COLORADO
Colorado Water Conservation Board
Department of Natural Resources

North Fork Elkhead Creek

EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	Headwaters in the Vicinity of UTM North: 4515748.48	UTM East: 310855.20
LOWER TERMINUS:	Confluence Elkhead Creek UTM North: 4504451.45	UTM East: 306665.08
WATER DIVISION:	6	
WATER DISTRICT:	44	
COUNTY:	Routt	
WATERSHED:	Upper Yampa	
CWCB ID:	15/6/A-008	
RECOMMENDER:	Colorado Parks and Wildlife (CPW)	
LENGTH:	9.39 miles	
FLOW RECOMMENDATION:	1.8 (12/01 - 03/31) 5.4 (04/01 - 06/30) 1.2 (07/01 - 07/31) 0.57 (08/01 - 09/17) 1.4 (09/18 - 11/30)	

North Fork Elkhead 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.

CPW recommended that the CWCB appropriate an ISF water right on a reach of North Fork Elkhead Creek. North Fork Elkhead Creek originates from the southeast flank of Bears Ears Peak at an elevation of approximately 10,000 ft. The creek flows in a southwesterly direction as it drops to an elevation of approximately 6,800 ft where it joins Elkhead Creek. The proposed reach is located within Routt County (See Vicinity Map) and extends from its headwaters downstream to the confluence with Elkhead Creek. Sixty-four percent of the land on the 9.39 mile proposed reach is publicly owned and managed by the U.S. Forest Service (USFS) (See Land Ownership Map). The CPW recommended this reach of North Fork Elkhead 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/2017ProposedISFRecommendations.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 the 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.

The North Fork Elkhead Creek starts as a first order stream and then is a second order stream for the lower 6 miles. This recommended reach drops about 2,250 ft over 9.4 miles, so that much of the creek is fairly high gradient. Because the North Fork valley is fairly confined, the stream is relatively straight for much of its course and most of the channel is a single thread channel. Any hydrologic connection to the floodplain most likely occurs only during spring runoff or high precipitation events. The stream's banks are mostly intact and stable, although some areas have been impacted by beaver activity. A prominent and healthy riparian corridor exists throughout this segment and plays a significant role in the energy and food web dynamics of and for the aquatic environment, providing food for both the aquatic macro-invertebrates and fish. The riparian community is primarily composed of willows, alders, and cottonwoods. Stream cover is variable, but is mostly forested with a few openings in the riparian canopy. The health of the riparian canopy is a major factor in protecting this small stream from solar radiation and heating during times of low flow during the late

summer months. Due to the stream's relative steepness, a majority of the habitat is small pool and short riffle sections. The stream's substrate is predominantly boulders and large cobble.

The Elkhead Creek Basin has been designated both by CPW and the USFS as a priority basin for native species conservation projects. The target fish species is the Colorado River cutthroat trout (CRCT) (see Table 1). In addition, CPW and the USFS are involved in habitat protection projects for boreal toad (*Bufo boreas boreas*), a state endangered species in the Elkhead basin. The management of CRCT is covered by a multi-state (Colorado, Wyoming, and Utah) and federal interagency conservation agreement. The states consider CRCT to be of special concern and the federal agencies consider CRCT to be a sensitive species (CRCT Conservation Team 2006). While CRCT is the main species of concern in this basin, other native species identified in Table 1 will benefit from CRCT conservation efforts. These species include mottled sculpin (*Cottus bairdi*), speckled dace (*Rhinichthys osculus*), and the mountain sucker (*Catostomus playtrhynchus*), which is also a state species of special concern (CRCT Conservation Team 2006). The entire Elkhead Creek basin upstream and including the North Fork of Elkhead Creek is the subject of current and ongoing stream health management projects, and is being enhanced through a variety of interagency projects to restore both cutthroat trout and boreal toad habitat. The Elkhead CRCT is identified in conservation planning documents as a population of high genetic purity and is considered a core conservation population (CRCT Conservation Team 2006).

Reducing non-native competition and hybridization is another critical aspect of CRCT conservation efforts. All non-native salmonids have been removed from the basin, and migration barriers are either in place or planned. All brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorrhynchus mykiss*) have been removed from the system. Brook and rainbow trout are strong competitors for food and habitat, and rainbow trout also readily hybridize with cutthroat trout (NRCS 2007).

