Bi-monthly Educational Topic #13 for CCGCD
by Texas Hill Country Weather Services, LLC
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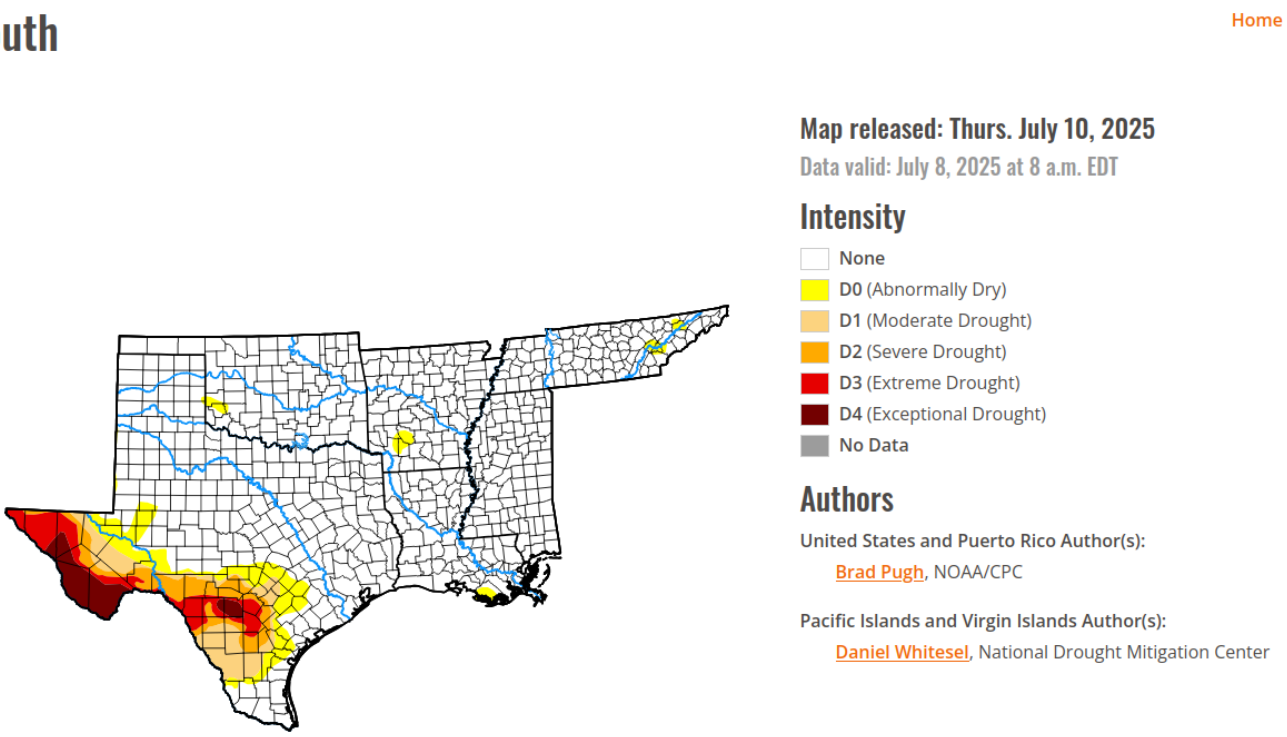
Current conditions:

As of July 8, 2025, due to the most recent series of moderate to heavy rainfall events in late June through early July 2025, the severity of the on-going drought has decreased across Kendall County. This is obviously welcomed news, not originally expected at the beginning of this Summer. We need some good news. The intensity of the drought ranges from D0 (abnormally dry) in the far northeastern portion of the county, to D1 (moderate drought) across a thin section within the central portion of the county and then up to D2 (severe drought) across the southern half of the county (per the latest available US Drought Monitor map provided below). So, the drought does continue, but it has been relieved from the previous update in late June 2025 which reported intensities ranging from D2 up to D4 (exceptional drought) across the county. Some more rainfall events are expected to impact Kendall County through middle August, but how much more rainfall is in question considering this time of the year is usually hot with extended periods of dry weather spells.



This topic discusses the difference between a meteorological “arithmetic mean (or average)” value and a meteorological “normal” value. Why discuss this topic? CCGCD uses both values within the analyses presented to the Board of the District which aid their monthly decision-making process to determine the latest drought restriction stage. As of this writing, the District is in Drought Stage 4 (drought emergency) for Kendall County.

The arithmetic mean:

In meteorology, the arithmetic mean value, which is often called the average, represents the simple calculation of the average for a set of numeric values for a specific period, not constrained in time or space. So, an example of the mean value could be the average amount of rainfall that has occurred and measured across Kendall County in a given month, quarter of a year or a full calendar annual period of

time. The calculation of the mean value for the rainfall average for a given period of time can be based on hourly, daily, weekly or monthly datasets for one or multiple locations within the county.

The equation (1) for calculating the arithmetic mean is the sum (Σ) of all values (x_i) divided by the total number of values (n), as follows:

$$\text{Arithmetic mean} = \Sigma x_i/n \quad (1)$$

The District wants to know how the June 2025 monthly arithmetic mean value (in units of inches) of rainfall across Kendall County compares to the historic arithmetic mean value (in units of inches) of rainfall from only the Boerne weather station.

The monthly rainfall accumulation for each CoCoRaHS station inside Kendall County is acquired from that database for June 2025. The monthly accumulation from each CoCoRaHS station is assumed to be complete and representative of the actual rainfall that occurred in the month across the county, and the accumulation from each station is then summed together to get a county-wide total rainfall value (Σx_i) measured in units of inches. In this example, we will assume that there is data for sixty (n) different CoCoRaHS stations with complete and representative accumulations that are spread across Kendall County. The June 2025 county-wide summed rainfall total is 198 inches, let's say. To get the arithmetic mean for June 2025, we finally divide this total by 60 to get 3.30 inches. Thus, the arithmetic mean (or average) rainfall for June 2025 across Kendall County is 3.30 inches. We now have one half of our answer for the District.

Next, we need the historic arithmetic mean value of rainfall from the Boerne weather station for the month of June. Fortunately, this historic value for this one weather station in Boerne, which covers a period of time from 1893 through 2025, is already computed and readily available from the NWS's website (https://www.weather.gov/wrh/climate?wfo=ewx. It's value is 3.16 inches. This is the second half of our answer for the District.

Now we can make the comparison, and we can conclude that the June 2025 arithmetic mean (or average) rainfall across Kendall County is slightly above the historic June mean (3.30 in – 3.16 = +0.14 of an inch), leading to a wet June 2025 for Kendall County.

Going through the historical Boerne rainfall dataset, only 54 years of 132 years of data had wet months of June. Thus, for any given month of June, we have an approximate 40% chance of a likelihood of receiving wet conditions. This year we beat the odds if we are using the arithmetic mean methodology comparing to the historic arithmetic mean. Now, let's shake things up and look at the "normal" conditions.

The normal:

While both the arithmetic mean and the normal involve calculating the statistical average value as applied to a meteorological parameter such as rainfall, the term "normal" has a specific, standardized meaning, referring to the 30-year average and usually is a site-specific location rather than being applied to multiple locations across an entire county area.

The 30-year normal (or average) value is periodically updated, usually every 10 years. For example, within the USA, the current normal period for rainfall averages is 1991 – 2020, which accounts for thirty consecutive years of rainfall data at one site location. Such locations are referred to as "climate" locations,

meaning there are much less of these locations than there are of CoCoRaHS stations that contain less years of data.

An example of a climate location is the large and very active San Antonio International Airport located in Bexar County. Other example climate locations are Austin Bergstrom, Austin Mabry, and Del Rio. These too are also large and very airports. Each of these types of airports uses very expensive and highly calibrated federal/state-regulated meteorological surface instrumentation called Automated Surface Observing System (ASOS) or Automated Weather Observing System (AWOS). These systems can cost hundreds of thousands of dollars, have high annual maintenance costs and are used for their 24/7 airport and pilot operations.

These airports have been collecting meteorological data for 50-, 75-, +100-years meeting the criteria to crunch the 30-year normal values for rainfall. These datasets also contain sub-hourly, hourly, and daily values in which weekly, monthly and annual meteorological trends and statistics can be calculated.

The problem with these systems is that they are sparsely located and not required to be located within each county. Thus, Kendall County to date is not large enough nor does it have an active airport to support the cost to construct and maintain such an expensive ASOS or AWOS operation.

The closest AWOS operations that exist but are not considered “climate” locations because their datasets are limited in time historically and are not maintained as strictly as the large active airports are: the San Antonio-Boerne Stage Airfield (in Bexar County), the Kerrville Municipal Airport (in Kerr County) and the Gillespie County Airport in Fredericksburg. These are good stations. However, they are just not used to calculate the normal values for rainfall.

The calculation of the normal value is essentially the same as the arithmetic mean above except that rainfall data from only one location such as a large and active airport is used. Because of the sparse locations associated with normal values and no location inside Kendall County is used to calculate the normal rainfall value, the District has chosen to go with the use of the arithmetic mean calculated from several rainfall data collection sites across Kendall County and using the normal value from the San Antonio International Airport as a reference, guide or comparison.

Stay tuned into CCGCD’s website page, as TXHCWS will soon be providing more educational materials.