<u>Stream:</u> Meadow Creek

Executive Summary

Water Division: 5
Water District: 39
CPW#: 21131
CWCB ID: 12/5/A-006

Segment: OUTLET MEADOW CREEK RESERVOIR TO CONFLUENCE MAIN ELK CREEK

Upper Terminus: OUTLET MEADOW CREEK RESERVOIR AT
UTM North: 4409432.89 UTM East: 282092.06

Lower Terminus: CONFLUENCE MAIN ELK CREEK AT
UTM North: 4398191.75 UTM East: 279846.06

Watershed: Colorado headwaters-Plateau (HUC#: 14010005)
Counties: Garfield
Length: 8.21 miles
USGS Quad(s): Deep Creek Point, Meadow Creek Lake
Flow Recommendation: 2.1 cfs (4/1 – 9/30)
1.3 cfs (10/1 – 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. Colorado Parks and Wildlife (CPW) recommended this segment of Meadow Creek to the CWCB for a water right under the Instream Flow Program. Meadow Creek is being considered because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Meadow Creek is approximately 8.5 miles long and originates just above Meadow Creek Reservoir at an elevation of 9,600 feet. It flows in a southerly direction as it drops to an elevation of 8,640 feet where it joins Main Elk Creek. One-hundred percent of the land on the 8.21 mile segment addressed by this report is publicly owned (see Table 1). Meadow Creek is located within Garfield County and the total drainage area of the creek is approximately 12.4 square miles.

The subject of this report is a segment of Meadow Creek beginning at the outlet of Meadow Creek Reservoir and extending downstream to the confluence with Main Elk Creek. The proposed segment is located approximately 9 miles north of the town of New Castle. Staff has received one recommendation for this segment from the CPW, which is discussed below.

Instream Flow Recommendation

CPW recommended flows of 2.1 cfs (4/1 – 9/30) and 1.3 cfs (10/1 – 3/31), based on its August 18, 2010 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 Meadow Creek

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Outlet of Meadow Creek Reservoir	Confluence Main Elk Creek	8.21	0%	100%

All of the public lands in this segment are managed by the US Forest Service.

Biological Data

Meadow Creek is classified as a small stream (between 10 to 19 feet wide) and fishery surveys indicate the stream environment supports brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*).

Field Survey Data

CPW 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 CPW 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, one data set was 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

Party	Date	Q (cfs)	Accuracy Range (cfs)	Winter (2/3) (cfs)	Summer (3/3) (cfs)
CPW	8/18/2010	1.6	0.6 – 4.0	1.3	2.1

The summer flow recommendation which met 3 of 3 criteria and is within the accuracy range of the R2CROSS mode is 2.1 cfs. The winter flow recommendation which met 2 of 3 criteria and is within the accuracy range of the R2CROSS model is 1.3 cfs.

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 Meadow Creek has a 12.4 square mile drainage basin. The average elevation of the basin is 9,380 ft and the average precipitation is 33.07 inches. There are 19 small (less than 0.002 cfs each) spring water rights within the drainage basin tributary to the proposed ISF. There is also a small reservoir, Meadow Creek Reservoir, operated by CPW. According to the Water Commission and Division Engineer (Ben Krause and Alan Martellaro) this reservoir is operated as a run of the river dam and is essentially always full. The water rights and reservoir therefore have minimal impact and streamflow is essentially natural.

There is not a streamflow gage on Meadow Creek. The closest gage is located downstream on Main Elk Creek (USGS 09086470, operated 1990 to 1997). There are not many diversions in the drainage basin tributary to the gage, Hadley Consolidated (appropriation dates: 1887, 0.5 cfs; 1894, 0.2 cfs; 1908, 0.7 cfs; 1917, 0.3; 1921, 1.6 cfs for a total of 3.3 cfs) on the Main Elk and Butler Ditch (appropriation date 1912, 2.0 cfs) on Mansfield Creek a tributary of the Main Elk are the primary diversions. Therefore, streamflow is altered at the gage location, but likely not to a large degree. StreamStats is one other possible source of streamflow information.

Data Analysis

Due to the short period of record on the Main Elk gage, additional steps were taken to extend and evaluate the record. Other gages in the region were examined in an attempt to find a gage that could be used to extend the record through regression analysis. However, none of the gages evaluated produce a reasonable regression coefficient and none were found suitable for regression extension. Since there were only 7 years of record available at the Main Elk gage, an analysis of the long term record for the gage on the Colorado River at Cameo was performed to determine whether those seven years represented wet, dry or average conditions. The average annual streamflow from 1990 to 1997 was 3900 cfs compared to the POR for the Cameo gage of 3841 cfs. Three years were above average and 4 were below. This analysis indicates that the period of record for the Main Elk Creek gage was approximately during average or normal conditions.

Given the short period of record, only median streamflow was calculated for the period of record and the results were scaled to the lower terminus of the proposed instream reach using the area-precipitation method which results in a scaling factor of 0.14. 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. This ratio was outside of the range (0.5 to 2.5) suggested by (Archfield and Vogel, 2009) for drainage area scaling. While no other measurement data was available to verify the scaling ratio,this gage is located on the same river system and likely provides a reasonable estimate of streamflow.

The hydrograph (Figure 1) shows StreamStats results and the median streamflow calculated from the scaled gage record. The proposed instream flow rate is below the StreamStats mean-monthly streamflow for all months. The proposed instream flow rate is also below the median gage data for all but 43 days during the winter baseflow period and, the mean shortage was 0.05 cfs. In situations where the recommended flow is slightly below the calculated median flow rate, staff will calculate 95% confidence intervals. In this case, since there were only 7 years of data, it was not possible to calculate confidence intervals. However, since the recommend flow was only slightly above the median for a short period of time, and the recommendation was also below the StreamsStats analysis, staff has concluded that water is available for appropriation on Meadow Creek.

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.

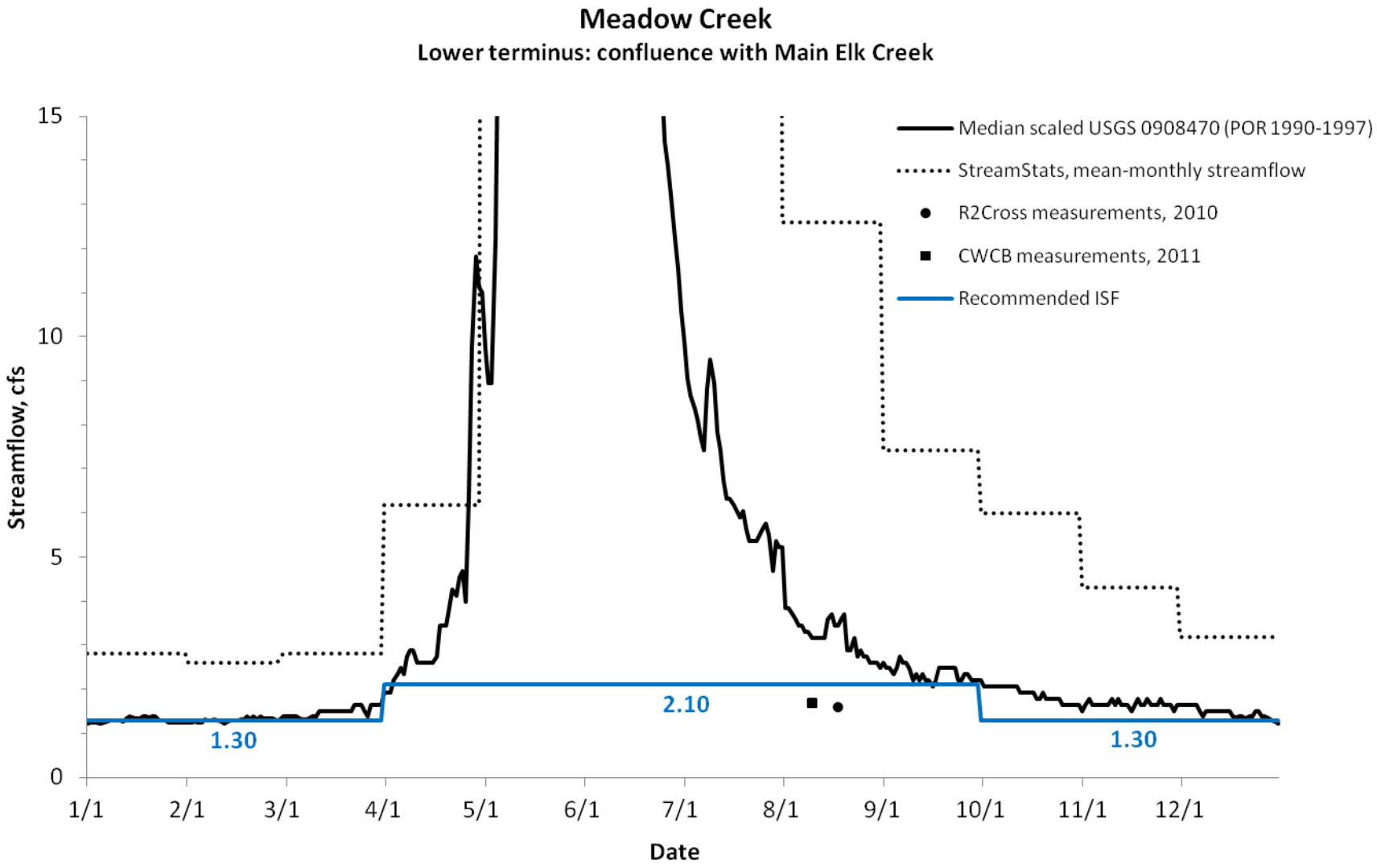


Figure 1. Hydrograph showing streamflow data and the proposed ISF flow rate on Meadow Creek.

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 Meadow 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: OUTLET MEADOW CREEK RESERVOIR TO CONFLUENCE MAIN ELK CREEK

Upper Terminus: OUTLET MEADOW CREEK RESERVOIR AT
UTM North: 4409432.89 UTM East: 282092.06
(Latitude 39° 48' 25.08"N) (Longitude 107° 32' 43.85"W)
SE NE Section 12, Township 3 South, Range 91West 6th PM
194' West of the East Section Line; 2,490' South of the North Section Line

Lower Terminus: CONFLUENCE MAIN ELK CREEK AT
UTM North: 4398191.75 UTM East: 279846.06
(Latitude 39° 42' 18.74"N) (Longitude 107° 34' 4.67"W)
SW NE Section 14, Township 4 South, Range 91 West 6th PM
1,296' West of the East Section Line; 1,661' South of the North Section Line

Watershed: Colorado headwaters-Plateau (HUC#: 14010005)
Counties: Garfield
Length: 8.21 miles
USGS Quad(s): Deep Creek Point, Meadow Creek Lake
Flow Recommendation: 2.1 cfs (4/1 – 9/30)
1.3 cfs (10/1 – 3/31)

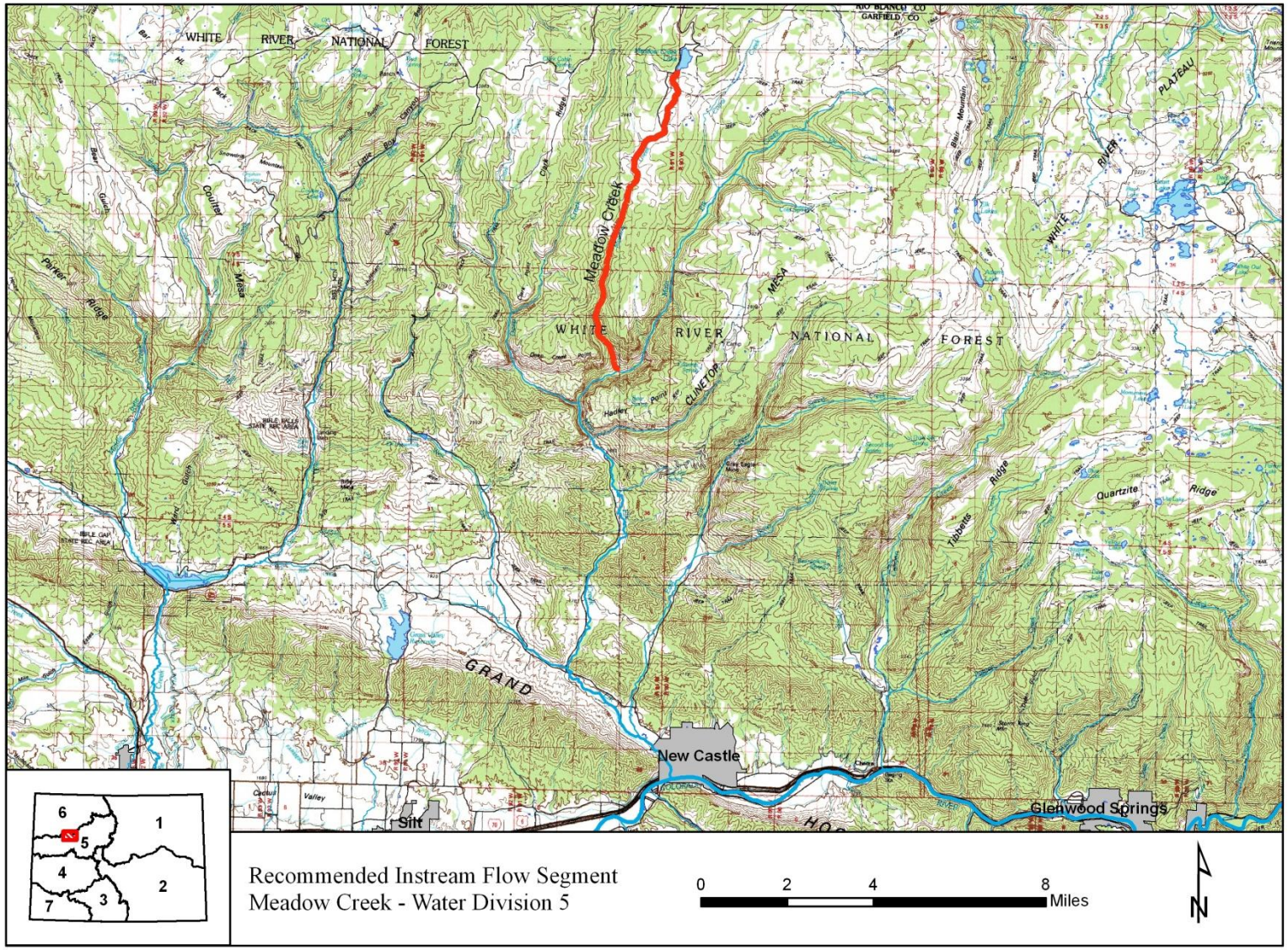
Metadata Descriptions:

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).

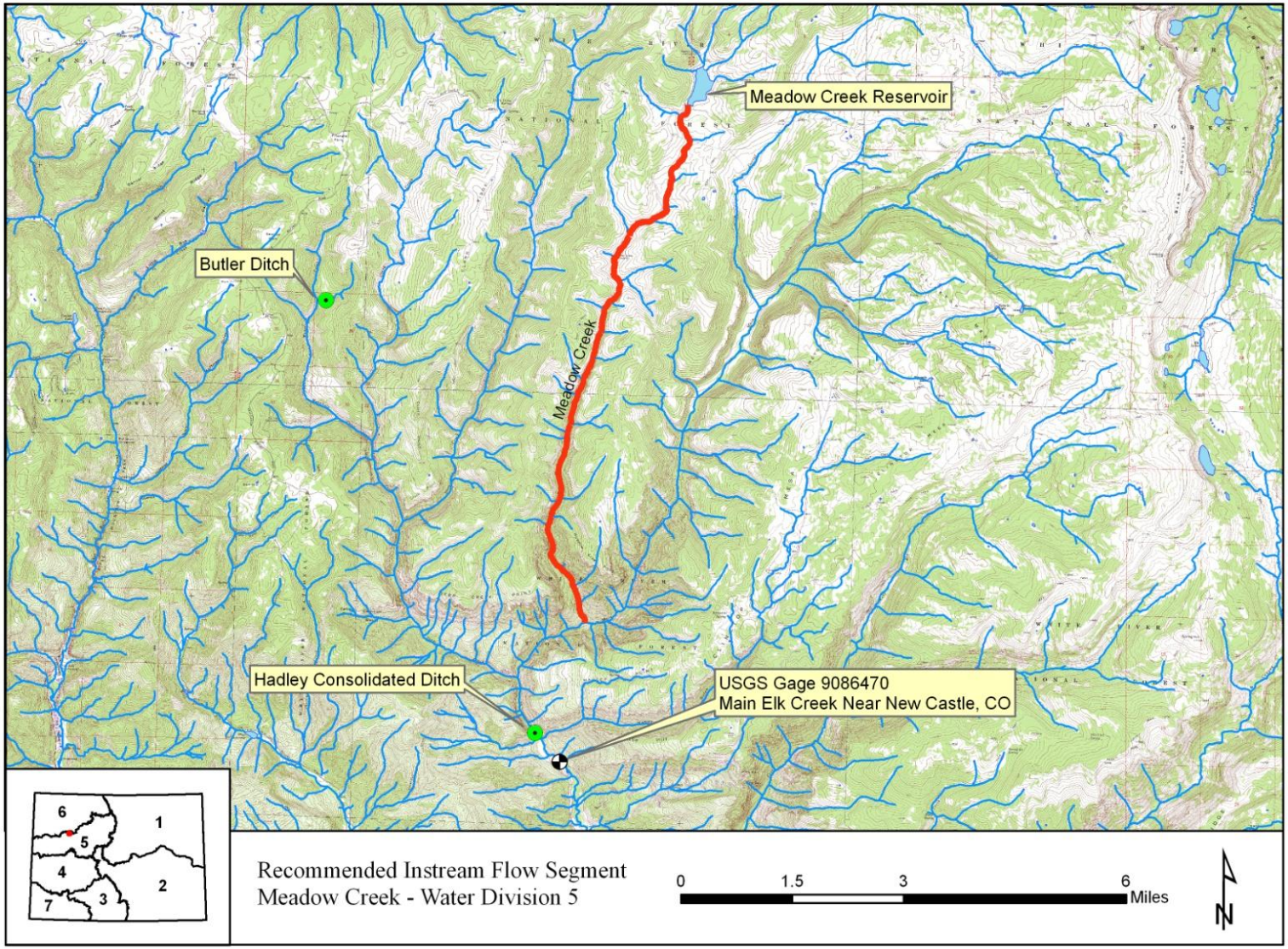
b) The PLSS locations were derived from CWCB GIS using 2005 PLSS data from the U.S. Bureau of Land Management's Geographic Coordinate Database

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

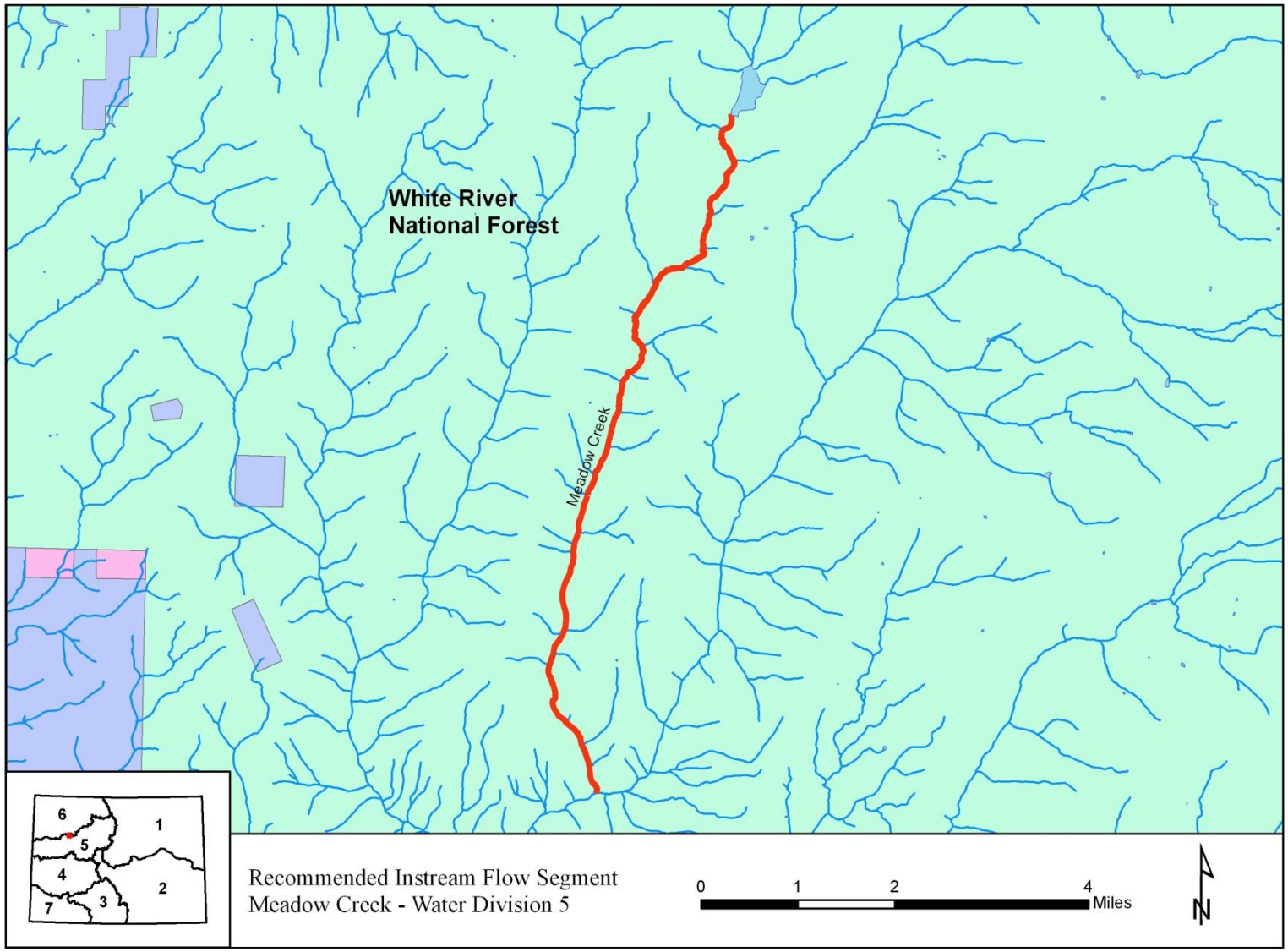
Vicinity Map



Water Rights Map



Land Use Map


White River
National Forest
Meadow Creek
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Meadow Creek - Water Division 5
0
1
2
4
Miles
N