



## COLORADO

Colorado Water  
Conservation Board

Department of Natural Resources

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# Sand Creek EXECUTIVE SUMMARY

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## CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS: Colorado - Wyoming Stateline  
UTM North: 4538599.90 UTM East: 482303.65

LOWER TERMINUS: confluence with an unnamed tributary  
UTM North: 4531763.76 UTM East: 486977.39

WATER DIVISION: 1

WATER DISTRICT: 3

COUNTY: Larimer County

WATERSHED: Cache la Poudre(HUC#: 10190007)

CWCB ID: 15/1/A-003

RECOMMENDER: Larimer County Department of Natural Resources &  
Colorado Parks and Wildlife

LENGTH: 6.59 miles

FLOW RECOMMENDATION: 1.5 cfs (7/1-5/15)  
5.5 cfs (5/16-6/30)



# Sand 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 Larimer County Department of Natural Resources (Larimer County) and Colorado Parks and Wildlife (CPW) recommended that the CWCB appropriate an ISF water right on a reach of Sand Creek. This reach is located within Larimer County about 16 miles northwest of the town of Wellington (See Vicinity Map). Sand Creek originates in Wyoming near the Town of Buford at an elevation of 8,400 ft. The creek flows in a southeasterly direction as it drops to an elevation of 4,600 feet where it joins the South Platte River. The proposed reach extends from the Colorado - Wyoming border downstream to the confluence with an unnamed tributary. Eighty-two percent of the land on the 6.59 mile proposed reach is owned and managed by Larimer County (See Land Ownership Map). Larimer County and CPW recommended this reach of Sand 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.

Over and understory vegetation on large portions of Sand Creek include the following species. Narrowleaf cottonwood (*Populus angustifolia*) is the dominant riparian tree forming a canopy over diverse shrub species including rocky mountain maple (*Acer glabrum*), wild plum (*Prunus americana*), sandbar willow (*Salix exigua*), plains cottonwood (*Populus deltoides*), chokecherry (*Prunus virginiana*), bluestem willow (*Salix irrorata*), skunkbush, snowberry (*Symphoricarpos oreophilus*) and cottonwood (*Populus acuminata*). The herbaceous understory in the riparian areas includes Kentucky bluegrass, needle-and-thread, western wheatgrass, lupine (*Lupinus argenteus*), sticky geranium (*Geranium caespitosum*), water sedge (*Carex aquatilis*), field horsetail (*Equisetum arvense*), poison ivy (*Toxicodendron rydbergii*) and field mint (*Mentha arvensis*). Haygood Canyon supports a rare narrowleaf cottonwood/chokecherry (*Populus angustifolia*/*Prunus virginiana*) community.

Sand Creek was sampled by CPW for fish composition. Fish species captured were mixed age class, small brook trout (*Salvelinus fontinalis*) with evidence of recruitment and reproduction. The water quality and temperature and native aquatic insect assemblage in Sand Creek are very good and have

the potential to support introduction of the native state and federally threatened greenback cutthroat trout (*Oncorhynchus clarki stomias*).

In March 2007 and again in 2012, an aquatic insect survey was completed by Colorado State University (Boris Kondratieff, and others) on Sand Creek with excellent results showing that the assemblage of native aquatic insects is intact. During the sampling, over 128 total macroinvertebrate taxa were identified from both qualitative samples and quantitative benthic samples. Of these, 53 mayfly/stonefly/caddisfly taxa were collected from Sand Creek, a remarkable biodiversity and number for any known Front Range stream. Species recorded include stoneflies such as the rare snowfly (*Capnura wanica*), Gunnison snowfly (*Utacapnia poda*), Angulate snowfly (*Paracapnia angulata*), blue-winged olive (*Baetis tricaudatus*), stoneflies (*Sweltsa* sp.), Oregon forestfly (*Zapada oregonensis*) and alderflies (*Sialis* sp.).

**Table 1. List of fish species identified in Sand Creek.**

| Species Name   | Scientific Name              | Status |
|----------------|------------------------------|--------|
| brook trout    | <i>Salvelinus fontinalis</i> | None   |
| fathead minnow | <i>Pimephales promela</i>    | 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

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 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). 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 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 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 5.5 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a winter flow of 3.4 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 Sand Creek.**

| Entity     | Date          | Streamflow (cfs) | Accuracy Range (cfs) | Winter Rate (cfs) | Summer Rate (cfs) |
|------------|---------------|------------------|----------------------|-------------------|-------------------|
| CPW & CWCB | 3/26/2014 - 1 | 4.99             | 2.0 - 12.5           | 3.5               | 5.5               |
| CPW & CWCB | 3/26/2014 - 2 | 5.07             | 2.0 - 12.7           | Out of Range      | Out of Range      |
| CPW & CWCB | 7/10/2014     | 3.50             | 1.4 - 8.8            | 3.3               | Out of Range      |
|            |               |                  | Mean                 | 3.4               | 5.5               |

### ISF Recommendation

The CPW recommends flows of 3.4 cfs (7/1 - 5/15), and 5.5 cfs (5/16 - 6/30) based on R2Cross modeling analyses and biological expertise. The CPW recommendation was modified by staff during the base flow period as a result of water availability.

5.5 cubic feet per second is recommended during the warm weather period from May 16 to June 30.

1.5 cubic feet per second is recommended during the base flow period, from July 1 to May 15. This recommendation is driven by limited 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 Sand Creek is 20.3 square miles, with an average elevation of 7,070 ft. and average annual precipitation of 17.97 inches. Three diversion structures are located within the proposed reach, but there are no diversion records. Approximately 9.1 square miles of the drainage basin is located in Wyoming, which represents approximately 44% of the total basin. Staff identified 6 reservoirs with a total of 58.4 AF in storage capacity and one surface water diversion of 0.21 cfs in the portion of the drainage located in Wyoming. No large scale diversions were apparent based on review of 2013 National Agricultural Imagery Program aerial photography and 2014/2015 Google Earth imagery.

### **Available Data**

There are no current or historic streamflow gages on Sand Creek or any nearby creeks that are likely to be representative. There also are no diversion records that provide information about stream flow in the proposed reach. Due to limited available data in the area, CWCB staff installed a temporary streamflow gage on Boxelder Creek at the mouth of the canyon 3/4 of a mile northeast of Table Mountain. The temporary gage on Boxelder Creek measured streamflow on the 16.7 square mile drainage basin adjacent to Sand Creek, which has an average elevation of 7,320 ft. and average annual precipitation of 18.49 inches, similar to the Sand Creek drainage basin. The pressure transducer was installed on 9/4/2014 and is still operating. The pressure transducer records water depth every 15 minutes, which staff converted to streamflow using a rating curve staff developed. This 15-minute interval data was used to calculate daily average streamflow values.

CWCB staff made 11 streamflow measurements on the proposed reach of Sand Creek between 3/26/2014 and 9/29/2015, including 3 measurements used for R2Cross analysis. The measurements on Sand Creek were made at the mouth of Haywood Canyon, approximately in the top third of the proposed reach. These measurements are included in the water availability analysis.

In addition, Charles Gindler, resource specialist for the Larimer County Natural Resources Department, estimated that based on his observations, streamflow is typically between 1 and 2 cfs on a consistent basis, but can be as high as 5 cfs at times. He also stated that streamflow can be significantly higher during rain events.

### **Data Analysis**

Staff compared and used streamflow measurements on Sand Creek and the Boxelder Creek gage data to develop a regression equation relating the flow in Boxelder Creek to Sand Creek. The two data sets showed good correlation ( $r^2$  value was 0.94) when the highest streamflow measurement taken on

5/12/2015 was excluded. The regression equation was used to estimate streamflow on Sand Creek. The data was not scaled to the proposed lower terminus, which is located downstream from the measurement location on Sand Creek. Median streamflow and 95% confidence interval for median streamflow were not calculated due to the short period of record.

Due to the short period of record for the temporary Boxelder Creek gage, Staff examined nearby climate stations to evaluate the available record. The nearest climate station with a long period of record is located in Cheyenne, Wyoming, roughly 23 miles northeast from the lower terminus (Cheyenne, USW00024018; accessed 12/7/2015). This station has nearly 100 years of precipitation records (1915 to 2015). The average annual precipitation at the Cheyenne station for years with complete records (1915 to 2014) is 15.24 inches. In 2014, the climate station recorded 17.88 inches of precipitation, which was somewhat above average. During the time the gage operated in 2014 (September through December), precipitation was similar to the average fall precipitation in the climate record. In 2015, the climate record was not complete at the time of analysis and did not contain precipitation values after July. However, 2015 tied 1995 for the highest monthly precipitation recorded in the month of May and the magnitude and duration of the peak were likely unusually high and long.

#### **Water Availability Summary**

The hydrographs (See Complete and Detailed Hydrographs) show the scaled Boxelder Creek temporary gage data and all measurements on Sand Creek. All streamflow measurements were above or equal to the proposed ISF rates. The available data and observations made by Charles Gindler form a basis for staff to conclude that the proposed ISF rates are available.

#### **Material Injury**

Because the proposed ISF on Sand 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.

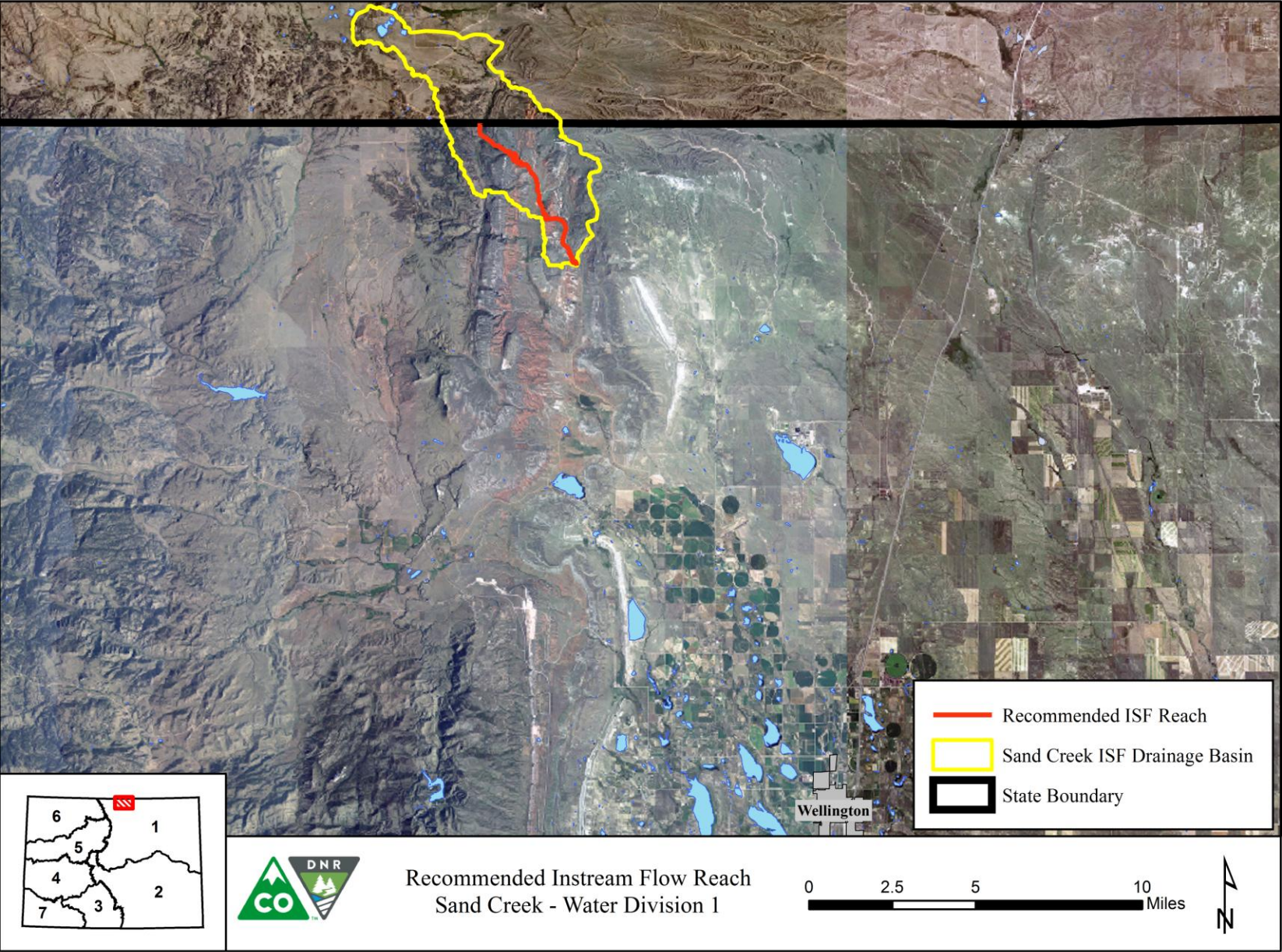
#### **Metadata Descriptions**

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.

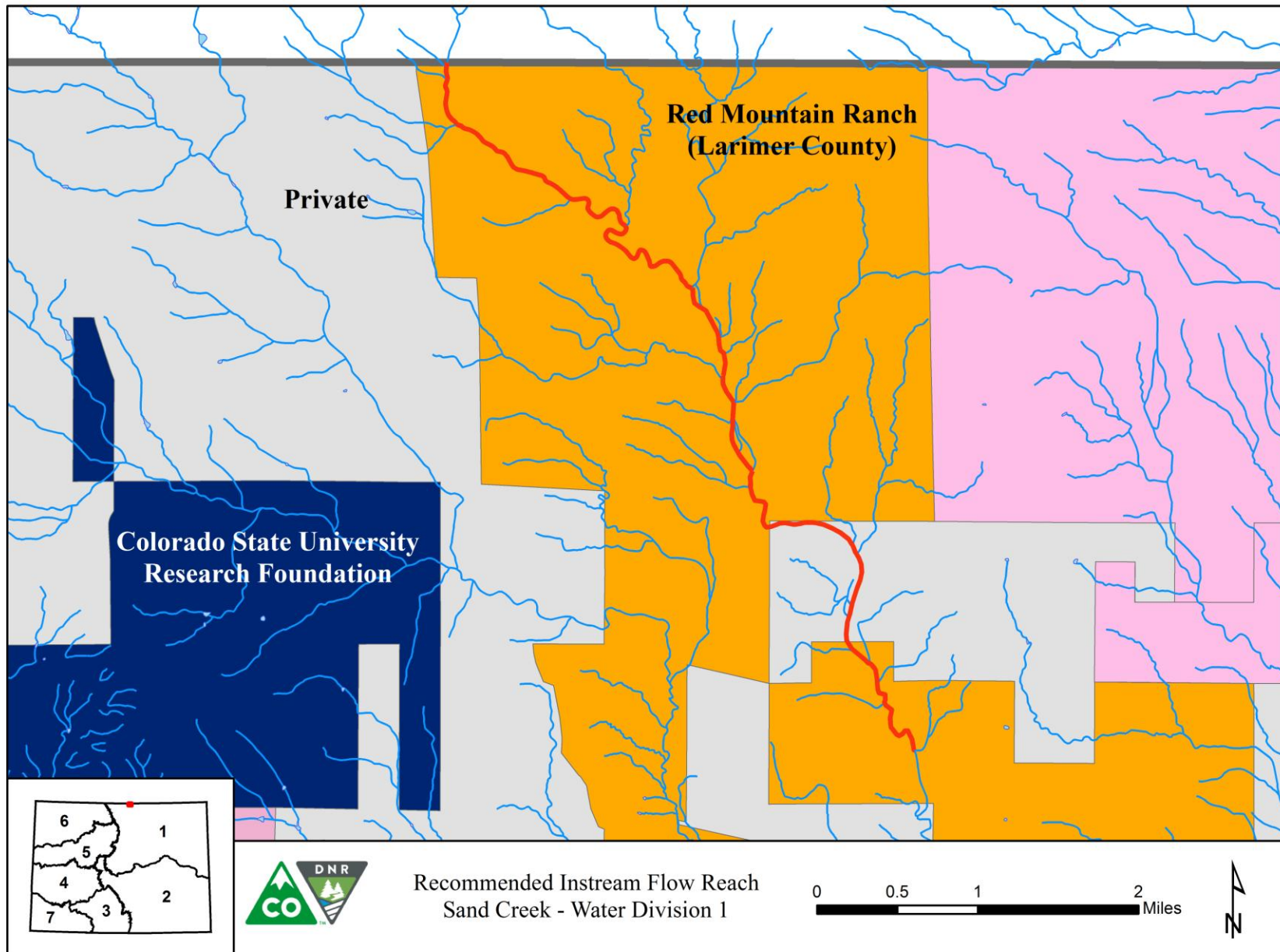


VICINITY MAP



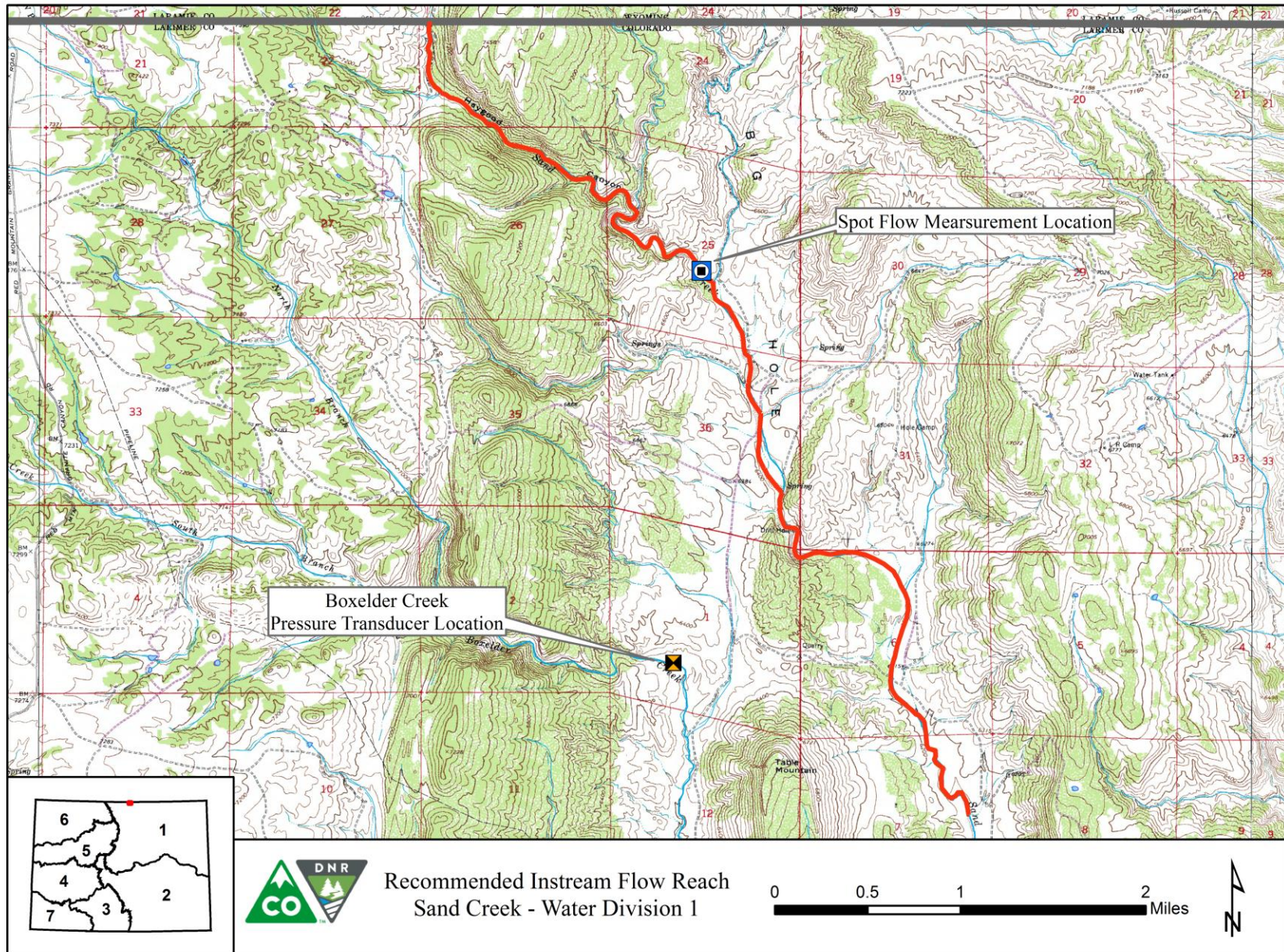


## LAND OWNERSHIP MAP

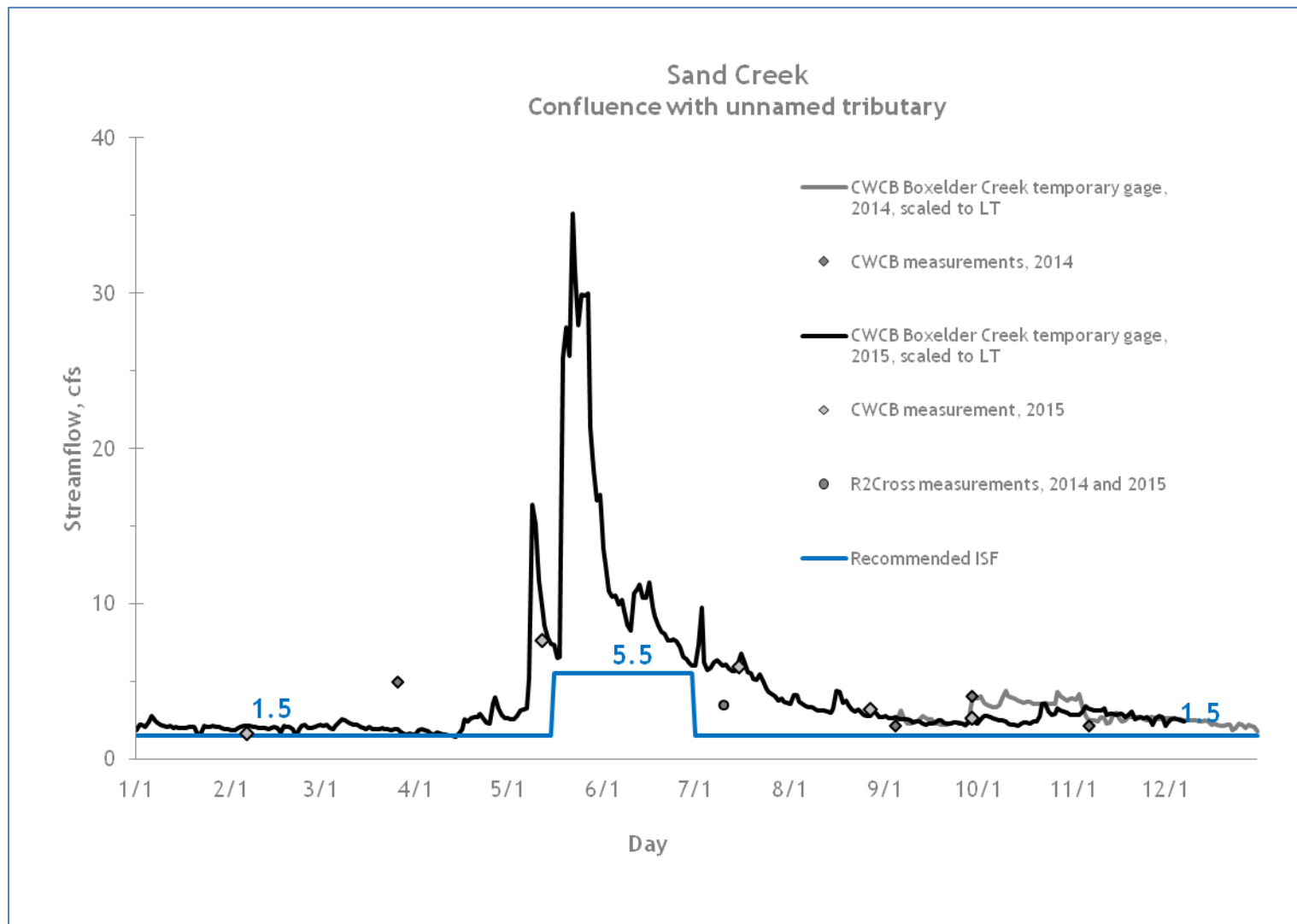




## HYDROLOGIC FEATURES MAP



## COMPLETE HYDROGRAPH





## DETAILED HYDROGRAPH

