APPENDIX G. A LAYPERSON'S GUIDE TO DETAW

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DETAW (Delta Evapotranspiration of Applied Water) is a computerized mathematical model of the Sacramento – San Joaquin Delta Service Area (DSA). It estimates both the consumptive water demands and the source of the water to meet the demand (precipitation, diversions, seepage from channels) on a daily time step for the historical hydrological period WY1922-2015. The historical consumptive demands use historical land use (where acreages change annually), and the projected consumptive demands which assume a fixed land use for every year of the simulation (e.g., 1920 leve, or 1950 level, 2000, 2050, etc).

Figure G-1 shows the DSA subdivided into 168 subareas numbered 1 to 168. Most of the subareas are islands within the Delta, but other are either parts of an island or a channel/water area within the Delta.

Each subarea includes one or more of the following land and water use categories (LWC):

1. Agricultural.
2. Urban.
3. Riparian vegetation.
4. Native vegetation.
5. Open water (channels or lakes).

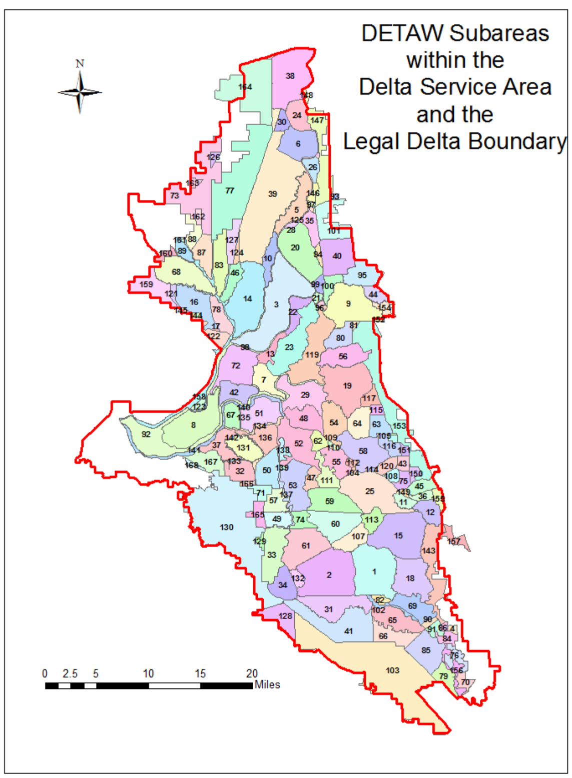

Figure G-1. DETAW Subareas within the Delta Service Area and the Boundary for the Legal Delta

For each agricultural category described above, Figure G-2 shows how the computations proceed in DETAW. The main demand is ETc. The sources of water to meet ETc are (by priority): seepage from channels, precipitation, root zone soil moisture, diversions from channels.

Note: For the purposes of this report the only relevant component of DETAW is ETc (Figure G-2).

The steps are as follows (for each time step):

1. Calculate the Evapotranspiration ETc.
2. Estimate the seepage (priority 1) to meet ETc. Seepage is estimated as follows: The maximum allowed seepage is 0.25 inches per foot rooting depth.
3. Estimate the precipitation (priority 2) to meet the remainder shortage of ETc in step 2.
4. Estimate the root zone (priority 3) contribution to meet the remainder shortage of ETc in step 3.
5. Estimate the channels net diversions (priority 4) to meet the shortage remaining in step 3.

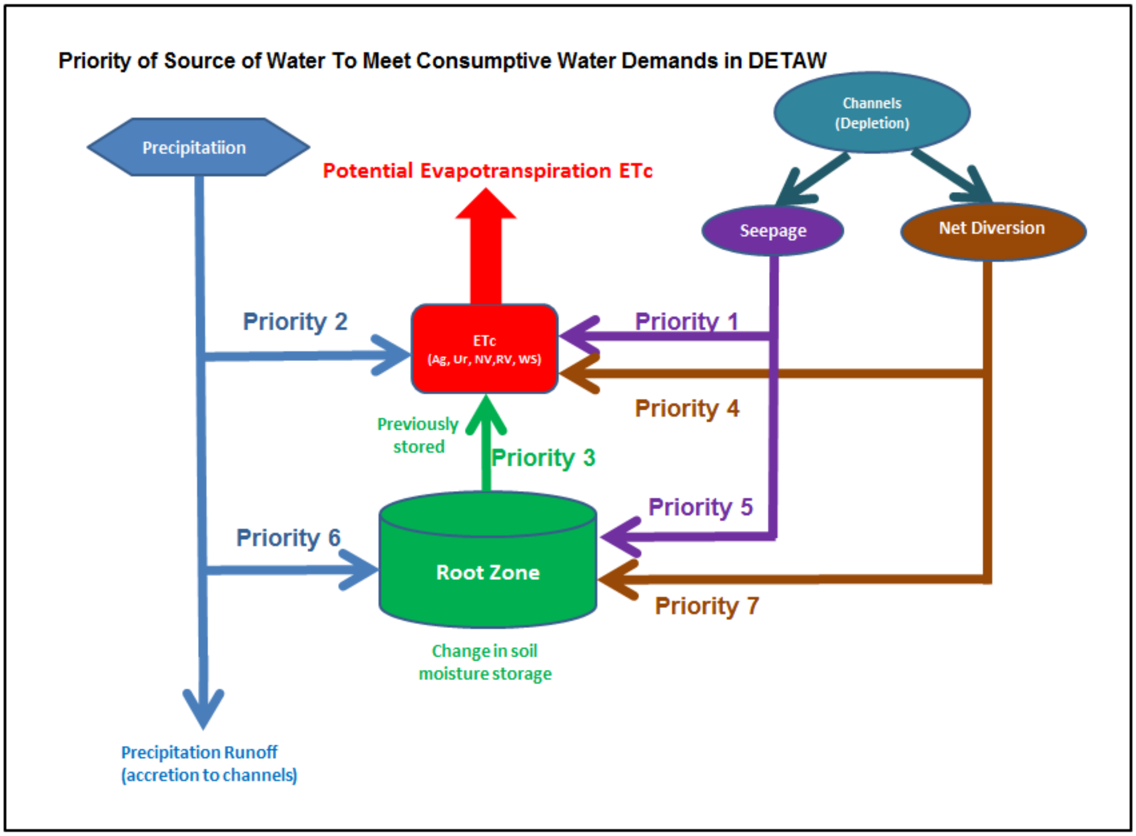

Figure G-2. Priority source of water to meet the consumptive demand ETc.

The root zone acts as a reservoir both to receive water from precipitation, seepage, and channel diversions, and as a source of water to meet ETc as described above. Each root zone has a minimum allowable soil moisture below which and irrigation is triggered that would fill the root zone to the maximum allowable soil moisture (Field Capacity), as shown in Figure G-3. Therefore DETAW ensures that the soil moisture content in the root zone remains between the upper and lower bounds at all times. Estimating the amound of water for the root zone water source are as follows:

1. Estimate the amount of seepage from channels (priority 5). This quantity is the remainder of any seepage from Step 2 (up to the maximum prespecified) in the previous ETc section.

2. Estimate the amount of percolation to the root zone from precipitation (priority 6). This quantity is the remainder of the precipitation from Step 3 in the previous ETc section. Any remaining precipitation precipitation is considered runoff to the channels.

3. Estimate the amount of net diversion to the root zone from the channels to ensure the moisture content doesn't fall below the minimum as describe previously.

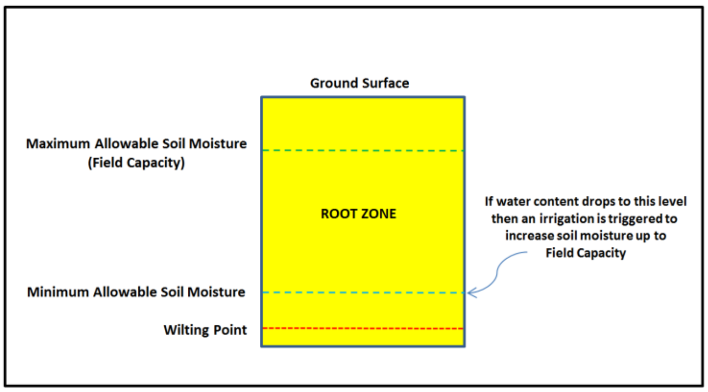

Figure G-3. Soil Moisture Limits in the Root Zone Representation in DETAW

For urban areas the root zone computations are the same keeping in mind that only "outdoor urban consumptive demands are calculated since indoor urban is assumed 100% recycled within the Delta within the time step of 1-day). For riparian and native vegetation computations the only difference is that there are no diversions from the channels. For the water subcategory, DETAW calculates the water evaporation based on surface area.

The primary demand of water in DETAW is ETc. ETc is computed as:

ETc (actual, or Eta) = ETo x Kc

Where ETo is the reference crop evapotranspiration and Kc is the "crop" coefficient. ETo computed based on the daily temperatures, though adjusted for the Delta to account for local weather such as wind.

DETAW was originally designed to meet "potential" ETc. In other words the water demands required under optimum agricultural practices. In the Delta, actual ETc may be lower than potential ETc due to a variety of stresses. These stresses reflect actual conditions in the Delta such as salinity, disease, pollutants, etc. DETAW has since been calibrated to the remote sensed SEBAL data for the 2007 and 2009 irrigation seasons by adjusting the crop coefficients Kc. There

DETAW results reflect "actual" ET (or ETc, sometimes referred to as ETa) rather than "potential" ETc.

The Kc (or crop coefficients) are factors that change daily throughout the year, but do not vary year to year.

The ETo is computed as follows:

1. Daily ETo is computed at the Lodi/Stockton CIMIS location using the Hargreaves-Samani Equation that relies on the minimum and maximum temperature of that day, along with other known constants (solar radiation, etc).
2. The ETo is step 1 is modified by a factor. That factor was obtained by calibrating the Hargreaves-Samani estimate of ETo to the CIMIS station at Lodi/Stockton location which uses the more "reliable" Pennman-Montieth Equation.

Note: The main reason for not using the CIMIS station data directly is that CIMIS stations data only go back historically to the mid-1980's, whereas DETAW needs estimate going back to 1922. Temperature data at Lodi/Stockton exists or can be estimated going back to 1922.

3. Finally the modified daily ETo at Lodi-Stockton in Step 2 is used to develop the daily ETo for each subarea in DETAW using another factor (fixed for any day) for that subarea. Those factors were developed as follows: Using data from the seven CIMIS stations in around the Delta (not the new CIMIS stations that were recently installed in the Delta as part of this report), lines of equal ETo values (isolines) were developed (similar to developing ground water contour lines from ground water well observations). These isolines are "normlized" to the ETo at Lodi/Stockton (see DETAW report for details). In general the subareas in the western part of the Delta have higher factors (e.g. 1.15 meaning the ETo at that location is 15% higher than at Lodi/Stockton) decreasing as one moves eastward, mainly because of the higher winds blowing through the western Delta.

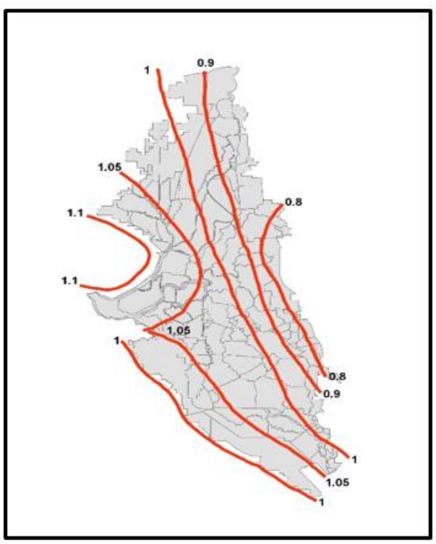

Figure G-4. Isolines for Correction Factors to Estimate ETo Relative to Lodi/Stockton CIMIS Location.

REFERENCES

Hargreaves, G. H., & Samani, Z. A. (1982). Estimating potential evapotranspiration. *Journal of the Irrigation and Drainage Division, 108*(3), 225-230.

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Snyder, R. L., Orang, M., Geng, S., & Matyac, J. C. (2006). Final Report, Delta Evapotranspiration of Applied Water (DETAW) Version 1.0. Department of Water Resources, California, and Department of Air, Land and Water Resources, University of California, Davis.