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Willow Creek (Lower)

EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Confluence with Beaver Creek UTM North: 4514833.43	UTM North: 338266.19
LOWER TERMINUS:	Confluence with Lester Creek UTM North: 4514098.44	UTM East: 339789.19
WATER DIVISION:	6	
WATER DISTRICT:	58	
COUNTY:	Routt County	
WATERSHED:	Upper Yampa (HUC#: 14050001)	
CWCB ID:	13/6/A-004	
RECOMMENDER:	Bureau of Land Management	
LENGTH:	1.47 miles	
FLOW RECOMMENDATION:	13.0 cfs (4/16-6/30) 3.0 cfs (7/1-7/31)	
EXISTING ISF:	6-77W1273; 7.0 cfs (1/1-12/31)	

Willow Creek (Lower)

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 increase to the existing ISF water right on Willow Creek. The CWCB currently holds an instream flow water right on Willow Creek for 7.0 cfs (1/1-12/31), decreed in Case No. 6-77W1273. The BLM does not consider the current instream flow water right to be sufficiently protective of the natural environment in Willow Creek, in light of CWCB's current application of R2Cross. The current 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.

This reach is located within Routt County and is about 16 miles northwest of the Town of Steamboat Springs (See Vicinity Map). Willow Creek originates west of Hahns Peak at an elevation of about 8,360 feet. The creek flows in a southeasterly direction as it drops to an elevation of 7,600 feet where it joins the Elk River. The proposed reach extends from the confluence with Beaver Creek downstream to confluence with Lester Creek. One-Hundred percent of the land on the 1.47 mile proposed reach is publicly owned and managed by the BLM and U.S. Forest Service (See Land Ownership Map).

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/2016ProposedISFRecommendations.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.

This portion of Willow Creek is a cold-water, low gradient stream that flows through wide stream valleys before entering the Routt National Forest. The stream has a good mix of riffle, run, and deep pool habitats. Substrate ranges from gravels to eight-inch cobbles. Presence of some filamentous algae indicates that the creek may have nutrient loading and/or excessively high water temperatures.

Fishery surveys revealed a self-sustaining native fishery which includes mountain suckers, mottled sculpin, and speckled dace. White suckers, which are native to the Front Range, were also

documented in the creek. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly and caddisfly.

The riparian community along Willow Creek is in good condition, and streambank stability appears to be improving. The riparian community is comprised mainly of willows and sedges, and it occupies the entire valley bottom.

Table 1. List of fish species identified in Willow Creek.

Species Name	Scientific Name	Status
mottled sculpin	*Cottus bairdii*	None
mountain sucker	*Catostomas platyrhynchus*	State Species of Special Concern BLM Sensitive Species
speckled dace	*Rhinichthys osculus*	None
white suckers	*Catostomus commersonii*	None

Justification for Increase

The R2Cross data summarized below clearly indicates that the current instream flow water right does not provide sufficient physical habitat during the warm weather portions of the year when the fish populations are feeding, growing and spawning. When the existing instream flow rights are applied to the cross sections that were collected, the stream averages 55 percent wetted perimeter, so a significant portion of the potential habitat is not available. The available habitat is further reduced when the existing instream flow rates are applied to the cross section collected, because average depths are only 0.22 to 0.32 feet. These depths occur in a stream that averages 35 feet in width. While 0.22 feet is sufficient for fish passage, the fact that 0.22 feet is an *average* depth shows that, in many portions of the channel, depths are significantly *less* than 0.22 feet and may not be usable by the fish population. During the warm weather season, the fish population needs to have access to as much of the stream channel as possible for feeding, resting and spawning if it is to survive the pronounced cold winters in this location.

After Willow Creek leaves Steamboat Lake, it exhibits a wide channel with almost no shading from shrubs and trees. In this type of creek environment, aquatic habitat can be at risk from excessively high temperatures during the summer months. For example, when the BLM surveyed the creek in August 2011, the stream temperature was 21 degrees Celsius, which is at the upper limit of what many cold water species, such as speckled dace and mottled sculpin, can tolerate without excessive stress on the fish population. This stream temperature was not taken on an excessively hot day or during excessively low flow conditions. CWCB staff installed a temperature sensor in this reach of stream from July 1, to November 4, 2013 and confirmed that the reach regularly experiences excessively high temperatures during the summer months.

Protecting a higher flow rate will provide greater depths and faster velocities, which tend to reduce stream temperatures. In addition, the higher flow rate will allow the fishery greater access to locations with overhanging banks, where temperatures typically are cooler. An increased flow rate will provide more physical habitat during the spawning and growth seasons, which will help the fish population recover from any temperature extremes. In addition, the BLM believes that this creek has the potential to support trout species year-round if excessively high temperatures are prevented.

The BLM notes that speckled dace and mottled sculpin are present, and these species typically co-inhabit streams with trout species. BLM also notes that trout species are found in most of the perennial tributaries to Willow Creek.

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

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 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). 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 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 four transects for this proposed increased 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 20 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 Willow Creek.

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
BLM	8/16/2011 - 1	16.89	6.8 – 42.2	Out of Range	27.89
BLM	8/16/2011 - 2	16.56	6.6 – 41.4	8.56	15.97
BLM	9/26/2011 – 1	13.78	5.5 – 34.4	6.09	16.44
BLM	9/26/2011 – 2	12.69	5.1 – 31.7	Out of Range	20.89
			Mean	**7.33**	**20.32**

ISF Recommendation

The BLM recommends increased flows of 13.0 cfs (4/16-6/30), and 3.0 cfs (7/1-7/31) based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

An increase of 13.0 cubic feet per second to the existing 7.0 cfs instream flow water right is recommended during the snowmelt runoff period, from April 16 through June 30. This recommendation is driven by the average depth criteria. This flow rate will assist in maintaining the native fish assemblage, by maintaining a sufficient amount of physical habitat during their spawning period. Appropriation of an additional 13.0 cfs would bring the total instream flow water right up to 20.0 cfs during the April 16 to June 30 period.

An increase of 3.0 cubic feet per second is recommended from July 1 to July 31, and is driven by water availability. While this flow rate doesn't meet the average depth criteria, it will provide an average velocity of 1.33 feet per second, average wetted perimeter of 63 percent, and average depth of 0.3 feet. Appropriation of an additional 3.0 cfs would bring the total instream flow water right up to 10.0 cfs during the July 1 to July 31 period. This additional amount of protection is critical to addressing high temperatures during one of the warmest months of the year.

Water Availability

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

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 lower Willow Creek is 65.2 square miles, with an average elevation of 8,670 ft and average annual precipitation of 30.88 inches. The drainage basin tributary to the lower terminus has a number of surface water diversions. There is a total of 41.42 cfs in decreed active diversion structures with records. Steamboat Reservoir operations have a substantial impact on the proposed reach of Willow Creek. There are no known absolute surface water diversions in the proposed reach. In addition to Ways Gulch and Red Creek, which are tributary to the upper Willow Creek reach, the lower Willow Creek reach benefits from flow contributed by Beaver Creek. Due to surface water diversions and the reservoir, hydrology in this drainage basin does not represent natural flow conditions. See the Hydrologic Features Map.

Available Data

There is one gage located approximately 4.8 miles upstream from the proposed reach at the outlet of Steamboat Lake. The Willow Creek below Steamboat Lake gage (WILBSLCO) is operated by the Division of Water Resources. The available period of record as of 11/17/2015 was 10/1/1978 to 12/31/2014. The gage appears to operate primarily during the irrigation season and there are many years without records. The total number of records available on any given day varies between 8 and 14 years depending on the day. The Willow Creek gage has a 35.3 square mile drainage basin, and therefore has less contributing area than at the lower terminus of the reach.

The upper terminus of the proposed reach is the confluence with Beaver Creek. Beaver Creek has a 13.5 square mile drainage basin and contributes additional flow to Willow Creek. There is no known gage or streamflow data available for Beaver Creek. There are 15 surface water diversions (ditches, pumps, or pipelines) with a total of 10.82 cfs in decreed diversions in the Beaver Creek drainage. StreamStats results are used in the hydrologic analysis to provide some indication of streamflow in the Beaver Creek basin. However, StreamStats does not account for water diversions.

Data Analysis

Because streamflow in the proposed reach of Willow Creek is largely controlled by Steamboat Lake releases, it is not reasonable to extend the period of record at the Willow Creek gage through regression analysis with other gages. However, because of the short period of record, staff examined climate stations to compare conditions during the gaged period of record to a longer term record. The Steamboat Springs climate station (Station ID USC00057936, downloaded 12/1/2015) is located about 20 miles south from the lower terminus. This climate station has a relatively long period of record with fairly consistent records starting in 1909 and some records as early as the 1890s. Only

years with complete records, meaning that all 12 months had data, were included in the analysis. The average annual precipitation at the Steamboat Springs Station for the period of record for years with complete records was 23.86 inches. During the years the Willow Creek gage operated with complete climate data, the average annual precipitation was 24.31 inches. Therefore, the Willow Creek gage represents approximately average precipitation conditions.

Median streamflow was calculated using the available Willow Creek gage record. 95% confidence intervals were not calculated due to the short period of record and variable number of days of record.

Water Availability Summary
The hydrographs (See Complete and Detailed Hydrographs) show the median streamflow based on the Willow Creek gage record. StreamStats for the Beaver Creek basin is provided for comparison. Releases from Steamboat Lake indicate that water is available for the proposed increase in April, May, and June. In July, the median releases are as low as 5 cfs. The StreamStats results for Beaver Creek indicate that mean monthly streamflow in July is 32.4 cfs. The water commissioner estimated that typical Beaver Creek streamflow in July is 5 or 6 cfs (Brian Romig, personal communication 11/14/2014). Adding the median streamflow at the Willow Creek gage (5 cfs) to the water commissioner's more conservative estimate of Beaver Creek flow (5 cfs) results in an estimate of 10 cfs available in July. Staff has concluded that water is available for appropriation.

Material Injury
Because the proposed ISF on Willow 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. (2015), 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.

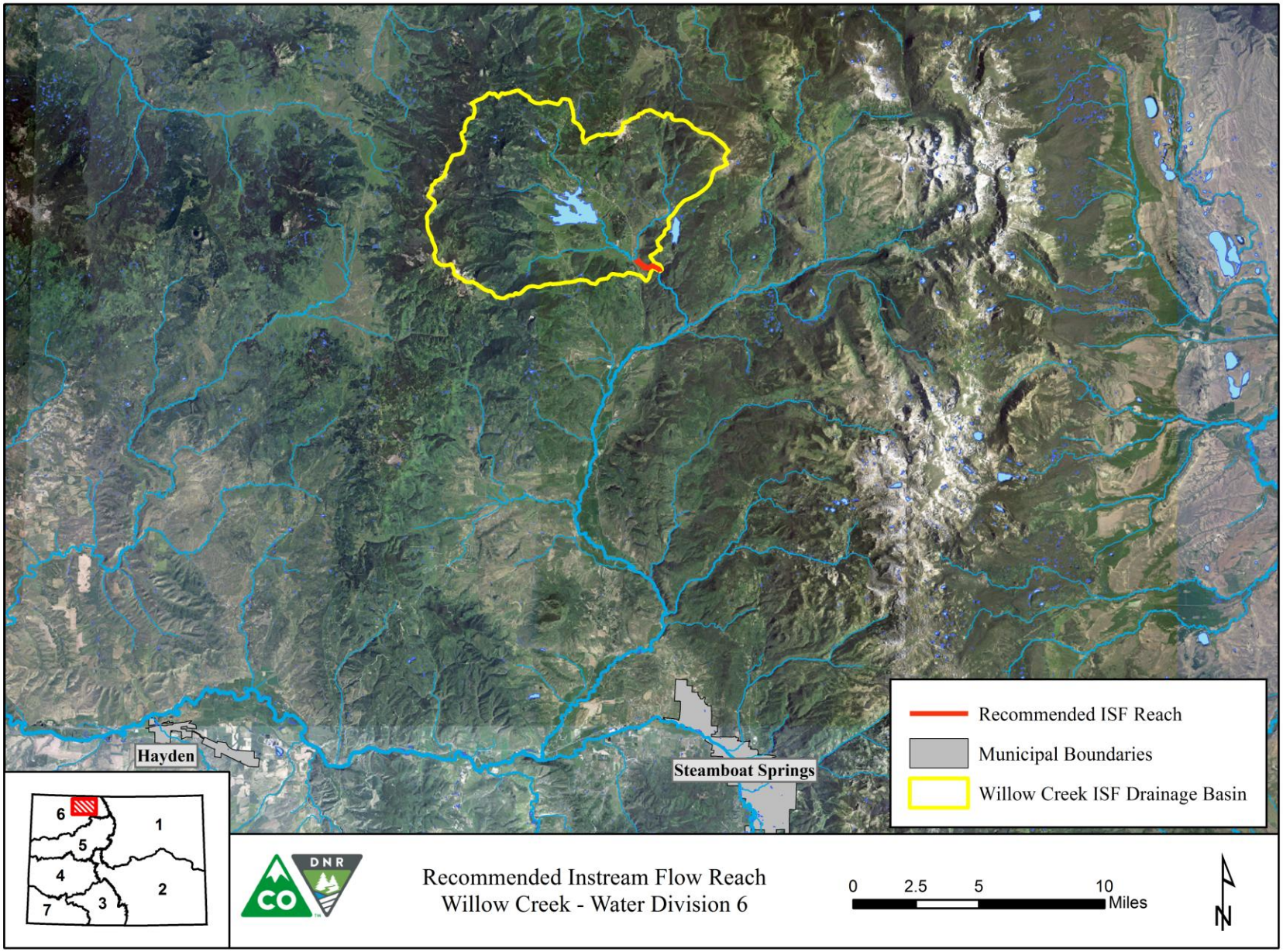
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

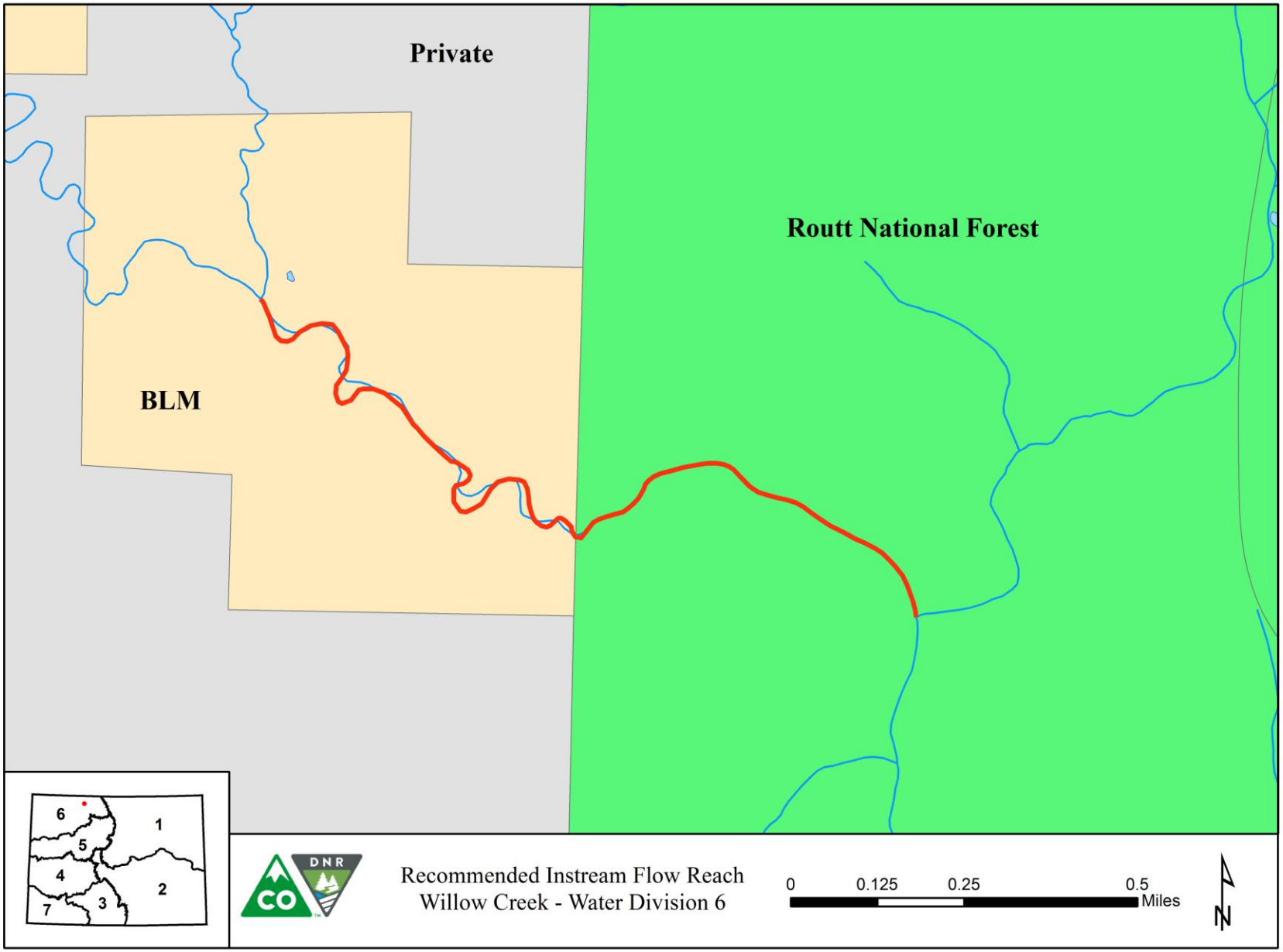
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

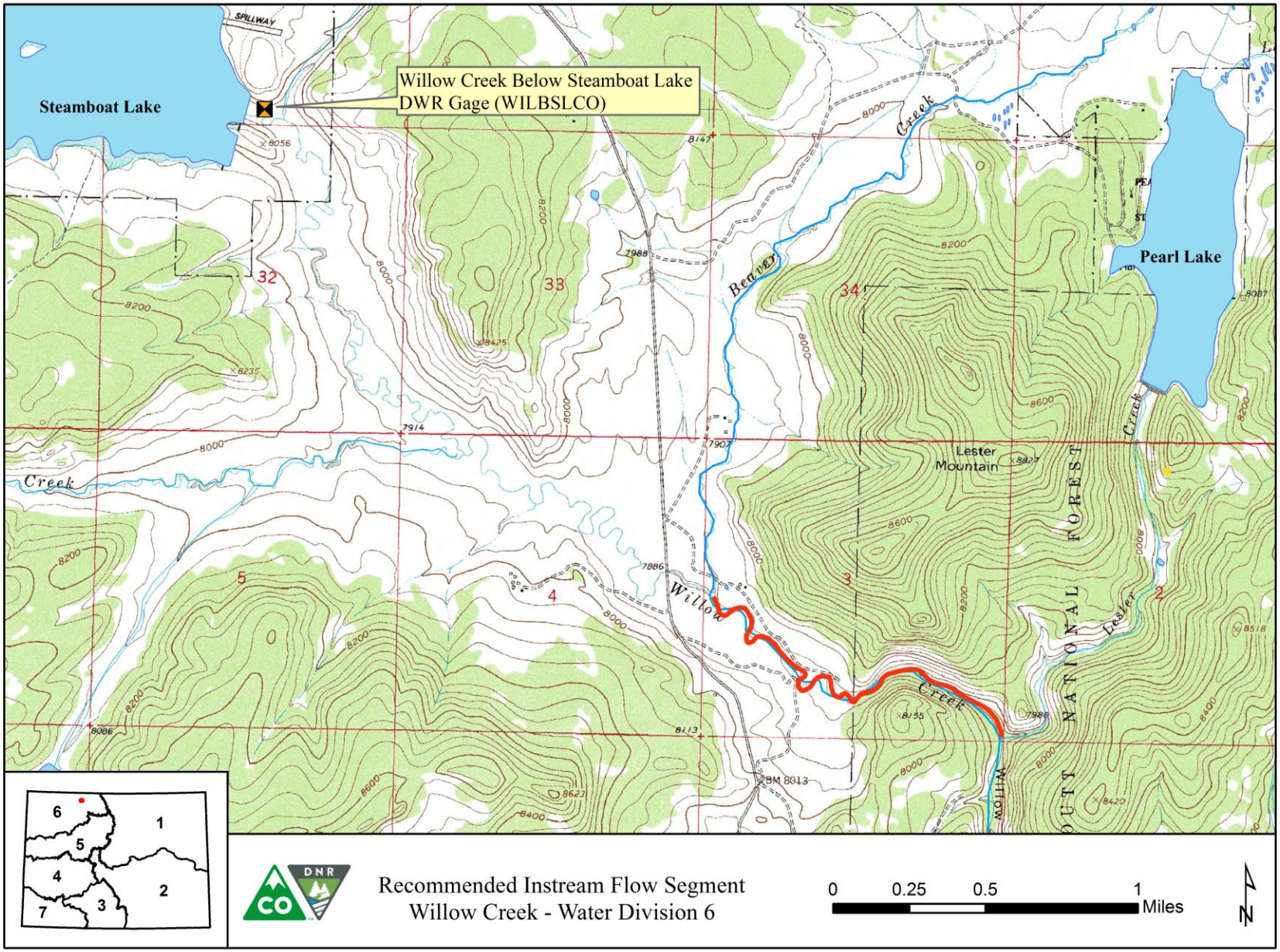
VICINITY MAP



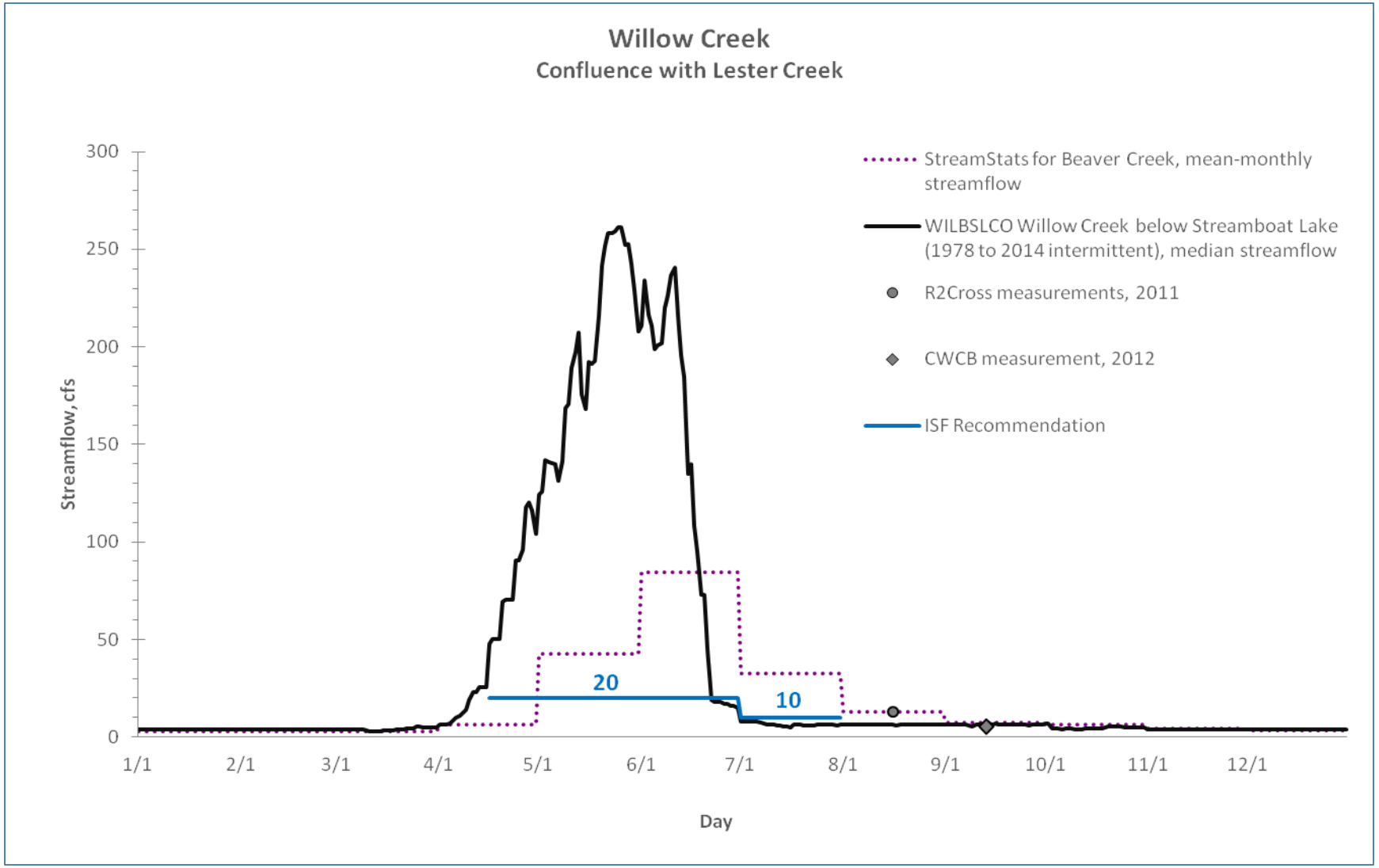
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH