Storm Signals

Houston/Galveston National Weather Service Office

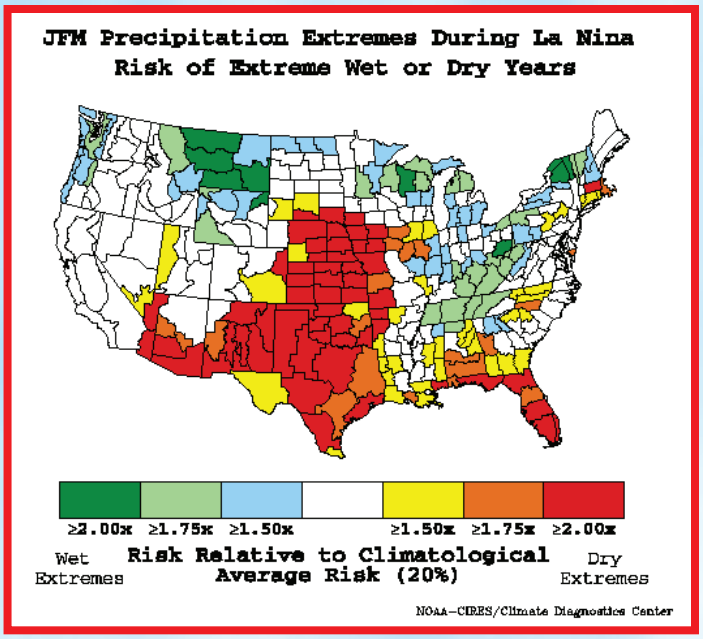
Volume 87 Sept 2011

Exceptional Drought Continues Across Southeast Texas

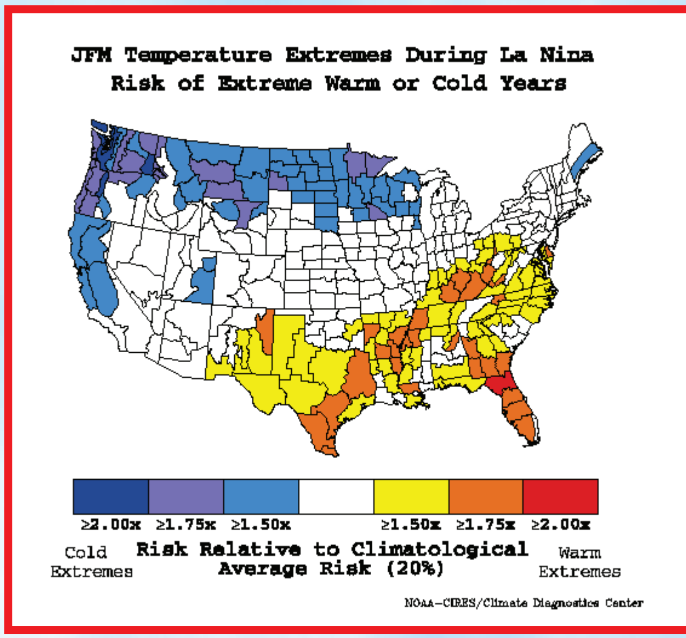
By Charles Roeseler

A nine month drought has left Southeast Texas parched. The lack of rain, record warmth and gusty winds has hindered agricultural interests and water resource managers. Although Southeast Texas suffered a rainfall deficit in 2009 and again in 2010, the drought intensified significantly during February 2011. The spring of 2011 was the driest such period on record for most of Southeast Texas. Rainfall deficits since October 1st 2010 exceed 20 inches and are approaching values between 25 and 27 inches below normal.

How did the drought of 2010-2011 develop? First, let's define a few terms. An El Nino is a term used to describe warmer than normal temperatures of the central equatorial Pacific ocean. A La Nina is the opposite or cooler than normal temperatures of the central equatorial Pacific ocean. These particular ocean phenomena have an effect on atmospheric circulations. Certain inferences can be made if a strong La Nina or El Nino episode is forecast. A weak El Nino episode was forecast to come to an end in the spring of 2010 and a strong La Nina episode was forecast to develop during the summer of 2010. The La Nina was expected to persist through the autumn and winter, ending in early summer. A La Nina episode will typically bring warmer and drier conditions to Southeast Texas during the fall and winter.



Jan - Feb - Mar precipitation extremes forecast



Jan - Feb - Mar temperature extremes forecast

Exceptional Drought Continues Across Southeast Texas

The stronger the La Nina signal generally corresponds to stronger effects such as record warmth or record dryness. The Oceanic Nino Index (ONI) for this La Nina was one of the stronger signals in recent history and compared rather favorably with other significant droughts to affect Southeast Texas such as the drought of 1954-1956. Here is a breakdown of the ONI for this La Nina event as it compares with other significant drought events:

YEAR	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1954	0.5	0.3	-0.1	-0.5	-0.7	-0.7	-0.8	-1.0	-1.2	-1.1	-1.1	-1.1
1955	-1.0	-0.9	-0.9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.4	-1.8	-2.0	-1.9
1956	-1.3	-0.9	-0.7	-0.6	-0.6	-0.6	-0.7	-0.8	-0.8	-0.9	-0.9	-0.8
1957	-0.5	-0.1	0.3	0.6	0.7	0.9	0.9	0.9	0.9	1.0	1.2	1.5
1973	1.8	1.2	0.5	-0.1	-0.6	-0.9	-1.1	-1.3	-1.4	-1.7	-2.0	-2.1
1974	-1.9	-1.7	-1.3	-1.1	-0.9	-0.8	-0.6	-0.5	-0.5	-0.7	-0.9	-0.7
1975	-0.6	-0.6	-0.7	-0.8	-0.9	-1.1	-1.2	-1.3	-1.5	-1.6	-1.7	-1.7
1976	-1.6	-1.2	-0.8	-0.6	-0.5	-0.2	0.1	0.3	0.5	0.7	0.8	0.7
2007	0.8	0.4	0.1	-0.1	-0.1	-0.1	-0.1	-0.4	-0.7	-1.0	-1.1	-1.3
2008	-1.4	-1.4	-1.1	-0.8	-0.6	-0.4	-0.1	0.0	0.0	0.0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	0.6	0.7	0.8	0.9	1.2	1.5	1.8
2010	1.7	1.5	1.2	0.8	0.3	-0.2	-0.6	-1.0	-1.3	-1.4	-1.4	-1.4
2011	-1.3	-1.2	-0.9	-0.6	-0.2	0.0						

Blue numbers represent La Nina episodes
Red numbers represent El Nino episodes
Black numbers represent neutral conditions

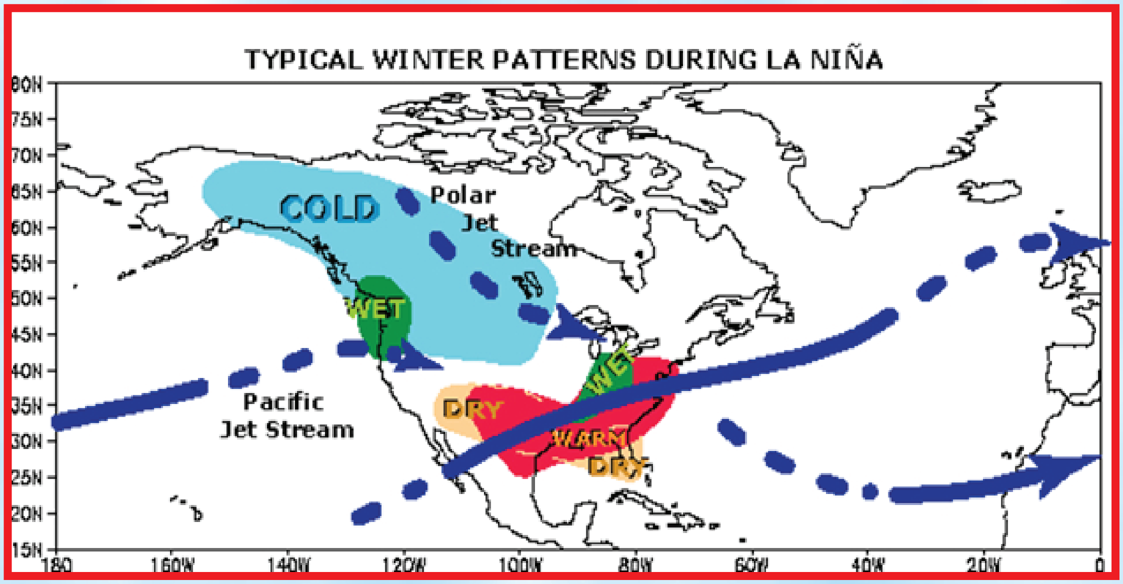
Let's take a look at the yearly rainfall for these La Nina years and compare them to each other and to the 30 year climatological normal (1971 - 2000). 2011 data is through June 30^{th}.

Year	City of Houston	Houston Hobby	College Station	Galveston	Danevang
Normal	47.84	53.96	39.67	43.84	45.37
1954	31.78	28.76	26.92	22.29	18.85
1955	41.08	41.88	25.08	34.09	30.96
1956	31.56	28.32	23.09	21.84	20.38
1957	57.27	61.11	56.10	37.31	55.86
1973	70.16	80.59	59.81	60.47	63.34
1974	49.29	57.97	49.89	43.26	50.21
1975	50.97	49.07	38.00	48.54	36.36
1976	54.62	69.66	43.20	42.06	45.21
2007	65.52	68.06	41.53	50.92	60.31
2008	53.00	56.26	30.70	35.80	36.59
2009	47.01	52.56	38.97	37.16	32.83
2010	42.72	46.99	27.78	33.14	50.86
2011	7.07	5.41	8.08	7.84	6.19

Exceptional Drought Continues Across Southeast Texas

The strong La Nina in the 1950's brought very dry conditions to Southeast Texas. The most recent La Nina in 2010-11 also brought very dry conditions to the region. There is an anomaly in the data set and that occurred during the strong La Nina of the 1970's.

Why do La Nina events generally bring warmer and drier weather to Southeast Texas? The jet stream is displaced to the north and this allows upper level ridging to build into Texas shunting storm systems to the north and east of the region. Here is an image that can illustrate the type of weather pattern that has dominated Southeast Texas:



The last significant rain event to affect Southeast Texas was in September 2010 when Tropical Storm Hermine made landfall well to the south. Moisture was pulled northward and parts of the region received over 10 inches of rain during the month. It was like someone turned off a spigot in October and nary a drop of rain fell over the region. Although droughts never really have a start or end date, it was apparent in October that drought conditions were here and the only question left unanswered was how severe would this drought event be and when will drought conditions abate? We now know that the drought of 2010-2011 is one of the most severe droughts that this region has faced. It is currently either the driest or second driest period on record for most of Southeast Texas.

Drought conditions lingered through November and much of December with areas north of Houston suffering the greatest rainfall deficits. There were pockets of heavier rain near the coast in early November, late December and early January. Rainfall amounts were much lighter over the northern half of the region. Somerville tallied 4.97 inches of rain between October and March while College Station reported an even 6.00 inches of rain during the same six month period. Houston Hobby and Galveston were fortunate to receive some heavy rain in late December and early January as several strong fronts crossed the coast. Some thought that the La Nina was not as strong as forecast and the area dodged a bullet. Ah, such optimism was misguided. Conditions changed radically in February. The month of February began on a very cold note and the first 14 days of the month rivaled the coldest start to any February in recorded history. It was like someone turned on a light switch on February 15th. Everything changed. Temperatures began to warm and precipitation came to an end. The drought intensified greatly in February and has increased in intensity since then. The city of Houston failed to tally an inch of rain in February, March, April, May and June. The city has never endured five consecutive months with less than an inch of rain per month.

Exceptional Drought Continues Across Southeast Texas

The U.S. Drought monitor classifies droughts on a scale from D0 through D4. Here is a brief definition of each of the drought classifications.

D4 - Exceptional drought – Exceptional or widespread crop/pasture loss
A shortage of water in reservoirs and streams creating a water emergency.

D3 – Extreme drought - Major crop/pasture losses. Widespread water shortages and restrictions.

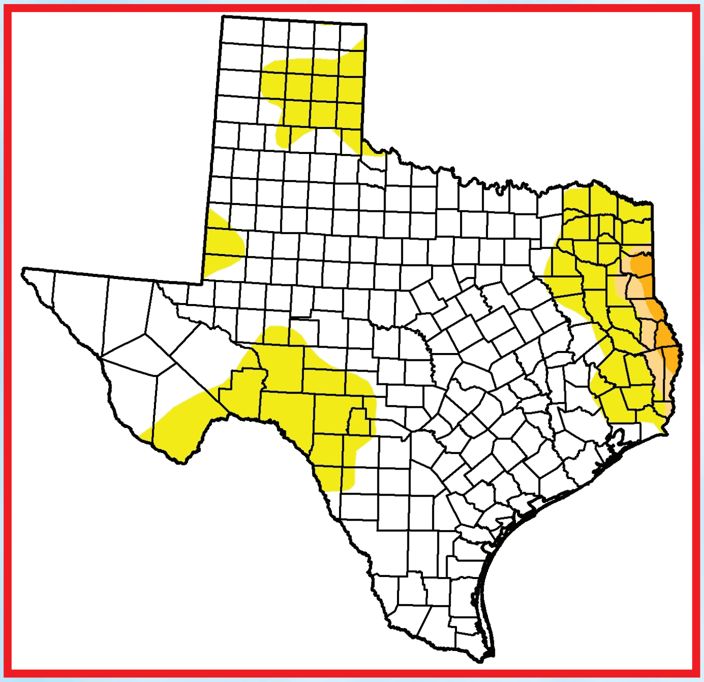
D2 – Severe drought - Crop or pasture losses likely. Some water shortages common and some water restrictions imposed.

D1 – Moderate drought – Some damage to crops and pastures. Reservoirs or wells low. Voluntary water restrictions imposed.

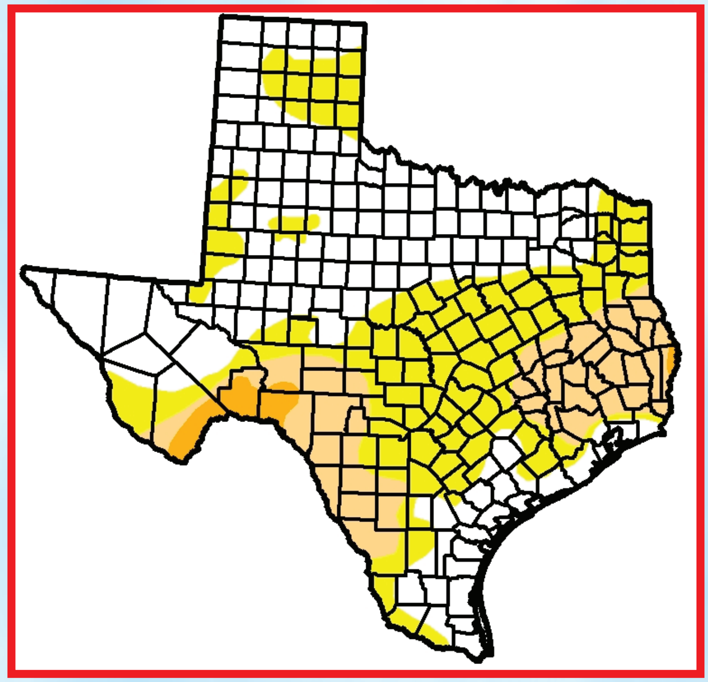
D0 - Abnormally dry – Short term dryness. Plant growth slows. Minor water deficits.

A series of maps on the next two pages chronicle how the drought has intensified and expanded across the state of Texas. Notice how the drought expands westward into East Texas from Louisiana during the fall. Drought conditions blossom during the fall over much of South Texas. D3 conditions appear in December. Conditions briefly improve in January before drought conditions intensify during the spring. D4 conditions make their first appearance over parts of Southeast Texas in early April. D4 conditions now cover almost 65 percent of the state.

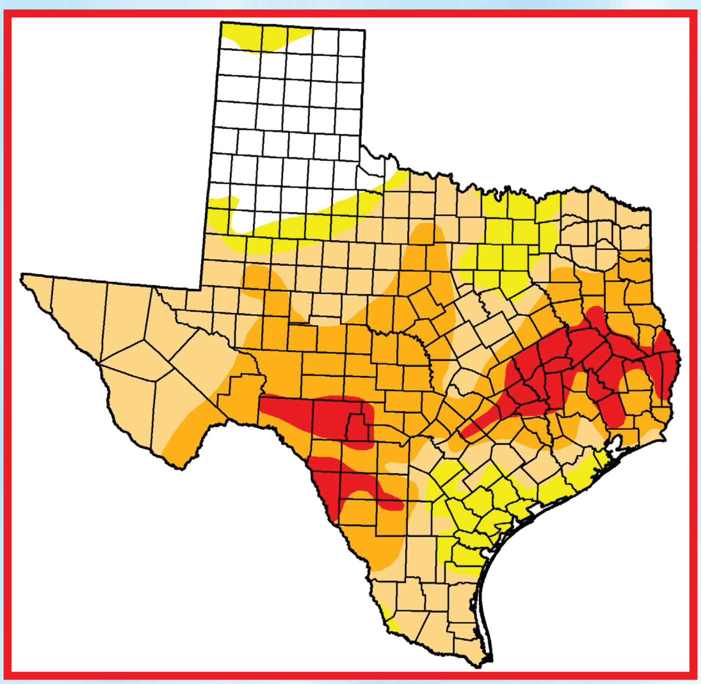
Exceptional Drought Continues Across Southeast Texas



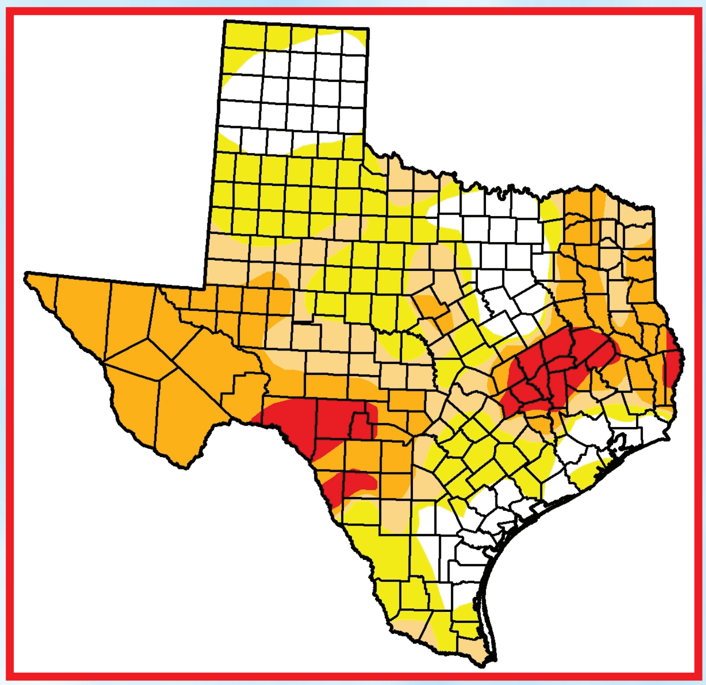
October 5, 2010



November 2, 2010



December 21, 2010



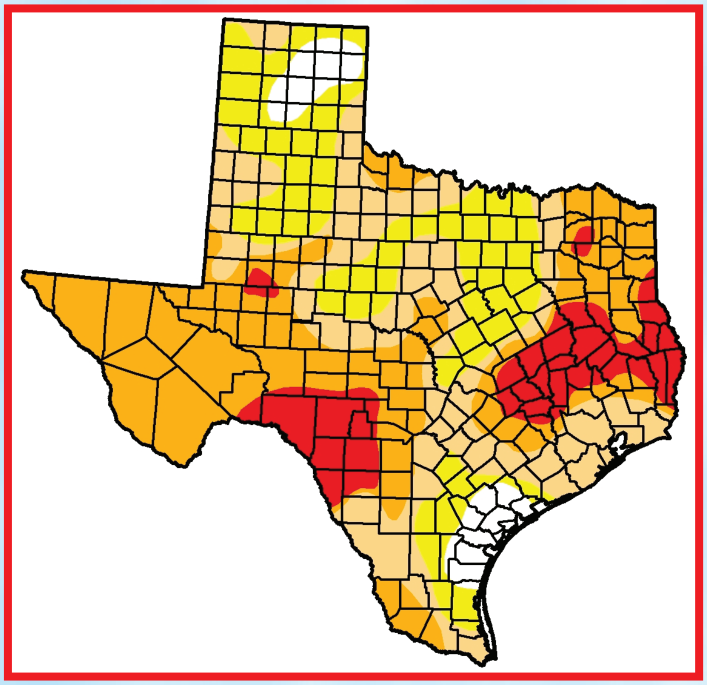
February 1, 2011

Drought Severity

- D0 - Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Texas drought conditions

Exceptional Drought Continues Across Southeast Texas



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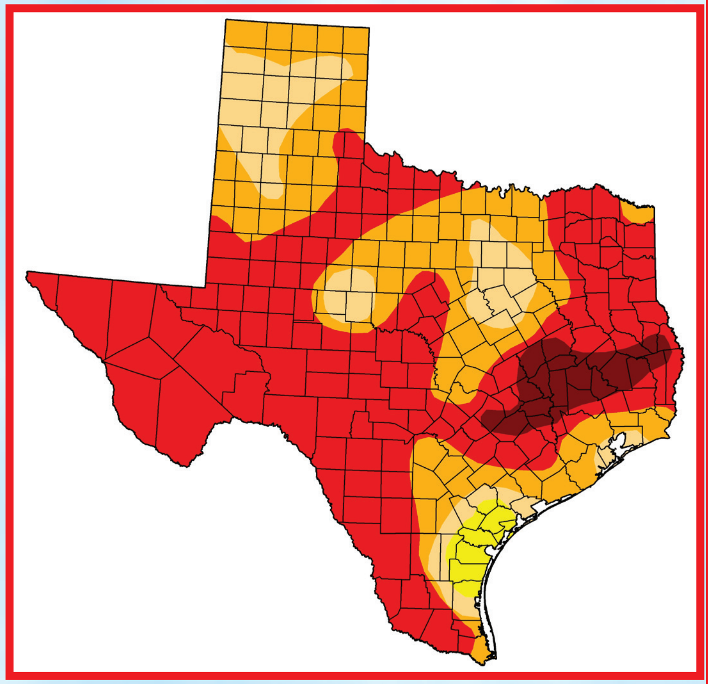
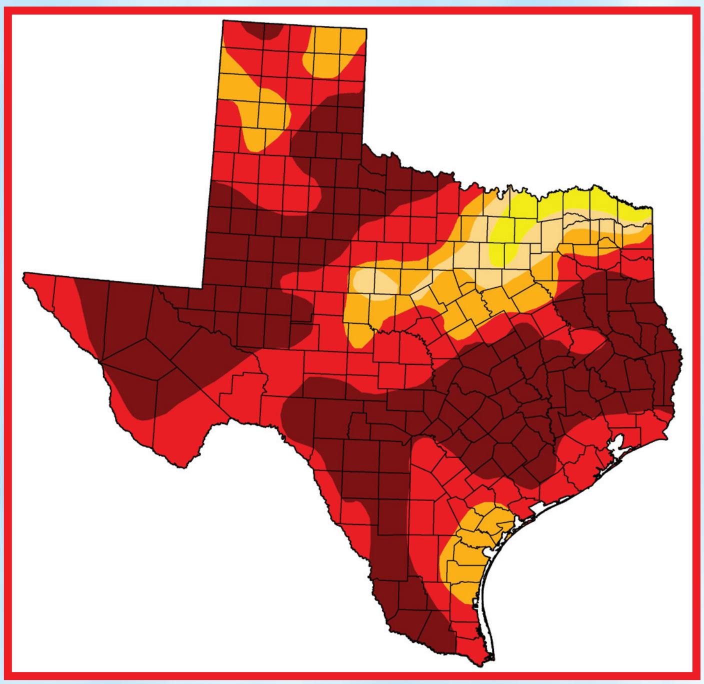
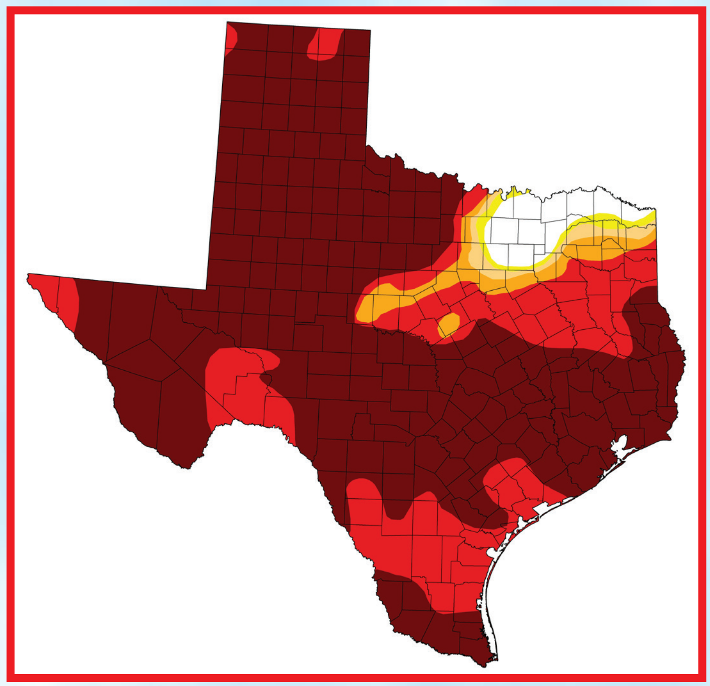


April 5, 2011



May 10,2011



June 21, 2011

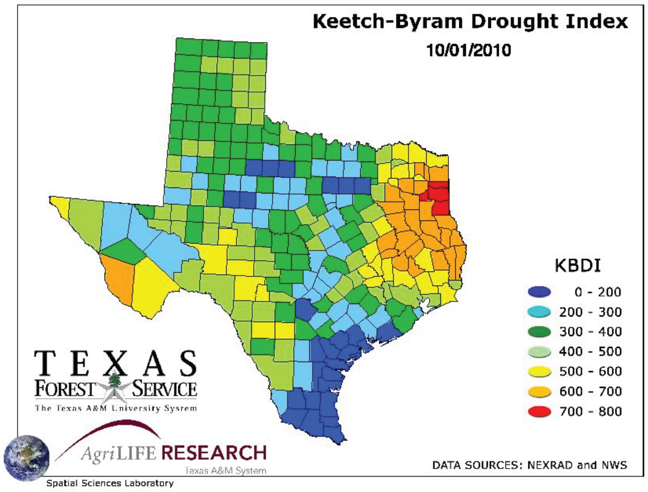
Texas Drought Conditions

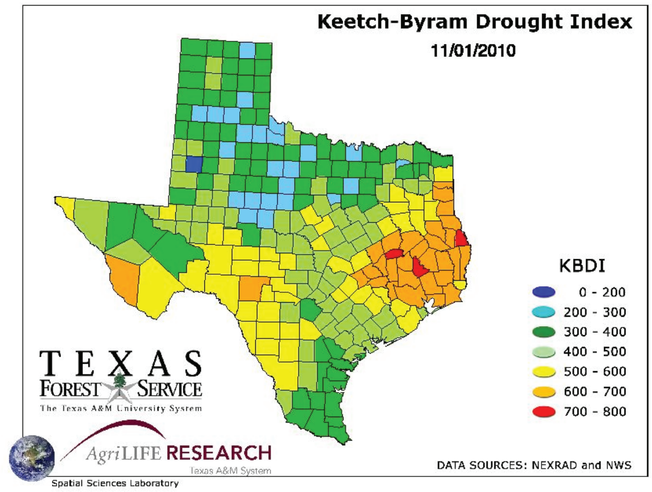
Drought Severity

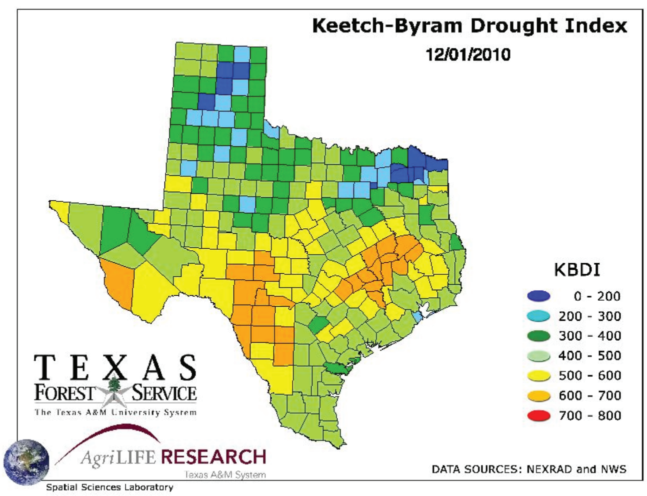
- D0 - Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

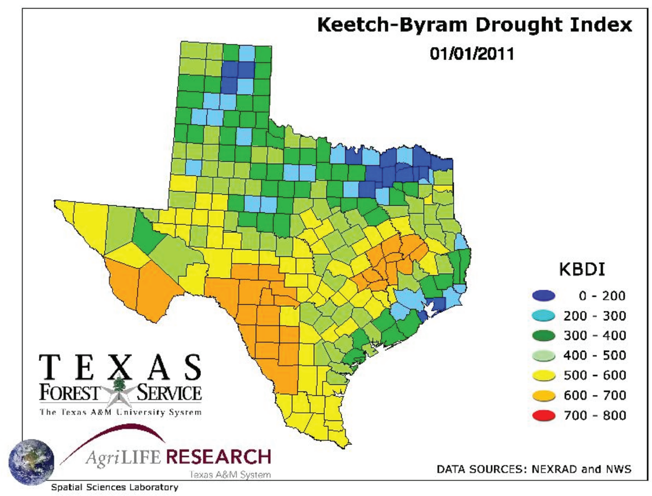
Exceptional Drought Continues Across Southeast Texas

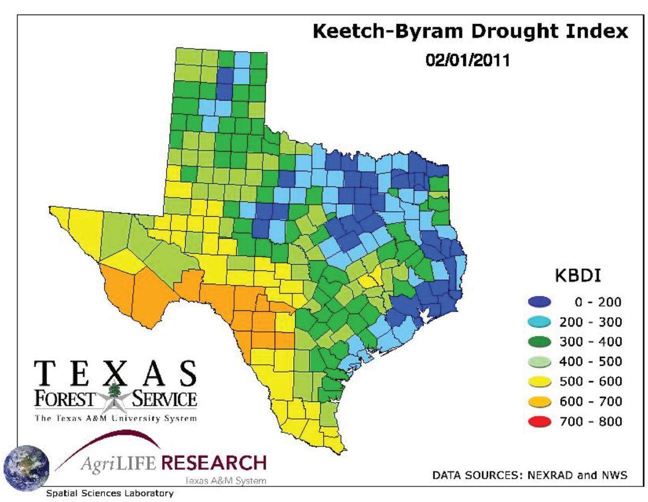
The lack of rain was disruptive enough, but toss in record warmth and strong winds and you have a the perfect recipe for dangerous fire weather conditions. Burn bans were hoisted area wide. KBDI numbers increased to values greater than 700. Here are the KBDI images for the first day of each month to show how fire weather conditions have deteriorated across Southeast Texas:

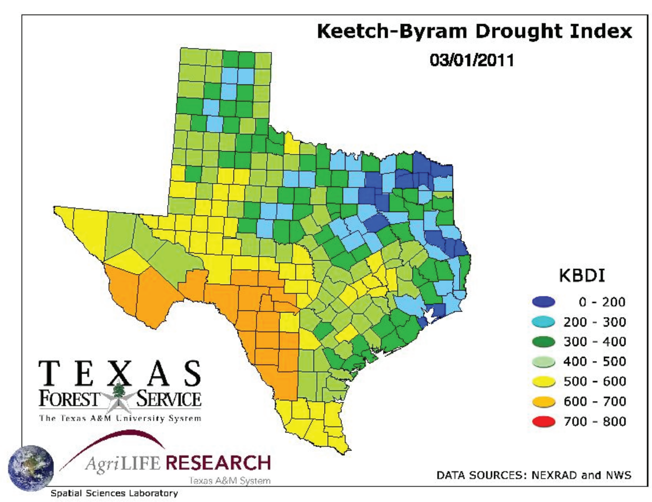












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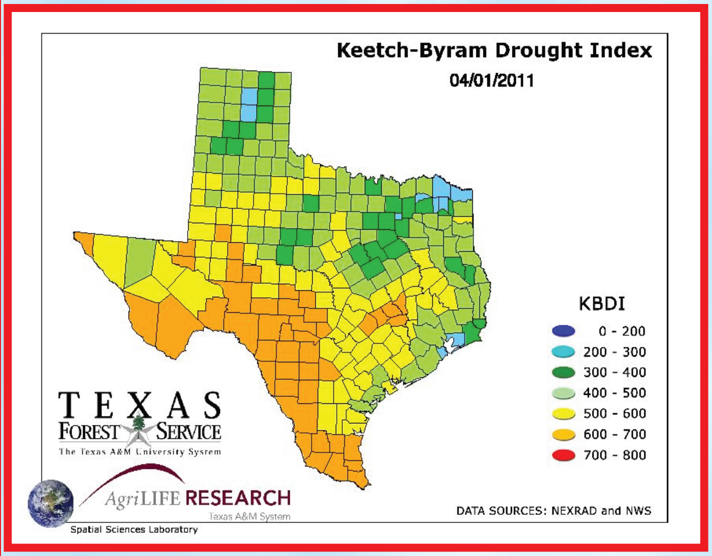

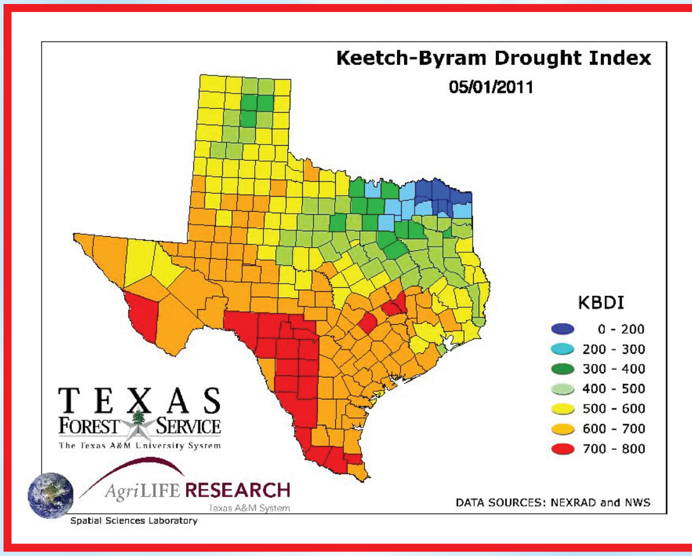

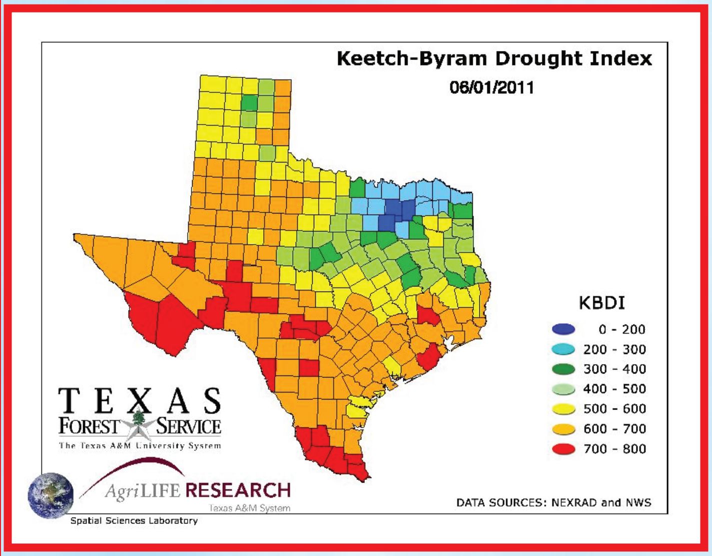

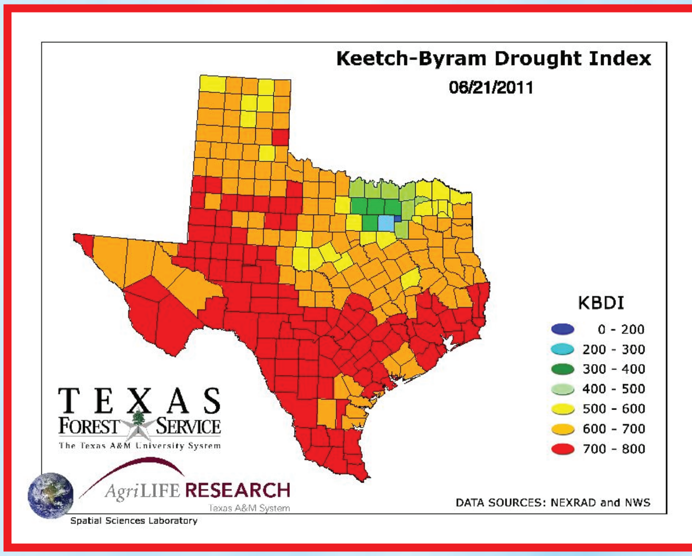

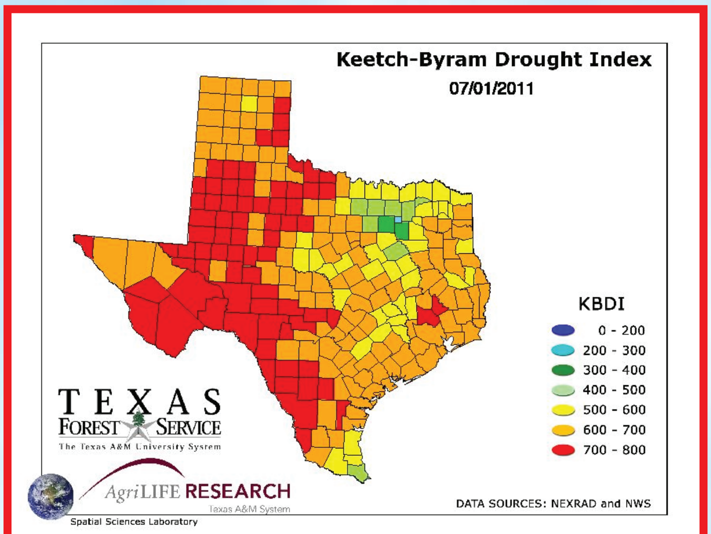

It is clear that conditions deteriorated during the fall, improved a bit in winter and then completely crashed during spring. Fire weather conditions will remain critical through the summer until heavy rains return.

During mid-June, KBDI values increased to 750 over parts of Harris, Brazoria, Montgomery and San Jacinto counties. Values over 700 indicate the potential for extreme wild fire behavior. Three significant wild fires burned over 30,000 acres around Father's Day. The Bearing fire in Polk and Trinity counties burned over 22,200 acres, the Dyer Mills fire in Grimes county burned over 5500 acres and the Midway fire in Walker and Madison counties burned 4500 acres. The image above (dated 06/21/2011) is at the peak of the fires and the image to the left (dated 07/01/2011) is in the wake of some late June rains.

Exceptional Drought Continues Across Southeast Texas

Agriculture has also been widely affected. The winter wheat crop has been at 73 percent poor or very poor across the state. Corn has already tassled out and turned yellowish brown. Soybeans struggled and yields were well below normal. The only crop doing reasonably well is grain sorghum and even this crop has struggled during the drought. To the right is a picture of a corn field that already tasseled out and turned yellow in May near Hockley Texas.

The lack of rain has been the primary weather story for 2011 but how far below average are we? Below is a table with the monthly rainfall totals for some locations across Southeast Texas since October 1st.

Location	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Anahuac	0.30	4.67	4.72	3.93	0.82	1.34	0.04	0.60	2.87	19.29
Normal	4.06	4.31	4.30	4.84	2.83	3.33	3.56	5.22	5.88	38.33
Dep										-19.04
Angleton	0.08	3.95	1.62	3.52	1.13	1.36	0.04	0.30	1.70	13.70
Normal	4.25	4.86	4.17	4.76	3.50	3.76	3.74	5.20	6.44	40.68
Dep										-26.98
Bellville	T	1.28	0.98	2.75	0.76	1.14	0.04	1.21	2.45	10.61
Normal	3.70	3.76	3.16	3.33	2.48	2.92	3.25	5.64	3.58	31.82
Dep										-21.22
Brenham	0.03	1.45	1.28	4.15	0.81	0.80	0.02	2.19	2.87	13.57
Normal	4.48	4.17	3.29	3.41	2.78	2.93	3.39	5.14	4.66	34.25
Dep										-20.68
Cleveland	0.02	7.24	2.38	4.56	0.85	1.66	2.93	1.97	0.84	22.45
Normal	5.34	5.25	4.85	4.76	3.79	4.04	3.75	5.89	5.32	42.99
Dep										-20.54
Col Station	T	0.90	0.81	2.99	0.61	0.69	T	3.37	2.87	12.24
Normal	4.22	3.18	3.23	3.32	2.38	2.84	3.20	5.05	3.79	31.21
Dep										-18.97
Columbus	0.00	2.59	1.30	3.51	0.64	0.48	0.05	1.80	3.80	14.17
Normal	4.16	3.99	3.21	3.61	2.84	2.93	3.57	5.75	5.03	35.09
Dep										-20.92
Conroe	T	5.33	1.49	4.04	0.61	0.35	0.41	0.66	1.45	14.34
Normal	4.70	4.79	4.37	4.21	2.97	2.94	3.85	5.50	4.58	37.91
Dep										-23.56
Crockett	0.85	3.43	1.12	5.29	0.70	0.35	3.28	2.41	1.18	18.61
Normal	4.22	3.93	4.02	4.00	3.10	3.45	3.87	4.66	4.46	35.71
Dep										-17.10
Danevang	0.03	2.40	4.28	3.81	0.62	0.05	0.02	1.63	2.88	15.72
Normal	4.56	3.68	3.08	3.23	2.67	2.83	2.63	5.08	4.83	32.59
Dep										-16.87
Galveston	1.37	6.90	2.13	3.86	0.67	2.70	0.12	0.38	0.94	19.07
Normal	3.49	3.64	3.53	4.08	2.61	2.76	2.56	3.70	4.04	30.41

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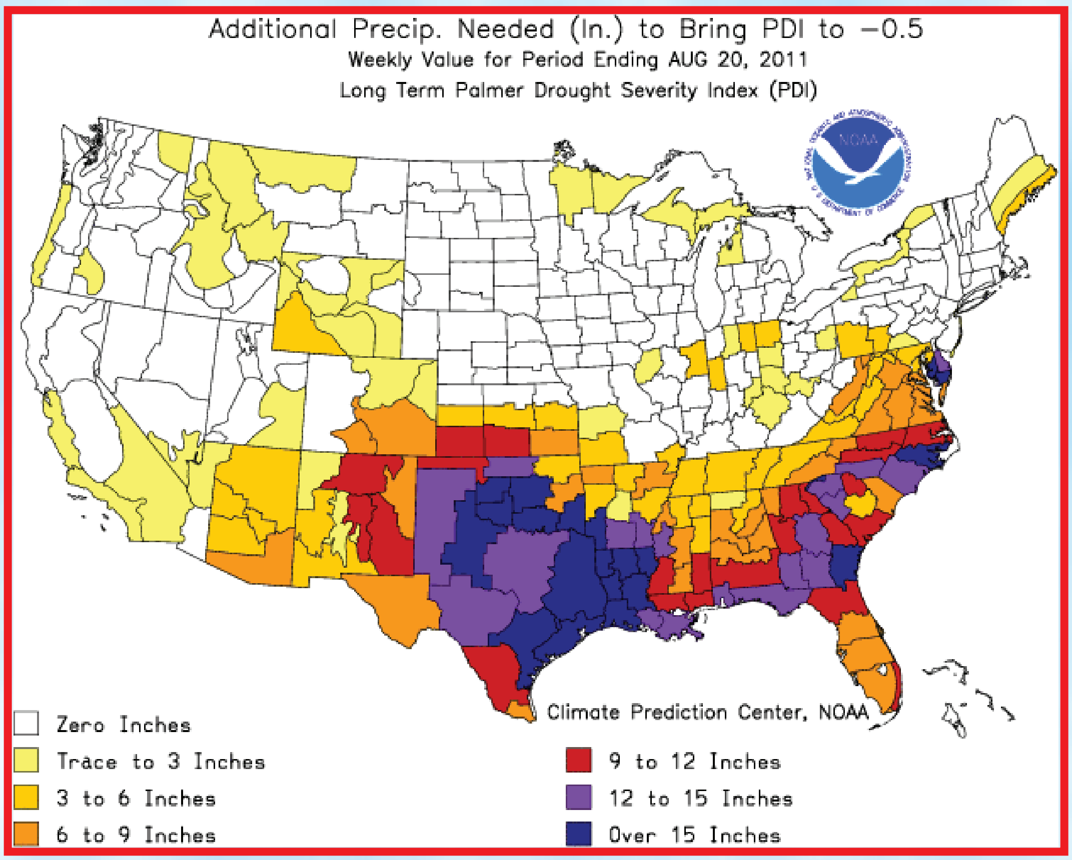
Dep										-11.34
Location	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Total**
Houston	0.02	2.71	3.04	5.05	0.69	0.78	0.11	0.33	0.92	13.65
Normal	4.50	4.19	3.69	3.68	2.98	3.36	3.60	5.15	5.35	36.50
Dep										-22.85
Hou Hobby	0.07	4.76	5.84	4.10	0.34	0.78	T	0.19	1.79	17.87
Normal	5.26	4.54	3.78	4.25	3.01	3.19	3.46	5.11	6.84	39.44
Dep										-21.57
Houston NWS	1.27	7.66	3.91	3.28	1.56	1.96	0.02	0.10	2.54	22.30
Normal	5.82	5.16	4.43	4.94	3.14	3.54	4.09	4.34	6.71	42.17
Dep										-19.87
Hou Westbury	T	5.54	4.81	3.46	0.86	0.63	0.05	0.82	1.70	17.87
Normal	3.96	4.52	3.67	4.23	3.16	3.11	3.38	5.09	6.46	37.58
Dep										-19.71
Huntsville	0.58	2.01	1.23	3.62	0.37	0.07	0.46	2.69	1.39	12.42
Normal	4.32	4.87	4.10	4.28	3.14	3.47	3.50	5.08	4.66	37.42
Dep										-25.00
Liberty	0.43	5.68	3.56	3.42	0.75	1.78	0.49	1.29	2.83	20.23
Normal	5.77	5.84	5.01	4.91	3.74	3.84	4.01	5.80	6.88	45.80
Dep										-25.57
Livingston	0.14	3.23	1.38	3.73	0.89	0.84	1.26	1.28	1.43	14.18
Normal	3.82	4.76	4.92	4.64	3.47	3.89	3.92	5.54	5.20	40.16
Dep										-25.98
Madisonville	0.21	1.05	1.09	2.89	0.81	0.95	0.08	2.91	1.78	11.77
Normal	4.41	4.01	3.62	3.81	2.83	3.24	3.26	5.06	3.89	34.13
Dep										-22.36
Matagorda	0.05	2.85	1.66	3.42	0.61	0.27	0.00	1.01	0.65	10.52
Normal	3.72	4.19	2.57	3.63	2.81	2.54	2.63	4.53	4.44	31.06
Dep										-20.54
New Caney	0.00	6.18	2.71	6.42	0.96	0.90	0.17	0.63	0.99	18.96
Normal	4.57	4.83	4.40	4.22	3.31	3.96	3.86	5.89	5.90	40.94
Dep										-21.98
Palacios	0.08	2.54	1.31	3.87	0.72	0.77	0.01	2.66	1.66	13.62
Normal	5.01	3.39	3.08	3.18	2.45	2.70	2.80	4.55	4.31	31.47
Dep										-17.85
Richmond	T	1.96	3.84	1.49	0.53	0.69	0.02	0.69	1.56	10.78
Normal	4.14	4.80	3.44	3.86	2.98	3.06	3.46	4.28	4.98	35.00
Dep										-24.22
Somerville	0.03	0.88	0.80	2.77	0.41	0.08	0.00	3.34	2.42	10.73
Normal	4.33	3.63	3.14	2.93	2.53	2.62	2.92	4.39	4.21	30.70
Dep										-19.97
Sugarland	T	2.33	4.33	3.05	0.75	1.40	0.16	0.53	2.03	14.58
Normal	4.03	4.58	3.36	4.06	2.98	3.24	3.48	4.69	5.51	35.93
Dep										-21.35
Wharton	T	2.06	3.35	2.51	0.83	0.13	0.00	0.82	3.07	12.77
Normal	4.44	4.35	3.36	3.42	2.80	2.90	3.11	4.91	4.47	33.76
Dep										-20.99

Exceptional Drought Continues Across Southeast Texas

The first six months of 2011 were very dry. Houston received 7.88 inches of rain during the first six months of 2011. This was the driest January through June in city history. The previous driest January through June occurred in 1917 with only 8.84 inches of rain. Galveston received 8.67 inches of rain since January 1st and this was the sixth driest start to the year. Droughts and heat typically go together. 2011 has been no exception. Despite the chilly start to February, the average temperature for the period January through June was 68.9 degrees and this tied for the fifth warmest start to the year in city history. Galveston recorded a six month average temperature of 68.6 degrees which tied for the 12th warmest start to the year. Thourgh June 30th, Houston recorded seven days with the high temperature at or above 100 degrees. Typically, Houston records only three days with the temperature at or above 100 degrees for the year (based on normals from 1971 - 2000). Houston also established the warmest temperature ever recorded in the month of June when the mercury rose to 105 degrees on June 5th and 6th. June 2011 was the warmest June in city history. Galveston also recorded the warmest June in its long history. The city also tied its warmest daily temperature of the month when the mercury rose to 99 degrees on June 5th.

The summer of 2011 has been tremendously hot! June 2011 was the warmest June on record and July was the third warmest on record. Nothing compares to the first half of August. As of August 23rd, Houston has recorded 23 consecutive days with temperatures at or above 100 degrees. This is a new record breaking the previous record of 14 consecutive days back in 1980. Houston has also recorded 34 days with temperatures at or above 100 degrees in 2011. This is also a new yearly record breaking the previous record of 32 days established back in 1980. The summer of 2011 is now the benchmark in which all other summer heat waves will be compared.

When will the drought end? The honest answer is, nobody knows for sure. The La Nina phase ended during the last half of spring and neutral conditions have been in place through the summer. However, there are long term climate signals that indicate a secondary La Nina may be forming. The Climate Prediction Center has issued a La Nina watch for the upcoming fall and winter. The signal is not as strong as last year so the intensity of the La Nina is still in question. Be prepared for a continuation of the drought into the fall and winter months. How much rain will Southeast Texas need to end the drought? It will take at a minimum, 20 to 25 inches of rain to help recharge area reservoirs and ground water tables.



Incident meteorologists at the NWS Houston/Galveston office

Incident meteorologists (IMETs) are specially trained meteorologists that are sent to provide on-site weather support for wildfires, oil spills, HAZMAT (hazardous materials) incidents, and high-profile national events such as the Super Bowl. The National Weather Service has nearly 100 IMETs stationed in forecast offices scattered across the country, including the Houston/Galveston office. These IMETs are on call 24 hours a day, 7 days a week to provide incident support, primarily for wildfires.

The forerunners of today's IMETs traveled to fires with weather equipment on horseback beginning in the early 1900s, but now IMETs carry a satellite receiver and laptop, along with camping gear should the need to 'rough it' arise. In addition wireless connectivity can be utilized to receive data when IMETs are deployed in more urban areas, such as when responding to HAZMAT incidents or in support of local officials at an emergency operations center during or after other severe weather such as tornado outbreaks, or a landfalling hurricane. IMETs work long shifts, up to 16 hours per day, to provide weather information to response officials.

The IMET prepares forecasts tailored to the specific needs of the users on an incident. Weather can greatly influence the progression of a fire and therefore having accurate weather information can help make fighting these wildfires safer and less costly. For a wildfire, the firefighters need to know the relative humidity, temperature, wind direction, chance for thunderstorms, as well as such things as when fog may develop or low-lying smoke may lift as these can limit aircraft operations. Wind and relative humidity forecasts are especially crucial on fires as these can turn a small low intensity fire into a firestorm racing across the plains or through a forest. Accurate forecasts can help firefighters prepare for these scenarios, allowing them to evacuate persons in the expected path of the fire in addition to helping keep the firefighters themselves safe. For an oil

An IMET discusses weather conditions with weather observers on the Wallow Fire near Reserve, NM. The Wallow Fire became the largest fire in Arizona history, burning over 500,000 acres in eastern Arizona and western New Mexico from late May through early July.

spill, the IMET may need to forecast how rough the waters will be, how strong the winds will be or when thunderstorms are expected. During a HAZMAT event, such as a train derailment, forecasts of wind direction and maximum temperature can be critical in determining what communities may need to be evacuated, as they can help predict the spread of hazardous smoke or fumes or whether the potential exists for an explosion. Each incident is different and the IMET needs to pick up the unique weather conditions for a particular area very quickly. Throughout the year, the IMETs train for some of these different incidents both locally or at national workshops. IMETs are often involved in planning exercises with local and state emergency managers, FEMA, the Coast Guard, EPA, and law enforcement which can be invaluable both for practicing response plans and learning what weather information is most critical for a particular event.

IMET briefing fire crews at Merkel.

Bearing Fire in Trinity county advancing through Pine Plantation.Photograph courtesy of the Texas Forest Service.

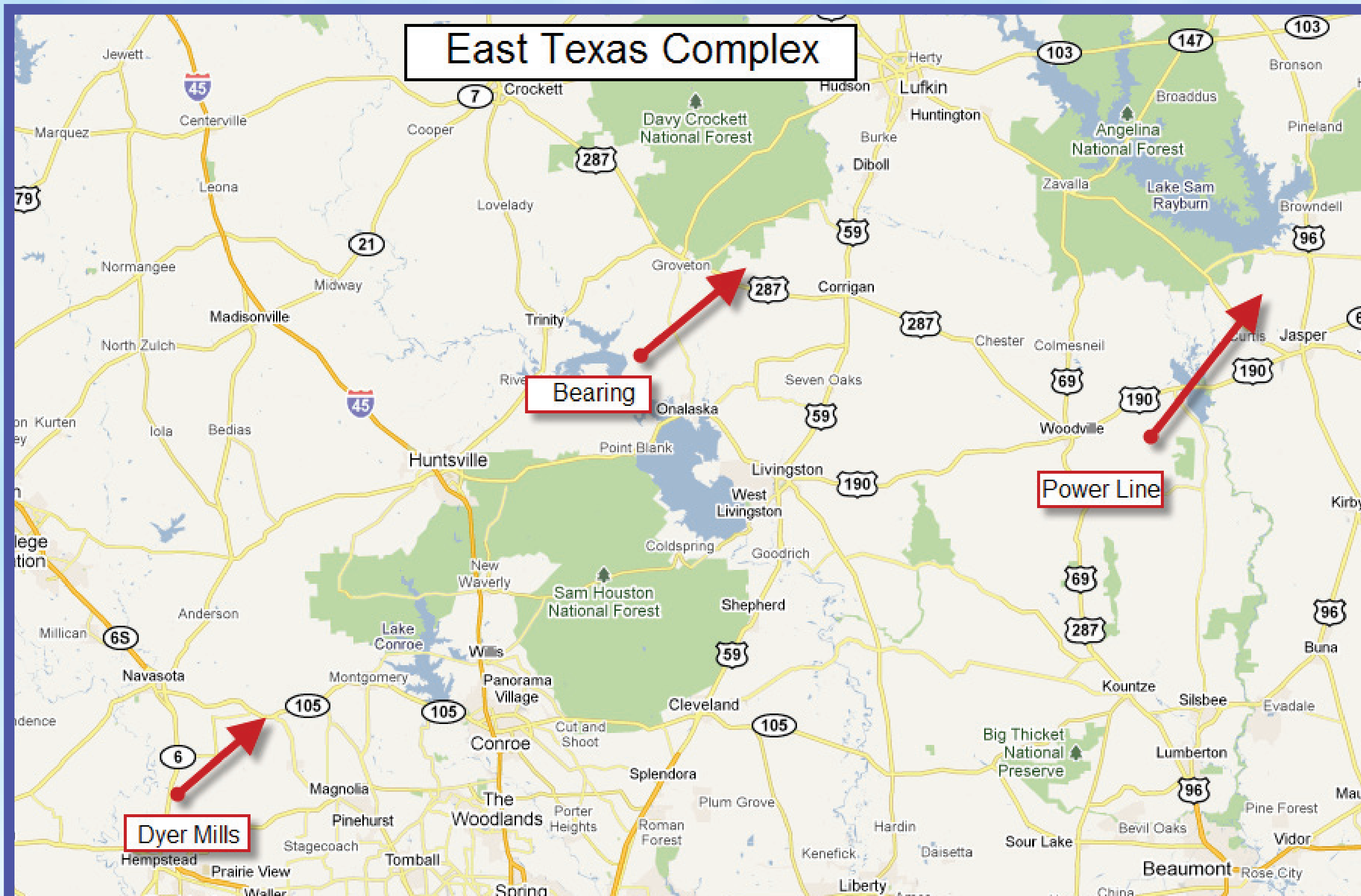
This has been a busy year for the two IMETs at the Houston/Galveston National Weather Service office, with a local HAZMAT event, a two-week deployment to the huge Wallow Fire complex in Arizona and New Mexico, and two deployments to Merkel, TX supporting the Texas Forest Service as they managed the wildfires that have been ongoing across the state.

The severe drought that has affected the state set the stage for a historic fire season in Texas. From November 2010 through mid July, local fire departments and the Texas Forest Service have responded to 13,467 fires that have burned 3,292,070 acres, or 5143 square miles.

Incident meteorologists at the NWS Houston/Galveston...continued

To put that into perspective, that is an area almost 3 times the size of Harris County. While supporting the Texas Forest Service at Merkel, the IMETs typical daily duties included an aviation briefing for firefighting aircraft across the state, a crew briefing for fire crews at Merkel that were headed out to fight fires in the western portions of the state, a statewide weather briefing for operations and planning purposes for the same day and the next three to five days, in addition to highly detailed hourly spot forecasts for specific fires and long term forecasts out to two weeks in the future. The days would typically last from 6 am until late in the evening but were also very rewarding.

The ongoing drought, coupled with unusually hot and windy conditions in May and June led to fire weather conditions across southeast Texas well in excess of what is usually seen. Three large fires burned across the region: the Midway Fire between Huntsville and Madisonville, the Dyer Mills Fire east of Navasota, and the Bearing Fire in Trinity and Polk counties. The Bearing and Dyer Mills fires were eventually grouped into the East Texas Complex, shown below. At over 20,000 acres, the Bearing Fire was the largest fire in east Texas since the Texas Forest Service has kept records across the region.



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