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		REPORT FOR: MONTH **July** YEAR **2013**
TO: Hydrometeorological Information Center, W/OH2 NOAA / National Weather Service 1325 East West Highway, Room 7230 Silver Spring, MD 20910-3283		SIGNATURE **Steven F. Piltz** (Meteorologist-in-Charge) DATE **August 2, 2013**

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 Hydrologic Service Area (HSA) during the month above.**

The first half of July 2013 was hot and dry, with the second half bringing periods of heavy rain and cooler temperatures. 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.

Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 1a), rainfall totals for July 2013 ranged from 2" to 11", with a large portion of the HSA receiving 3"-6". However, a few locations in Crawford and Washington Counties in northwest AR and Choctaw and Pushmataha Counties in southeast OK only received 1"-2" this month. Locations north of Hwy 412 in eastern OK, as well as Le Flore, Benton, and Carroll Counties ended the month well above normal, receiving 150% to 300% of the normal July rainfall (Fig. 1b). The remainder of the area had near normal rainfall, with the exception of Washington (AR), Crawford, Pushmataha, and Choctaw Counties, which only received 25%-75% of the normal rainfall for the month.

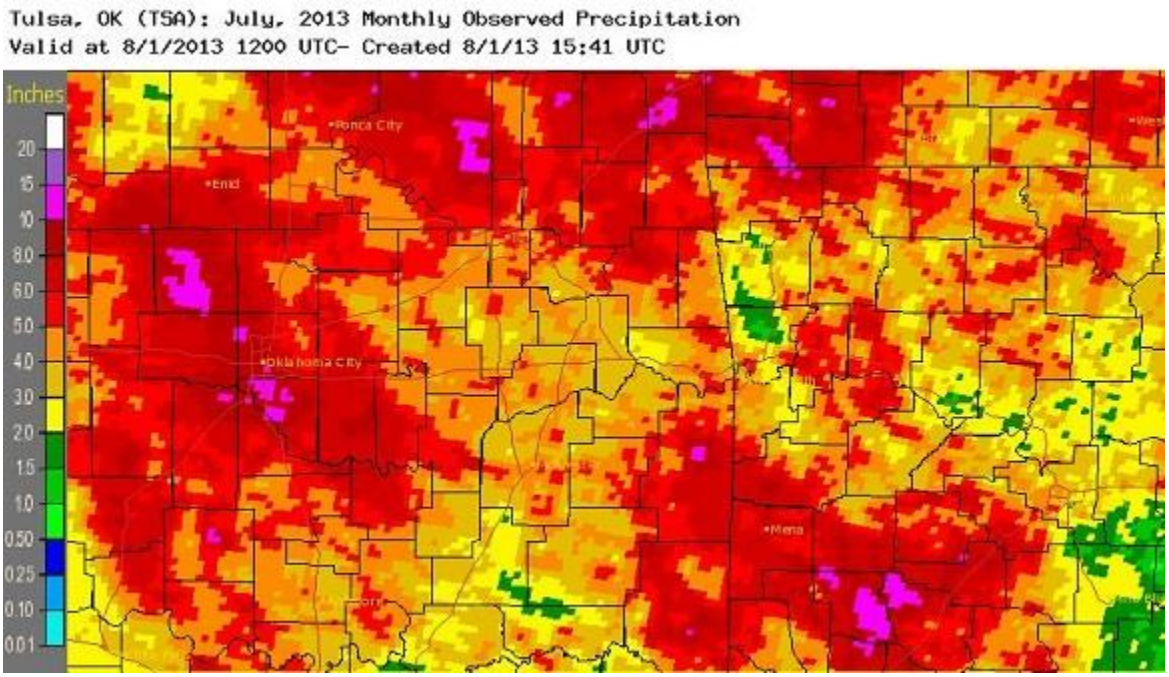


Fig. 1a. Estimated Observed Rainfall for July 2013

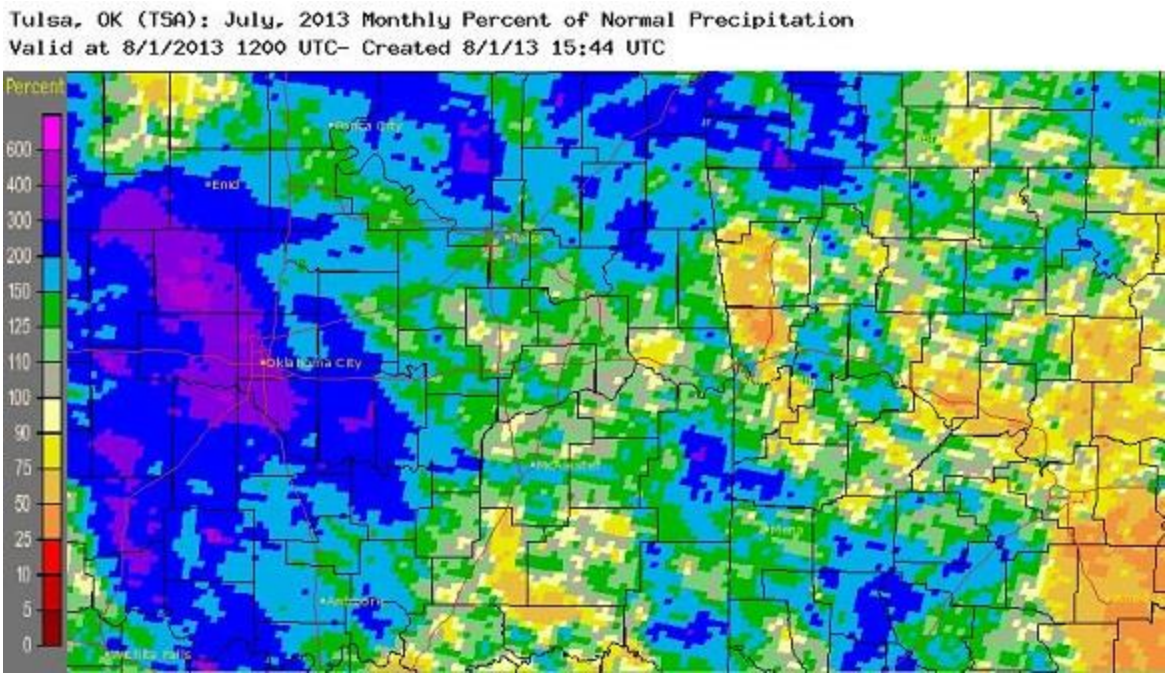


Fig. 1b. Estimated % of Normal Rainfall for July 2013

In Tulsa, OK, July 2013 ranked as the 28th coldest July (81.1°F; since records began in 1905) and the 26th wettest July (4.93"; since records began in 1888). Fort Smith, AR was the 62nd coldest July (81.9°F, tied 1958, 1990; since records began in 1882) and the 36th wettest July (3.95"; since records began in 1882). Fayetteville, AR was the 11th coldest (76.1°F) and the 30th wettest (2.78") July since records began in 1950.

Some of the larger precipitation reports (in inches) for July 2013 included:

Wister, OK (meso)	10.69	Foraker, OK (meso)	8.89	Miami, OK (meso)	8.63
Vinita, OK (meso)	8.34	Skiatook, OK (meso)	8.28	Miami, OK (coop)	7.95
Tahlequah, OK (meso)	7.80	Nowata, OK (meso)	7.53	Burbank, OK (meso)	7.19

Some of the lowest precipitation reports (in inches) for July 2013 included:

Antlers, OK (meso)	2.20	Antlers, OK (coop)	2.25	Mountainburg 2NE, AR (coop)	2.56
Fayetteville, AR (ASOS)	2.78	Okmulgee, OK (meso)	2.98	Scipio 1S, OK (coop)	3.08
Muskogee, OK (ASOS)	3.11	Webbers Falls, OK (meso)	3.14	Porter, OK (meso)	3.15

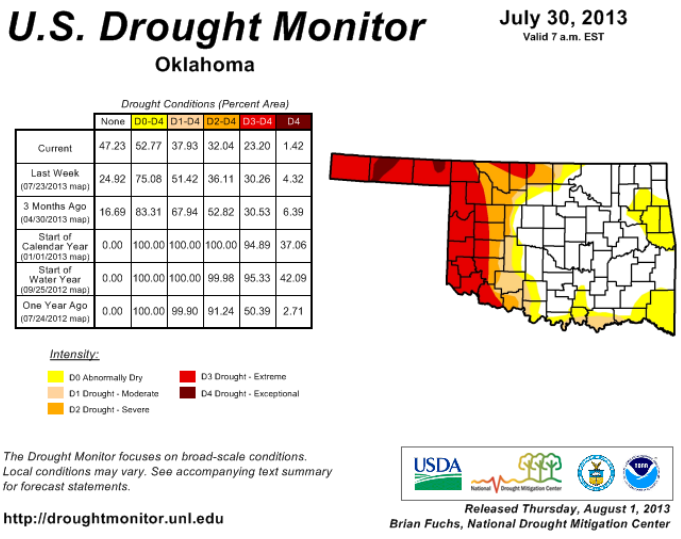


Fig. 2. Drought Monitor for Oklahoma

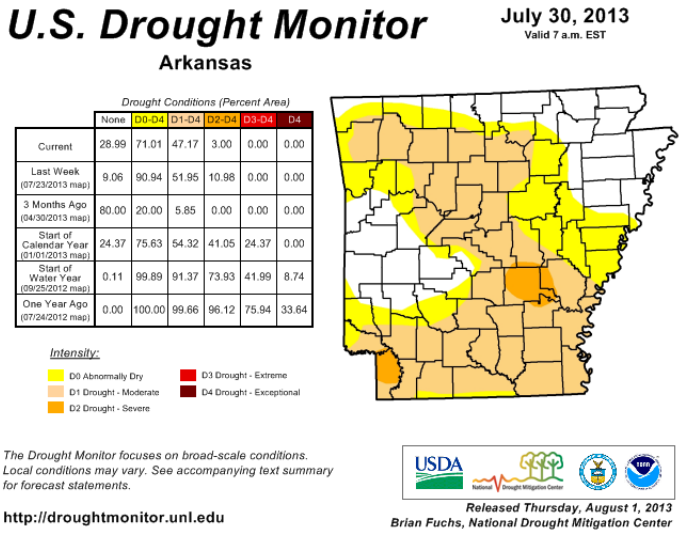


Fig. 3. Drought Monitor for Arkansas

According to the U.S. Drought Monitor (USDM) from July 30, 2013 (Figs 2, 3), only Washington and Madison Counties in northwest AR were in Moderate (D1) Drought in eastern OK and northwest AR. Portions Mayes, Wagoner, Cherokee, Adair, Delaware, Sequoyah, Pushmataha, and Choctaw Counties in northeast OK and Benton, Carroll, Crawford and Franklin Counties in northwest AR were classified as abnormally dry (D0), but

not experiencing drought conditions.

Most of the major reservoirs in the HSA were operating within their flood control pools, though a few remained within ±3% of the top of their conservation pools. Just a few lakes were below normal: Skiatook Lake 82%, Heyburn Lake 95%, Hugo Lake 94%, and Beaver Lake 94%. The following lakes were ≥103% of their pools: Kay Lake 116%, Birch Lake 112%, Oologah Lake 111%, Ft. Gibson Lake 109%, Pensacola Lake 109%, Hudson Lake 107%, Keystone Lake 107%, Eufaula Lake 107%, Wister Lake 106%, and Tenkiller Lake 104%.

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

Rank since 1921	Last 30 Days (Jul 2-Jul 31)	Summer-to-Date (Jun 1 – Jul 31)	Last 90 Days (May 3 – Jul 31)	Warm Growing Season (Mar 1 – Jul 31)	Year-to-Date 2013 (Jan 1 – Jul 31)	Water Year-to-Date (Oct 1, 2012 – Jul 31, 2013)	Last 365 Days (Aug 1, 2012 – Jul 31, 2013)
Northeast OK	9th wettest	33rd wettest	18th wettest	25th wettest	21st wettest	41st wettest	42nd driest
East Central OK	18th wettest	33rd wettest	29th wettest	28th wettest	24th wettest	37th driest	39th driest
Southeast OK	16th wettest	23rd wettest	20th wettest	21st wettest	23rd wettest	36th driest	28th driest
Statewide	7th wettest	22nd wettest	22nd wettest	33rd wettest	24th wettest	40th driest	33rd driest

Outlooks

The Climate Prediction Center (CPC) outlook for August 2013 (issued July 31, 2013) indicates equal chances for above, near, and below normal temperatures and precipitation across all of northeast OK and northwest AR. This outlook is based primarily on dynamical computer models.

For the 3-month period Aug-Sep-Oct 2013, CPC is forecasting a slightly enhanced chance for above normal temperatures and an equal chance for above, near, and below median precipitation across all of eastern OK and northwest AR (outlook issued July 18, 2013). According to CPC, ENSO neutral conditions remained through July. ENSO neutral conditions are expected to continue into Autumn 2013, followed by greater uncertainty in the ENSO state from late 2013 onwards. Therefore, this outlook is primarily based on recent trends, soil moisture conditions, and dynamic computer model output, with some input from statistical forecast tools and long-term trends.

Summary of Precipitation Events

July 1-13

Isolated thunderstorms dampened a few 4th of July afternoon celebrations, including Tulsa proper, on the 4th. This activity was short-lived during the heat of the afternoon, bringing around 0.50” or less of rain to the affected areas. However, small areas beneath the core of the storms did receive 0.50” to near 1.5” of rain.

Widely scattered showers and thunderstorms developed along an outflow boundary on the afternoon of the 10th. With temperature of 100°F+ and relatively dry low-levels, downburst/microburst winds produced some wind damage with some of the storms. Those locations that did receive rainfall, recorded around 0.10”-0.50”, with a couple of spots around 1.5” in Franklin and southern Madison Counties. Afternoon ‘popcorn’ showers and thunderstorms developed again during the heat of the afternoon on the 11th, bringing isolated 0.10” to near 2” of rain to a few locations.

July 14-31

An upper-level low, with a very unusual southwest propagation across AR and OK from the Midwest, brought several days of much needed rain to the region July 14-16. Showers and thunderstorms developed ahead of the westward moving low during the early morning hours of the 14th, primarily affecting the locations southwest

of a Bartlesville to Tulsa to Fort Smith line throughout the day. Rainfall totals were generally 0.25" to around 1", with isolated higher amounts of 1.5" to 3" (Fig. 4). The upper low was over the southern Texas Panhandle on the afternoon of the 15th, allowing deep southeasterly flow to maintain moist conditions over the HSA. These conditions aided in the development of widely scattered to numerous showers and thunderstorms on the 15th and 16th. Locations that experienced rain received anywhere from a few hundredths to near 1.5" in isolated spots.

Fig. 4. Estimated Observed 24-hr Rainfall ending 7am CDT 7/15/2013.

Upper-level ridging then built into the region, though a moist airmass remained in place. Isolated showers and thunderstorms developed during the heat of the afternoon on the 17th-19th, with the higher terrain areas of southeast OK and northwest AR favored. Locations near the cores of these storms received from 0.50" to around 2" of rain.

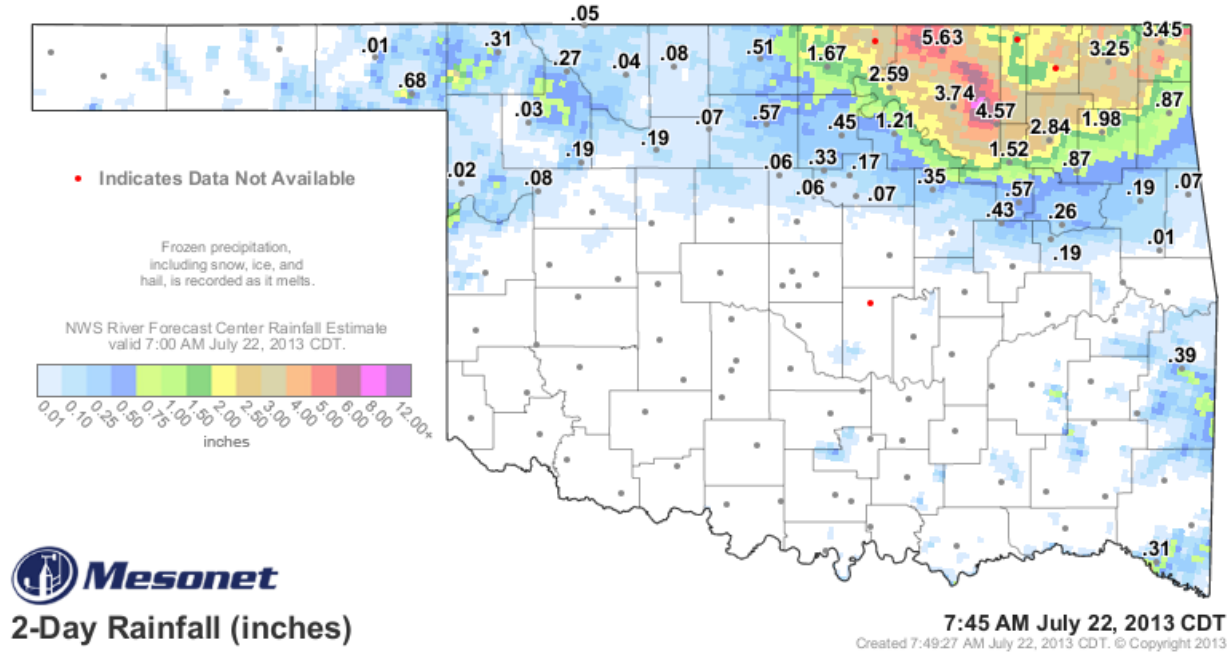


Fig. 5. Mesonet measured and NWS estimated rainfall for July 21, 2013.

Fig. 6. Estimated Observed 24-hr Rainfall ending 7am CDT 7/21/2013.

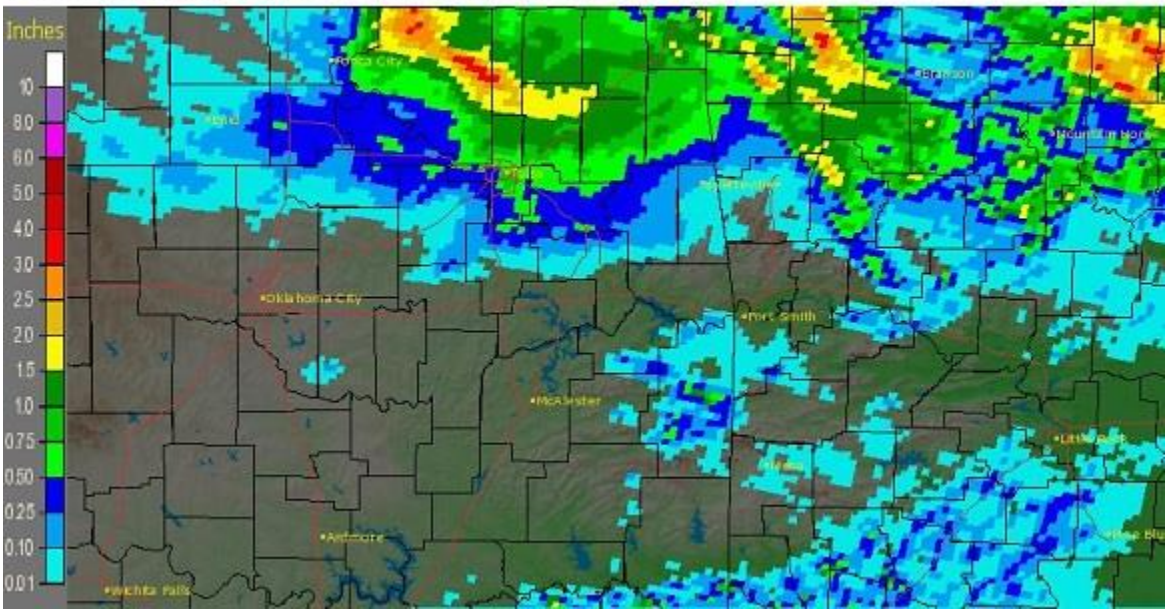


Fig. 7. Estimated Observed 24-hr Rainfall ending 7am CDT 7/22/2013.

Isolated showers and thunderstorms continued on the 20th, primarily over west central and northwest AR. Additional storms developed across southern KS/MO during the afternoon and moved south into northeast OK during the evening and continued through the morning of the 21st as an MCV drifted over southeast KS. This led to heavy rain primarily north of Hwy 412 in northeast OK and northwest AR, with Osage County receiving the highest amounts of widespread 2”-4” (Figs. 5, 6, 7). Isolated totals approached 9”: Birch Lake (Barnsdall 2S, OK) measured 8.80”, Bird Creek at Avant measured 6.79”, and the mesonet station in Skiatook measured 4.54”. Due to antecedent dry conditions, no mainstem river flooding occurred despite the high rainfall totals.

Fig. 8. Estimated Observed 24-hr Rainfall ending 7am CDT 7/23/2013.

A few storms developed during the late evening of the 21st and early morning of the 22nd in far northeast OK and northwest AR along a surface boundary. This activity continued into the early afternoon hours. Some additional storms then developed in the heat of the afternoon in eastern OK and west central AR, with a few downbursts occurring (Figs. 7, 8). Rainfall totals were generally 0.50" to around 1.5" from all of this activity.

Severe thunderstorms developed during the late afternoon and evening hours of the 23rd over southern KS. The airmass was extremely hot and unstable south of these storms where afternoon heat indices reached 110°. An upper-level disturbance moved southeastward during the evening and helped drive a complex of severe storms into eastern OK between 10pm and 3am. The severe storms had a history of producing wind gusts to 80mph earlier in the evening in the Wichita, KS area, and they continued to do the same as the complex moved into the Tulsa area. The Tulsa International Airport recorded a 76 mph wind gust as the storms rolled in, the highest ever recorded at the site. Several Oklahoma mesonet sites recorded wind gusts in excess of 65mph in Osage and Tulsa Counties, as seen in Figs 11, 12.

The damaging winds pushed across Tulsa and surrounding areas and caused widespread tree and power line damage, leaving over 100,000 without power during the overnight and early morning hours. Some of the outages lasted for several days. The long-lived bow echo, or derecho, continued southward reaching Choctaw County shortly after 2am. Heavy rains also fell during the night with some flooding reported in the Tahlequah and Miami areas. The heaviest rains fell along the OK-AR border, where 3" to 5" were reported (see Figs 9, 10). The river forecast point along the Baron Fork at Eldon (ELDO2) measured 5.37" of rain, with 1.92" falling in just 1 hour (from midnight to 1am; with 1.46" from 11pm to midnight and 1.10" from 1am-2am)! Once again, due to antecedent dry conditions, no mainstem river flooding occurred despite the high rainfall totals. More information about this event can be found at http://www.srh.noaa.gov/tsa/?n=weather-event_2013July23

Measured 24-hr rainfall totals (inches) ≥3" ending at 7am CDT July 24, 2013:

Eldon, OK (DCP)	5.37	Poteau 1ENE, OK (DCP)	5.20	Tahlequah 4NNW, OK (Mesonet)	5.18
Wister 3ENE, OK (Mesonet)	4.56	Panama, OK (DCP)	4.07	Mayo L&D 14, OK (DCP)	4.06
Barber 3NE, OK (DCP)	4.00	Tahlequah 2ENE, OK (DCP)	3.83	Locust Grove 4S, OK (DCP)	3.55
Short 1W, OK (DCP)	3.28	Van Buren, AR (DCP)	3.08	Jay 3.3NNE, OK (CoCoRaHS)	3.05

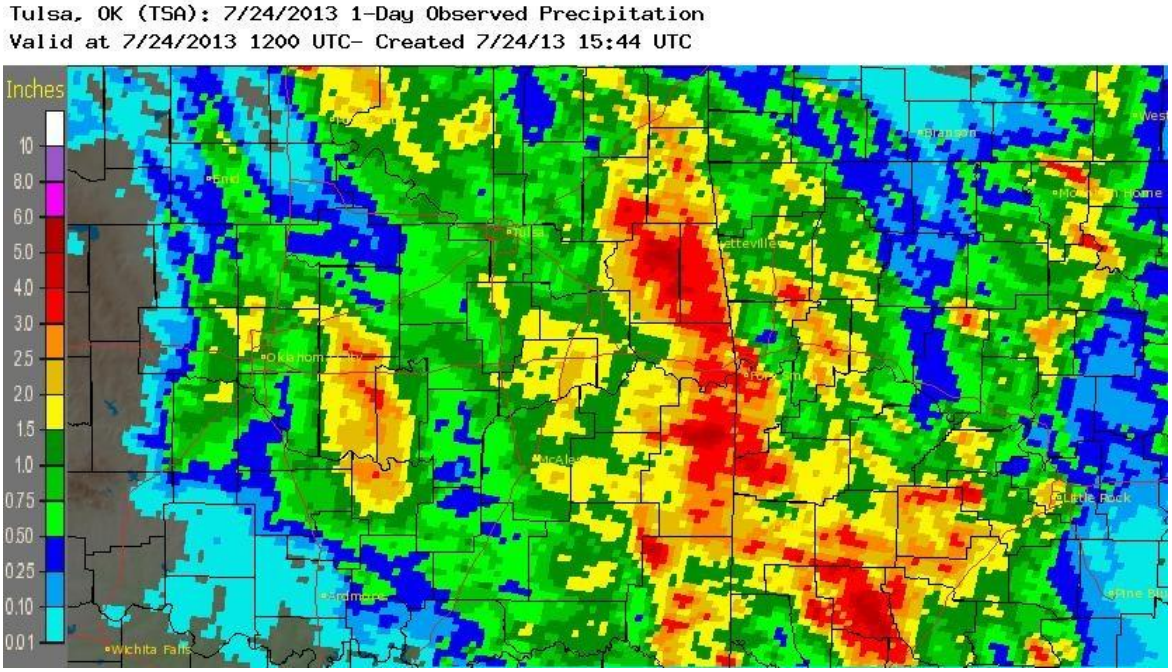


Fig. 9. Estimated Observed 24-hr Rainfall ending 7am 7/24/2013.

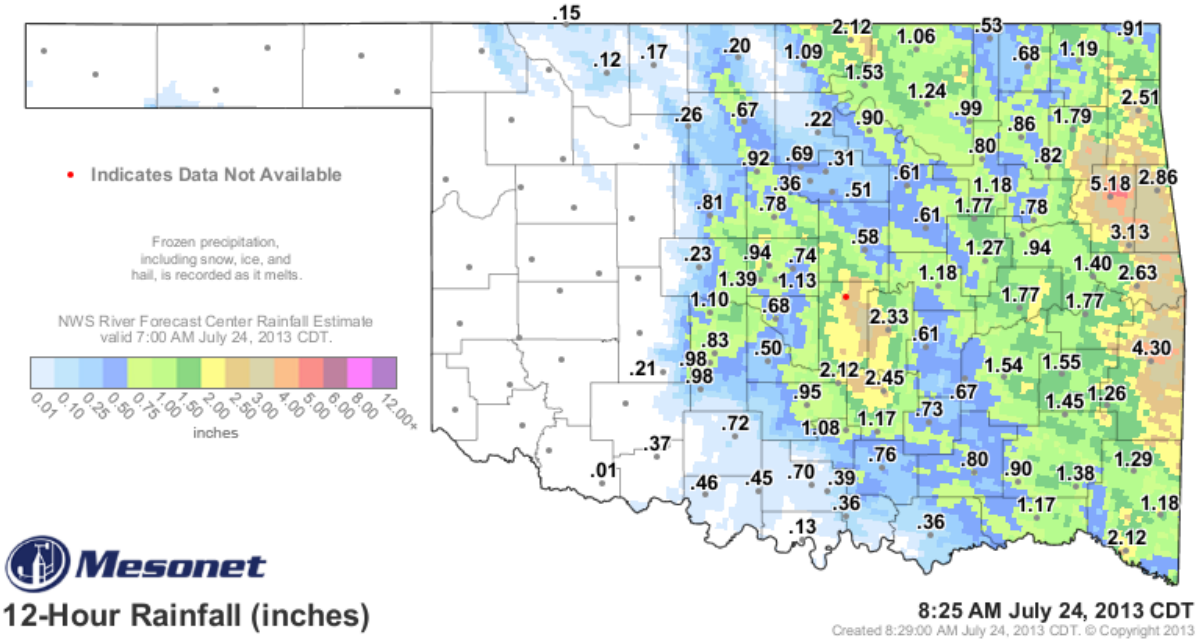


Fig. 10. Mesonet measured and NWS estimated rainfall for the overnight damaging derecho July 23-24, 2013.

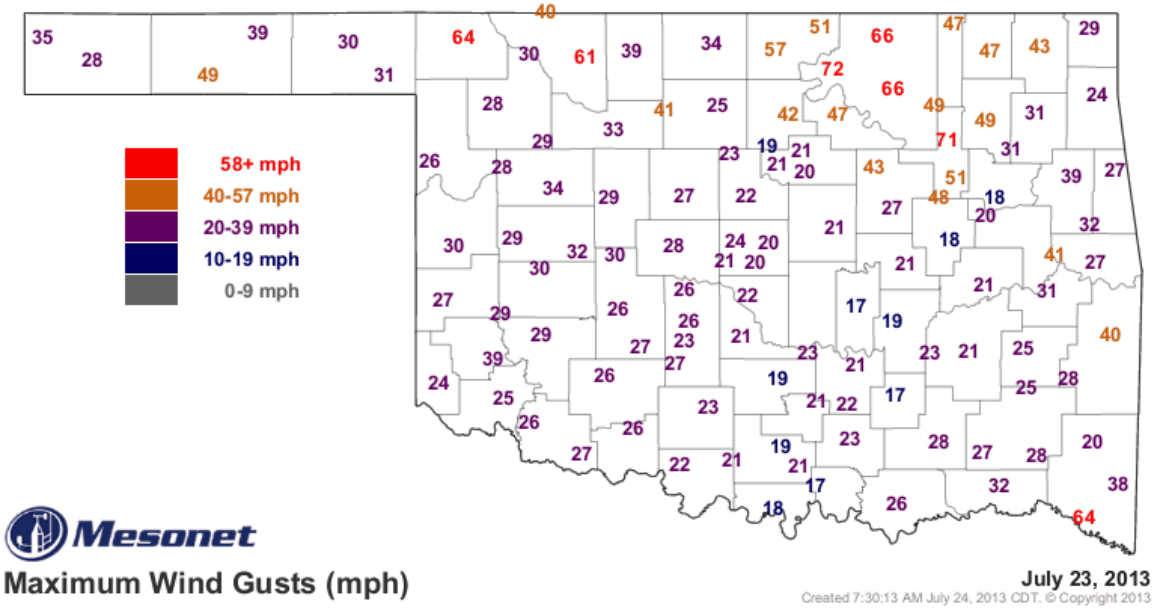


Fig. 11. Measured maximum wind gusts at Oklahoma Mesonet locations on July 23, 2013.

