West Steuben Creek is isolated by a waterfall which prevents fish passage and hybridization. Below the waterfall barrier, CPW sampling indicates both CRCT and Brook Trout are present. Macroinvertebrate populations have also been observed to be diverse and robust in West Steuben Creek.

**Table 1. List of species identified in West Steuben Creek.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Colorado River Cutthroat Trout | *Oncorhynchus clarkii pleuriticus* | State - Species of Greatest Conservation Need<br>State - Species of Special Concern |
| Brook Trout | *Salvelinus fontinalis* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**

CPW staff used the R2Cross method to develop the ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022). Riffles are the stream habitat type that are most vulnerable to dry if streamflow

ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macroinvertebrates (Nehring, 1979). CPW staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree or withdraws the recommendation.

**Data Collection and Analysis**

CPW collected R2Cross data at four transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 1.09 cfs and a summer flow of 4.46 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for West Steuben Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 08/11/2020, 1 | 12.60 | 0.29 | 0.57 | 6.21 |
| 08/11/2020, 2 | 11.87 | 0.28 | 1.08 | 2.73 |
| 08/04/2021, 3 | 17.29 | 0.47 | 2.08 | 3.23 |
| 08/04/2021, 4 | 17.09 | 0.47 | 0.61 | 5.65 |
| | | | 1.09 | 4.46 |

**ISF Recommendation**

CPW recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

2.2 cfs is recommended from April 1 to April 30 during the late spring rising limb to mimic flow initiation. This flow rate is reduced due to water availability limitations. This early season flow

recommendation will support beneficial spawning conditions for cutthroat trout, a species that spawn in the spring.

4.5 cfs from May 1 to July 31 during the summer season. This rate maintains adequate depth, velocity, and wetted perimeter during the high flow period when fish are active and moving throughout the creek. This flow rate will support ideal spawning conditions for cutthroat trout during runoff and the receding limb of the hydrograph.

1.5 cfs is recommended from August 1 to September 30 as a transitional flow. This flow rate is reduced due to water availability limitations. This rate maintains available habitat, depth, and wetted perimeter and allows fish to move as flows recede during the late-summer.

1.1 cfs is recommended from October 1 to November 30 as a transitional flow to baseflow conditions. This flow rate is reduced due to water availability limitations in October. This rate maintains adequate wetted perimeter and depth to support habitat availability during baseflow conditions.

0.8 cfs is recommended from December 1 to March 31; this flow rate is reduced due to water availability limitations. This rate will provide sufficient overwintering habitat, specifically in pools and deep glides.

**WATER AVAILABILITY**
CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**
Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**

The drainage basin of the proposed ISF on West Steuben Creek is 5.0 square miles, with an average elevation of 10,854 feet and average annual precipitation of 30.65 inches (See the Hydrologic Features Map). West Steuben Creek is a snowmelt driven hydrologic system, with variable timing and magnitude in snowmelt runoff.

*Water Rights Assessment*

There are two decreed diversions within the West Steuben Creek contributing basin, Elk Home Number 1 Ditch (WDID 5900886, appropriated 1897) and Elk Home Number 2 Ditch (WDID 5900887, appropriated 1902). In 2018 use of the Elk Home No. 2 Ditch ceased for irrigation purposes. Elk Home Ditch No. 2 commanded the entire streamflow of a tributary to West Steuben Creek. The ditch terminated at an unnamed tributary channel directly upstream from the headgate for Elk Home Ditch No. 1. Elk Home Ditch No. 1 also commands the entire streamflow of a West Steuben tributary creek and carries it to Rainbow Lake on Willow Creek. The decreed Elk Home No. 1 Ditch flow rate of 7.25 cfs for irrigation use has historically been aggregated with Elk Home Ditch No. 2 diversions. Diversion records, available in Hydrobase, show ditch use from May through October with average total seasonal recorded diversions of 358 acre-feet. However, because of the aggregation of flow from two different contributing basins, it is unclear how much water is exported from West Steuben Creek from the remaining Elk Home Ditch No. 1.

**Data Collection and Analysis**

*Representative Gage Analysis*

There are no current or historic gages on West Steuben or Steuben Creek. Staff investigated nearby gages for similarities in basin characteristics and hydrology and for data collection histories. No gages were sufficiently similar to be used to estimate streamflow on West Steuben Creek.

*Multiple Regression Model*

The CSUFlow18 regression model predicts mean-monthly flow in West Steuben Creek and provides best estimate for year-round streamflow conditions.

CWCB staff visited the site on October 9, 2020, but no streamflow measurements were made.

**Water Availability Summary**

The hydrograph shows CSUFlow18 results for mean-monthly streamflow and the proposed ISF rate (See Complete Hydrograph). Presented modeled streamflow has been reduced by average recorded monthly diversions from the Elk Home Ditch No 1 during May through October. Because this reduction represents recorded diversions of the aggregated ditches, it is likely an

overprediction of exported water from West Steuben Creek. Staff has concluded that water is available for appropriation.

**MATERIAL INJURY**

As a new junior water right, the proposed ISF on West Steuben Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**

**Citations**

Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

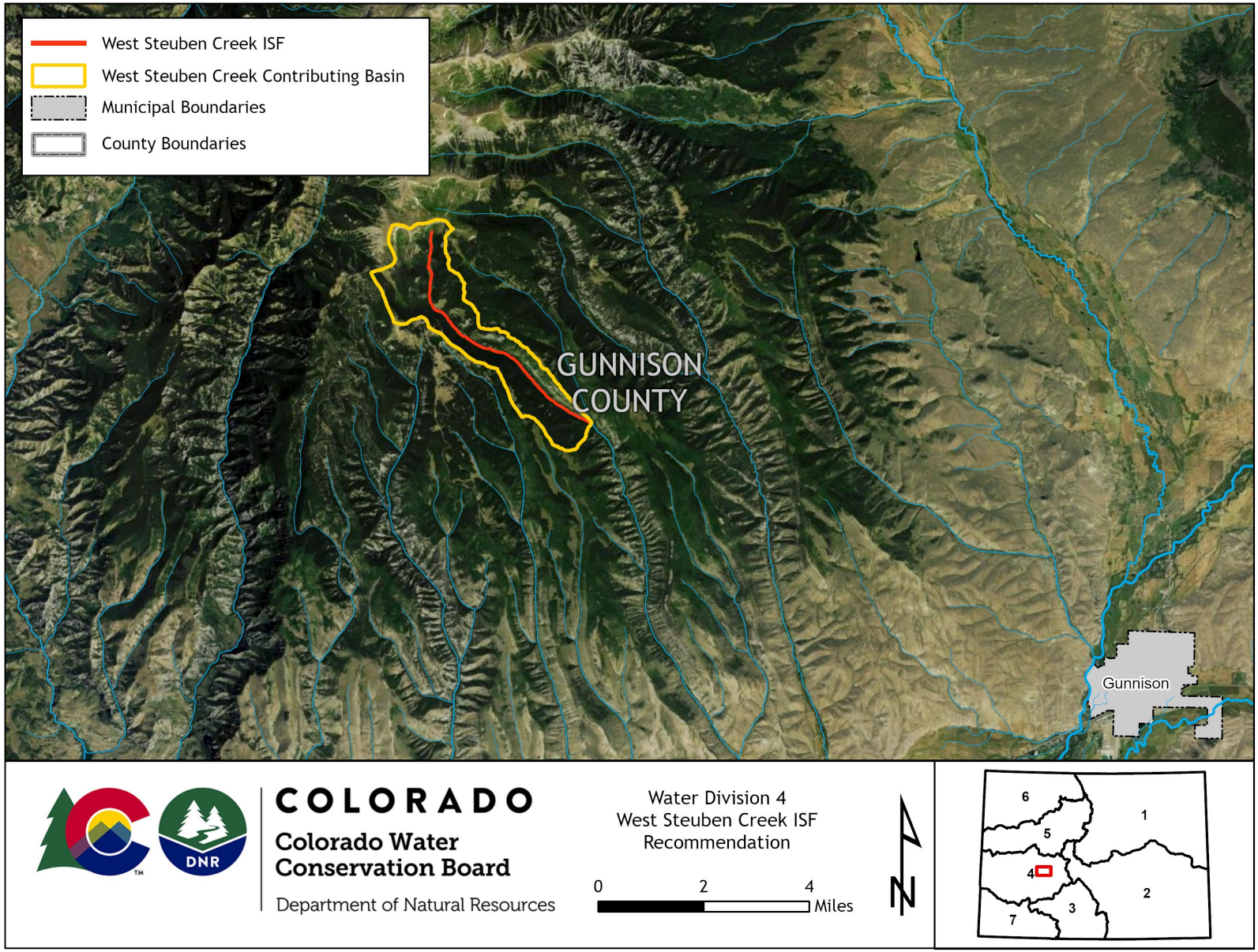
Nehring, B.R., 1979, Evaluation of instream flow methods and determination of water quantity needs for streams in the State of Colorado, Colorado Division of Wildlife.

**Metadata Descriptions**

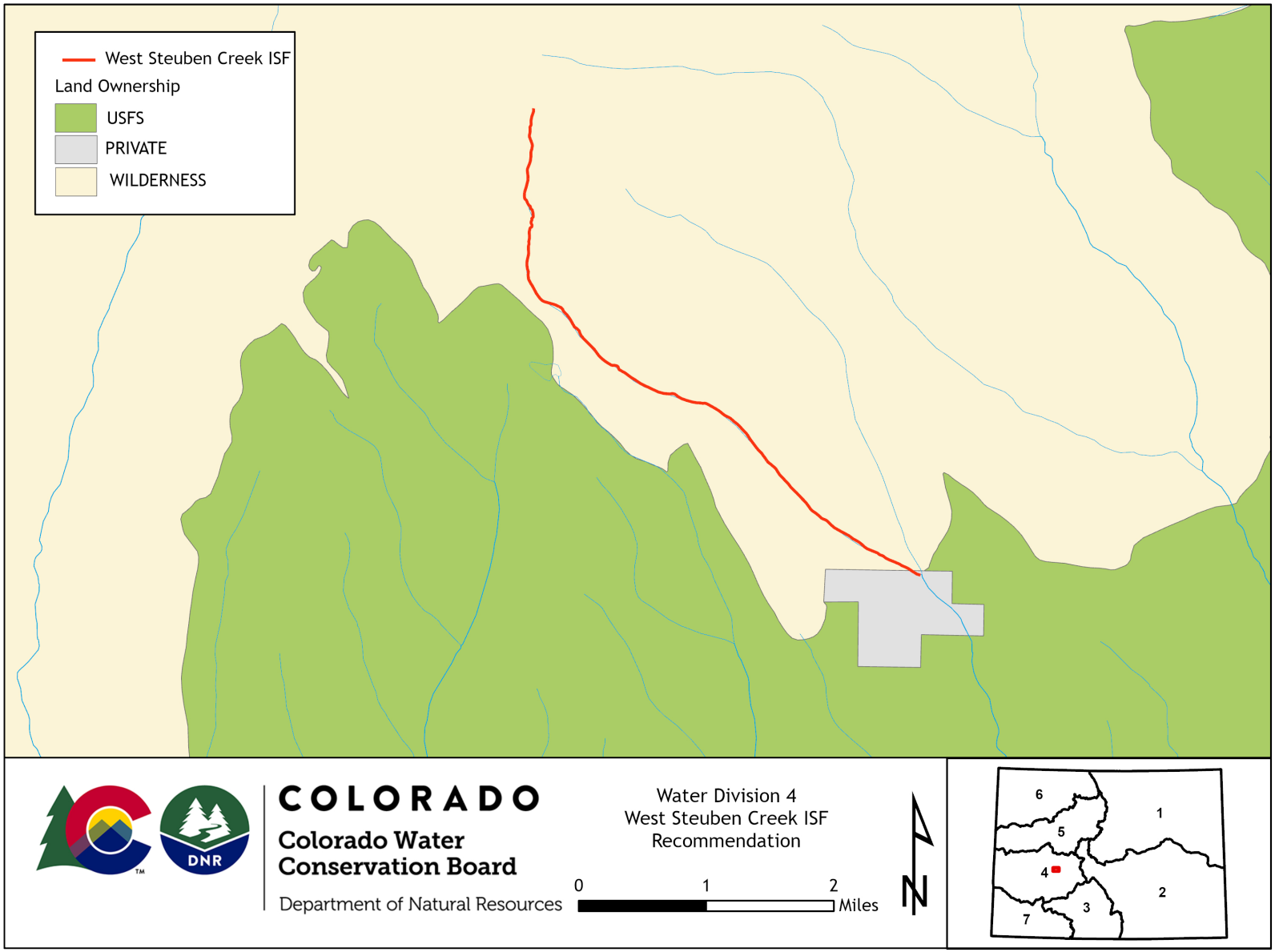
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System:  NAD 1983 UTM Zone 13N.

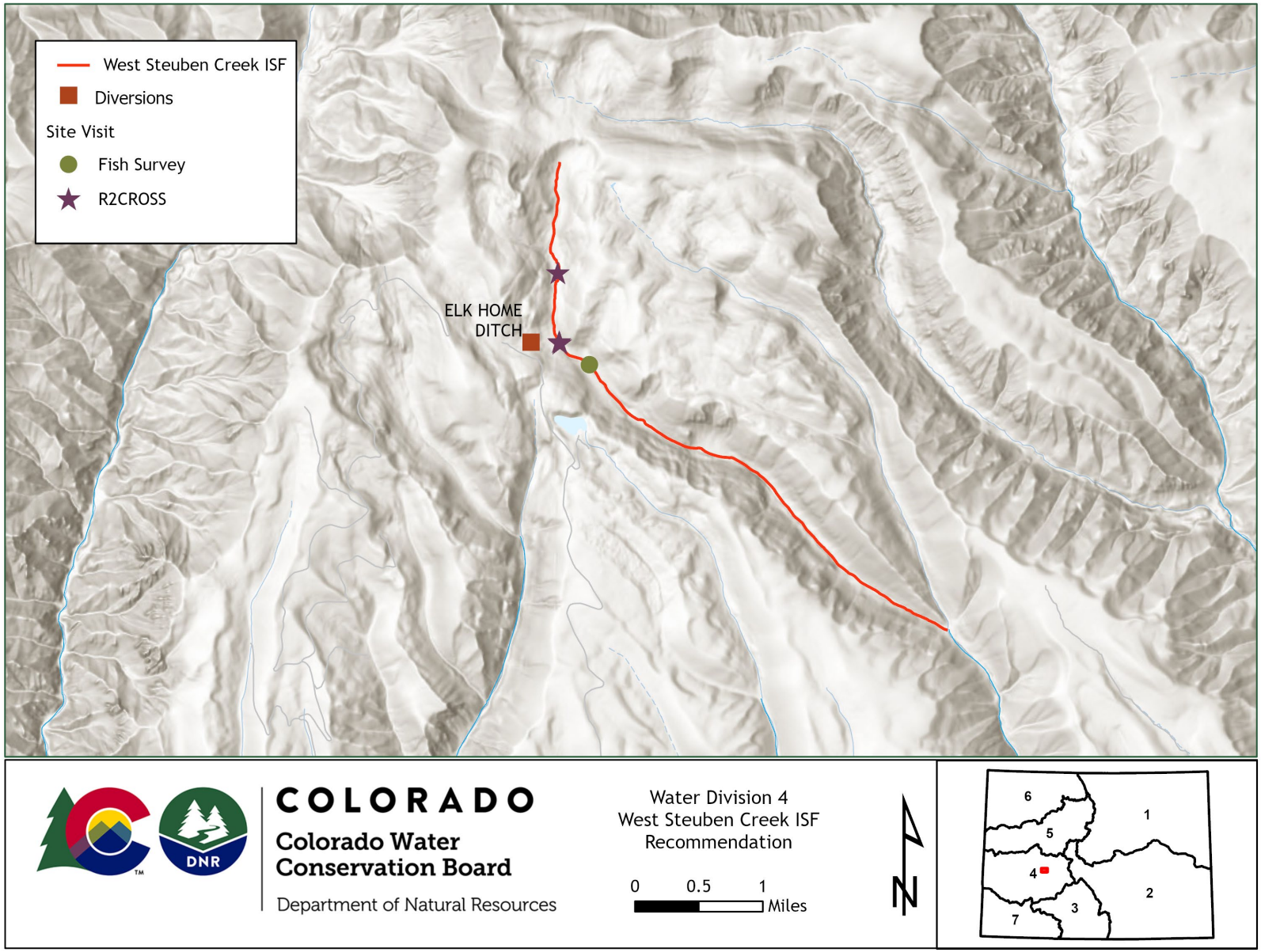
# VICINITY MAP



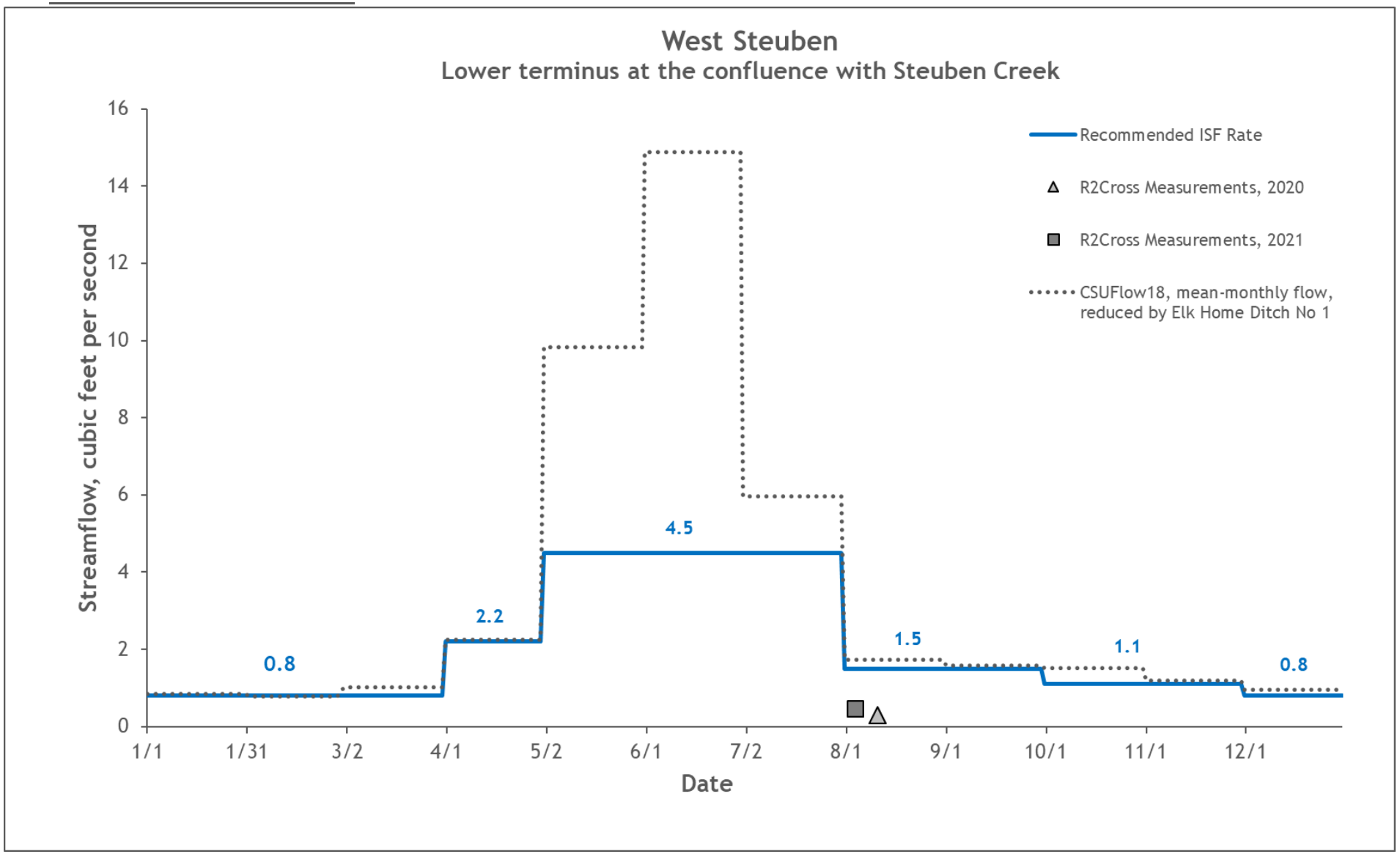
# LAND OWNERSHIP MAP



# HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



# Hack Lake Executive Summary

**CWCB STAFF NATURAL LAKE LEVEL RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| CENTER POINT: | UTM North: 4409994.98 UTM East: 316816.32 |
| WATER DIVISION: | 5 |
| WATER DISTRICT: | 53 |
| COUNTY: | Garfield |
| WATERSHED: | Colorado Headwaters |
| CWCB ID: | 23/5/A-004 |
| RECOMMENDER: | Bureau of Land Management (BLM) |
| RECOMMENDED SURFACE ELEVATION: | 9,875.0 feet |
| RECOMMENDED VOLUME: | 8.92 acre feet |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

BLM recommended that the CWCB appropriate a Natural Lake Level (NLL) water right on Hack Lake. Hack Lake is located within Garfield County and is approximately 12 miles northeast from Dotsero at 9,875 feet in elevation (See Vicinity Map). The lake is in the headwaters of Hack Creek within the Hack Lake Wilderness Study Area, adjacent to the Flat Tops Wilderness Area.

The lake is spring fed and has no above ground outlet. The entire proposed lake is located on public lands managed by BLM (See Land Ownership Map). Hack Lake is located along the Johnny Meyer trail which is a popular recreational route to the Flattops Wilderness. BLM maintains a trailhead and camping area that supports use of Hack Lake for camping, fishing, and wildlife viewing. The NLL will assist in maintaining the habitat and fish species for recreational fishing as well as meeting BLM's wildlife habitat management objectives by providing a perennial source of water.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Hack Lake was sent to the mailing list in November 2022 and March 2022. A public notice about this recommendation was also published in the Glenwood Springs Post Independent on December 21, 2022.

Staff presented information about the ISF program and this recommendation to the Garfield County Board of County Commissioners on November 14, 2022. In addition, staff contacted Deputy Water Comissioner Timothy Ritchard and the Water Commissioner Rick Bumgardner on December 13, 2022 and on January 4, 2023 regarding water availability on Hack Lake.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

Hack Lake is located in a relatively flat region between mountain ridges and steep cliffs north of Sweetwater Lake. Hack Lake is a high elevation, cold-water lake fed by three visible, perennial springs on the north shore. The lake bottom is made up of porous volcanic rock the size of small boulders. Small sections of shallow areas along the north shore have silty substrate. Outflow from the lake is subterranean.

Colorado Parks and Wildlife (CPW) collaborates with BLM in stocking Hack Lake with Colorado River Cutthroat Trout, a Colorado species of greatest conservation need and species of special concern. The water quality is suitable for sustaining long-term populations of salmonids such as trout. Mayfly and caddisfly are the primary trout food source. These species were observed by CWCB staff. Surveying conducted by CPW indicates that natural reproduction of trout is not occurring in Hack Lake, which is likely due to the lack of suitable spawning areas. CPW & BLM are considering minor modifications to the lakebed to create adequate spawning areas. An NLL water right will assist in protecting this resource and support further investments in this effort.

