Attachment L

Affidavit of Bob Rose

APPLICATION OF THE LOWER COLORADO RIVER AUTHORITY FOR EMERGENCY AUTHORIZATION	**§ § § §**	**BEFORE THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY**

AMENDED AFFIDAVIT OF BOB ROSE

THE STATE OF TEXAS	§
	§
COUNTY OF TRAVIS	§

Before me, the undersigned authority, personally appeared Robert H. Rosenzweig, also known as Bob Rose, a person known by me to be competent and qualified in all respects to make this affidavit, who being by me first duly sworn, deposed as follows:

1. I am over 21 years of age, of sound mind, and have never been convicted of a felony or crime of moral turpitude. I am fully competent and qualified in all respects to make this affidavit.

2. The facts stated in this amended affidavit are within my personal knowledge and are true and correct. This amended affidavit reflects changes I have made since my affidavit dated May 14, 2015, which was filed in support of LCRA's Application for Emergency Relief filed on May 15, 2015, and is intended to replace that affidavit in its entirety.

3. I, Bob Rose, am an individual residing in Austin, Texas.

4. I am the Chief Meteorologist for the Lower Colorado River Authority (LCRA). I have held this position since 1995. I have worked as a meteorologist in Texas for 30 years. A true and correct copy of my resume, detailing my prior work history and education, is attached hereto under Tab 1.

5. As part of my duties at the LCRA, I regularly review and summarize short-term and long-term weather predictions and drought indices for the Central Texas region. My opinion is based on my experience in the field and a review of data and forecasts from the National Weather Service's Climate Prediction Center, National Oceanic and Atmospheric Administration's (NOAA's) Earth System Research Laboratory, Texas State Climatologist Dr. John Nielsen-Gammon, and Research Scientist Gregory J. McCabe.

6. Extraordinary drought conditions have gripped much of Texas, including the Colorado River basin, for more than four (4) years, dating back to October of 2010. The drought has been unprecedented relative to the long-term climate record in a number of ways: record low precipitation, extreme, record-setting summer heat and enormous wildfires. The drought conditions include both meteorological drought (taking into account rainfall and temperature) and hydrologic drought (taking into account streamflow and evaporation).

7. Rainfall. According to the Texas State Climatologist, Dr. John Nielsen-Gammon, on a statewide basis, rainfall during the 12 month period from Oct. 1, 2010 to Sept. 30, 2011 was the lowest ever recorded, dating back to 1895. (Available at http://climatexas.tamu.edu/files/2011_drought.pdf.) My review of rainfall data indicates the following:

a) Total average rainfall across Texas from Oct. 1, 2010 to Sept. 30, 2011 was 11.18 inches, just 38 percent of the long-term average. This is much lower than the previous record of 13.91 inches occurring between October 1955 and September 1956.

b) Total average rainfall across Texas in 2012 was 24.10 inches, 2.98 inches below normal.

c) Total average rainfall across Texas in 2013 was 26.02 inches, 1.06 inches below normal.

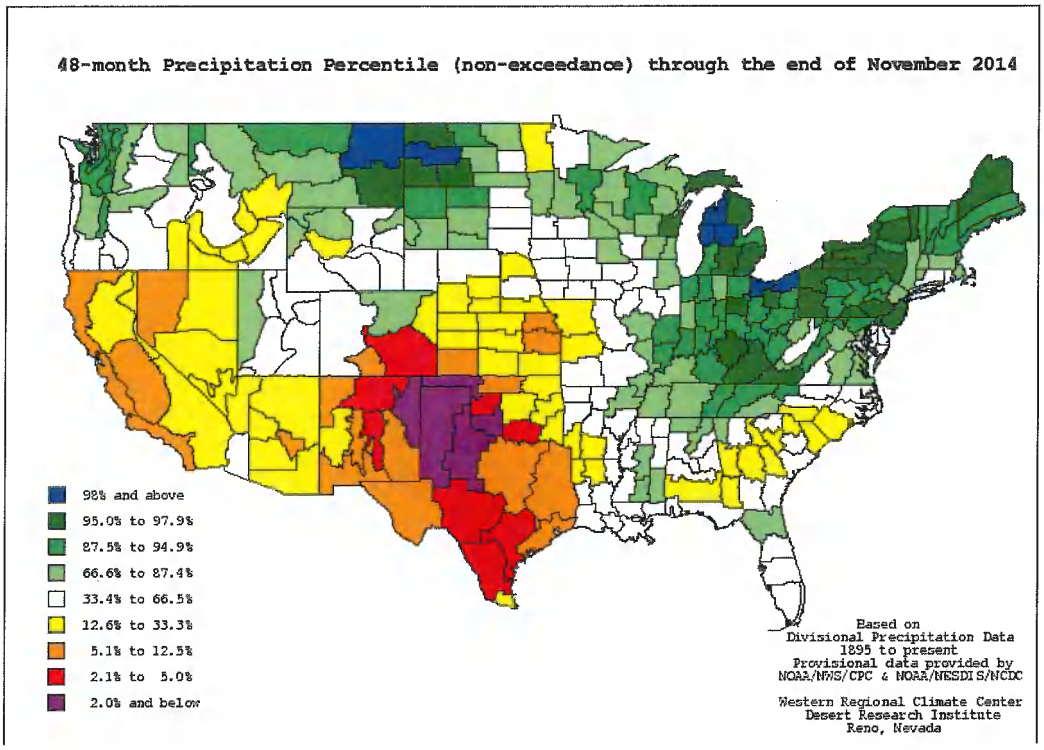
d) While 2014 started off unusually dry, significant rains occurred in the spring and fall months bringing totals closer to normal. The annual statewide rainfall totaled 24.01, 3.07 inches below normal, the 34th driest on record, dating back to 1895. (Available at http://www.ncdc.noaa.gov/temp-and-precip/climatological-rankings/index.php?periods%5B%5D=12&parameter=pcp&state=41&div=0&month=12&year=2014 last visited on May 13, 2015.)

e) Statewide rainfall for the four-year period from November 2010 to October 2014 was well below normal, totaling 86.56 inches. This was 21.95 inches below normal, or 80 percent of normal. This is the 4th driest four-year period beginning in November on record dating back to 1895. (Available at http://www.ncdc.noaa.gov/temp-and-precip/climatological-rankings/index.php?periods%5B%5D=48&parameter=pcp&state=41&div=0&month=10&year=2014 last visited Dec. 15, 2014.)

f) According to data provided by NOAA's Western Regional Climate Center, the 48 month rainfall from November 2010 to October 2014 across the Hill Country and Central Texas regions fell within the 2.1 to 5.0 percentile for precipitation. In other words, similar 48-month rainfall periods during the period of record were lower than the current period only about two to five percent of the time. *See* Figure 1 below. (Available at http://www.wrcc.dri.edu/cgi-bin/spiFmap.pl?per48 last visited Dec. 15, 2014.)

g) Rainfall increased across Texas during the first four months of 2015. According to data from the National Center for Environmental Information, statewide rainfall from January 1 through April 30 measured 11.12 inches, 4.02 inches above normal. This period ranks as the 12th wettest such period on record. (Available at http://www.ncdc.noaa.gov/temp-and-precip/climatological-rankings/index.php?periods%5B%5D=4&parameter=pcp&state=41&div=0&month=4&year=2015 last visited May 7, 2015).

Figure 1. National Precipitation Percentiles for 48-month period ending November 2014



h) May 2015 rainfall across Texas was estimated by State Climatologist Dr. John Nielsen-Gammon, to be over 8 inches. This would make it not only the wettest month of May on record since records began in 1895, it would also be the wettest month ever recorded. The previous wettest month on record was June 2004 with 6.66 inches. Dr. Nielsen-Gammon also estimates the 2-month period of April through May will end up being the wettest 2-month period on record for Texas, with an estimated total of over 12 inches. The previous wettest 2-month period on record was 11.88 inches, occurring April-May in 1957.

8. Several rain events and corresponding runoff and inflows to the Highland Lakes in the current drought have been compared to events from 2007. Prior to May 2015, the sporadic nature of rain events produced well below average runoff over the past four years. (*See* Amended Affidavit of Ryan Rowney.)

a) Heavy, widespread rainfall in the Llano River and San Saba River watersheds above the Highland Lakes on Sept. 19 and 20, 2013 averaged two to three inches, with some rain gages reporting totals as high as six or seven inches.

b) Two heavy rain events occurred during October 2013, but both of these events occurred primarily downstream of the watershed to the Highland Lakes. The first event occurred on October 12 and 13, producing up to a foot of rain over southwest Austin and southwest Travis County. The second event occurred on October 30 and 31, producing widespread totals of 8 to 12 inches over parts of Travis, Hays and Comal Counties. The majority of the

runoff from both rain events drained into the Colorado River below Austin.

c) Two notable rain events occurred across the Hill Country and Central Texas regions during November 2014. The first event on November 4, 5 and 6th produced a steady light to moderate rain with totals of 2 to 3 inches. The second event, occurring on November 21 and 22 produced moderate to heavy rain with totals in the range of 1-3 inches.

d) A rain event on March 20 through 22, 2015 included widespread rainfall above the Highland Lakes averaging 1 to 2.5 inches, with heavier rainfall totals below the Highland Lakes.

e) Two notable rain events also occurred in March 2007. The first event, occurring March 11 and 12 caused widespread moderate to heavy rain across the Hill Country and Central Texas regions, with totals of 2 to 4 inches. The second rain event occurred on March 26 and 27 with widespread moderate to heavy rain. This event also produced fairly widespread totals of 2 to 4 inches across the Hill Country and Central Texas.

f) An analysis of 2014 rainfall across the Hill Country indicated the rain was very sporadic in nature, with long gaps of several weeks between most significant rain events. In addition, there were very few intense rain events with totals of 2 inches of more in a 24-hour period. In fact, data from Llano, showed only 1 day out of the entire year contained a 24-hour total of at least 2 inches. Meanwhile, an analysis of rainfall across Central Texas and the middle Texas coast showed 2014 rainfall was less sporadic and more frequent evenly distributed compared to the Hill Country. More intense rain events occurred as well. For example, Austin reported a 24-hour rainfall total of 6.64 inches on September 17th. The highly sporadic nature of the Hill Country rains was a major factor in limiting any significant drought improvement across the Colorado River watershed in 2014.

9. According to the early June edition of the U.S. National Drought Monitor, a product of the National Weather Service, the U.S. Department of Agriculture, and the National Drought Mitigation Center, the drought was shown to have ended across the majority of Texas due to the development of widespread and soaking rains in May. Only 5 percent of the state was still shown to be in drought. Part of the lingering drought was depicted across the Hill Country region, generally in the area stretching from San Saba County south to Gillespie and Kerr Counties. This area was shown to be in "moderate drought" the first level of four drought classifications. The moderate drought classification reflects rainfall deficits from earlier this year and lower than normal reservoir levels. (*See* http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?TX last visited June 2, 2015)

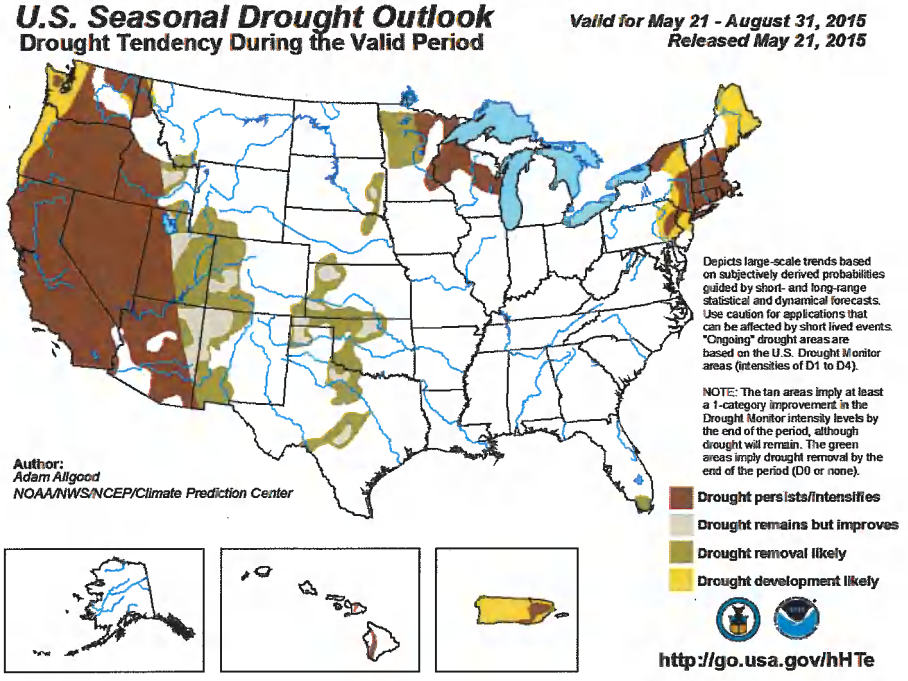
10. Heat. Another factor that has contributed to the severity of the ongoing drought has been the unprecedented heat. For Texas, the average temperature between June 1 and August 31 of 2011 was the hottest summer average temperature ever recorded in Texas and the second hottest summer average temperature for any state in the U.S., dating back to 1895. Summer 2011 was also, by far, the hottest

summer on record for Austin. Statewide, calendar year 2011 was the second hottest year ever recorded and the hottest year on record for Austin. The combination of well below normal rainfall and unprecedented heat created some of the most severe drought conditions ever recorded. (*See* http://www.ncdc.noaa.gov/sotc/drought/2011/9, last visited July 1, 2013 and http://www.srh.noaa.gov/images/ewx/wxevent/sum2011.pdf, last visited July 1, 2013.) These conditions even surpassed the drought conditions of the 1950s. The unprecedented hot temperatures combined with numerous sunny days to create much higher than normal losses from evaporation. Abnormally warm temperatures also continued in 2012. Statewide, the summer of 2012 was the 10th hottest summer on record. And it was the 11th hottest summer on record for Austin. Statewide, 2012 tied with 1921 for the warmest year ever recorded in Texas history. For Austin, summer temperatures in 2012 were the 9th warmest on record. Summer temperatures for Austin in 2013 were the 5th warmest on record. Summer temperatures for Austin in 2014 were milder than most recent years, ranking as the 34th warmest on record.

11. Weather Forecast Sources. In developing my forecast, I have relied on various sources, including the National Weather Service's Climate Prediction Center, NOAA's Earth Science Research Laboratory, Texas State Climatologist John Nielsen-Gammon, and Gregory McCabe, Research Scientist.

a) The National Weather Service's Climate Prediction Center (CPC) 3-Month Drought Outlook calls for continued drought improvement and possible drought elimination across the Hill Country region between the months of June and August. No drought is forecast across Central Texas or the middle Texas coast. *See* Figure 2.

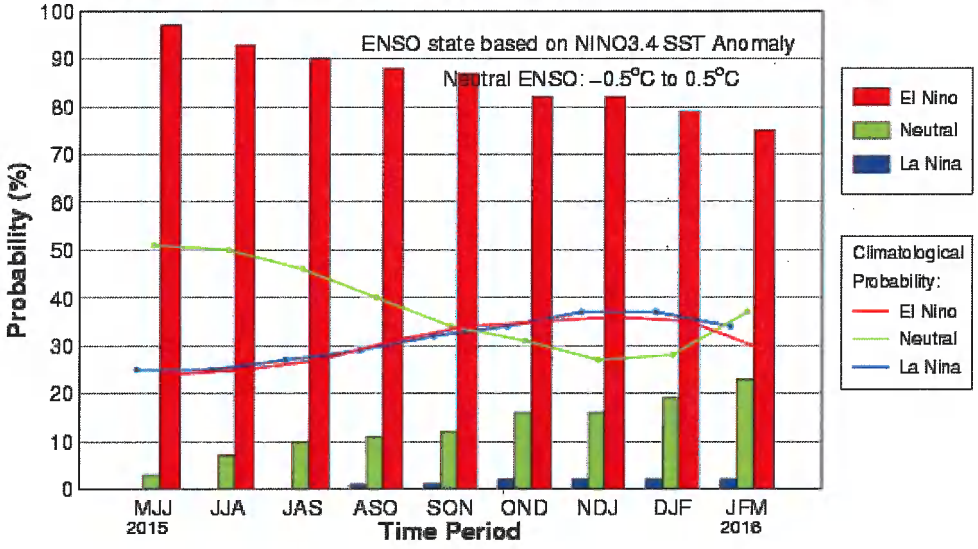
Figure 2.



According to CPC forecasters, "A series of shortwave troughs ejecting from the Pacific and interacting with ample Gulf moisture has produced repeated widespread and very heavy precipitation events across the Plains states. The generous rainfall has resulted in significant large scale drought reductions, particularly across Texas and Oklahoma, but also unfortunately has caused localized issues with flooding and severe weather. Thirty-day surpluses of 5-10 inches are common across the eastern two thirds of Texas and much of Oklahoma. The Spring precipitation events have also improved long term drought conditions across the Great Plains, with surpluses now observed on the 12 month time scale across Texas, Oklahoma, and western Kansas." *See* http://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_discussion.html, last visited June 2, 2015.

The International Research Institute, a partner of the National Weather Service's Climate Prediction Center, forecasts at least a 90 percent probability El Niño conditions will persist through summer with a greater than 80 percent chance for El Niño conditions forecast this fall and early winter. (*See* Figure 3, available at http://iri.columbia.edu/our-expertise/climate /forecasts/enso/current (last visited June 2, 2015.)

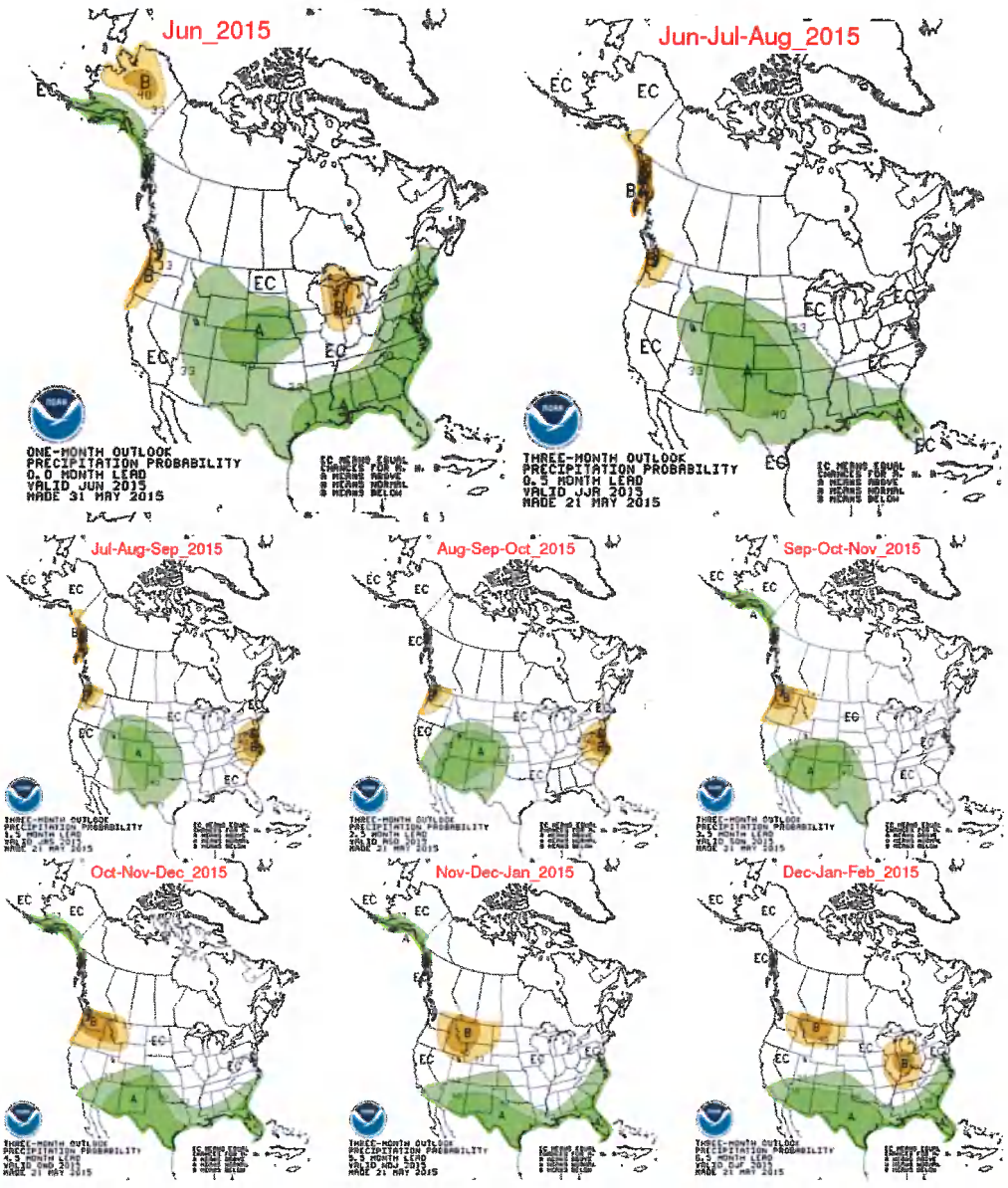
Figure 3.
Mid–May IRI/CPC Plume–Based Probabilistic ENSO Forecast



b) The latest National Weather Service precipitation outlook calls for above normal precipitation across Central and South Texas from June through August, In addition, above normal rainfall is also forecast this upcoming fall and winter. *See* Figure 4. Climate Prediction Center forecasters state: "There is good agreement among the NMME (National multimodel ensembles), IMME (International multimodel ensembles) El Niño composites and constructed analogs based both on SSTs (sea surface temperatures) and

current soil moisture conditions for enhanced chances for above median precipitation amounts over much of the CONUS (continental US), extending from the intermountain west to the central and southern Great Plains, and southward to include the southeastern states. El Niño conditions are expected to continue with sufficient strength into the wintertime to produce its typical precipitation impacts. Thus the chances for above-median precipitation are elevated throughout the southern CONUS from October-November-December 2015 through January-February-March 2016." (*See* http://www.cpc.ncep.noaa.gov/products /predictions/90day/fxus05.html last visited June 2, 2015.)

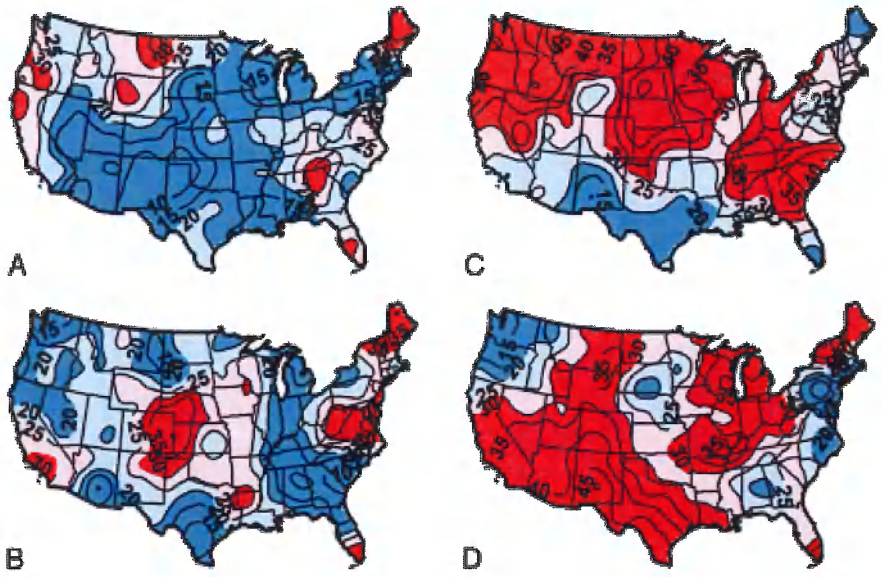
Figure 4. National Weather Service Precipitation Outlook



c) Well above normal sea surface temperatures are currently in place in the tropical Pacific, stretching from the west coast of South America to beyond the International Date Line. These sea surface temperatures are consistent with the presence of a moderate El Niño. Most long-range climate forecast models indicate tropical Pacific waters will remain well above the threshold for El Niño through the upcoming fall and winter. The National Weather Service has now posted an El Niño advisory. NWS forecasters state "By early May 2015, weak to moderate El Niño conditions were reflected by above-average sea surface temperatures (SST) across the equatorial Pacific, and by the corroborating tropical atmospheric response. This coupling includes enhanced convection over the central equatorial Pacific, along with persistent low-level westerly wind anomalies over the western and central equatorial Pacific and persistent upper-level easterly wind anomalies over the central Pacific. Also, the equatorial Southern Oscillation Index (EQSOI) remained negative during the month. Collectively, these features reflect weak to moderate strength El Niño conditions. Nearly all models predict El Niño (3-month values of the Niño-3.4 index 0.5 degrees C or greater) to continue throughout 2015, and many are also predicting SST anomalies to increase during the next several months. These forecasts are supported by the continuation of positive subsurface temperature anomalies, enhanced convection near the Date Line, and the persistence of low-level westerly wind anomalies. Given these factors, it is likely that SST anomalies will continue to increase in the coming months." (*See* http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.html last visited June 2, 2015.) El Niños typically cause a pattern of above normal rainfall across Central Texas during the fall, winter and spring months. El Niño's influence often weakens during summer.

d) In 2004, McCabe et. al. published a statistical study of drought frequency in the lower 48 states versus the Pacific Decadal Oscillation (PDO) and the Atlantic Multidecadal Oscillation (AMO). (*See* Figure 5, below, available at http://www.pnas.org/content/101/12/4136.long.) Over the past year, a belt of warm water developed across the eastern Pacific Ocean, from the Gulf of Alaska south to Mexico. These warmer waters across the eastern Pacific changed the phase of PDO from negative to positive. At the same time, waters in the North Atlantic Ocean cooled, changing the phase of the AMO from positive to negative. Oceanic conditions in both the Atlantic and Pacific Oceans seem to influence long-term drought conditions within the United States. Scientists monitoring both oceans have been able to match the changing phases of multi-decadal oscillations within each ocean to the presence or absence of long-term drought across the U.S. McCabe pointed out the difference between the dust bowl drought in the 1930s when the PDO and AMO were both positive and the multi-year drought of the 1950s over the south central and southwestern U.S. when the PDO was negative and the AMO was positive.

Figure 5. Drought probability for the four classes of Pacific Decadal Oscillation and Atlantic Multidecadal Oscillation



A is Cold (-) AMO and Warm (+) PDO. B is Cold (-) AMO and Cold (-) PDO.
C is Warm (+) AMO and Warm (+) PDO. D is Warm (+) AMO and Cold (-) PDO.

The Pacific and Atlantic Oceans have been indicative of classification D from 2010-2014, suggesting persistent drought for Texas and the southwestern United States. McCabe in 2004 wrote, "Should the current positive AMO (warm North Atlantic) conditions persist into the upcoming decade, we suggest two possible drought scenarios that resemble the continental-scale patterns of the 1930s (positive PDO) and 1950s (negative PDO) drought."

But as of spring 2015, the current state of the Atlantic and Pacific Oceans is now indicative of classification A, suggesting a change to a wetter pattern across Texas and the southern Plains states.

12. Weather Forecast. Based on my experience and a review of data and forecasts from the sources listed above, it is my opinion a general pattern of near normal to above normal rainfall will be in place across Central and South Texas this summer. I expect a pattern of above normal rainfall this fall and winter due to the influence from the moderate to strong El Niño. Historical analogs show a good correlation with above normal rainfall across Texas during the fall and winter months and a moderate or strong El Niño. From a meteorological standpoint, this wetter forecast should cause continued drought improvement and drought elimination across the basin.

13. Further affiant sayeth not.

Bob Rose
BOB ROSE, AFFIANT

SWORN TO AND SUBSCRIBED before me on the 3rd day of June, 2015.

TABETHA JASKE
Notary Public, State of Texas
My Commission Expires
January 11, 2018

Tabetha Jaske
Notary Public in and for the State of Texas

My Commission Expires: 1-11-2018

Tab 1

BOB ROSE

P.O. Box 220
Austin, TX 78767-0220
bob.rose@lcra.org

EDUCATION

Texas A&M University, College Station, Texas
Bachelor of Science in Meteorology 1979.

PROFESSIONAL EMPLOYMENT

Jan 1995 to Present — *Chief Meteorologist,* **Lower Colorado River Authority, Austin, Texas**

- Responsible for the daily forecast of weather conditions and temperatures affecting the Lower Colorado River Authority's power generation, electrical transmission, flood control and water supply operations.
- Produce a daily weather blog about Central Texas weather: http://www.lcra.org/water/conditions/weather/weather_column.html
- Write daily operational weather briefs to keep all departments of LCRA apprised of expected weather conditions.
- Provide advance notice significant weather event e mails to emergency management officials, county judges along with city and state agencies.
- Present a bi-weekly video weather blog about Central Texas weather. Give numerous talks to various civic groups and organizations about the weather.
- Provide weather information to a number of newspapers and media outlets across Central Texas about regional weather.

Feb 1988 to Jan 1995 — *Meteorologist,* **KVUE-TV (ABC), Austin, Texas**

- Responsible for the morning and midday newscasts for 4 years, weekend newscasts for 3 years.
- Prepared a weekly astronomical report called Skywatch, and did occasional science and environmental reporting.

Sep 1978 to Jan 1988 — *Weekend Meteorologist,* **KBTX-TV, Bryan, Texas (ABC/CBS).**

- Responsible for the forecasting, preparation and presentation of the 10 PM weekend weathercasts.

PROFESSIONAL MEMBERSHIPS

Member, American Meteorological Society. TV Seal #501, AMS Certified Broadcast Meteorologist.
Member, Austin-San Antonio chapter, American Meteorological Society
Currently serving on the Board for Private Sector Meteorology with the American Meteorological Society

RELATED ACTIVITES:

A regular contributor to the National Drought Monitor.
Member of the Southern Climate Impacts Planning Program (SCIPP)
Travis and Williamson County Coordinator for CoCoRaHS