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

January 2021 Instream Flow Recommendations

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Dry Gulch Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
January 25-26, 2021

UPPER TERMINUS:	headwaters UTM North: 4395039.45 UTM East: 421166.28
LOWER TERMINUS:	confluence Clear Creek UTM North: 4394414.43 UTM East: 425249.35
WATER DIVISION:	1
WATER DISTRICT:	7
COUNTY:	Clear Creek
WATERSHED:	Clear Creek
CWCB ID:	21/1/A-001
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	2.83 miles
FLOW RECOMMENDATION:	0.67 cfs (01/01 - 04/30) 5.4 cfs (05/01 - 07/31) 2 cfs (08/01 - 09/30) 0.85 cfs (10/01 - 12/31)

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Introduction

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.

Colorado Park and Wildlife (CPW) recommended that the CWCB appropriate an ISF water right on a reach of Dry Gulch because it has a natural environment that can be preserved to a reasonable degree. The proposed reach extends from Dry Gulch's headwaters downstream to the confluence with Clear Creek. Dry Gulch is located within Clear Creek County (See Vicinity Map), and originates about 1.8 miles north of the Eisenhower Tunnel at an elevation of approximately 11,800 feet. Dry Gulch flows in an easterly direction for 2.83 miles before it joins Clear Creek at an elevation of 10,600 feet. One hundred percent of the land on the 2.83 mile proposed reach is owned and managed by the U. S. Forest Service (See Land Ownership Map).

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/2021-isf-recommendations.

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 is used to provide the Board with a basis for determining that a natural environment exists.

Dry Gulch is a cold-water, high gradient mountain stream with a mean basin elevation at almost 12,000 feet. Its contributing basin is high-alpine and forested, with snowmelt driven hydrology fed by high elevation snowpack. This stream is first order and tributary to Clear Creek. A majority of its reach is single thread with some side channel formation, though there is a great deal of braiding and side channels in portions of the reach. Good habitat variety is present with a mixture of coarse substrate riffles and runs, along with pools formed by large boulders and ample woody debris. The substrate mostly consists of medium-sized cobble to boulders. Macroinvertebrate populations were observed in the field to include two types of caddisfly nymphs, mayfly nymphs, stonefly nymphs, and flatworm.

In its recommendation for Dry Gulch, CPW states:

> A significant avalanche cycle in 2019 added notable large woody debris to the creek, creating numerous log jam scour pools. Suitable trout habitat is plentiful

including large pools, smaller pocket pools, undercut banks, and abundant riparian cover in the forested, high-gradient reach of the creek. Riparian willows are dense in the lower-gradient transition zone from the alpine to the high-gradient forested cascading reach.

Dry Gulch contains a population of Bear Creek greenback cutthroat trout, which are listed as a threatened species by both the state and federal government. In 2016, CPW and Trout Unlimited conducted a Bear Creek greenback cutthroat trout reintroduction and reclamation project. CPW relocated the existing Colorado River cutthroat fish population. Greenback cutthroat trout were then stocked in Dry Gulch from 2017 through 2019. In 2019, CPW conducted a fish survey showing a fish population of exclusively greenback cutthroat, which was CPW's goal. The agency expects to find evidence of natural recruitment among the population in the coming years.

Table 1. List of species identified in Dry Gulch.

Species Name	Scientific Name	Protection Status
greenback cutthroat - Bear Creek strain*	*Oncorhynchus clarkii stomias*	Federal - Threatened Species, State - Threatened Species & Species of Greatest Conservation Need
mayfly	*Ephemeroptera*	None
caddisfly	*Trichoptera*	None
stonefly	*Plecoptera*	None
aquatic fly larve	*Diptera*	None
flatworm	*Platyhelminths*	None

*indicates native fish species

ISF Quantification

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. 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 methodology 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). Riffles are a stream habitat type that are most easily visualized as sections of the stream that would dry up first should streamflow cease. The data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: 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 interprets the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow recommendation

is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides 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 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 1.51 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a summer flow of 5.39 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 Dry Gulch.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
08/17/2020, 1	12.40	3.05	1.22 - 7.63	1.56	4.33
08/28/2020, 1	16.50	2.97	1.19 - 7.43	1.45	6.45
			Mean	1.51	5.39

ISF Recommendation

The CPW recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis. Based on the hydrology from StreamStats, there appear to be water availability limitations during the baseflow period from October through March. Therefore, the ISF flow recommendation has been refined based on water availability to the following:

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

2.0 cfs is recommended from August 1 through September 31. This flow rate is reduced due to water availability constraints, but will maintain available habitat and allows fish movement as they are headed into the overwintering period.

0.85 cfs is recommended from October 1 through December 31. This flow rate is reduced due to water availability constraints, but will provide sufficient habitat availability in pools and deep glides.

0.67 cfs is recommended from January 1 through April 30. This flow rate is reduced due to water availability constraints, but will provide sufficient habitat availability 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.

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 streamflows 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) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be 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; 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 Dry Gulch is 3.22 square miles, with an average elevation of 11,845 feet and average annual precipitation of 33.62 inches (See the Hydrologic Features Map). The hydrology of Dry Gulch is primarily driven by snowmelt runoff; however, the creek was noted to sustain relatively high streamflow even during August of 2020, which was very dry across the State. There are no known water rights in the entire basin and hydrology is unaltered from natural flow conditions.

Available Data and Analysis
There are no historic or current streamflow gages on Dry Gulch and no nearby representative gages were identified. StreamStats provides the best available estimate of streamflow on Dry Gulch. CWCB staff made one streamflow measurement on the proposed reach of Dry Gulch as summarized in Table 3.

Table 3. Summary of Streamflow Measurement Visits and Results for Dry Gulch.

Visit Date	Flow (cfs)	Collector
10/13/2020	1.63	CWCB

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

Material Injury
Because the proposed ISF on Dry Gulch is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2020), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations
Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

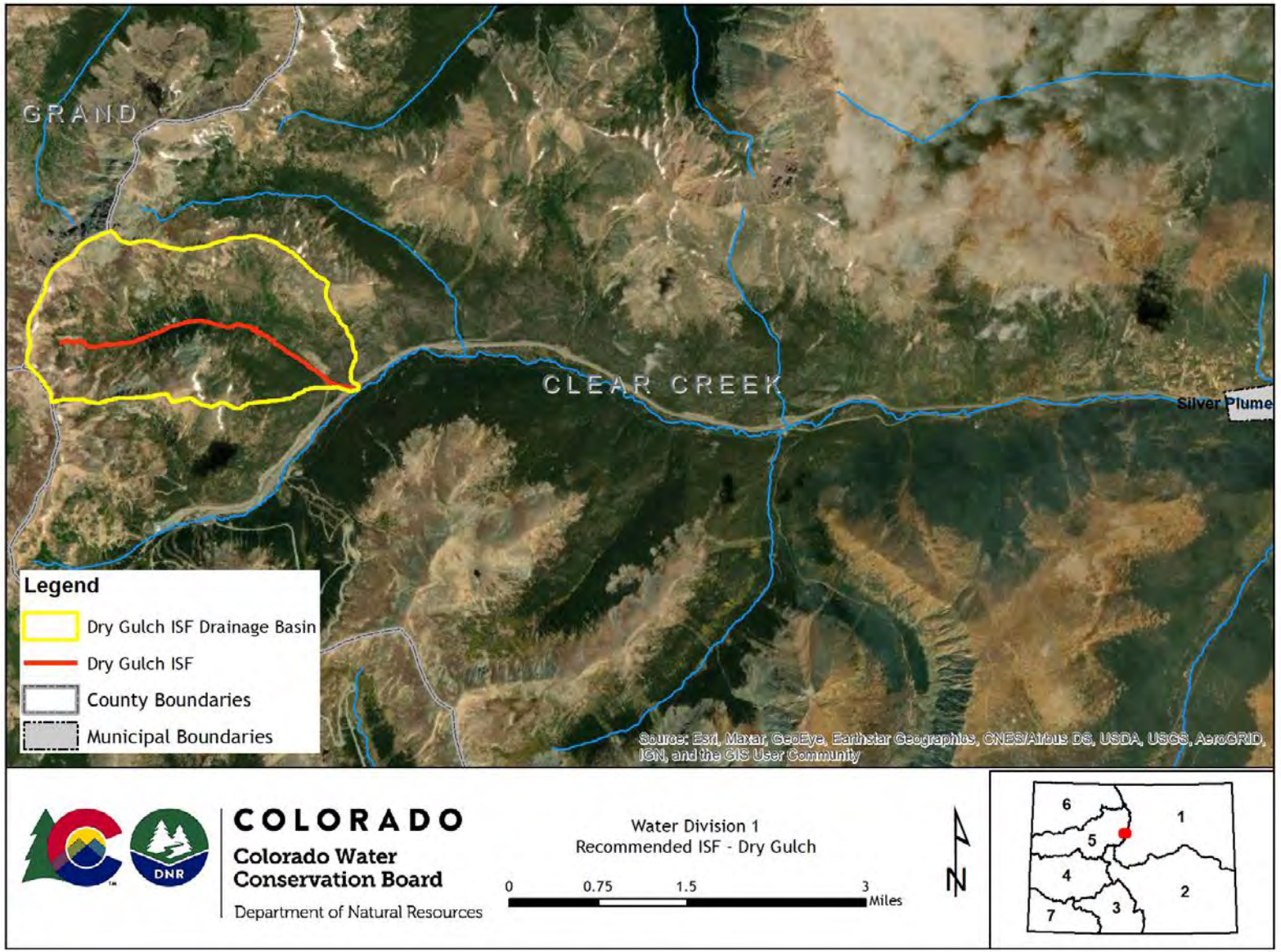
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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).

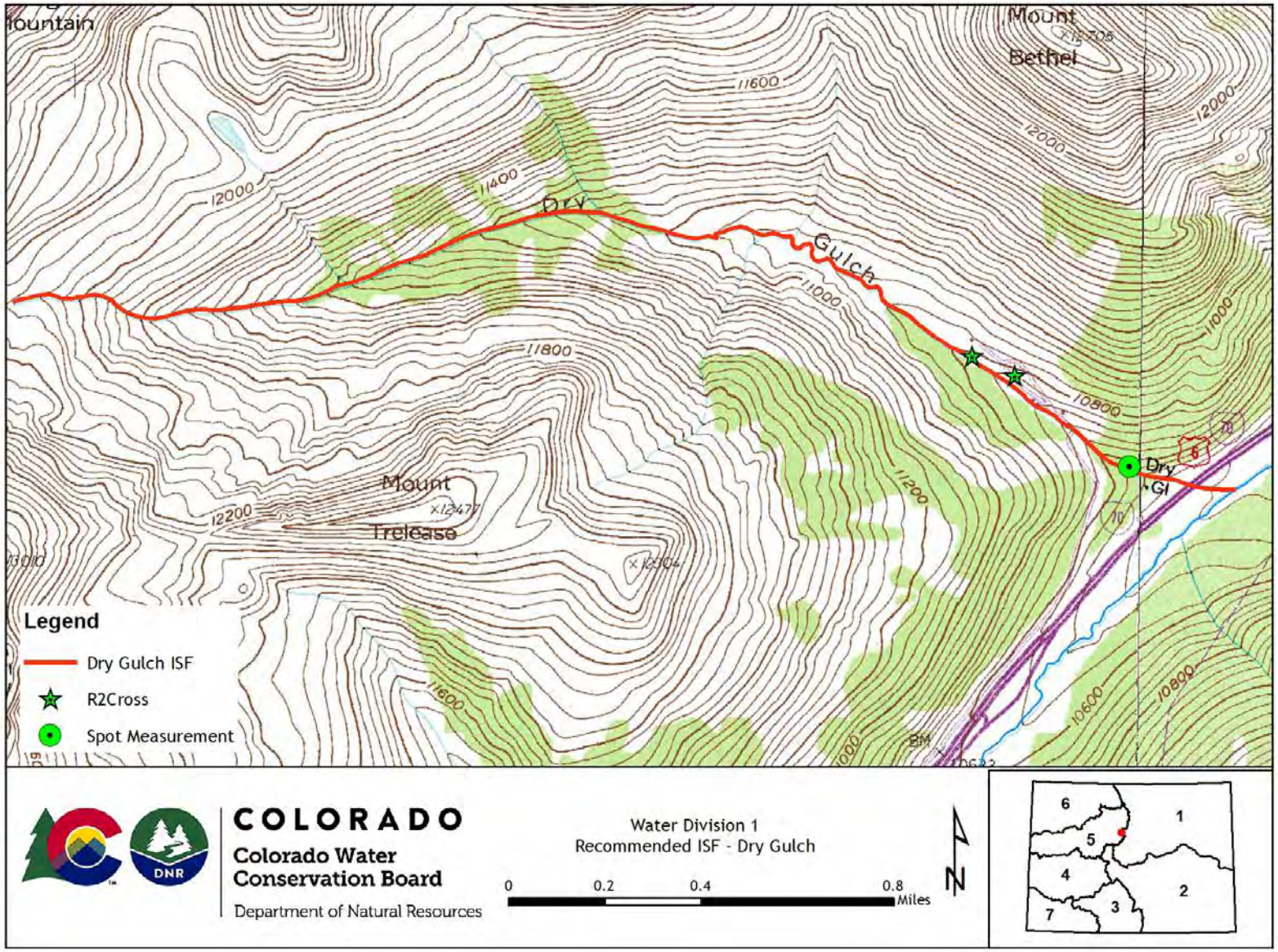
Projected Coordinate System: NAD 1983 UTM Zone 13N.

VICINITY MAP

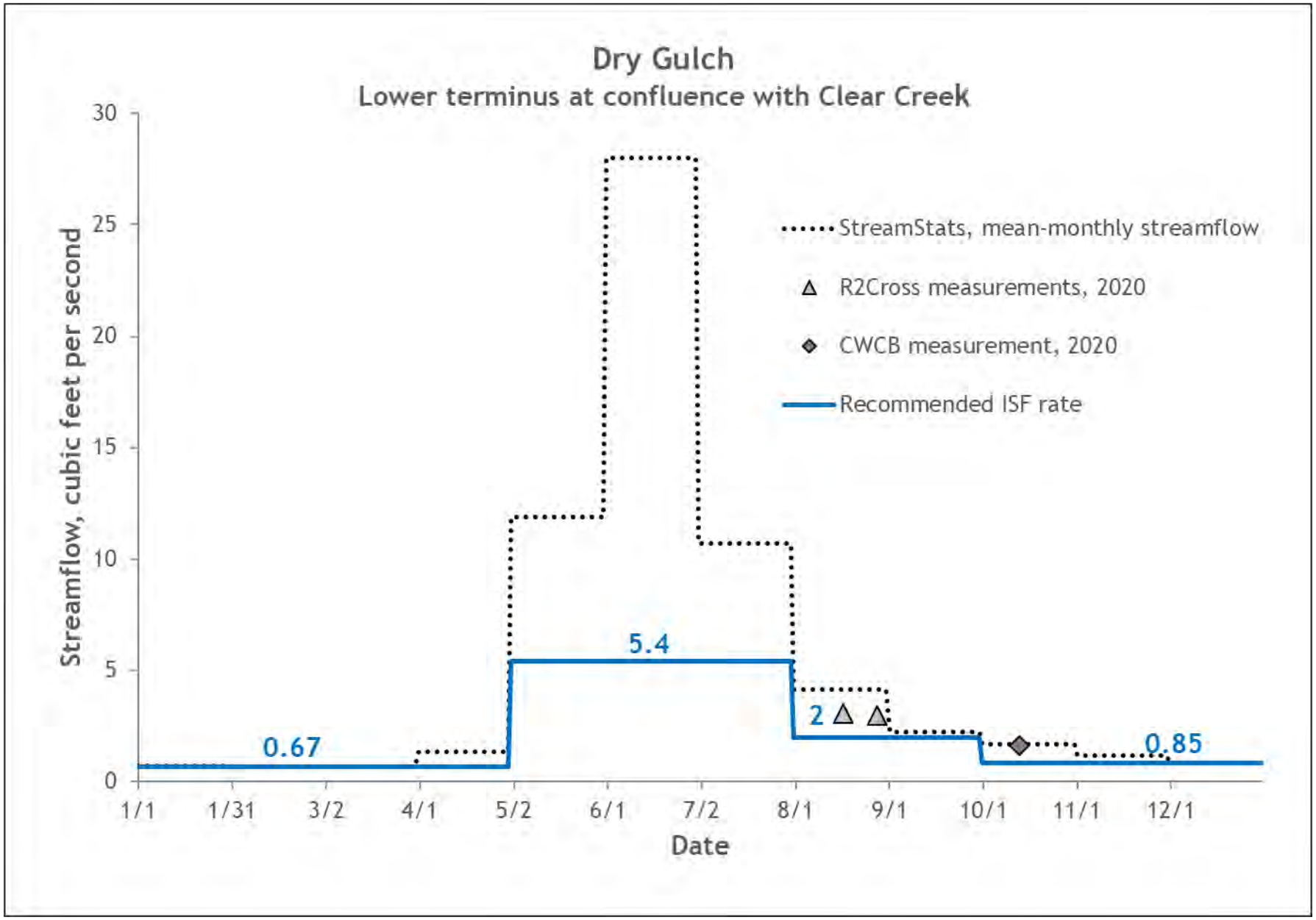


LAND OWNERSHIP MAP

HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



North Fork Little Thompson River Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
January 25-26, 2021

UPPER TERMINUS:	confluence Hell Canyon Creek UTM North: 4465680.11 UTM East: 473124.37
LOWER TERMINUS:	confluence Little Thompson River UTM North: 4461361.09 UTM East: 474370.33
WATER DIVISION:	1
WATER DISTRICT:	4
COUNTY:	Larimer
WATERSHED:	Big Thompson
CWCB ID:	18/1/A-002
RECOMMENDER:	Colorado Parks and Wildlife, Larimer County Department of Natural Resources (CPW, LCDNR)
LENGTH:	3.77 miles
FLOW RECOMMENDATION:	5 cfs (04/25 - 06/10) 2 cfs (06/11 – 06/30)

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Introduction

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.

Colorado Parks and Wildlife (CPW) and Larimer County Department of Natural Resources (LCDNR) recommended that the CWCB appropriate an ISF water right on a reach of the North Fork Little Thompson River because it has a natural environment that can be preserved to a reasonable degree. The proposed reach extends from the confluence with Hell Canyon Creek downstream to the confluence with the Little Thompson River. The North Fork Little Thompson River is located within Larimer County (See Vicinity Map), and originates about four miles east of Lake Estes at an elevation of approximately 8,600 feet. It flows in a southeasterly direction for 12 miles where it joins the Little Thompson River at an elevation of 5,900 feet. One hundred percent of the land on the 3.77 mile proposed reach is privately owned, but Larimer County holds a conservation easement that covers a large portion of this land (See Land Ownership Map).

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/2021-isf-recommendations.

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 is used to provide the Board with a basis for determining that a natural environment exists.

The channel of the North Fork Little Thompson River is mainly single-thread, with a mixture of riffles, runs, glides and pools. The 2013 floods significantly altered the channels, causing erosion and bank degradation that are still apparent in 2020. The substrate ranges from sand to boulders, with sections of exposed bedrock. In some areas, bedrock outcroppings and woody debris form large deep pools that can hold water year round.

The riparian community is well established and includes cottonwood, narrow-leaf willow, and peachleaf willow, which provide abundant shade and cover for the stream. In addition, the upland contributing basin is comprised of a healthy ecosystem including ponderosa pine, mountain mahogany, and sage brush.

North Fork Little Thompson River provides a suitable variety of aquatic habitat with large woody debris contributions. Large pools and shade provided by the riparian community present refuge for fish during periods with little to no streamflow. Rainbow trout, creek chub, and longnose sucker were identified in the reach during the 2020 survey conducted by CPW. Fish, including trout and creek chub, have also been regularly observed in the large pools by the CWCB staff during site visits. Crawfish and macroinvertebrate populations include two species of caddisfly, mayfly, diptera, and black worms. A wide range of wildlife has been observed by local residents including muskrats, mink, beaver, mountain lion, black bear, fox, and numerous bird, amphibian, and reptile species.

Table 1. List of species identified in North Fork Little Thompson River.

Species Name	Scientific Name	Protection Status
rainbow trout	*Oncorhynchus mykiss*	None
creek chub	*Semotilus atromaculatus*	None
longnose sucker*	*Catostomus catostomus*	None
cottonwood	*Populus spp.*	None
narrowleaf willow	*Salix exigua*	None
peachleaf willow	*Salix amygdaloides*	None
caddisfly	*Tricoptera*	None
mayfly	*Ephemeroptera*	None
aquatic fly larvae	*Diptera*	None
black worm	*Lumbriculus variegatus*	None

*indicates state species native to Colorado (East slope)

ISF Quantification

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

Quantification Methodology

CPW and LCDNR staff used the R2Cross methodology 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). Riffles are a stream habitat type that are most easily visualized as sections of the stream that would dry up first should streamflow cease. The data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: 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, and LCDNR staff interpret the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow

recommendation is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides 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 Analysis

CPW collected R2Cross data at 3 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 8.46 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a summer flow of 14.15 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 North Fork Little Thompson River.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
05/29/2019, 1	32.76	10.75	4.30 - 26.88	4.42	Out of range
05/29/2019, 2	33.97	11.59	4.64 - 28.98	Out of range	11.95
04/28/2020, 3	48.39	14.04	5.62 - 35.10	12.49	16.34
			Mean	8.46	14.15

ISF Recommendation

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

5.0 cfs is recommended from April 25 through June 10. This flow rate is limited by water availability. Although this flow rate will not maintain velocities of 1 ft/s, it will provide adequate wetted perimeter and depth to support fish passage during the spring to early summer, enabling larger-bodied trout to move to pools for the remainder of the year. Because the stream supports trout approximately 6 inches and smaller, as well as smaller-bodied native species, average depth greater than approximately 0.2 feet should be sufficient in this case.

2.0 cfs is recommended from June 11 through June 30. This flow rate is limited by water availability, but will allow protection during the receding limb of the hydrograph after the high flow period. This will allow fish to continue to move to larger pools as streamflow recedes after

the snowmelt runoff. Average depths between 0.15 to 0.25 feet over the surveyed cross-sections will facilitate this migration for the resident fish populations.

CPW and LCNDR do not recommend a base flow rate outside of the spring to early-summer period due to water availability.

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.

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 streamflows 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) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be 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; 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 North Fork Little Thompson River is 27.90 square miles, with an average elevation of 7,558 feet and average annual precipitation of 19.06 inches (See the Hydrologic Features Map). The stream's hydrology is driven by melt from low elevation snowpack, causing peak flows to typically occur in the late spring. CWCB staff observed some ground water seeps feeding the stream during spring snow melt. As the water table recedes in early to mid-summer, CPW and CWCB staff observed little to no streamflow at times. Sporadic

events of significant rainfall in mid to late summer and early fall have been observed to return streamflow. There are no significant decreed surface water diversions in the proposed reach. However, a portion of the Bureau of Reclamation (BOR) Colorado-Big Thompson (C-BT) Project can impact streamflow in the headwaters of the North Fork Little Thompson River.

A portion of the C-BT Project transports water through the Olympus Tunnel at Lake Estes to the Pole Hill Tunnel, before continuing to Pinewood Reservoir via Rattlesnake Tunnel and then to Flatiron Reservoir, Carter Lake, and Horsetooth Reservoir. The Pole Hill Power Plant is located in the North Fork Little Thompson Creek drainage approximately 1.7 miles north of the proposed upper terminus. This power plant generates hydroelectric power as part of the C-BT Project. Under typical operation, approximately 550 cfs from the Pole Hill Tunnel goes through the penstocks to generate power, then continues to the power plant's afterbay and back into the system through Rattlesnake Tunnel. During times of maintenance or emergency shut off, the system has the ability to "bypass" the penstock by rerouting water into the North Fork Little Thompson River (through Little Hells Canyon). Bypass in this context refers to routing water around the penstocks, it does not refer to bypassing native flow. This water is then recaptured by a diversion structure (referred to as "rediversion structure") that spans the width of the North Fork Little Thompson. The rediversion structure can be adjusted using stop-logs. The recaptured water is then routed into the Pole Hill Power Plant afterbay and back into the C-BT system.

BOR's rediversion structure is manually operated and generally not adjusted more than a few times a year. For the majority of the year, the rediversion structure is set to allow typical North Fork Little Thompson flows to pass through the structure. However, when the North Fork Little Thompson River is running high, particularly after a rainfall or snowmelt event, some of the native flow of the North Fork Little Thompson River is inadvertently captured by the rediversion structure and routed into the C-BT system. The stop-logs are usually only lowered all the way down during maintenance periods, which usually occur once a year for approximately one month. When the stop-logs are all the way down and the system is routing project water through Little Hells Canyon, the rediversion structure captures all water (both native North Fork Little Thompson and C-BT water) except for some water that leaks through the rediversion structure and continues down the North Fork Little Thompson. In recent years, the timing of the maintenance period has shifted from late fall to spring.

Figure 1. Downstream of the North Fork Little Thompson Rediversion Structure. Image was captured by BOR during a bypass event in August of 2020.

Data Analysis

CWCB Gage Data

There are no current or historic gages on the proposed ISF reach. Due to limited available data, CWCB staff installed a temporary streamflow gage on the North Fork Little Thompson River in July of 2017 at a bridge approximately 0.5 miles upstream from the lower terminus. This gage was operated between July 27, 2017 and March 16, 2018. This location did not provide a good hydraulic control and was impacted by accumulation of leaf debris in the fall and winter. On March 22, 2018, the gage was moved upstream approximately 1 mile. This location is where the stream flows through a bedrock channel and provides a stable hydraulic control. The gage has a drainage area of 25.7 square miles, 7,650 feet average basin elevation, and 19.09 inches of average basin annual precipitation. There are no surface water diversions affecting the gage other than the BOR operations described above.

Due to the short period of record at the gage, staff examined a nearby streamgage, Little Thompson River at Canyon Mouth near Berthoud, CO (LYCANYCO) to assess how 2018 through 2020 compared hydrologically to a longer record. The Little Thompson River gage is located 5.8 miles southeast of the proposed lower terminus. The gage recorded data between 1961 to 1969, 1993 to 2013, and 2017 to present for a total of 33 years of record. This gage is affected by diversions but is one of the few long-term gages in proximity to the CWCB gage. The Little Thompson gage is a seasonal gage with an inconsistent amount of days where data was recorded each year, so an assessment of the total annual streamflow could not be done. However, Staff computed median flows at the Little Thompson gage and compared them to flows from 2018-2020. In comparison to historical flows, 2018 was extremely dry and experienced below median flows for the entirety of the year. 2019 was an exceptionally wet year and experienced above

median flows for the majority of the year. 2020 experienced an early and above median peak, but a dry spring and summer and flows fell much below average starting in late May.

Pole Hill Power Plant Data
Staff has coordinated with BOR staff regarding this ISF recommendation. The BOR provided staff with information about the timing of power plant operations. At times, routing C-BT water through the upper reaches of the North Fork Little Thompson appeared to coincide with short spikes of higher flows at the CWCB gage, suggesting that this operation provided additional water to the proposed ISF reach. However, at other times, these operations did not appear to result in higher flows at the CWCB gage.

The drainage basin of the North Fork Little Thompson that could potentially be captured in the rediversion structure is approximately 6.59 square miles, which is about 23.4% of the total drainage basin for the proposed ISF. The exact amount of native water inadvertently captured cannot be directly measured, but the loss of this water is reflected in the CWCB gage data. At this time, staff has concluded that no more analysis or data collection is necessary.

Representative Gage Analysis
Because the Little Thompson at Canyon Mouth gage has a longer period of record, it was also used to estimate streamflow on the North Fork Little Thompson River. The Little Thompson River gage has a drainage basin of 100 square miles, an average elevation of 7,503 feet, and average precipitation of 19.6 inches. There are approximately 11 cfs of decreed water rights and 1,900 AF of decreed storage in the basin. This gage is likely to be more heavily impacted by water use than North Fork Little Thompson. The use of this gage in the analysis likely under-estimates streamflow on North Fork Little Thompson.

The area-precipitation method was used to scale the Little Thompson River gage to the lower terminus of North Fork Little Thompson. The method estimates streamflow based on the ratio of the precipitation weighted drainage area. The scaling factor for North Fork Little Thompson at the lower terminus is 0.27. Median streamflow and 95% confidence intervals for median streamflow were calculated.

Landowner Comments
In addition to the CWCB gage data and streamflow measurements, staff has been in contact with a local landowner who has owned and resided on land adjacent to the North Fork Little Thompson since 1989. During their time in the area, they have observed a range of hydrologic conditions on the River. The landowner has kept record of the presence of water at their property since 1991. In the 1990s, they often experienced water year-round, but since 2000, years with year-round flow have been rare. From the landowner's records, flow was fairly consistent between April and the end of June.

CWCB Staff Measurements
CWCB staff made 21 streamflow measurements to support development of a rating curve for the temporary gage and provide additional information.

Table 3. Summary of Streamflow Measurement Visits and Results for North Fork Little Thompson River.

Visit Date	Flow (cfs)	Collector
07/27/2017	0.05	CWCB
08/07/2017	2.00	CWCB
09/13/2017	0.01	CWCB
09/29/2017	0.53	CWCB
10/18/2017	0.63	CWCB
12/06/2017	0.17	CWCB
03/02/2018	0.12	CWCB
03/16/2018	0.16	CWCB
03/16/2018	0.15	CWCB
03/22/2018	0.17	CWCB
04/23/2018	0.43	CWCB
04/30/2018	2.78	CWCB
04/15/2019	0.76	CWCB
05/29/2019	11.17	CWCB
07/15/2019	3.38	CWCB
09/19/2019	0.06	CWCB
05/13/2020	4.92	CWCB
05/13/2020	2.82	CWCB
05/19/2020	2.82	CWCB

Water Availability Summary

The Complete Hydrograph shows streamflow data, streamflow measurements, the prorated Little Thompson gage daily median flows with 95% confidence intervals, and the proposed ISF. Due to the variability of hydrologic conditions during the period of record of the CWCB gage, the Little Thompson gage likely provides the best indication of seasonality of the North Fork Little Thompson. Additionally, information from the landowner indicates that flows typically occur during April through July on the North Fork Little Thompson. With the exception of 2018, the temporary gage data demonstrates that the recommended flow rates occur during these time frames. Based on measurements at the gage, the prorated Little Thompson gage and information from the long-term landowner, Staff has concluded that water is available for a seasonal ISF.

Material Injury
Because the proposed ISF on North Fork Little Thompson River is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2020), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations
Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

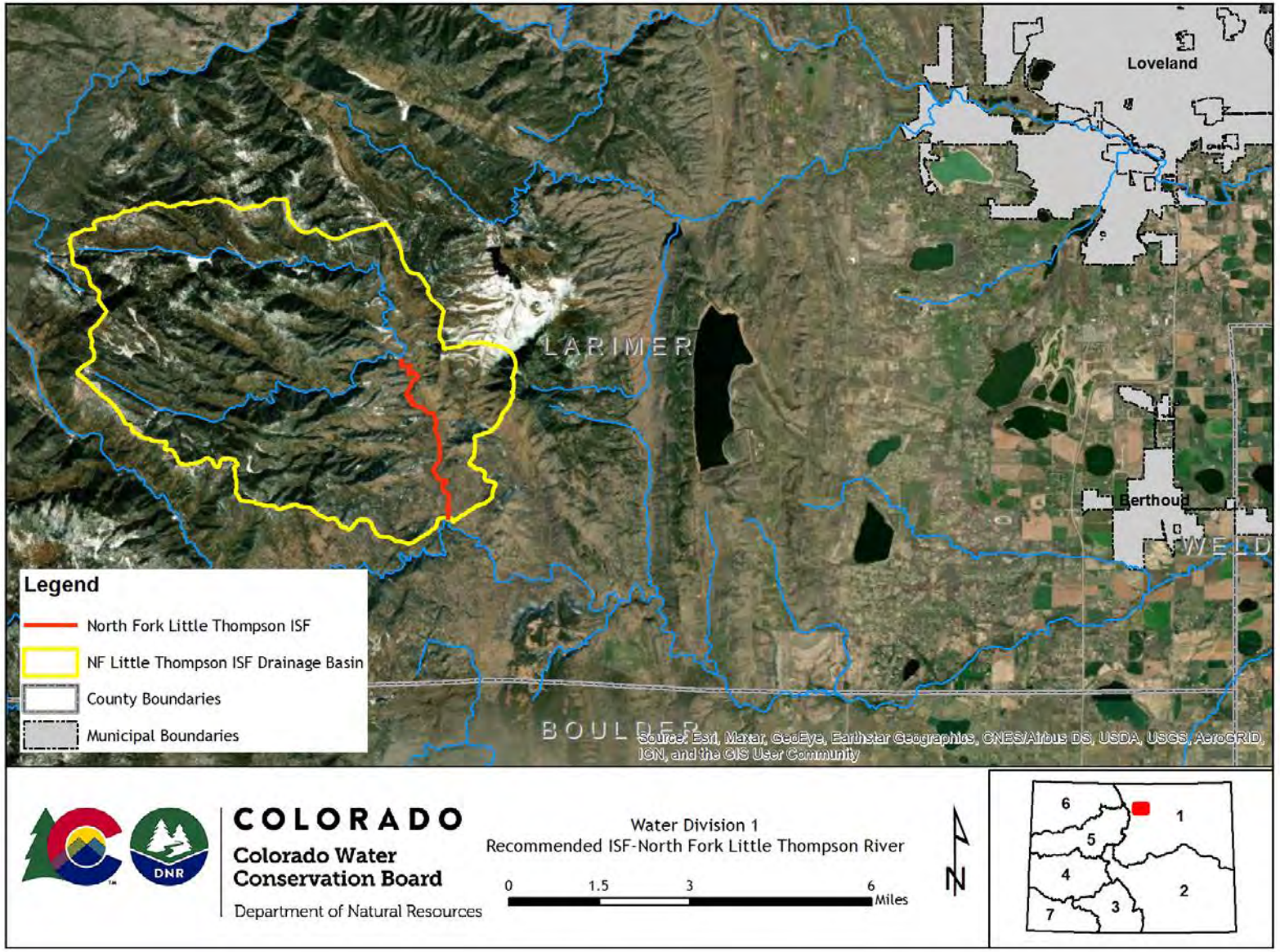
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

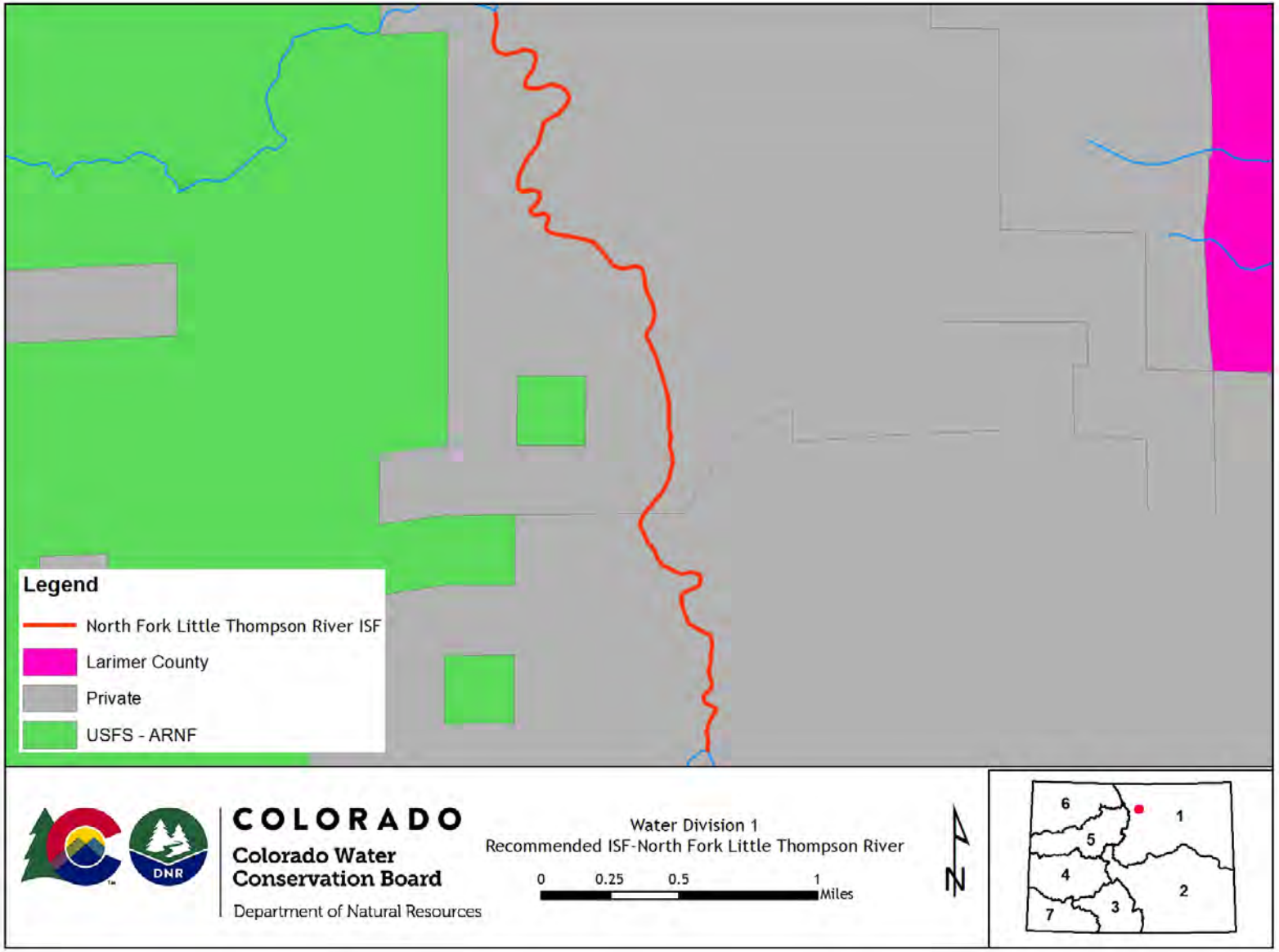
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

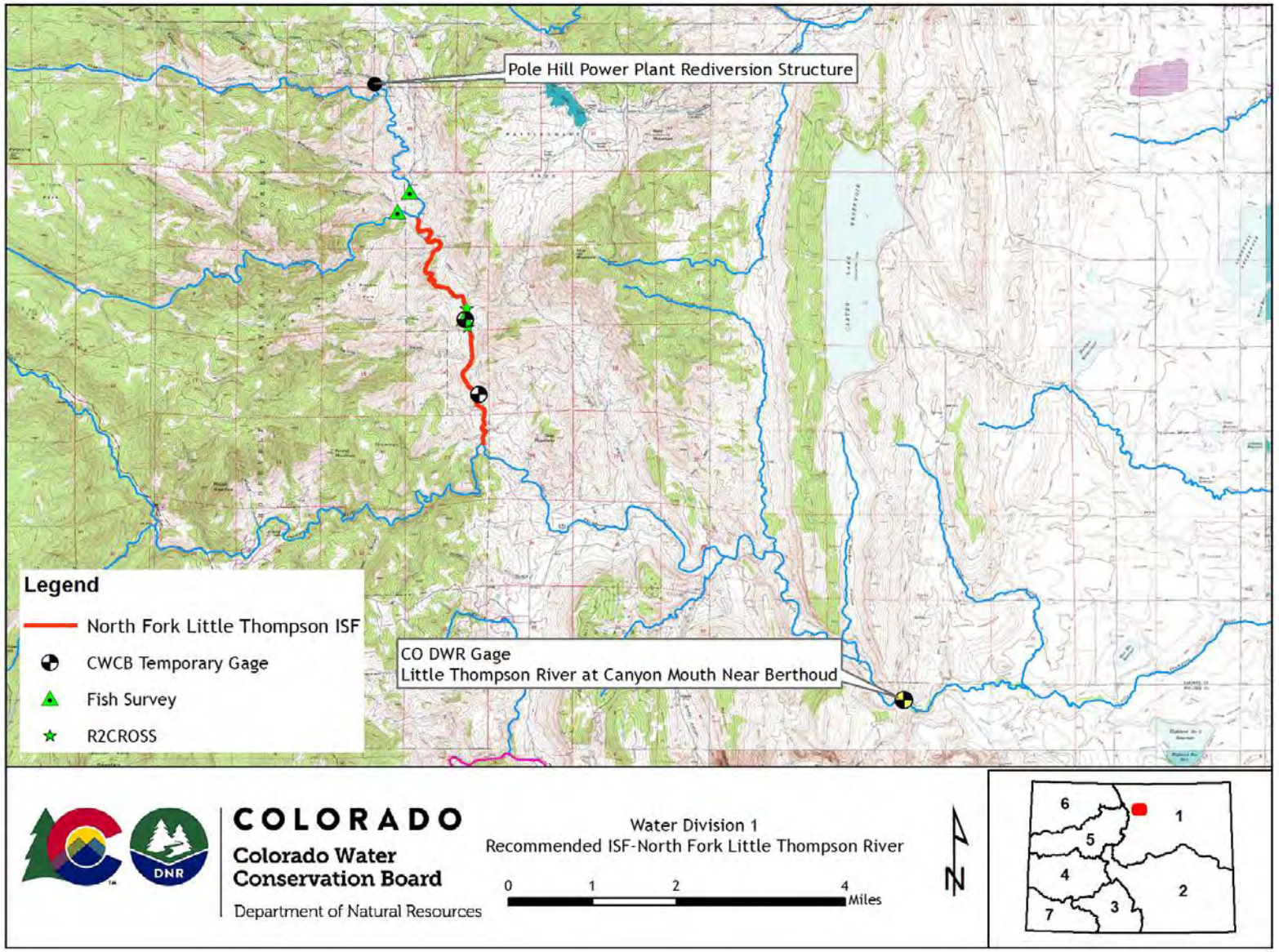
VICINITY MAP



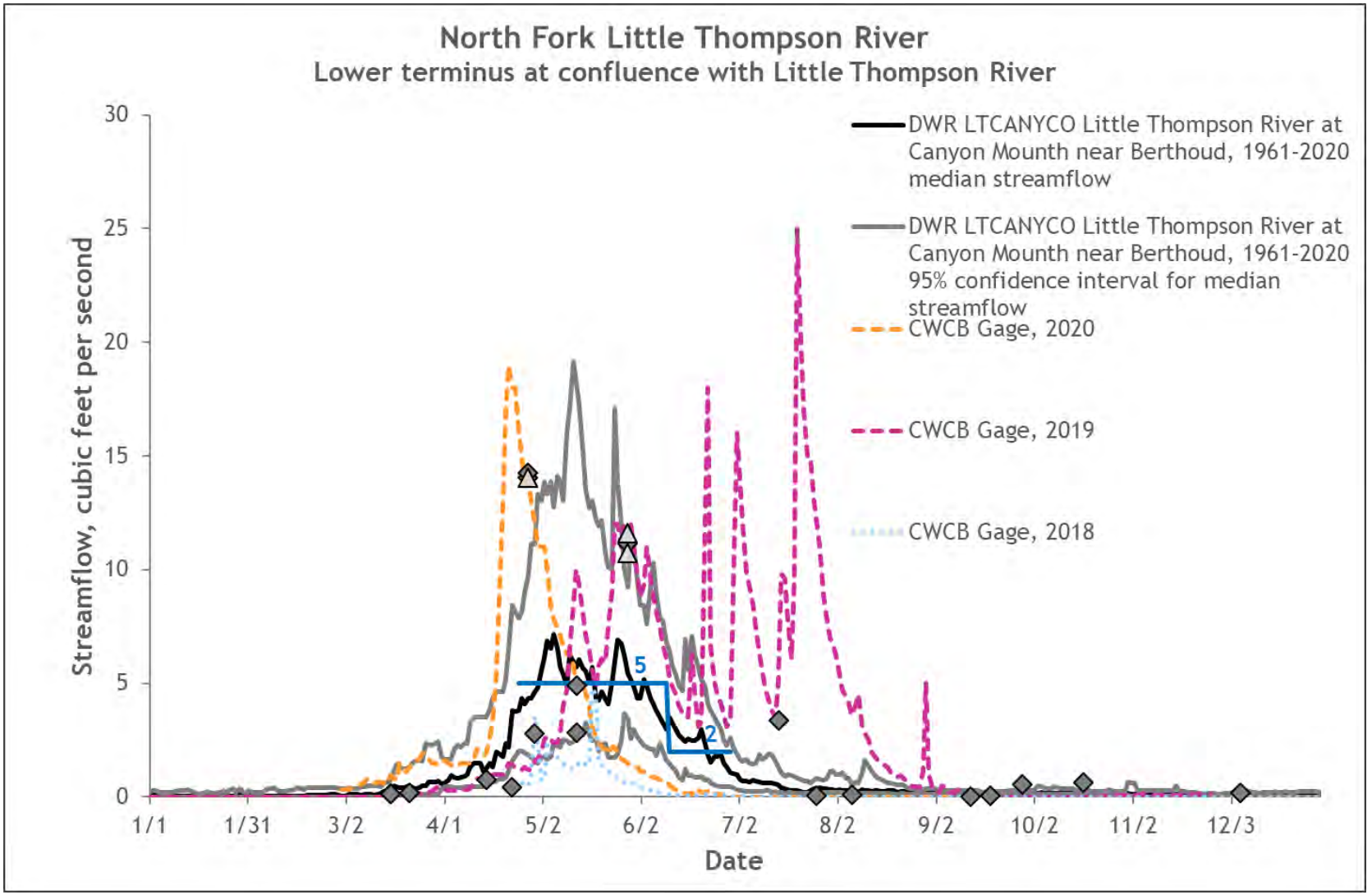
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



Redstone Creek Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
January 25-26, 2021

UPPER TERMINUS:	headwaters UTM North: 4496738.38	UTM East: 472174.81
LOWER TERMINUS:	confluence Buckhorn Creek UTM North: 4480748.18	UTM East: 482372.71
WATER DIVISION:	1	
WATER DISTRICT:	4	
COUNTY:	Larimer	
WATERSHED:	Big Thompson	
CWCB ID:	20/1/A-001	
RECOMMENDER:	Colorado Parks and Wildlife, Larimer County Department of Natural Resources (CPW, LCDNR)	
LENGTH:	16.33 miles	
FLOW RECOMMENDATION:	6.2 cfs (05/01 – 06/15)	

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Introduction

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.

Colorado Parks and Wildlife (CPW) and Larimer County Department of Natural Resources (LCDNR) recommended that the CWCB appropriate an ISF water right on a reach of Redstone Creek because it has a natural environment that can be preserved to a reasonable degree. The proposed reach extends from the headwaters downstream to the confluence with Buckhorn Creek. Redstone Creek is located within Larimer County near Masonville (See Vicinity Map), and originates on the north side of Buckhorn Mountain at an elevation of approximately 7,500 feet. Redstone Creek flows in a southerly direction for 16 miles before it joins Buckhorn Creek at an elevation of 5,350 feet. Ninety-eight percent of the land on the 16.33 mile proposed reach is privately owned, 1% of the land is owned by Larimer County and the remaining 1% is owned by the Northern Colorado Water Conservancy District (See Land Ownership Map).

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/2021-isf-recommendations.

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 is used to provide the Board with a basis for determining that a natural environment exists.

Redstone Creek contains a variety of stream features, large woody debris, and shade from the riparian community providing good fish habitat in the stream. The lower portion of the reach on Larimer County Open Land is low gradient and characterized by a mixture of riffles, runs, glides and pools. Substrate varies from medium sized cobble to sand.

CPW documented creek chub, longnose dace, and white sucker populations in Redstone Creek in 1993. No fish were observed during recent site visits, but macroinvertebrate populations are present, including: caddisfly adults and nymphs, mayfly nymphs, diptera larvae, and water striders. A wide range of birds and wildlife have also been noted in the area, including golden eagles, elk, and western rattlesnake.

The riparian community includes well-established mature cottonwood gallery forests and junipers along the recommended reach. Upland species in the basin include mountain mahogany

and Bell's twin pod. Bell's twin pod is a species endemic to the northern Front Range and is considered to be imperiled at a global and state level by the Colorado Natural Heritage program.

Table 1. List of species identified in Redstone Creek.

Species Name	Scientific Name	Protection Status
creek chub	*Semotilus atromaculatus*	None
longnose sucker*	*Catostomus catostomus*	None
white sucker*	*Catostomus commersonii*	None
caddisfly	*Trichoptera*	None
fly larve	*Diptera*	None
Mayfly	*Ephemeroptera*	None
Bell's twin pod	*Physaria bellii*	State and globally imperiled
Cottonwood	*Populus spp.*	None

*indicates fish species native to Colorado (East slope)

ISF Quantification

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. 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 methodology 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). Riffles are a stream habitat type that are most easily visualized as sections of the stream that would dry up first should streamflow cease. The data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: 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 interprets the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow recommendation is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides 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 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 6.15 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 Redstone Creek.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
05/30/2019, 1	23.90	11.56	4.62 - 28.90	Out of range	Out of range
05/30/2019, 2	24.50	11.41	4.56 - 28.53	Out of range	7.33
04/29/2020, 3	23.29	12.00	4.80 - 30.00	Out of range	4.96
			Mean		6.15

ISF Recommendation

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

6.2 cfs is recommended from May 1 through June 15. This flow rate will provide adequate depth and percent wetted perimeter across the surveyed riffles, although velocity of 1 ft/s is not met in the widest riffle cross-section.

CPW does not recommend a winter recommendation due to water availability.

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.

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 streamflows 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) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be 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; 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 Redstone Creek is 30.9 square miles, with an average elevation of 6,690 feet and average annual precipitation of 19.59 inches (See the Hydrologic Features Map). Redstone Creek experiences flashy spring flows driven by low elevation snow melt and rain events. The hydrology is driven by melt from low elevation snowpack, with the highest elevation of contributing snowpack at no more than 8,300 feet. Groundwater seeps have been observed by CWCB staff during spring snow melt. Flows in the stream typically recede in mid to late summer.

There is one decreed surface water diversion, Soderberg Bros Ditch 1 (WDID 400882, appropriation date 1971, 2 cfs) located 8.5 miles upstream from the lower terminus. Lastly, there are a large number of small ponds that total 26.5 AF of decreed storage in the basin. Due to limited surface water diversions and storage, hydrology in the basin largely reflects natural flow patterns.

Data Analysis

CWCB Gage

There is no current or historic gage on Redstone Creek. Due to the limited available data, CWCB staff installed a temporary gage near the location of the lower terminus. This gage location records the impacts from consumptive uses in the basin. The gage was operated from June 2019 to present. Median hydrology was not calculated due to the short period of record.

Due to the short period of record, staff evaluated the Buckhorn Creek near Masonville, CO gage (USGS 06739500, period of record 1947-1955, 1959-1977, and 1993 – present), located 3.2 miles south of the proposed lower terminus, to assess how 2019 and 2020 compared hydrologically to a longer record. The Buckhorn gage changed to a seasonal gage in 2014, so the total annual streamflow could not be assessed. However, in comparison to median flows, 2019 had a late and above average runoff flow followed by a dry summer that lead to flows quickly receding to

median around mid-July. In 2020, runoff peaked quite a bit earlier than typical, and a dry spring and summer lead to flows well below median starting in mid-May and continuing for the remainder of the year.

Representative Gage Analysis
Because the Buckhorn Creek near Masonville gage has a longer period of record, it was also used to estimate streamflow on Redstone Creek. The Buckhorn Creek gage has a drainage basin of 135 square miles, average precipitation of 20.42 inches, and an average elevation of 7,403 feet. There are approximately 75 cfs of decreed water rights and 2,500 AF of decreed storage in the basin. This gage is more heavily impacted by water use than Redstone Creek. The use of this gage in the analysis likely under-estimates streamflow on Redstone Creek.

The area-precipitation method was used to scale the Buckhorn Creek gage to the lower terminus of Redstone Creek. The method estimates streamflow based on the ratio of the precipitation weighted drainage area. The scaling factor for Redstone Creek basin at the lower terminus is 0.22. Median streamflow and 95% confidence intervals for median streamflow were calculated.

CWCB Staff Measurements
CWCB staff made five streamflow measurements on the proposed reach of Redstone Creek to support development of a rating curve for the temporary gage and provide additional information as summarized in Table 3.

Table 3. Summary of Streamflow Measurement Visits and Results for Redstone Creek.

Visit Date	Flow (cfs)	Collector
05/13/2020	4.82	CWCB
4/29/2020	11.56	CWCB
4/29/2020	12.44	CWCB
7/15/2019	1.02	CWCB
6/5/2019	5.66	CWCB

Water Availability Summary
The Complete Hydrograph shows streamflow collected at the CWCB gage, the prorated Buckhorn Creek gage daily median flows with 95% confidence intervals, and the proposed ISF rate. Knowing that 2020 runoff occurred earlier than typical, staff determined that the recommended flow rate likely does not occur until May 1st in most years. Additionally, the recommended flow rate is generally below the median of the prorated Buckhorn Creek gage and below the upper 95% confidence interval for median flow at all times. This is a seasonal recommendation because the CWCB gage did not record baseflows in 2019 or 2020. Based on the available information and the observed patterns of streamflow on Redstone Creek, staff believes that water is available for a seasonal ISF appropriation.

Material Injury
Because the proposed ISF on Redstone Creek is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2020), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations
Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

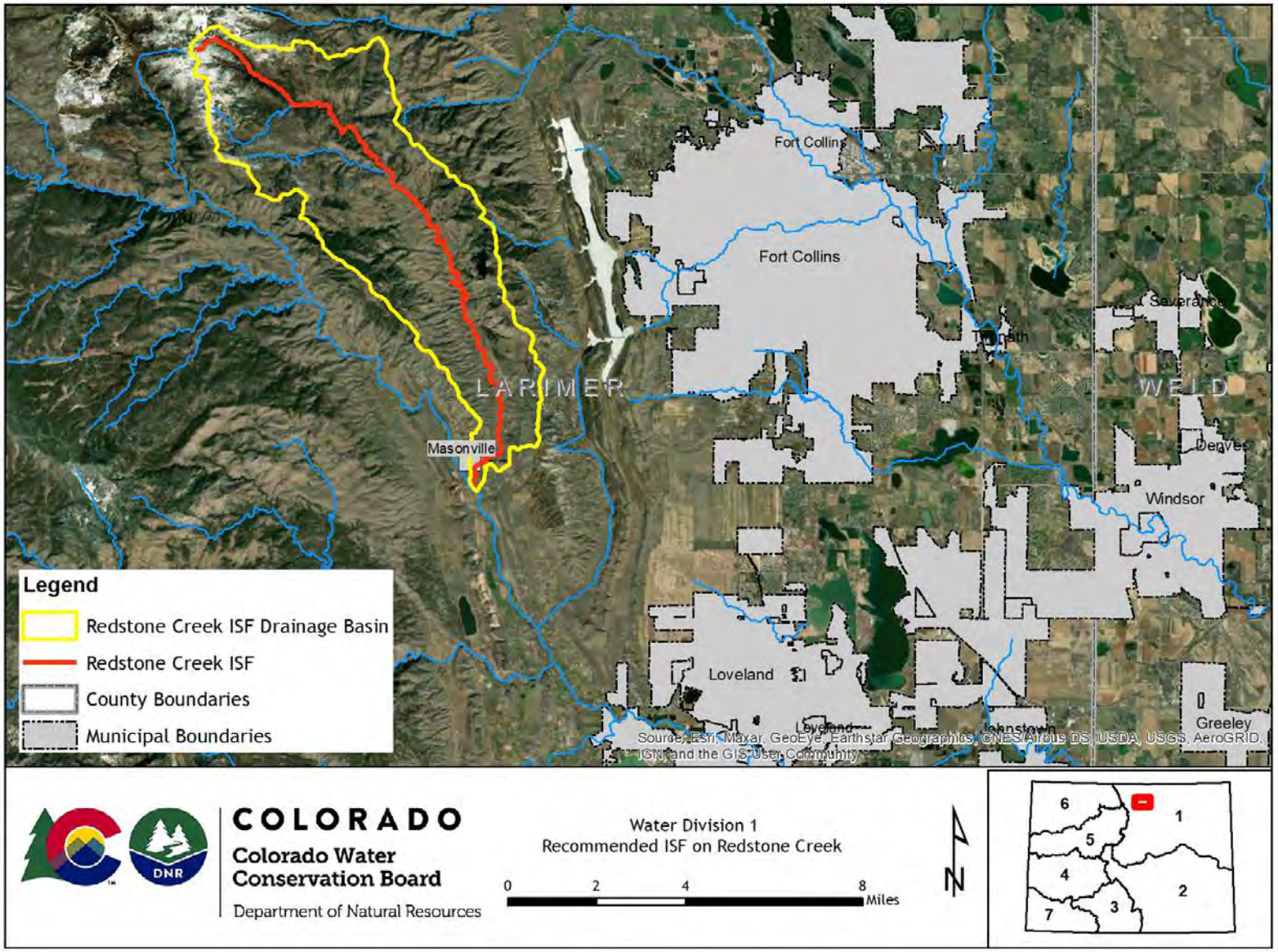
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

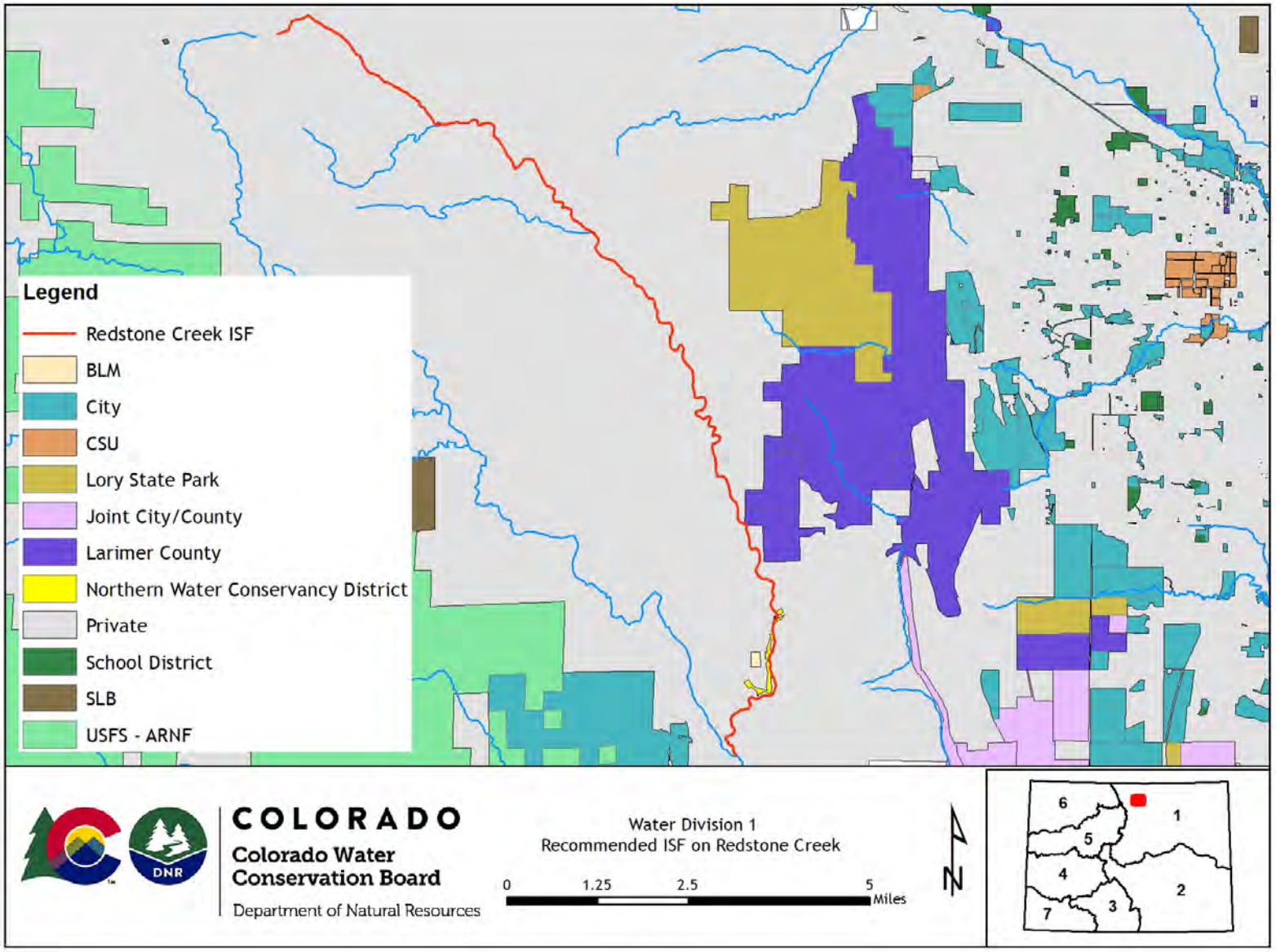
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

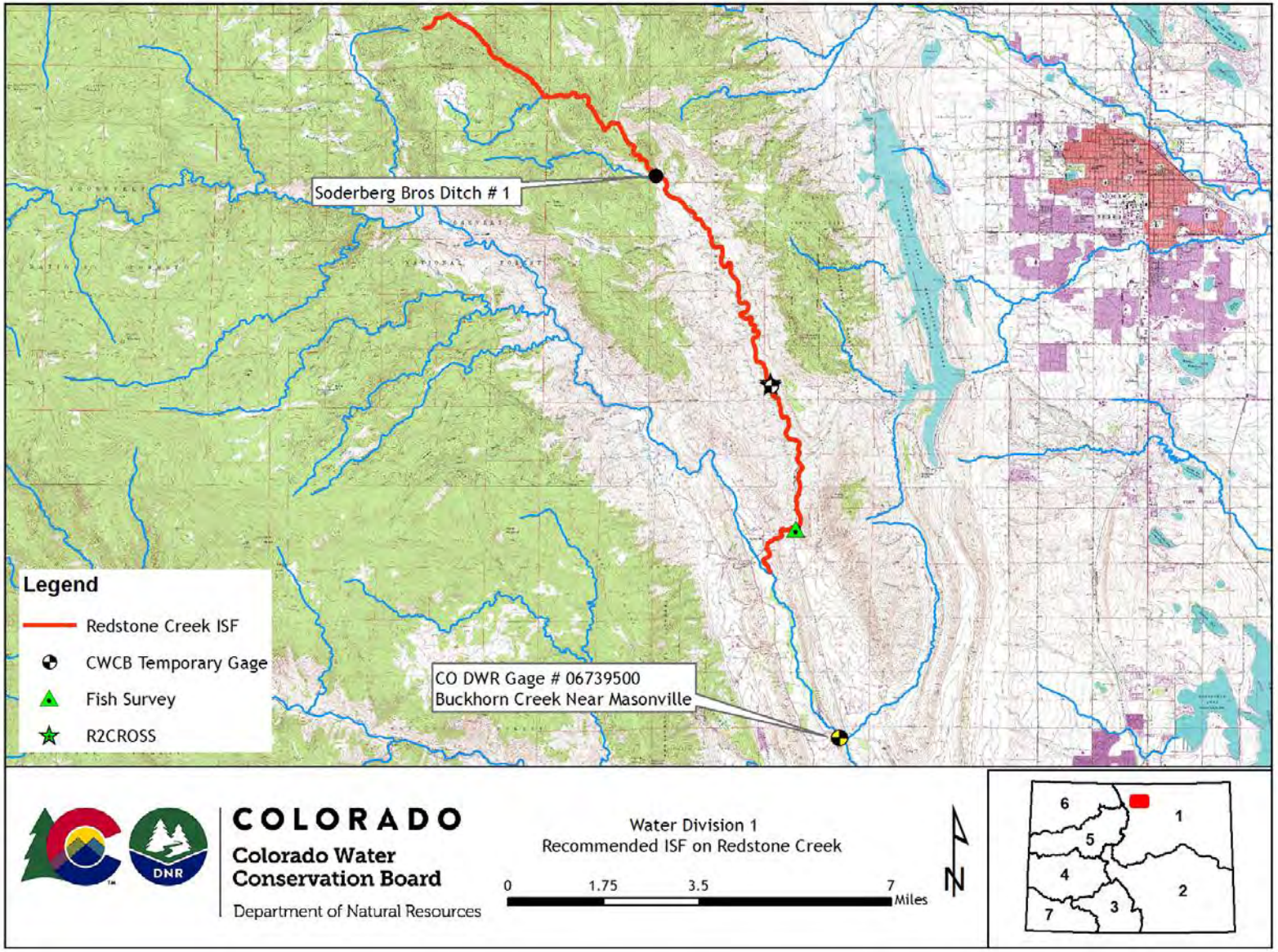
VICINITY MAP



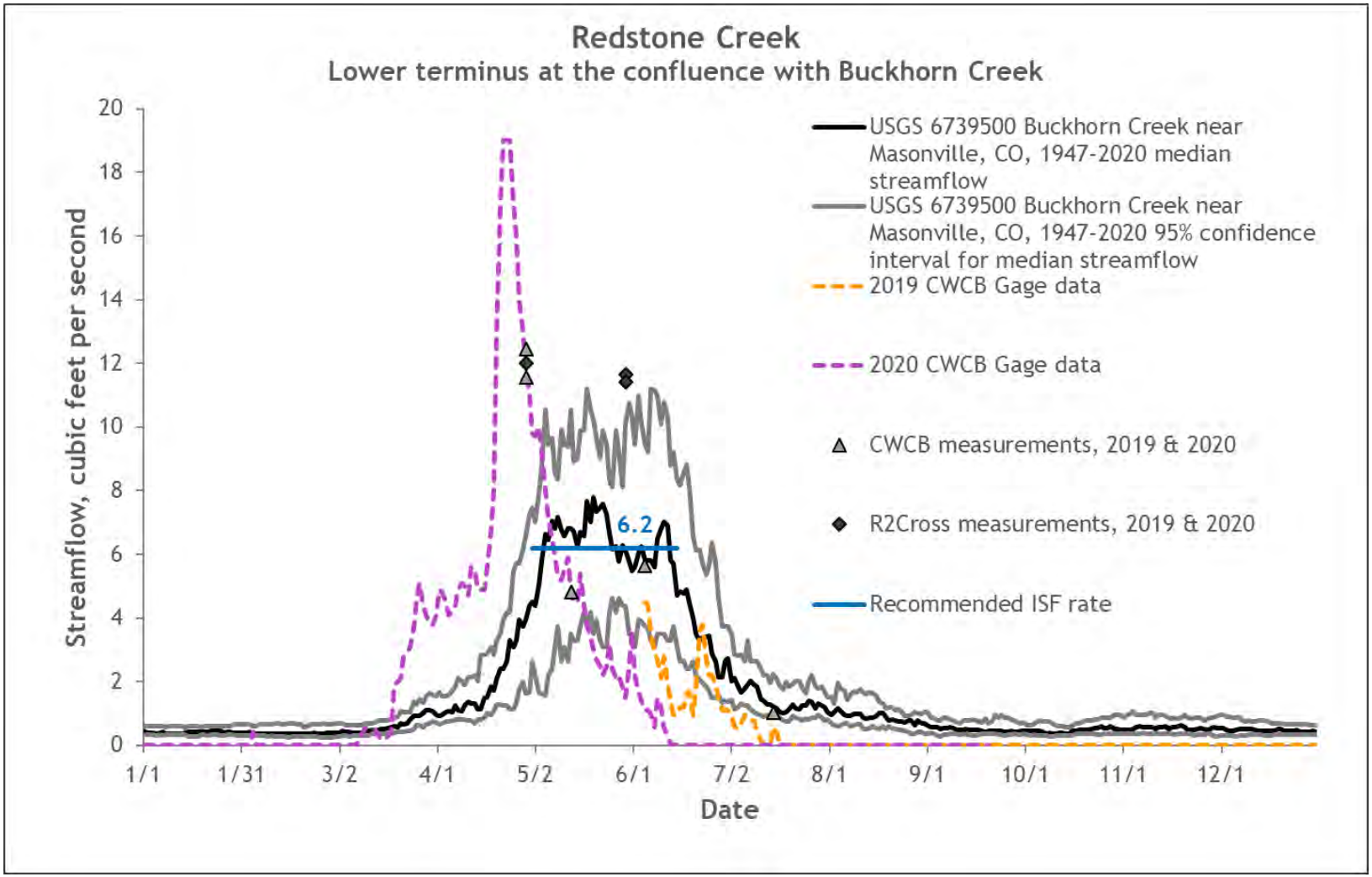
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



Elk Creek Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
January 25-26, 2021

UPPER TERMINUS:	headwaters UTM North: 4306042.49 UTM East: 320535.44
LOWER TERMINUS:	confluence Coal Creek UTM North: 4302804.98 UTM East: 321286.22
WATER DIVISION:	4
WATER DISTRICT:	59
COUNTY:	Gunnison
WATERSHED:	East-Taylor
CWCB ID:	21/4/A-006
RECOMMENDER:	High Country Conservation Advocates (HCCA)
LENGTH:	2.66 miles
FLOW RECOMMENDATION:	0.2 cfs (08/16 - 04/30) 1.5 cfs (05/01 - 07/10) 0.65 cfs (07/11 – 08/15)

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Introduction

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.

High Country Conservation Advocates (HCCA) recommended that the CWCB appropriate an ISF water right on a reach of Elk Creek because it has a natural environment that can be preserved to a reasonable degree. The proposed reach extends from Elk Creek's headwaters downstream to the confluence with Coal Creek. Elk Creek is located within Gunnison County (See Vicinity Map), and originates about 4.5 miles west of the Town of Crested Butte in the Gunnison National Forest at an elevation of approximately 11,500 feet. It flows in a southeasterly direction for 2.66 miles until the confluence with Coal Creek at an elevation of 9,500 feet. Ninety percent of the land on the 2.66 mile proposed reach is owned and managed by the U.S. Forest Service, and 10% is privately owned (See Land Ownership Map).

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/2021-isf-recommendations.

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 is used to provide the Board with a basis for determining that a natural environment exists.

Elk Creek is a cold-water, high gradient stream. The stream channel is a mixture of cascades and small pools with cobble-sized substrate, some large boulders, and ample woody debris. Elk Creek has been impacted by historic mining operations. The Environmental Protection Agency (EPA) recently completed reclamation at the Standard Mine Superfund Site to improve the water quality of Elk Creek.

The riparian zone is in good condition with a robust pine-spruce forest, providing ample shade for the aquatic ecosystem. EPA and Colorado Parks and Wildlife (CPW) identified brook trout and rainbow trout in lower Elk Creek. These populations are believe to be self-sustaining because Elk Creek is not stocked. Numerous macroinvertebrates have been observed, along with a tiger salamander.

Table 1. List of species identified in Elk Creek.

Species Name	Scientific Name	Protection Status
tiger salamander	*Ambystoma tigrinum*	None
rainbow trout	*Oncorhynchus mykiss*	None
brook trout	*Salvelinus fontinalis*	None
mayfly	*Ephemeroptera*	None

ISF Quantification

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. 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 methodology 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). Riffles are a stream habitat type that are most easily visualized as sections of the stream that would dry up first should streamflow cease. The data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: 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 interprets the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow recommendation is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides 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 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 0.75 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a

summer flow of 1.51 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 Elk Creek.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
10/03/2019, 1	8.80	0.12	0.05 - 0.30	0.20	Out of range
06/24/2020, 2	7.70	2.31	0.92 - 5.78	1.30	1.51
			Mean	0.75	1.51

ISF Recommendation

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

0.2 cfs is recommended from August 16 to April 30. This recommendation is limited by water availability, but will protect the natural environment during the base flow period.

1.5 cfs is recommended from May 1 to July 10 to protect the natural environment during summer months.

0.65 cfs is recommended from July 11 to August 15. This recommendation is limited by water availability, but will protect late summer flows.

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.

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 streamflows 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) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be 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; 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 Elk Creek is 1.68 square miles, with an average elevation of 10,955 feet and average annual precipitation of 33.75 inches (See the Hydrologic Features Map). There are no known surface water diversions in the basin tributary to the proposed reach or within the proposed reach. Due to the lack of surface water diversions, hydrology in this drainage basin represents natural flow conditions.

Available Data and Analysis

Gage Analysis

The EPA contracts with the USGS to operate the Elk Creek at Coal Creek above Crested Butte, CO gage (USGS 09110990) seasonally from April 1st to November 15th each year. This gage is located approximately 400 feet upstream from the proposed lower terminus. The period of record for this gage is October 17, 2017 to present. Median hydrology was not calculated due to the short period of record. Additionally, there are no surface water diversions on Elk Creek so no adjustments were made to the gage.

Because the gage is operated seasonally, staff evaluated methods to estimate missing winter data. Staff examined the nearby Slate River above Baxter Gulch at HWY 135 near Crested Butte, CO gage (USGS 385106106571000). The Slate River gage is located 5.75 miles east of the Elk Creek gage and has a period of record from 2006 to present. The drainage basin of the Slate River gage is 69 square miles, with an average elevation of 10,334 feet and average precipitation of 33.65 inches. The correlation between the Elk Creek gage and the Slate River gage produced a high r^2 value of 0.95. Staff used this correlation to fill data gaps in the winter months of the Elk Creek gage.

Climate Data

Due to the short period of record at the Elk Creek gage, staff evaluated the nearby streamgage, East River below Cement Creek near Crested Butte, CO (USGS 09112200) to assess how 2017 through 2020 compared hydrologically to a longer record. The gage recorded data during most years between 1963 and 2020 for a total of 38 years of records. The East River gage is located approximately 11 miles southeast of the Elk Creek gage. This gage is affected by diversions, but is a reasonable representation of hydrology because it is not affected by large reservoir releases. Based on this analysis, 2017 was near the 75th percentile for total annual streamflow and the fall of 2017 (when the Elk Cr gage was installed) was near median flows. 2018 was the third driest year on record. 2019 was near the 75th percentile for total annual streamflow. In analyzing median daily flow at the gage, the majority of this total annual flow was a result of

a high snowpack that peaked later than most years, but due to a dry summer, 2019 flows quickly dropped to median in early September. 2020 was in the 10th percentile for annual flows, with flows much below median for the majority of the spring and summer.

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

Table 3. Summary of Streamflow Measurement Visits and Results for Elk Creek.

Visit Date	Flow (cfs)	Collector
09/30/2020	0.16	CWCB

Water Availability Summary

The Complete Hydrograph shows the measured and estimated streamflows for the Elk Creek gage from 2017 to 2020, streamflow measurements, and the proposed ISF. The measured streamflow is generally above the proposed ISF, with the exception of portions of the known hydrologically dry year of 2018. Staff has concluded that water is available for appropriation.

Material Injury

Because the proposed ISF on Elk Creek is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2020), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations

Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

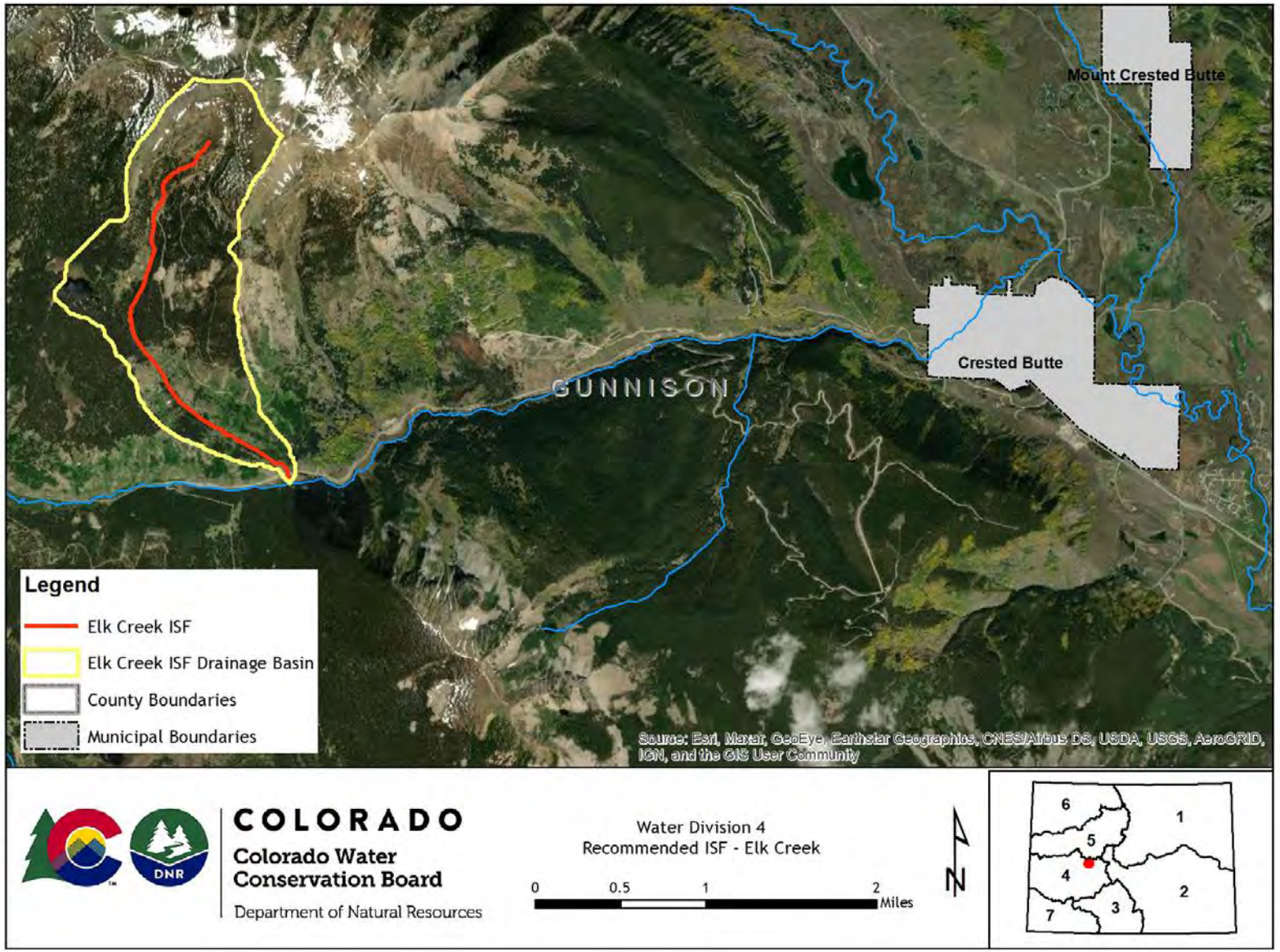
Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

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

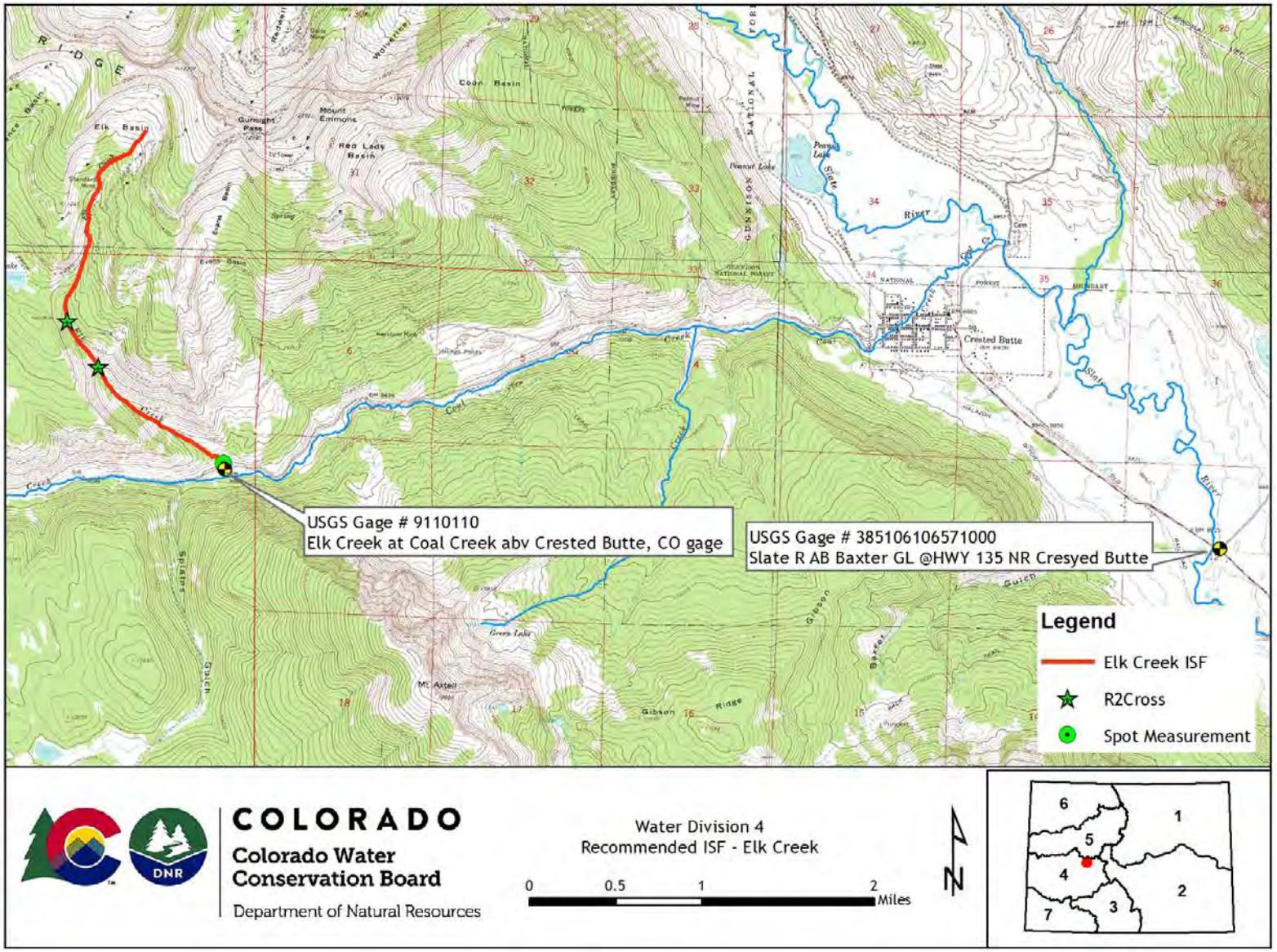
Projected Coordinate System: NAD 1983 UTM Zone 13N.

VICINITY MAP

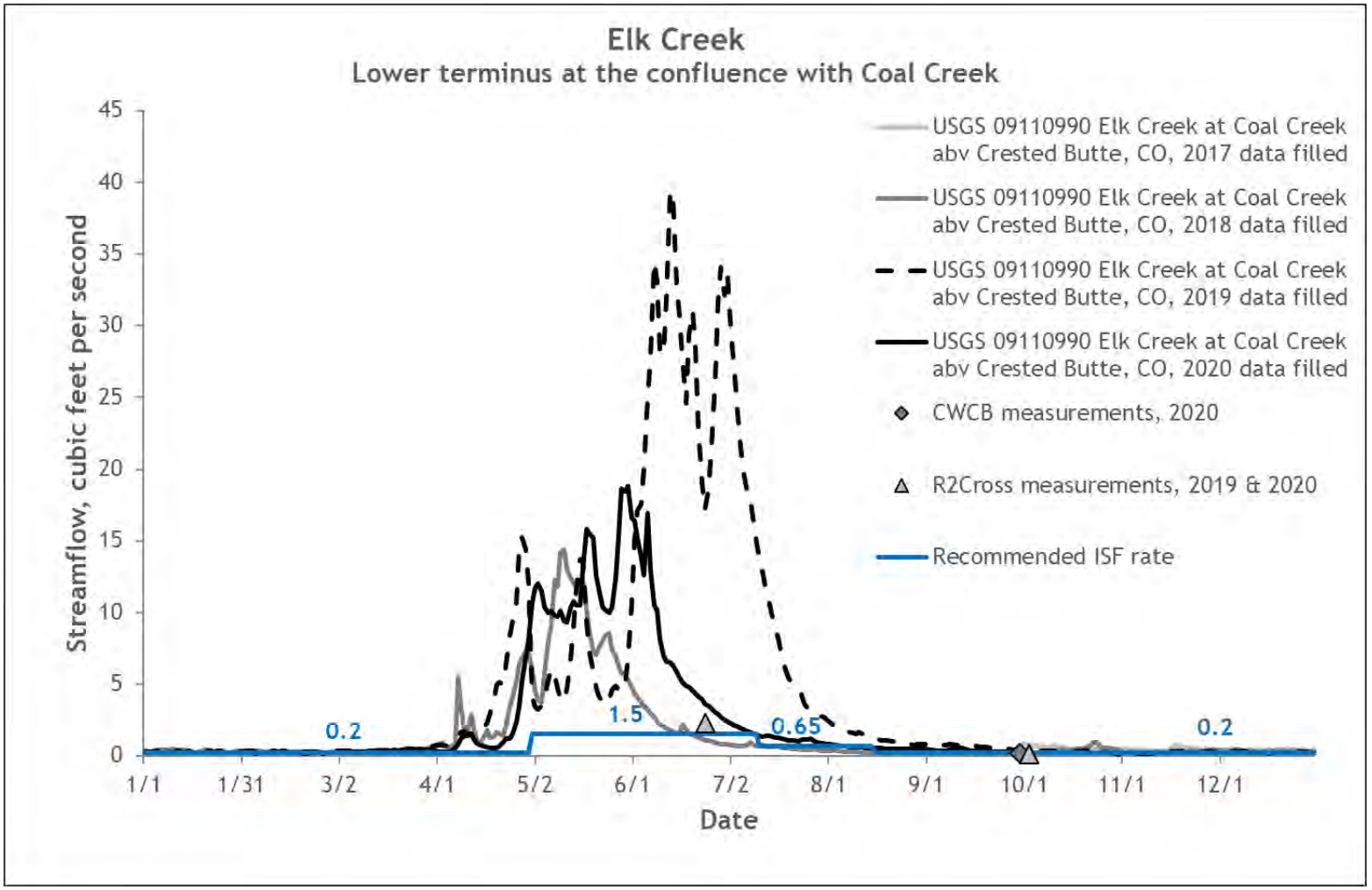


LAND OWNERSHIP MAP

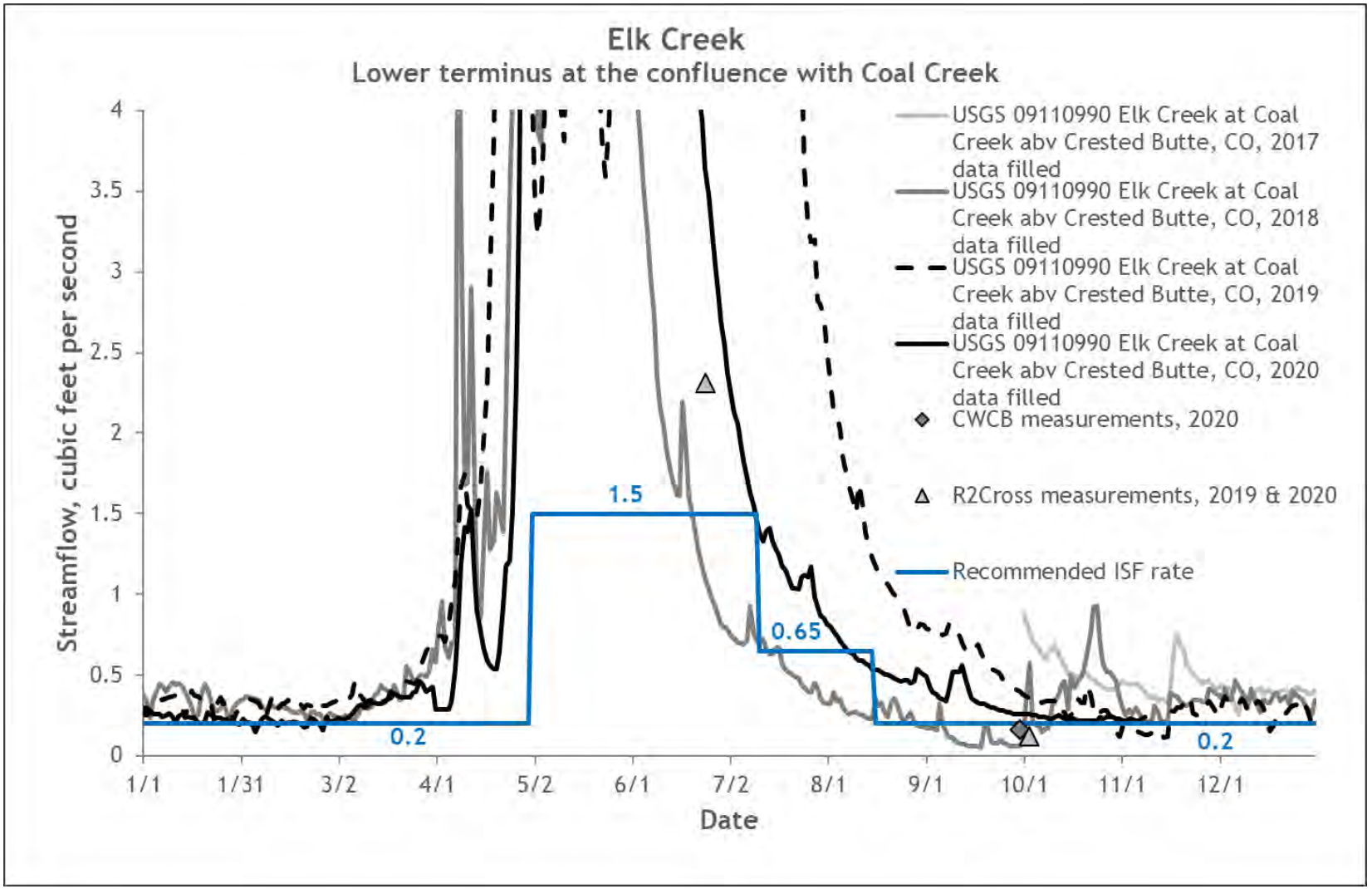
HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH



Wildcat Creek Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
January 25-26, 2021

UPPER TERMINUS:	outlet of Green Lake UTM North: 4301420.95 UTM East: 323800.20
LOWER TERMINUS:	confluence Coal Creek UTM North: 4304206.95 UTM East: 325687.24
WATER DIVISION:	4
WATER DISTRICT:	59
COUNTY:	Gunnison
WATERSHED:	East-Taylor
CWCB ID:	21/4/A-013
RECOMMENDER:	High Country Conservation Advocates (HCCA)
LENGTH:	2.48 miles
FLOW RECOMMENDATION:	0.35 cfs (12/1 - 03/31) 0.65 cfs (04/01 - 04/30) 2.1 cfs (05/01 - 08/31) 0.6 cfs (09/01 - 11/30)

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Introduction

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.

High Country Conservation Advocates (HCCA) recommended that the CWCB appropriate an ISF water right on a reach of Wildcat Creek because it has a natural environment that can be preserved to a reasonable degree. The proposed reach extends downstream from the outlet of Green Lake to the confluence with Coal Creek. Wildcat Creek is located within Gunnison County (See Vicinity Map), and originates in the Gunnison National Forest about 2.5 miles southwest of the Town of Crested Butte at an elevation of approximately 10,600 feet. It flows in a northeasterly direction for 2.48 miles before it joins Coal Creek at an elevation of 9,100 feet. Forty-five percent of the land on the proposed reach is privately owned, 30% is owned by the U.S. Forest Service, and 25% is owned by the Bureau of Land Management (BLM) (See Land Ownership Map). The BLM formally submitted a letter of support of HCCA's ISF recommendation on Wildcat Creek to the CWCB.

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/2021-isf-recommendations.

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 is used to provide the Board with a basis for determining that a natural environment exists.

Wildcat Creek is a cold-water stream that runs through a primarily pine-spruce forest at a high gradient. The stream's low water temperatures are protected by the north-facing aspect of the watershed. The substrate of Wildcat Creek ranges from small gravel to large cobble and some boulders. Pool-drop features are frequent in the channel due its steep nature and substantial woody debris forms a mixture of riffles and small pools. The riparian community along the recommended reach has been described by BLM and HCCA as robust and in very good condition. The spruce and pine provide ample shade for the aquatic ecosystem and findings of BLM's land health analysis indicate good water quality in this reach of stream.

The riparian community and variety of habitat in Wildcat Creek supports a healthy aquatic ecosystem. Colorado Park and Wildlife identified a substantial cutthroat trout population in 2008, though it has yet to identify their lineage. The BLM identified a diverse and robust

community of macroinvertebrate species in August of 2019. In addition, an abundance and variety of wildlife tracks were found along the stream banks during site visits.

Table 1. List of species identified in Wildcat Creek.

Species Name	Scientific Name	Protection Status
cutthroat trout- unknown lineage	*Oncorhynchus clarkii*	None
ameletus mayfly	*Ameletus Spp.*	None
blue quill mayfly	*Paraleptophlebia spp.*	None
blue-winged olive mayfly	*Baetis spp.*	None
dark red quills mayfly	*Cinygmula spp.*	None
spiny crawler mayfly	*Drunella doddsi*	None
western march brown mayfly	*Rhithrogena spp.*	None
capniidae stonefly	*Capniidae*	None
golden stonefly	*Hesperoperla pacifica*	None
green stonefly	*Choroperlidae*	None
sallfly stonefly	*Sweltsa spp.*	None
zapada stonefly	*Zapada spp.*	None
common forestfly stonefly	*Zapada cinctipes*	None
oregon forestfly stonefly	*Zapada oregonensis*	None
free-living caddisfly	*Rhyacophila brunnea-vemna*	None
neothremma caddisfly	*Neothremma spp.*	None
netspinning caddisfly	*Parapsyche elsis*	None
snow sedge caddisfly	*Psychoglypha spp.*	None
riffle beetle	*Heterlimnius corpulentus*	None
non-biting midge	*Chironomidae*	None
meringodixa midge larve	*Meringodixa spp.*	None
black fly larve	*Diptera*	None
pericoma moth fly larvae	*Pericoma spp.*	None
simulium black fly larvae	*Simulium spp.*	None
dance fly larvae	*Wiedemannia spp.*	None
lerbertia water mite	*Lebertia spp.*	None
sperchon mite	*Sperchon spp.*	None
springtail	*Collembola*	None
fingernail clam	*Pisidium spp.*	None
trombidiformes	*Trombidiformes*	None
worm	*Oligochaeta*	None

ISF Quantification
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. 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 methodology 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). Riffles are a stream habitat type that are most easily visualized as sections of the stream that would dry up first should streamflow cease. The data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: 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 interprets the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow recommendation is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides 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 Analysis
HCCA collected R2Cross data at 3 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 0.87 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a summer flow of 2.12 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 Wildcat Creek.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
10/09/2019, 1	10.40	0.28	0.11 - 0.70	0.36	Out of range
06/24/2020, 2	8.20	2.71	1.08 - 6.78	Out of range	2.44
06/24/2020, 3	11.45	2.77	1.11 - 6.93	1.38	1.79
			Mean	0.87	2.12

ISF Recommendation

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

0.35 cfs is recommended from December 1 through March 31. This flow rate was reduced due to water availability limitations, but will still protect base flows.

0.65 cfs is recommended from April 1 through April 30. This flow rate was reduced due to water availability limitations.

2.1 cfs is recommended from May 1 through August 31. This flow rate meets all 3 of the R2Cross criteria.

0.60 cfs is recommended from September 1 through November 30. This flow rate was 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.

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 streamflows 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) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion

records will also be 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; 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 Wildcat Creek is 2.0 square miles, with an average elevation of 10,370 feet and average annual precipitation of 31.12 inches (See the Hydrologic Features Map). The proposed upper terminus is Green Lake, which is a the CWCB decreed a NLL water right on in Case No. 77W3358 with an appropriation date of May 12, 1976.

The Town of Crested Butte has a water supply intake on Coal Creek located approximately 0.8 miles west of the proposed lower terminus. This structure, the Crested Butte Water Ditch and Wildcat Pipeline (WDID 5900842, 6 cfs, appropriation date 1893), has a decreed alternative point pipeline on Wildcat Creek that mostly serves as a backup intake for the system. The pipeline is located approximately 0.1 miles upstream from the proposed lower terminus. The intake to the system is continuously open, but the system does not have the ability to take the full decreed rate due to the size of the pipeline. The diversion structure currently does not have the ability to sweep the stream, but in an emergency, a temporary structure may be put in place to do so.

Data Analysis

StreamStats

There are no current or historic streamgages on the proposed ISF reach. The nearest gage is the Elk Creek at Coal Creek above Crested Butte, CO gage (USGS 9110990) located approximately 2.8 miles southwest from the proposed lower terminus. The gage is a seasonal gage, which operates from April to November in most years. The period of record for the gage is 2017 to 2020. Due to the short period of seasonal records, this gage was not used in this analysis. StreamStats provides the best available estimate of streamflow on Wildcat Creek. In addition, CWCB staff made one streamflow measurement on the proposed reach of Wildcat Creek as summarized in Table 3.

Table 3. Summary of Streamflow Measurement Visits and Results for Wildcat Creek.

Visit Date	Flow (cfs)	Collector
09/30/2020	0.05	CWCB

Diversion Adjustment
Staff spoke with the Director of Public Works from the Town of Crested Butte, who estimated that the Crested Butte Water Ditch and Wildcat Pipeline diverts approximately 5% of the water in the creek at low flows (Shea Early, personal communication, 12/9/2020). To account for diversions made at the Wildcat Pipeline, StreamStats estimates were adjusted down by approximately 5%.

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

Material Injury
Because the proposed ISF on Wildcat Creek is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2020), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations
Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

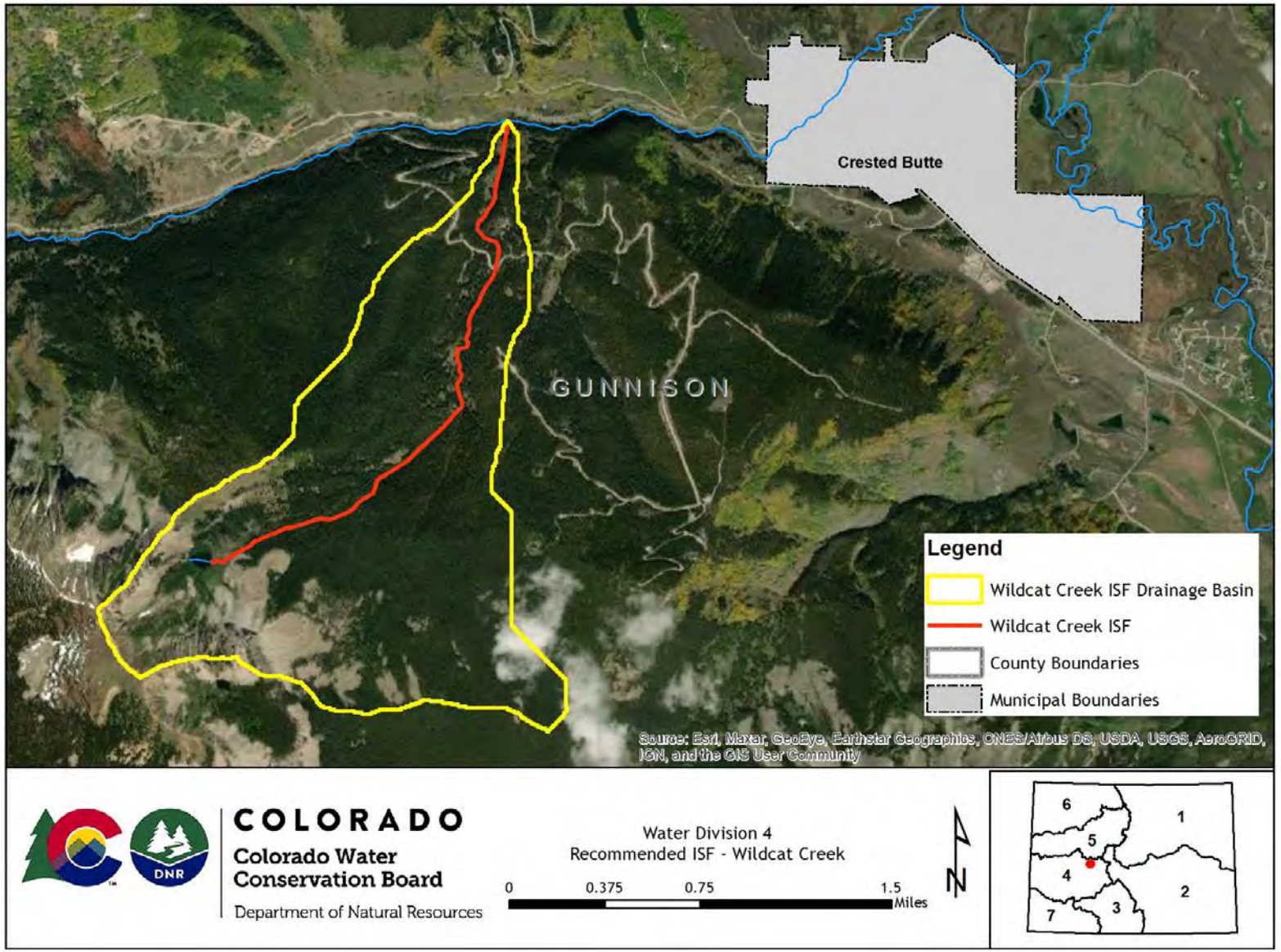
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

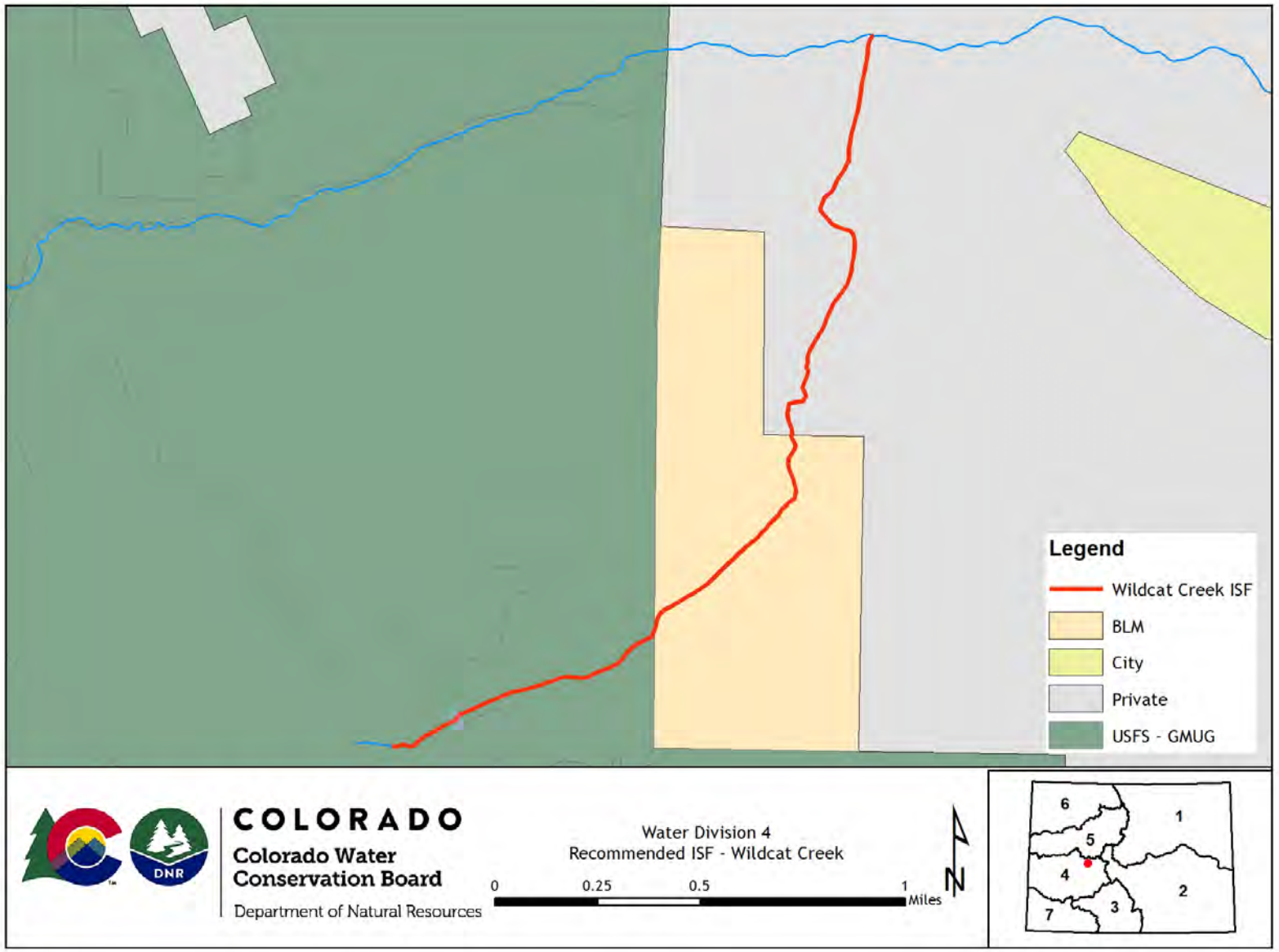
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

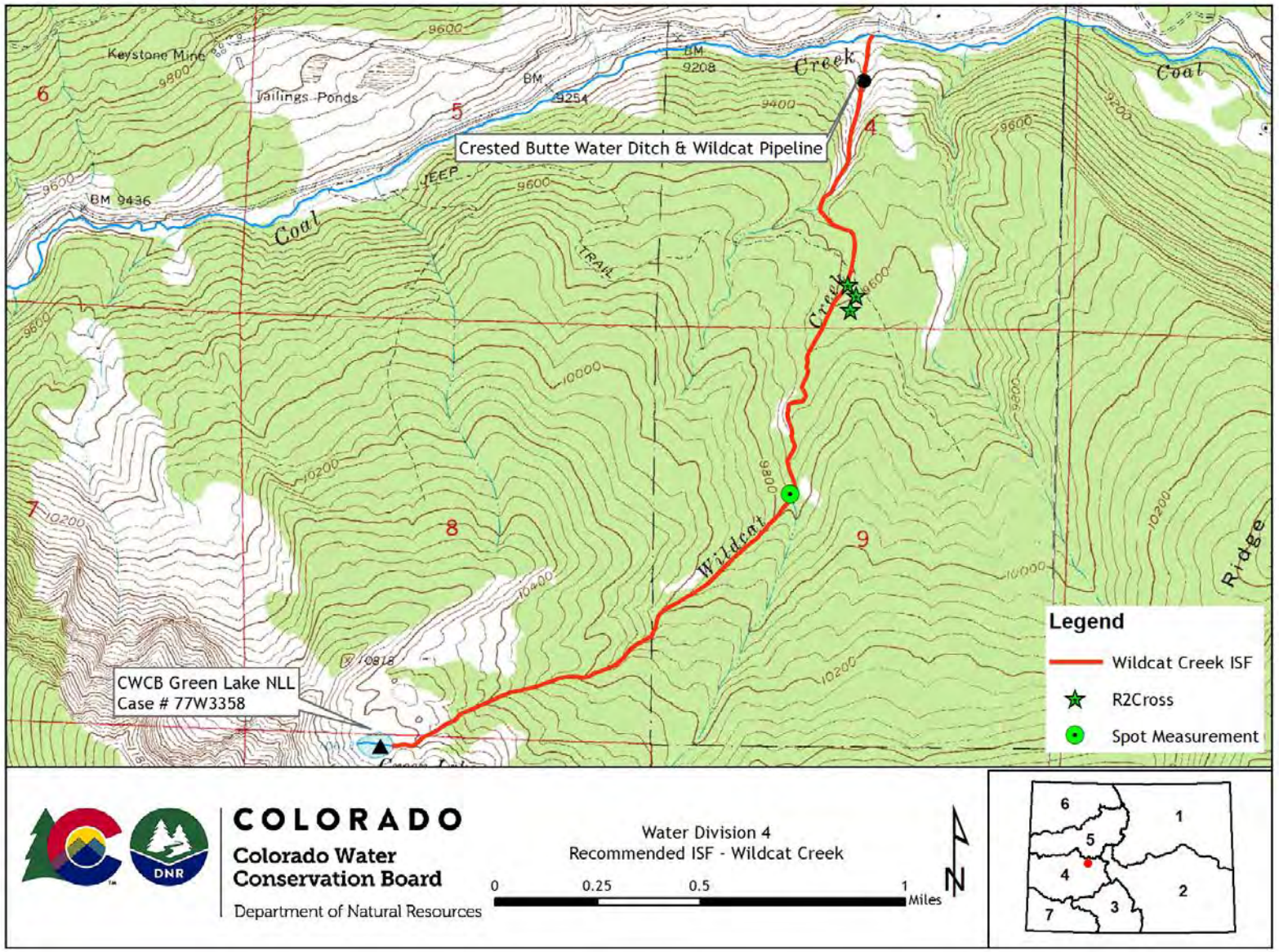
VICINITY MAP



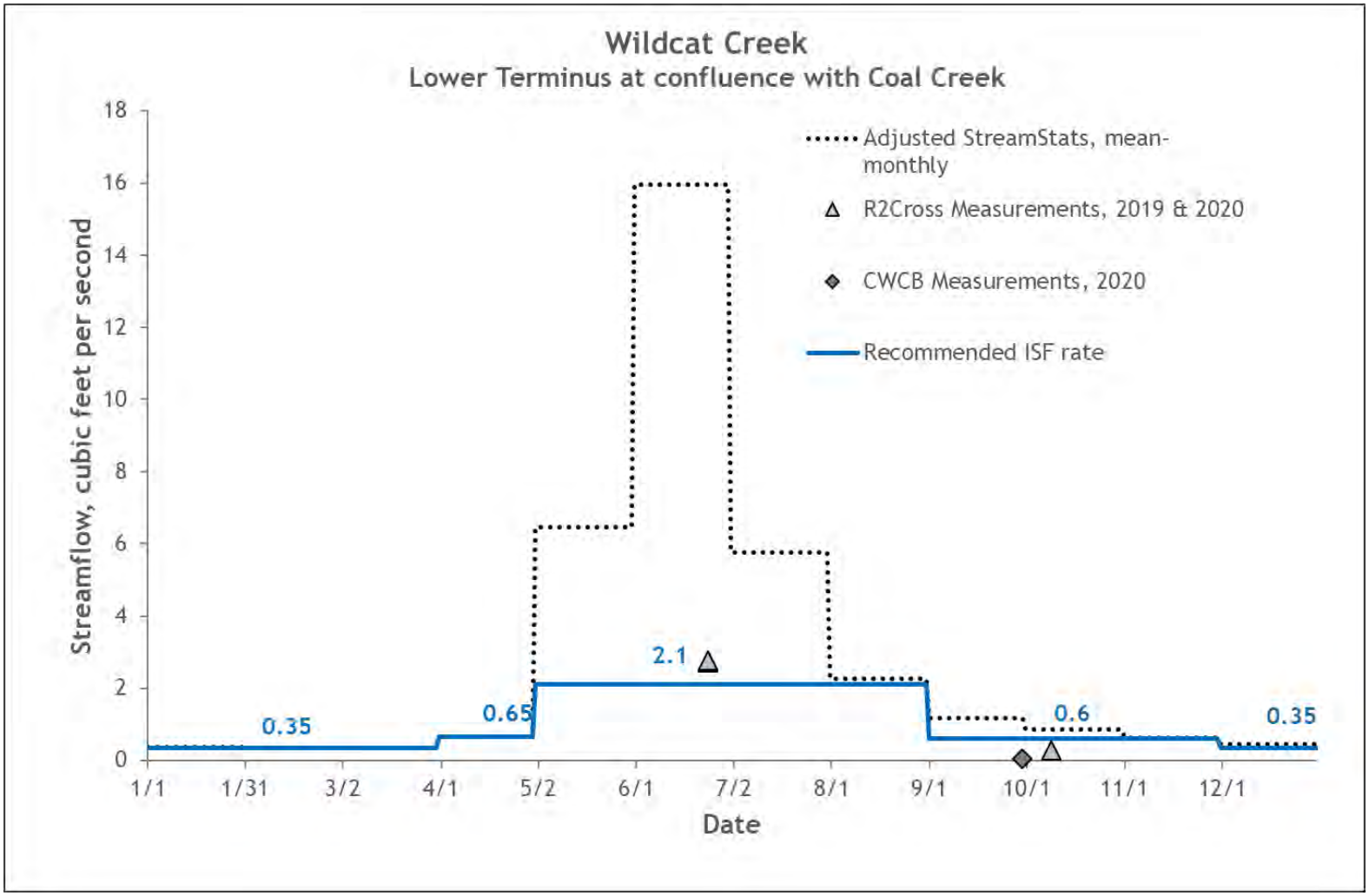
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



Watson Creek Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
January 25-26, 2021

UPPER TERMINUS:	confluence Moody Creek UTM North: 4442915.57 UTM East: 331641.39
LOWER TERMINUS:	Hardscrabble Ditch headgate UTM North: 4447907.65 UTM East: 335946.66
WATER DIVISION:	6
WATER DISTRICT:	58
COUNTY:	Routt
WATERSHED:	Upper Yampa
CWCB ID:	19/6/A-008
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	5.86 miles
FLOW RECOMMENDATION:	1.1 cfs (01/01 - 03/31) 1.9 cfs (04/01 - 06/21) 1.1 cfs (08/16 - 12/31)

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Introduction

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 Bureau of Land Management (BLM) recommended that the CWCB appropriate an ISF water right on a reach of Watson Creek because it has a natural environment that can be preserved to a reasonable degree. The proposed reach extends from the confluence with Moody Creek downstream to the Hardscrabble Ditch headgate. Watson Creek is located within Routt County (See Vicinity Map) about 1.5 miles east of the Town of Yampa. It originates in the Routt National Forest at an elevation of approximately 8,200 feet and it flows for 11 miles before it joins the Yampa River at an elevation of 7,600 feet. Ninety-three percent of the land on the 5.86 mile proposed reach is privately owned and 7% of the land is owned and managed by the BLM (See Land Ownership Map).

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/2021-isf-recommendations.

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 is used to provide the Board with a basis for determining that a natural environment exists.

Watson Creek is a cool-water stream that runs through high elevation, shrubby grasslands with a low to moderate gradient. The recommended reach flows through a shallow valley, which ranges from a quarter mile to a half mile in width. The land in the reach is primarily agricultural pastures used for grazing livestock. The stream channel appears to have natural sinuosity and low human channelization activity, with good bank stability. There are healthy riparian communities of willow, sedges, and rush species, which are more abundant in areas fenced off from grazing. BLM and CWCB noted some areas with bank erosion and lower abundance of riparian species in locations with higher livestock usage. There is evidence of some nutrient and sediment loading with some algal growth. BLM staff identified the water quality as being acceptable for supporting cool-water fish species. The substrate consists mostly of sand with some small to medium gravel and cobble. The largest cobbles noted by staff were four inches in diameter.

BLM fish surveys documented self-supporting populations of longnose suckers, whitehead suckers, and creek chub. Fish were also frequently noted by CWCB staff during site visits, as well as a resident mink. Populations of macroinvertebrate species that are tolerant of cool to warm water were found in the reach, including mayfly nymphs, caddisfly nymphs, and water boatmen. Three distinct species of aquatic plants were also found growing near the CWCB's streamflow measurement location.

Table 1. List of species identified in Watson Creek.

Species Name	Scientific Name	Protection Status
white sucker*	*Catostomus commersonii*	None
longnose sucker*	*Catostomus catostomus*	None
creek chub	*Semotilus atromaculatus*	None
Mayfly	*Ephemeroptera*	None
Caddisfly	*Tricoptera*	None
water boatmen	*Corixidae*	None

*indicates fish species native to Colorado (East slope)

ISF Quantification

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. 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 methodology 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). Riffles are a stream habitat type that are most easily visualized as sections of the stream that would dry up first should streamflow cease. The data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: 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). BLM staff interprets the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow recommendation is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides 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 Analysis

R2Cross data was collected at two transects for this proposed ISF reach by BLM (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 1.10 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a summer flow of 1.91 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 Watson Creek.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
08/02/2017, 1	12.77	2.52	1.01 - 6.30	1.10	2.27
08/02/2017, 2	10.19	2.57	1.03 - 6.43	Out of range	1.54
			Mean	1.10	1.91

ISF Recommendation

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

1.90 cfs is recommended from April 1 to June 21. This recommendation is driven by the average depth criteria and wetted perimeter criteria. During the early irrigation season, which typically begins in May, maintaining this flow rate in the creek would provide adequate habitat for maintaining fish species while irrigation diversions occur. This flow rate will maintain sufficient physical habitat in the creek for the fish population to complete important parts of their life cycle while physical habitat is abundant due to higher flows.

An instream flow water right is not recommended for the peak irrigation season, from June 22 through August 15. Several ditches in the recommended reach regularly sweep the stream, leaving short stretches that may be completely dry.

1.10 cfs is recommended from August 16 through March 31. This recommendation is driven by the average velocity criteria. This flow rate should provide adequate habitat during late summer and fall for the fish populations to complete important parts of their life cycle after habitat is restricted during the annual period of high irrigation diversions. This flow rate should also prevent complete icing of the numerous pools in this reach, allowing the fish populations to overwinter.

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.

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 streamflows 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) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be 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; 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 Watson Creek is 16.4 square miles, with an average elevation of 8,867 feet and average annual precipitation of 28.06 inches (See the Hydrologic Features Map). Hydrology in the region is primarily driven by snowmelt runoff with relatively high flows during spring and early summer and lower flows in mid to late summer due to irrigation uses.

There are a number of water uses in the basin tributary to the proposed Watson Creek ISF, including 47.2 cfs in absolute surface water diversions and 510.5 AF in storage water rights. In addition, the Coal Creek Ditch (WDID 5800589, 8 cfs, appropriation date 1945) imports water from Bear Creek into Watson Creek. Four ditches are located within the proposed ISF reach (Table 3). Of these, all but the Ferguson Ditch are known to dry up the stream, primarily after snowmelt runoff in later summer. Due to surface water diversions and transbasin imports both upstream and within the ISF reach, hydrology in this drainage basin does not represent natural flow conditions.

Table 3. Structures located within the proposed ISF reach on Watson Creek.

WDID	Structure Name	Total Decreed Flow Rate, cfs	Appropriation Dates
5800634	Ferguson Ditch	15	1886, 1930
5800827	Powell Ditch 1	1	1889, 1919
5800725	Laramore Ditch	5	1885, 1888, 1919
5800828	Powell Ditch 2	2	1892, 1919, 1962

Available Data and Analysis

Gage Data

There are no current or historic streamflow gages on Watson Creek. No representative gages on nearby streams were identified in part due to the high level of water use in Watson Creek and the nearest streams with gages. However, a number of gages in the region were evaluated to assess the typical timing of snowmelt runoff (Table 4). These gages consistently show that runoff starts between mid-March and early April, with a peak occurring mid-April to mid-May.

Table 4. Nearby gages evaluated to determine typical timing of snowmelt runoff. Reported location is described relative to the proposed lower terminus on Watson Creek.

ID	Gage Name	Period of Record	Location
09238000	Oak Creek near Oak Creek	1952-1957	7.1 miles northwest
09243900	Foidel Creek at Mouth	1975-2001	15.6 miles north
09060700	Egeria Creek near Toponas	1965-1973	8.7 miles southeast

CWCB Gage and Staff Measurements

CWCB Staff installed a pressure transducer near the lower terminus and made 12 streamflow measurements on Watson Creek. Due to site conditions, it was difficult to develop a complete stage-discharge relationship. However, the measurements do provide information that helps to better understand hydrology primarily during the irrigation season. These measurements reflect the impact from consumptive uses in the basin; in other words, water lost to consumptive use is reflected in the measurements, but the measurements do not capture potential dry up points upstream. These measurements were made between 2018 and 2020 (Table 5). All of the measurements are higher than the proposed ISF flow rates.

Table 5. Summary of Streamflow Measurement Visits and Results for Watson Creek.

Visit Date	Flow (cfs)	Collector
05/07/2018	6.24	CWCB*
05/06/2019	12.86	CWCB
06/04/2019	12.28	CWCB
06/28/2019	11.54	CWCB
07/29/2019	10.25	CWCB
07/29/2019	4.62	CWCB*
11/07/2019	3.60	CWCB

12/06/2019	2.94	CWCB
07/08/2020	3.59	CWCB
07/23/2020	6.16	CWCB
09/18/2020	2.58	CWCB
10/11/2020	2.53	CWCB

*Indicates a measurements made at BLM lands midway through the proposed reach, which are not included in the hydrograph.

Staff evaluated the Yampa River at Steamboat gage (USGS 09239500, period of record 1904 to 2020 with three missing years), to assess how 2018, 2019, and 2020 compared hydrologically to a longer record. This gage is located approximately 22 miles north from the proposed lower terminus on Watson Creek. Based on this analysis, water year 2018 was less than the 25th percentile for total annual streamflow, 2019 was near the 75th percentile, and 2020 was just less than the 50th percentile. However, both 2019 and 2020 experienced little to no summer precipitation resulting in unusually low streamflow late summer through fall. Therefore, the available streamflow data from 2018 represents very low flows, 2019 represents high runoff, and 2020 represents below median flows. All three years show dry late summer and fall conditions.

Diversion Records

In some cases, diversion records can be used to provide an indication of water availability in a stream reach. The Hardscrabble Ditch, which is located at the proposed lower terminus, is decreed for 2.0 cfs (0.5 cfs with an 1885 appropriation date and 1.5 cfs with a 1919 appropriate date). The diversion structure historically was used fairly consistently starting in the 1930s, but has seen no or limited use since about 1990 (there is recorded use in 1909, 2000, 2010, and 2014). Because of the large number of years without use, median diversions were calculated without including zeros. The records generally show that median diversions (in years with diversions) exceed the proposed ISF rate between June and mid-September. The median diversions in early spring and late fall are somewhat less; these time periods have very limited data which likely reflects reduced irrigation demand rather than water availability limitations. Measuring structures have only recently been installed in this area and some structures are under orders to install them; therefore, the historic diversion records are based on the professional judgment of the water commissioner or estimated values submitted by the ditch owners.

StreamStats

The USGS StreamsStats tools was used to estimate streamflow during late fall, winter, and spring when stock and irrigation uses are minimal or non-existent. StreamStats results are not relied on during the main irrigation season.

Water Commissioner Comments

In addition to the CWCB streamflow measurements, staff contacted Scott Hummer, who is the current water commissioner. Mr. Hummer has been the water commissioner on Watson Creek since 2017. Between 2017 and 2020, the Yampa River basin has a large range in hydrologic conditions. Based on the Yampa River at Steamboat gage (USGS 09239500, period of record 1904 to 2020 with 3 missing years), the total flow volume in water years 2017 and 2018 were

ranked less than the 25th percentile, 2019 was near the 75th percentile, and 2020 was just less than the 50th percentile. 2018 and 2020 were also the first years that the Yampa River was placed under administration.

Based on these conditions, Mr. Hummer has observed that the Powell Ditch 1 & 2 and the Laramore Ditch can and do sweep the stream, typically from late June to mid-August. Because of this observation, water may not be available for appropriation from June 21 to August 15. Other than those time-frames, water users appear to have sufficient water and no local calls have been placed on Watson Creek. In Mr. Hummer's experience, the proposed ISF flow rates are available for appropriation.

Water Availability Summary
The Complete Hydrograph shows the streamflow measurements, the median diversions for the Hardscrabble ditch, StreamStats mean-monthly streamflow, and the proposed ISF. This ISF reach presents challenging conditions to evaluate water availability. Water may not be available from June 21 to August 15 due to the potential for dry up points within the stream reach. The CWCB streamflow measurements and StreamStats indicate that water is available for appropriation from late September to late May. The availability of water from late May to June 20th and August 16th to late September is based on streamflow measurements, the diversion records, and the expertise of the water commissioner. Taken together, these data and the observations from the water commissioner support the finding that water is available during the proposed time-frames.

Material Injury
Because the proposed ISF on Watson Creek is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2020), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations
Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

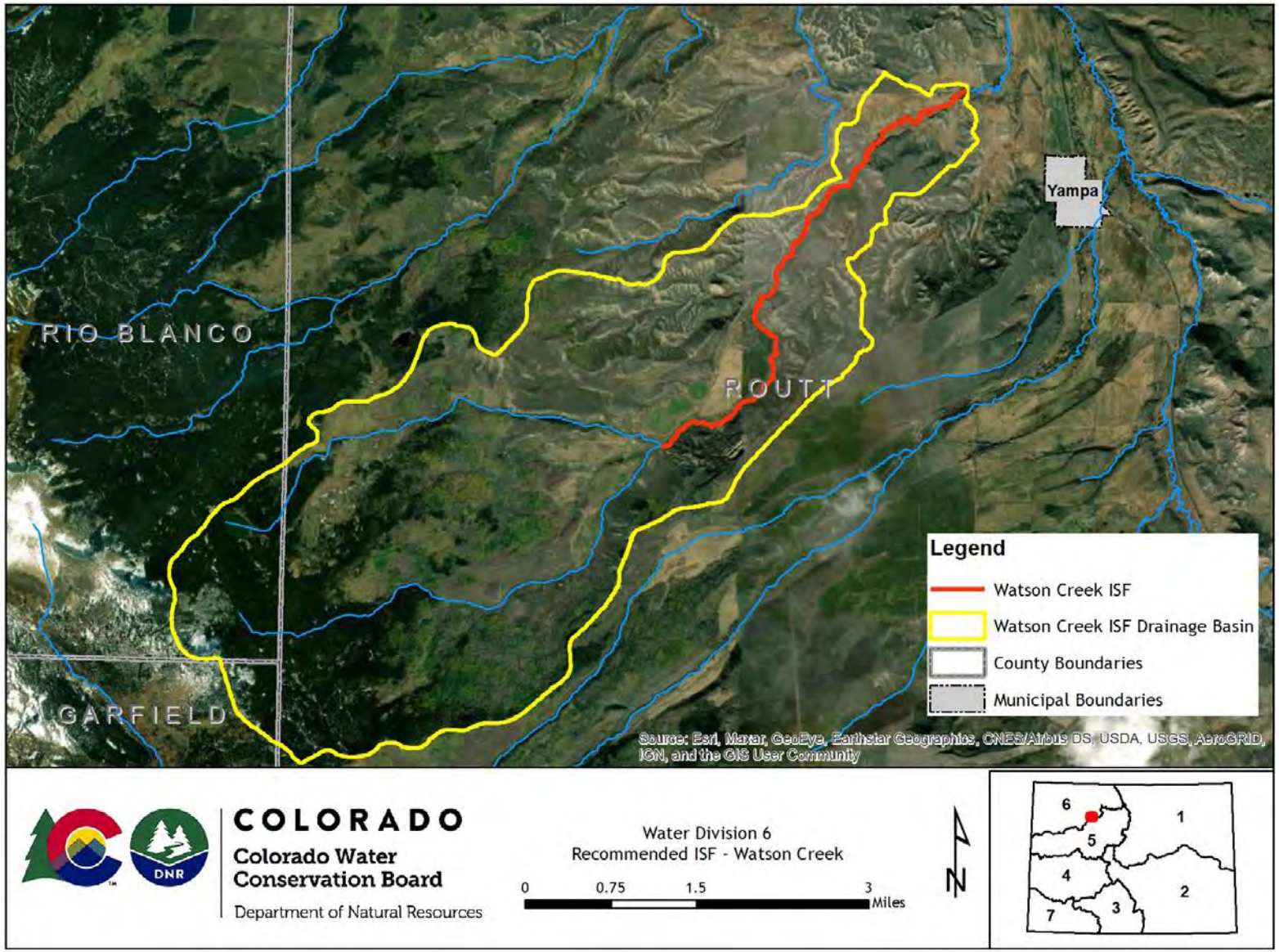
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

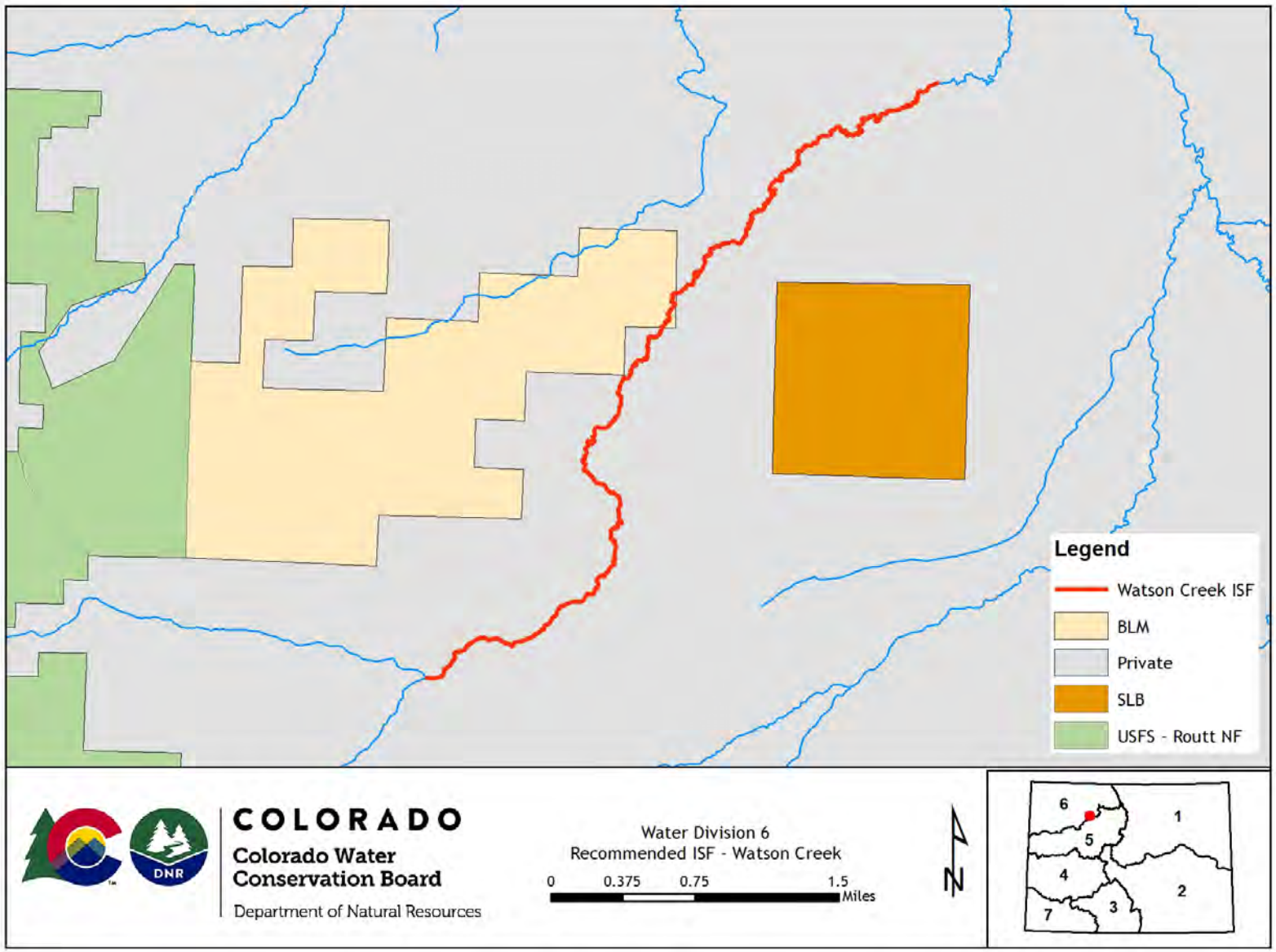
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

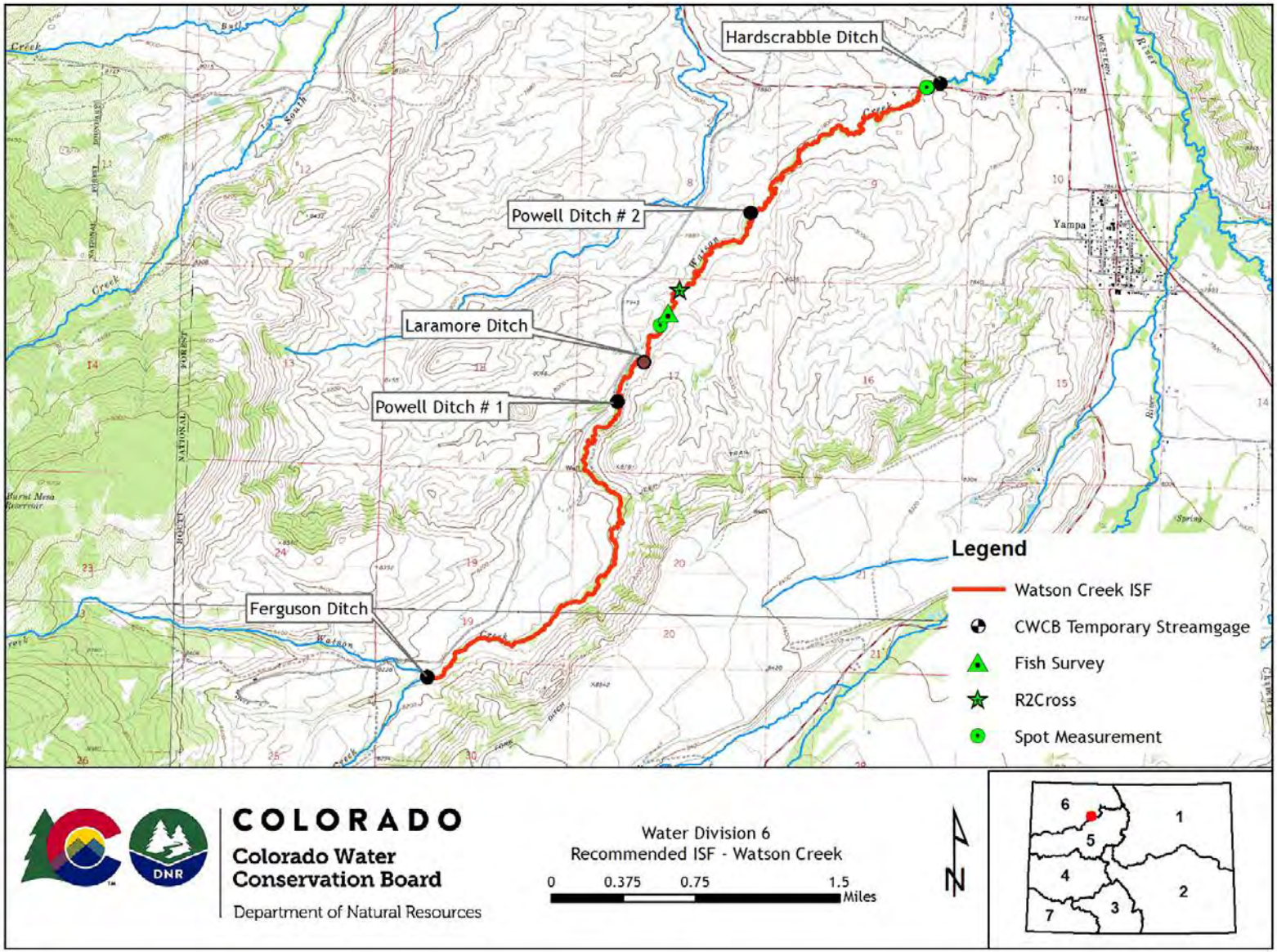
VICINITY MAP



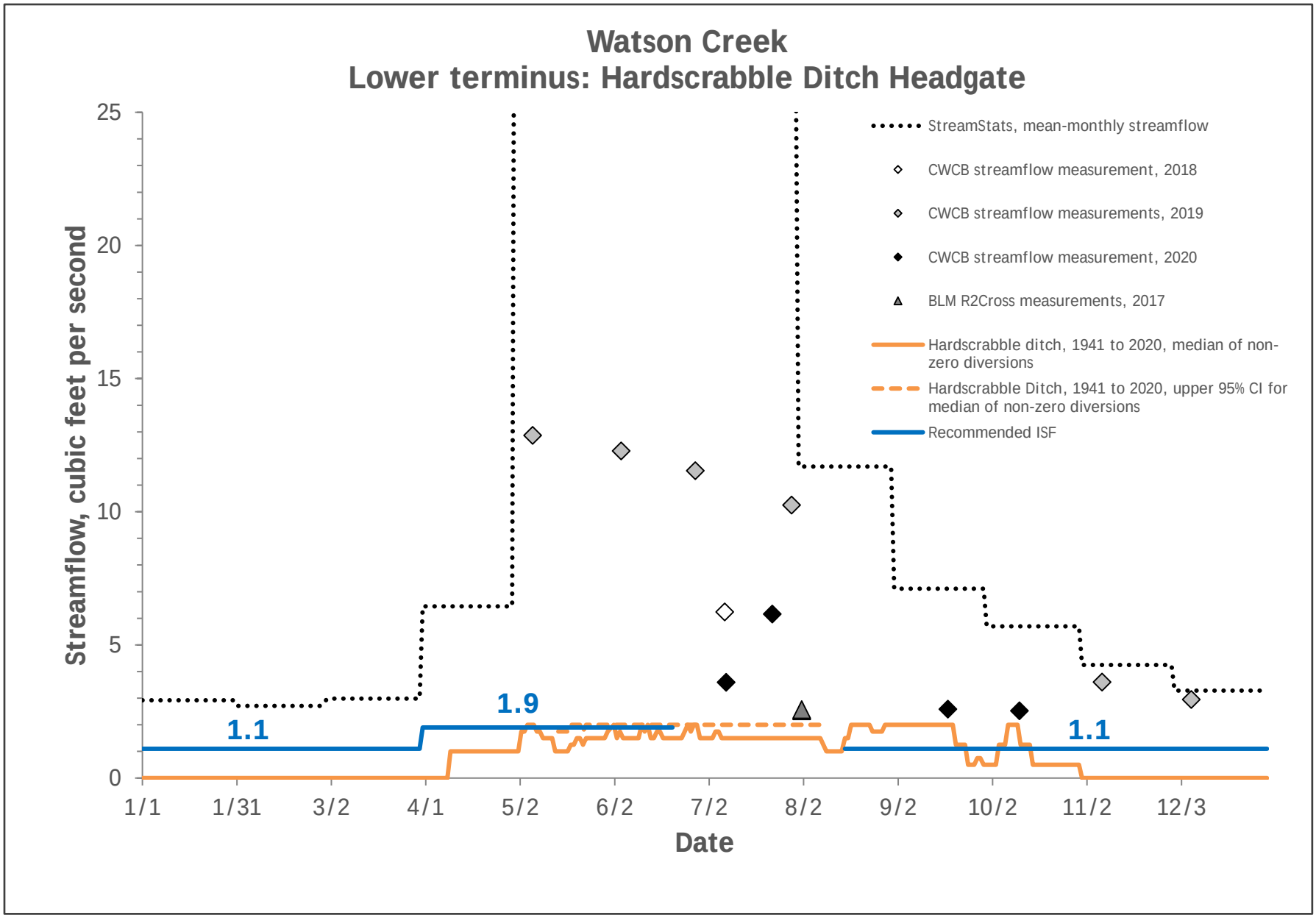
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



Rincon La Vaca Creek Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
January 25-26, 2021

UPPER TERMINUS:	headwaters UTM North: 4170340.18 UTM East: 288830.29
LOWER TERMINUS:	confluence Los Pinos River UTM North: 4171003.14 UTM East: 294776.30
WATER DIVISION:	7
WATER DISTRICT:	31
COUNTY:	Hinsdale
WATERSHED:	Upper San Juan
CWCB ID:	18/7/A-002
RECOMMENDER:	Colorado Parks and Wildlife (CPW)
LENGTH:	4.47 miles
FLOW RECOMMENDATION:	1.2 cfs (11/01 - 04/30) 2.8 cfs (05/01 - 10/31)

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Introduction

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.

Colorado Parks and Wildlife (CPW) recommended that the CWCB appropriate an ISF water right on a reach of Rincon La Vaca Creek because it has a natural environment that can be preserved to a reasonable degree. The proposed reach extends from Rincon La Vaca Creek's headwaters downstream to the confluence with the Los Pinos River. Rincon La Vaca Creek is located within Hinsdale County (See Vicinity Map), and originates at an elevation of approximately 12,440 feet. It flows in an easterly direction for 4.47 miles before it joins Los Pinos Creek at an elevation of 10,555 feet. One hundred percent of the land on the 4.47 mile proposed reach is part of the Weminuche Wilderness Area managed by the U.S. Forest Service (See Land Ownership Map).

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/2021-isf-recommendations.

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 is used to provide the Board with a basis for determining that a natural environment exists.

Rincon La Vaca is a cold-water stream that runs through an alpine forest and meadow in the northern Weminuche Wilderness of the San Juan National Forest. The average elevation of the basin is 12,000 feet. Rincon La Vaca is a first order, headwater mountain stream. Flowing down from the mountains toward the valley meadow, the upper portion of the stream is high gradient, gradually decreasing in steepness as it heads towards the confluence with Los Pinos River. The channel is defined in the upper portion of the reach by boulders and woody debris forming pools with cobble to boulder sized substrate. Sinuosity of the channel increases as it enters the alpine meadow and substrate changes to predominantly sand. The watershed drains approximately six square miles of high elevation mountains, hydrologically driven by snowmelt from the snowpack of the local peaks. The riparian community is robust and healthy with a vast diversity of forest and meadow species of the San Juan Mountain Range. CWCB staff observed evidence of diverse wildlife, including moose and a variety of birds.

The USFS has documented a trout population in Rincon La Vaca Creek that is self-sustaining and contains individuals of multiple age classes. CPW has sampled this population and identified them as Colorado River cutthroat trout with genetic testing pending. Populations of macroinvertebrates were also observed to include caddisfly, mayfly and stonefly.

Table 1. List of species identified in Rincon La Vaca Creek.

Species Name	Scientific Name	Protection Status
Colorado River cutthroat trout*[1]	*Oncorhynchus clarkii pleuriticus*[1]	State - Species of Greatest Conservation Need & Species of Special Concern
caddisfly*	*Trichoptera*	None
mayfly*	*Emphemeroptera*	None
stonefly*	*Plecoptera*	None

[1]Genetic testing pending
*Indicates native species

ISF Quantification

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. 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 methodology 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). Riffles are a stream habitat type that are most easily visualized as sections of the stream that would dry up first should streamflow cease. The data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: 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 interprets the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow recommendation is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides 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 Analysis

R2Cross data was collected at seven transects for this proposed ISF reach by USFS and CPW (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 1.15 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a summer flow of 2.75 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. 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 Rincon La Vaca Creek.

Date, Xsec #	Entity	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
09/11/2014, 1	USFS	10.45	3.62	1.45 - 9.05	Out of range	4.22[1]
09/11/2014, 2	USFS	8.70	3.91	1.56 - 9.78	Out of range	2.10
09/11/2014, 3	USFS	10.39	3.90	1.56 - 9.75	Out of range	2.36
10/06/2016, 1	CPW	12.32	6.97	2.79 - 17.43	Out of range	Out of range
10/06/2016, 2	CPW	11.85	7.29	2.92 - 18.23	Out of range	Out of range
09/29/2020, 1	CPW	14.62	2.75	1.10 - 6.88	1.15	2.73
09/29/2020, 2	CPW	13.50	3.43	1.37 - 8.58	Out of range	3.79
				Mean	1.15	2.75

[1] The USFS did not include results from their XS 1 in their analysis because bankfull indicators were not well defined, and the riffle was higher gradient and shorter than their XS 2 and 3. Deferring to USFS expertise, USFS XS 1 results were not included in the flow recommendation.

ISF Recommendation

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

2.8 cfs is recommended from May 1st to October 31st. This flow rate will maintain an average velocity of 1 ft/s, average depth of at least 0.2 feet, and at least 50 percent wetted perimeter of the stream channel on average over the measured cross sections.

1.2 cfs is recommended from November 1st to April 30th. This flow rate will maintain depths of 0.2 feet on average and over 50 percent wetted perimeter.

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.

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 streamflows 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) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be 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; 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 Rincon La Vaca Creek is 5.9 square miles, with an average elevation of 11,827 feet and average annual precipitation of 40.2 inches (See the Hydrologic Features Map).

There is one diversion on the proposed ISF reach, Weminuche Pass Ditch (WDID 3104637, appropriation date 1934, 1935, 1950 with net decreed rate of 40 cfs). Weminuche Pass Ditch is operated by CPW and located approximately 0.5 miles upstream from the proposed lower terminus. The ditch is a transbasin diversion that exports water from Rincon La Vaca Creek in Division 7 across the basin divide to the headwaters of Weminuche Creek, a tributary to the Rio Grande River in Division 3. CPW stores diversions from this water right in the Rio Grande Reservoir and makes releases to supplement irrigation on historically irrigated lands below the reservoir in exchange for wildlife benefits and youth hunting opportunities. Due to surface water diversions and transbasin exports, hydrology in this drainage basin does not represent natural flow conditions.

Available Information and Data Analysis

Weminuche Pass Ditch Diversion and CPW bypass

The Weminuche Pass Ditch is decreed for a total of 40 cfs, but embankment failures have limited diversions in recent years. Weminuche Pass Ditch diversions occur primarily during spring runoff season, typically from the beginning of June to mid-July. Later in the season, diversions are subject to call by senior water rights located downstream in Division 7.

In most years, the Weminuche Pass Ditch has the legal ability to dewater the lower 0.5 miles of Rincon La Vaca Creek. In the interest of sustaining the fishery, CPW has agreed to bypass 2.8 cfs to help preserve the natural environment to a reasonable degree. It is anticipated that outside of the season of use for the Ditch, the Ditch will bypass all of the native flow in the creek. This practice will be memorialized through CPW's special use permit authorization with the USFS and bypass flows will be protected by this proposed ISF water right.

StreamStats

The USGS StreamsStats tools was used to estimate monthly streamflow. StreamStats based estimates do not account for the Weminuche Pass Ditch diversions.

Site Visits

Staff visited the site in September 2020 to collect additional R2Cross data. No other site visits were made by CWCB staff to collect additional flow data.

Water Availability Summary

The hydrograph (See Complete Hydrograph) shows StreamStats results for mean-monthly streamflow. Staff has concluded that water is available based on StreamStats estimates and the commitment by CPW to bypass the ISF flow rates.

Material Injury

Because the proposed ISF on Rincon La Vaca Creek is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2020), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations

Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

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Metadata Descriptions

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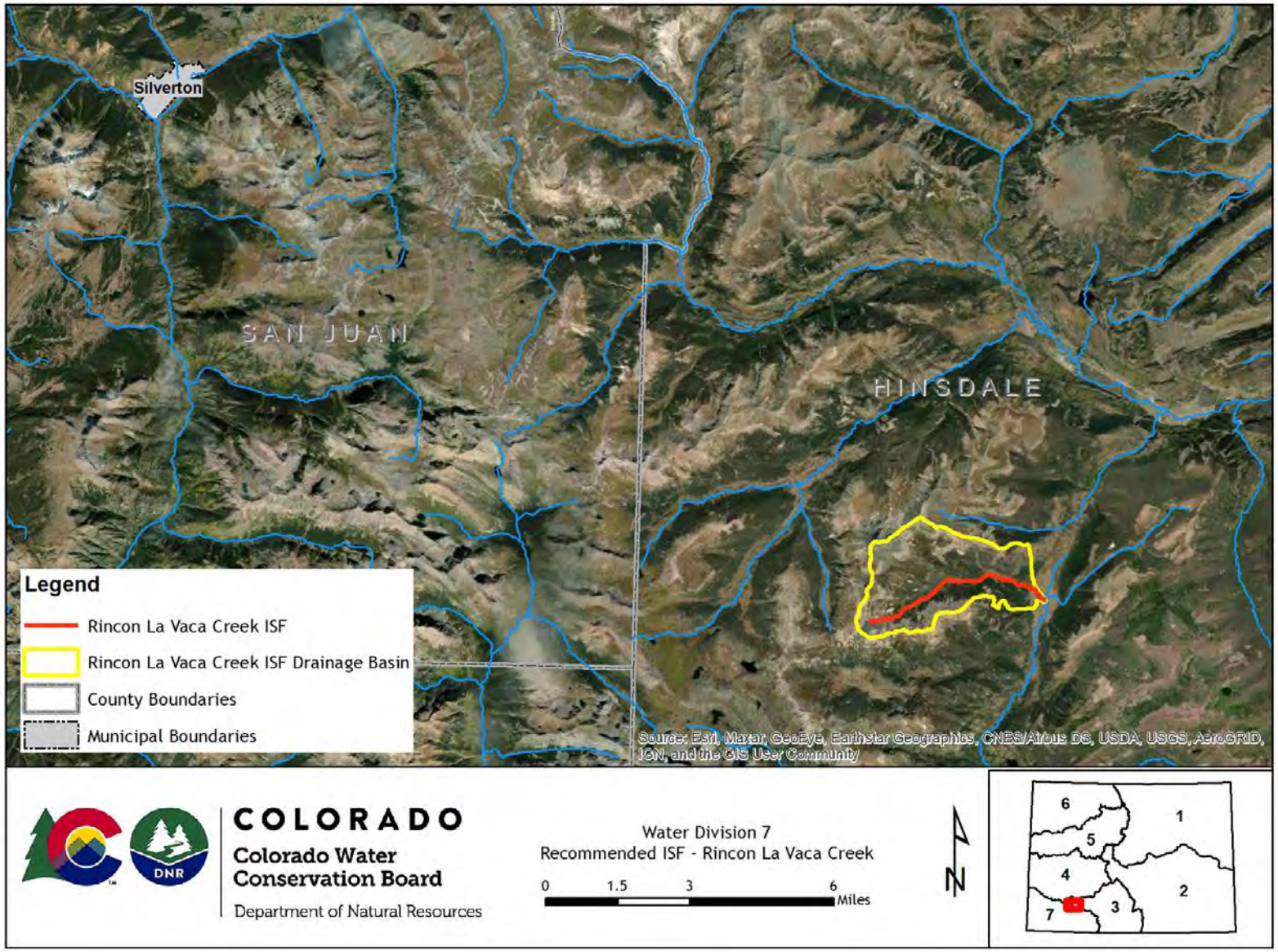
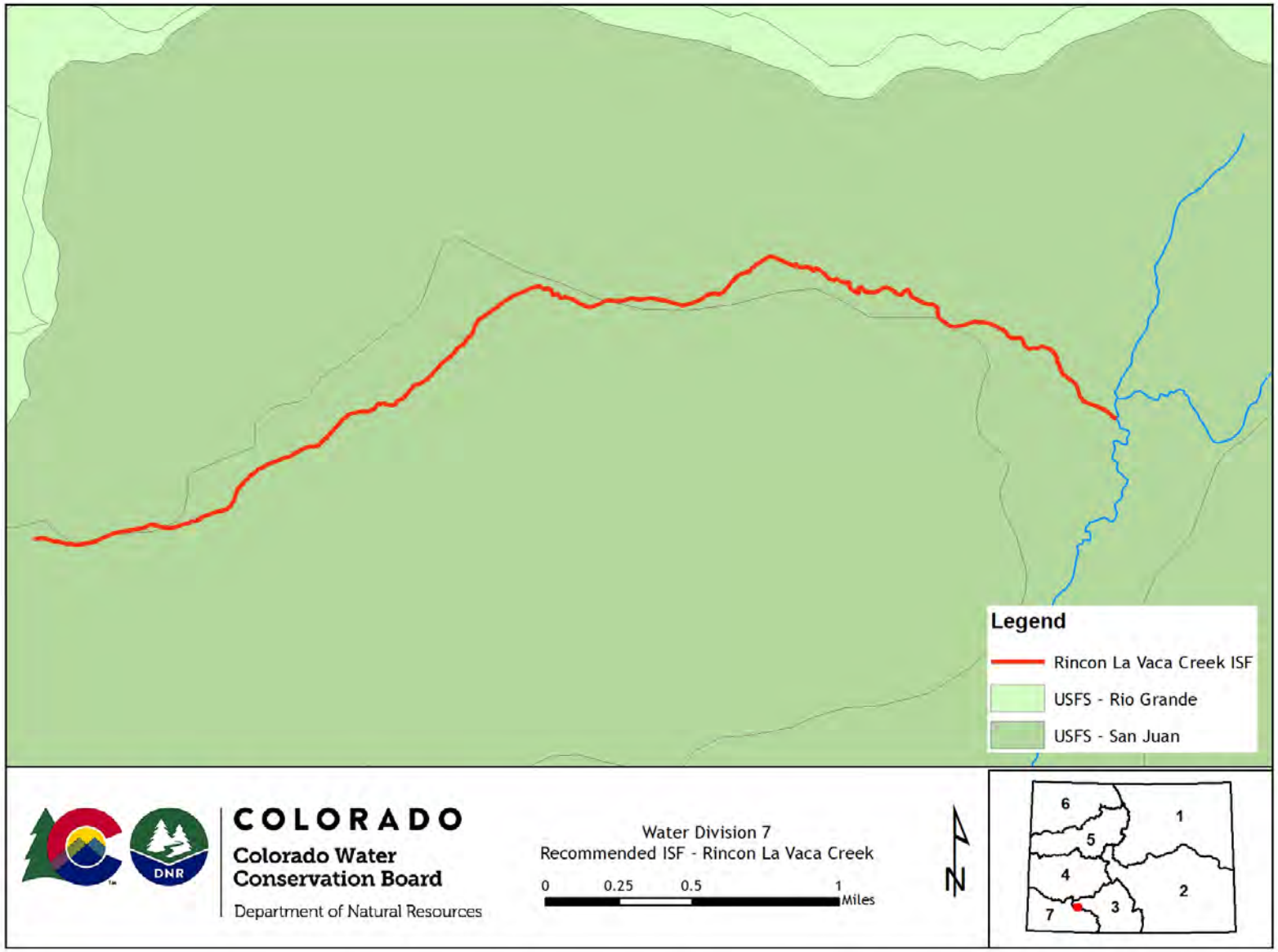
Projected Coordinate System: NAD 1983 UTM Zone 13N.

VICINITY MAP



LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP

COMPLETE HYDROGRAPH