The riparian community near the lake includes willow, red osier dogwood, aspen, twinberry, and sedges. The south and east shores are lined with dense alpine forest, and woody debris is visible along these shores. The water supply and plant communities at the lake support area wildlife such as mountain lions, Rocky Mountain elk, Rocky Mountain bighorn sheep, black bear and mule deer. CWCB Staff also observed grouse and marmots. Table 1 includes a list of species identified in Hack Lake.

**Table 1. List of species identified in Hack Lake.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Colorado River Cutthroat Trout | *Oncorhynchus clarkii pleuriticus* | State - Species of Greatest Conservation Need<br>State - Species of Special Concern |
| caddisfly | *Tricoptera* | None |
| dragonfly | *Odonata* | None |
| mayfly | *Ephemeroptera* | None |
| water strider | *Gerridae* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**
CWCB staff relies upon the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. In NLL appropriations, BLM recommends that the entire volume of water in a natural lake be appropriated to preserve the natural environment to a reasonable degree. BLM has determined that appropriating a lesser volume would likely result in diminution of habitat to which species have become accustomed.

**Data Collection and Analysis**
BLM and CPW staff conducted a survey of Hack Lake on September 22, 2021. This included a bathymetric survey of the lake, the perimeter of the lake at the time of the survey, and the perimeter of the lake at full pool. This survey data and lidar data were used to determine the surface water elevation, surface area, and volume when Hack Lake is full (See Table 2). The appendices include a report produced by CPW that provides additional detail about survey methods and data processing.

**Table 2. Hack Lake measurements.**

| Volume (acre-feet) | Elevation (feet) | Average Depth (feet) | Surface Area (acres) |
|---|---|---|---|
| 8.92 | 9,875 | 6.4 | 1.29 |

**NLL Recommendation**
The BLM recommends that Hack Lake be protected at an elevation of 9,875.0 feet and a volume of 8.92 acre-feet based on survey results and biological expertise.

**WATER AVAILABILITY**
CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Basin Characteristics**
The drainage basin of the proposed NLL on Hack Lake is 0.91 square miles, with an average elevation of 10,399 feet and average annual precipitation of 37.02 inches (See the Hydrologic Features Map). Inflows to the lake include perennial springs identified by BLM as well as groundwater and any other flow from the contributing basic area. During typical conditions, there is not an outlet to the lake. According to BLM, the water-surface elevation of the Lake varies seasonally due to changing flow rates and changing evapotranspiration rates. The lake is typically full during the snowmelt runoff season and then gradually recedes during the summer and fall. There are no water diversions in the basin tributary to Hack Lake, therefore the hydrology reflects natural conditions.

**Data Collection**
BLM collected discharge measurements on the largest springs on September 21, 2021. The total discharge from all three measured springs was 140.22 gallons per minute. This measurement and the bathymetric survey were both completed during drought conditions and the spring discharge was the lowest ever observed by BLM staff. CWCB visited the site on 8/20/2022 and estimated that the total spring flow was approximately 1 cfs.

**Water Availability Summary**
Hack Lake is clearly identified on USGS 1:24000 scale maps and in the Geographic Names Information System (GNIS), a database of federally recognized feature names. Based on the persistence of the lake through time, staff concludes that water is available for appropriation.

**MATERIAL INJURY**
As a new junior water right, the proposed NLL on Hack Lake can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this NLL water right is appropriated.

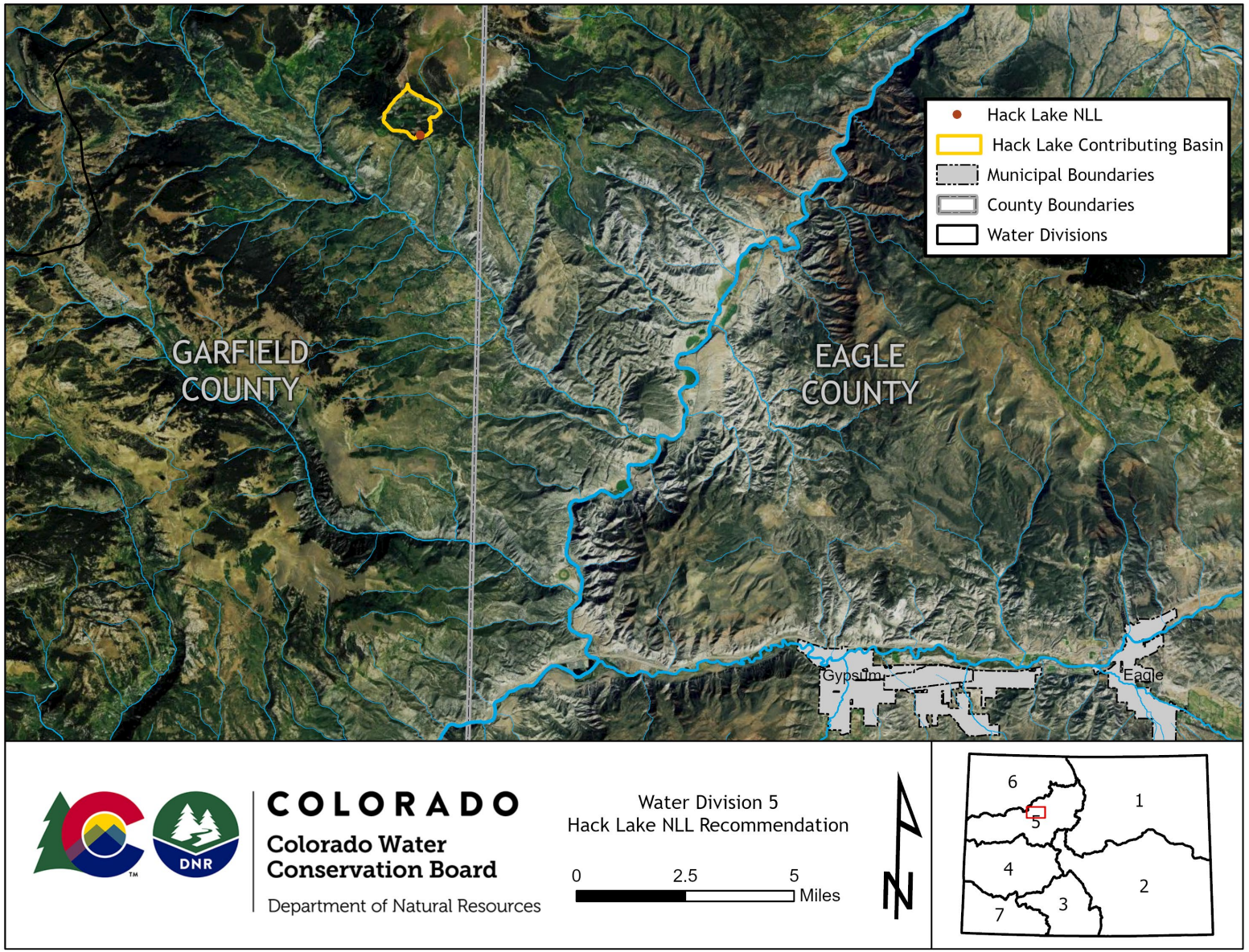
**ADDITIONAL INFORMATION**

**Citations**
United States of America Board on Geographic Names, 2022, The geographic names information system (GNIS): the federal and national standard for geographic nomenclature. Retrieve from URL: https://www.usgs.gov/tools/geographic-names-information-system-gnis

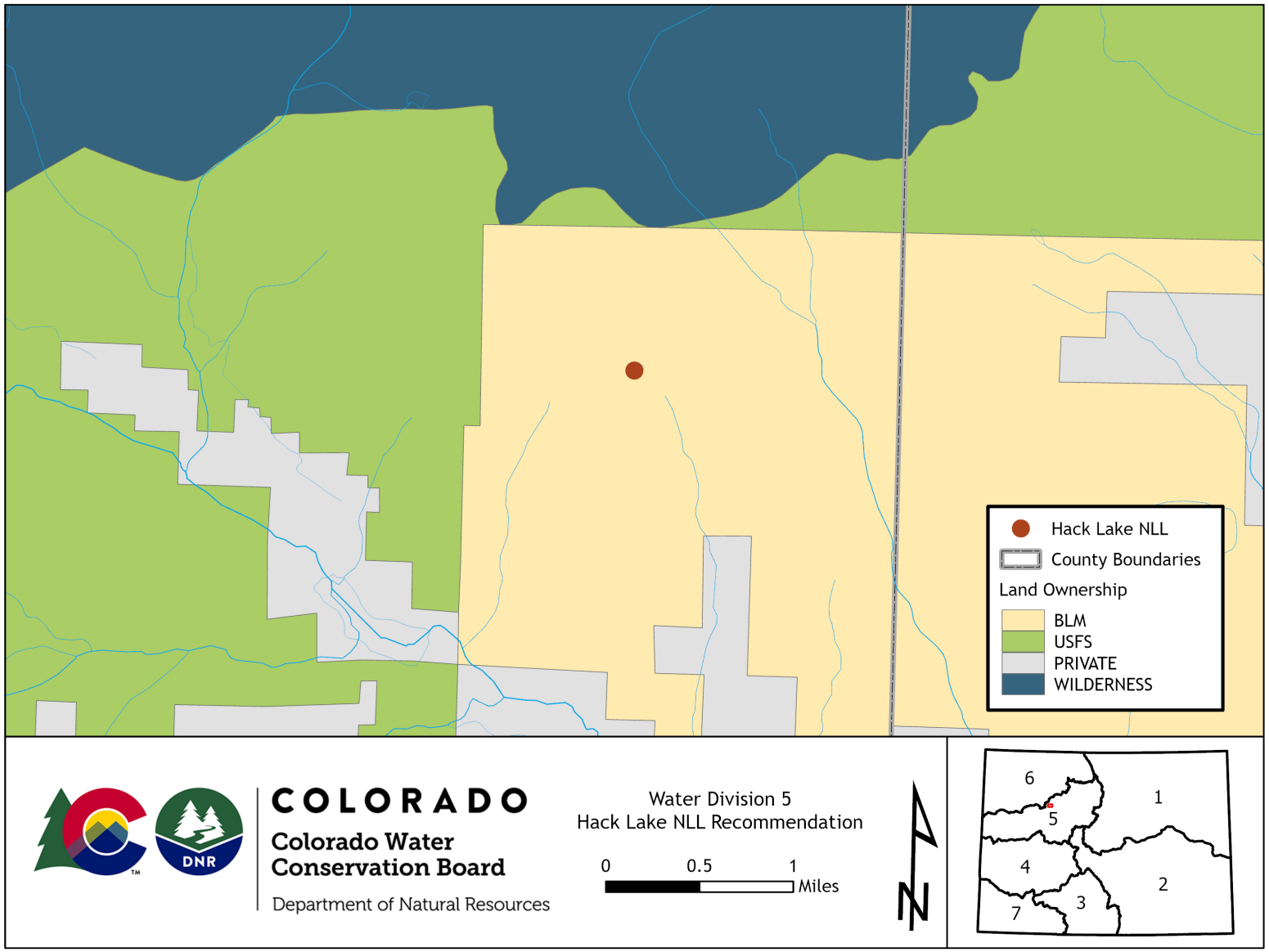
**Metadata Descriptions**
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

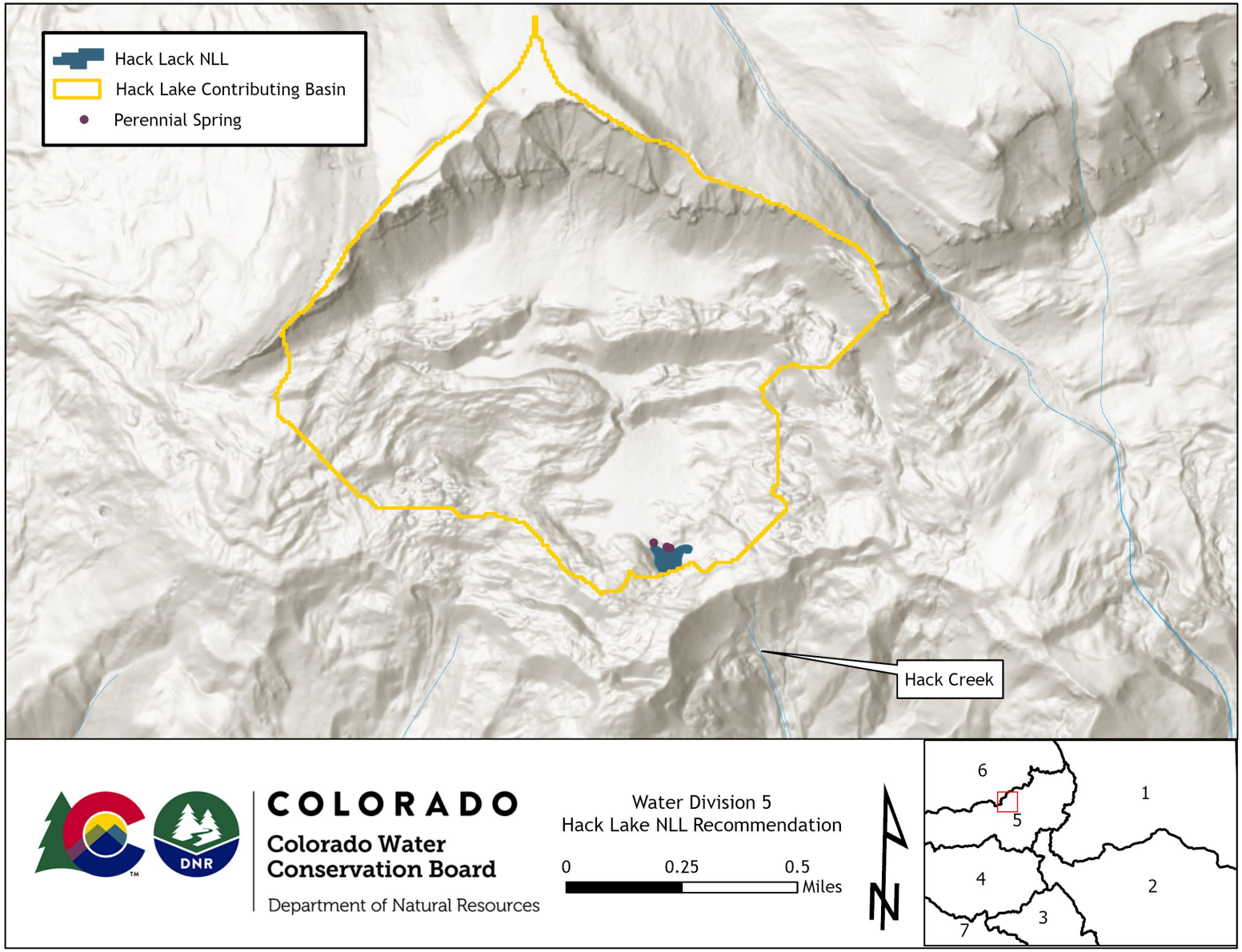
# VICINITY MAP



# LAND OWNERSHIP MAP



# HYDROLOGIC FEATURES MAP



# Piceance Creek (Upper) Executive Summary

**CWCB STAFF INSTREAM FLOW RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | headwaters in the vicinity of<br>UTM North: 4408182.72 UTM East: 253674.05 |
| LOWER TERMINUS: | confluence with unnamed tributary at<br>UTM North: 4402272.35 UTM East: 247589.12 |
| WATER DIVISION: | 6 |
| WATER DISTRICT: | 43 |
| COUNTY: | Garfield, Rio Blanco |
| WATERSHED: | Piceance-Yellow |
| CWCB ID: | 17/6/A-001 |
| RECOMMENDER: | Bureau of Land Management (BLM) |
| LENGTH: | 6.93 miles |
| FLOW RECOMMENDATION: | 0.2 cfs (07/01 - 02/29)<br>0.8 cfs (03/01 - 03/31)<br>1.5 cfs (04/01 - 04/30)<br>1.4 cfs (05/01 - 05/31)<br>0.8 cfs (06/01 - 06/31) |

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

The BLM recommended that the CWCB appropriate an ISF water right on a reach of Piceance Creek. The proposed reach on Piceance Creek is located within Garfield and Rio Blanco County and is approximately 16 miles northwest from the town of Riffle (See Vicinity Map). The stream originates on the western edge of Big Mountain at approximately 9,000 feet in elevation and flows west and north until it reaches the confluence with the White River.

The proposed ISF reach extends from the headwaters downstream to the confluence with an unnamed tributary for a total of 6.93 miles. The land on the proposed reach is 16% BLM, 11% United States Forest Service (USFS), and 73% private (See Land Ownership Map). BLM is interested in protecting this stream to meet management goals aimed at maintaining and enhancing habitat that supports fish species, maintaining and improving the function of riparian areas, and protecting riparian and wetland systems.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Piceance Creek was sent to the mailing list in March 2022, November 2021, November 2021, October 2021, March 2021, March 2020, November 2019, March 2019, March 2018, March 2017, and November 2016. Staff sent letters to identified landowners adjacent to Piceance Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Rio Blanco Herald Times on December 22, 2022.

Staff presented information about the ISF program and this recommendation to the Garfield County Board of County Commissioners on August 15, 2017, December 17, 2018, and November 14, 2022. Staff also presented information about the ISF program and this recommendation to the Rio Blanco Board of County Commissioners on August 14, 2017, October 8, 2018, and October 8, 2019 and to the White River Integrated Water Initiative Planning Advisory Committee on November 9, 2021. In addition, staff spoke with Brett Waston, Water Commisioner on April

8, 2016 and Shanna Lewis, Water Commissioner on November 19, 2021, reguarding water availability on Piceance Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

This portion of Piceance Creek is a cold-water, high gradient stream. This reach flows through a broad canyon with a valley floor approximately 1,000 to 3,000 feet in width. The stream cuts through alluvial deposits in the valley and is confined by bedrock in some locations. The stream generally has small-sized substrate, consisting of gravels, small cobbles, and small boulders.

The riparian community is generally comprised of coyote willow, Geyer's willow, sedges and rushes. The riparian community is in good condition and provides shading and cover for fish habitat. The stream has a good mix of pools, small riffles, and runs. While deep pool habitat is absent, the existing pools are sufficient for overwintering fish. CWCB Staff also observed beaver complexes.

Fisheries surveys have revealed a self-sustaining native fish population comprised of speckled dace and mountain suckers. Intensive macroinvertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly. Staff have identified mayfly, stonefly, and caddisfly in the field, which are all taxa know to be sensitive to water quality. Their presence indicates good water quality (Hilsenhoff, 1987).

**Table 1. List of species identified in Piceance Creek.**

| Species Name | Scientific Name | Status |
|---|---|---|
| Mountain sucker | *Catostomus platyrhynchus* | State - Species of Greatest Conservation Need<br>State - Species of Special Concern |
| Speckled Dace | *Rhinichthys osculus* | None |
| caddisfly | *Trichoptera* | None |
| mayfly | *Ephemeroptera* | None |
| stonefly | *Plecoptera* | None |

**ISF QUANTIFICATION**

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

**Quantification Methodology**

BLM staff used the R2Cross method to develop the ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022). Riffles are the stream habitat type that are most vulnerable to dry if streamflow

ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macro-invertebrates (Nehring, 1979). BLM staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree or withdraws the recommendation.

**Data Collection and Analysis**

BLM collected R2Cross data at five transects for this proposed ISF reach (Table 2). Results obtained at more than one transects are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 0.52 cfs and a summer flow of 1.46 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Piceance Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 06/15/2015, 2 | 6.70 | 3.91 | 0.52 | 1.78 |
| 06/15/2015, 3 | 6.96 | 3.73 | 0.47 | 2.22 |
| 07/07/2015, 2 | 7.36 | 1.98 | 0.84 | 1.35 |
| 07/20/2022, 2 | 3.96 | 0.11 | 0.31 | 1.03 |
| 07/20/2022, 1 | 4.05 | 0.07 | 0.47 | 0.90 |
| | | | 0.52 | 1.46 |

**ISF Recommendation**

BLM recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

1.5 cubic feet per second is recommended period from April 1 through April 30 during the beginning of the snowmelt runoff period. This recommendation is variously driven by the mean depth criteria, mean velocity criteria, or wetted perimeter criteria, depending on the cross section surveyed. This portion of the creek is small and habitat availability is very susceptible to even small changes in flow from diversions. It is important to protect a flow rate that makes most of this habitat available to the fish population while they are completing critical life history functions during the warm weather months.

1.4 cubic feet per second is recommended from May 1 to May 31. The rationale for this flow rate is the same as the rationale for the April 1 to April 30 recommendation, except that the flow rate has been slightly reduced because of more limited water availability.

0.8 cubic feet per second is recommended from June 1 through June 30 during the conclusion of the snowmelt runoff period. This flow rate does not meet all three instream flow criteria, but it exceeds two of three instream flow criteria and provides a transitional flow rate between maximum habitat availability during snowmelt runoff and limited habitat availability during the base flow period.

0.2 cubic feet per second is recommended from July 1 through February 29 during the base flow period. This recommendation is driven by very limited water availability. This flow rate should maintain pool habitat during the late summer and fall and prevent pools from freezing during the extended cold weather period, allowing the fish population to successfully overwinter. Even though the base flow in this creek is small, it can persist during drought conditions, allowing the fishery to continue.

0.8 cubic feet per second is recommended from March 1 through March 31 during the low elevation snowmelt period. This flow rate does not meet all three instream flow criteria, but it exceeds two of three instream flow criteria and provides a transitional flow rate between limited habitat availability during the winter and maximum habitat availability during peak snowmelt runoff.

**WATER AVAILABILITY**

CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**

Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by

Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**

The drainage basin of this proposed ISF on Piceance Creek is 9.4 square miles, with an average elevation of 8,200 feet and average annual precipitation of 23.0 inches (See the Hydrologic Features Map). Streamflow in the Piceance basin can be highly variable in terms of both the magnitude and timing of runoff. Piceance Creek is primarily a snowmelt runoff system, but runoff may start early compared to other locations in the state.

*Water Right Assessment*

There are a number of water rights and water practices in the basin tributary to the proposed reach that alter hydrology. Four water rights appear to divert directly from the Piceance Creek (Table 3). There is a total of 4.72 cfs in absolute and active surface water diversions and 5.5 acre feet in absolute storage based on HydroBase. There are also a number of absolute small springs and wells that total less than 0.25 cfs. Staff also identified conditional water rights that appear to be in use. This includes at least 5.2 cfs in conditional surface water rights (ditches and springs) that have diversion records and multiple storage rights that appear to exist based on the location of ponds in aerial images. These conditional water rights are generally located higher in the basin and are junior to water rights near the proposed lower terminus.

**Table 3. Absolute diversion located within the proposed ISF reach on Piceance Creek.**

| WDID | Structure Name | Decreed Flow rate, cfs | Appropriation Date |
|---|---|---|---|
| 4302563 | Ryan's Pond Feeder Ditch* | 1 | 2001 |
| 4300754 | Larson Ditch** | 2.5 | 1886 |
| 4300831 | Morgan Ditch 2 | 0.4 | 1886 |
| 4300832 | Morgan Ditch 1 | 1, 0.4 | 1883,1886 |
| | **Total** | **5.3** | |

** Listed as conditional but included because of the existence of diversion records*

***Larson Ditch is listed as a structure that can be used to fill the Larson Reservoir Enlargement, at a flow rate of 10 cfs in 88CW240, this right is currently conditional.*

The administrative call record was reviewed for Piceance Creek to better understand current administration. According to the previous water commissioner, (Shanna Lewis, personal communication 11/19/2021) Piceance Creek can have a dry reach below both of the proposed ISFs reaches but above the confluence with the White River. This creates a situation where downstream calls may be futile. Because of this, the basin can have two different calls that cover lower and upper portions of the basin. The upper basin calls extend to the headwaters and go through both proposed ISF reaches. Calls related to the upper basin occurred in 2022, 2021, 2020, 2018, 2012, 2007, 2004, and 2003. These calls are often senior to all water rights in Table 3 with the exception of the 1883 Morgan Ditch #1 right. In short, when the basin is under administration by downstream senior water rights, most available water will remain in the proposed ISF reach.

**Data Collection and Analysis**

*Historic Gage Data*

There was a historic streamflow gage on Piceance Creek near the proposed lower terminus, Piceance Creek at Rio Blanco, CO (USGS 09305500). This gage was located upstream from the lower terminus between the Larson and the Morgan 1 and 2 Ditches. It operated during the water year from 1952 through 1957, for a total of five years of record. This gage record does not reflect a number of more recent water rights and changes to water rights that have occurred in the basin since the 1950s. Many more recent water rights are located higher in the basin and are primarily for household use and ponds. In addition, a number of water rights were changed in the 1980s to allow additional uses including commercial, industrial, and augmentation. Because this gage record does not adequately reflect current water use practices, this data was not used as the primary basis for determining water availably. This gage data does indicate that historically April and May had the highest mean-monthly streamflow at rates, which were typically in excess of 1.5 cfs.

*BLM Temporary Gage*

Given the lack of recent streamflow data, the BLM installed and operated a temporary gage on Piceance Creek approximately 2.6 miles downstream from the lower terminus of this proposed reach. The gage was installed on 6/16/2016 and records include information through 7/27/2020. The drainage basin of the BLM gage was 21.6 square miles, with an average elevation of 7,920 feet and average annual precipitation of 21.71 inches. There are no active intervening water rights between the lower terminus of the proposed reach and the downstream BLM gage location. CWCB staff assisted in making measurements at the BLM gage and developed all rating curves and final flow data used in this analysis. BLM and CWCB staff made additional measurements near the lower terminus of the proposed reach as shown in Table 3.

**Table 3. Summary of streamflow measurements for Piceance Creek (Upper).**

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 08/09/2016 | 0.06 | CWCB |
| 07/07/2015 | 1.97 | CWCB |
| 11/02/2022 | 0.45 | CWCB |
| 12/04/2019 | 1.37 | CWCB |
| 12/04/2019 | 7.48 | CWCB |
| 12/04/2019 | 0.34 | CWCB |
| 11/03/2022 | 0.55 | BLM |
| 11/16/2022 | 0.26 | BLM |
| 11/28/2022 | 0.36 | BLM |

The BLM gage record was compared to a nearby gage to evaluate how the temporary gage time period compares to a longer record. The Piceance Creek below Ryan Gulch, near Rio Blanco gage (USGS09306200) is the closest gage with a long-term record (1964-2020). This gage is located roughly 24 miles downstream and is affected by substantial water right uses. This assessment looked at the total flow volume at the gage for a calendar year based on the most recent contemporary 30 years (1991 to 2020, omitting 1998 and 1999 which did not have complete records). This showed that 2016 was the only year that the BLM gage operated during nearly average annual streamflow. Streamflow in 2019 was slightly above the 25$^{th}$ percentile. Streamflow in 2017 was less than the 25$^{th}$ percentile. Streamflow in 2018 and 2020 were less than the 10$^{th}$ percentile. In general, the data recorded by the BLM gage includes multiple years that were exceptionally dry compared to the last 30 years in the area.

The BLM temporary gage recorded variable, but generally modest streamflow between 2016 and 2020. The highest peak occurred in 2019 and runoff extended further into summer that year due to delayed snowmelt. Runoff in 2018 and 2020 was relatively short duration, lasting about two months in April and May. Streamflow after runoff was generally low with some periods of zero or near zero flow recorded at the gage.

In order to estimate streamflow in this reach of Piceance Creek (Upper), the BLM temporary gage record was prorated to the proposed lower terminus based to the weighted area-precipitation method (proration factor = 46.1%). Staff believes that this method may under-estimate the amount of water available at the proposed lower terminus because most of the tributaries below the upper reach are intermittent and are unlikely to contribute water year-round. No other adjustments were made for diversions in the proposed reach. The primary water rights in the reach show little to no use in recent years or use primarily for augmentation which left water in the stream, all uses are reflected in the gage record. Due to the short period of record at the gage, mean-monthly streamflow was calculated using the available record rather than median daily streamflow.

**Water Availability Summary**
The hydrograph (See Complete Hydrograph) shows mean-monthly streamflow prorated from the BLM temporary gage and streamflow measurements made in the proposed ISF reach.

This water availability assessment was challenging due to exceptionally dry hydrologic conditions and changing water use patterns through time. The BLM temporary gage records include multiple years with exceptionally dry conditions compared to the last 30 years. In addition, the BLM temporary gage includes new and changed water rights uses but operated during a period of very little water use by the most senior water rights.

Staff's water availability assessment primarily relies on the BLM gage record, which reflects more recent conditions and is generally a more conservative (lower) estimate of available streamflow. The proposed ISF rates are below the prorated BLM gage mean-monthly streamflow estimates in all months except November and December. Flow rates in winter months are typically fairly consistent. The low value in November is likely due in part to limited gage data in November and the rate in December is just 0.01 cfs less than the mean-monthly streamflow based on the BLM gage. Based on the available information, staff believes the proposed ISF flow rates are available.

**MATERIAL INJURY**
As a new junior water right, the proposed ISF on Piceance Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**
**Citations**
Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

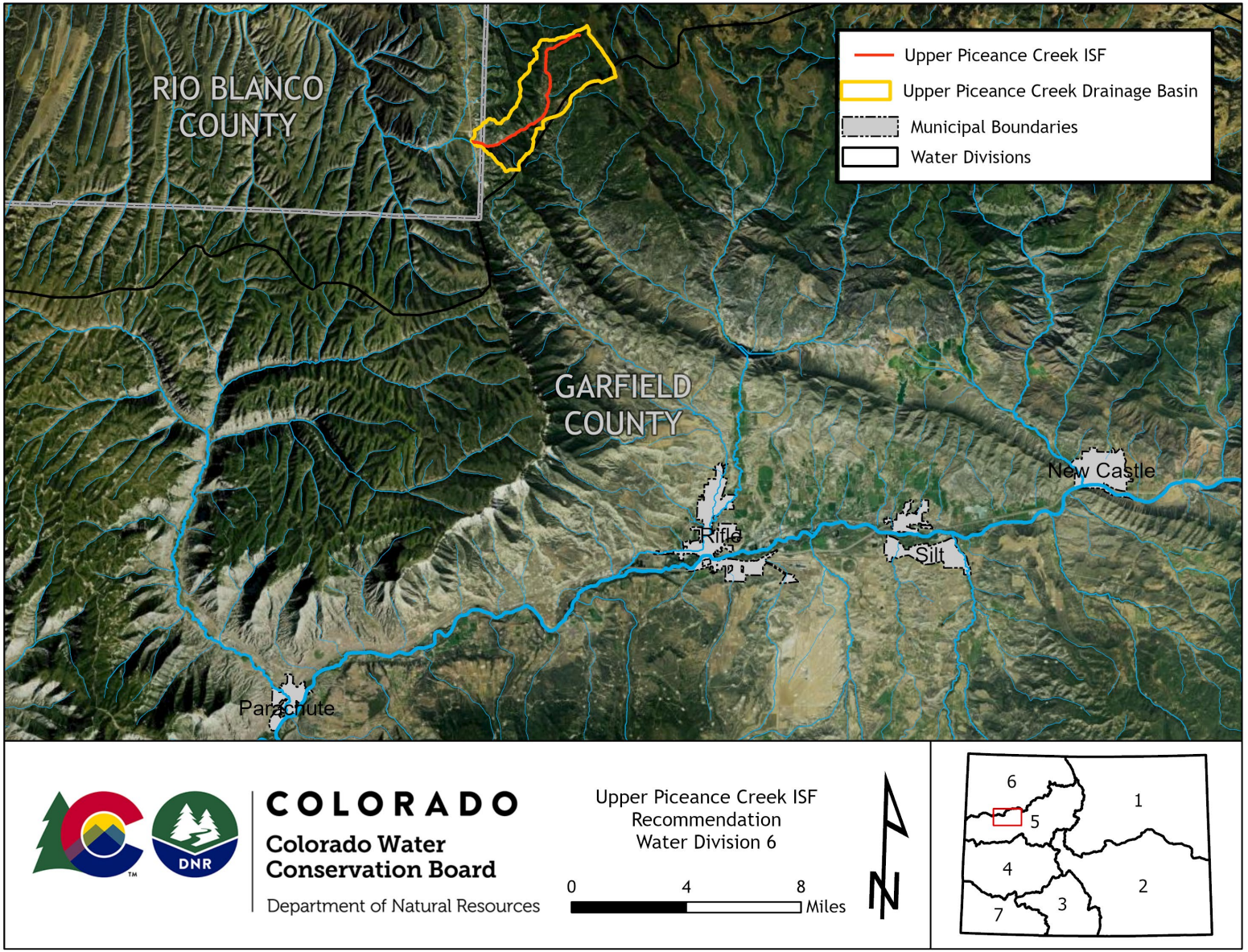
Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

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.

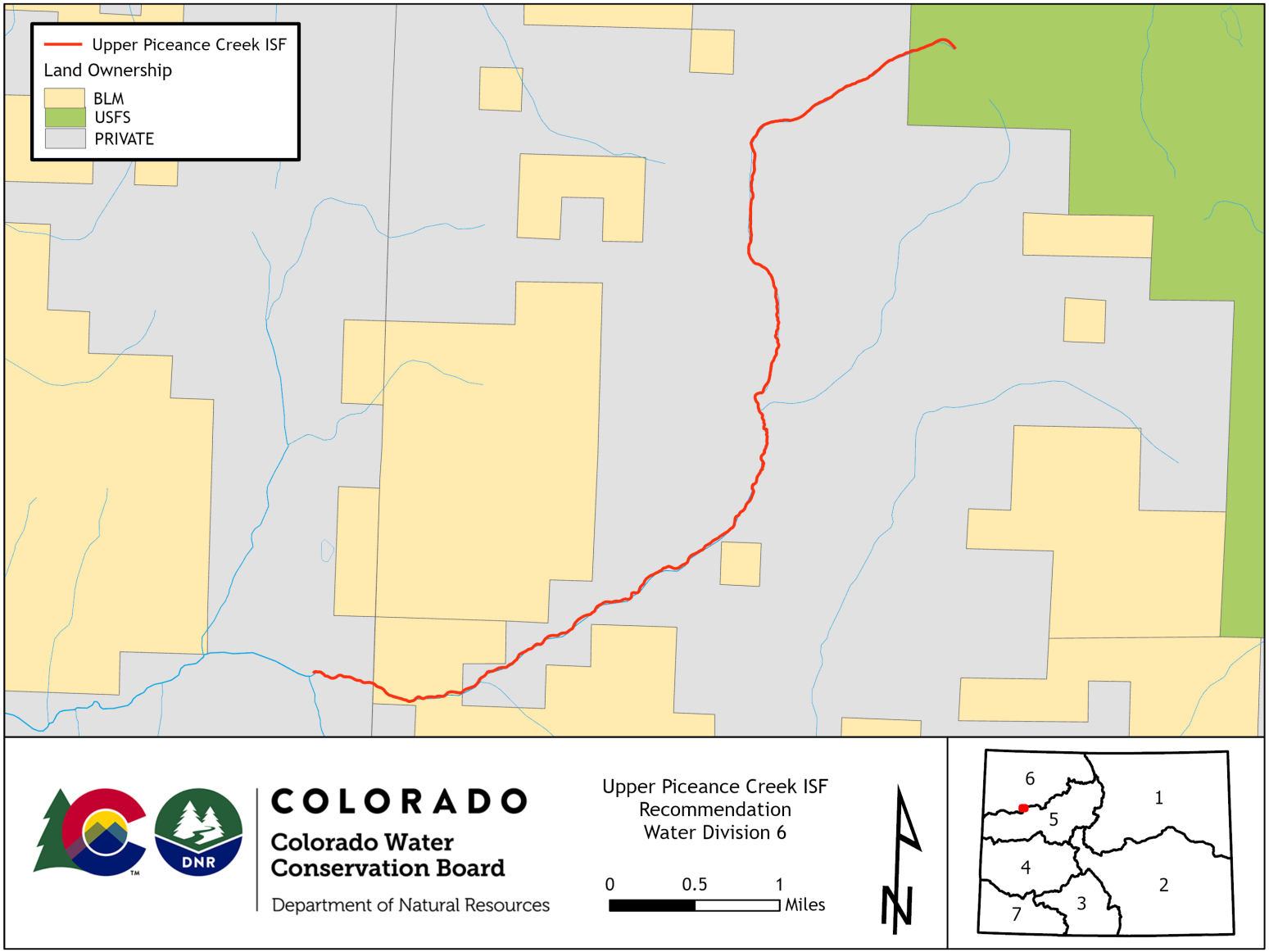
**Metadata Descriptions**
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

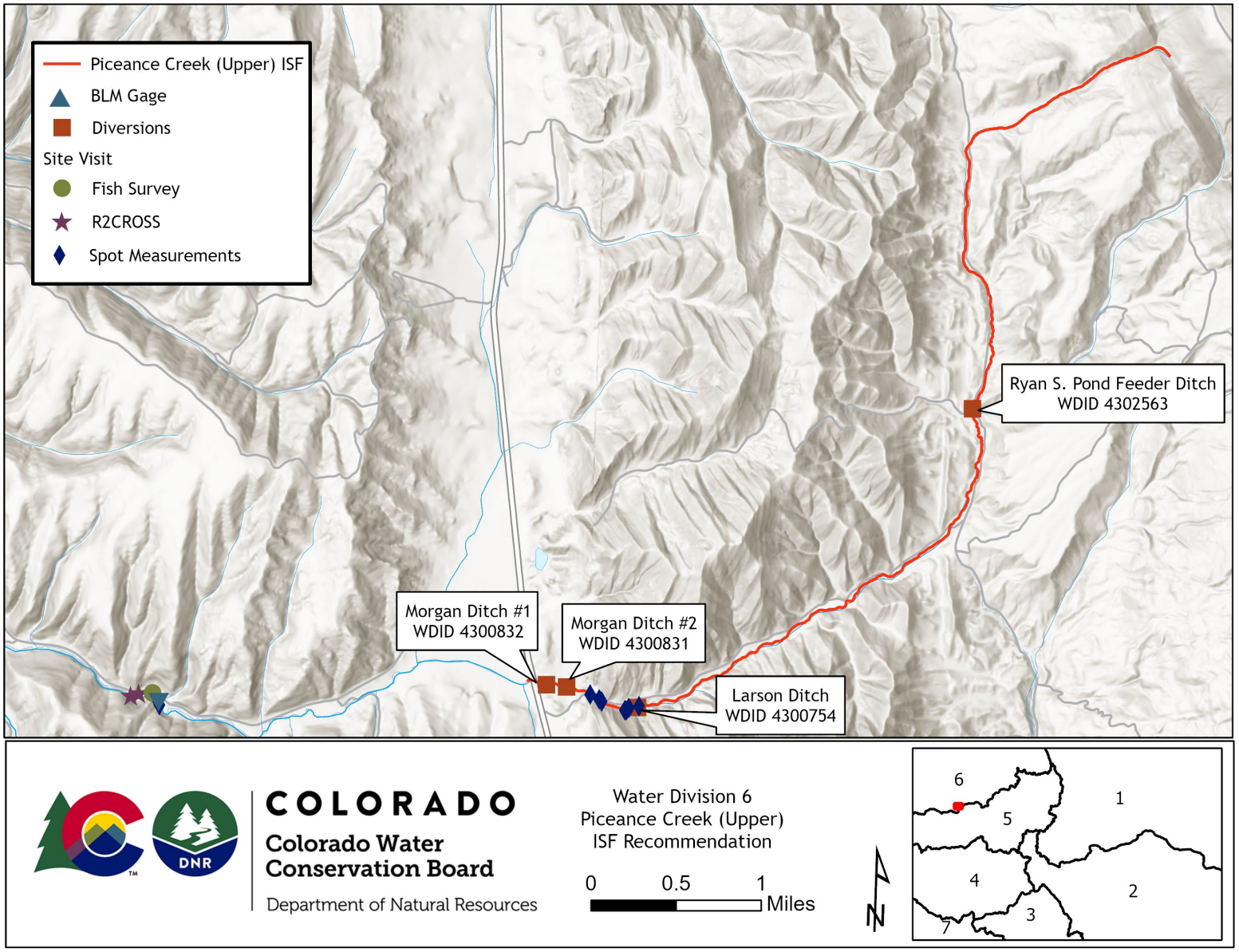
# VICINITY MAP



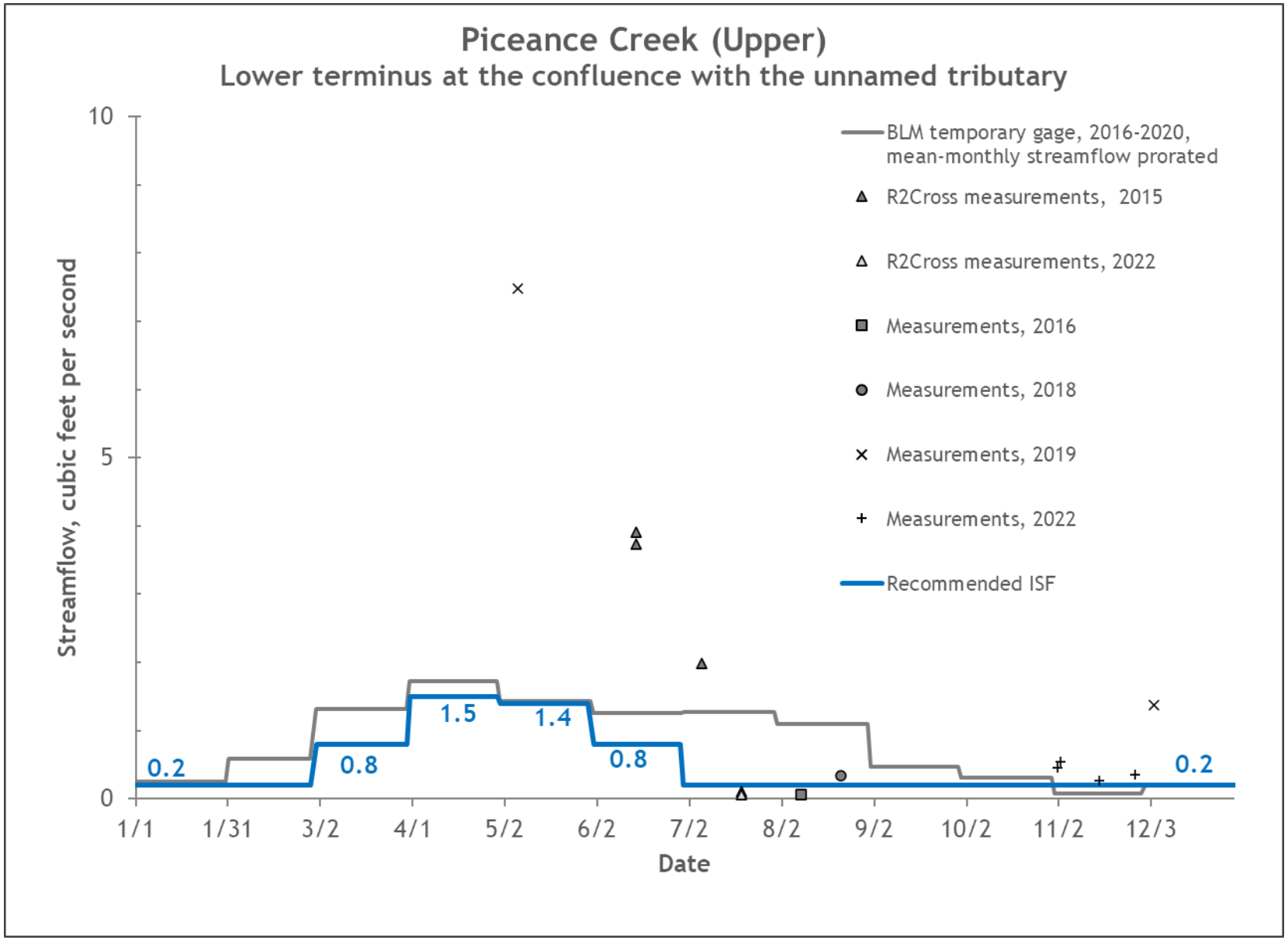
# LAND OWNERSHIP MAP



# HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



# Piceance Creek (Lower) Executive Summary

**CWCB STAFF INSTREAM FLOW RECOMMENDATION**
**January 24-25, 2023**

| | |
|---|---|
| UPPER TERMINUS: | confluence with unnamed tributary at<br>UTM North: 4402272.35 UTM East: 247589.12 |
| LOWER TERMINUS: | Piceance Ditch at<br>UTM North: 4402597.00 UTM East: 243003.00 |
| WATER DIVISION: | 6 |
| WATER DISTRICT: | 43 |
| COUNTY: | Rio Blanco |
| WATERSHED: | Piceance-Yellow |
| CWCB ID: | 17/6/A-002 |
| RECOMMENDER: | Bureau of Land Management (BLM) |
| LENGTH: | 3.69 miles |
| FLOW RECOMMENDATION: | 0.4 cfs (07/01 - 02/29)<br>1.5 cfs (03/01 - 03/31)<br>2.9 cfs (04/01 - 05/31)<br>1.5 cfs (06/01 - 06/30) |

COLORADO
Colorado Water Conservation Board
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**BACKGROUND**

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2023-isf-recommendations.

**RECOMMENDED ISF REACH**

BLM recommended that the CWCB appropriate an ISF water right on a reach of Piceance Creek. The proposed reach on Piceance Creek is located within Rio Blanco County and is approximately 16 miles northwest from the town of Riffle (See Vicinity Map). The stream originates on the western edge of Big Mountain at approximately 9,000 feet in elevation and flows west and north until it reaches the confluence with the White River.

The proposed ISF reach extends from the confluence with the unnamed tributary downstream to Piceance Ditch for a total of 3.69 miles. The land on the proposed reach is 29% BLM and 71% private (See Land Ownership Map). The BLM is interested in protecting this stream to meet management goals aimed at maintaining and enhancing habitat that supports fish species, maintaining and improving the function of riparian areas, and protecting riparian and wetland systems.

**OUTREACH**

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Piceance Creek was sent to the mailing list in March 2022, November 2021, November 2021, October 2021, March 2021, March 2020, November 2019, March 2019, March 2018, March 2017, and November 2016. Staff sent letters to identified landowners adjacent to Piceance Creek based on information from the county assessors website. A public notice about this recommendation was also published in the Rio Blanco Herald Times on December 22, 2022.

Staff presented information about the ISF program and this recommendation to the Garfield County Board of County Commissioners on August 15, 2017, December 17, 2018, and November 14, 2022. Staff also presented information about the ISF program and this recommendation to the Rio Blanco Board of County Commissioners on August 14, 2017, October 8, 2018, and October 8, 2019 and to White River Integrated Water Initiative Planning Advisory Committee on November 9, 2021. In addition, staff spoke with Brett Waston, Water Commisioner on April 8,

2016 and Shanna Lewis, Water Commissioner on November 19, 2021, reguarding water availability on Piceance Creek.

**NATURAL ENVIRONMENT**

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

This section of Piceance Creek is a cold-water, high gradient stream. This reach begins in a broad valley that is more than a mile in width, where several small tributaries converge. The stream then enters a narrow valley approximately 1,000 feet in width. The stream reach generally has small-sized substrate, consisting of gravels, small cobbles, and small boulders. The channel is mostly single thread, narrow, and deep with some undercut banks.

The riparian community is generally comprised of coyote willow, Geyer's willow, sedges and rushes. The riparian community is in good condition and provides shading and cover for fish habitat. The stream has a good mix of pools, small riffles, and runs. While deep pool habitat is absent, the existing pools are sufficient for overwintering fish. CWCB Staff also observed beaver complexes.

Fisheries surveys have revealed a self-sustaining native fish population comprised of Speckled Dace and Mountain Suckers. Intensive macroinvertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly. CWCB Staff have identified mayfly and caddisfly in the field, which are all taxa know to be sensitive to water quality. Their presence indicates good water quality (Hilsenhoff, 1987).

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| caddisfly | *Trichoptera* | None |
| mayfly | *Ephemeroptera* | None |

**ISF QUANTIFICATION**

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**Quantification Methodology**

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ceases. The data collected consists of a streamflow measurement, survey of channel geometry and features at a cross-section, and survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macro-invertebrates (Nehring, 1979). BLM staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three a hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree or withdraws the recommendation.

**Data Collection and Analysis**

BLM collected R2Cross data at two transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 1.40 cfs and a summer flow of 2.92 cfs. R2Cross field data and model results can be found in the appendix to this report.

**Table 2. Summary of R2Cross transect measurements and results for Piceance Creek.**

| Date, XS # | Top Width (feet) | Streamflow (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|---|---|---|---|---|
| 06/15/2015, 1 | 8.10 | 5.83 | 0.23 | 3.33 |
| 07/07/2015, 1 | 12.48 | 3.25 | 1.40 | 2.50 |
| | | | 0.82 | 2.92 |

**ISF Recommendation**

BLM recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

2.9 cubic feet per second is recommended from April 1 through May 31 during the beginning of the snowmelt runoff period. This recommendation is driven by the average velocity and wetted perimeter criteria. This portion of the creek is small and habitat availability is very susceptible to even small changes in flow from diversions. It is important to protect a flow rate that makes most of this habitat available to the fish population while they are completing critical life history functions during the warm weather months.

1.5 cubic feet per second is recommended from June 1 through June 30 during the conclusion of the snowmelt runoff period. This flow rate does not meet all three instream flow criteria, but it exceeds two of three instream flow criteria and provides a transitional flow rate between maximum habitat availability during snowmelt runoff and limited habitat availability during the base flow period.

0.4 cubic feet per second is recommended from July 1 through February 29 during the base flow period. This recommendation is driven by very limited water availability. This flow rate should maintain pool habitat during the late summer and fall and prevent pools from freezing during the extended cold weather period, allowing the fish population to successfully overwinter.

1.5 cubic feet per second is recommended from March 1 through March 31 during the low elevation snowmelt period. This flow rate does not meet all three instream flow criteria, but it exceeds two of three instream flow criteria and provides a transitional flow rate between limited habitat availability during the winter and maximum habitat availability during peak snowmelt runoff.

**WATER AVAILABILITY**

CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

**Water Availability Methodology**

Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al. 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year.

The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

**Basin Characteristics**

The drainage basin of the proposed ISF on Piceance Creek is 22.90 square miles, with an average elevation of 7,905 feet and average annual precipitation of 21.60 inches (See the Hydrologic Features Map). Streamflow in the Piceance basin can be highly variable in terms of both the magnitude and timing of runoff. Piceance Creek is primarily a snowmelt runoff system, but runoff may start early compared to other locations in the state.

*Water Right Assessment*

There are a number of water rights and water practices in the basin tributary to the proposed reach that alter hydrology, but no on-channel water rights directly divert from this proposed reach of Piceance Creek. There is a total of 5.78 cfs in absolute and active ditch diversions and 67.7 acre feet in absolute storage based on Hydrobase. There are a number of absolute small springs and wells that total less than 0.6 cfs. Staff also identified conditional water rights that appear to be in use. This includes at least 5.2 cfs in conditional surface water rights that have diversion records and multiple storage rights that appear to exist based on the location of ponds in aerial images. These conditional water rights are generally located higher in the basin, in or above the upper proposed ISF reach on Piceance Creek.

The administrative call record was reviewed for Piceance Creek to better understand current administration. According to the previous water commissioner, (Shanna Lewis, personal communication 11/19/2021) Piceance Creek can have a dry reach below both of the proposed ISFs reaches but above the confluence with the White River. This creates a situation where downstream calls may be futile. Because of this, the basin can have two different calls that cover lower and upper portions of the basin. The upper basin calls extend to the headwaters and go through both proposed ISF reaches. Calls related to the upper basin occurred in 2022, 2021, 2020, 2018, 2012, 2007, 2004, 2003. These calls are often senior to all water rights in the basin above the proposed reach, with the exception of the Morgan Ditch 1 (WDID 4300832 1 cfs, appropriation date 1883). In short, when the basin is under administration by downstream senior water rights, most available water will remain in the proposed ISF reach.

**Data Collection and Analysis**

*Historic Gage Data*

There is a historic streamflow gage on Piceance Creek just upstream of the proposed reach, Piceance Creek at Rio Blanco, CO (USGS 09305500). This gage was located upstream from the upper terminus between the Larson and the Morgan 1 and 2 Ditches. It operated during the water year from 1952 through 1957, for a total of five years of record. This gage record does not reflect a number of more recent water rights and changes to water rights that have occurred in the basin since the 1950s. Many more recent water rights are located higher in the basin and are primarily for household use and ponds. In addition, a number of water rights were changed in the 1980s to allow additional uses including commercial, industrial, and augmentation. Because this gage record does not adequately reflect current water use practices, this data was

not used as the primary basis for determining water availably. However, this gage data does indicate that historically April and May had the highest mean-monthly streamflow.

*BLM Temporary Gage*

Given the lack of recent streamflow data, the BLM installed a temporary gage on Piceance Creek approximately one mile upstream from the lower terminus of this proposed reach. The gage was installed on 6/16/2016 and records include information through 7/27/2020. The drainage basin of the BLM gage was 21.6 square miles, with an average elevation of 7,920 feet and average annual precipitation of 21.71 inches. CWCB staff assisted in making measurements at this gage (Table 3) and developed all rating curves and final flow data used in this analysis.

**Table 3. Summary of streamflow measurements for Piceance Creek (Lower).**

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 07/07/2015 | 3.33 | CWCB |
| 08/29/2016 | 3.28 | BLM |
| 09/21/2016 | 0.44 | BLM |
| 11/21/2016 | 1.26 | BLM |
| 12/16/2016 | 3.28 | BLM |
| 12/16/2016 | 3.28 | BLM |
| 02/16/2017 | 3.53 | BLM |
| 06/22/2017 | 0.50 | BLM |
| 07/12/2017 | 0.11 | BLM |
| 08/22/2018 | 0.07 | CWCB |
| 09/14/2018 | 0.05 | CWCB |
| 09/14/2018 | 0.06 | CWCB |
| 05/07/2019 | 7.70 | CWCB |
| 07/09/2019 | 13.98 | BLM |
| 10/16/2019 | 0.60 | CWCB |
| 12/04/2019 | 0.64 | CWCB |
| 01/16/2020 | 0.53 | BLM |
| 01/16/2020 | 0.62 | BLM |
| 03/03/2020 | 0.90 | CWCB |
| 05/28/2020 | 0.93 | BLM |

| Visit Date | Flow (cfs) | Collector |
|---|---|---|
| 06/29/2020 | 0.08 | BLM |
| 09/21/2020 | 0.16 | BLM |
| 11/02/2022 | 0.23 | CWCB |
| 11/03/2022 | 0.37 | BLM |
| 11/16/2022 | 0.21 | BLM |
| 11/28/2022 | 0.17 | BLM |

The BLM gage record was compared to a nearby gage to evaluate how the temporary gage time period compares to a longer record. The Piceance Creek below Ryan Gulch, near Rio Blanco gage (USGS09306200) is the closest gage with long term record (1964-2020). This gage is located roughly 24 miles downstream and is affected by substantial water right uses. This assessment looked at the total flow volume at the gage for a calendar year based on the most recent contemporary 30 years (1991 to 2020- omitting 1998 and 1999 which did not have complete records). This showed that 2016 was the only year that the BLM gage operated during nearly average annual streamflow. Streamflow in 2019 was slightly above the 25$^{th}$ percentile. Streamflow in 2017 was less than the 25$^{th}$ percentile. Streamflow in 2018 and 2020 were less than the 10$^{th}$ percentile. In general, the data recorded by the BLM gage includes multiple years that were exceptionally dry compared to the last 30 years in the area.

The BLM temporary gage recorded variable but generally modest streamflow between 2016 and 2020. The highest peak occurred in 2019 and runoff extended further into summer that year due to delayed snowmelt. Runoff in 2018 and 2020 was relatively short duration, lasting about 2 months in April and May. Streamflow after runoff was generally low with some periods of zero or near zero flow recorded at the gage.

The BLM temporary gage record was not prorated to the proposed lower terminus due to the relatively small difference in drainage basin characteristics. Due to the short period of record at the gage, mean-monthly streamflow was calculated using the available record rather than median daily streamflow.

**Water Availability Summary**

The hydrograph (See Complete Hydrograph) shows mean-monthly streamflow from the BLM temporary gage and streamflow measurements made in the proposed ISF reach.

This water availability assessment was challenging due to exceptionally dry hydrologic conditions and changing water use patterns through time. The BLM temporary gage records include multiple years with exceptionally dry conditions compared to the last 30 years. In addition, the BLM temporary gage includes new and changed water rights uses but operated during a period of very little water use by the most senior water rights.

Staff‘s water availability assessment primarily relies on the BLM gage record, which reflects more recent conditions and is generally a more conservative (lower) estimate of available

streamflow. The proposed ISF rates are below the BLM gage mean-monthly streamflow estimates in all months except November. Flow rates in winter months are typically fairly consistent, the low value in November is likely due in part to limited gage data in November. Based on the available data, the proposed ISF flow rates are available.

**MATERIAL INJURY**

As a new junior water right, the proposed ISF on Piceance Creek can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

**ADDITIONAL INFORMATION**

**Citations**

Colorado Water Conservation Board, 2022, R2Cross model-user's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Espegren, G.D., 1996, Development of instream flow recommendations in Colorado using R2CROSS, Colorado Water Conservation Board.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

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.

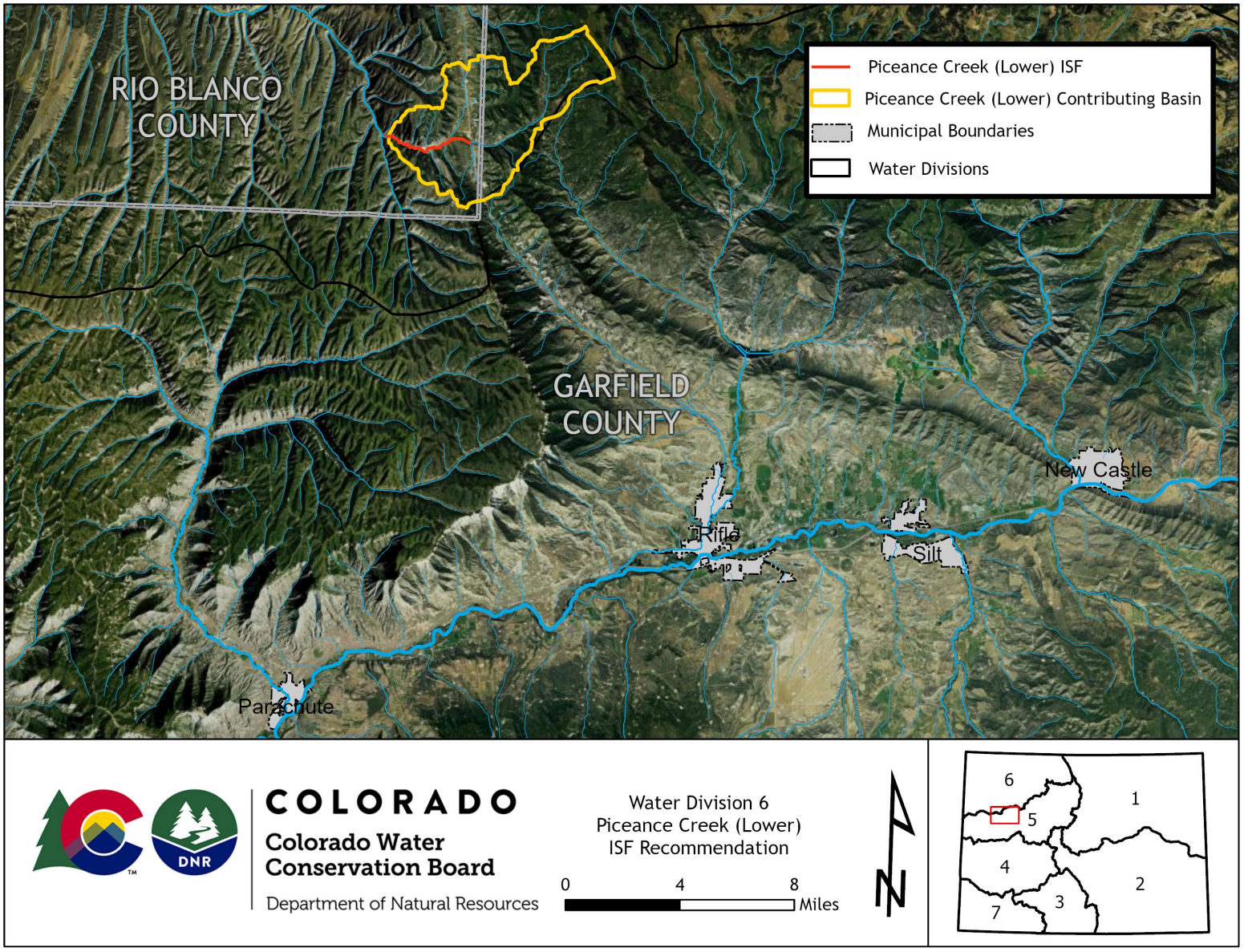
Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Michigan Entomology Society. 20(11):9-13

**Metadata Descriptions**

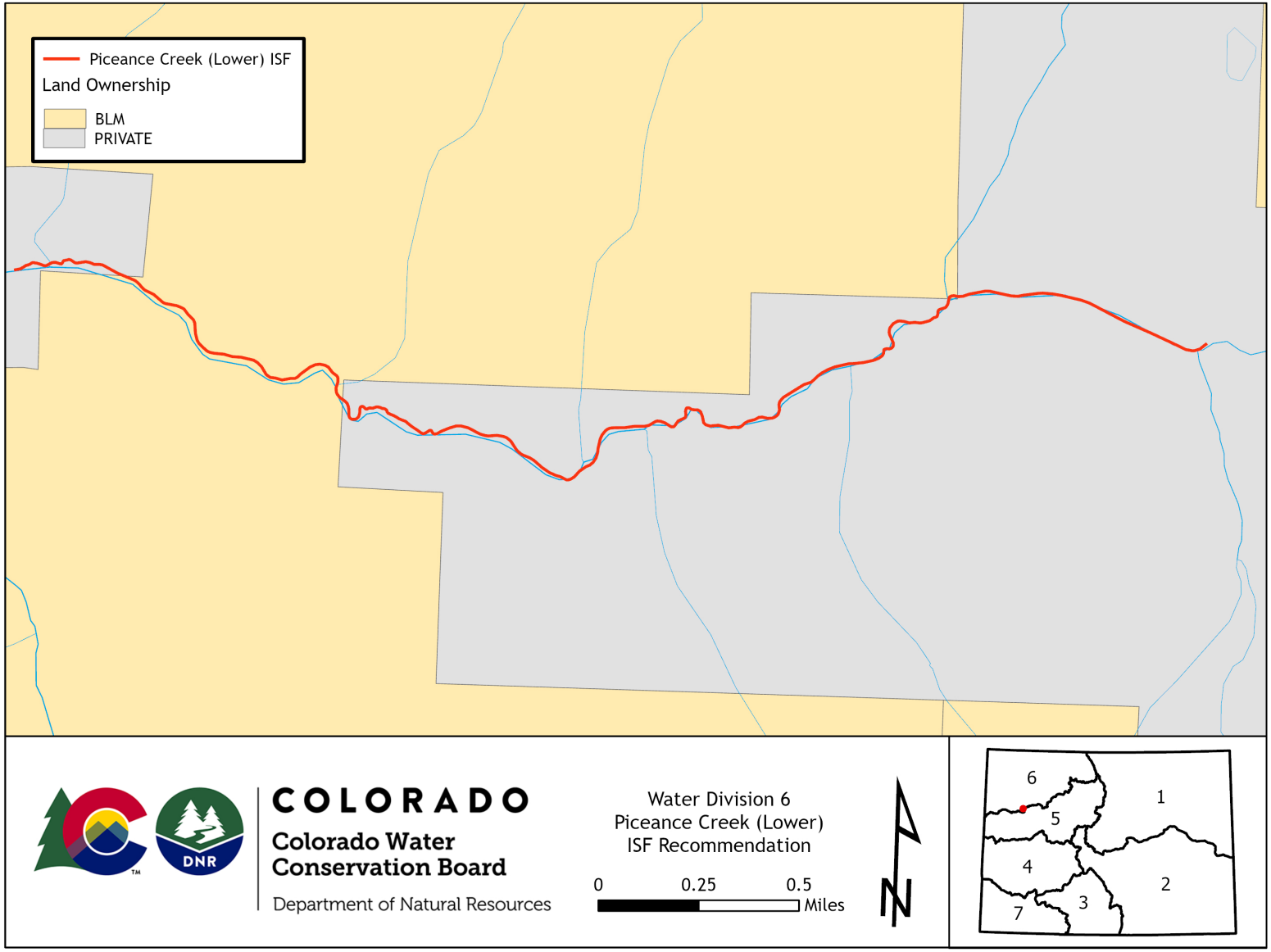
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

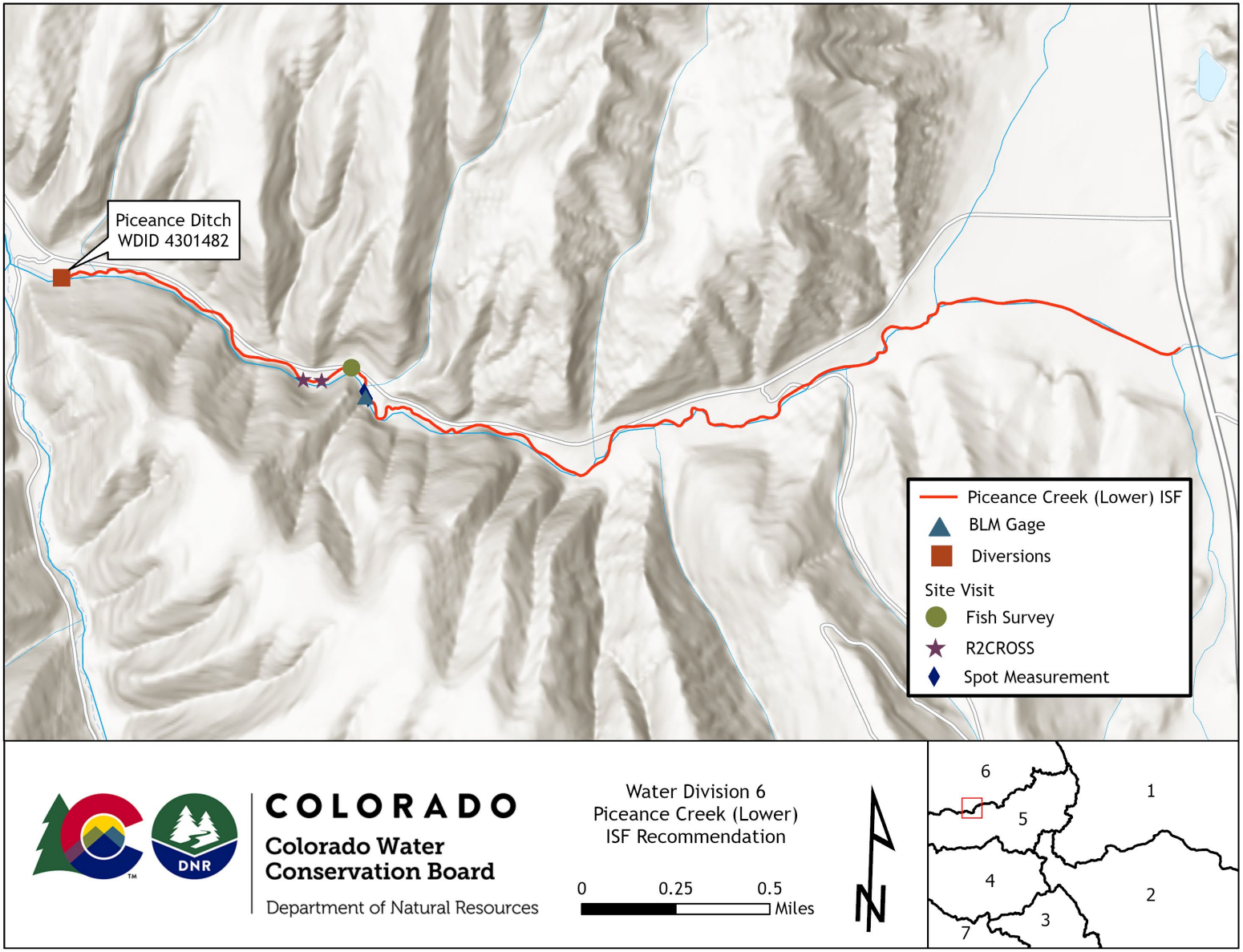
# VICINITY MAP



# LAND OWNERSHIP MAP



# HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH