October 14, 2020

Advisory Committee for County GSAs
Item 9: Allocation Discussion and Recommendation

Within the joint GSP in the Madera Subbasin and the GSP in the Chowchilla Subbasin, the Groundwater Sustainability Agencies (GSAs) managed by Madera County ("Madera County GSAs") have identified several methods for reducing demand to achieve sustainability from 2020 to 2040:

- allocations
- allocations with a market
- land easements/resting/retirement
- a fee structure to pay for projects, including incentives for land easements/resting/retirement and recharge basins (dedicated as well as on-farm)

After discussion for more than a year, the key components of an allocation approach are ready for review by the Advisory Committee and to be brought to the Board of Directors of the County GSAs.

Principles

The key principles of the Allocation for the County GSAs are described below:

- Certainty – An allocation approach should provide users certainty on water quantities and predicted annual costs.
- Domestic Water Protection – An allocation approach will seek to maintain/enhance groundwater conditions for DACs and other residential users.
- Fairness – An allocation approach must equitably reflect for all agricultural types and operations in the Madera County GSAs.
- Flexibility – An allocation approach will provide flexibility to agricultural in the County GSAs as it transitions to consuming significantly less groundwater.
- Overlying Rights Protection – An allocation approach will not affect a landowner's overlying right to groundwater.
- Simplicity – An allocation approach should have rules that are easy to understand and follow and be helpful for future decisions.

Farming Units and Farming Unit Zones

To allow for both flexibility and to mimic real-world farming conditions in which resources are shared among commonly owned lands, the County GSA's per-acre, parcel-based allocations will be allowed to be shared within designated "farm units" meeting criteria defined by the Madera County GSAs. For the purpose of sharing water allocations, more than one parcel could be grouped together to form a farm unit. In order for the grouping to exist, the parcels would likely need to be owned by the same family or organization, or possibly for parcels managed by the same company, and be within the same zone on the map as indicated in **Figure 1** (Chowchilla East, Chowchilla West, Madera East north of the Fresno River, Madera East south of the Fresno River, Madera West, and Delta Mendota).

Overall, groundwater modeling suggested that the farm units should be permitted only within a specified zone. The zones take into account groundwater conditions, land uses, aquifer characteristics and other considerations such as locations of concentrations of domestic wells. Given the large size of the Madera County East GSA within Madera Subbasin (and its extent from northwest to southeast), two zones of this GSA should be delineated – Madera County East GSA Northern Zone (north of the Fresno River) and Madera County East GSA Southern Zone to the south of the Fresno River (**Figure 1**). The proposed zones should serve initially to minimize likelihood for concentrated groundwater pumping (and associated groundwater depressions) in a given area along with limiting potential for causing increases in groundwater flow from adjacent subbasins as a result of the pumping distribution. Additional conditions may likely also be developed regarding the designation of parcels within specific farm units, such as whether parcels have ever been irrigated, the proximity of domestic and municipal wells, and potentially grouping of small parcels operated by designated disadvantaged owners or tenants. The County will continue to develop a mechanism that espouses the foundational principles.

Proposed Allocation Rules

The proposed allocation for agricultural water users has two types of water:

1. Sustainable yield of native groundwater is water that naturally exists through seepage and percolation. It is available to the entire subbasin as a whole and has been allocated within the subbasin proportionally based on acreage. This water could be offered as "opt in". If someone were to "opt in" as an approach, they would also be opting in for fees associated with the management of the sustainable yield. If someone chooses not to opt-in, they would not be able to access this water other than for domestic or stock water (ranching, cattle). Their non-use would be monitored. There would be a process to opt back in after a period of being out by paying for back charges as well as current charges, at a minimum.

2. Transitional water is water that equates to continued overdraft within the Madera County GSAs and is accepted by the other GSAs as a strategy to manage the economic transition to lower consumptive use of groundwater over time. During the first 10 years of GSP implementation, this type of water could be offered in two pools to facilitate annual planning by irrigators and administration by the County GSAs, such as:

a. Pool #1 – 70% of the available transitional water
b. Pool #2 – the remaining 30% of the available transitional water, plus any water not allocated from Pool #1

How An Allocation Approach Works

Step	County GSA Action	Grower Action
	Sustainable Yield To preserve overlying water rights, County GSA offers the ability to access Sustainable Yield (SY) to those with overlying water rights. This is offered every five years, though may also be an avenue associated with real estate transactions (e.g. the purchase/sale of a parcel).	Choose to opt in for SY (or not) by parcel at some point in time. Track estimated ETAW online.
1	**Sustainable Yield for the Year** County GSA offers the ability to pump SY in Year 1 to those overlying landowners who have opted in for SY.	Indicate intent to pump SY (or not), applicable to all parcels in a farming unit for that year. Track estimated ETAW online.
2	**Transitional Water – Pool 1** County GSA offers Transitional Water (TW) Pool 1 to those who indicated intent to pump the SY in Year 1.	Indicate intent to purchase from TW Pool 1 or not. Track estimated ETAW online.
3	**Transitional Water – Pool 2** County GSA allocates remaining TW through Pool 2, which is a combination of remaining quantity of TW not allocated in Pool 1 plus any unrequested Pool 1 (TW Pool 2 would most likely be offered only to those who signed up for Pool 1).	Indicate intent to purchase from TW Pool 2 or not. Track estimated ETAW online.
4	**Adjustment** – Make a mid-year adjustment based on conditions (e.g. heavy rainfall has reduced need).	Indicate need for more water if available. Track estimated ETAW online.
5	**Allocation Evaluation** – Evaluate participants' total ETAW from groundwater (consumptive use of applied groundwater) and compare to the participants' allocation for the farm unit. Fees may apply. There will be an appeals process.	Log into on-line portal to reconcile estimated ETAW with allocation.

Monitoring

Monitoring of ET and ETAW willbe done with satellite technology provided by Irriwatch. Quality assurance and quality control would be performed by both Irriwatch and by Madera County staff.

Three training sessions are budgeted to review IrriWatch functionality and applications. The first session will inform growers how Evapotranspiration (ET) is calculated within IrriWatch using the SEBAL model, and how Evapotranspiration of applied water (ETaw) is calculated within IrriWatch using root zone water budget modeling. The second and third training sessions will be conducted after IrriWatch becomes operational and will focus on the use of IrriWatch. Topics for the three training are summarized below followed by brief descriptions of SEBAL and IrriWatch.

SEBAL

SEBAL (Surface Energy Balance Algorithm for Land) was developed by Dr. Wim Bastiaanssen of The Netherlands. SEBAL uses spectral radiances recorded by satellite-based sensors, plus ordinary meteorological data, to solve the energy balance at the Earth's surface (Figure 1). SEBAL computes actual evapotranspiration (ET_a) for each pixel in a multispectral satellite image by applying radiative, aerodynamic and energy balance physics in 25 computational steps incorporated into 19 models.

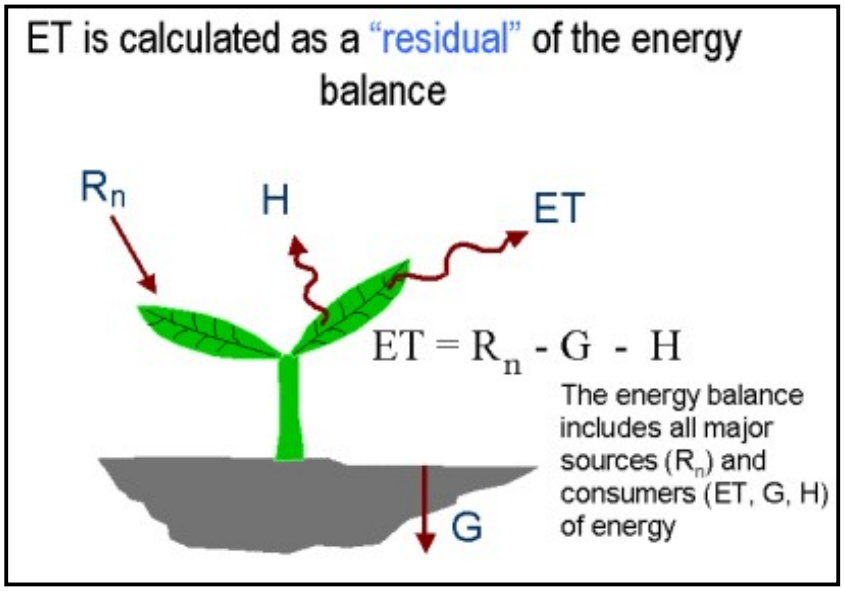

Figure 1. Conceptual Schematic of the Surface Energy Balance

The Surface Energy Balance Algorithm for Land (SEBAL) is a remote sensing algorithm that converts raw satellite data into radiation, heat and water vapor transfer fluxes to calculate the energy balance at the land surface. The actual evapotranspiration (ET) is the desired output, and it is determined from the radiation and

heat fluxes. The radiation component considers all forms of incoming and reflected solar radiation to determine net radiation (net energy in). The heat flux component describes the heating rate of soil and air during the daytime. All energy that is not used for heating the soil and air is used to evaporate water, or ET. So, the net energy is dissipated in either heating the soil and air or evaporating water, and this dissipation depends on the soil moisture conditions. Wet land surfaces have a high ET and a low heat flux. Dry land surfaces have a low ET and a high heat flux. Satellite measurements of land surface temperature are fundamental for computing this energy balance.

Training Date: November 6, 2020 10 to 11:30 am SEBAL and root zone water budget training

The training will describe how SEBAL works, provide examples of temperature maps, and show also how other (non-ET) factors affect the heat map. The link to other remote sensing crop parameters will also be explained. The root zone water budget used to determine ET from precipitation and ET from applied water will be explained. Biomass and its relationship to crop production will be explained with real world examples.

IrriWatch is a daily irrigation scheduling and crop production information service. It is based on the SEBAL model outputs and other data and the data is disseminated through a portal, an App or an API. The main objective is to inform growers about the irrigation status of fields and recommend irrigation activities of the day. Growers with weekly schedules can check the need for corrective actions. For instance, the urgency of certain fields to receive water immediately or whether desirable stress levels are still ok. Sometimes mild stress is desirable, but the stress should not adversely impact the crop production. Besides irrigation advice for the day, also the status of the fields from yesterday are portrayed. This helps in understanding whether soil moisture and soil water potential in the root zone are still in the pre-defined range. If soil moisture signatures show a low and irregular value, then the grower sees that the current irrigation schedule is not appropriate. If soil moisture signatures are high, then water could be conserved. IrriWatch shows the accumulated crop production and ET values, and also applied water and Nitrogen status. This info together with the allocation helps growers making decisions on the timing and amounts of irrigation. The data portal is suitable for planning and monitoring. The App is developed mainly to check todays situation. The API is designed for growers having own data platforms so, that they have automated access to the pixel data.

Training Date: January 20, 2021 10 to 11:30 am IrriWatch Set up and use training

This training will explain the data portal, including how to register, log in, define parcels, assemble farm units and set allocations. How to read and interpret available data will be explained. How IrriWatch determines the irrigation status of a field will be described. How to view ETaw versus allocation will also be described. The IrriWatch App will also be demonstrated. The training will include a few case studies where irrigation practices will be discussed in relation to IrriWatch data.

Training Date: Mid to late summer 2021 10 to 11:30 am IrriWatch follow up training 2

This training will focus more on feedback, queries, comparison with field measurements. By this time, the farmers will have experience with IrriWatch and possibly some questions. A status report on the comparison with flow meter readings would be presented and reviewed. Relationships between AW, ET and ETaw for a number of different fields will be reviewed.