STATE OF COLORADO

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TO: Colorado Water Conservation Board Members

FROM: Jeff Baessler
Stream and Lake Protection Section

DATE: January 14, 2013

SUBJECT: **Agenda Item 31, January 28-29, 2013, Board Meeting**
Stream and Lake Protection Section – New Appropriation Recommendations in Water Division 6

Introduction

This memo provides an overview of the technical analyses that were performed by both the recommending entities and CWCB staff to provide the Board with sufficient information to declare its intent to appropriate in accordance with the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program ("ISF Rules"). Staff's detailed analysis of each stream, contained in the Instream Flow Recommendation Reports attached to this memo, provides the technical basis for each appropriation.

Staff Recommendation

Staff recommends that, pursuant to ISF Rule 5d., the Board declare its intent to appropriate an ISF water right on each stream segment listed on the attached Tabulation of Instream Flow and Natural Lake Level Recommendations, and direct Staff to publicly notice the Board's declaration of its intent to appropriate.

Background

Pursuant to Rule 5d. of the ISF Rules, staff is requesting the Board to declare its intent to appropriate instream flow water rights on the stream segments identified in the attached table. Staff has reviewed each proposed stream segment to ensure that for each instream flow recommendation, the data set is complete and standard methods and procedures were followed. In addition, staff has completed its water availability studies. Staff has identified two stream segments in Water Division 6 for which sufficient information has been compiled and analyses performed upon which the Board can base its intent to appropriate. These segments are located in Routt County and Jackson County.

Technical Investigations

Staff's executive summary and technical analysis of each stream are contained in the Instream Flow Recommendation Reports and form the basis for staff's recommendations. In addition to the reports, the scientific data and technical analyses performed by the recommending entity are

accessible on the Board's web site at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2013ProposedInstreamFlowAppropriations.aspx

Natural Environment Studies

The Bureau of Land Management (BLM) has conducted field surveys of the natural environment resources on these streams and has found natural environments that can be preserved. To quantify the resources and to evaluate instream flow requirements, the BLM has collected biologic and hydraulic data that were analyzed by CWCB staff. Based on the results of these analyses, staff prepared recommendations of the amount of water necessary to preserve the natural environment to a reasonable degree for each of the streams listed on the attached Tabulation of Instream Flow and Natural Lake Level Recommendations.

Water Availability Studies

Staff has conducted an evaluation of water availability for the streams listed. To determine the amount of water physically available for the Board's appropriations, staff analyzed available USGS gage records, available streamflow models, and/or utilized appropriate standard methods to develop a hydrograph of median and/or mean daily flows for each stream flow recommendation. In addition, staff analyzed the water rights tabulation for each stream and has consulted with the Division Engineer's Office to identify any potential water availability problems. Based upon its analyses, staff has determined that water is available for appropriation on each stream to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid water rights.

Instream Flow Rule 5d.

Rule 5d. provides that the Board may declare its intent to appropriate ISF water rights after reviewing Staff's recommendations for the proposed appropriations. Rule 5d. also sets forth the activities that take place after the Board declares its intent that initiate the public notice and comment procedure for the ISF appropriations. Specifically,

5d. Board's Intent to Appropriate. Notice of the Board's potential action to declare its intent to appropriate shall be given in the January Board meeting agenda and the Board will take public comment regarding its intent to appropriate at the January meeting.

(1) After reviewing Staff's ISF recommendations for proposed ISF appropriations, the Board may declare its intent to appropriate specific ISF water rights. At that time, the Board shall direct the Staff to publicly notice the Board's declaration of its intent to appropriate.

(2) After the Board declares its intent to appropriate, notice shall be published in a mailing to the ISF Subscription Mailing Lists for the relevant water divisions and shall include:

  (a) A description of the appropriation (e.g. stream reach, lake location, amounts, etc.);
  (b) Availability (time and place) for review of Summary Reports and Investigations Files for each recommendation; and,
  (c) Summary identification of any data, exhibits, testimony or other information in addition to the Summary Reports and Investigations Files supporting the appropriation.

(3) Published notice shall also contain the following information:

  (a) The Board may change flow amounts of contested ISF appropriations based on information received during the public notice and comment period.

(b) Staff will maintain, pursuant to Rule 5e.(3), an ISF Subscription Mailing List for each water division composed of the names of all persons who have sent notice to the Board Office that they wish to be included on such list for a particular water division. Any person desiring to be on the ISF Subscription Mailing List(s) must send notice to the Board Office.

(c) Any meetings held between Staff and members of the public will be open to the public. Staff may provide Proper Notice prior to any such meetings and may provide notice to persons on the ISF Subscription Mailing List(s).

(d) Any Notice to Contest must be received at the Board office no later than March 31st, or the first business day thereafter. All Notices of Party status and Contested Hearing Participant status must be received at the Board office no later than April 30th, or the first business day thereafter.

(e) Staff will announce its Final Staff ISF Recommendation concerning contested appropriations at the September Board meeting and will send notice of the Final Staff Recommendation to all persons on the Contested Hearing Mailing List.

(f) The Board may take final action on any uncontested ISF appropriations at the May Board meeting.

(4) After the Board declares its intent to appropriate, notice of the Board's action shall be mailed within five working days to the County Commissioners of the county(ies) in which the proposed reach or lake is located.

Attachment

Colorado Water Conservation Board

Instream Flow Tabulation - Streams

Water Division 6

Case Number	Stream	Watershed	County	Upper Terminus	Lower Terminus	Length (miles)	USGS QUADS	Amount(dates) (CFS)	Approp Date
13/6/A-001	Government Creek	North Platte headwaters	Jackson	headwaters in the vicinity of lat 40 53 18N long 106 9 26W	Government Ditch no. 2 hdgt at lat 40 53 6N long 106 14 22W	5.03	Kings Canyon	0.5 (10/1 - 4/30) 3.6 (5/1 - 7/31) 1 (8/1 - 9/30)	
13/6/A-002	Red Creek	Upper Yampa	Routt	USFS Boundary at lat 40 46 7N long 106 59 3W	confl Willow Creek at lat 40 46 30N long 106 55 56W	4.01	Hahns Peak	1.85 (4/1 - 7/15) 0.7 (7/16 - 3/31)	

Totals for Water Division 6

Total # of Stream Miles = 9.04

Total # of Appropriations = 2

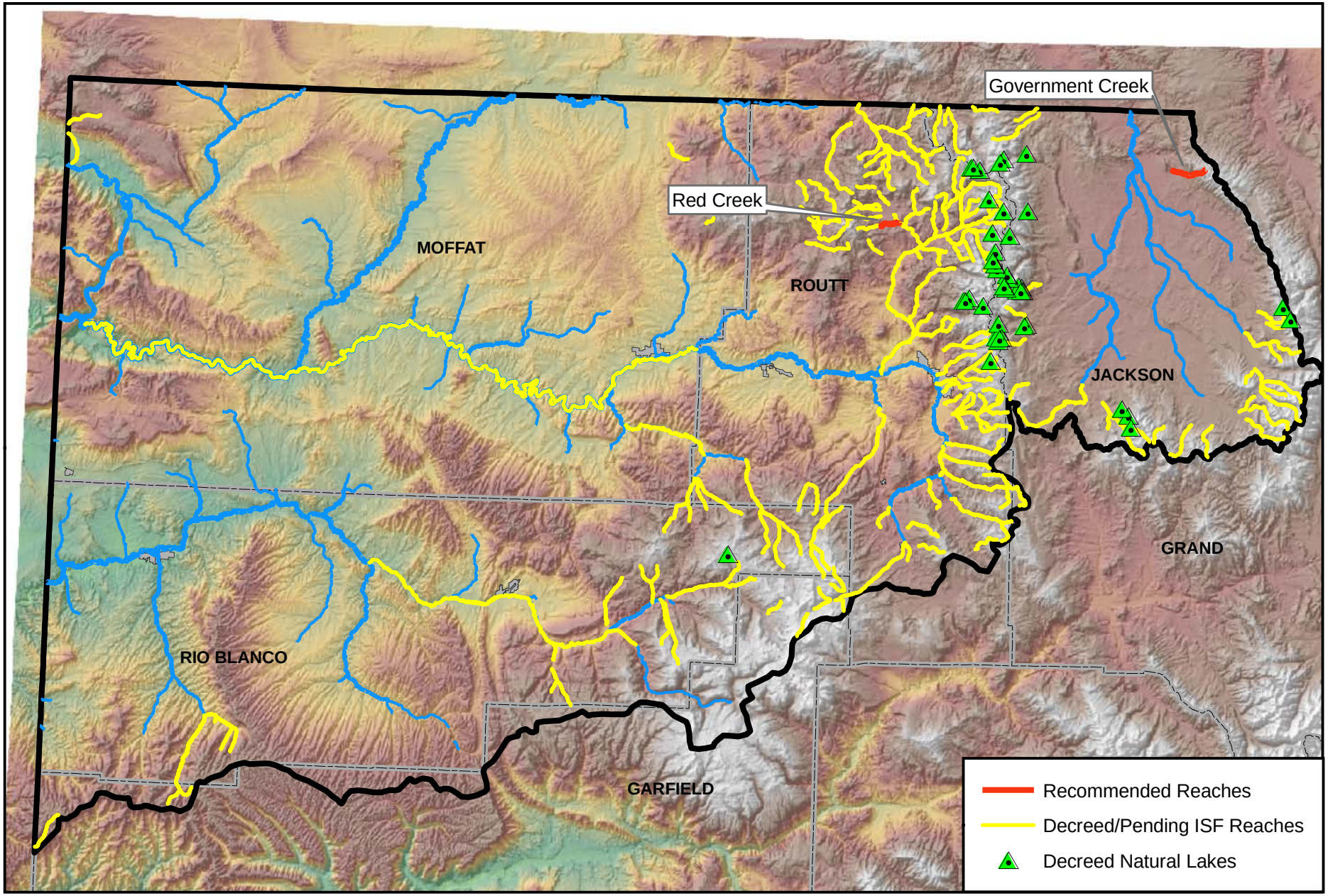
(Totals do not include donated/acquired water rights)

Report Totals

Total # of Stream Miles = 9.04

Total # of Appropriations = 2

(Totals do not include donated/acquired water rights)


Government Creek
Red Creek
MOFFAT
ROUTT
JACKSON
GRAND
RIO BLANCO
GARFIELD
Recommended Reaches
Decreed/Pending ISF Reaches
Decreed Natural Lakes

<u>Stream:</u> Government Creek

Executive Summary

Water Division: 6
Water District: 47
CDOW#: 11041
CWCB ID: 13/6/A-001

Segment: HEADWATERS TO THE HEADGATE OF THE GOVERNMENT DITCH NO. 2
Upper Terminus: HEADWATERS IN THE VICINITY OF
UTM North: 4527002.57 UTM East: 402519.24

Lower Terminus: HEADGATE OF THE GOVERNMENT DITCH NO. 2
UTM North: 4526731.68 UTM East: 395567.14

Watershed: North Platte Headwaters (HUC#: 10180001)
Counties: Jackson
Length: 5.03 miles
USGS Quad(s): Kings Canyon
Flow Recommendation: 3.6 cfs (May 1 – July 31)
1.0 cfs (August 1 – September 30)
0.5 cfs (October 1 – April 30)

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/2013ProposedInstreamFlowAppropriations.aspx) forms 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 in 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 Government Creek to the CWCB for a water right under the Instream Flow Program. Government Creek is being considered because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Government Creek is approximately 9 miles long and originates in the Medicine Bow Range at an elevation of 9,600 feet. It flows in a westerly direction as it drops to an elevation of 7,980 feet where it joins the Canadian River. Eighty-four percent of the land on the 5.0 mile segment addressed by this report is publicly owned. Government Creek is located within Jackson County and the total drainage area of the creek is approximately 14.9 square miles.

The subject of this report is a segment of Government Creek beginning at the headwaters and extending downstream to the headgate of the Government Ditch No. 2. The proposed segment is located approximately 11 miles northeast of Walden. Staff has received one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Instream Flow Recommendation

The BLM recommended a flow of 3.6 cfs (May 1 – July 31), 1.0 cfs (August 1 – September 30) and 0.5 cfs (October 1 – April 30) based on its July 12, 2011 data collection efforts and staff's water availability analyses.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Headwaters	Headgate Government Ditch No. 2	5.0	16%	84%

76 % of the public land is managed by the State Land Board, 20% by the BLM, and 4 % by the USFS.

Biological Data

Government Creek is a cold-water, moderate gradient stream in a narrow canyon. In the upper portion of the recommended reach, the stream is confined by bedrock and generally has large substrate. In the lower part of the recommended reach, the stream is less confined by bedrock, flows through areas with sand and gravel soils, and has smaller substrate. The stream has a good mix of riffle, run, and deep pool habitats to support a salmonid fishery.

Fishery surveys revealed an abundant and self-sustaining brook trout fishery. Even though Government 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. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The health of the riparian community along Government Creek is on upward trend, providing increasing amounts of cover and shading for the stream. The riparian community is comprised mainly of alder, willow, sedges, and rushes, but the creek does have some problems with weedy species in the riparian zone.

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, aquatic habitat in pools and runs will also be maintained 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 1 below. Table 1 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 required.

Table 1: R2Cross Results

Party	Date	Q (cfs)	Accuracy Range (cfs)	Winter (2/3) (cfs)	Summer(3/3) (cfs)
BLM	7/12/2011	2.66	1.06 – 6.65	1.13	3.18
BLM	7/12/2011	2.90	1.16 – 7.25	1.23	3.99
			Average	**1.18**	**3.59**

3.6 cubic feet per second is recommended for the snowmelt runoff period, from May 1 through July 31. This recommendation is driven by the average velocity 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.

1.0 cubic feet per second is recommended for the late-summer period, from August 1 to September 30. This recommendation is driven by a combination of more limited water availability and the average depth criteria. This flow rate is capable of preventing excessively high water temperatures during late summer.

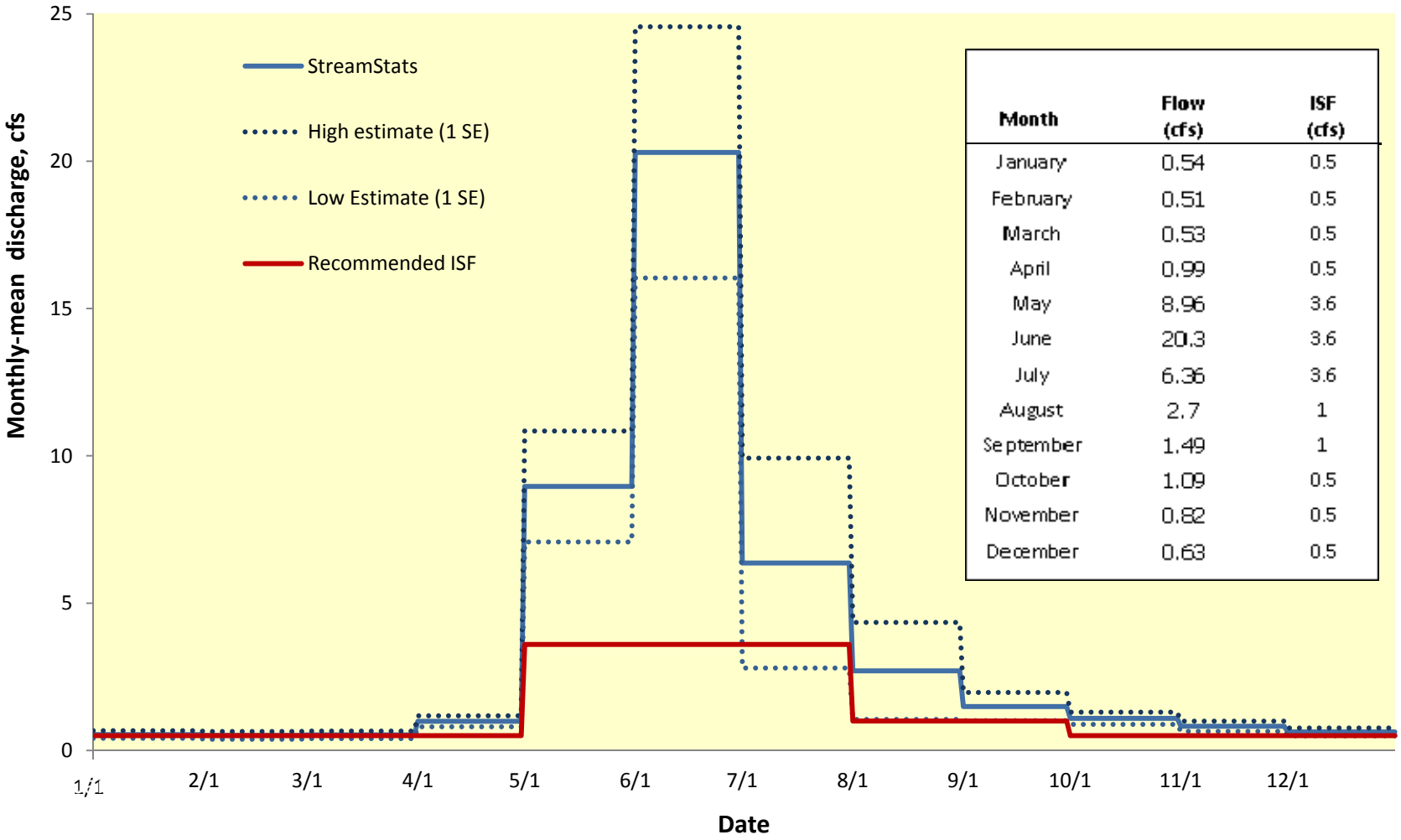
0.5 cubic feet per second is recommended for the fall/winter period from October 1 to April 30. This recommendation is driven by limited water availability. This flow rate meets the wetted perimeter criteria and provides an average depth of approximately 0.14 feet. It should provide sufficient flow to prevent pools from freezing and protect overwintering fish.

Hydrologic Data and Analysis

Staff evaluated the hydrology of Government Creek to determine if water is physically available for an instream flow appropriation. Government creek does not have a gage at or near the lower terminus or anywhere within the drainage basin. Two gages were identified within about 26 miles of Government Creek with similar average elevation, precipitation, and orientation to the Government Creek drainage basin. Of these, the Canadian River gage (USGS Gage 06619400) had a very short record, 1978 to 1983, that was not deemed sufficient for further analysis. The North Fork of the Michigan River (USGS Gage 0661600) had a longer historical record, 1950 to 1982, but the gage is located downstream from North Michigan Creek Reservoir which alters the stream hydrology making it inappropriate for comparison to Government Creek. Given the lack of suitable

gage data, regional flow equations developed to estimate natural stream flow were the most efficient option. These equations, developed by the USGS (Regional Regression Equations for Estimation of Natural Streamflow statistics in Colorado, 2009), estimate monthly-mean flow based on drainage basin area, average drainage basin elevation, and average drainage basin precipitation. Figure 1 shows that water is available based on the recommending agencies revised flow recommendations.

Government Creek
Lower Terminus: Government Ditch No. 2



Month	Flow (cfs)	ISF (cfs)
January	0.54	0.5
February	0.51	0.5
March	0.53	0.5
April	0.99	0.5
May	8.96	3.6
June	20.3	3.6
July	6.36	3.6
August	2.7	1
September	1.49	1
October	1.09	0.5
November	0.82	0.5
December	0.63	0.5

Figure 1. Water availability analysis

Existing Water Right Information

Staff has analyzed the water rights tabulation and contacted the Division Engineer Office (DEO) to identify any potential water availability problems. There are two decreed surface diversions at the proposed lower terminus of this recommended reach: Livingstone Ditch (1 cfs, 1892 appropriation) and Government Ditch No. 2 (8 cfs, 1892 appropriation). Staff has determined that water is available for appropriation on Government Creek from the headwaters to the Government Ditch No. 2 headgate, 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 the Board form its intent to appropriate on the following stream reach:

Segment: HEADWATERS TO THE HEADGATE OF THE GOVERNMENT DITCH NO. 2
Upper Terminus: HEADWATERS IN THE VICINITY OF
UTM North: 4527002.57 UTM East: 402519.24
(Latitude 40° 53' 17.9"N) (Longitude 106° 09' 25.64"W)
SW SW Section 28, Township 11 North, Range 78 West 6th PM
932' East of the West Section Line; 394' North of the South Section Line

Lower Terminus: HEADGATE OF THE GOVERNMENT DITCH NO. 2
UTM North: 4526731.68 UTM East: 395567.14
(Latitude 40° 53' 6.04"N) (Longitude 106° 14' 22.49"W)
SE NE Section 34, Township 11 North, Range 79 West 6th PM
782' West of the East Section Line; 1,576' South of the North Section Line

Watershed: North Platte Headwaters (HUC#: 10180001)
Counties: Jackson
Length: 5.03 miles
USGS Quad(s): Kings Canyon
Flow Recommendation: 3.6 cfs (May 1 – July 31)
1.0 cfs (August 1 – September 30)
0.5 cfs (October 1 – April 30)

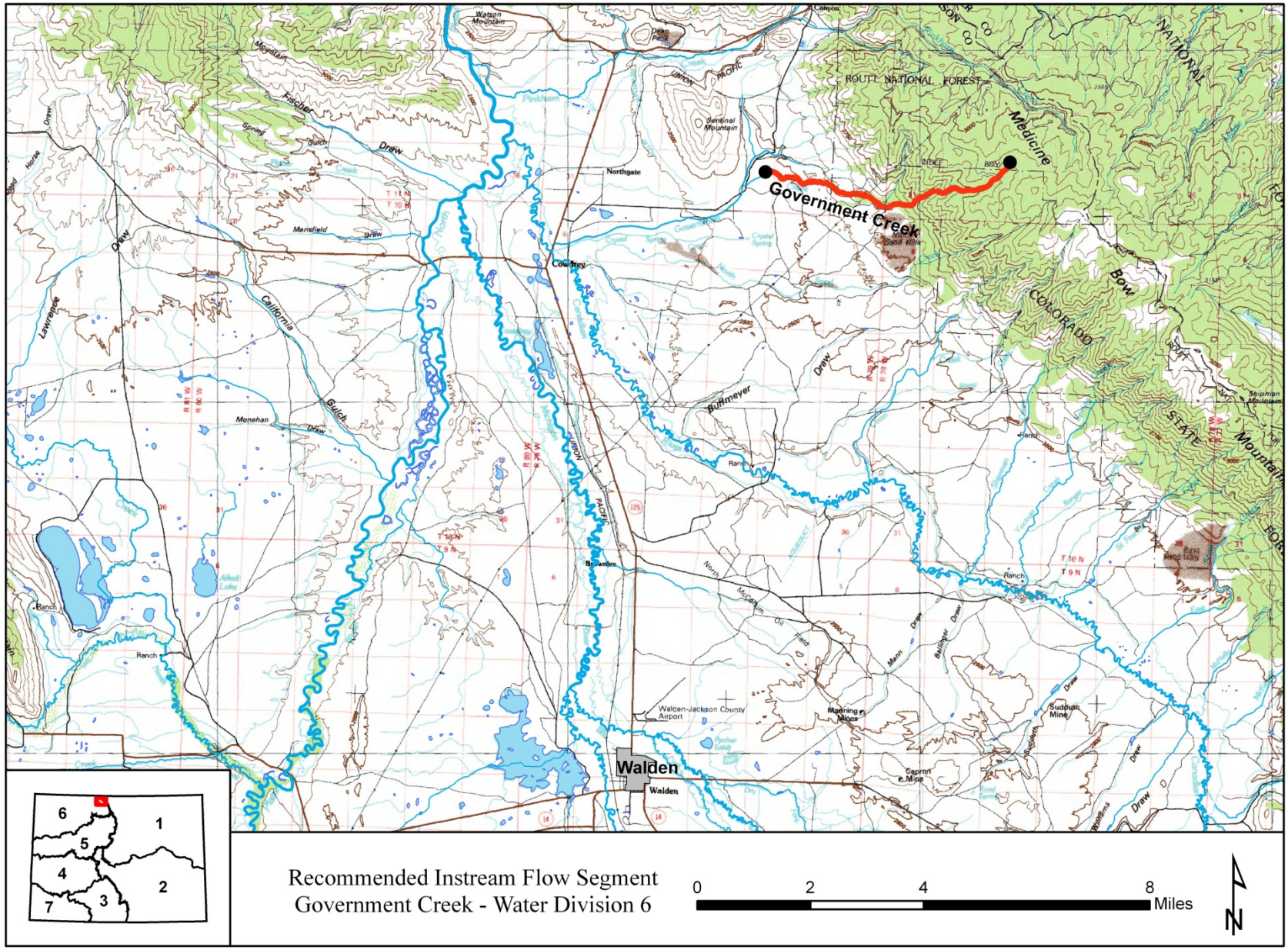
Metadata Descriptions:

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).

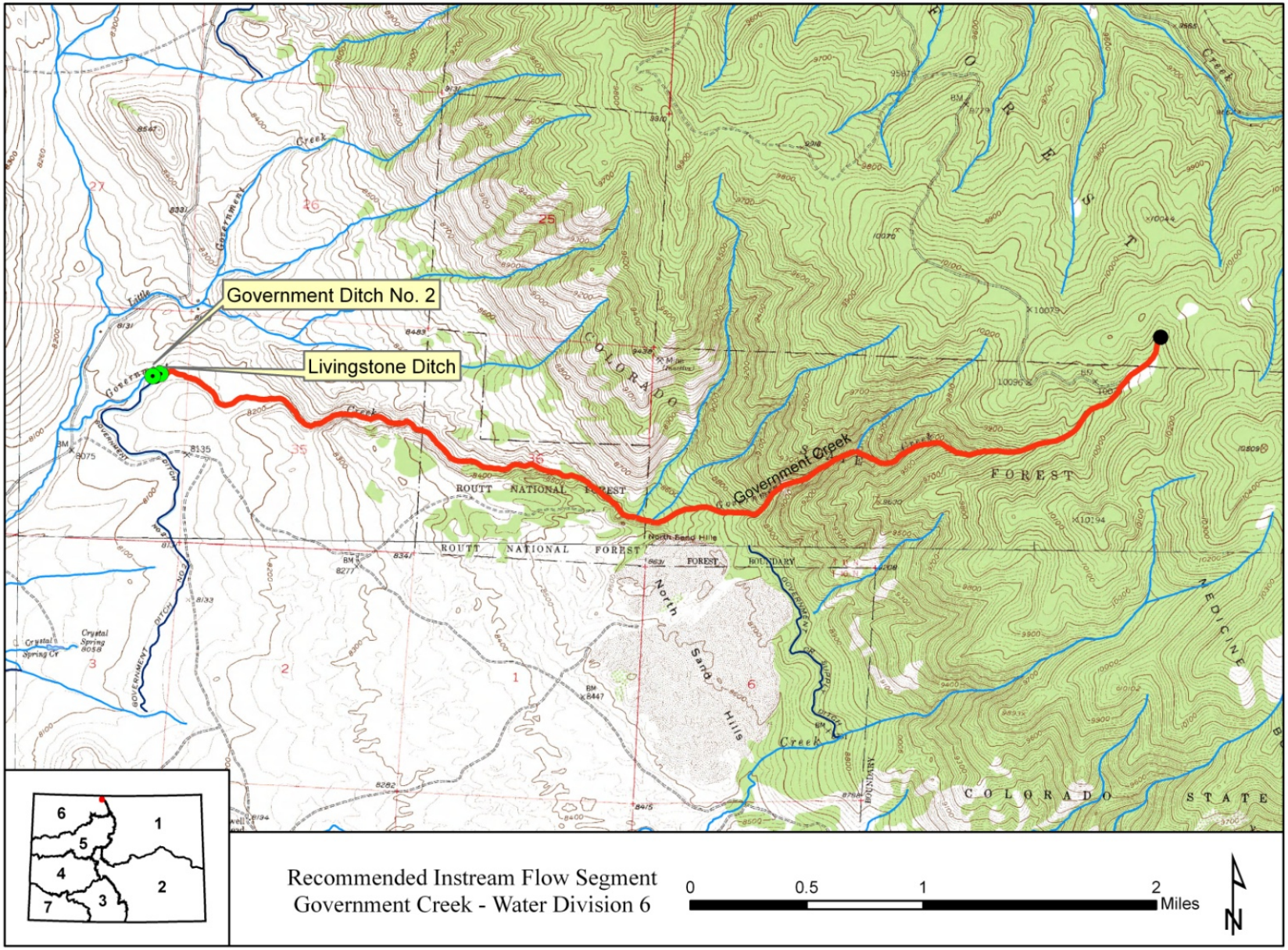
b) The PLSS locations were derived from CWCB GIS using 2005 PLSS data from the U.S. Bureau of Land Management's Geographic Coordinate Database

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

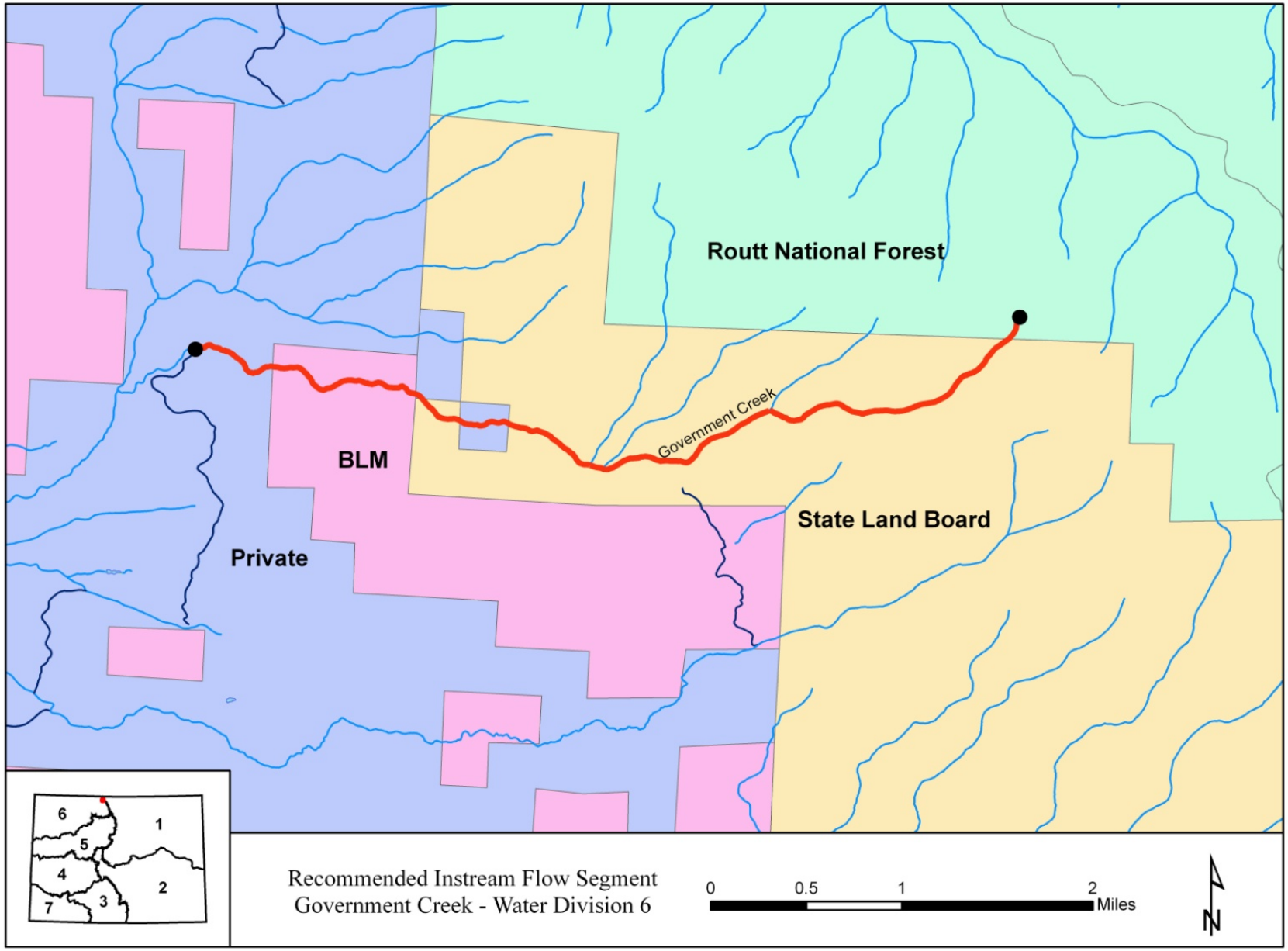
Vicinity Map



Water Rights Map



Land Use Map


Routt National Forest
Government Creek
BLM
State Land Board
Private
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Government Creek - Water Division 6
0
0.5
1
2
Miles
N

<u>Stream:</u> Red Creek

Executive Summary

Water Division: 6
Water District: 58
CDOW#: 21600
CWCB ID: 13/6/A-002

Segment: U.S. FOREST SERVICE BOUNDARY TO CONFLUENCE WITH WILLOW CREEK
Upper Terminus: USFS BOUNADRY AT
UTM North: 4514949.39 UTM East: 332549.21

Lower Terminus: CONFLUENCE WITH WILLOW CREEK AT
UTM North: 4515585.43 UTM East: 336949.19

Watershed: Upper Yampa (HUC#: 14050001)
Counties: Routt
Length: 4.0 miles
USGS Quad(s): Hahns Peak
Flow Recommendation: 1.85 cfs (April 1 – July 15)
0.7 cfs (July 16 – March 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/2013ProposedInstreamFlowAppropriations.aspx) forms 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 in 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 Red Creek to the CWCB for a water right under the Instream Flow Program. Red Creek is being considered because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Red Creek is approximately 8 miles long and originates on Sand Mountain at an elevation of 9,000 feet. It flows in an easterly direction as it drops to an elevation of 7,900 feet where it joins Willow Creek. Thirty-four percent of the land on the 4.0 mile segment addressed by this report is publicly owned. Red Creek is located within Routt County and the total drainage area of the creek is approximately 9.28 square miles and is oriented west to east.

The subject of this report is a segment of Red Creek beginning at the USFS Boundary and extending downstream to the confluence with Willow Creek. The proposed segment is located approximately 15 miles northwest of Steamboat Springs. Staff has received one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Instream Flow Recommendation

The BLM recommended a flow of 1.85 cfs (April 1 – July 15) and 0.7cfs (July 16 – March 31) based on its August 17, 2011 data collection efforts and staff's water availability analyses.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
USFS Boundary	Confluence with Willow Creek	4.0	66%	34%

All of the public lands in this segment are managed by the BLM.

Biological Data

Red Creek is a cold-water, low gradient stream in rolling foothills below the Routt National Forest. The stream meanders through a valley floor that is approximately 200 feet wide. Red Creek has substrate ranging from gravels to small cobbles. The stream has a good mix of riffle, run, and deep pool habitats to support a salmonid fishery. The creek also supports an active beaver community.

Fishery surveys revealed a self-sustaining native fishery which included mountain suckers, mottled sculpin, and speckled dace. White suckers, which are native to the Front Range, were also documented in the creek. Even though Red 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. Intensive macro-invertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, caddisfly, and stonefly.

The riparian community along Red Creek is in good condition, and provides adequate cover, overhanging banks, and habitat diversity for the fish population. The riparian community is comprised mainly of willows and sedges and occupies the entire valley bottom.

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, aquatic habitat in pools and runs will also be maintained 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 1 below. Table 1 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 required.

Table 1: R2Cross Results

Party	Date	Q (cfs)	Accuracy Range (cfs)	Winter (2/3) (cfs)	Summer(3/3) (cfs)
BLM	8/17/2011	1.15	0.46 – 2.88	1.30	2.01
BLM	8/17/2011	0.98	0.39 – 2.45	1.68	1.70
			Averages	1.5	1.85

1.85 cubic feet per second is recommended for the snowmelt runoff period from April 1 through July 15. This recommendation is driven by the average depth criteria. Because of its small size and low flows during the base flow period, it is important to protect as much physical habitat as possible during the limited time when snowmelt runoff flows are available.

0.7 cubic feet per second is recommended for the remainder of the year, from July 16 to March 31. This recommendation is driven by water availability, because insufficient water is available to meet two of three flow criteria at 1.5 cfs, as recommended by the R2Cross modeling effort. 0.7 cubic feet per second come close to meeting the average velocity and wetted perimeter criteria, but provides an average depth of only 0.135 feet. This flow rate should prevent excessively high water temperatures during the late summer period and it should protect overwintering fish by preventing pools from freezing.

Hydrologic Data and Analysis

After receiving the cooperating agency's biologic recommendation, the CWCB staff conducted an evaluation of the stream hydrology to determine if water was physically available for an instream flow appropriation. This evaluation was done through a computation that is, in essence, a "water balance". In concept, a "water balance" computation can be viewed as an accounting exercise. When done in its most rigorous form, the water balance parses precipitation into all the avenues water pursues after it is deposited as rain, snow, or ice. In other words, given a specified amount of water deposition (input), the balance tries to account for all water depletions (losses) until a selected end point is reached. Water losses include depletions due to evaporation and transpiration, deliveries into ground water storage, temporary surface storage, incorporations into plant and animal tissue and so forth. These losses are individually or collectively subtracted from the input to reveal the net amount of stream runoff as represented by the discharge measured by stream gages.

CWCB staff attempts to use this idea of balancing inputs and losses to determine if water is available for the recommended instream flow appropriation. Of course, this effort must be a practical exercise rather than a lengthy, and costly, scientific investigation. As a result, staff simplifies the process by lumping together some variables and employing certain rational and scientifically supportable assumptions. The process that is typically used by Staff incorporates, where possible, diversion records as well as the stream gage data collected by the US Geological Survey and DNR's Water Resources Division. All of these data are available in the DWR database called Hydrobase.

To determine water availability, Staff begins by characterizing the hydrologic regime at the Lower Terminus (LT) of the recommended ISF reach. In the best case, this means looking at data that has been collected for a long period of time from a gage that is located at the LT. Preferably, the period of data collection includes both wet and dry conditions. However, in the case of Red Creek, there is no gage and hence no record of discharge collected by either the USGS or DWR. Lacking such data, the description of flow above the Red Creek LT can be indirectly described through reference to a "representative" gage station. There are two USGS gage stations that measure tributaries in reasonably close proximity to Red Creek, either of which could represent the hydrology of Red Creek. The first of these is Elkhead Creek Near Clark, CO (USGS 09244500). This gage is at an elevation of 7,800 ft above mean sea level (amsl), has a generally East – West orientation, and a drainage area of 46 mi^2. The period of record (POR) of 16 years was collected between 1942 and 1973. The hydrograph (plot of discharge over time) for this gage includes consumptive depletions from several diversions, although diversions and consumptive uses do not necessarily constitute a major limitation upon the use of the data from the gage.

The second gage is South Fork Elk River Near Clark, CO (USGS 09240800) This gage is at an elevation of 7,980 ft amsl, has a generally Southeast – Northwest orientation, and a drainage area of 34 mi^2. The POR of 5 years was collected between 1966 and 1973. The hydrograph for this gage includes consumptive depletions due to stockwater use and out-of-basin transfers, although such uses and transfers do not necessarily constitute a major limitation upon the use of the data from the gage.

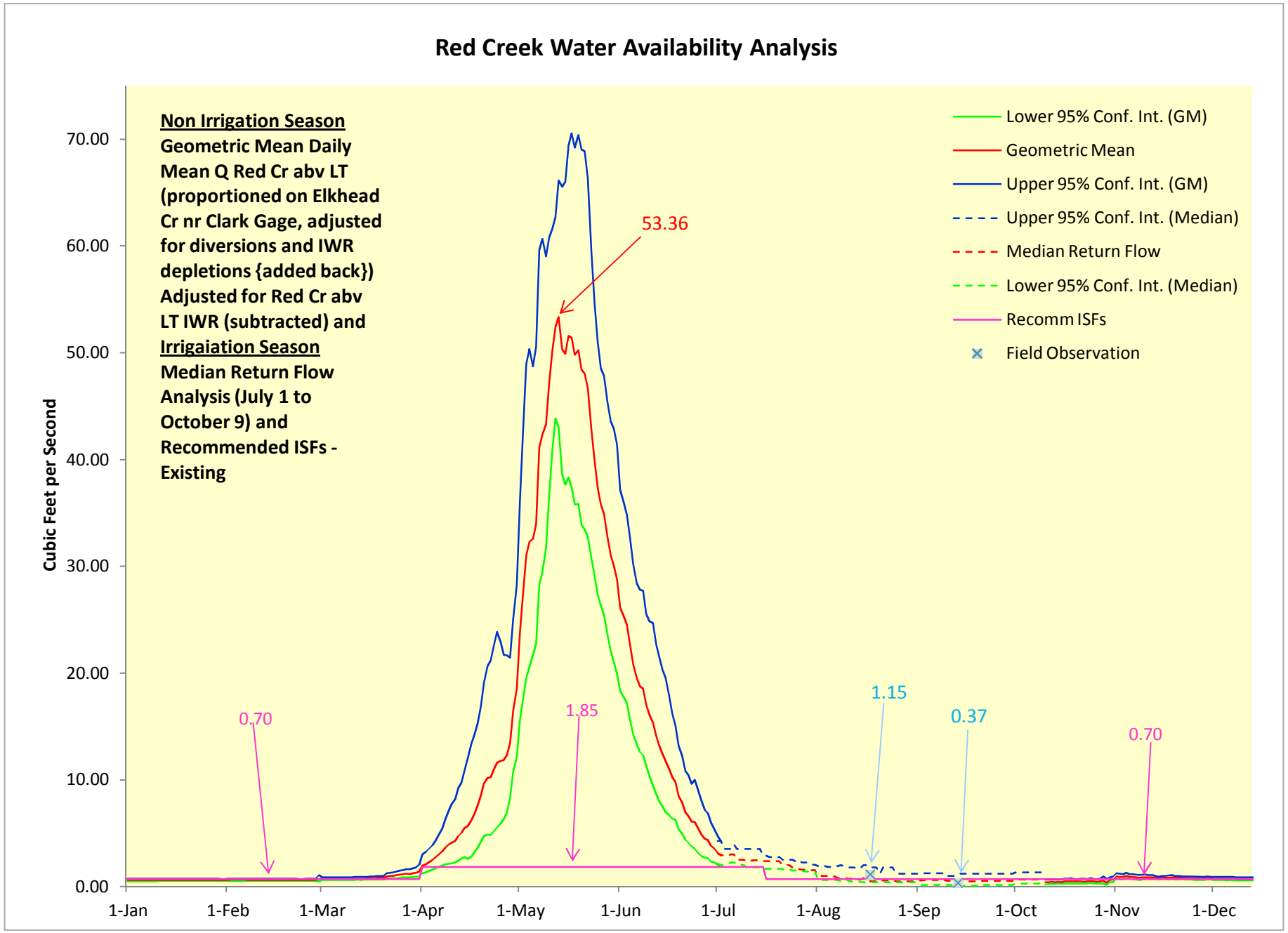
The gages described above were found to have certain limitations that compromised their potential for use as gages "representative" of the hydrology of Red Creek. The greatest limitation for the Elkhead Creek gage was found in the irrigation season – a period of great importance to instream flow recommendations. Based on spot discharge measurements of Red Creek, the apportionment from the Elkhead Creek gage seems to under predict available water. Otherwise, the Elkhead Creek watershed was well suited to serve as "representative" of Red Creek (similar areal elevation distribution, and a shared location boundary, etc).

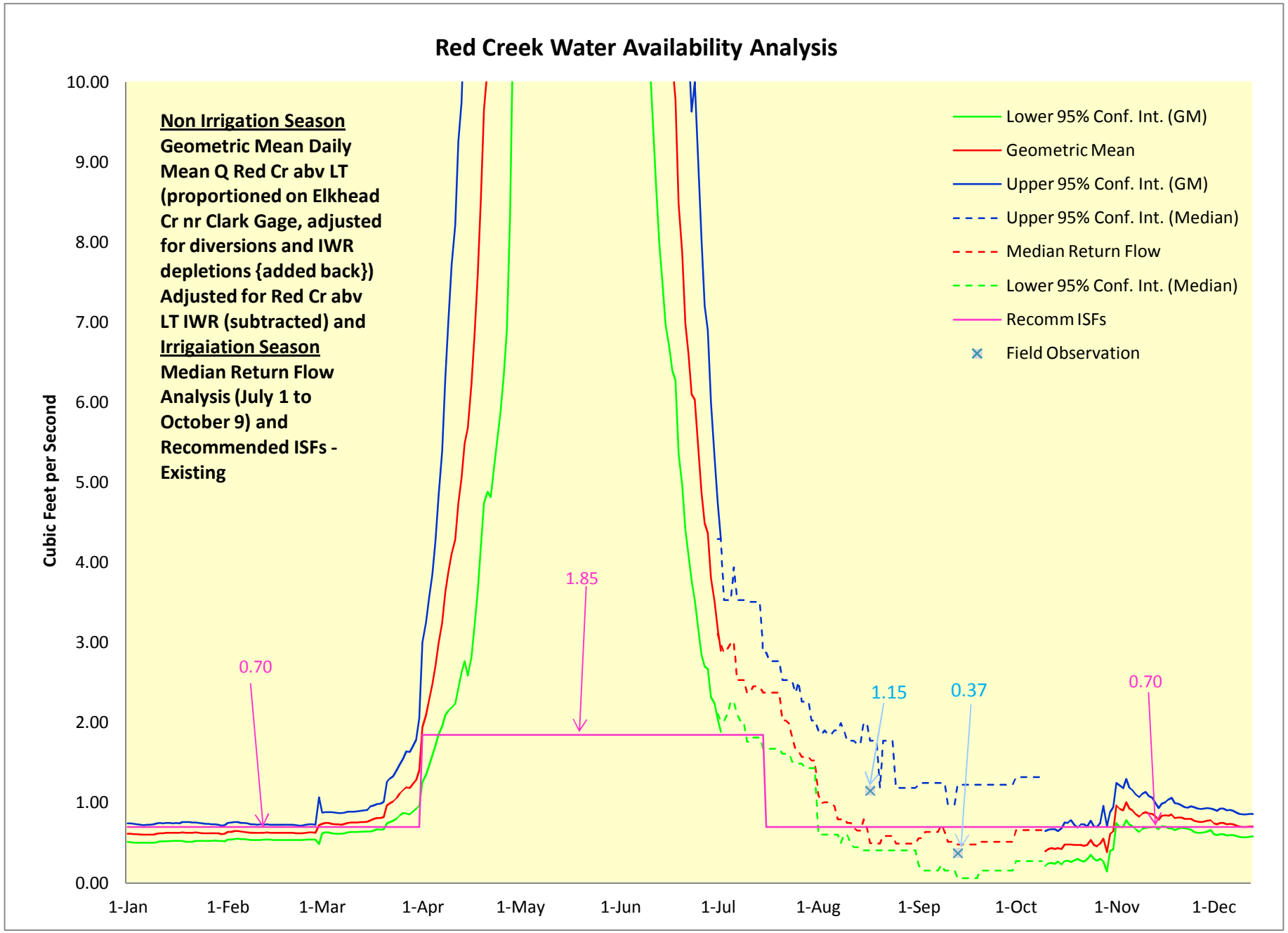
The significant problem with the South Fork Elk River gage was that its elevation was distributed considerably higher than Red Creek. This gage did not suffer from the same irrigation season problem as Elkhead Creek. However, the gage record was short and the slope orientation was different than the subject creek.

Hydrograph development for ungaged streams becomes more difficult when Staff finds itself with a lack of gage data on a recommended stream and a seemingly unrepresentative season from the "representative" gage. Recognizing the limitations of the Elkhead Creek gage for this analysis, it is the best available data and was used for the proration as the "representative" gage in the non irrigation portion of the year. Staff then employed a water balance analysis, using diversion records and irrigation water requirements, to determine the likely irrigation season flows on Red Creek.

The water balance analysis examined the historic diversion records: daily diversion records, the irrigated acres records, crop and irrigation method. These were used to determine the portion of water consumed. The NRCS soil maps and USGS geologic maps were consulted to confirm the assumption that water is traveling through the shallow alluvial system and returning to Red Creek is reasonable. This information is used to determine the median amount of water left in the basin. For the water balance analysis, median was selected as the representative statistic because the diversion record was examined and making Gaussian distribution assumption in normal or log space was not appropriate.

For Red Creek, Staff's water balance analysis resulted in a median monthly hydrograph for the irrigation season, which when coupled with the areal apportionment was used to help determine a more representative hydrograph, as judged by field observation, than was obtained from using a simple area proration of the daily data from the Elkhead Creek gage. The prorated geometric mean (solid lines) and median return water (dashed lines) hydrograph utilizing the Elkhead Creek gage and diversion record data shows that water is available for appropriation (See Figures 1 and 1a).


Red Creek Water Availability Analysis
Non Irrigation Season
Geometric Mean Daily Mean Q Red Cr abv LT (proportioned on Elkhead Cr nr Clark Gage, adjusted for diversions and IWR depletions {added back}) Adjusted for Red Cr abv LT IWR (subtracted) and
Irrigaiation Season
Median Return Flow Analysis (July 1 to October 9) and Recommended ISFs - Existing
Cubic Feet per Second
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
53.36
0.70
1.85
1.15
0.37
0.70
Lower 95% Conf. Int. (GM)
Geometric Mean
Upper 95% Conf. Int. (GM)
Upper 95% Conf. Int. (Median)
Median Return Flow
Lower 95% Conf. Int. (Median)
Recomm ISFs
Field Observation


Red Creek Water Availability Analysis
Non Irrigation Season
Geometric Mean Daily Mean Q Red Cr abv LT (proportioned on Elkhead Cr nr Clark Gage, adjusted for diversions and IWR depletions {added back}) Adjusted for Red Cr abv LT IWR (subtracted) and
Irrigaiation Season
Median Return Flow Analysis (July 1 to October 9) and Recommended ISFs - Existing
Cubic Feet per Second
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Lower 95% Conf. Int. (GM)
Geometric Mean
Upper 95% Conf. Int. (GM)
Upper 95% Conf. Int. (Median)
Median Return Flow
Lower 95% Conf. Int. (Median)
Recomm ISFs
Field Observation
0.70
1.85
1.15
0.37
0.70

Existing Water Right Information

Staff has analyzed the water rights tabulation and contacted the Division Engineer Office (DEO) to identify any potential water availability problems. There are no decreed surface diversions within this reach of stream. Staff has determined that water is available for appropriation on Red Creek between the USFS Boundary to Confluence with Willow Creek, 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 the Board form its intent to appropriate on the following stream reach:

Segment: U.S. FOREST SERVICE BOUNDARY TO CONFLUENCE WITH WILLOW CREEK
Upper Terminus: USFS BOUNADRY AT
UTM North: 4514949.39 UTM East: 332549.21
(Latitude 40° 46' 6.5"N) (Longitude 106° 59' 2.65"W)
NE SW Section 1, Township 9 North, Range 86 West 6th PM
2,609' East of the West Section Line; 2,516' North of the South Section Line

Lower Terminus: CONFLUENCE WITH WILLOW CREEK AT
UTM North: 4515585.43 UTM East: 336949.19
(Latitude 40° 46' 30.3"N) (Longitude 106° 55' 55.67"W)
NW NW Section 4, Township 9 North, Range 85 West 6th PM
1,096' East of the West Section Line; 372' South of the North Section Line

Watershed: Upper Yampa (HUC#: 14050001)
Counties: Routt
Length: 4.0 miles
USGS Quad(s): Hahns Peak
Flow Recommendation: 1.85 cfs (April 1 – July 15)
0.7 cfs (July 16 – March 31)

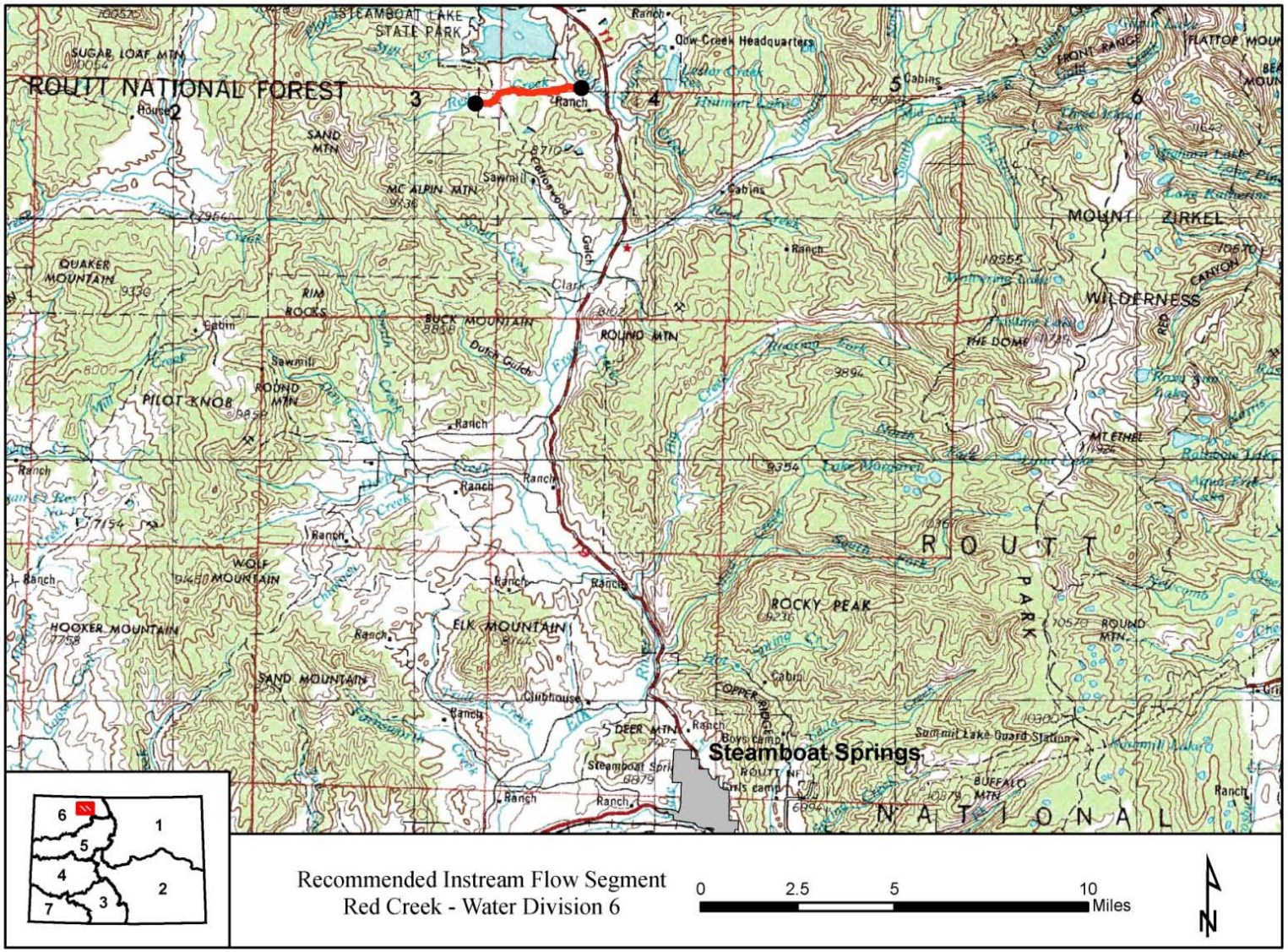
Metadata Descriptions:

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).

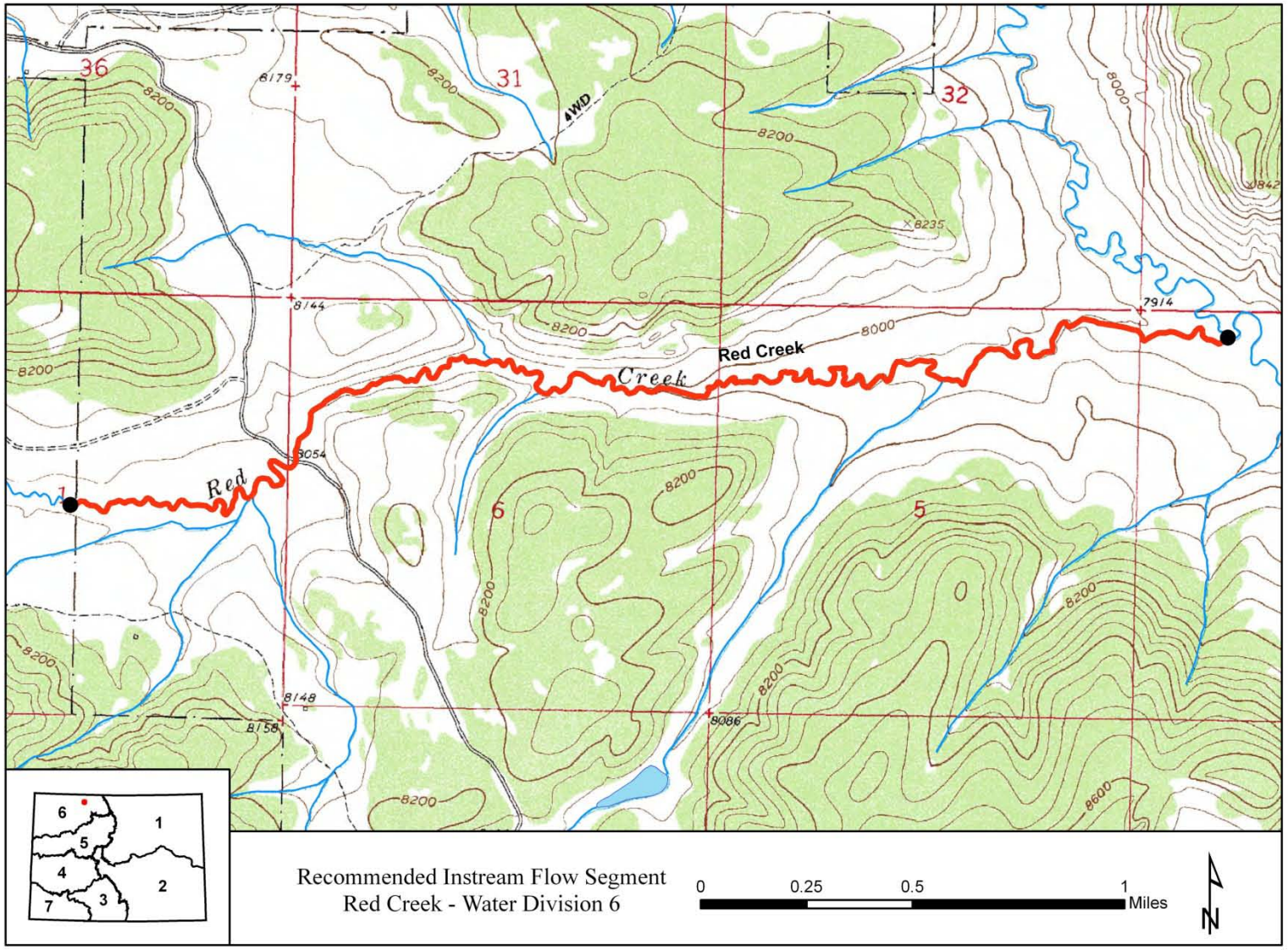
b) The PLSS locations were derived from CWCB GIS using 2005 PLSS data from the U.S. Bureau of Land Management's Geographic Coordinate Database

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

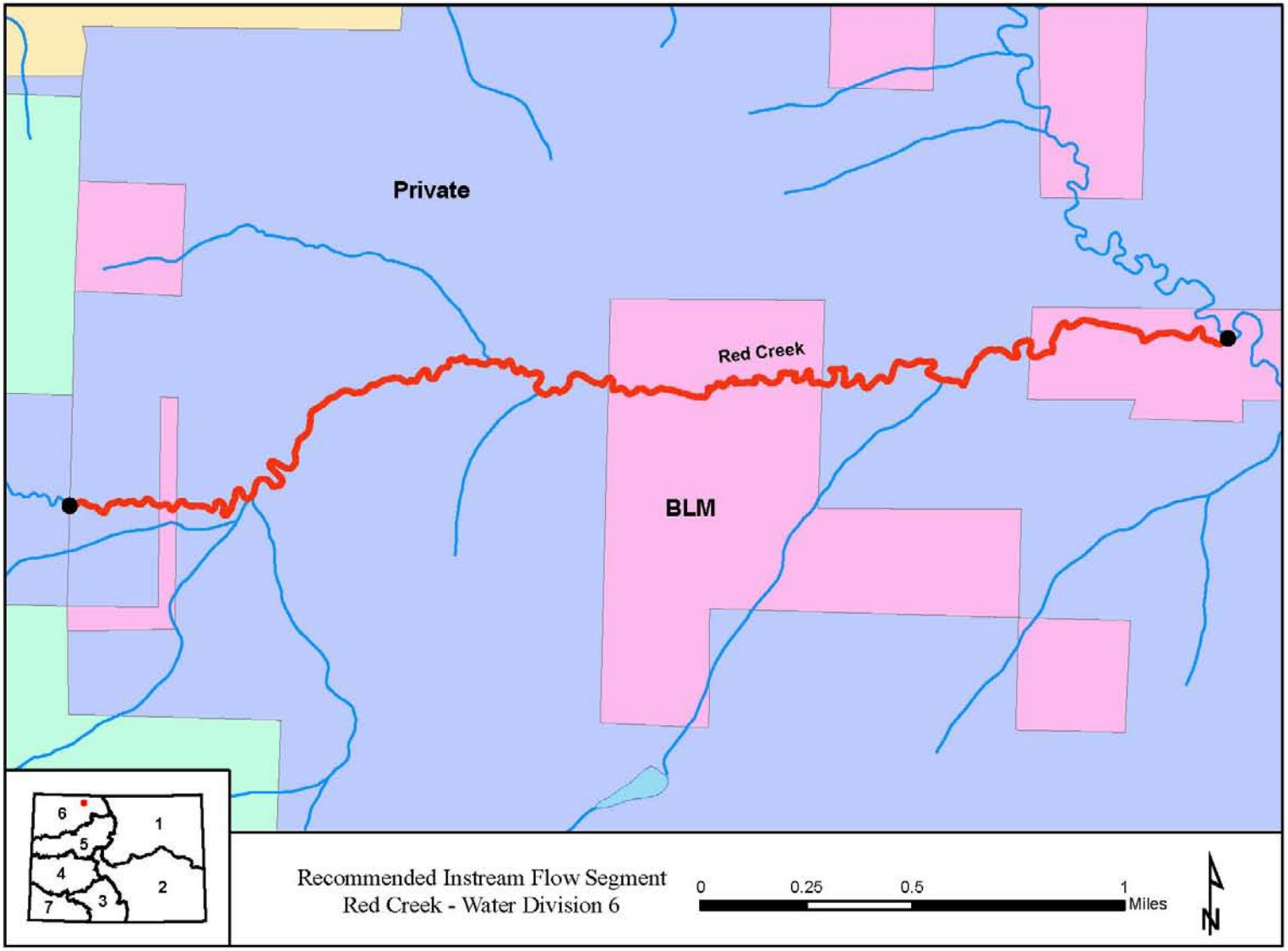
Vicinity Map



Water Rights Map



Land Use Map


Private
Red Creek
BLM
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Red Creek - Water Division 6
0
0.25
0.5
1
Miles
N