

Memorandum

To: Eric Osterling, GKGSA Executive Director

From: Matt Klinchuch, PE

Subject: GKGSA Pumping Analysis

Date: August 14, 2022

Comments:

The following is a summary of the analysis of the estimated groundwater pumping for agriculture within the Greater Kaweah Groundwater Sustainability Agency (**GKGSA**) to have an approximate baseline when considering future pumping reductions.

Data

To estimate the agricultural groundwater pumping within the GKGSA data used in the development of the Basin Setting and Water Budget for the 2020 Groundwater Sustainability Plan (**GSP**) and following Annual Monitoring Reports (**AMR**) for the 2019 – 2021 water years was reviewed. The primary data available is the Applied Water estimate within the GSP that has estimates back to Water Year 1981 (October 1, 1980). Much of these Applied Water estimates are based from soil moisture modeling provided by Davids Engineering. This method estimates the gross water applied intending to account for irrigation efficiencies. The Davids Engineering methodology was utilized through Water Year 2020 (September 30, 2020). In Water Year 2021 (October 1, 2020 – September 30, 2021) the Kaweah Subbasin utilized data from LandIQ which reports the consumed ET value of the crop.

It should be noted that both the Davids Engineering and LandIQ data sets were inclusive of both groundwater and surface water to meet crop demand. An attempt was not made to differentiate between how much of the demand was met by groundwater and the amount met through surface water. It was assumed that crop demand is relatively consistent and that absent surface water (in dry years) the demand would have to be met with groundwater.

Analysis

The analysis took the Applied Water data available and reviewed across multiple time periods, which included: the entire period (1981-2021), the GSP Base Period (1997-2017), the Base period to present (1997-2021), and the period since the enacting of the Sustainable Groundwater Management Act (**SGMA**). The annual total for acre-feet was then applied across an estimate of irrigated acreage to understand the demand, or pumping, intensity on an acre-foot per acre (**AF/ac**) basis.

The irrigated acreage used is based on more recent cropping data that estimates approximately 163,300 acres for irrigated acreage within the GKGSA. For this analysis, the irrigated acreage was held constant. Historical cropping sets are more sparse and more focus is on the recent cropping demand. Applying the annual Applied Water to the same acreage shows a slight increasing trend over the period of record. Figure 1 is a chart for the 1981-2021 period for the estimated Applied Water and corresponding AF/ac demand. However, there are many factors such as changing crops types, changing hydrology, and changes in surface water management

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decisions that could be factors in this trend beyond just the amount of irrigated acres. This analysis did not delve into the various impacts that could be resulting in a higher AF/ac demand in recent years versus historical.

Another component to the analysis was evaluating the data sets between “gross” pumping (Applied Water) versus the “net” ET (crop consumption). With most of the data through the GSP estimated as Applied Water (gross), the 2021 LandIQ data reported as ET was converted to better align with the majority of the data. The conversion was based on an estimated 85% efficiency. This estimate has been used for approximation across the Kaweah Subbasin capturing the blend of high efficiency and flood irrigation. With the GKGSA having not yet established management areas, the analysis is being done across a large area and utilized this 85% efficiency assumption.

Results

Following the processing and analysis of the Applied Water and irrigated acreage, the AF/ac breakdown for the 1981-2021 period was evaluated and then summarized to the time periods of interest. The following table summarizes the results.

Analysis Period (Water Years)	Avg. Annual Applied Water (AF)	Avg. Annual Applied Water (AF/ac)	Estimated ET AF/ac (85% efficiency)
1981 – 2021	547,808	3.35	2.85
1997-2017	559,119	3.42	2.91
1997-2021	563,736	3.45	2.93
2015-2021	570,654	3.49	2.97

The GKGSA currently has the ability to track demand via ET measurements by LandIQ. The ET estimates are provided for supporting evaluation of the estimate level of demand/pumping present within the GKGSA ahead of management actions related to pumping reduction. The average ET is in the range of 2.90 AF/ac when evaluating the total period of record and the GSP current period (1997-2017). Accounting for the more recent years since SGMA has been enacted and since submittal of the GSP, the average ET has increased to closer to 2.95 AF/ac. These recent years have had less moisture due to little rainfall and has experienced warmer temperatures.

Utilizing the GSP period (1997-2017), which was a more balanced hydrologic period, the 2.91 AF/ac ET can set the baseline pumping. Following current draft of the Rules & Regulations with a 10% reduction results in 2.62 AF/ac, or just over 31 inches.

As the GKGSA evaluates pumping caps and allocations around three “buckets” of water with the Native/Sustainable Yield, Tier 1, and Tier 2, the amounts in each bucket should be considered as these values will be the starting point for which further reductions and accounting are made. With this in mind, a 2.5 AF/ac (30 inches) or 2.67 AF/ac (32 inches) is recommended to be considered in the decision-making as after removing the current 10 inches for Native, the remaining amount for Tier 1 and Tier 2 can be evenly split at 10 or 11 inches.

Recommendations

Further recommendations for consideration include:

- Further evaluation of Management Areas is recommended as there are nuances across the GKGSA boundary from cropping, precipitation, and aquifer type. Splitting out smaller

areas for management would likely prove beneficial for future management decisions related to allocations and/or impacts related to lowering groundwater levels and subsidence.

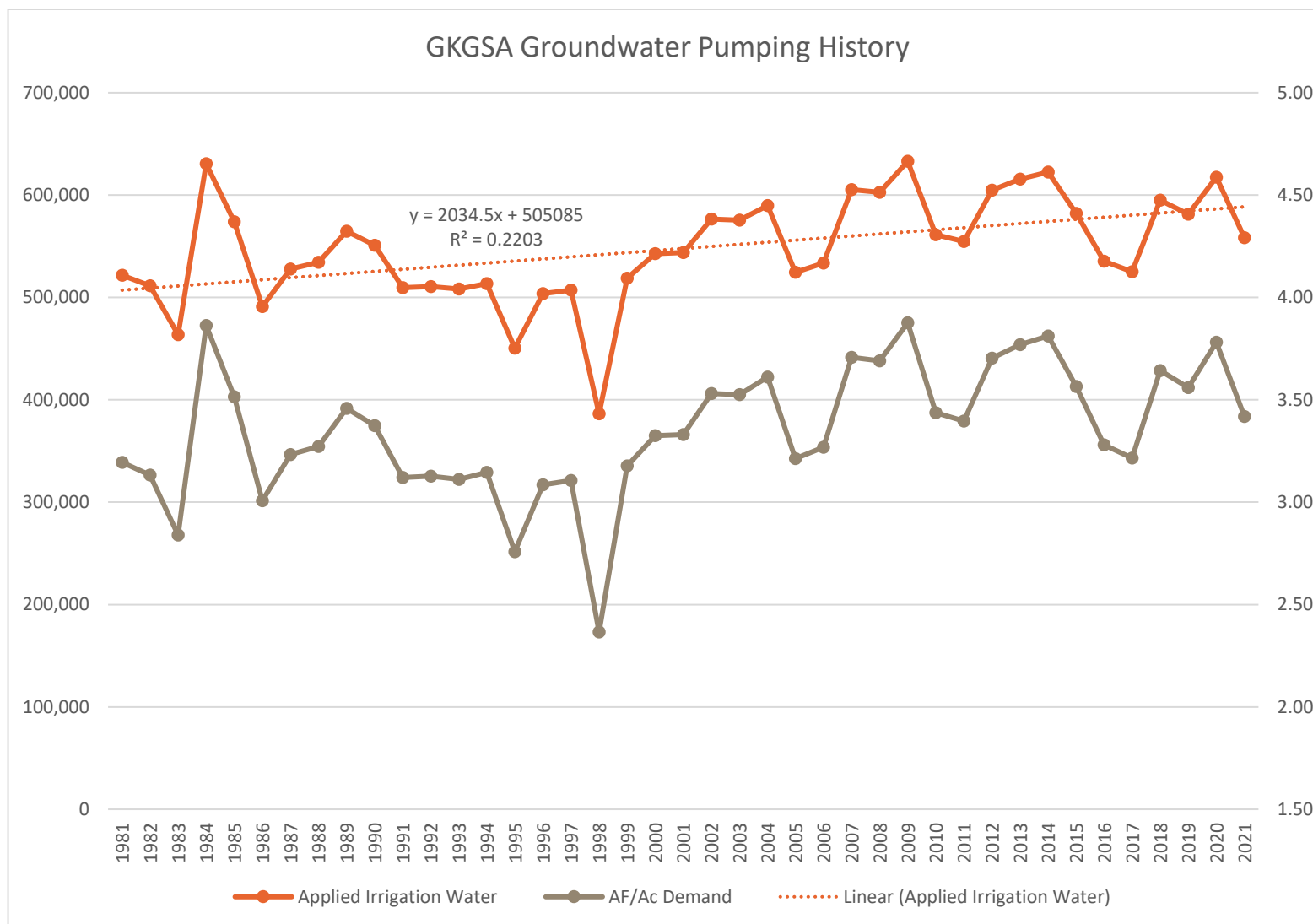
- Further study to understand the irrigation efficiencies in the GKGSA and the difference between the Applied Water and new ET consumed is anticipated to support future management decisions as well as help landowners understand their operations in terms of water supplies versus the amount used by their crops.

Attachments

Figure 1: WY 1981-2021 Applied Water Trend

Attachment 1: Tabular Summary of Applied Water Data

Figure 1



Gross Applied Irrigation Water (Crop Water Demand)
(Acre-Feet)

163,287 Cropped Acres

Water Year	Greater Kaweah Total Applied	Water Intensity (AF/ac)	
1981	521,599	3.19	
1982	511,392	3.13	
1983	463,678	2.84	
1984	630,773	3.86	
1985	574,049	3.52	
1986	491,114	3.01	
1987	527,837	3.23	
1988	534,383	3.27	
1989	564,725	3.46	
1990	550,975	3.37	
1991	509,654	3.12	
1992	510,680	3.13	
1993	508,139	3.11	
1994	513,635	3.15	
1995	450,387	2.76	
1996	503,706	3.08	
1997	507,209	3.11	
1998	386,268	2.37	
1999	518,885	3.18	
2000	542,887	3.32	
2001	543,821	3.33	
2002	576,501	3.53	
2003	575,595	3.53	
2004	589,767	3.61	
2005	524,611	3.21	
2006	533,569	3.27	
2007	605,444	3.71	
2008	602,592	3.69	
2009	632,943	3.88	
2010	561,261	3.44	
2011	554,663	3.40	
2012	604,761	3.70	
2013	615,606	3.77	
2014	622,440	3.81	
2015	582,099	3.56	
2016	535,511	3.28	
2017	525,067	3.22	
2018	594,916	3.64	
2019	581,228	3.56	
2020	617,441	3.78	
2021	558,319	3.42	
Maximum	632,943	3.88	
Minimum	386,268	2.37	Avg. ET
Average	547,808	3.35	2.85

	Average		Avg. ET
1997-2017	559,119	3.42	2.91
1997-2021	563,736	3.45	2.93
2015-2021	570,654	3.49	2.97