Table 1. List of species identified in North Fork Elkhead Creek.

Species Name	Scientific Name	Status
Colorado River cutthroat	*Oncorhynchus clarkii pleuriticus*	State - Species of Special Concern
mottled sculpin	*Cottus bairdii*	None
mountain sucker	*Catostomus platyrhynchus*	State - Species of Special Concern
speckled dace	*Rhinichthys osculus*	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 two transects for this proposed ISF reach (See 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 2.5 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a summer flow of 5.40 cfs.

Table 2. Summary of R2Cross transect measurements and results for North Fork Elkhead Creek.

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
CPW/CWCB	10/28/2015 # 1	2.21	0.88 - 5.53	4.00	5.50[1]
CPW/CWCB	10/28/2015 # 2	2.12	0.85 - 5.30	0.89	5.30[1]
			Mean	2.50	5.40

[1] *This flow is derived from the upper limit of the R2CROSS modeling accuracy and is used in the computation of the summer flow recommendation. The flow that meets all three instream flow criteria is outside of the confidence interval for this data set.*

ISF Recommendation

CPW recommended flow rates were based on R2Cross modeling analyses, biological expertise, and a preliminary water availability analysis. 5.4 cfs was recommended for the snowmelt runoff period from April 1 through June 30. This recommendation was driven by velocity criteria to provide critical habitat for the aquatic environment. 2.5 cfs was recommended for the base flow period from July 1 to March 30. This flow was mainly driven by depth and wetted perimeter. The goal of this

recommendation is to provide spawning habitat and overwintering habitat for the native species present.

The CPW recommendation was modified by staff as a result of water availability. The final recommendations numbers are as follows:

1.8 cfs is recommended for the period December 1 to March 31.

5.4 cfs is recommended for the snowmelt runoff period from April 1 to June 30.

1.2 cfs is recommended for the period July 1 to July 31.

0.57 cfs is recommended for the period August 1 to September 17.

1.4 cfs is recommended for the period September 18 to November 30.

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 North Fork Elkhead Creek is 22.5 square miles, with an average elevation of 8,400 ft and average annual precipitation of 31.25 inches (See the Hydrologic Features Map). The drainage basin tributary to the proposed ISF reach has one known surface diversion (Ellis and Kitchens Ditch, appropriation date 1903 for 1.66 cfs and appropriation date 1966, 6.0 cfs for a total of 7.66 cfs). There are a small number of spring water rights, one 10 AF reservoir, and other small reservoirs (0.5 – 2 AF). Most of the water rights in the area are used to raise alfalfa or pasture. According to the water commissioner, Kathy Bower (contacted 9/7/2016), there is not very much irrigation use in the basin in the later part of the summer and early fall. Due to the number and amount of diversions, streamflow is somewhat altered from natural conditions.

Available Data
There is not a current streamflow gage on the proposed reach of North Fork Elkhead Creek. There was a historic gage, North Fork Elkhead Creek near Elkhead (USGS 09245500), located approximately 1 mile upstream from the proposed lower terminus at the confluence with Elkhead Creek. The gage operated from 1958 to 1973 and is no longer in use. The drainage basin of the gage is 21.4 square miles, with an average elevation of 8,460 ft and average annual precipitation of 31.51 inches. The Ellis and Kitchens Ditch is located upstream from the gage location. The effects of this diversion structure are partially included in the available gage data. According to the water commissioner, this structure does not sweep the stream. There are no known intervening diversions between the gage location and the proposed lower terminus.

CWCB staff made streamflow measurements during the 2015 site visit when R2Cross data was collected. These measurements are included in the water availability analysis.

Data Analysis
The Elkhead Creek near Elkhead gage has 15 years of record. This record is relatively long, which should provide good information about the range of hydrologic conditions in the area. The gage record was not scaled to the lower terminus because it would only result in a small increase in streamflow. Median streamflow and 95% confidence intervals for median streamflow were calculated using the North Fork Elkhead Creek near Elkhead gage record.

