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M E M O R A N D U M

To: Mike Faupel, PBAC

From: Robin Nimmer

Date: July 24, 2024

Alta Project No.: 24037

Subject: **Review of PBAC's Direct Use Paradise Creek (Sub-Alternative 5) Refinement Calculations for the Water Supply Alternative Investigation**

1 Introduction

As part of the next steps for the Palouse Basin Aquifer Committee's (PBAC's) Water Supply Alternatives project investigation, PBAC investigated Moscow / University of Idaho (UI) water demand compared to Paradise Creek discharge and turbidity data to better understand the potential availability of water to meet the targeted demand at Year 0 and at Year 50. PBAC performed the investigation to determine the percentage of the target demand using actual demand and assumptions on supply-limiting factors for Paradise Creek. At PBAC's request, Alta Science and Engineering, Inc. (Alta) performed a 3rd party review of the data and calculations used in the investigation. Based on the results, we concur with the findings from the investigation that direct use of water from Paradise Creek is a limiting factor in meeting the target demand, resulting in an increased cost per acre-foot.

2 Review of Alternative 5 Refinement Investigation

PBAC provided Alta with two spreadsheets. One contains Paradise Creek discharge and turbidity data upstream of Moscow's Wastewater Treatment Plant from November 26, 2001 to September 30, 2007. Data are provided on 15-minute intervals with no missing data. This file contains calculations percentage of the target supply for Year 0 and Year 50 based on different scenarios of assumptions for limits on minimum streamflow and maximum turbidity, as well as an assumed treatment efficiency.

The second file contains average monthly demand data from 2017 to 2021 for Moscow/UI and Pullman/WSU and calculated forecasted demand to Year 50. The demand assumes 1% conservation in Years 1-15 (decreasing the demand), 1% growth each year (increasing the demand), and a constant aquifer stabilization amount proportional to each community. This file also contains calculations of the usable supply for Paradise Creek (Moscow) and South Fork (SF) Palouse River (Pullman) based on a maximum available water value taken from previous reports.

Alta reviewed the data and equations in these spreadsheets for Alternative 5. We modified a few equations as needed and provided some additional assumptions; we will provide the

updated spreadsheets to PBAC. This results in some differences in the potentially available supply and percentage of the target demand compared to the data PBAC presented this spring.

In addition to the calculation review and following the methods developed for Moscow/UI and Paradise Creek supply and demand, we attempted to conduct a similar comparison with Pullman/WSU and SF Palouse River in Pullman as another sub-alternative within Alternative 5. There is not sufficient reliable turbidity data on the SF Palouse River, but Paradise Creek turbidity data were shown to be a potential surrogate based on an analysis by PBAC. The USGS has a stream gage on the SF Palouse River downstream of Paradise Creek in Pullman. The Paradise Creek discharge data could be subtracted to estimate flows upstream of the confluence. However, there are several discharge data points missing from SF Palouse River data set; thus, the same supply/demand analysis was not investigated further at this time.

3 Results

These spreadsheets are useful tools to better understand the data. The results of varying the limiting parameters of maximum turbidity for treatment, minimum streamflow, and a treatment efficiency show the degree to which these parameters impact the usable supply and the percentage of the target.

A treatment efficiency of 95% is a reasonable assumption and was selected based on discussions with an experienced water treatment professional, but an efficiency of 60% was also evaluated for comparison purposes. Maximum turbidity values selected ranged from 80 to 200 Nephelometric Turbidity Units (NTUs). The maximum turbidity within the data set is 2,000 NTUs. Minimum discharge values selected ranged from 5 to 10 cubic feet per second (cfs).

Figures 1-4 show charts of the potential available supply from Paradise Creek using data from January through April 2002 – 2007 based on varied parameter values. Red bars on the chart represent average Moscow/UI demand from 2017 - 2021; the upper bar is for Year 50 and the lower bar is for Year 0. These bars do not include the aquifer stabilization target of 257 millions of gallons per year (MGY) for the Moscow/UI portion. Tables associated with each chart in the figures show the percentage of the target for Year 0 and Year 50.

Figure 1 displays results with only the limiting factor of a minimum stream flow of 5 cfs. There is no limit on turbidity and assumes a 100% treatment efficiency. This is not a realistic scenario but used for comparison purposes.

Figure 2 displays results with the treatment efficiency as the variable. The chart and table show this has an impact on both the available supply and the percentage of target.

Figure 3 displays results with the turbidity as the variable. A comparison of the charts shows a fairly large difference in potential available supply. However, the percentage of target was the same between the two data sets in certain years (e.g., 2006) yet in other years they were quite different (2005). The reason is the limiting factor of the demand because the population can only use a certain amount of water, regardless of a surplus in supply.

Figure 4 displays results with the creek discharge as the variable. A comparison of the charts does not show a large difference in available supply. Similar to Figure 3, the percentage of target was the same in certain years and differed in other years.

With the combination of varied limiting parameters, none of the years would have been able to supply the yearly targeted demand, even at Year 0. This is due at least in part to this sub-alternative's direct use of the treated water instead of aquifer recharge, where water would be treated and injected into the aquifer for storage and recovery when needed.

Alta applied the average useable amount of water for each supply scenario for Year 0 and Year 50 to then update the cost per acre-foot of water in Year 50 using the 2021 total present value equations in the Water Supply Alternatives (WSA) report (Alta 2022). Table 1 presents the results. Prior to the refinement investigation, the cost per acre-feet of water in the WSA report was $51,584.

Table 1. Amount of Usable Supply and Resulting Cost per Acre-Foot of Water.

Max Turbidity (NTU)	Min Stream Flow (cfs)	Treatment Efficiency	Average Amount of Usable Supply (MGY)		Cost per Acre-foot
			Year 0	Year 50	Year 50
80	10	0.6	130	157	$117,769
80	10	0.95	144	191	$96,805
200	10	0.95	178	240	$77,041
100	10	0.95	155	208	$88,893
200	5	0.95	192	258	$71,666
100	5	0.95	171	233	$79,355
2000	5	1.00	198	270	$68,480

Notes:
NTU = nephelometric turbidity unit
cfs = cubic feet per second
MGY = millions of gallons per year

4 Conclusions

PBAC's investigation into the availability of water from Paradise Creek for direct use is an informative refinement of Alternative 5. The spreadsheets are useful tools for comparing water supply with demand for the Moscow/UI Paradise Creek sub-alternative and testing different combinations of parameters that limit the supply. The actual limits of turbidity, flow, and treatment efficiency are yet to be determined but the ranges used in PBAC's investigation and in this review are reasonable and provide credible insights to availability and cost per acre-feet of water.

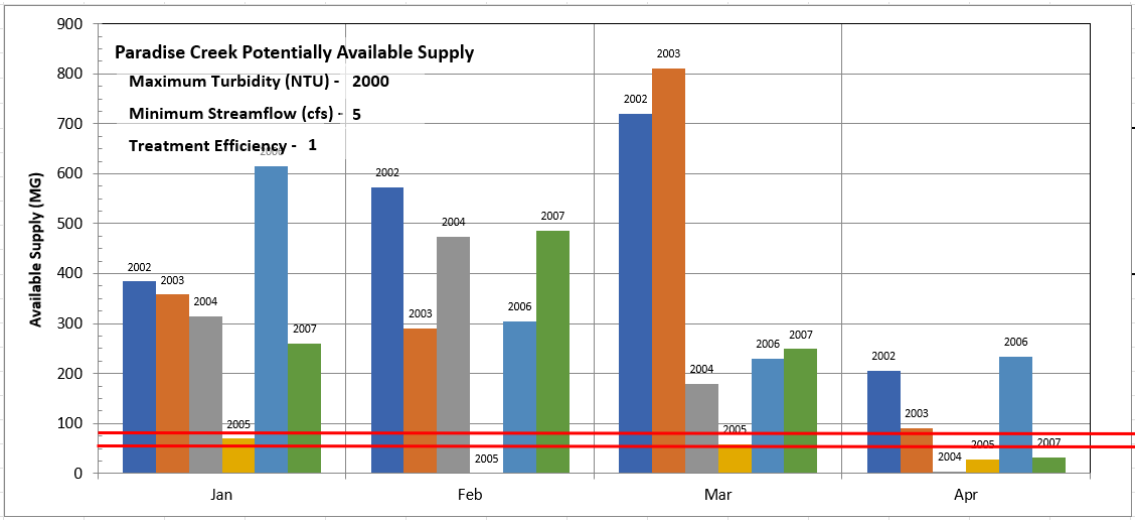
We concur with the findings of the refined investigation indicating the usable supply of water is less for direct use from Paradise Creek than represented in the WSA Report (Alta 2022). Therefore, the cost per acre-feet of water for the Moscow/UI Paradise Creek sub-alternative will be greater, calculations ranged from $71,666 - $88,893, based on reasonable assumptions. The data suggest that diversions from Paradise Creek for aquifer recharge may be more cost effective than direct use, where excess water can remain in the aquifer for storage.

Alta recommends PBAC consider similar analyses for the other sub-alternatives so that all direct use supply alternatives have the same refinement. Data gaps will be an issue because SF Palouse River (Pullman) discharge data and North Fork Palouse River (near Palouse) discharge and turbidity data have large gaps in time.

5 References

Alta Science and Engineering, Inc. (Alta), 2022. Palouse Groundwater Basin Water Supply Alternatives Report. August.

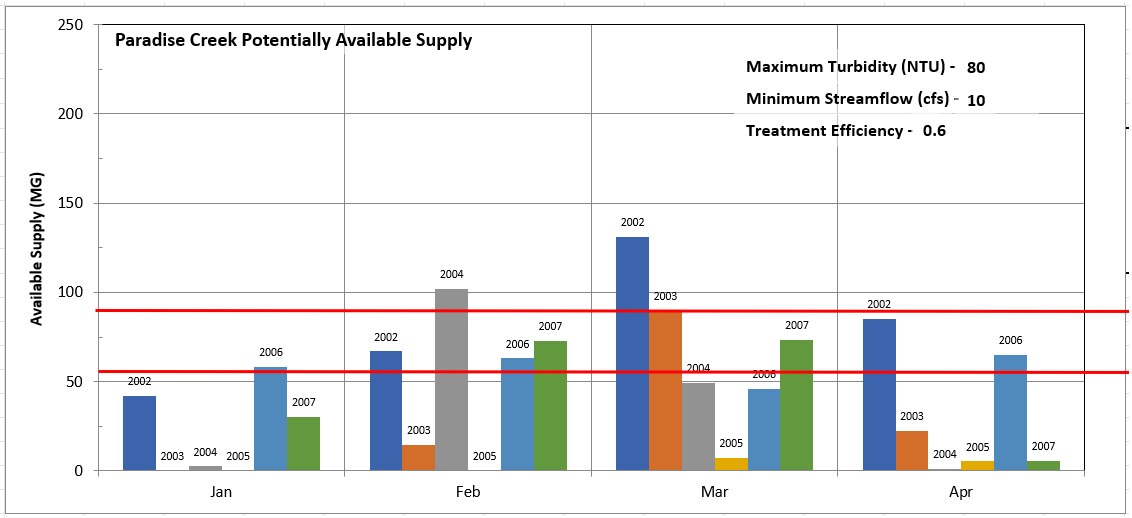
Figure 1. Paradise Creek Potential Available Supply and Percentage of Target for Moscow/UI. No Limitation on Turbidity and Treatment Efficiency is 100%.



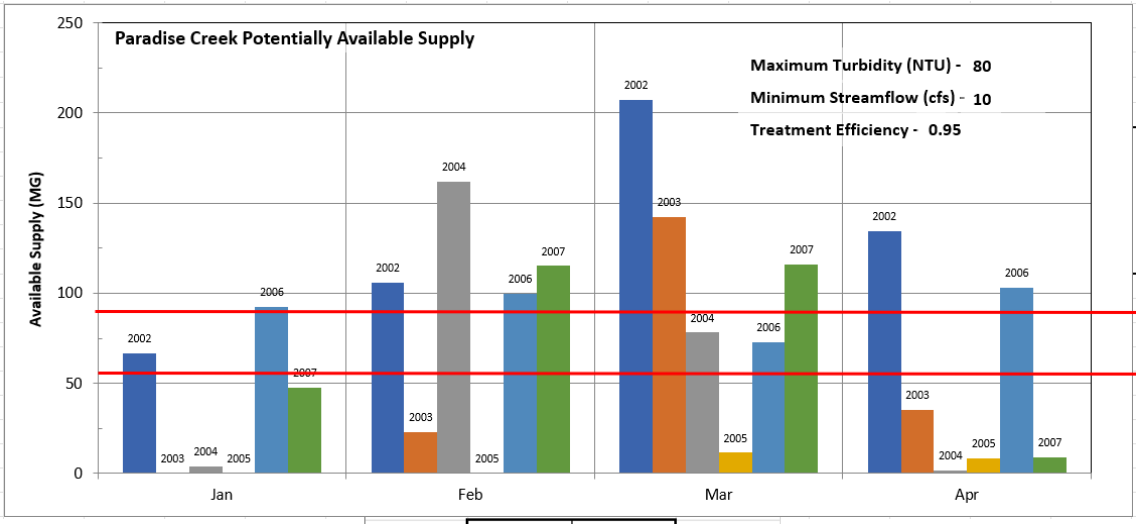
	Year 0	Year 50	
Percent of Target	81%	50%	2002
	81%	50%	2003
	62%	38%	2004
	51%	24%	2005
	81%	50%	2006
	72%	42%	2007

Red lines are average January – April 2017 – 2021 demand.
Top line is Year 50. Bottom line is Year 0.
Red lines do not include aquifer stabilization demand of 257 million gallons/year, whereas chart numbers include this.

Figure 2. Paradise Creek Potential Available Supply and Percentage of Target for Moscow/UI. Variable is treatment efficiency.



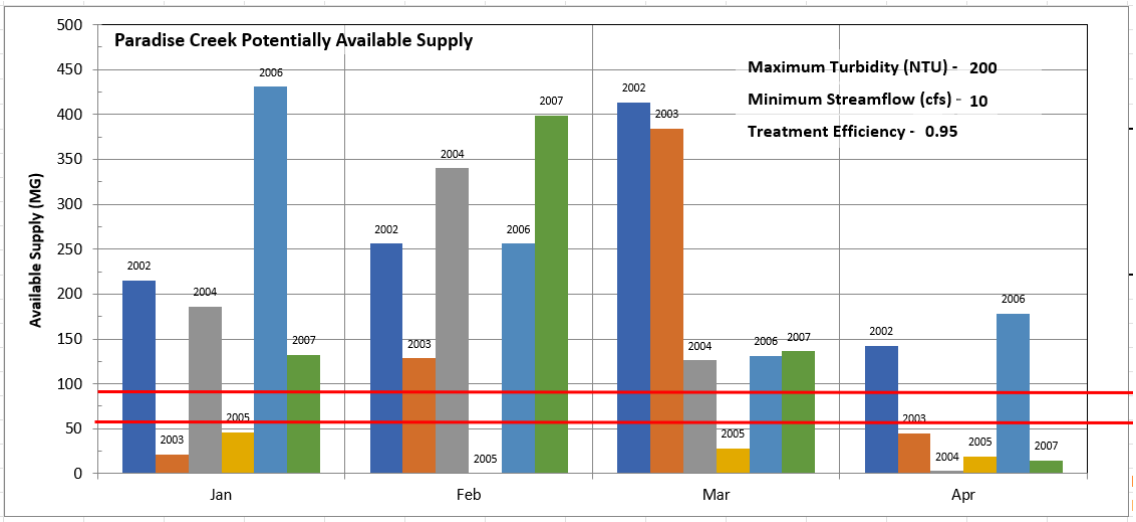
	Year 0	Year 50	
Percent of Target	75%	42%	2002
	34%	18%	2003
	38%	20%	2004
	5%	2%	2005
	77%	36%	2006
	52%	28%	2007



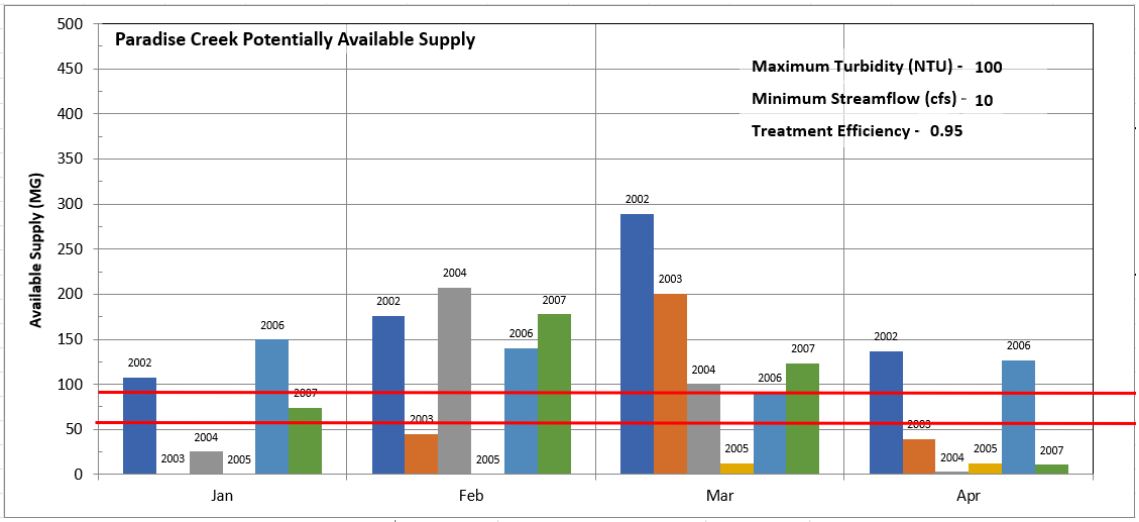
	Year 0	Year 50	
Percent of Target	81%	48%	2002
	42%	22%	2003
	42%	25%	2004
	7%	3%	2005
	81%	49%	2006
	60%	33%	2007

Red lines are average January – April 2017 – 2021 demand.
Top line is Year 50. Bottom line is Year 0.
Red lines do not include aquifer stabilization demand of 257 million gallons/year, whereas chart numbers include this.

Figure 3. Paradise Creek Potential Available Supply and Percentage of Target for Moscow/UI. Variable is turbidity.



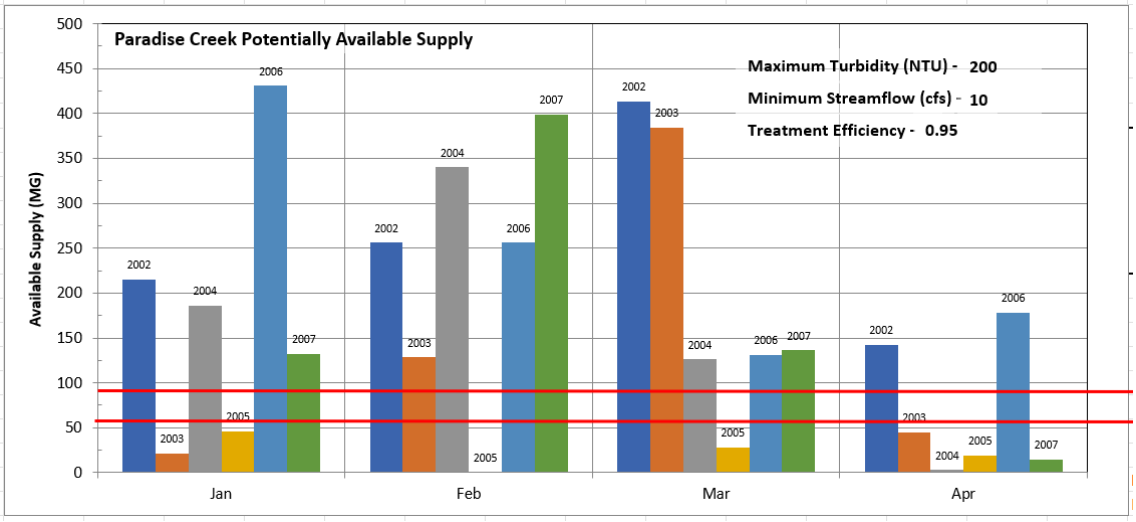
	Year 0	Year 50	
Percent of Target	81%	50%	2002
	64%	35%	2003
	61%	37%	2004
	34%	15%	2005
	81%	50%	2006
	65%	39%	2007



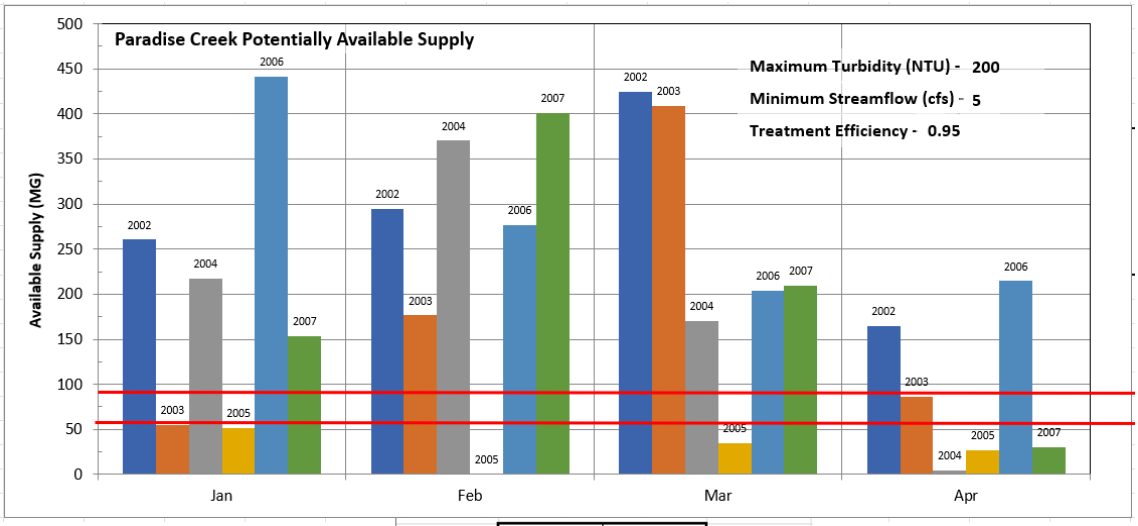
	Year 0	Year 50	
Percent of Target	81%	50%	2002
	51%	26%	2003
	50%	29%	2004
	9%	4%	2005
	81%	50%	2006
	64%	38%	2007

Red lines are average January – April 2017 – 2021 demand.
Top line is Year 50. Bottom line is Year 0.
Red lines do not include aquifer stabilization demand of 257 million gallons/year, whereas chart numbers include this.

Figure 4. Paradise Creek Potential Available Supply and Percentage of Target for Moscow/UI. Variable is stream discharge.



	Year 0	Year 50	
Percent of Target	81%	50%	2002
	64%	35%	2003
	61%	37%	2004
	34%	15%	2005
	81%	50%	2006
	65%	39%	2007



	Year 0	Year 50	
Percent of Target	81%	50%	2002
	80%	46%	2003
	62%	38%	2004
	41%	18%	2005
	81%	50%	2006
	71%	42%	2007

Red lines are average January – April 2017 – 2021 demand.
Top line is Year 50. Bottom line is Year 0.
Red lines do not include aquifer stabilization demand of 257 million gallons/year, whereas chart numbers include this.