Applegate Group, Inc.
Water Resource Advisors for the West

Memorandum

Date:	Feburary 09, 2020	AG Job No.:	10-118
To:	Craig Ullmann, P.E.		
From:	Abdullah Javed, E.I.		
Subject:	**Possible Impact of Moving the Lost Park/Ripple Creek Water Right Downstream**		

The purpose of this memo is to summarize the potential impacts to the Yellow Jacket Water Conservancy District's ability to effectively provide augmentation water to the White River due to the proposed change in the place of storage of the Lost Park/Ripple Creek water storage right. The Yellow Jacket Water Conservancy District (YJWCD) is currently investigating the possibility of moving the decreed location of the Lost Park/Ripple Creek water storage rights (which are currently located near the upstream end of the district and so able to provide augmentation water upstream of potential calls within the District boundaries) to a location at the downstream end of the district where it would only be effective at replacing depletions to the calls below the District, specifically the Taylor Draw Power Conduit call. This move may compromise the ability of YJWCD to provide replacements to other calls, particularly the White River instream flow water right held by the Colorado Water Conservancy Board (CWCB). A point flow analysis model was created in order to assess the impact of the proposed change by comparing the potential for calls for the current "as-is" condition versus the increased potential for calls due to new potential depletions within the District.

CWCB Instream Flow Call

The most critical CWCB instream flow water right impacting water users within the YJWCD was decreed in Case No. W-3652C for 200 cfs and encompasses the White River from the confluence of the North Fork and South Fork to the confluence with Piceance Creek. It has an appropriation date of November 15, 1977, and an adjudication date of December 31, 1977. Pursuant to C.R.S. §37-92-102(3)(b), the CWCB instream flow water rights are subject to the present uses in existence at the time of their appropriation, whether or not those uses were previously confirmed by the water court. Therefore, it would only affect new users (such as junior wells) that were first placed to beneficial use in 1978 or later. At this time there is no CWCB instream flow water right on the White River below its confluence with Piceance Creek.

Model Development

A point flow analysis model was developed for the reach of White River from the "White River below Elk Creek near Buford, CO" streamflow gauge to the "White River below Boise Creek near Rangely, CO" streamflow gauge. This overall White River reach is further subdivided into three sub reaches according to other streamflow gauge locations along the river. A water balance was calculated in between each river gage within the model domain (accounting for surface diversions from ditches and inflow from major tributaries) in order to determine unmeasured gains and losses within that sub reach. This information was then used to estimate the streamflow in the White River below every diversion point.

The minimum instream flow was set to 200 cfs in the main reach of the White River from Buford CO to the confluence with Piceance Creek and a nominal 10 cfs downstream between the Piceance Creek confluence and the confluence with Boise Creek. This nominal 10 cfs amount was selected due to the lack of a decreed instream flow right on that reach. If the flow below any point in the model fell below the minimum instream flow for that reach, it was considered a day of the potential call for the current "as-is" condition.

In order to determine the importance of having augmentation water available at the upstream end of the YJWCD boundaries, we compared the number of days of the potential call for the current "as-is" condition to the increased number of potential calls that would result if new depletions from junior wells within the YJWCD boundaries were included. Based on the location of the permitted and decreed wells identified in our April 24, 2017 memorandum, they were grouped together and their depletions were lagged to the nearest river reach. For irrigation wells, the depletions were distributed in the model only during the irrigation season, i.e. from April to Oct; all other well depletions (municipal, commercial, gravel pits, etc.) were distributed uniformly across the entire year. As with the current "as-is" condition, flows below every diversion structure were compared against the minimum instream flows for that reach. A call on the river was considered active when flow on a certain day in any year is less than the minimum instream flow.

Diversion Records

Daily records of historical ditch diversions and gauged streamflow were downloaded from Colorado's Decision Support Systems[1] and the United States Geological Survey[2] website. Based on the availability of stream gage data, a 14 year simulation period was selected to develop this model, spanning from January 2003 to December 2009 and from January 2012 to December 2018. The selected simulation period includes wet, dry, and average years. The days for which the streamflow data was missing because of the icy conditions in the field were filled by taking the average for the same date over the entire study period. The upstream gage located on the White River below Elk Creek near Buford, Colorado was not operational during the first eight months of the year 2012. Since this period represented an extreme drought it was desirable to include it in the analysis. Therefore, the gage data for these months were synthesized by adding the ditch diversions and average gain/loss of the last four months of the year 2012 for both the irrigation and non-irrigation season to the next downstream gage located on the White River near Meeker, Colorado.

Well Depletions

Two shapefiles, one containing decreed wells and the other containing permitted wells, were obtained from the Colorado Division of Water Resources.[3] The decreed and permitted wells located within the boundaries of the YJWCD and which were junior to 1978 were isolated, as further described in our April 24, 2017 memorandum.

The permitted wells shapefile was filtered to only include those wells that were constructed, or that had a permit issued. Furthermore, the dataset was filtered to only include those wells permitted for commercial, industrial, irrigation, municipal, and other (gravel pit) uses; wells permitted for domestic, household use only, geothermal, etc. were excluded as we assessed such wells would likely not be curtailed by a call due to the likelihood they are exempt from administration under the priority system. A total of 50 permitted wells and 39 decreed wells were thus selected for this analysis. The decreed wells that were listed as being active were the only ones included; non-existent or inactive structures were excluded.

In order to determine the annual volume of water consumed from each of the identified wells, a two-step process was adopted: first the annual volume pumped from the well was estimated, and second an assumed consumptive use factor was applied to that pumped volume to estimate what amount would be consumed

[1] http://cdss.state.co.us/Pages/CDSSHome.aspx, accessed December 26, 2019.
[2] https://waterdata.usgs.gov/nwis/rt, accessed December 26, 2019

from the well each year. The volume consumed would equal to the depletions caused by the wells to the White River.

For the permitted wells, the type of use and yield of the well (in gpm) is typically reported in the dataset. In a few cases, the annual appropriation from the well (in acre-feet) is also reported in the dataset. The annual volume pumped from each well was set equal to the annual appropriation if this value was reported. If not, the annual volume pumped was calculated as the yield multiplied by an assumed number of days of operation per year. The assumed days of operation varied according to the type of use as shown in Table 1. For the four gravel pits that were identified, the individual permits for these wells were evaluated and the annual volume pumped set equal to the annual appropriation amount set forth in the permit. The annual consumed volume was calculated by multiplying the annual pumped volume by the consumptive use factors set forth in Table 1 for each use type.

Table 1 – Permitted Well Use Type Assumptions

Use Type	Days of Operation	Consumptive Use Factor
Commercial	90	10%
Industrial	30	10%
Irrigation	180	50%
Municipal	180	30%
Gravel Pit	n/a	100%

The annual consumptive use was then converted to a daily flow rate for input into the model. Table 2 summarizes the estimated annual consumptive use flow rate for the 50 permitted wells.

Table 2 – Permitted Wells Consumptive Use

Use Type	No. of Wells	Consumptive Use Volume [ac-ft/yr]	Consumptive Flow Rate [cfs]
Commercial	29	35.31	0.05
Industrial	5	2.16	0.003
Irrigation	8	20.59	0.23 (Apr-Oct Only)
Municipal	4	145.84	0.2
Gravel Pit	4	326.00	0.45
Total	50	529.90	0.93

For the decreed wells, the dataset defines the decreed flow rate (in cfs) for each well (totaling 5.31 cfs for 39 decreed wells). Similar to the permitted wells, the dataset was filtered to only include those wells that are decreed for commercial, industrial, irrigation, and municipal uses; wells decreed for domestic, household use only, geothermal, etc. were excluded. Annual consumptive use flow rates for the 39 decreed wells are listed in Table 3.

Table 3 – Decreed Well Subset Consumptive Use

Use Type	No. of Wells	Consumptive Use Volume [ac-ft/yr]	Consumptive Flow Rate [cfs]
Commercial	1	1.11	0.0015
Irrigation	35	922.00	1.27 (Apr-Oct Only)
Municipal	3	8.24	0.011
Total	39	931.35	1.28

Results

As shown in Table 4, the results of this modeling effort show that there were 698 days in total during the entire 14 year study period when there was a potential for an instream call on the river within the model domain for the current "as-is" condition. This corresponds to a rate of approximately 13.65%.

Table 4 – Potential Days of Call for Current Condition

Number of days in each month when call is active													
	1	2	3	4	5	6	7	8	9	10	11	12	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2003	10	5	0	0	0	0	5	31	**12**	0	0	0	63
2004	0	0	0	0	0	0	4	31	20	0	1	2	58
2005	0	0	0	0	0	0	0	6	27	0	0	2	35
2006	0	2	0	0	0	0	0	2	15	0	0	0	19
2007	0	0	0	0	0	0	8	20	22	0	2	2	54
2008	7	0	0	0	0	0	0	4	19	0	0	0	30
2009	0	0	0	0	0	0	0	**20**	18	0	0	1	39
2012	0	0	0	0	0	22	**18**	28	30	**9**	0	4	111
2013	0	0	0	0	0	2	5	21	22	0	0	3	53
2014	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	20	14	0	0	1	35
2016	0	0	0	0	0	0	0	30	22	0	0	0	52
2017	0	0	0	0	0	0	0	**15**	22	0	0	1	38
2018	2	1	1	0	0	13	21	31	30	3	2	7	111
Average	1	1	0	0	0	3	4	19	20	1	0	2	50
							Total Number of Active Call Days					698	
							Percent of Time Call is Active					13.65%	

Conclusions

In order to determine the potential impact of moving the Lost Park/Ripple Creek water rights to the downstream end of the YJWCD, a point flow analysis model was developed for the White River from its confluence with Elk Creek on the upstream end to its confluence with Boise Creek on the downstream end. All major diversion structures and gauged creeks that feed into the river were included in the model. The model determined that, given current conditions, there is a potential for an instream call within this reach approximately 13.65% of the time.

Ultimately, this analysis reveals that there is the potential for an instream flow nearly every year in August and September, which would necessitate the delivery of augmentation supplies to the upstream end of the District in order to adequately replace junior depletions. During a severe drought year like 2012, the majority of the irrigation season could potentially be subject to an instream flow water right call. If the Lost Park/Ripple Creek water rights were moved to the downstream end of the YJWCD, they would be unable to provide augmentation replacements to meet this CWCB instream flow call. The water rights would still be adequately located to provide replacements for the downstream Taylor Draw Power Conduit, which could impact the White River year round. The attached map was prepared to depict the number of potential active call days from an instream flow call during the study period for various locations throughout the ISF reach. This map shows that there are a significant number of potential days during the study period where an instream flow call could have been in effect from the Miller Creek Ditch headgate all the way to Piceance Creek.

The location of a downstream reservoir could still have significant value as it could be utilized during times when the Taylor Draw Power Conduit was calling for water but the Instream Flow call was not on. A potential future scenario could involve constructing an upstream storage vessel first and using it as the sole source of water until the need exceeded the supply. At that point a downstream reservoir could be constructed to take the pressure off the upper reservoir and reserve the upper site for instream flow calls.

Several sites in the upper basin have been evaluated in the past. The furthest upstream location was an expansion of Lake Avery or construction of a new reservoir at the Sawmill Reservoir site. Alternate locations were evaluated along the Oak Ridge Park Ditch. These sites would be filled through the ditch. During a call scenario water from the reservoir could be released to meet a portion of the irrigation needs under the ditch and allow headgate diversions to be decreased. However, meeting the ISF call at all locations in the upper reaches would require some water to be stored at Lake Avery or Sawmill Reservoir as the off channel locations would be unable to augment depletions above the Oak Ridge Park Ditch Headgate.