<u>Stream:</u> Slate River (Upper Segment)

Executive Summary

Water Division: 4
Water District: 59
CPW#: 43116
CWCB ID: 14/4/A-002

Segment: CONFLUENCE POVERTY GULCH TO CONFLUENCE OH BE JOYFUL CREEK

Upper Terminus: CONFLUENCE POVERTY GULCH AT
UTM North: 4312815.03 UTM East: 321387.33

Lower Terminus: CONFLUENCE OH BE JOYFUL CREEK AT
UTM North: 4308782.63 UTM East: 323966.16

Watershed: East-Taylor (HUC #: 14020001)
Counties: Gunnison
Length: 3.69 miles
USGS Quad(s): Oh Be Joyful
Existing ISF: 4-80CW092A; 8 cfs (12/1 – 3/31), 15 cfs (4/1 – 11/30)
Flow Recommendation (Increase): 30 cfs (5/1 – 7/15)

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 the Slate River to the CWCB for an increased water right under the Instream Flow Program. The Slate Rive is being considered for an increase because it has a natural environment that can be preserved to a reasonable degree with an increased instream flow water right.

The Slate Rive is approximately 21 miles long and originates on the east flank of Purple Mountain at an elevation of 11,300 feet. It flows in a southeasterly direction as it drops to an elevation of 8,590 feet where it joins the East River. Seventy-six percent of the land on the 3.69 mile segment addressed by this report is publicly owned (see Table 1) The Slate River is located within Gunnison County and the total drainage area of the river is approximately 90 square miles.

The subject of this report is a segment of the Slate River from the confluence with Poverty Gulch extending downstream to the confluence with Oh Be Joyful Creek. The proposed segment is located approximately 10 miles northwest of the town of Crested Butte. Staff has received one recommendation for this segment from the BLM, which is discussed below.

Instream Flow Recommendation

BLM recommended a flow increase of 30 cfs (5/1 – 7/15) based on its September 29, 2011, June 7, 2012 and July 17, 2013 data collection efforts and staff's water availability analyses.

Justification for Instream Flow Increase

The BLM does not consider the current instream flow water right to be fully protective of the natural environment in the Slate River, pursuant to modern analytical procedures used by the CWCB. 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 period is especially critical for maintaining the fish population, because the fish population already experiences other stresses and biological limitations associated with the heavy metal pollutants.

Land Status Review

Table 1. Summary of land ownership data in the vicinity of the proposed ISF on the upper segment of the Slate River.

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence Poverty Gulch	Confluence Oh Be Joyful Creek	3.69	24%	76%

Breakdown of public lands by managing entity: 49 % US Forest Service, and 27 % BLM.

Biological Data

Above Oh Be Joyful Creek, the Slate River is a moderate gradient stream flowing through a canyon where bedrock restricts movement of the channel. The river carries a heavy load of large diameter sediments, due to natural erosion processes that occur in this type of metamorphic geology. The substrate is generally moderate in size, ranging from gravels up to cobbles eight inches in diameter.

Fishery surveys have revealed self-sustaining populations of brook trout and brown trout, with individuals up to 20 inches in length. Although fish distribution data is lacking before the 1970s, wild trout have been documented since that time. Colorado Parks and Wildlife have historically stocked the river with 10-inch rainbow trout, but limited fish numbers available for stocking resulted in the termination of stocking in 1994. Some portions of the recommended instream flow reach have numbers and biomass that are similar to other streams in this area. However, other portions of the recommended segment have reduced habitat available and fish numbers because of the high bed load transport in this watershed, which results in poor pool development.

Comprehensive macroinvertebrate surveys have been performed. Compared to other streams in the Southern Rocky Mountains ecoregion, the surveys revealed an above average abundance of macroinvertebrates in the Slate River, but below average diversity. This is to be expected in a river system that is affected by excessive heavy metal concentrations. The surveys also revealed that the river is populated exclusively by taxa that are intolerant of other forms of water pollution, such as sediments and organic pollution. This indicates that the watershed is in good condition except for contributions of heavy metals by historic mining activities.

In parts of the river confined by narrow canyons, the riparian community consists of a blue spruce and willow community. In parts of the river that flow through a wider river valley, the riparian community consists of various willow species, river birch, rushes, and sedges. The nonconsumptive water needs assessment performed by the Basin Roundtable identified this stream segment as having significant riparian communities worthy of protection

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, five 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 the upper segment of the Slate River.

Party	Date	Q (cfs)	Accuracy Range (cfs)	Winter (2/3) (cfs)	Summer (3/3) (cfs)
BLM	9/29/2011	9.7	3.9 – 24.3	9.59	Out of Range
BLM	9/29/2011	9.3	3.7 – 23.2	9.64	Out of Range
BLM	6/7/2012	78.7	31.5 – 196.8	Out of Range	45.52
BLM	6/7/2012	76.9	30.8 – 192.4	Out of Range	55.47
BLM	7/17/2013	30.7	12.3 – 76.7	23.45	34.88
			Averages	14.23	45.29

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:

45 cubic feet per second is recommended during the snowmelt runoff period between May 1 and July 15. Protecting this flow rate would require an increase of 30 cfs between May 1 and July 15. This recommendation is driven by the average depth criteria. This creek experiences consistently low flows during late summer and fall, so it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff flows are available. In addition, protection of a higher flow rate will help scour fine sediments from important spawning areas.

BLM recommends that the current instream flow water right of 15 cfs remain unchanged for the period between April 1 and April 30, and for the period between July 16 and November 30. BLM also recommends that the current instream flow water right of 8.0 cfs for the period between December 1 and March 31 remain unchanged.

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 the upper segment of the Slate River represents a headwater stream with a 16.9 square mile drainage basin. The average elevation of the basin is 10,600 ft and the average precipitation is 39.65 inches. The drainage basin tributary to the lower terminus of this reach has four diversion structures with a total of 0.228 cfs in water rights. Four additional rights are listed as inactive

with an additional 1.733 cfs in water rights. No diversion records are maintained for any of the water rights in the basin. Therefore, the hydrology is likely similar to natural or unaltered flow conditions.

There is not a gage at or near the lower terminus on the Slate River. However, there are two USGS gages available downstream on the Slate River in the vicinity of Crested Butte. The upstream most gage is the Slate River near Crested Butte, CO (USGS 09111500, operated from 1940 to 1951 and again from 1993 to 2006). This gage has a 68.9 square mile drainage basin that includes the Slate River, Coal Creek, and Washington Gulch. In 2007, USGS 09111500 was discontinued and a new gage was installed approximately 3 miles downstream, Slate River above Baxter CL @ HWY 135 near Crested Butte (USGS 385106106571000, operated 2007 to present). This gage includes approximately 4.4 additional square miles of drainage basin and a few minor tributaries.

The USGS, BLM, and CWCB also made 35 spot streamflow measurements at or near the lower terminus proposed for the upper segment of the Slate River. These measurements span 1995 to 2013, but were not made on a consistent basis.

Data Analysis

The two USGS gages provide the best available data for the upper segment of the Slate River. The data at USGS 09111500 and USGS 385106106571000 was scaled to the lower terminus of the upper segment of the Slate River based on the area-precipitation method. The area-precipitation method estimates streamflow based on the ratio of the precipitation weighted drainage area at the lower terminus location to that of the gage location. The gage data for each gage location were scaled using slightly different ratios (0.28 and 0.29) due to slight differences in drainage area and average annual precipitation between the two gages. The scaling ratios were less than the ratio (0.5 to 2.5) suggested by Archfield and Vogel (2009) for drainage area scaling. Therefore, the calculated scaling ratios were evaluated by comparing them to the ratio of the spot measurement on the upper segment of the Slate River to the daily streamflow measured at the gages. This comparison showed that the scaling ratios used were reasonable.

These scaled data sets were combined to produce a period of record including 1940-1951, and 1993-2012 for a total of approximately 32 years of data. Median streamflow and 95% confidence intervals for the median were calculated using the combined scaled gage data. Statistically there is 95% confidence that the true value of the median is located within the confidence interval. The hydrograph (Figure 1) shows that the proposed ISF rate is below the median for all but two days at the end of the recommendation in July. Those two days are well below the upper confidence interval for the median. Staff has concluded that water is available for appropriation on the upper segment of the Slate River.

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:10.10/29/2009WR008481.

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.

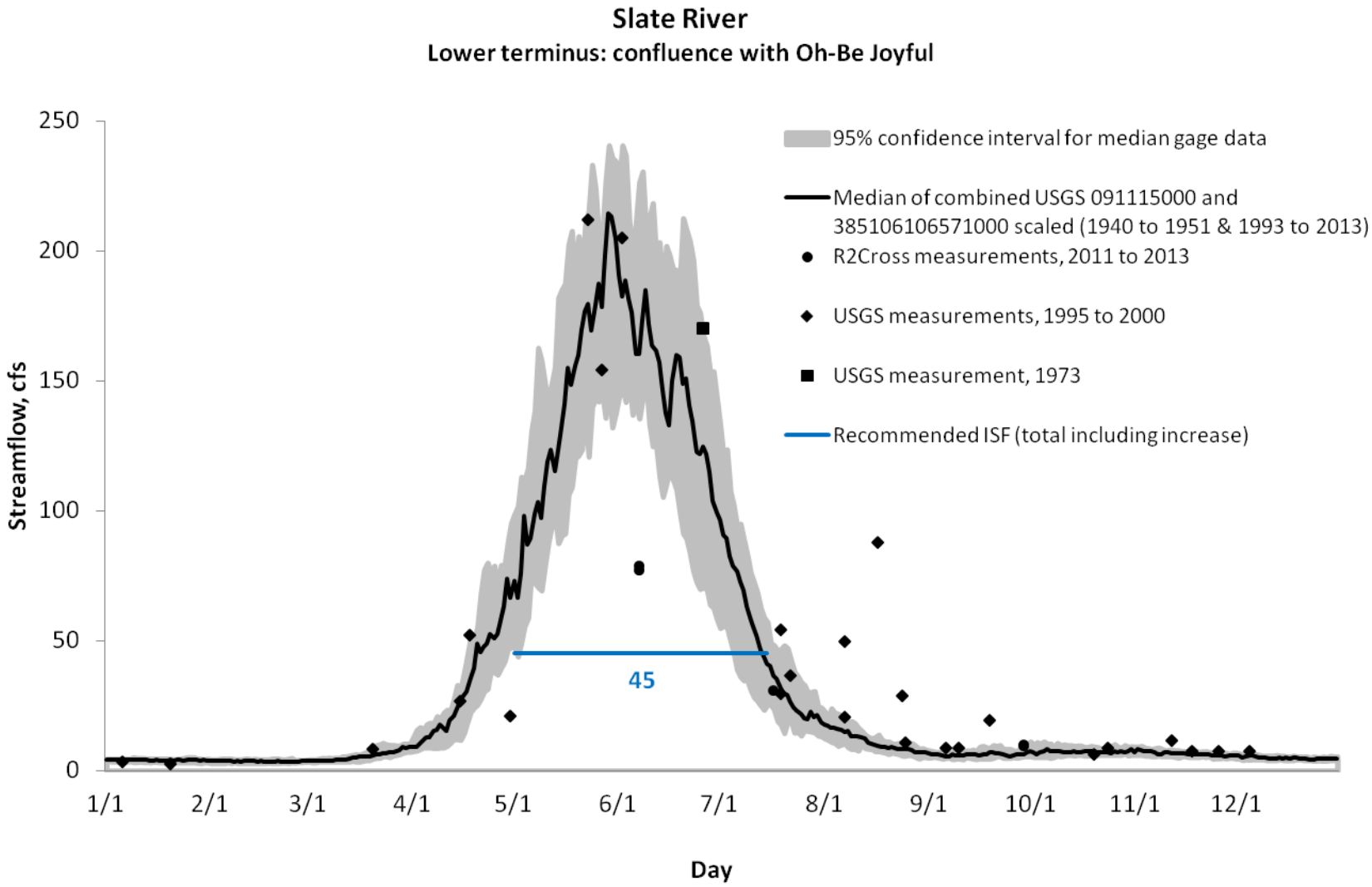


Figure 1. Hydrograph showing streamflow data and the proposed ISF rate on the upper segment of the Slate River.

Existing Water Rights

Staff has analyzed the water rights tabulation and determined that there is one decreed absolute surface diversion on this reach of stream; Berg Irrigation Ditch No. 1 for 1.5 cfs in case 79CW361 with an appropriation date of 10/6/1976. Staff has concluded that a new junior appropriation of water rights can exist on this segment of the Slate River 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: CONFLUENCE POVERTY GULCH TO CONFLUENCE OH BE JOYFUL CREEK

Upper Terminus: CONFLUENCE POVERTY GULCH AT
UTM North: 4312815.03 UTM East: 321387.33
(Latitude 38° 56' 45.96"N) (Longitude 107° 03' 39.75"W)
NE NE Section 12, Township 13 South, Range 87 West 6th PM
825' West of the East Section Line; 260' South of the North Section Line

Lower Terminus: CONFLUENCE OH BE JOYFUL CREEK AT
UTM North: 4308782.63 UTM East: 323966.16
(Latitude 38° 54' 37.10"N) (Longitude 107° 01' 48.95"W)
SE NW Section 20, Township 13 South, Range 86 West 6th PM
2,335' East of the West Section Line; 2,434' South of the North Section Line

Watershed: East-Taylor (HUC #: 14020001)
Counties: Gunnison
Length: 3.69 miles
USGS Quad(s): Oh-Be-Joyful
Existing ISF: 4-80CW092A; 8 cfs (12/1 – 3/31), 15 cfs (4/1 – 11/30)
Flow Recommendation (Increase): 30 cfs (5/1 – 7/15)

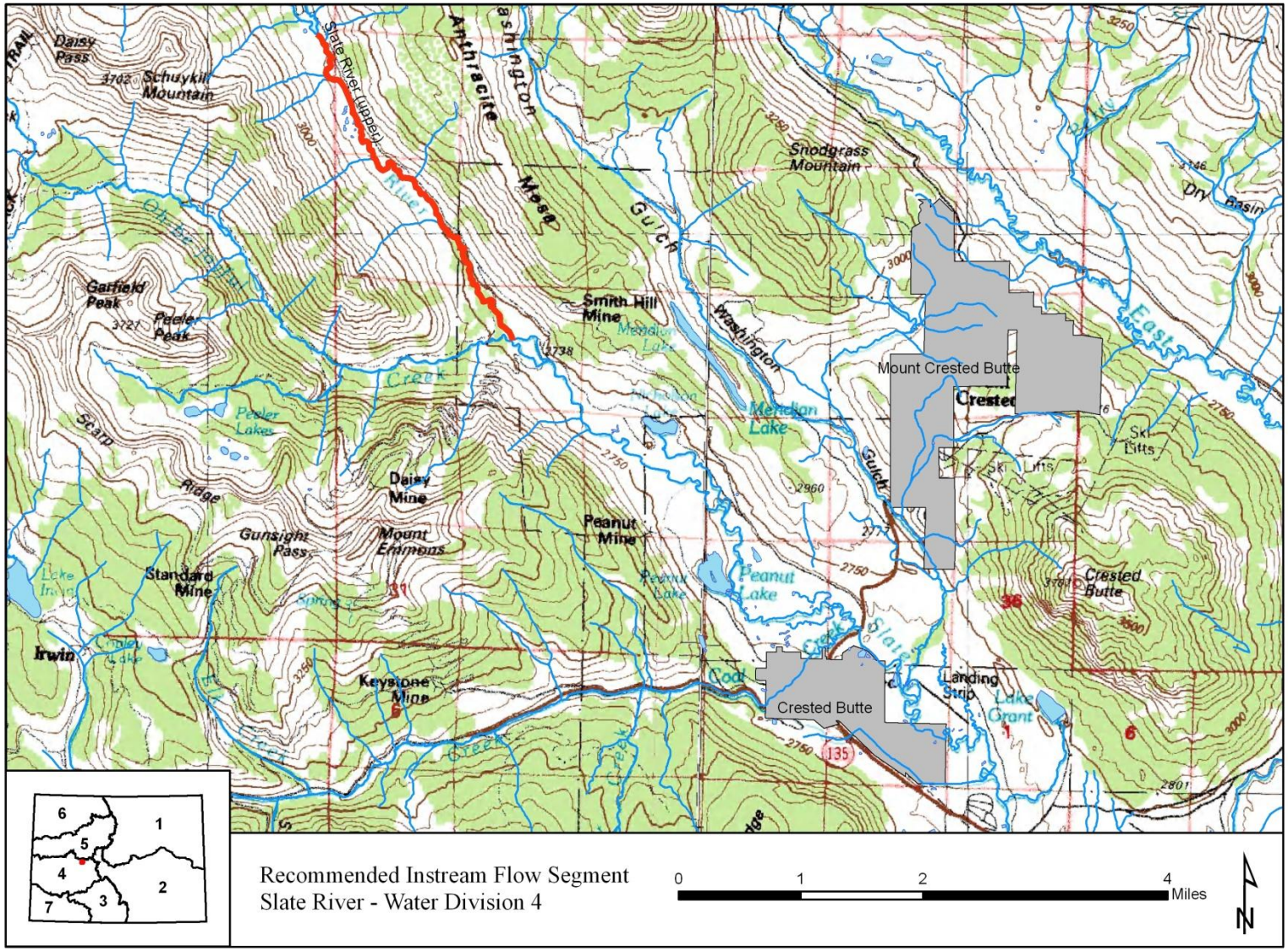
Metadata Descriptions:

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).

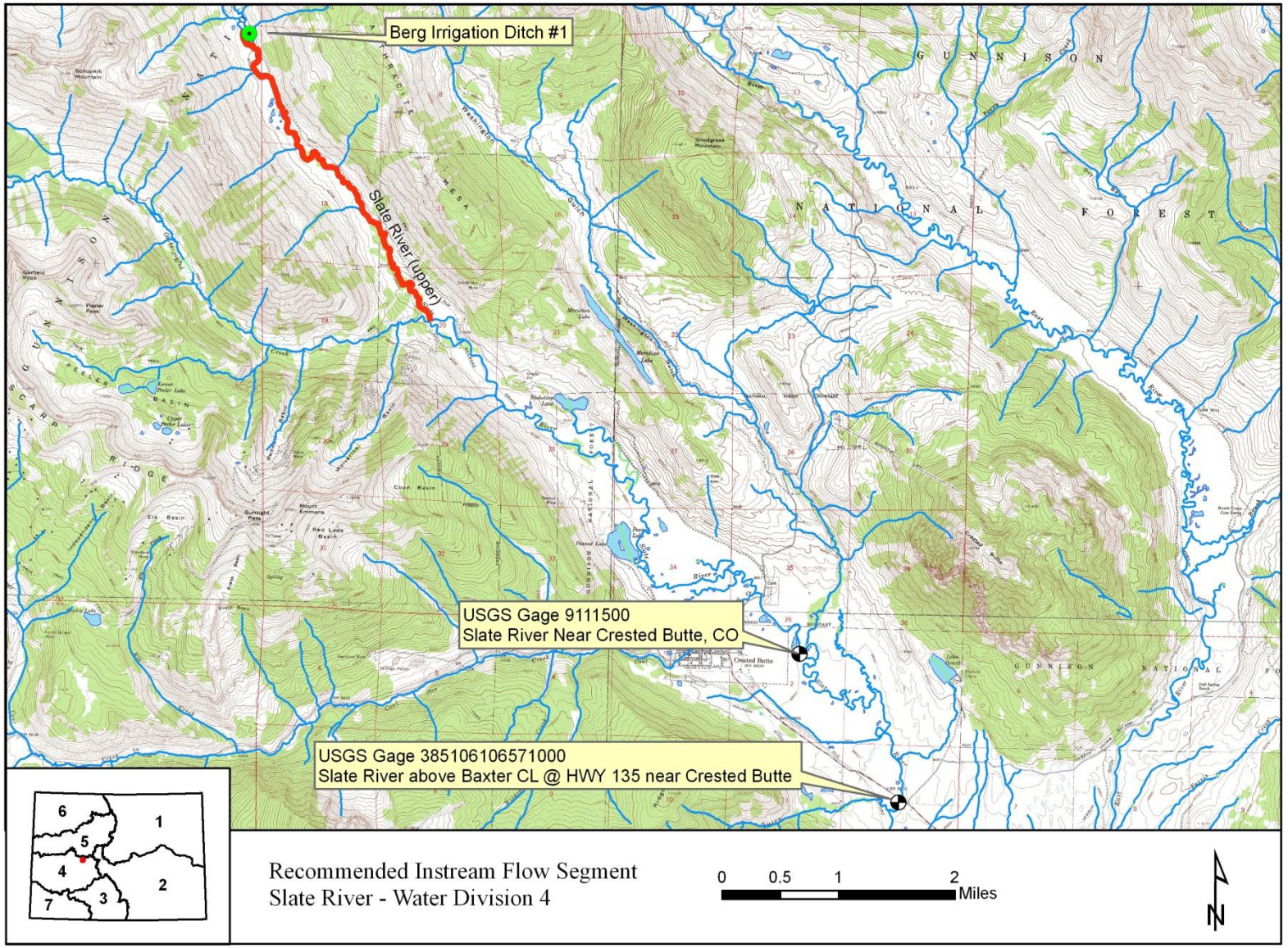
b) The PLSS locations were derived from CWCB GIS using 2005 PLSS data from the U.S. Bureau of Land Management's Geographic Coordinate Database

c) Projected Coordinate System: NAD 1983 UTM Zone 13N

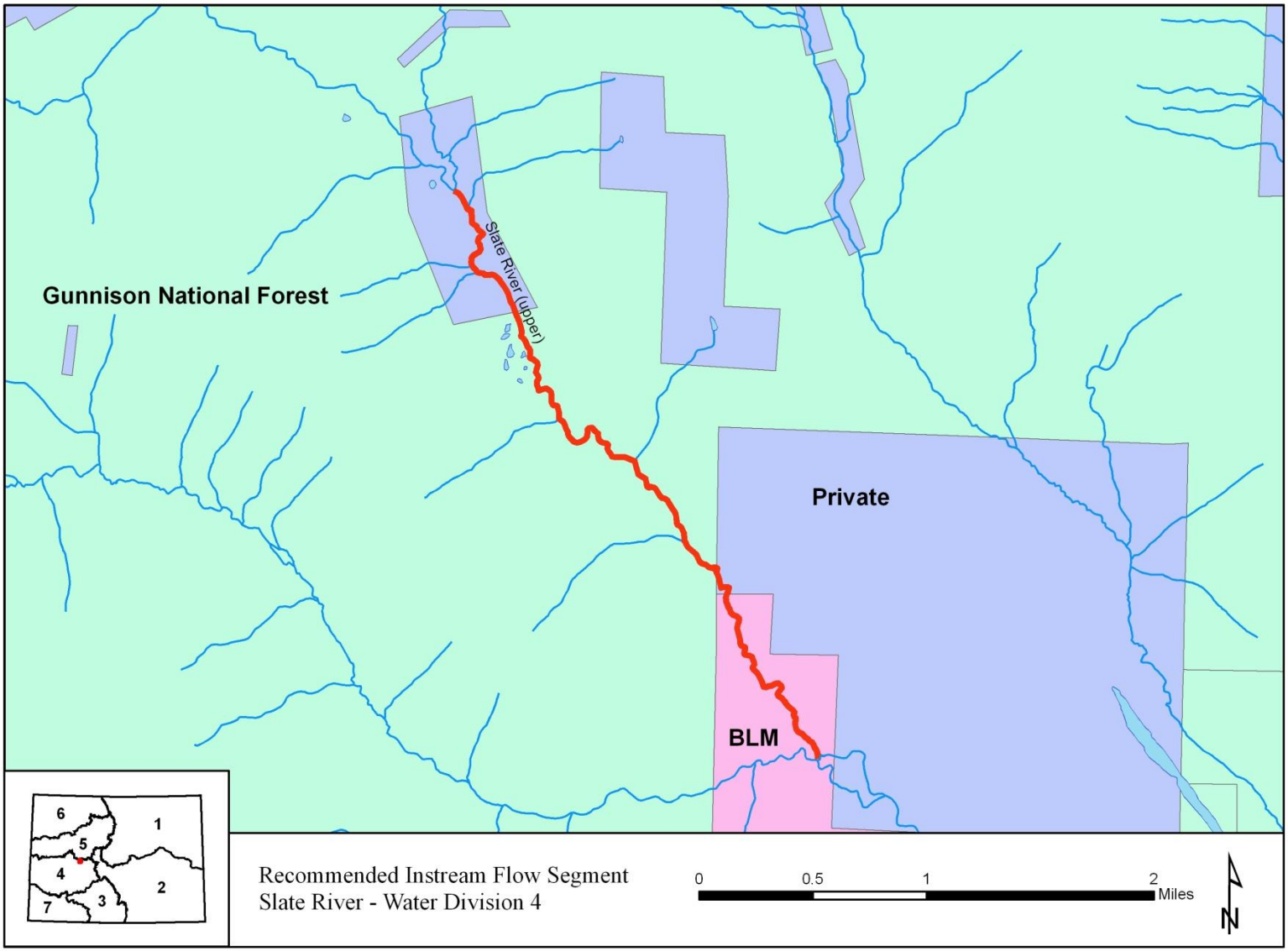
Vicinity Map



Water Rights Map



Land Use Map


Gunnison National Forest
Slate River (upper)
Private
BLM
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Slate River - Water Division 4
0
0.5
1
2
Miles
N