COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Brush Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Confluence Middle and East Brush Creeks UTM North: 4308647.90 UTM East: 339317.46
LOWER TERMINUS:	Confluence West Brush Creek UTM North: 4307385.91 UTM East: 336872.42
WATER DIVISION:	4
WATER DISTRICT:	59
COUNTY:	Gunnison
WATERSHED:	East-Taylor
CWCB ID:	17/4/A-002
RECOMMENDER:	American Rivers, High Country Conservation Advocates (HCAA)
LENGTH:	2.32 miles
Existing ISF:	83CW0236, 5 cfs (10/1-4/30) and 8 cfs (5/1-9/30)
FLOW RECOMMENDATION:	1.7 (01/01 - 04/14) 11 (04/15 - 04/30) 8 (05/01 - 08/31) 5 (09/01 - 09/30) 8 (10/01 - 10/15) 2.7 (10/16 - 12/31)

Brush Creek

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.

American Rivers and HCAA recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Brush Creek. The CWCB currently holds an instream flow water right on Brush Creek for 5.0 cfs (10/1-4/30) and 8.0 cfs (5/1-9/30), decreed in Case No. 83CW0236. The recommenders do not consider the existing ISF water right to be sufficiently protective of the natural environment in Brush Creek, in light of CWCB's current application of R2Cross. The existing instream flow water right does not meet all three instream flow criteria during the spring and summer, which is a critical growth and spawning period for the fish population.

Brush Creek forms at the confluence of Middle Brush Creek and East Brush Creek at an elevation of approximately 9,390 ft. The creek flows in a southwesterly direction as it drops to an elevation of approximately 8,920 ft where it joins the East River. This proposed reach is located within Gunnison County (See Vicinity Map) and extends from the confluence of Middle Brush Creek and East Brush Creek downstream to the confluence with West Brush Creek. One hundred percent of the land on the 2.32 mile reach is federally owned and managed by the U.S. Forest Service (See Land Ownership Map). American Rivers and HCAA recommended this reach of Brush Creek because it has a natural environment that can be preserved to a reasonable degree with an ISF water right.

The information contained in this report and the associated supporting data and analyses (located at: http://cwcb.state.co.us/environment/instream-flow-program/Pages/2017ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

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 headwaters of Brush Creek originate in and adjacent to the Maroon Bells-Snowmass Wilderness area. Brush Creek forms at the confluence of East Brush Creek and Middle Brush Creek, both popular locations for local fly-fishing companies to take customers on guided fly-fishing excursions. This segment of Brush Creek supports a Colorado River cutthroat trout population (See Table 1). Brush

Creek hosts an important recreational fishery and a healthy riverine ecosystem. Brush Creek, East Brush Creek, and Middle Brush Creek also offer numerous recreational opportunities, including beautiful waterfalls that are easily accessible from hiking and single-track trails.

Table 1. List of species identified in Brush Creek.

Species Name	Scientific Name	Status
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	State – Species of Special Concern

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.

Methodology

American Rivers and HCAA 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 most easily visualized as the stream habitat types that would dry up first should streamflow cease. The field data collected consists of streamflow measurements and surveys of channel geometry at a transect and 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 macro-invertebrates (Nehring, 1979). American Rivers and HCAA 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 quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. 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 one transect for this proposed ISF reach (Table 2). The R2Cross model results in a winter flow of 8.31 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 15.86 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model.

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

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Summer Rate (cfs)	Winter Rate (cfs)
HCCA	10/08/2015	15.91	6.36 - 39.78	15.86	8.31
			Mean	15.86	8.31

ISF Recommendation

American Rivers and HCCA recommend an increase to reach a total ISF rate of 15.86 cfs (4/15 – 10/5), which maintains all three of the R2CROSS hydrologic criteria (average velocity, average depth, and wetted perimeter). This flow helps to scour fine sediments from important spawning areas, provide opportunities for upstream and downstream fish passage, and promote aquatic macroinvertebrate and fish productivity during the summer months. American Rivers and HCCA also recommend increases to reach a total ISF rate of 8.31 cfs (10/16 – 12/31), which satisfies two of three hydraulic criteria and 7.17 (1/1 – 4/14), which satisfies the wetted perimeter criteria and results in an average velocity 0.96 ft/s.

The American Rivers and HCCA recommendation was modified by staff as a result of water availability and to conform to a standard number of significant digits in ISF water court applications. The final recommendations numbers are as follows:

An increase of 1.7 cfs to the existing 5.0 cfs ISF water right is recommended 1/1 to 4/14 to bring the total ISF water right up to 6.7 cfs. This satisfies the wetted perimeter criteria and results in an average velocity of 0.94 ft/s.

An increase of 11 cfs to the existing 5.0 cfs ISF water right is recommended 4/15 to 4/30 to bring the total water right up to 16 cfs.

An increase of 8 cfs to the existing 8.0 cfs ISF water right is recommended 5/1 to 8/31 to bring the total ISF water right up to 16 cfs.

An increase of 5 cfs to the existing 8.0 cfs ISF water right is recommended 9/1 to 9/30 to bring the total ISF water right up to 13 cfs.

An increase of 8 cfs to the existing 8.0 cfs ISF water right is recommended 10/1 to 10/15 to bring the total ISF water right up to 13 cfs.

An increase of 2.7 cfs to the existing 5.0 cfs ISF water right is recommended 10/16 to 12/31 to bring the total ISF water right up to 7.7 cfs. This satisfies the wetted perimeter criteria and results in an average velocity of 0.98 ft/s.

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 Brush Creek is 27.1 square miles, with an average elevation of 11,300 ft and average annual precipitation of 38.43 inches (Hydrologic Features Map). There is one surface water diversion within the basin tributary to the proposed ISF, the Wilde Ditch, which is a conditional right for 2 cfs. Hydrology in this drainage basin represents natural conditions.

Available Data
There is not a current or historic streamflow gage on Brush Creek. The closest gage identified was the historic East River near Crested Butte, CO gage (USGS 09110500). The gage was located approximately 4.8 miles downstream from the proposed lower terminus. The gage had a continuous period of record from 11/1/1939 to 9/30/1951. The drainage basin of the East River gage was 89.3 square miles, with an average elevation of 10,900 ft and average annual precipitation of 38.35 inches. The USGS also operates the East River below Cement Creek near Crested Butte, CO gage

(USGS 09112200). This gage is located downstream from the East River near Crested Butte gage. The gage has a sporadic record that includes 10/1/1963 to 9/30/1972, 10/1/1979 to 9/30/1981, and 10/1/1993 to present. The drainage basin of this gage is 239 square miles, with an average elevation of 10,500 ft and average annual precipitation of 36.8 inches. Further downstream, the USGS operates the East River at Almont, CO gage (USGS 09112500). This gage operated from 10/1/1910 to 9/30/1922 and 10/1/1934 to present. The drainage basin of this gage is 289 square miles, with an average elevation of 10,300 ft and average annual precipitation of 31.76 inches. In general, the number of diversions and other water use practices increases from the upstream most to the downstream most gages. Therefore, the two lower gages do not represent natural streamflow conditions and use of the gages in analysis will likely under-estimate streamflow on Brush Creek. However, the long-term record of the lowest gage was found to be useful in extending the gage record for the uppermost gage.

CWCB staff made two streamflow measurements on the proposed reach of Brush Creek as summarized in Table 3.

Table 3. Summary of streamflow measurement visits and results for Brush Creek.

Visit Date	Flow (cfs)	Method
07/13/2016	47.00	Wading Marsh McBirney
08/03/2016	24.70	Wading ADV

Data Analysis

Due to the short period of record available for the East River near Crested Butte gage, staff took additional steps to evaluate the record. The East River at Almont gage was the only gage that had a contemporary period of record. This gage was found to correlate well with the East River near Crested Butte gage (r^2=0.9644). Regression analysis was used to extend the record of the upper gage. Given the long period of record, Staff did not examine climate station data to assess the representativeness of the gage data. The area-precipitation method was used to scale the extended East River near Crested Butte gage data to the lower terminus on Brush Creek. The method estimates streamflow based on the ratio of the precipitation weighted drainage area. The scaling factor for Brush Creek basin at the lower terminus is 0.30. The scaled and extended data was analyzed for the entire period of record (1920 to 1922 and 1934 to 8/2/2016, approved data available through HydroBase as of 11/23/2016). Median streamflow and 95% confidence intervals for median streamflow were calculated.

Water Availability Summary

The hydrographs (See Complete and Detailed Hydrographs) show median and 95% confidence interval for median streamflow estimated at the lower terminus of Brush Creek. The proposed ISF is below the median streamflow estimate most of the time and below the 95% confidence interval for median streamflow at all times. Staff concludes that water is available for appropriation on Brush Creek.

Material Injury
Because the proposed ISF on Brush 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. (2016), 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.

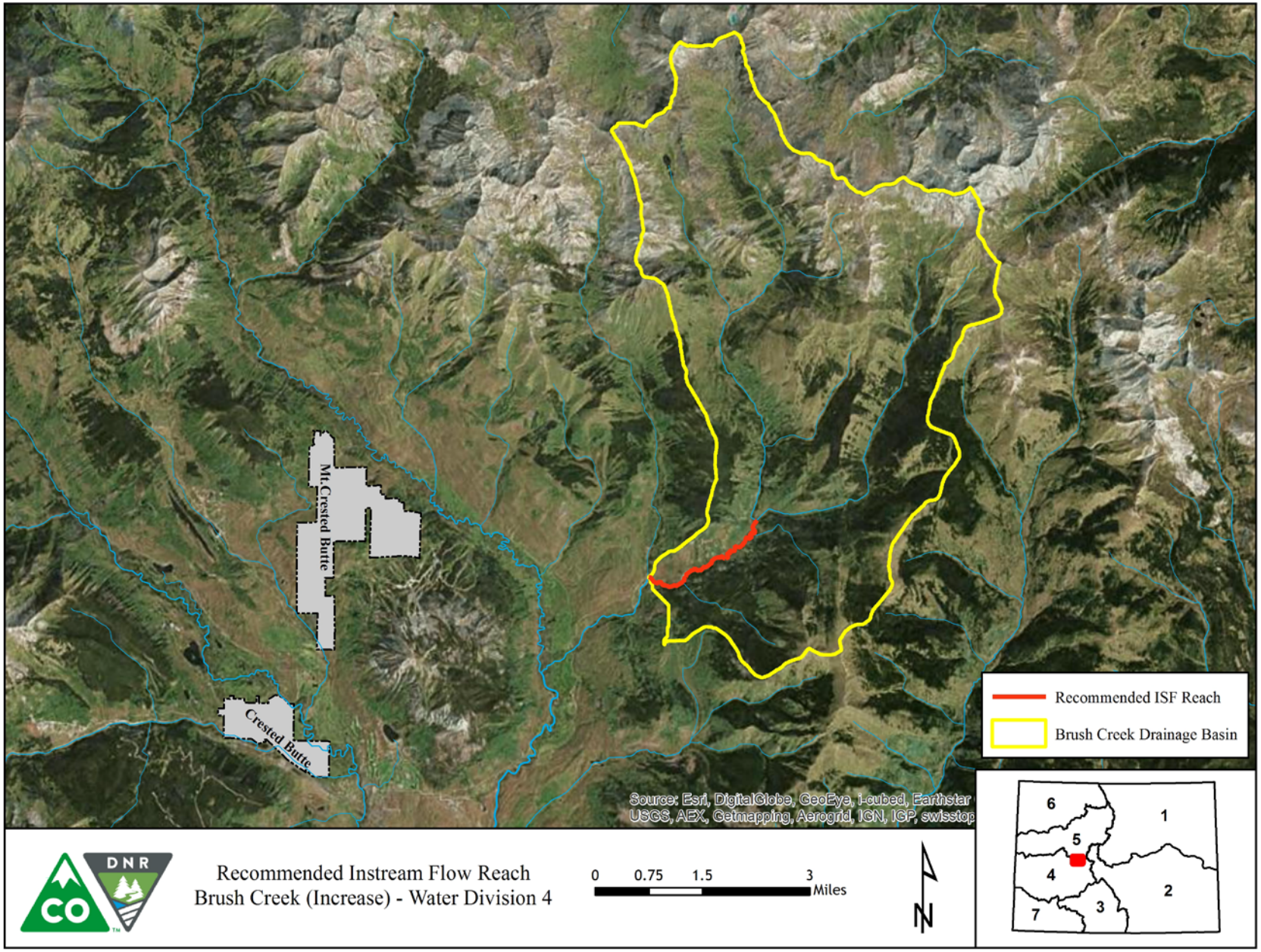
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

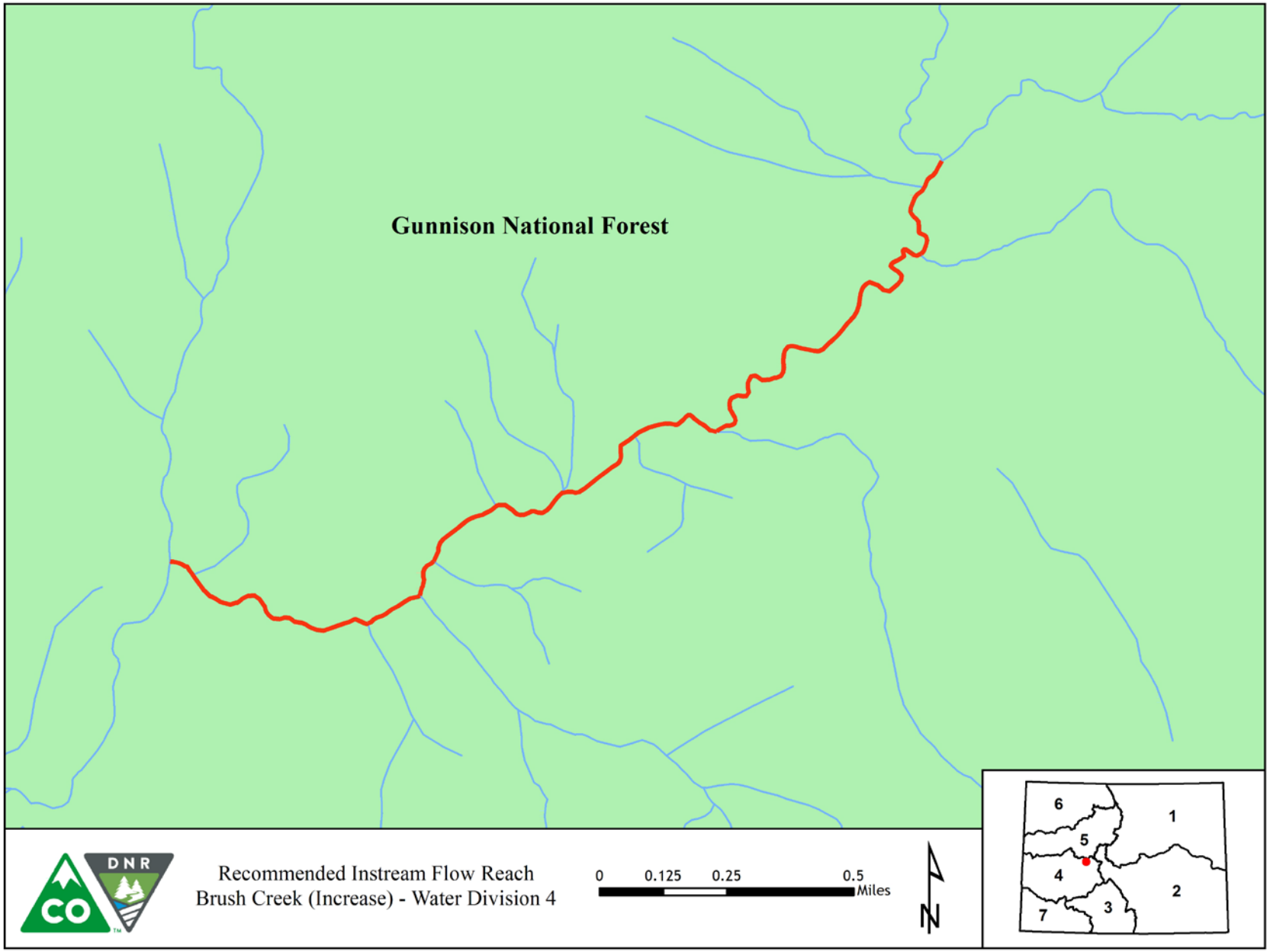
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

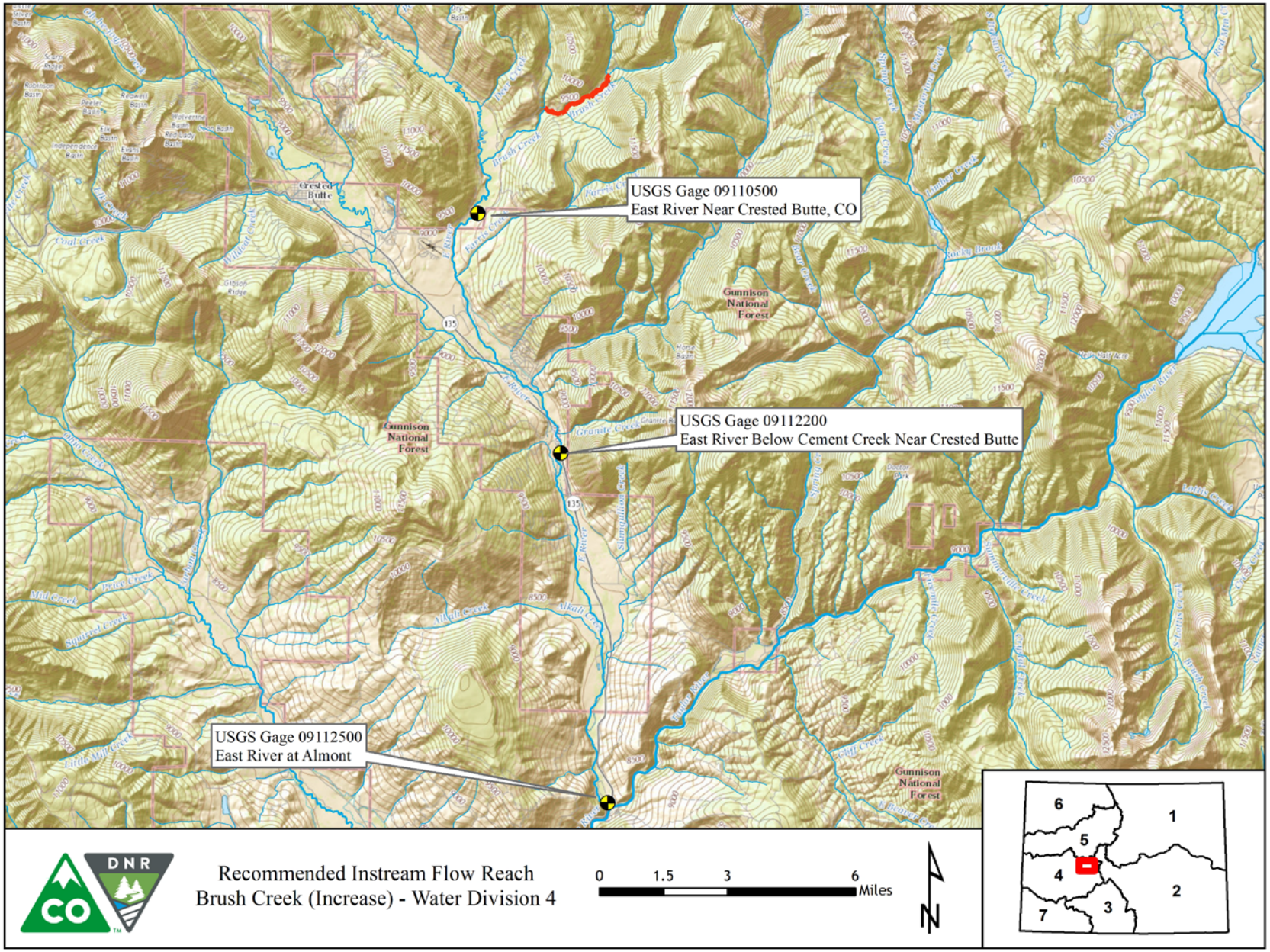
VICINITY MAP



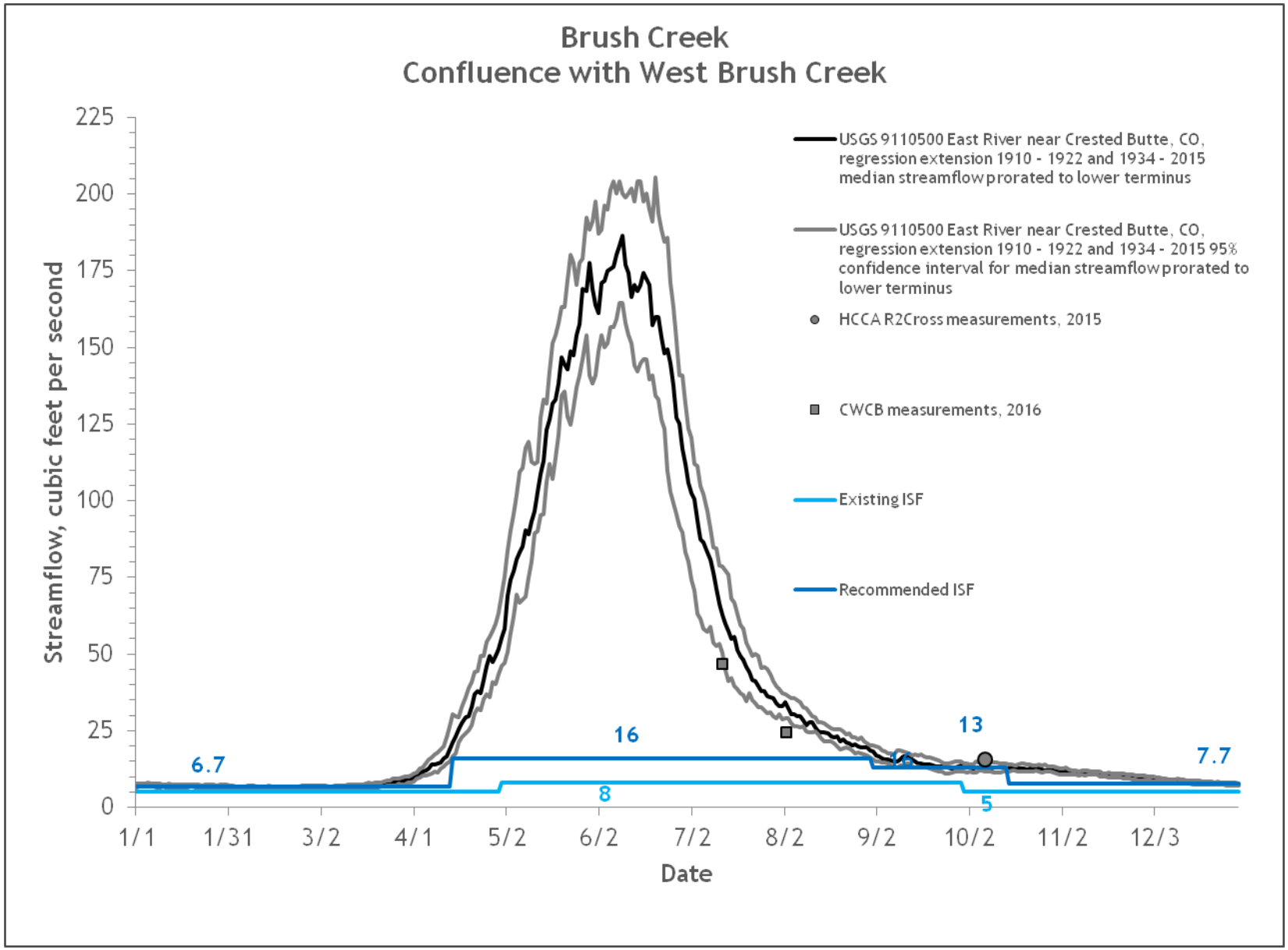
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH