Stream: Bent Creek

Executive Summary

Water Division: 4
Water District: 62
CDOW#: 39358
CWCB ID: 09/4/A-005

Segment: Headwaters to the Confluence with Lake Fork of Gunnison River

Upper Terminus: HEADWATERS IN THE VICINTY OF
(Latitude 37° 56’ 23.0”N) (Longitude 107° 24’ 30.8”W)

Lower Terminus: CONFLUENCE WITH LAKE FORK OF GUNNISON RIVER
(Latitude 37° 54’ 22.4”N) (Longitude 107° 22’ 46.3”W)

Watershed: Upper Gunnison (HUC#: 14020002)
Counties: Hinsdale
Length: 3.0 miles
USGS Quad(s): Redcloud Peak
Existing ISF: 4-80CW101; 2 cfs (1/1-12/31)
Flow Recommendation: 1.55 cfs (April 1 to October 31)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated instream flow file folder 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 Bent Creek to the CWCB for an increased water right under the Instream Flow Program. Bent Creek is being considered for an increase because it has a natural environment that can be preserved to a reasonable degree with an increased instream flow water right.

Bent Creek is 3.0 miles long. It begins on the east flank of Redcloud Peak at an elevation of approximately 12,120 feet and terminates at the confluence with Lake Fork of the Gunnison River at an elevation of approximately 9,380 feet. One hundred percent of the land along the 3.0-mile segment addressed by this report is publicly owned. The total drainage area of the creek is approximately 5.2 square miles. Bent Creek is located within Hinsdale County and generally flows in a southeasterly direction.

The subject of this report is a segment of Bent Creek beginning at the headwaters and extending to the confluence with the Lake Fork of the Gunnison River. The proposed segment is located approximately 11 miles southwest of Lake City. The staff has received only one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Instream Flow Recommendation(s)

The BLM recommended 1.55 cfs April 15 – October 31 based on its data collection efforts. The summer modeling results from this survey effort are within the confidence interval produced by the R2Cross model.

Justification for Instream Flow Increase

The BLM was prompted to re-examine the instream flow on Bent Creek because of the BLM water quality management objectives in the Henson Creek and Lake Fork watersheds. Both of these stream systems are affected by historic mining activities, and the BLM has begun to initiate projects to treat and minimize acid mine runoff and heavy metals contamination. Within these watersheds, streams that are presently able to support fish are extraordinarily valuable for the habitat they provide and for their ability to dilute runoff originating in more contaminated parts of the watershed. Finally, this creek is located along the very heavily used Alpine Loop

backcountry byway. Users of the byway seek opportunities to fish and camp along the uncontaminated streams within these watersheds.

The BLM's cross section analysis revealed that the current instream flow rate is not fully protective for several reasons. First, in locations where the stream widens out and is capable of providing significant riffle and physical habitat, the current 2.0 cfs water right provides an average of only 0.7 feet per second velocity, which is under the velocity preferred by salmonids. At 2.0 cfs, a very high percent of the usable habitat would not be at preferred velocities for salmonids in a situation where usable habitat is at a premium. Protecting flows necessary to meet the velocity criteria would result in an average of 75% wetted perimeter, which is a significant advantage in a high gradient stream with limited physical habitat. The BLM's conclusion is that it is prudent to protect a higher flow rate that is capable of making most of the limited physical habitat available for the fish population.

The BLM also believes that Bent Creek is capable of providing nursery habitat for the Lake Fork of the Gunnison. The BLM plans to undertake further investigations as to why our fish sampling resulted in few fish captured, when the creek appears to have excellent water quality, food sources, and pools. It is highly likely that some very modest management actions, such as restocking or removal of small barriers, would result in a robust fish population.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Headwaters	Confl.w/ Lake Fork of Gunnison River	3.0	0%	100%

100% of the public lands are owned by the BLM.

Biological Data

Overall, Bent Creek is a very high gradient stream with large substrate size. Most of the creek is confined by steep canyons and supports a spruce-fir riparian community. Near the confluence with Lake Fork, the valley widens and the gradient decreases somewhat. In this section, the stream widens slightly, and an extensive willow riparian community is present. The creek supports a healthy and diverse aquatic insect community, including caddisfly, stonefly, and mayfly. Fishery surveys indicate that the creek supports brook trout and rainbow trout.

Field Survey Data

The 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 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, 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.

Table 1: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
BLM	10/11/2007	2.44	6.1 – 1.0	2.96	Out of range
BLM	10/11/2007	2.52	6.3 – 1.0	4.15	Out of range

BLM = Bureau of Land Management

The summer flow, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model is 3.55 cfs. This flow was derived by averaging the results of the two data sets. The recommended flow of 1.55 cfs when added to the existing ISF of 2 cfs equals 3.55cfs. It is our belief that 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.

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. Of course, the measured stream flow need not be the end point of interest; indeed, when looking at issues of water use to extinction stream flow measurements

may only describe intermediate steps in the complex accounting process that is a water balance carried out to a net value of zero.

In its analysis, CWCB staff has attempted to use this idea of balancing inputs and losses to determine if water is available for the recommended Instream Flow Appropriation. Of course, this analysis must be a practical exercise rather than a lengthy, and costly, scientific investigation. As a result, staff has simplified the process by lumping together some variables and employing certain rational and scientifically supportable assumptions. The process may be described through the following description of the steps used to complete the evaluation for this particular stream.

The first step required in determining water availability is a determination of the hydrologic regime at the Lower Terminus (LT) of the recommended ISF reach. In the best case this means looking at the data from a gage at the LT. Further, this data, in the best case, has been collected for a long period of time (the longer the better) including wet and dry periods. In the case of **Bent Creek** no such gage is available at the LT. In fact, there is no gage on Bent Creek. It is thus necessary to describe the normal flow regime at Bent Creek above the LT through a "representative" gage station. The gage station selected for this purpose was MINERAL CREEK ABOVE SILVERTON, CO (USGS 09358900), a gage with a 7 year period of record (POR) collected between 1968 and 1975. The gage is at an elevation of 9,980 ft above mean sea level (amsl) and has a drainage area of 11 mi^2. The hydrograph (plot of discharge over time) produced from this gage includes the effects of two upstream transbasin diversions. These diversions were 100% consumptive to the basin because of their transbasin character. To make the measured data from Mineral Creek transferrable to Bent Creek above the LT, these diversions were added back to the measured Mineral Creek hydrograph. The resulting "adjusted" hydrograph could then be used on Bent Creek above the LT by multiplying the "adjusted" hydrograph by an area ratio; specifically, the area of Bent Creek above the LT (5.24 mi^2 above the LT) to Mineral Creek above Silverton, CO (11 mi^2 above the gage). Next, the resulting proportioned "adjusted" hydrograph was itself "adjusted" (decreased) to reflect the existing depletions on Bent Creek above the LT resulting from upstream consumptive irrigation uses. The final hydrograph thus represents a distribution of flow over time that has been reduced to reflect existing human uses.

{The Following discussion is based upon the US Geological Survey's *Techniques of Water-Resources Investigations* Series, *Book 4: Hydrologic Analysis and Interpretation, Chapter A3: Statistical Methods in Water Resources* (Chapter 3: Describing Uncertainty) by D.R. Helsel and R. M. Hirsch. This technical reference provides the scientific background and guidance important to the systematic interpretation of hydrologic data. The document is available online and is a valuable aid to understanding and interpreting the analyses described here.}

The next step in producing a representation of the discharge at Bent Creek is to compute the Geometric Mean of the area-prorated "adjusted" data values from the Mineral Creek above Silverton, CO hydrograph. This step is of value because of the inherent statistical weaknesses found in any collection of data intended to measure natural stream discharge. Without getting into the details of statistical theory, it is worth noting that a set of discharge measurements is inherently inaccurate, no matter how well collected, due to the difficulties attendant to data collection, especially hydrologic data. In this particular case, the short period of record lends

even greater merit to the use of this statistical tool. To give deference to this fact and to increase the value of the hydrograph product of this analysis, the Geometric Means of the data were computed and plotted along with the 95% Confidence Intervals about the data. The resultant hydrograph, including recommended Instream Flow values, is displayed in figure 1 with an enlargement displayed in figure 2. The data displayed in this hydrograph follow in Table 1.

Fig. 1. Geometric Mean Daily Q Bent Cr (prop on Mineral Cr adjusted for irr), Adjusted for Irr, & ISFs

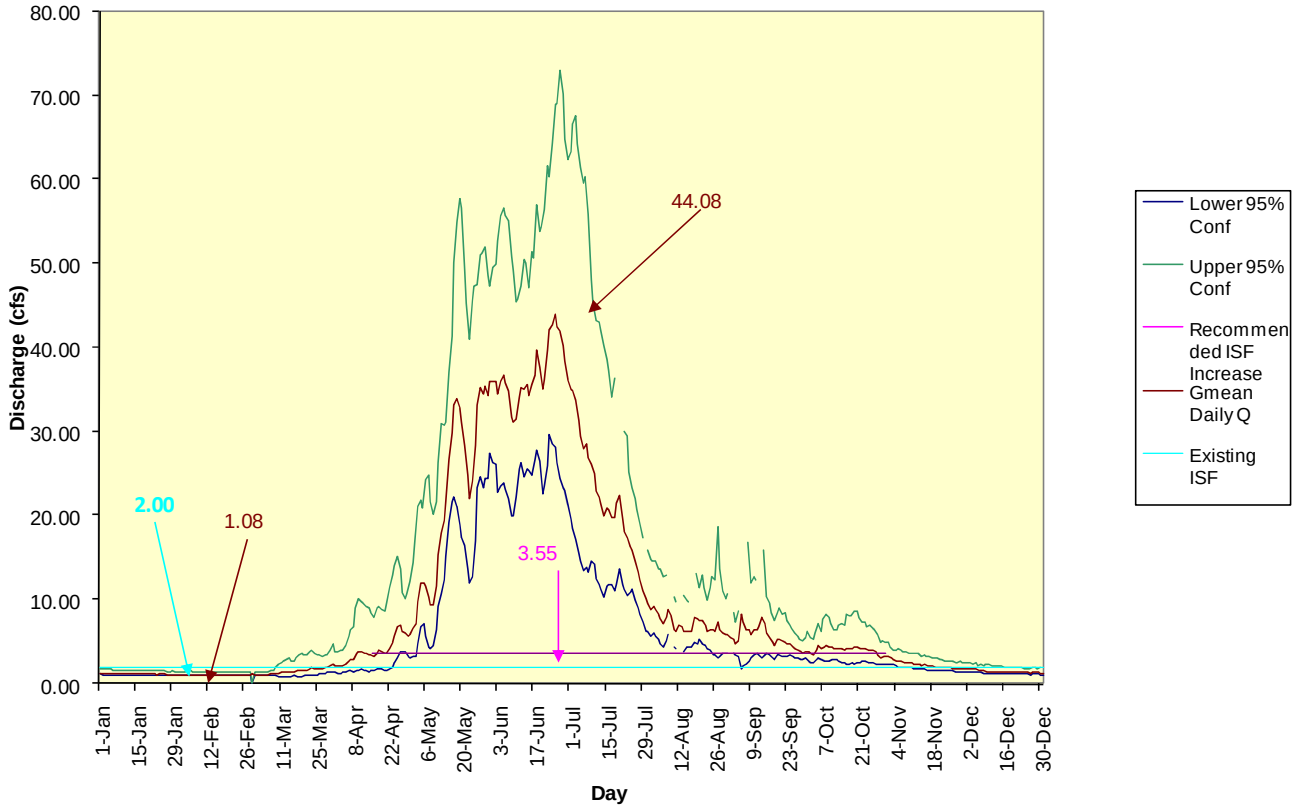


Fig 2. Geometric Mean Daily Q Bent Cr (prop on Mineral Cr adjusted for irr), Adjusted for Irr, & ISFs

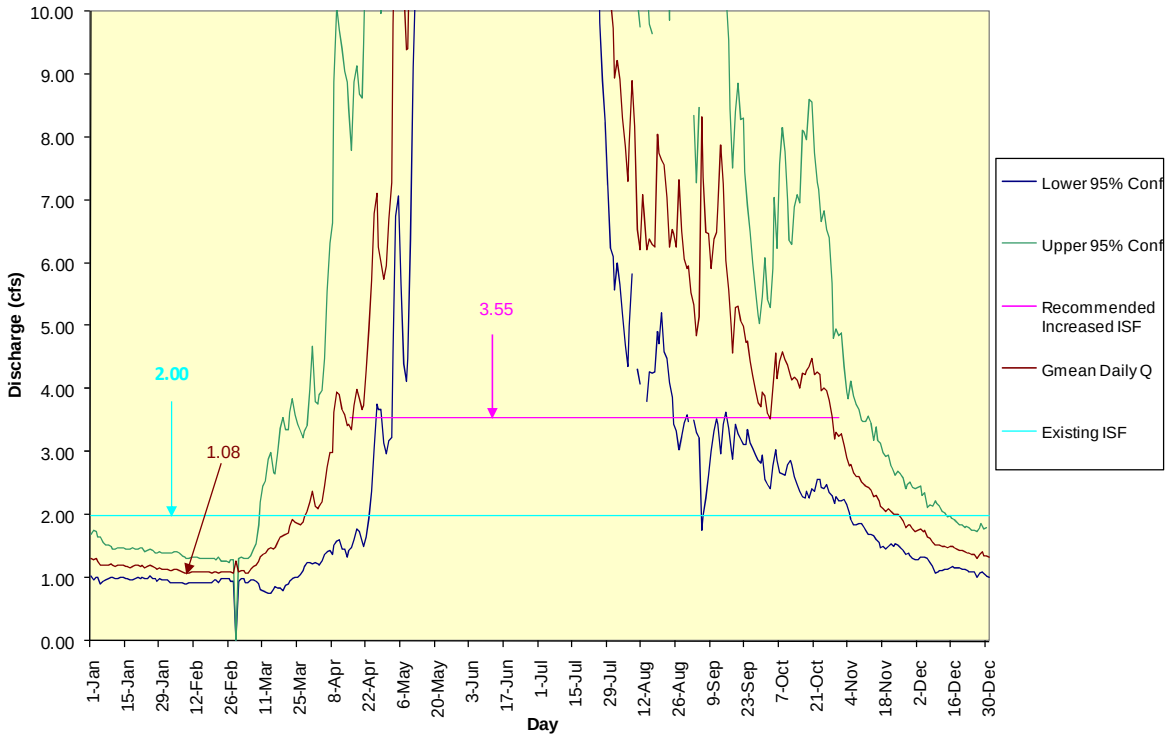


Table 1. Geometric Mean Discharge, Existing and Recommended Instream Flows

Date	Proportioned Adjusted GM (abv gage) Adj (-) for Irr & OoB in Bent Cr abv LT	Existing ISFs	Recommended Increases in ISF (cfs)	Recommended Total ISF
1-Jan	1.323518269	2.00		
2-Jan	1.293061127	2.00		
3-Jan	1.314778953	2.00		
4-Jan	1.284403075	2.00		
5-Jan	1.215568703	2.00		
6-Jan	1.215905315	2.00		
7-Jan	1.203168934	2.00		
8-Jan	1.216981341	2.00		
9-Jan	1.227868382	2.00		
10-Jan	1.203921275	2.00		
11-Jan	1.188609442	2.00		
12-Jan	1.207127019	2.00		
13-Jan	1.21545591	2.00		
14-Jan	1.215175958	2.00		
15-Jan	1.195426443	2.00		
16-Jan	1.187508318	2.00		
17-Jan	1.178741095	2.00		
18-Jan	1.19181111	2.00		

19-Jan	1.202587526	2.00
20-Jan	1.203297158	2.00
21-Jan	1.200416049	2.00
22-Jan	1.208528445	2.00
23-Jan	1.169805317	2.00
24-Jan	1.183509529	2.00
25-Jan	1.218514414	2.00
26-Jan	1.190079903	2.00
27-Jan	1.166489103	2.00
28-Jan	1.148310417	2.00
29-Jan	1.171688353	2.00
30-Jan	1.150714129	2.00
31-Jan	1.151424447	2.00
1-Feb	1.149690358	2.00
2-Feb	1.133737076	2.00
3-Feb	1.125708402	2.00
4-Feb	1.138354515	2.00
5-Feb	1.14352928	2.00
6-Feb	1.126710817	2.00
7-Feb	1.110662794	2.00
8-Feb	1.090633839	2.00
9-Feb	1.083729983	2.00
10-Feb	1.09095613	2.00
11-Feb	1.09790602	2.00
12-Feb	1.105661135	2.00
13-Feb	1.106267642	2.00
14-Feb	1.100287201	2.00
15-Feb	1.100287201	2.00
16-Feb	1.094585618	2.00
17-Feb	1.094585618	2.00
18-Feb	1.094585618	2.00
19-Feb	1.094102356	2.00
20-Feb	1.110346508	2.00
21-Feb	1.111958055	2.00
22-Feb	1.092252444	2.00
23-Feb	1.108563213	2.00
24-Feb	1.107988529	2.00
25-Feb	1.107754233	2.00
26-Feb	1.101020565	2.00
27-Feb	1.096101115	2.00
28-Feb	1.089976878	2.00
29-Feb	1.28628	2.00
1-Mar	1.110064802	2.00
2-Mar	1.13700233	2.00
3-Mar	1.133459424	2.00
4-Mar	1.093285047	2.00
5-Mar	1.09406364	2.00
6-Mar	1.14187702	2.00
7-Mar	1.180741017	2.00
8-Mar	1.208063249	2.00

9-Mar	1.280687421	2.00		
10-Mar	1.337604595	2.00		
11-Mar	1.391622962	2.00		
12-Mar	1.402460051	2.00		
13-Mar	1.47114586	2.00		
14-Mar	1.484268199	2.00		
15-Mar	1.47523697	2.00		
16-Mar	1.494648693	2.00		
17-Mar	1.58089525	2.00		
18-Mar	1.668054144	2.00		
19-Mar	1.679620121	2.00		
20-Mar	1.703455923	2.00		
21-Mar	1.723698349	2.00		
22-Mar	1.839776944	2.00		
23-Mar	1.937832994	2.00		
24-Mar	1.888251406	2.00		
25-Mar	1.863508049	2.00		
26-Mar	1.860716225	2.00		
27-Mar	1.896542693	2.00		
28-Mar	1.976645933	2.00		
29-Mar	2.054558495	2.00		
30-Mar	2.219008513	2.00		
31-Mar	2.386719046	2.00		
1-Apr	2.143146692	2.00		
2-Apr	2.11446306	2.00		
3-Apr	2.153395826	2.00		
4-Apr	2.21936666	2.00		
5-Apr	2.460319146	2.00		
6-Apr	2.776182482	2.00		
7-Apr	2.996560153	2.00		
8-Apr	2.996105106	2.00		
9-Apr	3.652897139	2.00		
10-Apr	3.95818399	2.00		
11-Apr	3.916092916	2.00		
12-Apr	3.681664098	2.00		
13-Apr	3.598215363	2.00		
14-Apr	3.41989311	2.00		
15-Apr	3.452428385	2.00	1.55	3.55
16-Apr	3.371833296	2.00	1.55	3.55
17-Apr	3.743535466	2.00	1.55	3.55
18-Apr	4.003519736	2.00	1.55	3.55
19-Apr	3.860898971	2.00	1.55	3.55
20-Apr	3.681381676	2.00	1.55	3.55
21-Apr	3.749196058	2.00	1.55	3.55
22-Apr	4.313122956	2.00	1.55	3.55
23-Apr	4.97237098	2.00	1.55	3.55
24-Apr	5.733390425	2.00	1.55	3.55
25-Apr	6.800345399	2.00	1.55	3.55
26-Apr	7.12603497	2.00	1.55	3.55
27-Apr	6.256229322	2.00	1.55	3.55

28-Apr	6.032843602	2.00	1.55	3.55
29-Apr	5.761401466	2.00	1.55	3.55
30-Apr	5.969967319	2.00	1.55	3.55
1-May	6.724465456	2.00	1.55	3.55
2-May	7.294026427	2.00	1.55	3.55
3-May	9.800339848	2.00	1.55	3.55
4-May	12.07375419	2.00	1.55	3.55
5-May	12.08366395	2.00	1.55	3.55
6-May	11.64449952	2.00	1.55	3.55
7-May	10.37374945	2.00	1.55	3.55
8-May	9.40838623	2.00	1.55	3.55
9-May	9.423570384	2.00	1.55	3.55
10-May	11.71082959	2.00	1.55	3.55
11-May	15.4050769	2.00	1.55	3.55
12-May	18.04227206	2.00	1.55	3.55
13-May	19.52441198	2.00	1.55	3.55
14-May	21.69324714	2.00	1.55	3.55
15-May	26.73375382	2.00	1.55	3.55
16-May	29.95176631	2.00	1.55	3.55
17-May	33.3208721	2.00	1.55	3.55
18-May	33.97685207	2.00	1.55	3.55
19-May	32.95933379	2.00	1.55	3.55
20-May	31.28755394	2.00	1.55	3.55
21-May	28.42247428	2.00	1.55	3.55
22-May	24.83693029	2.00	1.55	3.55
23-May	22.0916281	2.00	1.55	3.55
24-May	24.07251513	2.00	1.55	3.55
25-May	28.41028634	2.00	1.55	3.55
26-May	33.30909175	2.00	1.55	3.55
27-May	35.41251423	2.00	1.55	3.55
28-May	34.57390282	2.00	1.55	3.55
29-May	35.55964086	2.00	1.55	3.55
30-May	34.41491172	2.00	1.55	3.55
31-May	36.08815798	2.00	1.55	3.55
1-Jun	36.08240498	2.00	1.55	3.55
2-Jun	36.09561205	2.00	1.55	3.55
3-Jun	34.56667729	2.00	1.55	3.55
4-Jun	36.10270413	2.00	1.55	3.55
5-Jun	36.76376499	2.00	1.55	3.55
6-Jun	35.79745626	2.00	1.55	3.55
7-Jun	34.87632299	2.00	1.55	3.55
8-Jun	31.74412596	2.00	1.55	3.55
9-Jun	31.20727883	2.00	1.55	3.55
10-Jun	31.66583054	2.00	1.55	3.55
11-Jun	34.21692222	2.00	1.55	3.55
12-Jun	35.24032135	2.00	1.55	3.55
13-Jun	35.186476	2.00	1.55	3.55
14-Jun	35.75396077	2.00	1.55	3.55
15-Jun	34.48309023	2.00	1.55	3.55
16-Jun	35.74498678	2.00	1.55	3.55

17-Jun	36.79436212	2.00	1.55	3.55
18-Jun	39.71083793	2.00	1.55	3.55
19-Jun	37.68907731	2.00	1.55	3.55
20-Jun	35.05112796	2.00	1.55	3.55
21-Jun	36.33061132	2.00	1.55	3.55
22-Jun	39.86021967	2.00	1.55	3.55
23-Jun	42.2565348	2.00	1.55	3.55
24-Jun	42.75714058	2.00	1.55	3.55
25-Jun	44.07784319	2.00	1.55	3.55
26-Jun	42.54507277	2.00	1.55	3.55
27-Jun	42.10041008	2.00	1.55	3.55
28-Jun	40.28082525	2.00	1.55	3.55
29-Jun	38.51775743	2.00	1.55	3.55
30-Jun	36.35198822	2.00	1.55	3.55
1-Jul	35.11477904	2.00	1.55	3.55
2-Jul	34.99009076	2.00	1.55	3.55
3-Jul	33.88869411	2.00	1.55	3.55
4-Jul	31.37807998	2.00	1.55	3.55
5-Jul	29.64368832	2.00	1.55	3.55
6-Jul	28.13796177	2.00	1.55	3.55
7-Jul	28.68827823	2.00	1.55	3.55
8-Jul	27.01838864	2.00	1.55	3.55
9-Jul	26.29354933	2.00	1.55	3.55
10-Jul	25.16646451	2.00	1.55	3.55
11-Jul	22.96868526	2.00	1.55	3.55
12-Jul	22.27411299	2.00	1.55	3.55
13-Jul	21.58454534	2.00	1.55	3.55
14-Jul	20.09621914	2.00	1.55	3.55
15-Jul	21.00997749	2.00	1.55	3.55
16-Jul	20.74255883	2.00	1.55	3.55
17-Jul	19.88092907	2.00	1.55	3.55
18-Jul	19.96967903	2.00	1.55	3.55
19-Jul	21.58738328	2.00	1.55	3.55
20-Jul	22.49150244	2.00	1.55	3.55
21-Jul	19.74400529	2.00	1.55	3.55
22-Jul	18.14250064	2.00	1.55	3.55
23-Jul	17.48288006	2.00	1.55	3.55
24-Jul	16.36569577	2.00	1.55	3.55
25-Jul	16.04310395	2.00	1.55	3.55
26-Jul	14.613216	2.00	1.55	3.55
27-Jul	13.43579089	2.00	1.55	3.55
28-Jul	12.39187498	2.00	1.55	3.55
29-Jul	11.07540604	2.00	1.55	3.55
30-Jul	10.21083138	2.00	1.55	3.55
31-Jul	9.731704765	2.00	1.55	3.55
1-Aug	8.96262827	2.00	1.55	3.55
2-Aug	9.234353823	2.00	1.55	3.55
3-Aug	8.936709553	2.00	1.55	3.55
4-Aug	8.314064073	2.00	1.55	3.55
5-Aug	7.855621091	2.00	1.55	3.55

6-Aug	7.312839676	2.00	1.55	3.55
7-Aug	7.900610451	2.00	1.55	3.55
8-Aug	8.920623489	2.00	1.55	3.55
9-Aug	8.195606467	2.00	1.55	3.55
10-Aug	6.534662441	2.00	1.55	3.55
11-Aug	6.220583652	2.00	1.55	3.55
12-Aug	7.10764617	2.00	1.55	3.55
13-Aug	6.789535152	2.00	1.55	3.55
14-Aug	6.223840906	2.00	1.55	3.55
15-Aug	6.383364882	2.00	1.55	3.55
16-Aug	6.312540906	2.00	1.55	3.55
17-Aug	6.265043711	2.00	1.55	3.55
18-Aug	8.055465521	2.00	1.55	3.55
19-Aug	7.757342225	2.00	1.55	3.55
20-Aug	7.645534021	2.00	1.55	3.55
21-Aug	7.563035341	2.00	1.55	3.55
22-Aug	7.056628165	2.00	1.55	3.55
23-Aug	6.276240935	2.00	1.55	3.55
24-Aug	6.544588442	2.00	1.55	3.55
25-Aug	6.473796359	2.00	1.55	3.55
26-Aug	6.266915835	2.00	1.55	3.55
27-Aug	7.32911915	2.00	1.55	3.55
28-Aug	6.52094554	2.00	1.55	3.55
29-Aug	6.078997285	2.00	1.55	3.55
30-Aug	5.927472847	2.00	1.55	3.55
31-Aug	5.975960379	2.00	1.55	3.55
1-Sep	5.551552244	2.00	1.55	3.55
2-Sep	5.340802015	2.00	1.55	3.55
3-Sep	4.849914469	2.00	1.55	3.55
4-Sep	5.155591586	2.00	1.55	3.55
5-Sep	8.328201196	2.00	1.55	3.55
6-Sep	7.374655722	2.00	1.55	3.55
7-Sep	6.503150251	2.00	1.55	3.55
8-Sep	6.486748237	2.00	1.55	3.55
9-Sep	5.917488755	2.00	1.55	3.55
10-Sep	6.394743139	2.00	1.55	3.55
11-Sep	6.5039971	2.00	1.55	3.55
12-Sep	6.912364551	2.00	1.55	3.55
13-Sep	7.884110719	2.00	1.55	3.55
14-Sep	7.259830831	2.00	1.55	3.55
15-Sep	6.05223827	2.00	1.55	3.55
16-Sep	5.588076686	2.00	1.55	3.55
17-Sep	4.981961321	2.00	1.55	3.55
18-Sep	4.58683215	2.00	1.55	3.55
19-Sep	5.303020307	2.00	1.55	3.55
20-Sep	5.334863848	2.00	1.55	3.55
21-Sep	5.087295558	2.00	1.55	3.55
22-Sep	5.016447494	2.00	1.55	3.55
23-Sep	4.750048379	2.00	1.55	3.55
24-Sep	4.76496073	2.00	1.55	3.55

25-Sep	4.451237146	2.00	1.55	3.55
26-Sep	4.229084616	2.00	1.55	3.55
27-Sep	3.982268759	2.00	1.55	3.55
28-Sep	3.785531973	2.00	1.55	3.55
29-Sep	3.718182938	2.00	1.55	3.55
30-Sep	3.966839217	2.00	1.55	3.55
1-Oct	3.906974001	2.00	1.55	3.55
2-Oct	3.624221042	2.00	1.55	3.55
3-Oct	3.536710192	2.00	1.55	3.55
4-Oct	4.018929733	2.00	1.55	3.55
5-Oct	4.591616986	2.00	1.55	3.55
6-Oct	4.185242299	2.00	1.55	3.55
7-Oct	4.45573192	2.00	1.55	3.55
8-Oct	4.605190114	2.00	1.55	3.55
9-Oct	4.480759021	2.00	1.55	3.55
10-Oct	4.384148023	2.00	1.55	3.55
11-Oct	4.222457973	2.00	1.55	3.55
12-Oct	4.159068919	2.00	1.55	3.55
13-Oct	4.205200534	2.00	1.55	3.55
14-Oct	4.160963726	2.00	1.55	3.55
15-Oct	4.027098542	2.00	1.55	3.55
16-Oct	4.271136357	2.00	1.55	3.55
17-Oct	4.230911531	2.00	1.55	3.55
18-Oct	4.301136642	2.00	1.55	3.55
19-Oct	4.371067252	2.00	1.55	3.55
20-Oct	4.498883554	2.00	1.55	3.55
21-Oct	4.244437758	2.00	1.55	3.55
22-Oct	4.285746011	2.00	1.55	3.55
23-Oct	4.248720305	2.00	1.55	3.55
24-Oct	3.987937152	2.00	1.55	3.55
25-Oct	4.020815358	2.00	1.55	3.55
26-Oct	3.982987995	2.00	1.55	3.55
27-Oct	3.832834366	2.00	1.55	3.55
28-Oct	3.584082159	2.00	1.55	3.55
29-Oct	3.206471675	2.00	1.55	3.55
30-Oct	3.321675879	2.00	1.55	3.55
31-Oct	3.249084564	2.00	1.55	3.55
1-Nov	3.292625626	2.00		
2-Nov	3.116223576	2.00		
3-Nov	2.918400791	2.00		
4-Nov	2.790530736	2.00		
5-Nov	2.806376893	2.00		
6-Nov	2.672979062	2.00		
7-Nov	2.625081266	2.00		
8-Nov	2.612067063	2.00		
9-Nov	2.53935469	2.00		
10-Nov	2.49488416	2.00		
11-Nov	2.464911789	2.00		
12-Nov	2.457964093	2.00		
13-Nov	2.415504665	2.00		

14-Nov	2.293088588	2.00
15-Nov	2.329032892	2.00
16-Nov	2.228625612	2.00
17-Nov	2.150221227	2.00
18-Nov	2.117071073	2.00
19-Nov	2.05543789	2.00
20-Nov	2.102313368	2.00
21-Nov	2.056604876	2.00
22-Nov	2.027599988	2.00
23-Nov	2.013209252	2.00
24-Nov	2.022853427	2.00
25-Nov	1.972181712	2.00
26-Nov	1.91805774	2.00
27-Nov	1.811561028	2.00
28-Nov	1.849729624	2.00
29-Nov	1.845087677	2.00
30-Nov	1.779373259	2.00
1-Dec	1.749737404	2.00
2-Dec	1.760884031	2.00
3-Dec	1.797179139	2.00
4-Dec	1.745120836	2.00
5-Dec	1.756447754	2.00
6-Dec	1.666462215	2.00
7-Dec	1.629941534	2.00
8-Dec	1.581354552	2.00
9-Dec	1.528749132	2.00
10-Dec	1.539712842	2.00
11-Dec	1.530205506	2.00
12-Dec	1.500154745	2.00
13-Dec	1.507047308	2.00
14-Dec	1.495668236	2.00
15-Dec	1.51502352	2.00
16-Dec	1.508580262	2.00
17-Dec	1.489307295	2.00
18-Dec	1.466477595	2.00
19-Dec	1.449889629	2.00
20-Dec	1.448171741	2.00
21-Dec	1.424537621	2.00
22-Dec	1.411902934	2.00
23-Dec	1.400257628	2.00
24-Dec	1.382818594	2.00
25-Dec	1.375092383	2.00
26-Dec	1.320147688	2.00
27-Dec	1.382852674	2.00
28-Dec	1.425754811	2.00
29-Dec	1.370917845	2.00
30-Dec	1.352512883	2.00
31-Dec	1.333625788	2.00

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, the Freeman Ditch (8 cfs, appropriation dates 1912 & 1954). Staff has determined that water is available for an appropriation increase on Bent Creek, from the headwaters to the confluence of the Lake Fork Gunnison River, 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:

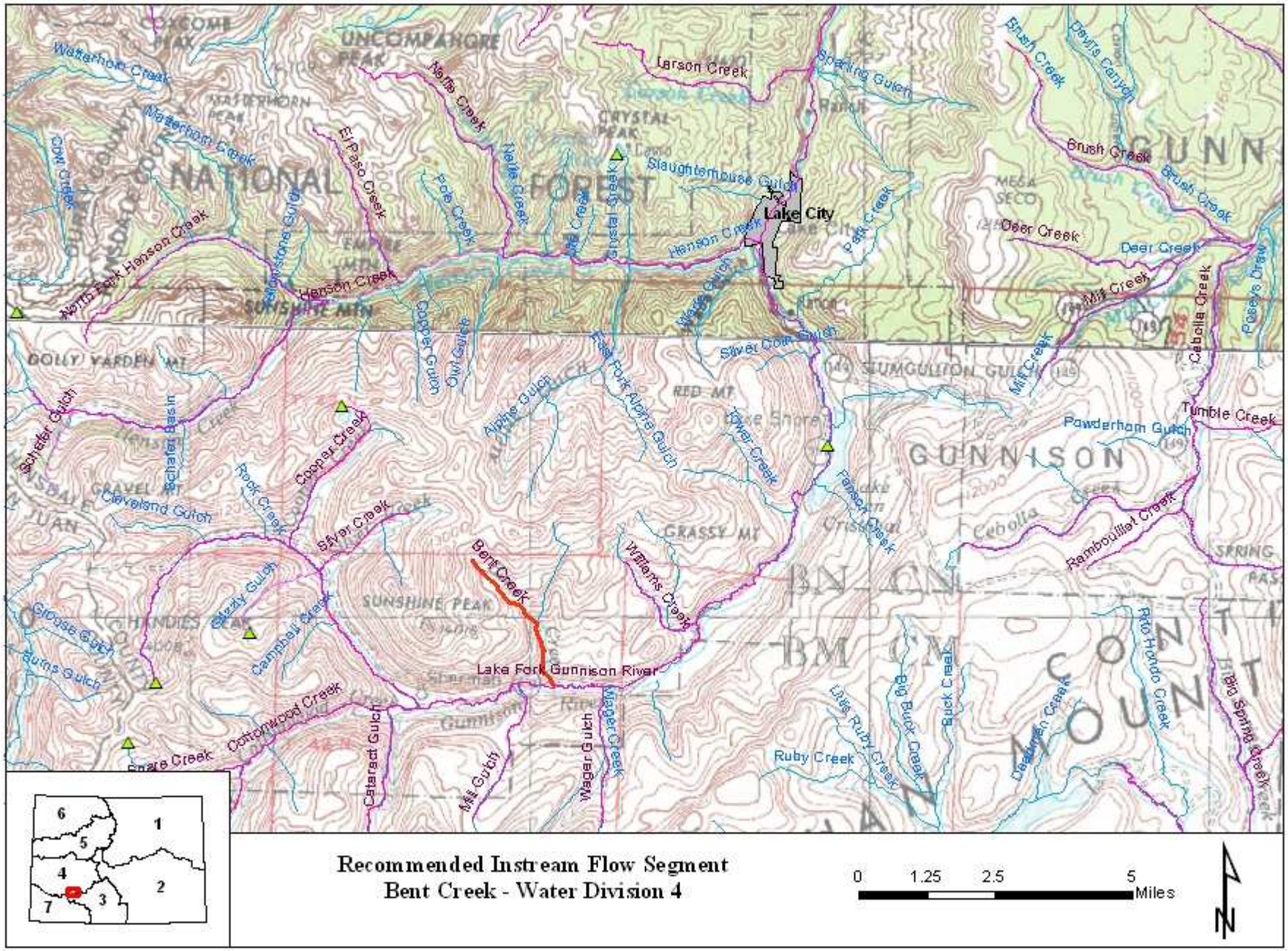
Segment: Headwaters to the Confluence with Lake Fork of Gunnison River

Upper Terminus: HEADWATERS IN THE VICINTY OF
(Latitude 37° 56' 23.0"N) (Longitude 107° 24' 30.8"W)
UTM North: 4201861.8 UTM East: 288346.5
S34 T43N R5W NMPM
1171' East of the West Section Line; 2087' North of the South Section Line

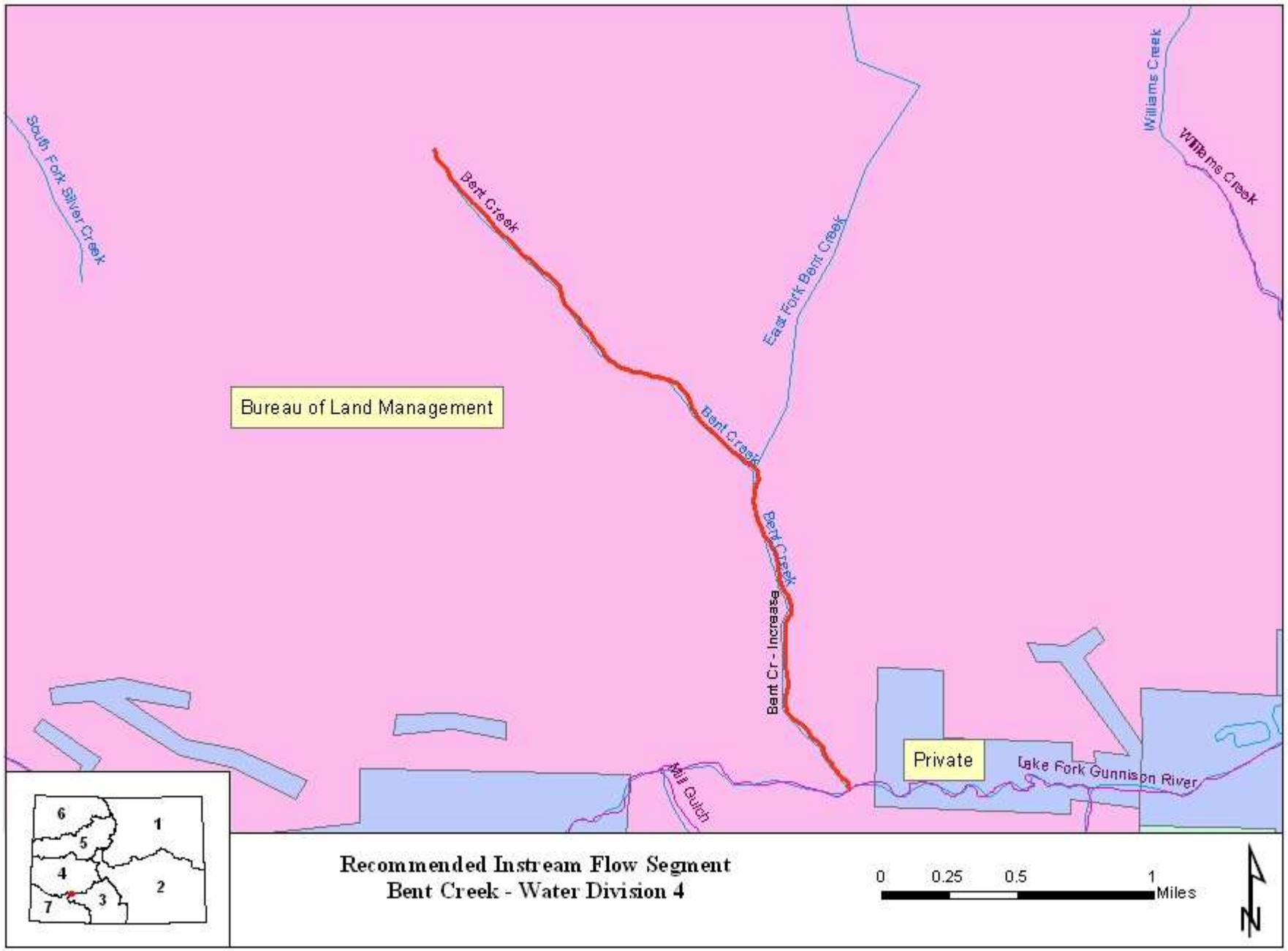
Lower Terminus: CONFLUENCE WITH LAKE FORK OF GUNNISON RIVER
(Latitude 37° 54' 22.4"N) (Longitude 107° 22' 46.3"W)
UTM North: 4198079.0 UTM East: 290803.3
S11 T42N R5W NMPM
1197 West of the East Section Line; 450' North of South Section Line

Watershed: Upper Gunnison (HUC#: 14020002)
Counties: Hinsdale
Length: 3.0 miles
USGS Quad(s): Redcloud Peak
Existing ISF: 4-80CW101; 2 cfs (1/1-12/31)
Flow Recommendation: 1.55 cfs (April 1 to October 31)

Vicinity Map



Land Use Map


South Fork Silver Creek
Bent Creek
East Fork Bent Creek
Williams Creek
Williams Creek
Bureau of Land Management
Bent Creek
Bent Creek
Bent Cr - Increase
Private
Lake Fork Gunnison River
Mill Gulch
6
1
5
4
2
7
3
Recommended Instream Flow Segment
Bent Creek - Water Division 4
0
0.25
0.5
1
Miles
N

Topographic & Water Rights Map