

**APPLICATION OF THE
LOWER COLORADO RIVER
AUTHORITY FOR EMERGENCY
AUTHORIZATION**

§
§
§
§

**BEFORE THE
TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY**

AFFIDAVIT OF BOB ROSE

THE STATE OF TEXAS

§
§
§

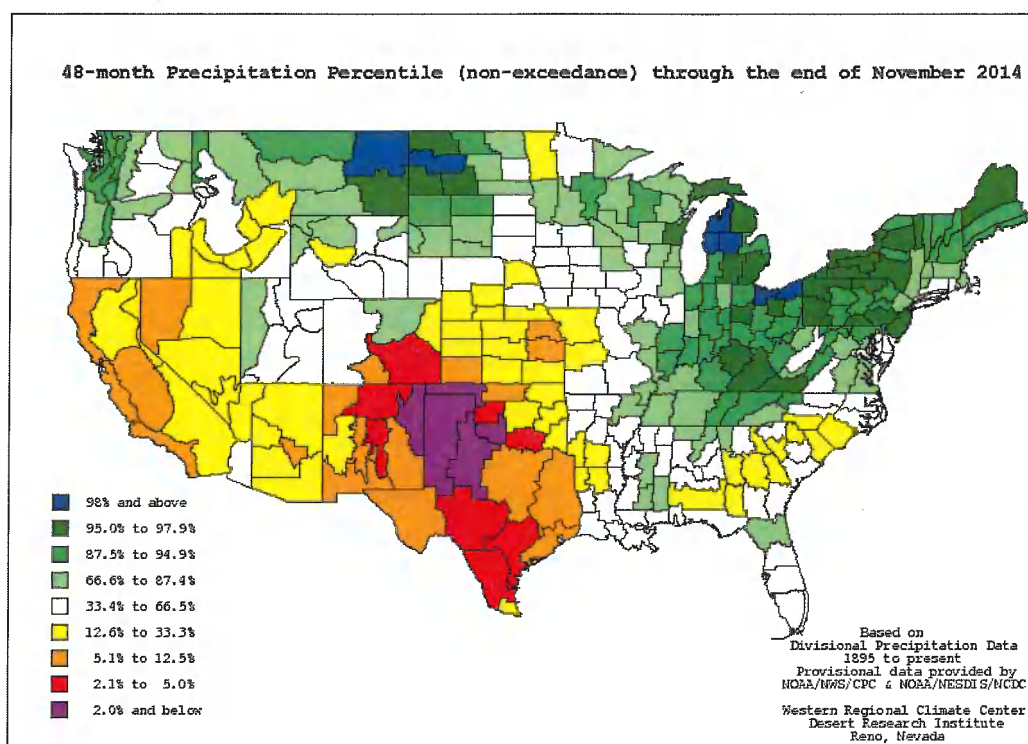
COUNTY OF TRAVIS

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 affidavit are within my personal knowledge and are true and correct.
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) While 2014 started off unusually dry, significant rains occurred in the spring and fall months bringing totals close to normal. January through November statewide rainfall totaled 22.70 inches, 2.60 inches below normal. This January through November period is the 36th driest on record, dating back to 1895. (Available at <http://www.ncdc.noaa.gov/temp-and-precip/ climatological-rankings/index.php?periods%5B%5D=11¶meter=pcp &state=41&div=0&month=11&year=2014> last visited on December 15, 2014.)
 - c) 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¶meter=pcp&state=41&div=0 &month=10&year=2014> last visited Dec. 15, 2014.)
 - d) According to data provided by NOAA's Western Regional Climate Center, 48 month rainfall (October 2010-November 2014) across the Hill Country and Central Texas regions ranked in 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.)

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

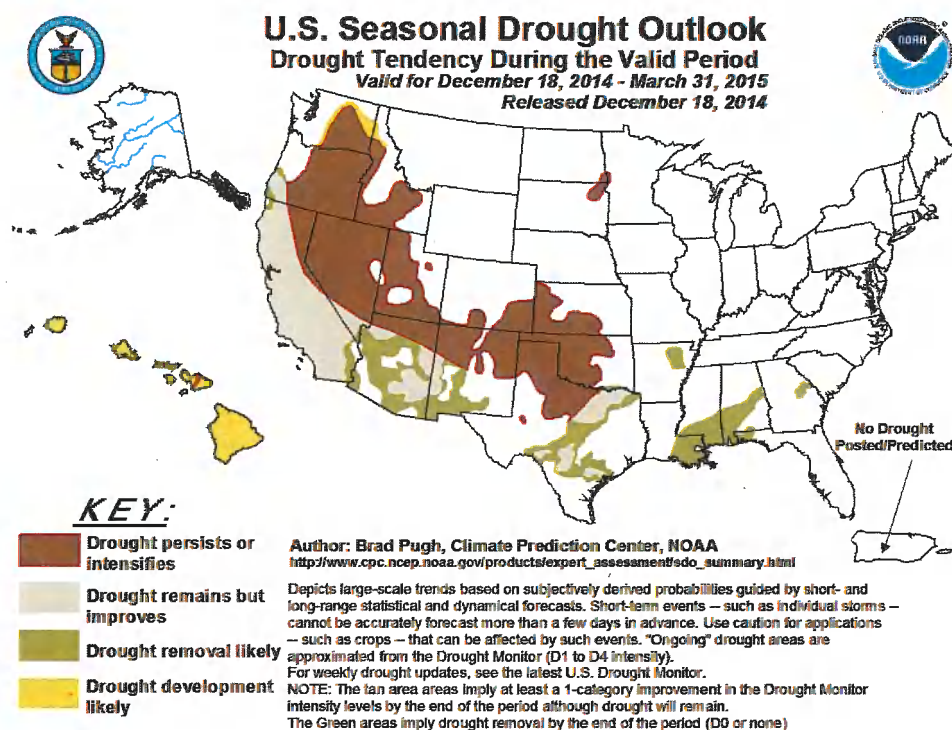


8. Recent rain events and corresponding runoff and inflows to the Highland Lakes have been compared to events from 2007. The sporadic nature of rain events has produced well below average runoff over the past four years. (See Affidavit of Ryan Rowney.)
 - a) Heavy, widespread rainfall in the Llano River 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) 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.

9. According to the mid-December U.S. National Drought Monitor, a product of the National Weather Service, the U.S. Department of Agriculture, and the National Drought Mitigation Center, much of the Texas Hill Country was designated as being in “moderate to severe drought,” the first and second of four drought classifications. Much of Central Texas and the coastal plains region were shown as being in moderate drought or “abnormally dry” due to significant rains in November. Note, the Drought Monitor does not specifically depict the state’s hydrologic drought, which is considerably worse than depicted. (See <http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?TX> last visited Dec. 18, 2014.)
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 US 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 drought improvement and possible drought elimination across the Hill Country, Central Texas and middle Texas coastal regions between the months of December and March. See Figure 2.

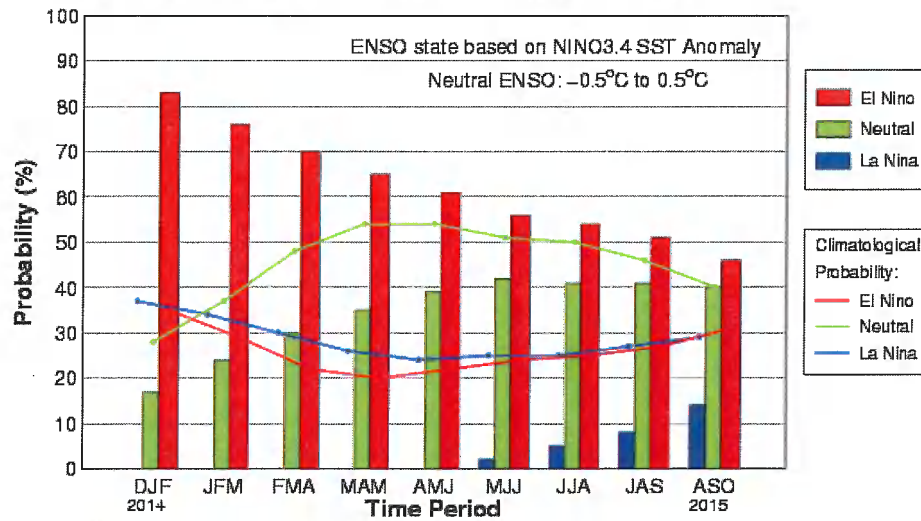
Figure 2.



According to CPC forecasters, “Varying intensity of drought persists across the central and southern Great Plains with exceptional drought centered over southwest Oklahoma and northwest Texas. Although a tilt in the odds towards above-median precipitation during [January-February-March] is forecast for the central and southern Great Plains, a relatively dry climatology favors persistence on a broad scale. (Drought) Improvement and/or removal is forecast for the remaining drought areas of Texas where the climatology during JFM is not as dry (as Kansas, western Oklahoma and northwestern Texas. Forecast confidence for the Kansas, western Oklahoma, and northwest Texas is moderate and low for the remainder of Texas.” (Available at http://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_discussion.html.)

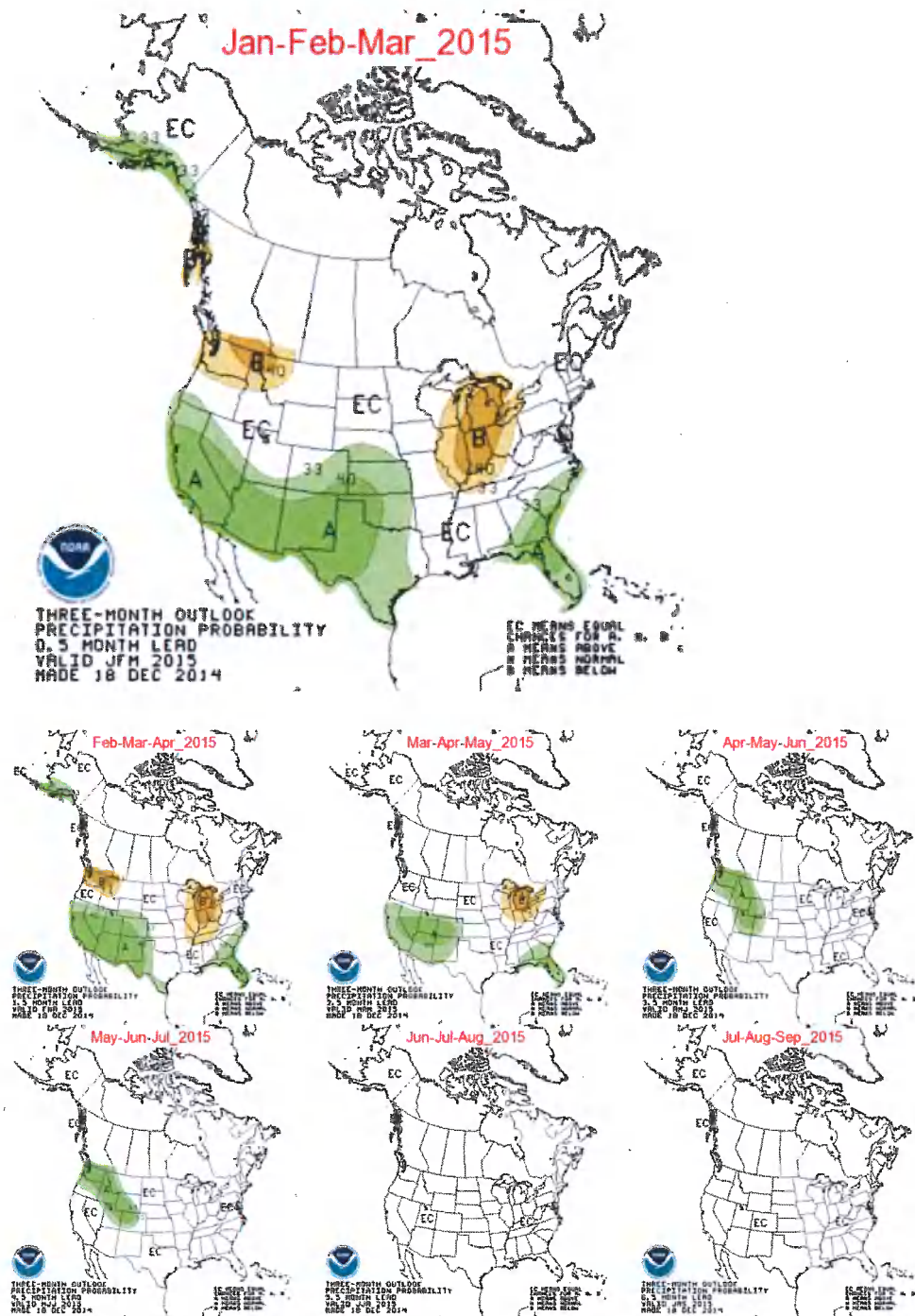
The International Research Institute, a partner of the National Weather Service’s Climate Prediction Center, forecasts a 70 to 80 percent probability for El Niño development this winter. A 60 to 70 percent chance for continued El Niño conditions is forecast from late winter through late spring. (See Figure 3, available at <http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current> (last visited Dec. 18, 2014.)

Figure 3.
Mid-Dec 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 this winter, with conditions becoming more uncertain late winter through spring. No clear trend in precipitation is forecast beyond winter. See Figures 4 and 5. Climate Prediction Center forecasters state: "The elevated chances for a weak El Niño event influences the precipitation maps through February/March/April 2015. Dynamical model forecasts from the NMME and IMME and their participant models generally support warm event composites. Precipitation forecasts from the global SST based constructed analog tools was also considered. The chances for above median precipitation amounts are elevated for California, across the Southwest parts of the southern Great Basin the southern Plains and the southeast CONUS from January/February/March through through February/March/April 2015." (See <http://www.cpc.ncep.noaa.gov/products/predictions/90day/fxus05.html> last visited Dec, 18, 2014.)

Figure 4. National Weather Service Precipitation Outlook



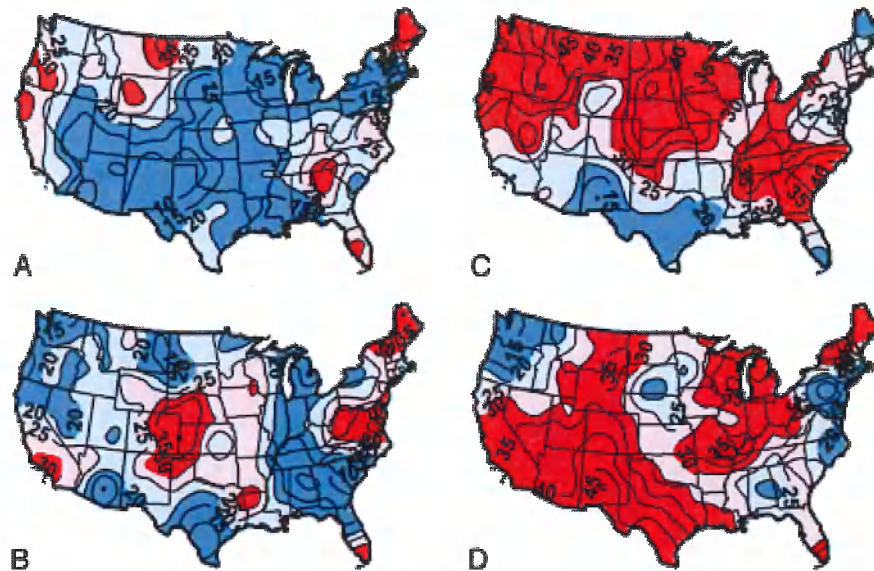
- c) Sea surface temperatures in the tropical Pacific are currently warmer than normal and above the threshold necessary for the development of El Niño. Most long-range climate forecast models indicate tropical Pacific waters will remain above the threshold for El Niño through late spring and possibly through summer. An El Niño watch remains posted. But while most indices such as sea surface temperature indicate El Niño, the National Weather

Service has yet to declare the arrival of El Niño conditions. NWS forecasters state “Although the sea surface temperature anomalies alone might imply weak El Niño conditions, the patterns of wind and rainfall anomalies generally do not clearly indicate a coupling of the atmosphere to the ocean. Therefore, despite movement toward El Niño from one month ago, the combined atmospheric and oceanic state remains ENSO-neutral.” (See http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.html last visited Dec. 15, 2014.) However, National Weather Service forecasters do believe this ocean/atmosphere coupling will develop later this winter, allowing a series of Pacific storm systems to track across Texas and the southern US. The forecasters thus expect a weak El Niño to develop and persist into early spring.

El Niños typically cause a pattern of above normal rainfall across Central Texas during the fall and winter months. But the El Niño influence often weakens during spring. Furthermore, it is important to note that the development of El Niño this winter is still far from certain since the ocean has had a difficult time linking up with the atmosphere. Back in August of 2012, tropical Pacific waters reached the threshold for an El Niño but sea surface temperatures unexpectedly cooled in September and October, and the El Niño failed to develop. By November of 2012, the Climate Prediction Center canceled the El Niño watch as Pacific waters continued to cool.

- d) In 2004, McCabe et. al. published a statistical study of drought frequency in the lower 48 states versus the PDO and Atlantic Multidecadal Oscillation (AMO). (See Figure 5, below, available at <http://www.pnas.org/content/101/12/4136.long>.) Currently, the Pacific Ocean is in the midst of a negative phase of the PDO where waters on the eastern side of the Pacific are unusually cool. At the same time, waters in the North Atlantic Ocean are unusually warm, a result of the positive phase of the AMO. 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 drought across the US. 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 US when the PDO was cold and the AMO was warm.

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 current conditions are indicative of classification D which indicates 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."

12. While longer-term projections are far from certain, the majority of the long-range dynamic and statistical climate models currently indicate the tropical Pacific waters will remain warmer than normal from late spring through late summer (although below the threshold for El Niño) with some models calling for the development of another El Niño next fall.
13. 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 above normal rainfall will be in place across Central and South Texas this winter into early spring due to the possible development of El Niño. However, the forecast beyond early spring is fairly uncertain due to the weakening El Niño (should it actually develop) and few other notable atmospheric trends. The pattern of above normal rainfall this winter and early spring should lead to drought improvement across much of Texas. However, the pattern isn't expected to be in place long enough to eliminate the long-term effects of the ongoing drought. With similar oceanic conditions in the Pacific and Atlantic to what was in place in the 1950s, it is quite possible that Texas is in the grip of a multi-year drought period, along the lines of what was observed in the drought years of the 1950s.

Further affiant sayeth not.

Bob Rose

BOB ROSE, AFFIANT

SWORN TO AND SUBSCRIBED before me on the 19th day of
December, 2014.



Tabetha Jaske

Notary Public in and for the State of Texas

My Commission Expires: 1-11-2018

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 | <p><i>Chief Meteorologist, Lower Colorado River Authority, Austin, Texas</i></p> <ul style="list-style-type: none"> • 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 | <p><i>Meteorologist, KVUE-TV (ABC), Austin, Texas</i></p> <ul style="list-style-type: none"> • 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 | <p><i>Weekend Meteorologist, KBTX-TV, Bryan, Texas (ABC/CBS).</i></p> <ul style="list-style-type: none"> • 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 ACTIVITIES:

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