Water Availability Summary
The hydrographs (see the Complete and Detailed Hydrographs) show median streamflow and 95% confidence intervals for the median streamflow calculated from the North Fork Elkhead Creek near Elkhead gage record. The proposed ISF rate is below the median gage data during the majority of the year and below the upper 95% confidence interval from median streamflow at all times. Staff concludes that water is available for appropriation on North Fork Elkhead Creek.

Material Injury
Because the proposed ISF on North Fork Elkhead 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. (2016), 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.

CRCT Conservation Team, 2006, Conservation agreement for Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in the states of Colorado, Utah, and Wyoming. Colorado Division of Wildlife, Fort Collins.

CRCT Conservation Team, 2006, Conservation strategy for Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in the states of Colorado, Utah, and Wyoming. Colorado Division of Wildlife, Fort Collins.

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

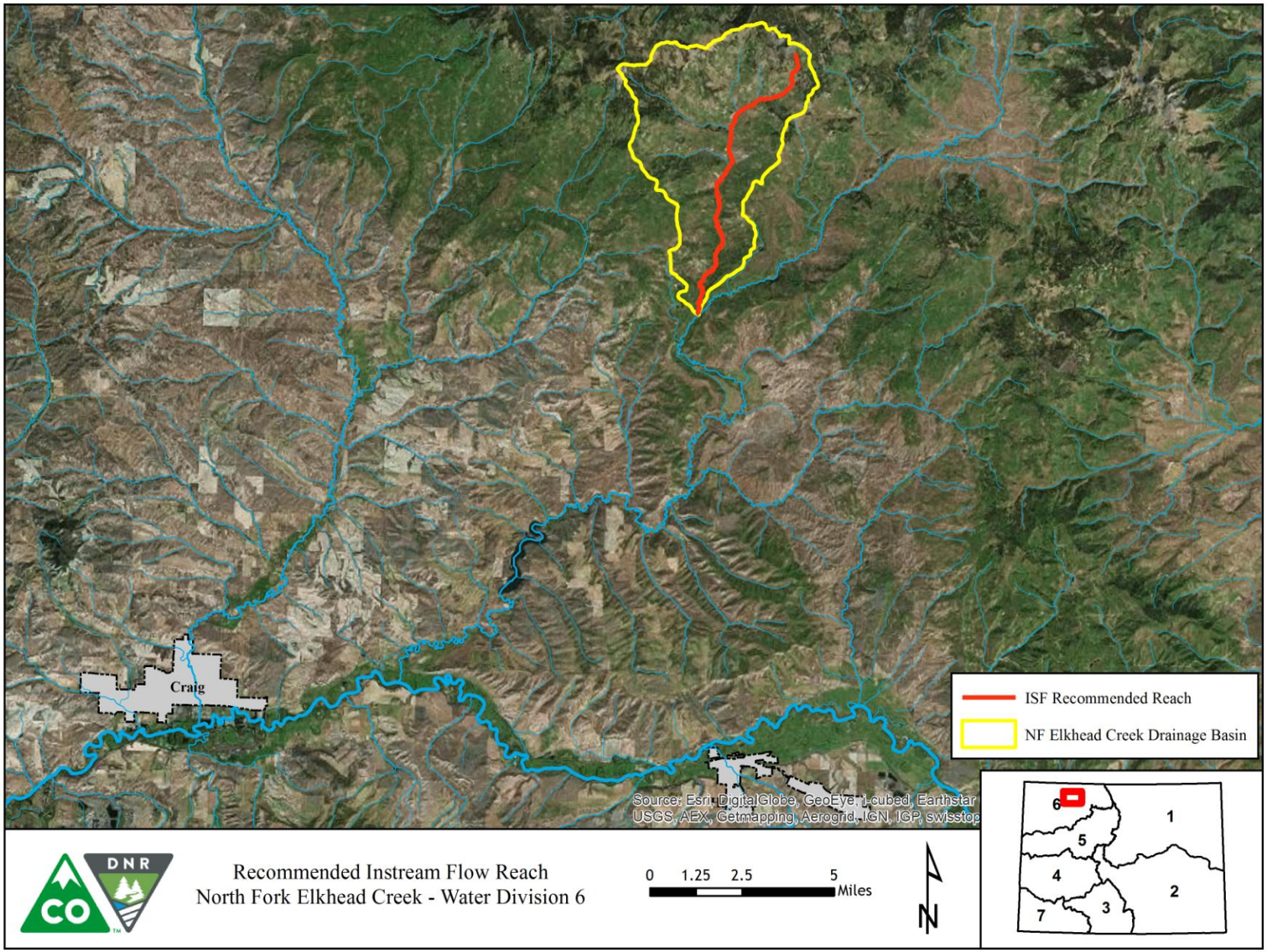
Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

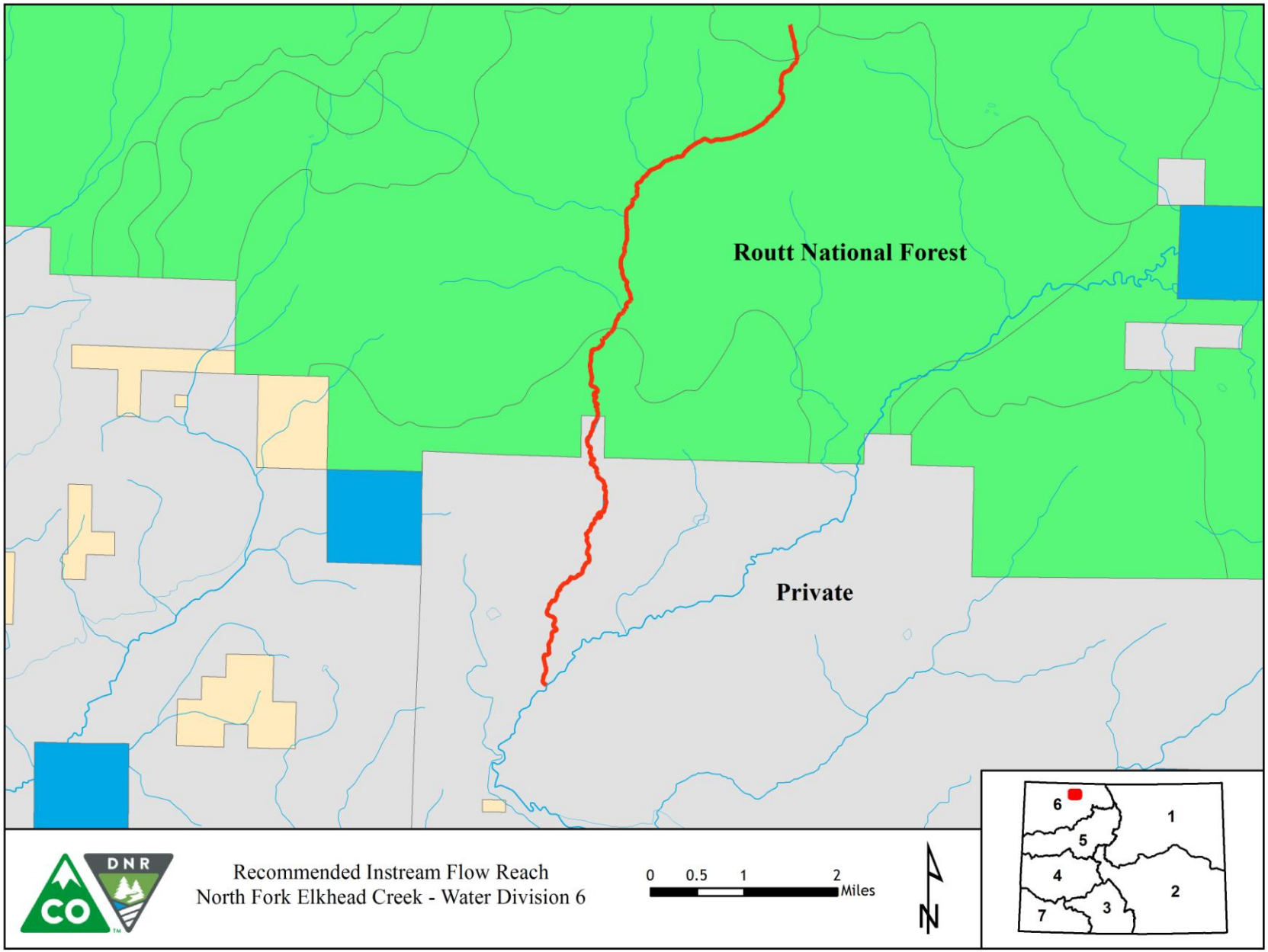
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

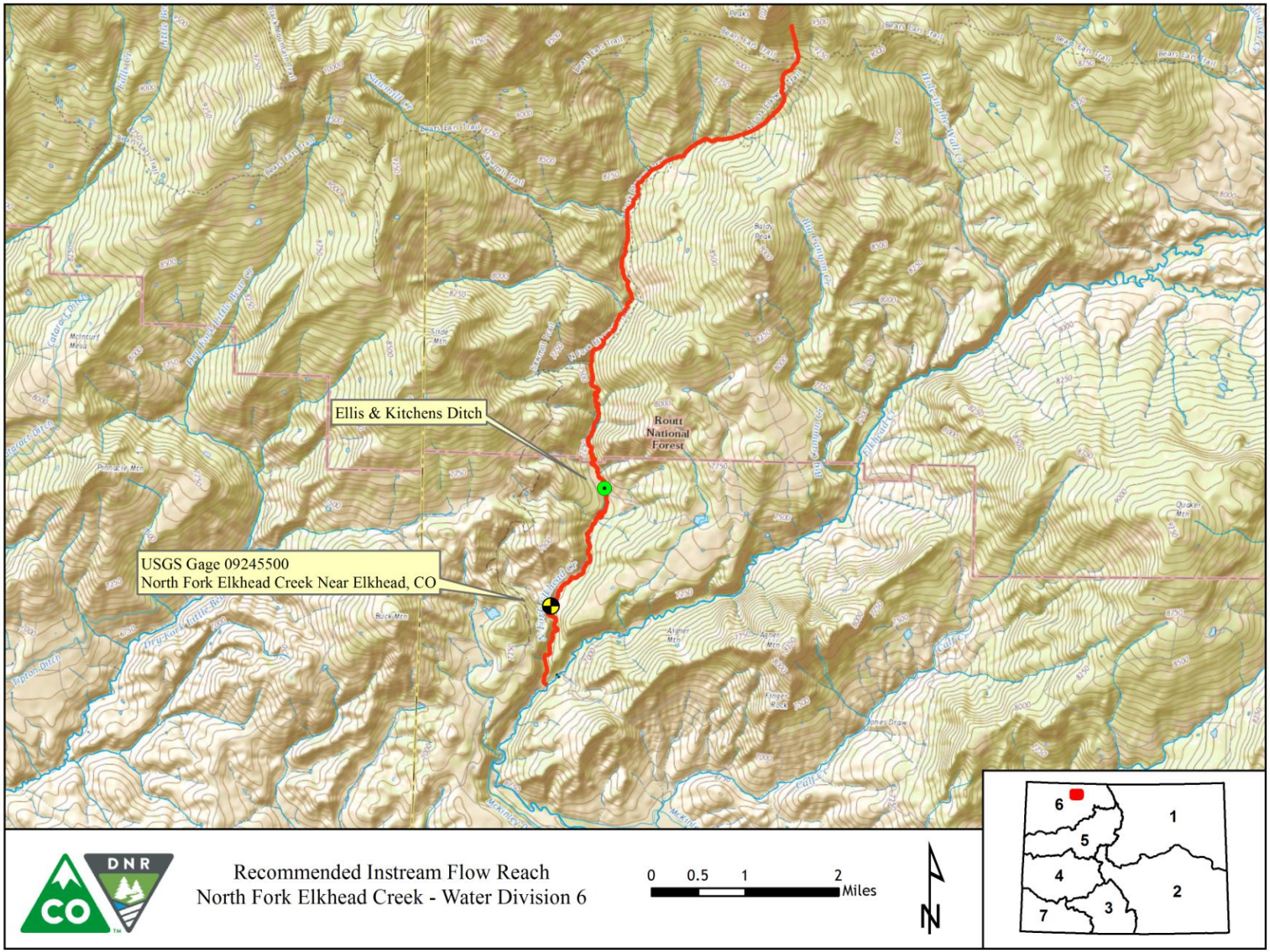
VICINITY MAP



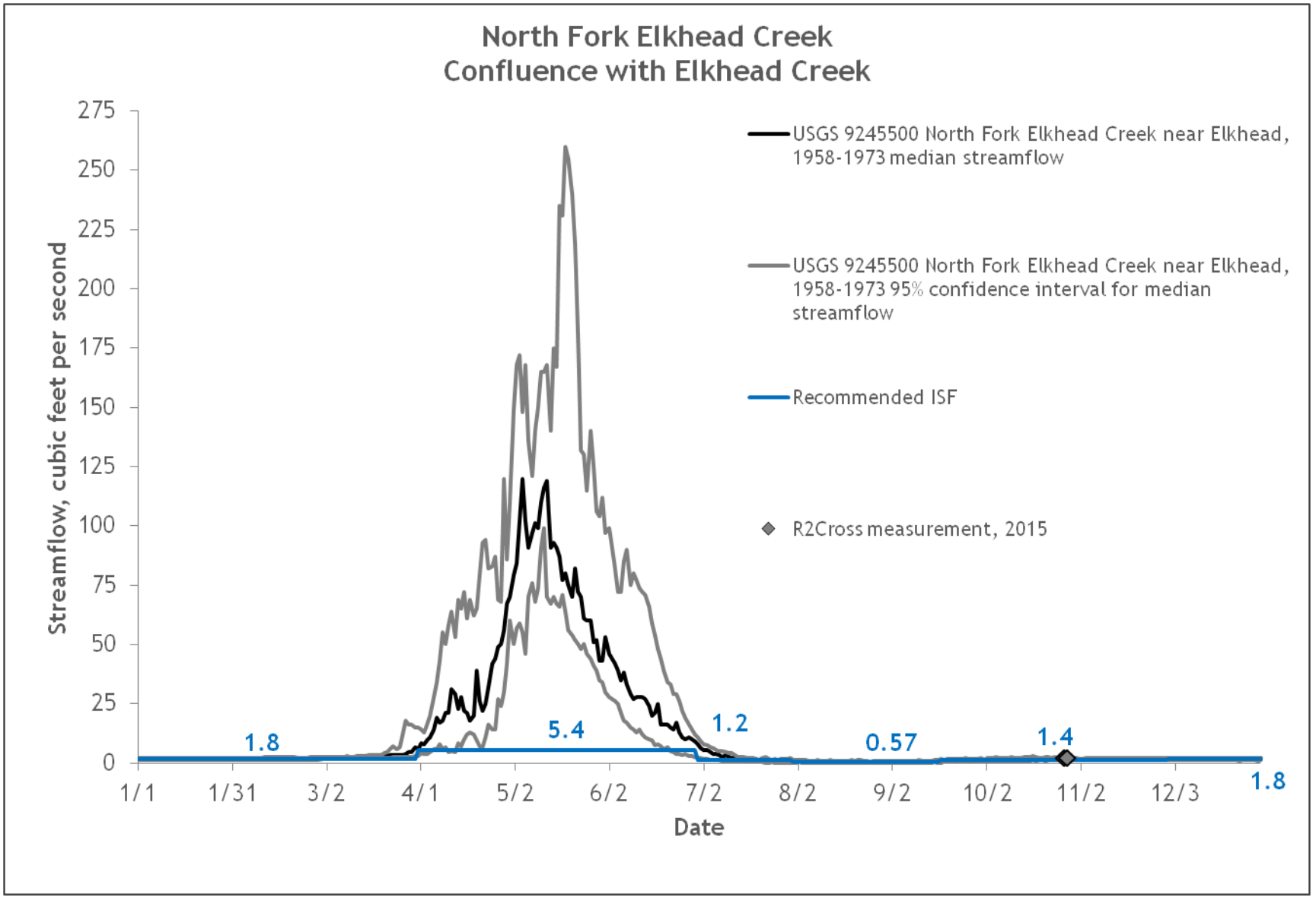
LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH