January 24, 2022

Dear Mid-Kaweah GSA growers,

Early season snowpack is encouraging, but reservoir and aquifer deficits are critically low. The dry conditions of Water Year 2021 began a lot of firsts. It was the first time the Oroville hydroelectric power plant was forced to shut down due to low water levels (37% of capacity, compared to the average 71% of capacity) and many of the reservoirs in the State reached all-time low storage levels. More locally, this was the first time the Tulare Basin 6-station index dropped below 10 inches of annual precipitation. The next lowest measured was 10.9 inches in 1976-1977.

The December 2022 snowpack is encouraging. The Central Sierra Snow Laboratory at Donner Pass recorded the heaviest December snowfall in its 50-year history (17 feet total) and the Kaweah Subbasin is 188% of average as of December 31st, only the 2011 water year was higher at this time of the year since the year 2000. However, the water supply outlook for 2022 remains uncertain. Groundwater management decisions can only be made on present conditions, and presently, groundwater levels are at a historic low following the 35-foot drop (TID-average) in just 2 years (Figure 1).

![Figure 1. Depth to groundwater hit a new historic low in 2021, dropping below 2015 levels.](image-url)
Emergency restrictions of groundwater pumping are necessary for 2022.

Due to the severity and proximity of the ongoing drought, the Mid-Kaweah Groundwater Sustainability Agency concluded it is necessary to limit groundwater extractions (pumping cap) in order to avoid undesirable results and maintain compliance with the Sustainable Groundwater Management Act (SGMA). For MKGSA water users, groundwater will be limited to 2.5 AF/acre, measured as evapotranspiration per assessed acre. Flexibility will be afforded in the first year of implementation. First of all, a year of groundwater will be allocated across a time frame shorter than a year (anticipated April 2022 – October 2022). Second, water users will be charged for groundwater pumping (evapotranspiration) based on the use of surface water (surface water users will pay nominal service fees for tracking and reporting, while growers who only use groundwater will be charged based upon the value of water to replace what was pumped). All water users will also have the ability to pay mitigation costs for an additional 1.0 AF/acre beyond the cap if it is exceeded (hereafter, “mitigation water”). The per-AF cost of mitigation water is not meant to be punitive but based on estimates for the MKGSA to replace water beyond what our aquifer can sustainably support. Third, the groundwater not used in the first year will roll over to next year at a 1:1 ratio. More details of the emergency implementation of this groundwater pumping cap will be coming soon. For more information please visit https://www.midkaweah.org/.

How will consumed groundwater be measured and monitored?

Crop evapotranspiration (ET) is calculated using satellite imagery. Satellite imagery is processed by LandIQ, a consulting firm specializing in remote sensing and agronomics, to provide monthly evapotranspiration and precipitation data spanning the MKGSA. LandIQ calibrates and validates satellite ET measurements using a network of 90 eddy covariance stations across Fresno, Kern, Kings, and Tulare counties. This dense network of stations is placed in nearly every type of crop grown in the area and spatially dispersed evenly. Evapotranspiration data measured by LandIQ will be modified by the MKSGA so growers are discounted precipitation and surface water applied evapotranspiring from the field (Equation 1), only ET from groundwater pumping is intended to count toward the pumping cap allocation. Return flows (water applied but not consumed) will not be measured as credits in the first year. However, a grower may have a significantly higher ET\text{total} as the quantity of surface water and precipitation increases.

\[
\text{Equation 1: } \text{ET}_{\text{gw}} = \text{ET}_{\text{total}} - C_1 S - C_2 P
\]

\(\text{ET}_{\text{gw}}\) = Evapotranspiration due to groundwater [AF/acre]  
\(\text{ET}_{\text{total}}\) = Total evapotranspiration, as measured by LandIQ [AF/acre]  
\(S\) = Surface water applied, long-term average in TID is approximately 1.5 [AF/acre]  
\(P\) = Precipitation. Long term average in the MKGSA is 9.7 acre*inches/acre [AF/acre]  
\(C_1\) = Irrigation efficiency. To be determined, but drip irrigation will be more efficient than flood [%]  
\(C_2\) = Effective precipitation coefficient, defined as the ratio of precipitation entering the soil profile and made available to the plant to total precipitation. Value to be determined [%]

Example Calculation: Assumes 2022 Allocation of 2.5 AF/Acre of ET for a Wheat and Corn Double Crop

\[
\text{Equation 1: } \text{ET}_{\text{gw}} = \text{ET}_{\text{total}} - C_1 S - C_2 P
\]

\(\text{ET}_{\text{gw}}\) = Evapotranspiration due to groundwater [AF/acre]  
\(\text{ET}_{\text{total}}\) = 3.3 AF/acre (From Table 1)  
\(S\) = 1.0 AF/acre applied water (assumed estimate)  
\(P\) = .80 AF/Acre (assumed estimate)  
\(C_1\) = 70% (assumed irrigation efficiency for flood irrigation on sand loam soils)  
\(C_2\) = 20% (assumed estimate)

\[
\text{Equation 1: } \text{ET}_{\text{gw}} = 3.3 - (.70) * (1.0) - (.20) * (.80)
\]

\[
\text{Equation 1: } \text{ET}_{\text{gw}} = 2.44 \text{ AF/acre}
\]

Allocation = 2.5 AF/Acre  
Carryover Credit to 2023 = 2.5 -2.44 = 0.06 AF/Acre
Know your evapotranspiration: Preparing for the 2022 groundwater allocation cap. The purpose of this report is to familiarize water users in the MKGSA of consumptive use (ET) by crop type, because ET is different than groundwater pumping. Table 1 provided below is intended to be a planning tool for the 2022 growing season by providing averages of the total evapotranspiration (ET$_{\text{total}}$) from each field by crop type. ET$_{gw}$ becomes lower than ET$_{\text{total}}$ as precipitation and surface water applied increases (Equation 1). Please consider the footnotes included in Table 1 while you interpret these results.

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Table 1: Important Disclaimer:
1. Crop types are based on TID crop activity only. The dataset may not be diverse enough to represent the average consumptive use of all farming practices.
2. Crop types are based on TID crop activity only. These values are the average of all fields, which will underestimate and overestimate permanent crop fields 5 years or less.
3. Analysis is based on an irrigated average only (ET$_{\text{irrig}}$). Analysis by APH will yield lower values than ET$_{\text{irrig}}$.
Figure 2. (left) Percent of average ET by permanent crop. For example, to estimate a 25 year old citrus crop, multiply 2.2 AF/acre from table 1 with 105% in Figure 2 to get 2.31 AF/acre (right) Crops types have considerable ET variability from crop age and irrigation method.

Individual Crop Monthly ET Charts
Provided below are individual monthly charts of ET per month. The light grey lines are individual field measurements of ET and the dark black line represents the average ET for the month. You will see in many crops, such as walnuts, there are fields that deviate significantly from the average, at least in-part due to crop yield, age of the crop, presence of cover crops, and irrigation method.

How will Growers Track their ET – Water Dashboard
The MKGSA is developing a Water Dashboard, a digital platform to check the status of evapotranspiration usage on a monthly basis. This will allow growers to visualize how much water has been used and how much water has yet to be allocated for the 2022 water year. This tool is anticipated to be complete in early-mid 2022. This system is being based on the Kaweah Basin Water Quality Association ILRP Farm program that growers use to track nitrogen management plans, which means existing user accounts will be used and new registration and passwords will not be required.

Request Individual Field ET for 2021
If you are interested in receiving your individual crop ET reports for 2021, please reach out to James Fisher, District Water Resources Engineer at jmf@tulareid.org or 559-686-3425 with your Assessor Parcel Numbers (APNs). Individual landowner reports will be prepared and delivered free of charge in the order that they are requested.