Stream: Beaver Creek

Executive Summary

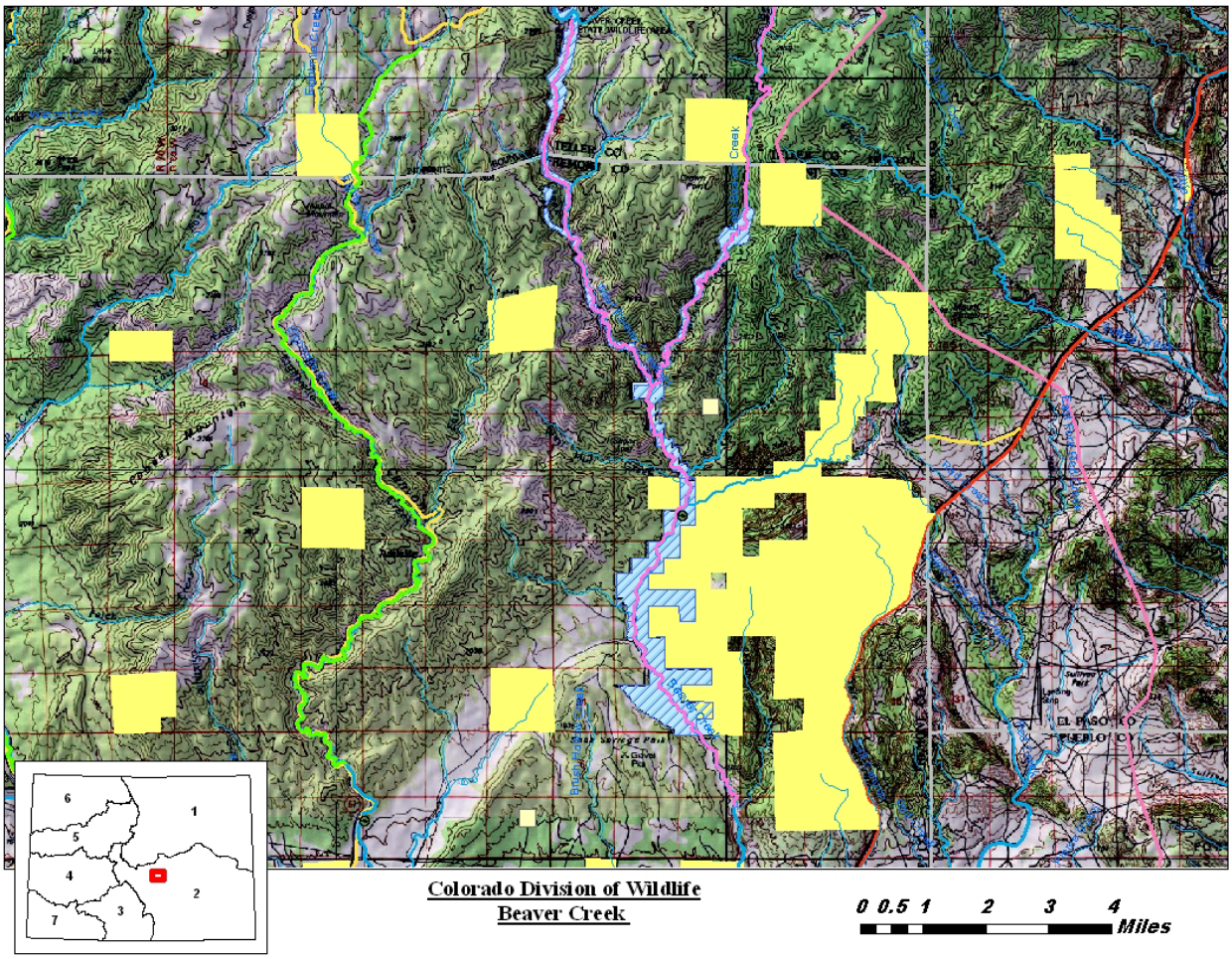
Water Division: 2
Water District: 12
CDOW#: 29173 & 29149

Segment: Douglas Gulch to Patton Canyon

Upper Terminus: Douglas Gulch
Latitude: 38º 41’ 02.5”N Longitude: 105º 02’ 47.0"W

Lower Terminus: Patton Canyon
Latitude: 38º 30’ 09.6”N Longitude: 104º 59’ 55.0"W

Counties: Teller and Fremont
Length: 14 miles
ISF Appropriation: 10.5 cfs (04/01 – 10/31)
6.0 cfs (11/01 – 03/31)



The information contained in this report and the associated instream flow file folder forms the basis for the instream flow recommendation to be considered by the Colorado Water Conservation Board (Board). It is the Colorado Division of Wildlife (CDOW) staff's opinion that the information contained in this report is sufficient for the Board's staff to begin the investigations required to support the findings required in Rule 5(i) of the Instream Flow Rules.

The State of Colorado's Instream Flow Program (ISFP) 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 Board 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 ISFP, the statute directs the Board to request instream flow recommendations from other state and federal agencies. The CDOW is recommending this segment of Beaver Creek to the Board for inclusion into the ISFP. Beaver Creek should be considered for inclusion into the ISFP because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

The CDOW is forwarding this stream flow recommendation to the Board to meet Colorado's policy "… that the wildlife and their environment are to be protected, preserved, enhanced, and

managed for the use, benefit, and enjoyment of the people of this state and its visitors … and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities" (See §33-1-101 (1) C.R.S.). The CDOW Strategic Plan states "[h]ealthy aquatic environments are essential to maintain healthy and viable fisheries, and critical for self-sustaining populations. The [CDOW] desires to protect and enhance the quality and quantity of aquatic habitats."

The subject of this report is a segment of Beaver Creek beginning at Douglas Gulch and extending downstream to Patton Canyon. The proposed segment is located north of the Town of Florence. The instream flow recommendation for this segment is discussed below.

Instream Flow Recommendation(s)

The CDOW is recommending 10.5 cfs, summer, and 6.6 cfs, winter, based on their data collection efforts. This recommendation is based on the physical and biological data collected to date and does not incorporate any water availability constraints.

- 10.5 cubic feet per second is required to maintain the three principal hydraulic criteria of average depth, average velocity and percent wetted perimeter;
- 6.6 cubic feet per second is required to maintain two of the three principal hydraulic criteria.

The modeling results from this survey effort are within the confidence interval produced by the R2CROSS model (see Table 1).

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Douglas Gulch	East Beaver Creek	6.5	0%	100%
East Beaver Creek	Patton Canyon	7.5	20%	80%

100% of the public lands are managed by the BLM and CDOW.

Biological and Field Survey Data

The CDOW, in 2003, 2006 and 2009, collected stream cross section information, natural environment data, and other data needed to quantify the instream flow needs for this reach of the Beaver Creek. Beaver Creek is classified as a large stream (between 36 to 59 feet wide) and fishery surveys indicate the stream environment of the Beaver Creek supports rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*) and white sucker (Catostomus commerson) (See CDOW Fish Survey in Appendix B).

Field Survey Data

CDOW 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. Appendix B contains copies of field data collected for this proposed segment.

Biological Flow Recommendation

The Board staff relies upon the biological expertise of the cooperating agencies 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. The CDOW 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, five 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, 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.

Table 1: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
DOW	10/20/09	11.5	28.6 – 4.6	4.8	4.6
DOW	10/28/03	7.8	18.0 – 2.9	7.8	7.2
DOW	10/28/03	7.2	17.9 – 2.9	15.0	7.4
DOW	10/28/03	7.2	17.9 – 2.9	14.3	12.3
DOW	06/06/06	3.5	8.7 – 1.4	17.8[R]	1.5

DOW = Division of Wildlife R = Outside of R2X Accuracy Range

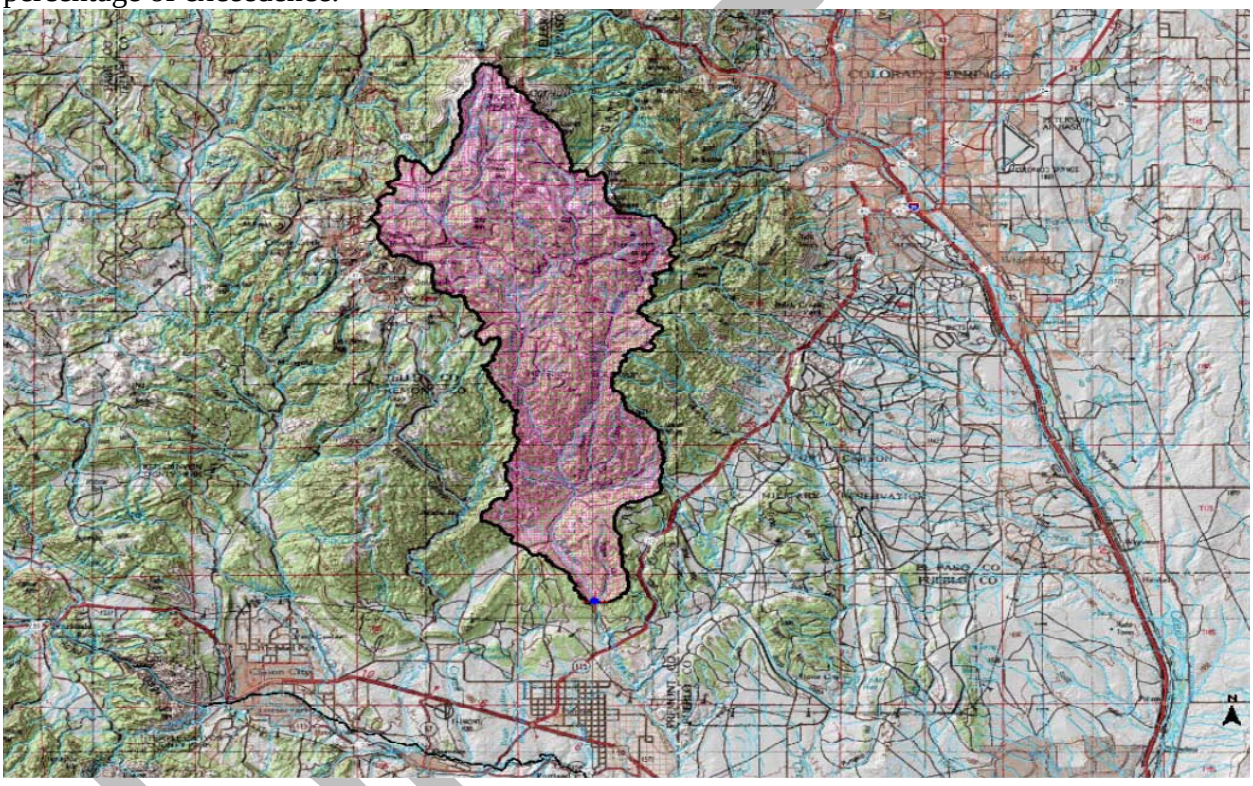
Biologic Flow Recommendation

The summer flow recommendations which met 3 of 3 hydraulic criteria and that were within the accuracy range of the model ranged from 15.0 cfs to 4.8 cfs. Averaging the summer flow recommendations that fell within the accuracy range of the R2CROSS model resulted in a summer flow recommendation of 10.5 cfs. The winter flow recommendations which met 2 of 3 hydraulic criteria and that were within the accuracy range of the model ranged from 12.3 cfs to 1.5 cfs. Averaging the winter flow recommendations that fell within the accuracy range of the R2CROSS model resulted in a winter flow recommendation of 6.6 cfs (See Table 1).

Hydrologic Data

The CDOW staff conducted a preliminary evaluation of the stream hydrology to determine if water was physically available for an instream flow appropriation. The hydrograph below was derived from data collected by the USGS stream gage for Beaver Creek above upper Beaver Creek cemetery near Penrose, CO (#07099050), which has a drainage area of 122 square miles

(See Gage Summary in Appendix C) and by the USGS StreamStats Water Resources Web Application Program (see http://water.usgs.gov/osw/streamstats/index.html). The total drainage area upstream of these ISF segments is 122 square miles (upstream of Patton Canyon) and 78 square miles (upstream of East Beaver Creek). The period of record for the Beaver Creek gage was 1991 – 2005 (March through November only), the period of record used by staff in their analysis was 1991 -2005, or 15 years of record. Table 2 below displays the estimated flow of Beaver Creek at the lower terminus of the upper and lower instream flow reaches in terms of a percentage of exceedence.



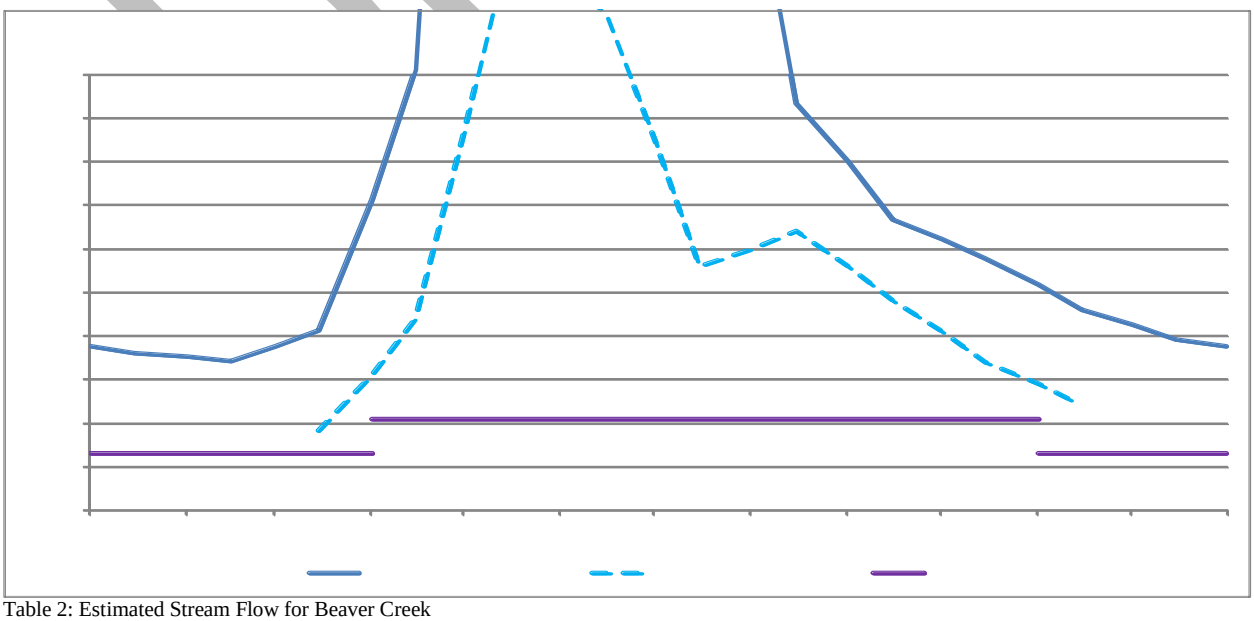


Table 2: Estimated Stream Flow for Beaver Creek

Beaver Creek				Drainage Area = 122								
Exceedences	January	February	March	April	May	June	July	August	September	October	November	December
1%	0.0	0.0	49.0	113.5	476.4	454.0	219.1	316.6	93.0	34.0	26.9	0.0
5%	0.0	0.0	23.6	93.0	379.8	286.0	150.8	138.0	71.5	32.0	23.0	0.0
10%	0.0	0.0	18.0	74.0	284.5	235.0	80.5	104.5	52.0	27.0	20.0	0.0
20%	0.0	0.0	15.0	49.0	140.0	125.0	56.0	77.0	38.0	24.0	16.0	0.0
50%	0.0	0.0	9.2	22.0	65.0	57.0	28.0	32.0	24.0	17.0	12.0	0.0
80%	0.0	0.0	6.6	12.0	30.0	22.0	16.0	13.0	12.0	9.1	7.4	0.0
90%	0.0	0.0	5.3	8.9	12.0	15.0	12.0	8.7	9.2	6.9	2.8	0.0
95%	0.0	0.0	4.6	6.6	6.1	4.7	4.3	2.8	1.6	1.6	1.6	0.0
99%	0.0	0.0	3.2	3.8	3.5	2.4	2.8	1.3	0.9	1.0	1.5	0.0

Beaver Creek Upstream of East Beaver Creek				Drainage Area = 78								
Exceedences	January	February	March	April	May	June	July	August	September	October	November	December
1%	0.0	0.0	31.3	72.6	304.6	290.3	140.1	202.4	59.5	21.7	17.2	0.0
5%	0.0	0.0	15.1	59.5	242.8	182.9	96.4	88.2	45.7	20.5	14.7	0.0
10%	0.0	0.0	11.5	47.3	181.9	150.2	51.5	66.8	33.2	17.3	12.8	0.0
20%	0.0	0.0	9.6	31.3	89.5	79.9	35.8	49.2	24.3	15.3	10.2	0.0
50%	0.0	0.0	5.9	14.1	41.6	36.4	17.9	20.5	15.3	10.9	7.7	0.0
80%	0.0	0.0	4.2	7.7	19.2	14.1	10.2	8.3	7.7	5.8	4.7	0.0
90%	0.0	0.0	3.4	5.7	7.7	9.6	7.7	5.5	5.9	4.4	1.8	0.0
95%	0.0	0.0	2.9	4.2	3.9	3.0	2.7	1.8	1.0	1.0	1.0	0.0
99%	0.0	0.0	2.0	2.4	2.2	1.5	1.8	0.8	0.5	0.7	1.0	0.0

Beaver Creek - Streamstats Mean Flow				Drainage Area = 122								
	January	February	March	April	May	June	July	August	September	October	November	December
	18.1	17.1	20.7	50.6	227.0	329.0	103.0	46.7	33.4	28.9	23.0	19.6

Green indicates flow greater than summer flow recommendation and Yellow indicates flow greater than winter flow recommendation

Beaver Creek u/s of East Beaver Creek - Streamstats Mea				Drainage Area = 78								
	January	February	March	April	May	June	July	August	September	October	November	December
	10.8	10.2	12.0	28.4	141.0	220.0	69.7	31.2	21.4	18.1	14.2	11.8

Green indicates flow greater than summer flow recommendation and Yellow indicates flow greater than winter flow recommendation

East Beaver Creek - Streamstats Mean Flow				Drainage Area = 25.6								
	January	February	March	April	May	June	July	August	September	October	November	December
	3.7	3.5	3.9	8.5	52.7	94.2	30.0	13.1	8.3	6.7	5.1	4.1

Green indicates flow greater than summer flow recommendation and Yellow indicates flow greater than winter flow recommendation

Table 2 shows that the summer flow recommendation of 10.5 cfs is available at least 50% of the time for the months of April through October. The estimated winter flow recommendation of 6.6 cfs is not available at least 50% of the time from November through March and was reduced to 6.0 cfs. After incorporating the above water availability constraints, the original instream flow recommendation was modified to the following:

- 10.5 cubic feet per second is recommended from April 1 through October 31;
- 6.0 cubic feet per second is recommended from November 1 through March 31.

However, if additional water is determined to be available in further investigations, the CDOW would recommend appropriating the additional water up to the recommended flow amounts to preserve the natural environment to a reasonable degree.

Precipitation Data

CDOW staff identified 4 local precipitation data sets located near the Beaver Creek Drainage: Victor, Fort Carson Butts AAF, Canon City and Penrose 3 NNW (see Precipitation Data in Appendix C).

Existing Water Right Information

CDOW staff has analyzed the water rights tabulation and will consult with the Division Engineer's Office (DEO) to identify any potential water availability problems due to existing diversions. Records indicate that there are several CDOW surface water diversions that are located within this reach.