

## **Stream: Shell Creek**

### **Executive Summary**

Water Division: 1

Water District: 76

CPW#: 13754

CWCB ID: 13/1/A-002

**Segment:** HEADWATERS TO BLM BOUNDARY

**Upper Terminus:** HEADWATERS IN THE VICINITY OF

UTM North: 4530204.76      UTM East: 428365.79

**Lower Terminus:** BLM BOUNDARY AT

UTM North: 4537065.11      UTM East: 425936.22

**Watershed:** Upper Laramie (HUC #: 10180010)

**Counties:** Larimer

**Length:** 6.25 miles

**USGS Quad(s):** Crazy Mountain, Sand Creek Pass

**Flow Recommendation:** 1.1 cfs (4/1 – 10/31)

1.0 cfs (11/1 – 3/31)



## **Staff Analysis and Recommendation**

### **Summary**

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/2014ProposedInstreamFlowAppropriations.aspx>) form the basis for staff's instream flow recommendation to be considered by the Board. It is staff's opinion that the information contained in this report is sufficient to support the findings required by ISF Rule 5.40.

Colorado's Instream Flow Program was created in 1973 when the Colorado State Legislature recognized "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 CWCB with the exclusive authority to appropriate and acquire instream flow and natural lake level water rights. In order to encourage other entities to participate in Colorado's Instream Flow Program, the statute directs the CWCB to request instream flow recommendations from other state and federal agencies. The Bureau of Land Management (BLM) recommended this segment of Shell Creek to the CWCB for a water right under the Instream Flow Program. Shell Creek is being considered because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Shell Creek is approximately 7.2 miles long and originates in the Roosevelt National Forest at an elevation of 9,540 feet. It flows in a northeasterly direction as it drops to an elevation of 7,650 feet where it crosses the state line. Seventy-one percent of the land on the 6.25 mile segment addressed by this report is publicly owned (see Table 1). Shell Creek is located within Larimer County and the total drainage area of the creek (Within Colorado) is approximately 9.6 square miles.

The subject of this report is a segment of Shell Creek from the headwaters extending downstream to the BLM boundary. The proposed segment is located approximately 25 miles south of Laramie, Wyoming. Staff has received one recommendation for this segment from the BLM, which is discussed below.

### **Instream Flow Recommendation**

BLM recommended flows of 1.1 cfs (4/1 – 10/31) and 1.0 cfs (11/1 – 3/31), based on its July 13, 2011 data collection efforts and staff's water availability analyses.

### **Land Status Review**

Table 1. Summary of land ownership data in the vicinity of the proposed ISF on Shell Creek

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Headwaters	BLM Boundary	6.25	29%	71%

Breakdown of public lands by managing entity: 90% BLM and 10% U.S. Forest Service.

## **Biological Data**

Shell Creek is a cold-water, high gradient stream in a narrow, forested canyon. The stream is confined by bedrock and has variable substrate, ranging from gravels to boulders up to 1 foot in diameter. The stream has a good mix of riffle, run, and deep pool habitats to support a salmonid fishery.

Fishery surveys revealed a self-sustaining brook trout fishery. Even though Shell Creek is a small stream, the fish population survived the 2002-2003 drought, indicating that base flows are sufficient to support the trout fishery through all types of climate conditions. However, fish surveys noted only one age class of fish, so reproduction in the stream may be limited in some types of hydrologic conditions. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The riparian community along Shell Creek is in good condition, and provides adequate cover and shading for the fish population. In the upper elevations of the creek, the riparian community is comprised of blue spruce, alder, willow, sedges, and rushes. At lower elevations, the riparian community also includes cottonwood and birch.

## **Field Survey Data**

BLM staff used the R2Cross methodology to quantify the amount of water required to preserve the natural environment to a reasonable degree. The R2Cross method requires that stream discharge and channel profile data be collected in a riffle stream habitat type. Riffles are most easily visualized as the stream habitat types that would dry up first should streamflow cease. This type of hydraulic data collection consists of setting up a transect, surveying the stream channel geometry, and measuring the stream discharge.

## **Biological Flow Recommendation**

The CWCB staff relied upon the biological expertise of the BLM to interpret output from the R2Cross data collected to develop the initial, biologic instream flow recommendation. This initial recommendation is designed to address the unique biologic requirements of each stream without regard to water availability. Three instream flow hydraulic parameters, average depth, percent wetted perimeter, and average velocity are used to develop biologic instream flow recommendations. Colorado Parks and Wildlife has determined that maintaining these three 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 invertebrates (Nehring 1979; Espegren 1996).

For this segment of stream, two data sets were collected, with the results shown in Table 2 below. Table 2 shows who collected the data (Party), the date the data was collected (Date), the measured discharge at the time of the survey (Q), the accuracy range of the predicted flows based on Manning's Equation (250% and 40% of Q), the summer flow recommendation based on meeting 3 of 3 hydraulic criteria, and the winter flow recommendation based upon 2 of 3 hydraulic criteria. Recommendations

that fall outside of the accuracy range of the model, over 250% of the measured discharge or under 40% of the measured discharge, may not give an accurate estimate of the necessary instream flow rate required.

Table 2. Summary of R2Cross measurements and analysis for Shell Creek.

<b>Party</b>	<b>Date</b>	<b>Q (cfs)</b>	<b>Accuracy Range (cfs)</b>	<b>Winter (2/3) (cfs)</b>	<b>Summer(3/3) (cfs)</b>
BLM	7/13/2011	1.25	0.5 – 3.1	0.95	1.14
BLM	7/13/2011	1.35	0.5 – 3.4	1.13	1.19
Averages				1.04	1.17

BLM’s analysis of this data, coordinated with Colorado Parks and Wildlife, indicates that the following flows are needed to protect the fishery and natural environment to a reasonable degree.

1.1 cubic feet per second is recommended for the warm weather period from April 1 through October 31. This recommendation is driven by the average depth criteria. Because of its small size and steep gradient, this creek possesses limited physical habitat suitable for fish. Accordingly, it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff flows are available. This flow rate is capable of preventing excessively high water temperatures.

1.0 cubic feet per second is recommended for the cold weather period from November 1 to March 31. This recommendation is driven by the average velocity criteria. This flow rate should prevent pools from freezing and protect overwintering fish.

## Hydrologic Data and Analysis

CWCB staff conducts hydrologic analyses for each recommended instream flow (ISF) appropriation to provide the Board with a basis for making the determination that water is available. 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 analyze 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 actual hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis 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, mean-monthly streamflow values will be presented.

### **Background Information**

The proposed instream flow on Shell Creek represents the headwaters of a relatively small (9.6 square mile) drainage basin that receives an average of 21.9 inches of precipitation. There is one surface water diversion within the basin with a decreed diversion rate of 0.001 cfs. There are also four small spring water rights in the basin. Given the small rates associated with these water rights, the hydrology on the proposed reach of Shell Creek should represent essentially natural or unaltered flow conditions.

There is not a gage at or near the lower terminus on Shell Creek, nor anywhere within the drainage basin. Two gages were located reasonably close to the Shell Creek drainage basin. The first of these is the Laramie River near Glendevy, CO gage (USGS 06657500, operated from 1904 to 1982), which is located approximately 13 miles to the south of the lower terminus. The second gage is the Sand Creek at the Colorado-Wyoming Stateline (USGS Gage 06659580, operated 1968 to present), located about 6.4 miles to the east of the lower terminus.

Both nearby gages had issues that limited their potential reliability as representative of the Shell Creek basin. The drainage basin for the Laramie River gage (101 square miles) is approximately 10 times larger than the Shell Creek drainage basin. Large differences in drainage basin size may produce inaccurate results when scaled to much smaller drainage basins. Archfield and Vogel (2009) suggest drainage basin area scaling ratios between 0.5 and 2.5. The Sand Creek gage drainage basin was 3 times larger than the drainage basin at the lower terminus of Shell Creek (29.2 square miles). However, only three years (1969 – 1971) in a 44-year period of record contain any recorded data from October 1 – April 1. Both gages also had consumptive depletions and in the case of Sand Creek, out-of-basin transfers, that complicate their use as representative gages.

In some cases, diversion records can be used to provide an indication of water availability in a stream reach. There are two diversion structures located downstream from the lower terminus of the proposed ISF reach. These are the John Goetz Ditch 2 (WDID 760504, 10 cfs) and Shell Creek Ditch (WDID

760505, 6.95 cfs). Both structures are listed as active; however, neither structure has maintained diversion records that can provide information about streamflow.

### **Data Analysis**

Due to limited available data, staff utilized StreamStats, a statistical hydrologic program, to estimate natural streamflow on Shell Creek. The hydrograph (see Figure 1) shows that the proposed instream flow rate is below the mean-monthly streamflow and that water is available. No revisions to the proposed ISF were necessary to meet 2 of 3 criteria in the winter and 3 of 3 criteria in the summer. Staff has concluded that water is available for appropriation on Shell Creek from the headwaters extending downstream to the BLM boundary.

### **Citations**

Archfield, S.A., and R.M. Vogel, 2009, Map correlation method: selection of reference streamgage to estimate daily streamflow at ungaged catchments, *Water Resources Research*, vol 46, W10513, doi:10.1029/2009WR008481.

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.

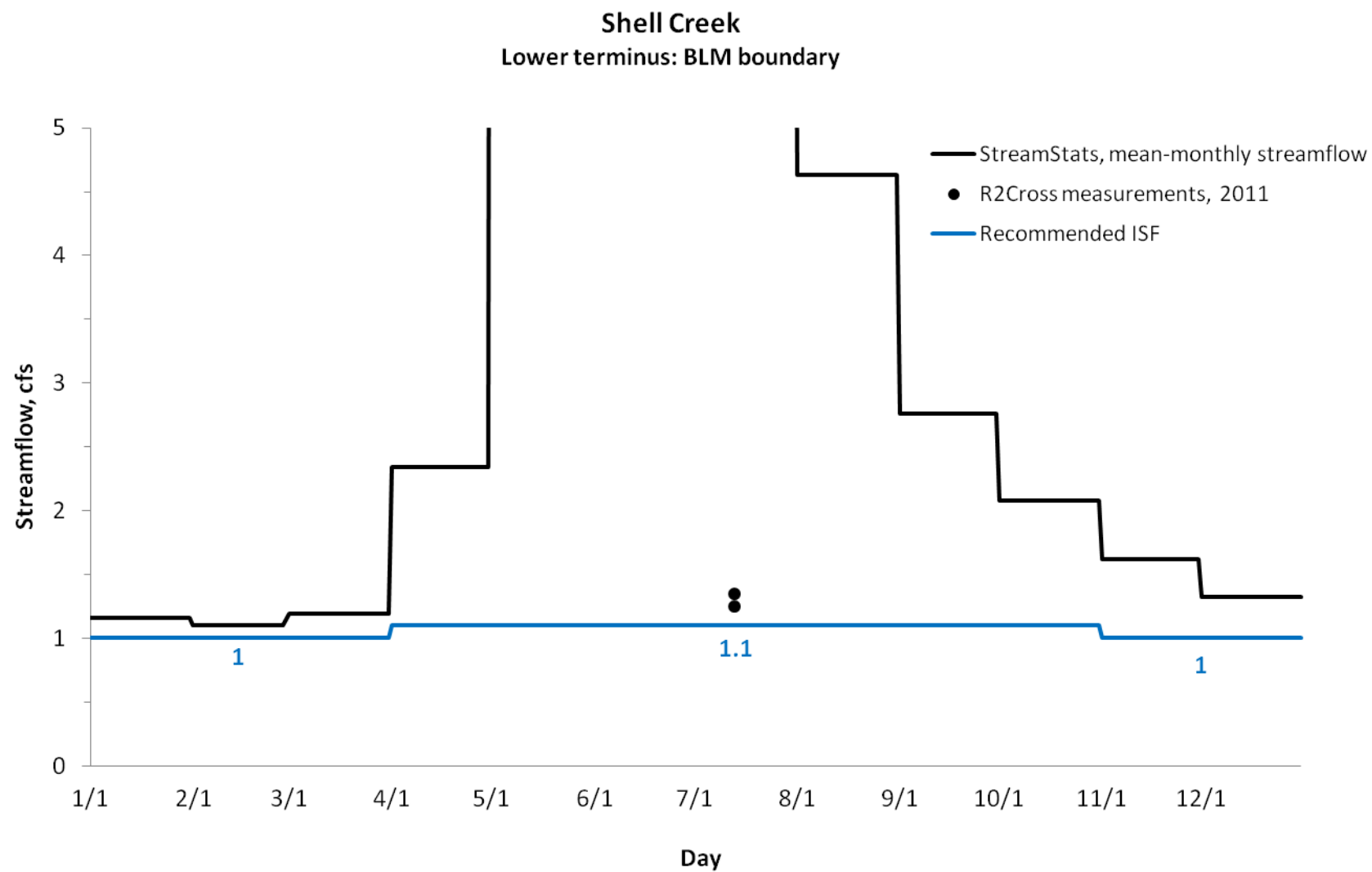


Figure 1. Hydrograph showing streamflow data and the proposed ISF rate on Shell Creek.

## **Existing Water Rights**

Staff has analyzed the water rights tabulation and determined that there are no decreed absolute surface diversions within this reach of stream. Staff has concluded that a new junior appropriation of water rights on Shell Creek can exist to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid existing water rights.

## **CWCB Staff's Instream Flow Recommendation**

Staff recommends that the Board form its intent to appropriate on the following stream reach:

**Segment:** HEADWATERS TO BLM BOUNDARY

**Upper Terminus:** HEADWATERS IN THE VICINITY OF

UTM North: 4530204.76      UTM East: 428365.79

(Latitude 40° 55' 11.35"N)    (Longitude 105° 51' 2.61"W)

NE SW Section 18, Township 11 North, Range 75 West 6<sup>th</sup> PM

1,910' East of the West Section Line; 1,642' North of the South Section Line

**Lower Terminus:** BLM BOUNDARY AT

UTM North: 4537065.11      UTM East: 425936.22

(Latitude 40° 58' 53.03"N)    (Longitude 105° 52' 49.42"W)

SE NE Section 26, Township 12 North, Range 76 West 6<sup>th</sup> PM

840' West of the East Section Line; 2,605' South of the North Section Line

**Watershed:** Upper Laramie (HUC #: 10180010)

**Counties:** Larimer

**Length:** 5.1 miles

**USGS Quad(s):** Crazy Mountain, Sand Creek Pass

**Flow Recommendation:** 1.1 cfs (4/1 – 10/31)

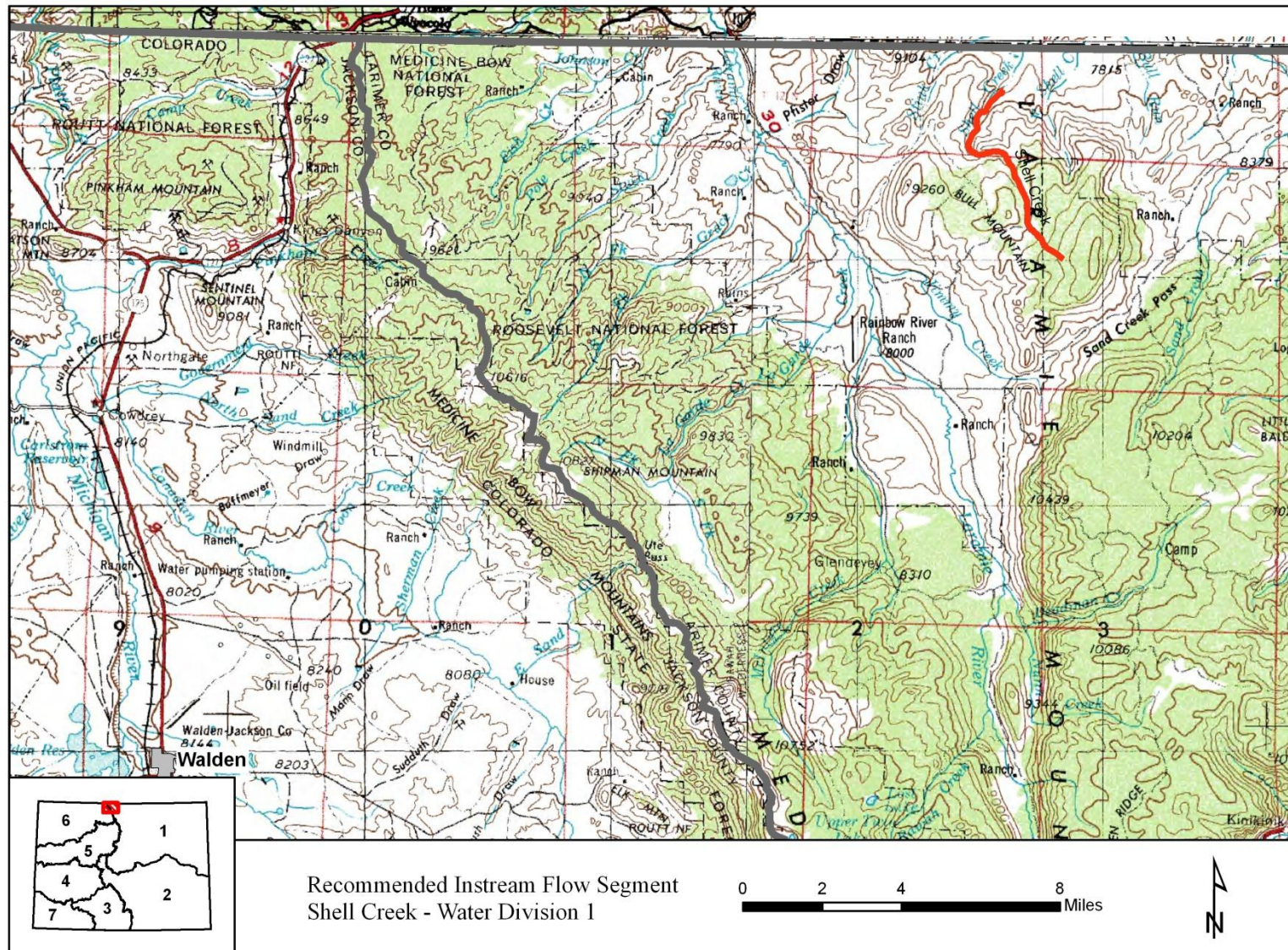
1.0 cfs (11/1 – 3/31)

### Metadata Descriptions:

- a) The UTM, PLSS and Lat/Long locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).
- b) The PLSS locations were derived from CWCB GIS using 2005 PLSS data from the U.S. Bureau of Land Management's Geographic Coordinate Database
- c) Projected Coordinate System: NAD 1983 UTM Zone 13N

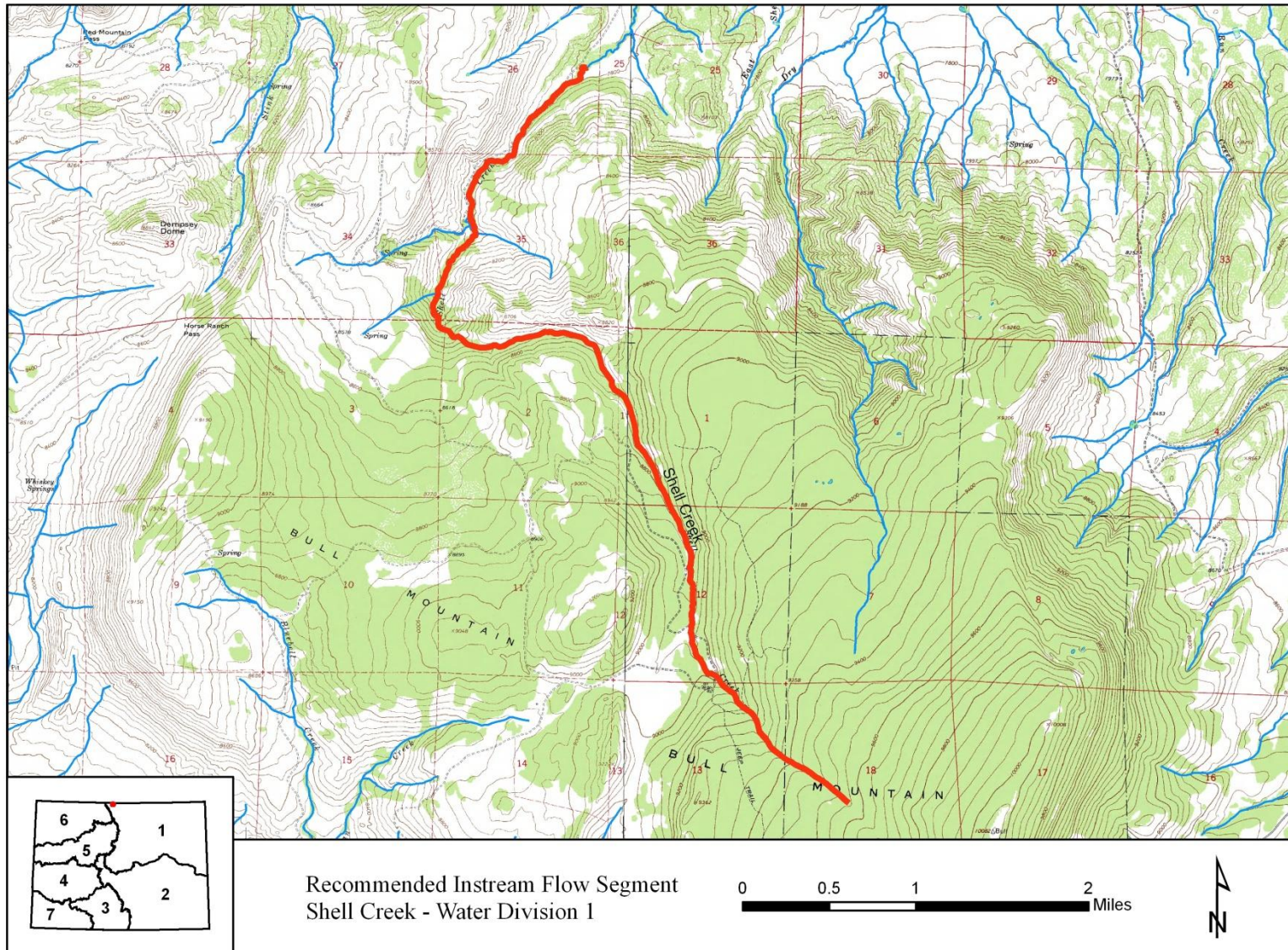


## Vicinity Map





## Water Rights Map



## Land Use Map

