COLORADO
Colorado Water Conservation Board
Department of Natural Resources

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Balm of Gilead Creek
EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Headwaters in the vicinity of UTM North: 4298857.94 UTM East: 452727.22
LOWER TERMINUS:	Bureau of Land Management Property Boundary UTM North: 4305120.04 UTM East: 453937.22
WATER DIVISION:	1
WATER DISTRICT:	23
COUNTY:	Park County
WATERSHED:	South Platte Headwaters (HUC#: 10190001)
CWCB ID:	16/1/A-002
RECOMMENDER:	Bureau of Land Management
LENGTH:	4.49 miles
FLOW RECOMMENDATION:	0.24 cfs (11/1 – 3/31) 0.35 cfs (4/1 – 4/30) 0.60 cfs (5/1 – 8/31) 0.35 cfs (9/1 – 10/31)

Balm of Gilead 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.

The Bureau of Land Management (BLM) recommended that the CWCB appropriate an ISF water right on a reach of Balm of Gilead Creek. This reach is located within Park County (See Vicinity Map). Balm of Gilead Creek originates on the north flank of Thirtynine Mile Mountain at an elevation of 10,500 ft approximately eight miles south of Elevenmile Canyon Reservoir. The creek flows in a northerly direction as it drops to an elevation of 8,600 feet where it joins Elevenmile Canyon Reservoir. The proposed reach extends from the headwaters downstream to the BLM property boundary. One-hundred percent of the land on the 4.49 mile proposed reach is publicly owned and managed by the U.S. Forest Service and the BLM (See Land Ownership Map). The BLM recommended this reach of Balm of Gilead 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/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.

Balm of Gilead Creek is a cold-water, high gradient stream. The reach flows through a shallow, rolling valley approximately one-fourth mile in width. The stream is confined by bedrock in some locations and travels through alluvium in other locations. The stream generally has medium-sized substrate, ranging from gravels to small boulders. The stream has a good mix of pools, small riffles, and runs.

Fisheries surveys indicate that the stream has supported a limited density rainbow trout population. Intensive macroinvertebrate surveys have not been conducted, but spot samples have revealed various species of black fly, midges, mayfly, caddisfly, and stonefly.

The riparian community is generally comprised of various willow species, alder, river birch, and potentilla. The riparian community is in fair to good condition. The structure of the riparian community provides only limited shading and cover for fish habitat.

Table 1. List of fish species identified in Balm of Gilead Creek.

Species Name	Scientific Name	Status
rainbow trout	*Oncorhynchus mykiss*	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.

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 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 0.25 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model.

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

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
BLM	8/17/2009 - 1	0.12	0.05 – 0.3	0.17	Out of range
BLM	8/17/2009 - 2	0.12	0.05 – 0.3	0.21	Out of range
BLM	5/19/2014 - 1	0.24	0.1 – 0.6	0.2	Out of range
BLM	5/19/2014 - 2	0.24	0.1 – 0.6	0.41	0.6*
			Mean	**0.25**	**0.6**

**The flow that meets all three instream flow criteria is outside of the confidence interval for this data set. 0.6 cfs is within the confidence interval, provides 0.72 feet per second average velocity, and meets the instream flow criteria for average depth and wetted perimeter.*

ISF Recommendation Creek

The BLM recommends flows of 0.24 cfs (11/1 – 3/31), 0.35 cfs (4/1 – 4/30), 0.60 cfs (5/1 – 8/31), and 0.35 cfs (9/1 – 10/31) based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

0.6 cubic feet per second is recommended during the warm weather period from May 1 to August 31. This recommendation is driven by the average velocity criteria. This creek is very small and steep and has limited physical habitat, so it is important to protect a flow rate that provides usable habitat in riffles when fish are completing critical life history functions during the warm weather months.

0.35 cubic feet per second is recommended during the fall period, from September 1 to October 31. This recommendation is driven by limited water availability. This flow rate meets two of three instream flow criteria.

0.24 cfs is recommended during the winter period from November 1 through March 31. This flow rate should prevent pools from freezing, allowing the fish population to successfully overwinter. Even though the base flow in this creek is small, it is extremely consistent, allowing the fishery to persist. The original BLM recommendation of 0.25 cfs was modified due to water availability issues.

0.35 cfs is recommended during the early portion of the snowmelt runoff period, from the April 1 to April 30. This flow rate meets two of three instream flow criteria, but reflects the fact that snowmelt runoff is not yet sufficient during April to meet all three instream flow criteria.

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 Balm of Gilead Creek is 3.72 square miles, with an average elevation of 9,940 ft and average annual precipitation of 14.93 inches. There are no known surface water diversions within the basin tributary to the proposed ISF. There are also no reservoirs or transbasin import or exports. Hydrology in this drainage basin represents natural flow conditions. See the Hydrologic Features Map for more information.

Available Data

There are no current or historic streamflow gages in the vicinity of the proposed ISF reach or in nearby drainages that would be representative of streamflow in this reach. In some cases, diversion records can be used to provide an indication of water availability in a stream reach. Balm of Gilead Ditch (1876 appropriation date, 1.1 cfs) was located near the lower terminus. However, while the diversion record provides some information about streamflow, it is not a perfect measure of streamflow because years in which water is available but not taken may be recorded as zero. Balm of Gilead Ditch has just five years with measured diversions and was transferred to the City of Aurora in 1983.

CWCB staff made four streamflow measurements on the proposed reach of Balm of Gilead Creek on 9/25/2015. Due to difficult measurement conditions, the measurements were averaged for inclusion in the water availability analysis.

Data Analysis
The small number of recorded diversions makes use of this record problematic. Most use occurred at different times, for example all in May, or all in June, such that any given day had at most 3 measurements. There are recorded diversions of up to 13 cfs (1980) and two separate years show 5 cfs diversions, but most years are zero or have no data. This record provides supporting evidence, but is too incomplete to use for water availability analyses.

StreamStats provides an estimate of mean-monthly streamflow. It should be noted that average annual precipitation for Balm of Gilead Creek is 14.93 inches, which is below the StreamStats model's suggested precipitation of 18 inches. Therefore, the model results are extrapolations, but remain the best available estimate of streamflow on Balm of Gilead Creek.

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 Balm of Gilead 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.

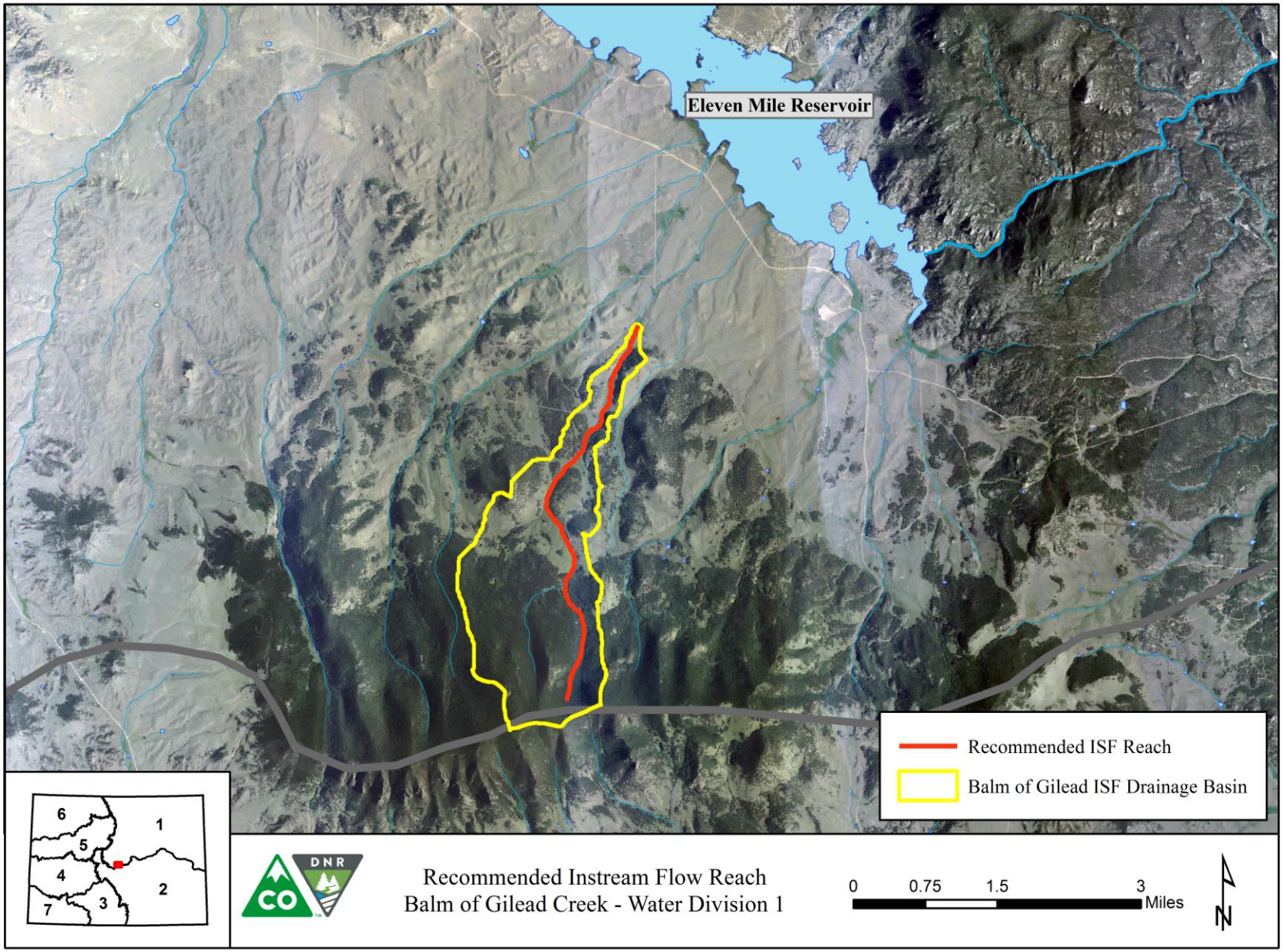
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

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.

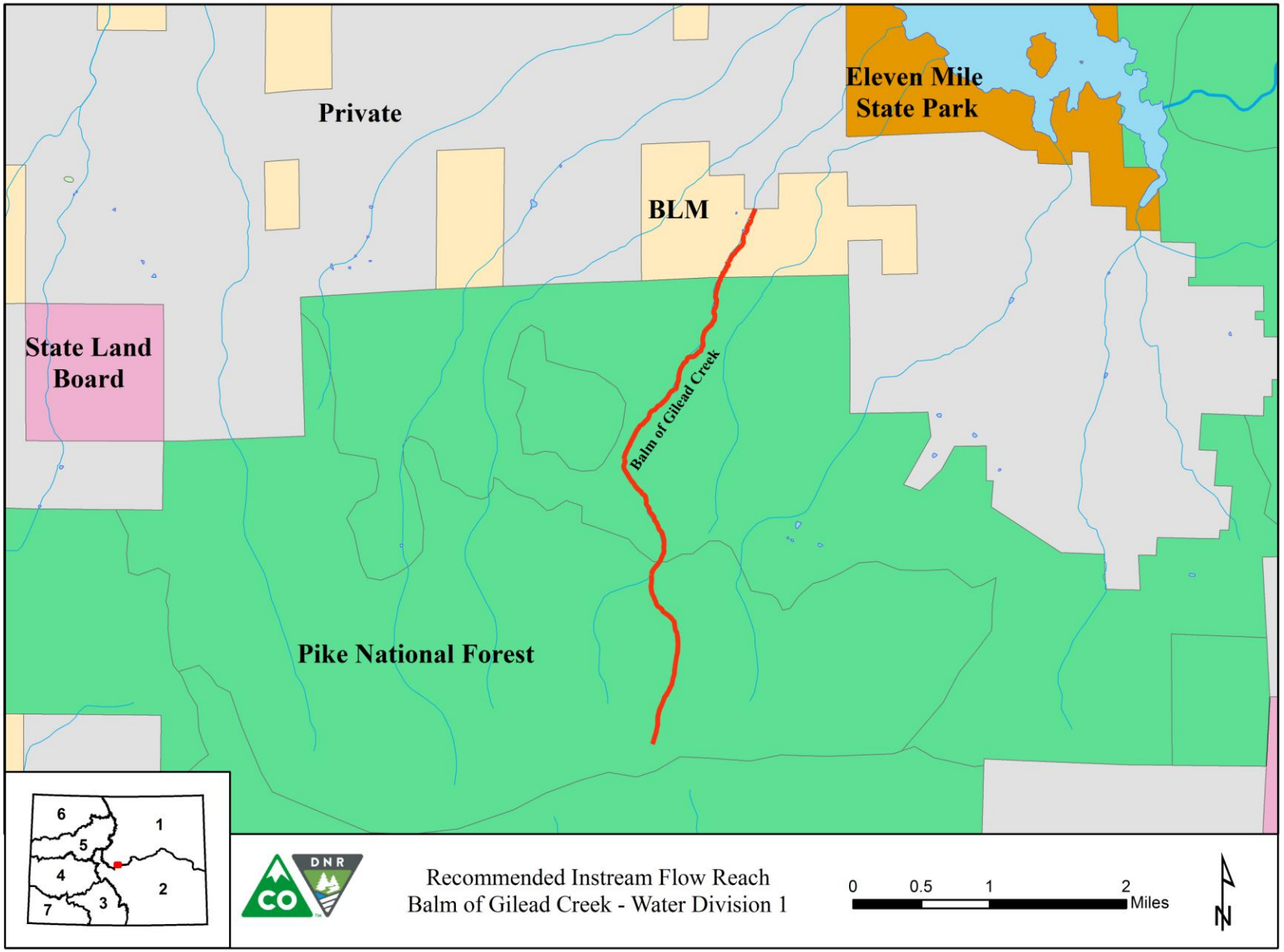
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

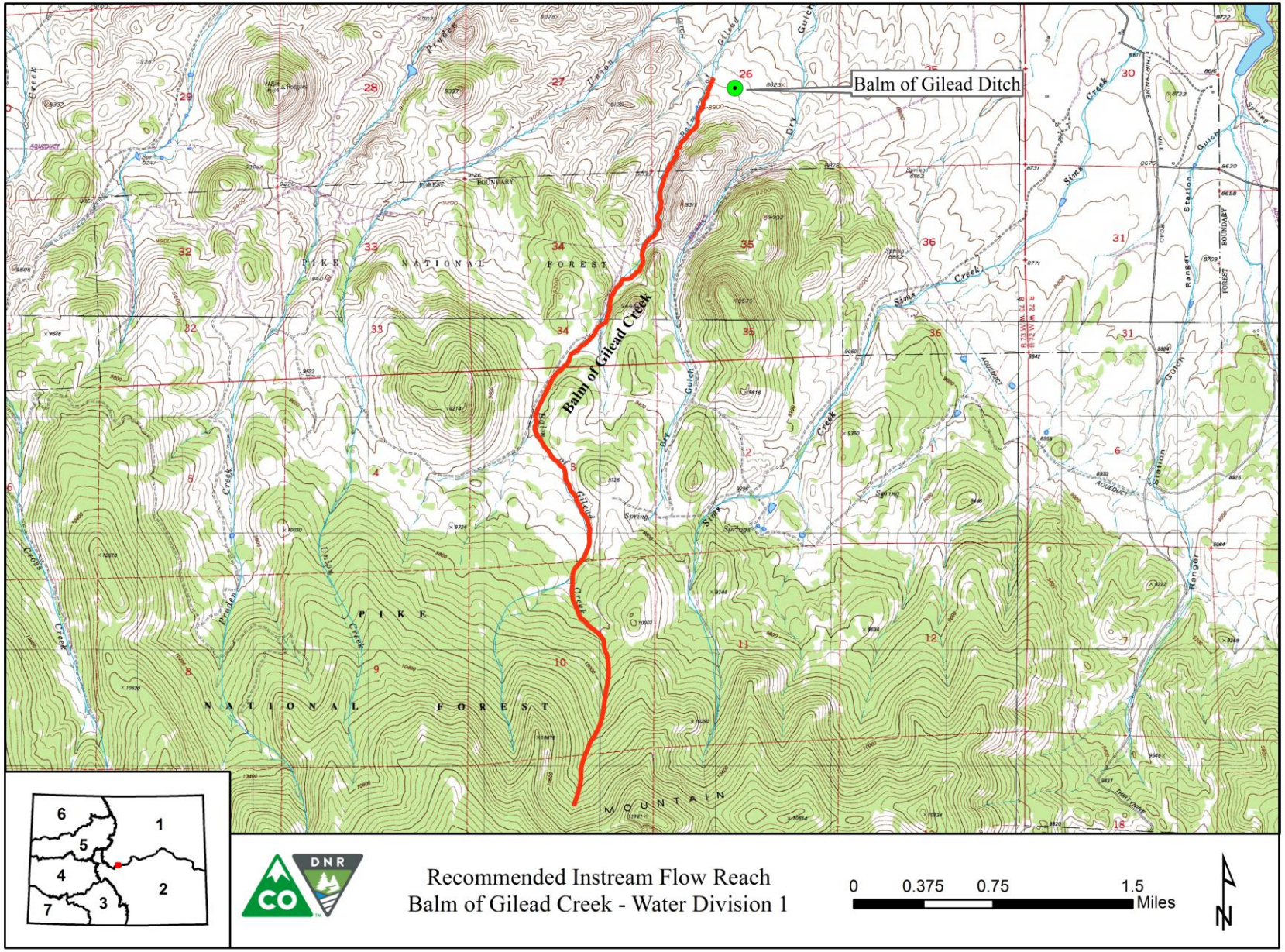
VICINITY MAP



LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH