<u>Stream:</u> Forrester Creek

Executive Summary

Water Division: 1
Water District: 48
CDOW#: 10950
CWCB ID: 12/1/A-001

Segment: Headwaters to Forrester Creek Ditch Headgate
Upper Terminus: HEADWATERS IN THE VICINITY OF
(Latitude 40° 51’ 43.73”N) (Longitude 106° 04’ 37.72”W)

Lower Terminus: FORRESTER CREEK DITCH HEADGATE
(Latitude 40° 55’ 9.5”N) (Longitude 105° 58’ 49.11”W)

Watershed: Upper Laramie (HUC#: 10180010)
Counties: Larimer
Length: 6.87 miles
USGS Quad(s): Old Roach, Crazy Mountain, Shipman Mountain
Flow Recommendation: 1.7 cfs (May 1 – August 31)
1.1 cfs (September 1 – October 31)
0.70 cfs (November 1 – April 30)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated supporting data and analyses (located on the enclosed CD) 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 Forrester Creek to the CWCB for inclusion in the Instream Flow Program. Forrester Creek is being considered for inclusion into the Instream Flow Program because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Forrester Creek is approximately 8.5 miles long and originates on the east side of the Medicine Bow Mountains at an elevation of 10,200 feet. It flows northeasterly as it drops to an elevation of 7,720 feet where it joins the Laramie River. Approximately 80 percent of the land on the 6.87 mile segment addressed by this report is publicly owned. Forrester Creek is located within Larimer County and the total drainage area of the creek is approximately 5.4 square miles.

The subject of this report is a segment of Forrester Creek beginning at the headwaters and extending downstream to the Forrester Creek Ditch headgate. The proposed segment is located approximately 14 miles northeast of the town 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 1.7 cfs (May 1 – August 31), 1.1 cfs (September 1 – October 31) and 0.70 cfs (November 1 – April 30) based on its August, 2, 2010 data collection efforts and staff's water availability analyses.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Headwaters	Forrester Creek Ditch Headgate	6.87	20%	80 %

68 % of the lands are managed by the USFS and 12 % of the lands are managed by the BLM.

Biological Data

Forrester Creek is a cold-water stream with moderate gradient, functional floodplains, and active beaver dams. The stream has a good mix of riffle, run, and deep pool habitats. Fish surveys show that Forrester Creek supports naturally reproducing brook population. Intensive macroinvertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, stonefly, caddisfly and midge.

The riparian community occupies most of the floodplain area and is comprised primarily of willows, alders, and sedges. The healthy riparian community has resulted in normal width-to-depth ratios, sinuosity, and bank stability.

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 (240% 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: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
BLM	8/2/2010	1.26	3.1 – 0.5	1.79	0.61
BLM	8/2/2010	1.14	2.8 – 0.5	1.64	0.77
			Averages	1.72	0.69

1.70 cubic feet per second is recommended for the snowmelt runoff period from May 1 through August 31. This recommendation is driven by the average depth criteria. It is important to maintain adequate depth in the riffles in this creek, because the creek has limited riffle habitat available for spawning.

1.1 cubic feet per second is recommended during the late summer and early fall period, from September 1 to October 31. This recommendation has been preliminarily reduced because of water availability concerns. This flow rate will meet the wetted perimeter and velocity criteria, while providing an average depth of 0.15 feet.

0.70 cubic feet per second is recommended during the cold temperature period, from November 1 to April 30. This recommendation is driven by the wetted perimeter criteria and depth criteria. During winter, this flow rate should provide sufficient velocity and depth to prevent icing of all physical habitat within the stream.

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 Forrester 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 Forrester Creek LT can only be indirectly described through reference to a "representative" gage station. There are two USGS gage stations in reasonably close proximity to Forrester Creek, either of which could represent the hydrologic functioning of Forrester Creek. The first of these is LARAMIE RIVER NEAR GLENDEVEY, CO (USGS 06657500). This gage is at an elevation of 8230 ft above mean sea level (amsl), has a generally North – South orientation, and a drainage area of 101 mi^2. The period of record (POR) of 74 years was collected between 1904 and 1982. 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 SAND CREEK AT COLORADO – WYOMING STATE LINE (USGS 066595800) This gage is at an elevation of 7580 ft amsl, has a generally Southwest – Northeast orientation, and a drainage area of 29.2 mi^2. The POR of 44 years was collected between 1968 and 2011. 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.

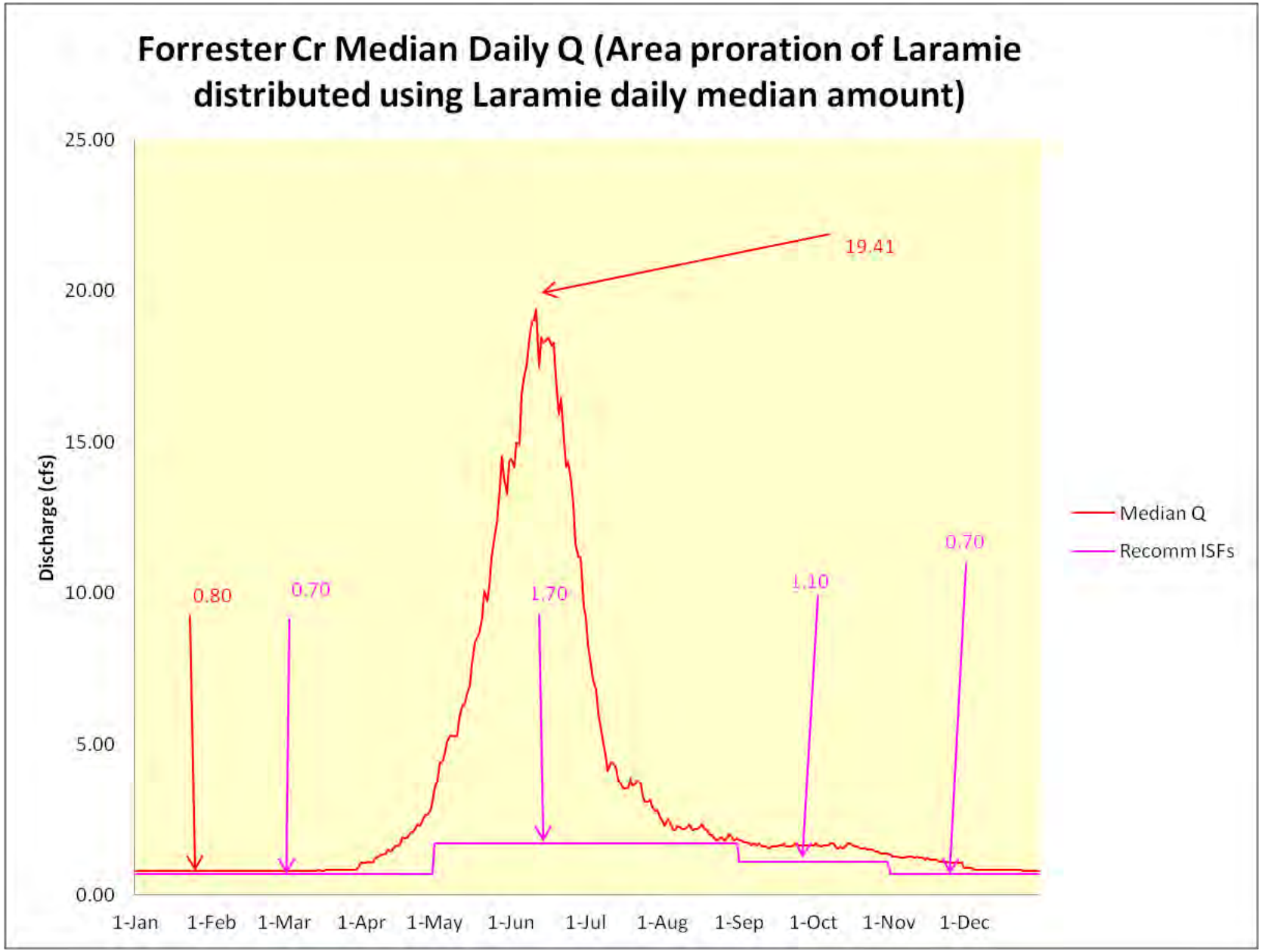
The gages described above were found to have certain limitations that compromised their potential for use as gages "representative" of the hydrology of Forrester Creek. The greatest limitation was found in the low flow periods of Fall through Spring – the period of greatest importance to instream flow recommendations. With the exception of three years (1969 – 1971), the Sand Creek gage contained virtually no data from 1 October until 1 April. A plot of the annual hydrograph that relied upon those three years to represent the low flow period resulted in an uncharacteristic graph with low flow values that had high standard deviations and conflicted with on-the-ground observations. Even though the Sand Creek watershed was otherwise well suited to serve as "representative" of Forrester Creek (similar size, orientation, shape, elevation, location, a long POR, etc), the paucity of low discharge values rendered the record of little or no value in the characterization of the hydrology of Forrester Creek.

The Laramie River gage had similar problems. This gage did not suffer from the same problem as Sand Creek with respect to the absence of low flow data. However, the gage record, although long, was not as current as that of Sand Creek and the basin orientation was nearly perpendicular to that of Forrester Creek and the other Laramie River basin creeks being recommended. While the Laramie River gage low flow records were approved for publication, a certain uniformity in values, especially in the older data led to some concern that more estimates of flow may have been made than has been

noted in the record. This is of importance because of the difficulty of verification due to the dearth of low flow season data in the Sand Creek record.

Hydrograph development for ungaged streams becomes more difficult when Staff finds itself with a lack of gage data on a recommended stream and no "representative" gage is available due to the absence of nearby gage stations or because the nearby gage station records are unusable. Under these circumstances, Staff may be forced to employ a basin characteristics approach to determine mean monthly discharge values for the ungaged watershed. The method used, called StreamStats, was developed by the USGS for the estimation of mean monthly discharge (and other flow-related parameters) at ungaged sites through the use of watershed attributes. The attributes used may include precipitation, basin area, amount of basin above 7,500 ft elevation, and other morphological indices.

For Forrester Creek, Staff's StreamStats analysis resulted in a mean monthly hydrograph, which was used to help determine the reasonableness of the results obtained by using a simple area proration of the daily data from the Laramie River Gage. The following prorated median flow hydrograph utilizing the Laramie River gage data shows that water is available for appropriation.


Forrester Cr Median Daily Q (Area proration of Laramie distributed using Laramie daily median amount)
Discharge (cfs)
25.00
20.00
15.00
10.00
5.00
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
19.41
0.80
0.70
1.70
1.10
0.70
Median Q
Recomm ISFs

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 is one decreed surface diversion within this reach of stream for the San Creek Ditch System with an 1899 appropriation date. Staff has determined that water is available for appropriation on Forrester Creek between the headwaters to Forrester Creed Ditch 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

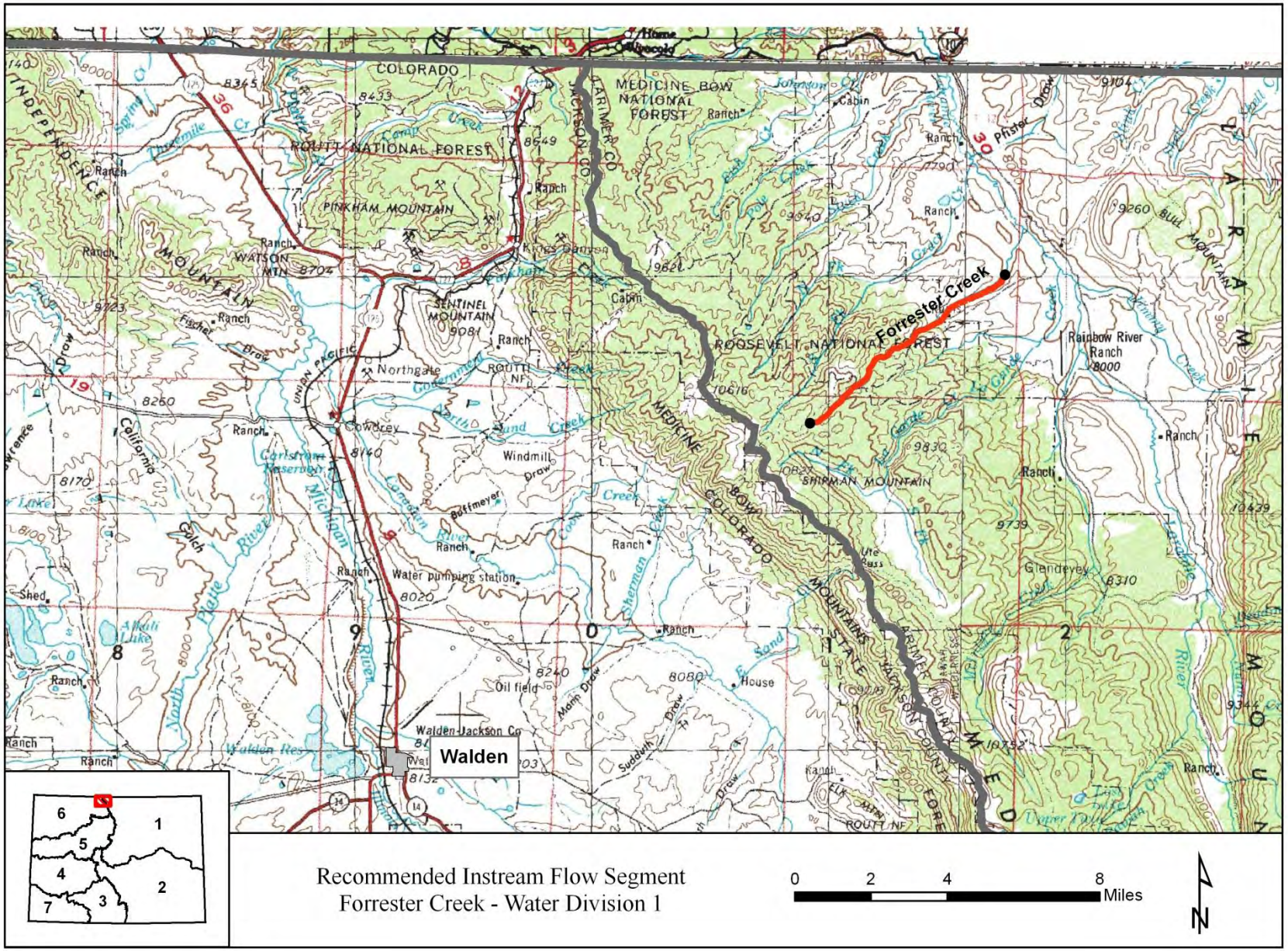
Staff recommends the Board form its intent to appropriate on the following stream reach:

Segment: Headwaters to Forrester Creek Ditch Headgate
Upper Terminus: HEADWATERS IN THE VICINITY OF
(Latitude 40° 51' 43.73"N) (Longitude 106° 04' 37.72"W)
UTM North: 4524012.63 UTM East: 409221.28
NW SE Section 6, Township 10 North, Range 77 West 6th PM
2213' West of the East Section Line; 1328' North of the South Section Line

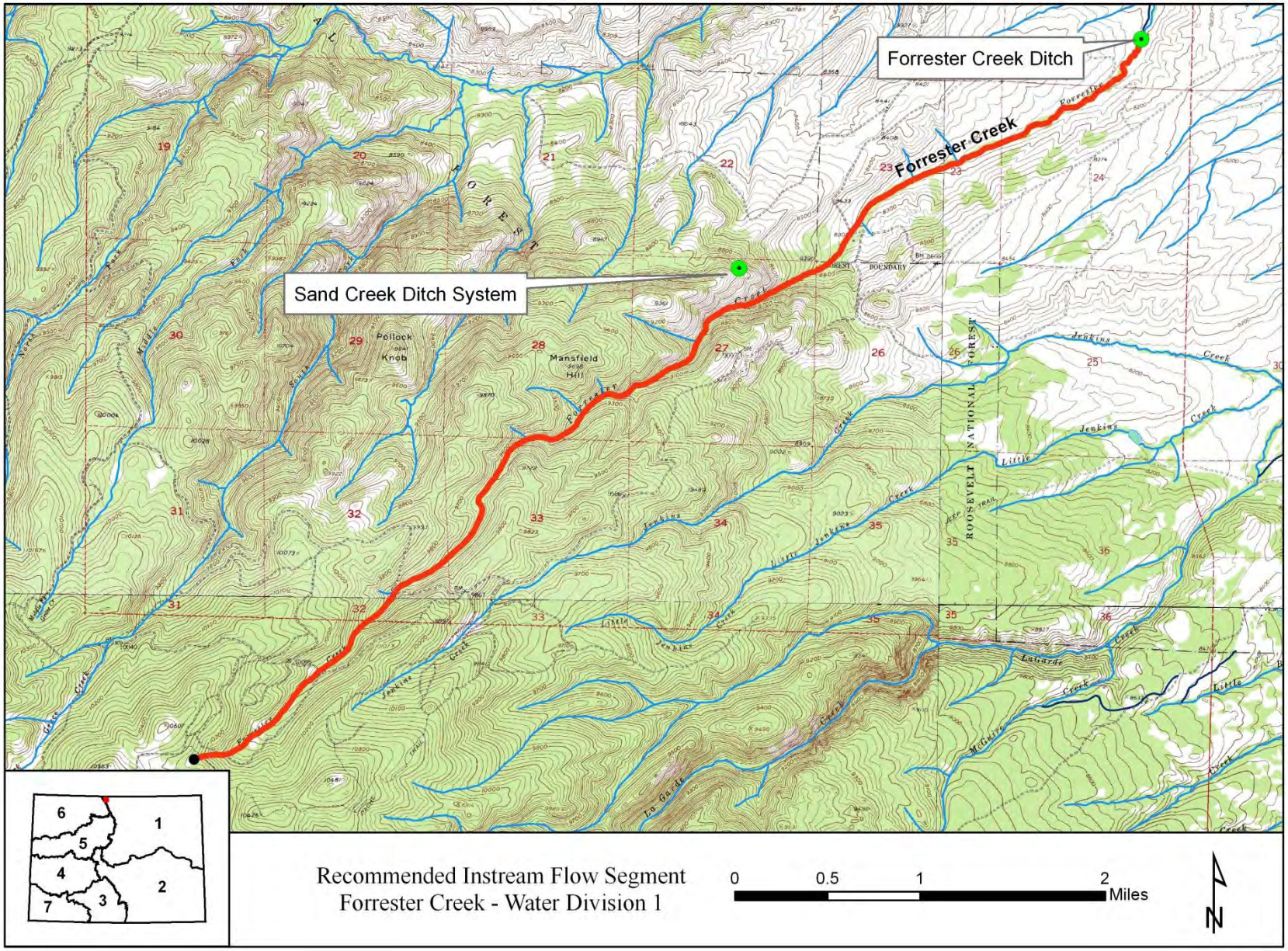
Lower Terminus: FORRESTER CREEK DITCH HEADGATE
(Latitude 40° 55' 9.5"N) (Longitude 105° 58' 49.11"W)
UTM North: 4530261.72 UTM East: 417453.60
NW SE Section 13, Township 11 North, Range 77 West 6th PM
1442' West of the East Section Line; 1358' North of the South Section Line

Watershed: Upper Laramie (HUC#: 10180010)
Counties: Larimer
Length: 6.87 miles
USGS Quad(s): Old Roach, Crazy Mountain, Shipman Mountain
Flow Recommendation: 1.7 cfs (May 1 – August 31)
1.1 cfs (September 1 – October 31)
0.70 cfs (November 1 – April 30)

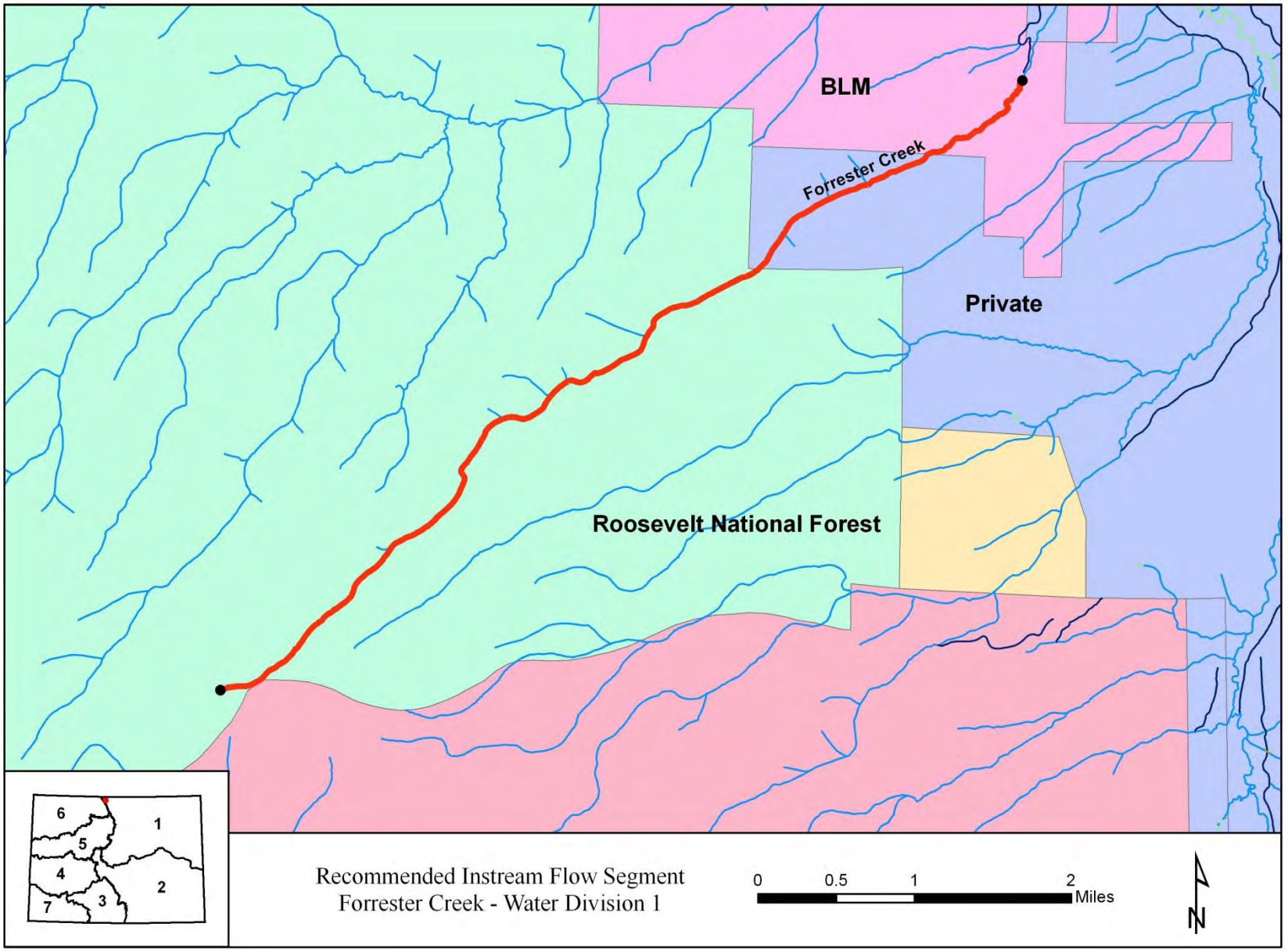
Vicinity Map



Water Rights Map



Land Use Map


BLM
Forrester Creek
Private
Roosevelt National Forest
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Forrester Creek - Water Division 1
0
0.5
1
2
Miles
N