

NWS FORM E-5 (11-88) (PRES. by NWS Instruction 10-924)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	HYDROLOGIC SERVICE AREA (HSA) Tulsa, Oklahoma (TSA)
	MONTHLY REPORT OF RIVER AND FLOOD CONDITIONS	
TO: Hydrometeorological Information Center, W/OH2 NOAA / National Weather Service 1325 East West Highway, Room 7230 Silver Spring, MD 20910-3283		REPORT FOR: MONTH July YEAR 2010
		SIGNATURE Steven F. Piltz (Meteorologist-in-Charge)
		DATE August 5, 2010

When no flooding occurs, include miscellaneous river conditions, such as significant rises, record low stages, ice conditions, snow cover, droughts, and hydrologic products issued (NWS Instruction 10-924)

An "X" in the box indicates no flood stages were reached in this HSA during the month above.

An unusually moist airmass brought locally heavy rain to the Hydrologic Service Area (HSA) throughout July 2010, and both river and flash flooding occurred this month. July is climatologically one of the drier months of the year across the Tulsa HSA. Normal rainfall for the month of July ranges from 2.6 inches in McIntosh County to 3.4 inches in Ottawa County. The Ozark region of northwest Arkansas averages 3.1 inches for the month.

Summary of Rain Events

July 1 - 5:

Tropical moisture increased from west to east over the Tulsa HSA during the first few days of July, bringing daily rainfall to the region. The tropical nature of the airmass led to locally heavy rainfall at times. The first round of showers and isolated thunderstorms affected southeast OK on the evening of July 2, with widely scattered rain elsewhere across eastern OK. Rainfall totals were less than half an inch. By the 3rd, remnant moisture from Hurricane Alex allowed showers and thunderstorms to spread further east, affecting all of eastern OK and northwest AR. Rainfall totals were generally around 1" or less. However, most of Okfuskee County and portions of Creek, Muskogee, Wagoner, and Mayes Counties received around 2" of rain. For the July 4th holiday, a line of training showers and thunderstorms slowly propagated east into mainly Creek, Pawnee, Osage, and Washington Counties. While most of the affected areas received less than half an inch of rain, Osage County received 1"-4" (see Fig. 1). A few showers and thunderstorms also developed across the higher terrain areas of northwest AR and far southeast OK on the 4th. Scattered showers and thunderstorms developed once again on the 5th across northeast and east central OK, as well as northwest AR. However, rainfall totals remained light, with most locations receiving less than half an inch of rainfall.

July 6 - 10:

During the early morning hours of the 6th, training showers and isolated thunderstorms developed near a weak surface trough that extended across Pawnee, Osage, Washington, and Nowata Counties. This activity continued into the afternoon hours, with additional development further east along outflow boundaries. Much of the HSA received rainfall, with the highest totals of 3"-5" occurring primarily across northeast OK (see Figs. 2, 3). Rainfall rates from several storms were in excess of 2"/hour, and these high rainfall rates led to areas of flash flooding, especially in Bartlesville, where several roads were closed and water was reported in a few buildings.

Cooperative observer measurements of over 2" of rain from 7 am July 6 – 7 am CDT July 7:

Spavinaw Dam 3.06" Bartlesville 2.97" Wann 2.87" Mannford 2.40"

For the calendar day of July 6:

Oklahoma Mesonet measurements: Copan 3.45" Miami 2.35"
 ASOS measurements: Bartlesville 3.75" Jenks Riverside Airport 3.29"

This heavy rain, in addition to high rainfall totals in southeast Kansas, caused moderate flooding along the Neosho River near Commerce and minor flooding along the Caney River at Bartlesville (see E3 report for details).

Tulsa, OK (TSA): 7/5/2010 1-Day Observed Precipitation
Valid at 7/5/2010 1200 UTC - Created 7/6/10 15:34 UTC

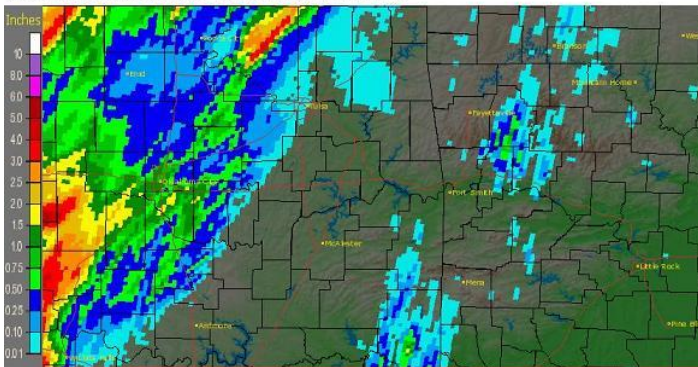


Fig. 1. Rainfall estimate ending at 7 am CDT 07/05/10

Tulsa, OK (TSA): 7/7/2010 1-Day Observed Precipitation
Valid at 7/7/2010 1200 UTC - Created 7/7/10 15:43 UTC

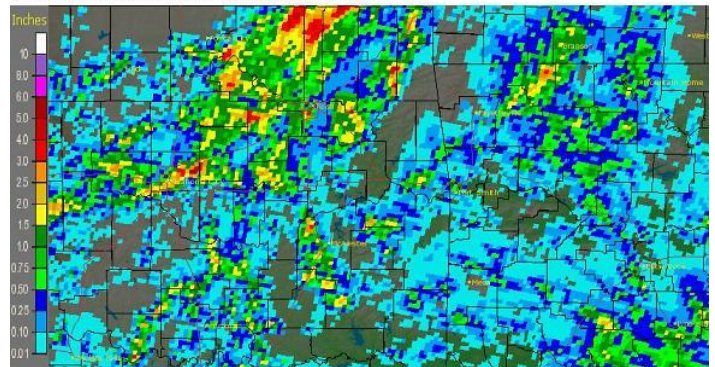


Fig. 2. Rainfall estimate ending at 7 am CDT 07/07/10

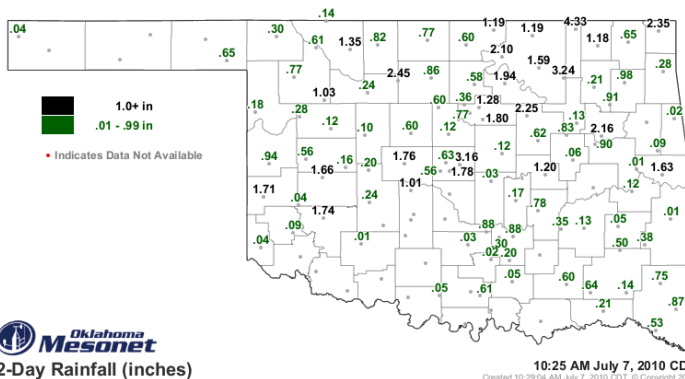


Fig. 3. 48-hr rainfall ending at 10:25 am CDT 07/07/10

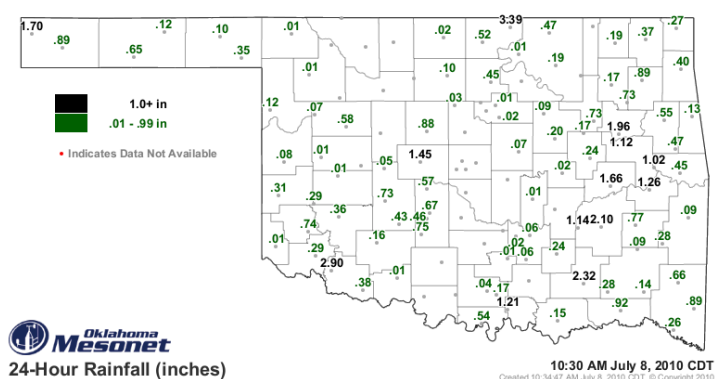


Fig. 4. 24-hr rainfall ending at 10:30 am CDT 07/08/10

A tropical low moved north out of TX and through southeast and central OK on the 7th, bringing more heavy rain. While most of the HSA received rain on the 7th, the highest totals of 2"-4" fell across eastern OK, including a portion of the Tulsa metro area (see Figs. 4, 5). Flash flooding was reported in Pittsburg County, with urban flooding in Tulsa.

City of Tulsa ALERT gage measurements of over 2.5" of rain from 7 pm July 7 – 7 am CDT July 8:

Joe Creek (near 61 st & Harvard)	3.98"	Fire Station 29 (near 71 st & Lewis)	2.91"
Fire Station 27 (near 31 st & Garnett)	2.80"	Polecat Creek near Jenks	2.68"

Cooperative observer measurements of over 2.5" of rain from 7 am July 7 – 7 am CDT July 8:

Muskogee	3.95"	Vinita 2N	3.22"
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ASOS measurements of over 2.0" of rain for the calendar day of July 7:

Muskogee	2.21"	McAlester	2.01"
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Tropical moisture continued to stream northward from the Gulf of Mexico into the Southern Plains on the 8th. A cold front moved into northeast OK on the 8th, making slow progress to the southeast before finally stalling near the Red River on the evening of the 9th. The interaction between the tropical moisture and cold front allowed for widespread, slow-moving, and efficient rain-producing storms near and south of the front. Several bands of training showers and thunderstorms set up across the HSA, as seen in Fig. 6. Rainfall totals in these bands ranged from 0.75" to over 4" and flash flooding was reported. After receiving heavy rainfall on the 6th, portions of the Tulsa metro area received an additional 0.25" to 3" inches on the 8th. This allowed high water to remain in the flood-prone and low-lying urban areas across Tulsa. The Tulsa International Airport ASOS site recorded a new record daily rainfall of 2.48" on the 8th, breaking the previous record of 1.02" set on July 8, 1906. The

Jenks Riverside Airport ASOS measured 2.71" on the 8th, making a 3-day total of 6.00". From 7 am July 8 – 7 am CDT July 9, the City of Tulsa ALERT gage located in Pratt Park near 15th and S. Florence measured 3.86" of rain and Fire Station 18 near 51st and S. Peoria measured 2.13". The McAlester ASOS also set a daily rainfall record with 1.26" on the 8th (previous record was 1.01" in 1988).

Widespread rain continued through the 9th across east central and southeast OK as well as northwest AR, with rainfall totals ranging from 0.5" to near 2.5" in localized areas. Widely scattered light rainfall occurred elsewhere. Isolated showers and thunderstorms redeveloped across southeast OK on the 10th in a very moist atmosphere. While most areas that received rainfall recorded less than half an inch of rain, locally higher amounts occurred in a few places.

Tulsa, OK (TSA): 7/8/2010 1-Day Observed Precipitation
Valid at 7/8/2010 1200 UTC- Created 7/8/10 17:43 UTC

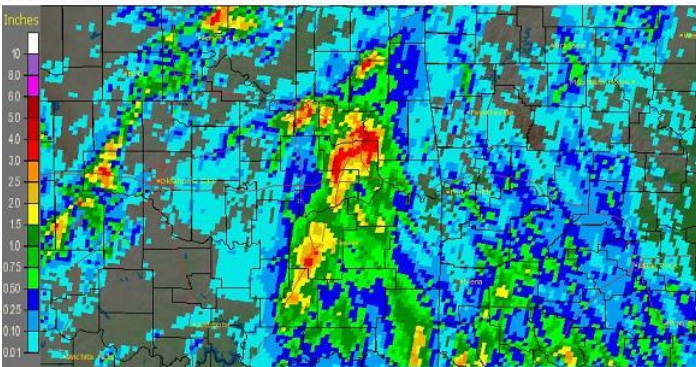


Fig. 5. Rainfall estimate ending at 7 am CDT 07/08/10

Tulsa, OK (TSA): 7/9/2010 1-Day Observed Precipitation
Valid at 7/9/2010 1200 UTC- Created 7/9/10 15:44 UTC

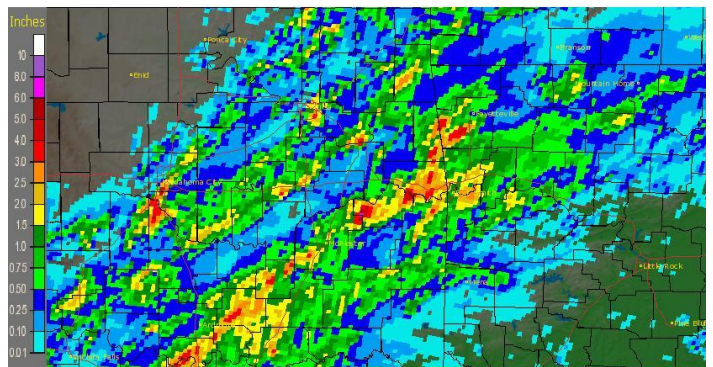


Fig. 6. Rainfall estimate ending at 7 am CDT 07/09/10

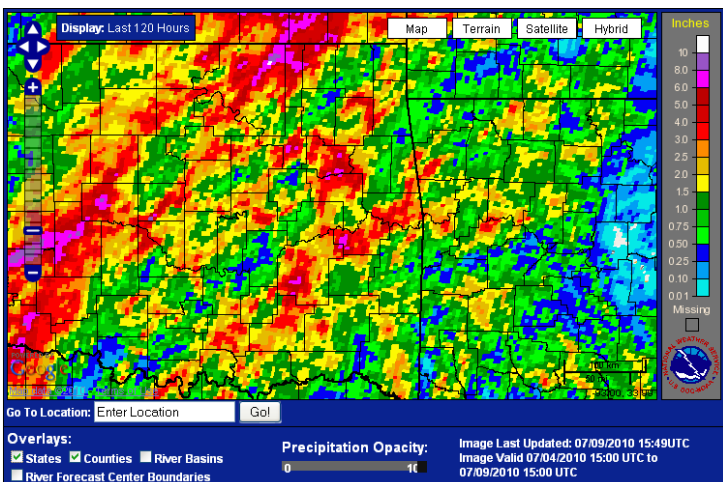


Fig. 7. 5-day rainfall estimate ending at 10 am CDT 7/09/10

Tulsa, OK (TSA): 7/13/2010 1-Day Observed Precipitation
Valid at 7/13/2010 1200 UTC- Created 7/15/10 15:31 UTC

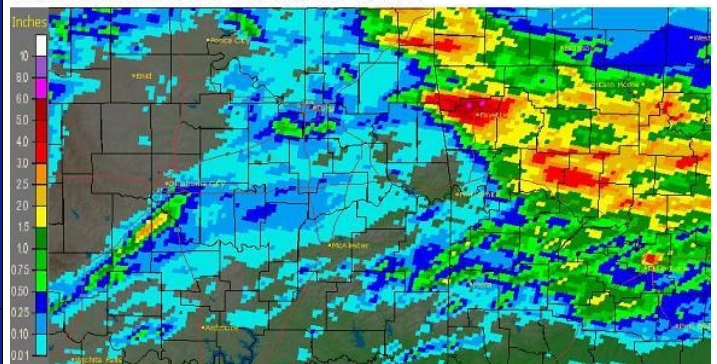


Fig. 8. Rainfall estimate ending at 7 am CDT 07/13/10

July 11 - 31:

A mesoscale convective system (MCS) moved out of southwest MO into northern AR on the 11th, bringing upwards of 1" of rain to portions of Madison and Carroll Counties. Additional scattered activity occurred near the Highway 412 corridor in northeast OK and northwest AR and along higher terrain areas of far southeast OK and west central AR. Rainfall totals in these areas were generally around half an inch or less. A mesoscale vorticity center tracked across the HSA on the 12th, initiating widespread showers and thunderstorms within a warm air advection regime. More scattered storms developed along the terrain of southeast OK during the afternoon hours. Around one half inch or less of rain occurred from this activity.

Thunderstorms that developed along a cold front in eastern KS on the 12th congealed into a MCS, which then tracked southeast across far northeast OK and into northwest AR late on the 12th and through the morning of the 13th. Heavy flooding rains occurred with this system, bringing 3" to 6" of rain to a large portion of the affected area (see Fig. 8). This heavy rain led to flash flooding, with water rescues and evacuations necessary in Washington County AR. Further, runoff from all of the rain created quick rises along the Illinois River, with minor flooding observed at the forecast point near Watts (see E3 report for details). Action stage was also

exceeded near Tahlequah and along Flint Creek near Kansas, causing dangerous recreational floating conditions.

A cold front and several outflow boundaries initiated showers and thunderstorms across northeast OK and northwest AR, primarily north of a Bristow, OK to St. Paul, AR line, during the afternoon of the 15th and lasting through the overnight hours. Weak flow and a continued very moist atmosphere led to slow moving, heavy rain producing storms. Rainfall totals ranged from around 0.5" to around 2", with the highest totals of 3" to 6" occurring across Washington County AR causing flash flooding (see Fig. 9). Many vehicles were reported stalled or submerged in and around the Fayetteville area. These high rainfall totals occurred in nearly the same location as the 3" to 6" that fell on June 12-13. The NWS cooperative observer at the Fayetteville Experimental Station measured 3.34", while the ASOS site at FYV recorded 2.15". In addition, the rain gage along Bird Creek near Avant measured 2.66". As instability increased during the afternoon of the 16th, scattered showers and thunderstorms once again developed along a stationary front and various outflow boundaries. Localized areas received 1" to 2" rainfall totals, including portions of Ottawa County where high water led to impassible streets in Commerce. As high pressure developed over the region, the coverage of thunderstorm activity decreased. Scattered showers and thunderstorms affected far southeast OK and west central AR on the 17th, with rainfall totals around 1" or less. A few thunderstorms developed during the afternoon of the 18th, affecting only Pushmataha, Le Flore, and Sebastian Counties and bringing around 0.5" of rain or less. High pressure then kept the rain at bay (with only very isolated and brief terrain showers in the afternoons) and continued the very hot and humid conditions across the HSA through July 23.

Primarily diurnal convection affected the area from the 24th through 28th, with the greatest coverage occurring on the 25th due to a weak frontal boundary and various outflow boundaries across the region. The very moist, tropical airmass allowed for locally heavy rainfall during this time period, while most locations received less than one inch of rainfall. However, on the 25th, rainfall totals of 2" to 4" were estimated across portions of Pawnee, Creek, and Franklin Counties (see Fig. 10). The last few days of the month were very hot and humid, with heat index values of 105° to over 110°.

Tulsa, OK (TSA): 7/16/2010 1-Day Observed Precipitation
Valid at 7/16/2010 1200 UTC- Created 7/16/10 15:43 UTC

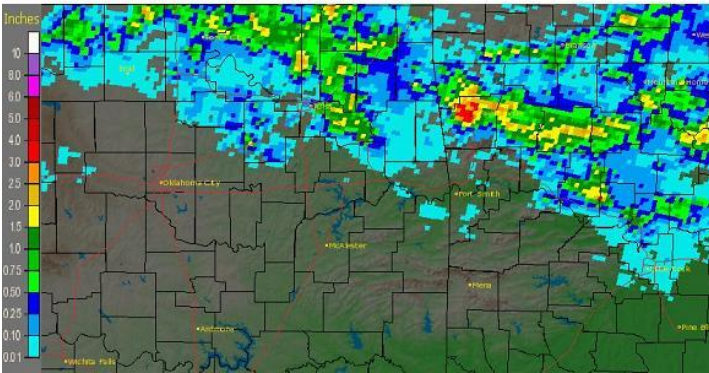


Fig. 9. Rainfall estimate ending at 7 am CDT 07/16/10

Tulsa, OK (TSA): 7/26/2010 1-Day Observed Precipitation
Valid at 7/26/2010 1200 UTC- Created 7/28/10 23:32 UTC

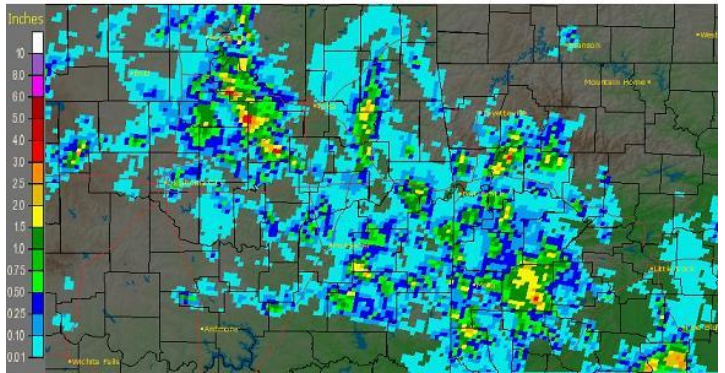


Fig. 10. Rainfall estimate ending at 7 am CDT 07/26/10

Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 11a.), rainfall totals for July 2010 primarily ranged from 2 to 6 inches across the HSA. However, there were pockets of only 1 to 2 inch totals, as well as areas which received around 10 inches of rain this month. Of particular note was the high rainfall total across the Fayetteville area, where rain gage measurements exceeded 9 inches for the month (most of which fell on the 13th and 15th). Some locations received over 200% of the normal July rainfall, with the Fayetteville area receiving around 400% of average. Many other locations throughout the HSA actually ended up only receiving between 25% and 75% of the average July rainfall (see Fig 11b.). For the most part, southeast OK and portions of west central AR received below average precipitation this month, while elsewhere, the above and below normal areas were more random. Interestingly, Washington Co. AR received a localized rainfall maximum (highest totals in the HSA this month) while immediately to the west, Adair and Cherokee Counties were in a localized minimum of rainfall (receiving some of the lowest rainfall totals this month). Another example illustrating the localized nature of this month's rainfall show up across the Tulsa Metro Area, where Jenks Riverside Airport (RVS) received a total of 8.63" of rain this July, while only ~12 miles away, Tulsa International Airport (TUL) received 4.67".

In Tulsa, OK, July 2010 ranked as the 30th warmest July (84.4°F, since records began in 1905; tied with 1999, 1993) and was the 29th wettest July (4.67", since records began in 1888). Fort Smith, AR was the 19th warmest June (84.4°F, tied with 1966, 1884) and was the 63rd driest June (2.47", tied with 1975) since records began in 1882. Overnight temperatures were especially warm during July, with the average minimum temperature in Tulsa ranking as the 7th warmest July (75.8°F) and Fort Smith ranking as the 2nd warmest July (75.3°F).

Tulsa, OK (TSA): July, 2010 Monthly Observed Precipitation
Valid at 8/1/2010 1200 UTC - Created 8/3/10 13:40 UTC

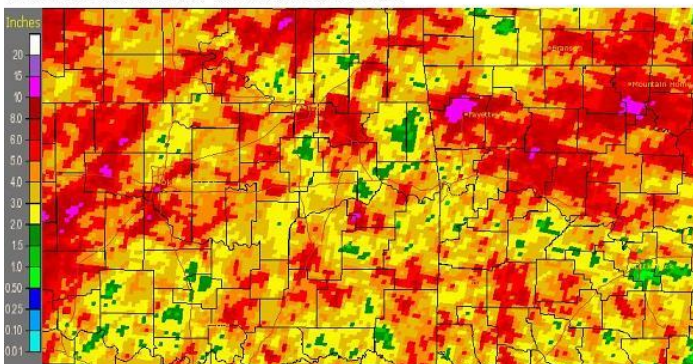
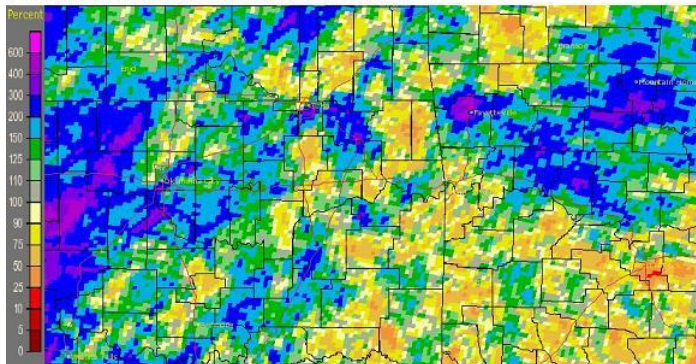


Fig. 11a. Estimated Observed Precip. for July 2010

Tulsa, OK (TSA): July, 2010 Monthly Percent of Normal Precipitation
Valid at 8/1/2010 1200 UTC - Created 8/3/10 13:44 UTC



11b. Estimated % of Normal Precip. for July 2010

Some of the larger precipitation reports (in inches) for July 2010 included:

Fayetteville Exp. Station, AR (coop)	9.89	Fayetteville, AR (ASOS)	9.25	Jenks Riverside Arpt, OK (ASOS)	8.63
Miami, OK (meso)	8.12	Skiatook, OK (meso)	7.50	Bartlesville, OK (ASOS)	7.14
St. Paul, AR (coop)	6.93	Copan, OK (meso)	6.90	Porter, OK (meso)	6.87

According to the [U.S. Drought Monitor](#) (USDM) from July 27, 2010, abnormally dry conditions (D0) and moderate drought (D1) existed across Choctaw, Pushmataha, and southern Le Flore Counties in southeast OK. Elsewhere in the HSA, drought conditions did not exist. For a brief period during July, severe drought (D2) conditions were reported by the drought monitor in southeast OK and a local Drought Information Statement was issued. However, local effects were not consistent with D2 conditions and therefore, this area was updated to reflect D1 conditions.

The major reservoirs in the Tulsa HSA reported full conservation pools with flood control storage within 3% as of August 3, 2010. However, several reservoirs were reporting pools into the flood control storage and one reservoir was experiencing deficits within the conservation pool. Flood control storage: Oologah Lake 18%, Ft. Gibson Lake 11%, Eufaula Lake 6%, Keystone Lake 6%, Tenkiller Lake 6%. Conservation pool deficit: Hugo Lake 42%.

According to statistics from the [Oklahoma Climatological Survey](#) (OCS):

Rank since 1921 ("Last XX days" ending July 31, 2010)	Last 30 days (July 2-31)	Year- to-Date 2010	Summer (Jun. 1 – Jul. 31)	Water Year (Oct. 1, 2009 – Ju. 31, 2010)	Warm Growing Season (Mar. 1 – Jul. 31)	Last 365 days (Aug. 1, 2009 – Jul. 31, 2010)
Northeast OK	21 st wettest	33 rd wettest	21 st wettest	28 th wettest	33 rd wettest	22 nd wettest
East Central OK	38 th wettest	37 th driest	38 th wettest	378 th wettest	39 th driest	26 th wettest
Southeast OK	32 nd driest	26 th driest	32 nd driest	39 th wettest	15 th driest	20 th wettest

The [Climate Prediction Center](#) (CPC) outlook for August 2010 (issued July 31, 2010) indicates a slightly enhanced chance for above average temperatures and equal chances for above, near, and below median precipitation. For the 3-month period Aug-Sep-Oct 2010, CPC is forecasting a slightly enhanced chance for above average temperatures and equal chances for above, near, and below median precipitation (outlook issued July 15, 2010). According to CPC, sea-surface temperatures in the equatorial Pacific have continued to decrease and La Niña conditions developed during July. The enhanced chance for above average

temperatures for the 1- and 3-month outlooks are consistent with a developing La Niña. A La Niña Advisory has been issued, and La Niña conditions are expected to strengthen and last through the Northern Hemisphere winter 2010-11.

Written by:
 Nicole M^cGavock,
 Service Hydrologist
 WFO Tulsa

Products issued:

- 8 River Flood Warnings (FLW)
- 36 River Flood Statements (FLS)
- 2 River Flood Advisories (FLS) (6 Advisory FLS CON/EXT/CAN)
- 0 River Flood Watches (FFA) (0 Watch FFA CON/EXT/CAN)
- 0 River Statements (RVS)
- 0 Hydrologic Outlooks (ESF)
- 1 Drought Information Statements (DGT)

***Graphs below are from the NWS AHPS website and do not reflect official crests/flows as set by the USGS.*