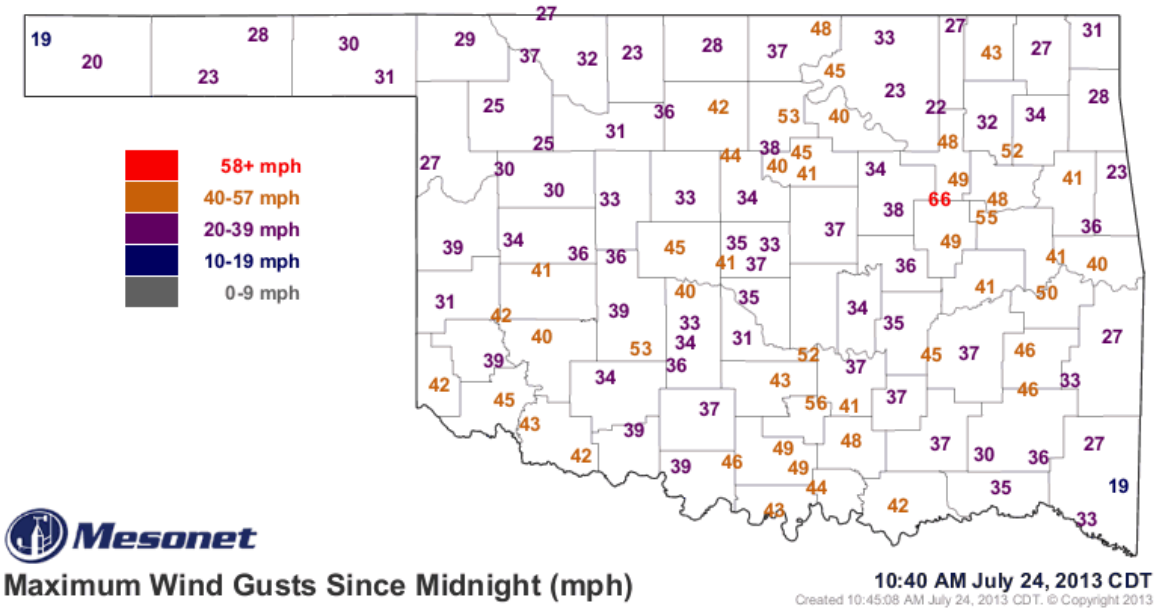


Fig. 12. Measured maximum wind gusts at Oklahoma Mesonet locations on July 24, 2013.

A complex of thunderstorms once again developed over KS and moved southeast into OK late on the 25th and continued through the day on the 26th. The heaviest rains affected central OK, bringing widespread flash flooding to that area. Rainfall totals remained lighter over eastern OK and western AR, bringing additional needed rainfall without any additional flooding to the entire HSA. Rainfall totals ranged from 0.50” to 1” across most of the HSA, with isolated higher and lower amounts (Figs. 13, 14, 15). The greatest rainfall occurred in far northeast and far southeast OK, with 2”-3” of rain reported.

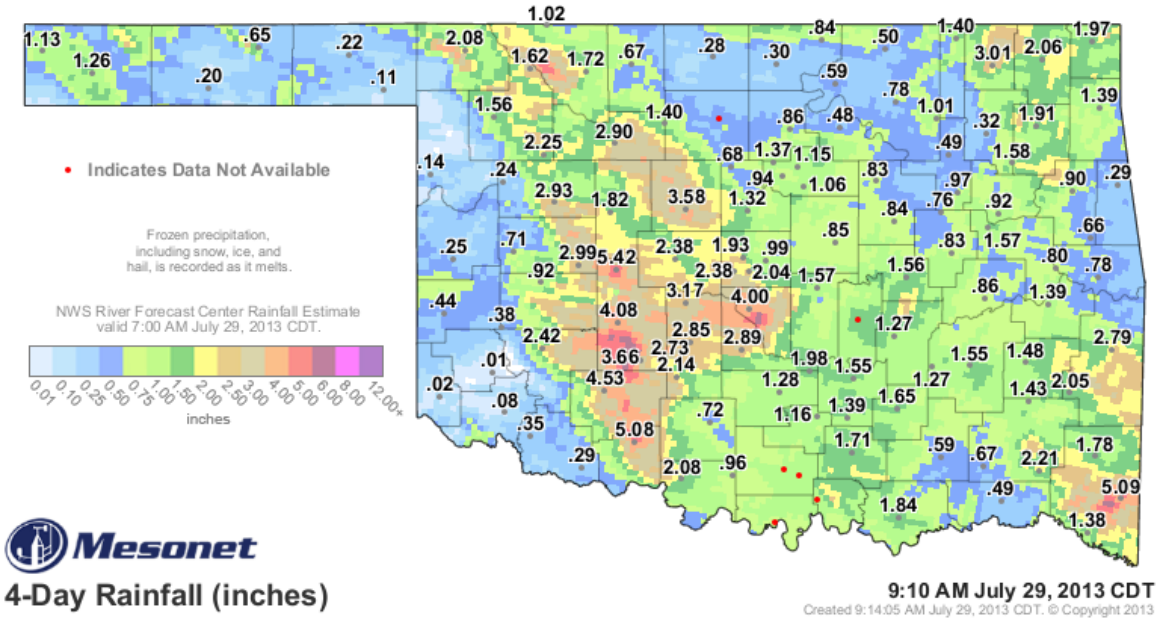


Fig. 13. Mesonet measured and NWS estimated rainfall 4-day total ending 9:10am July 29, 2013.

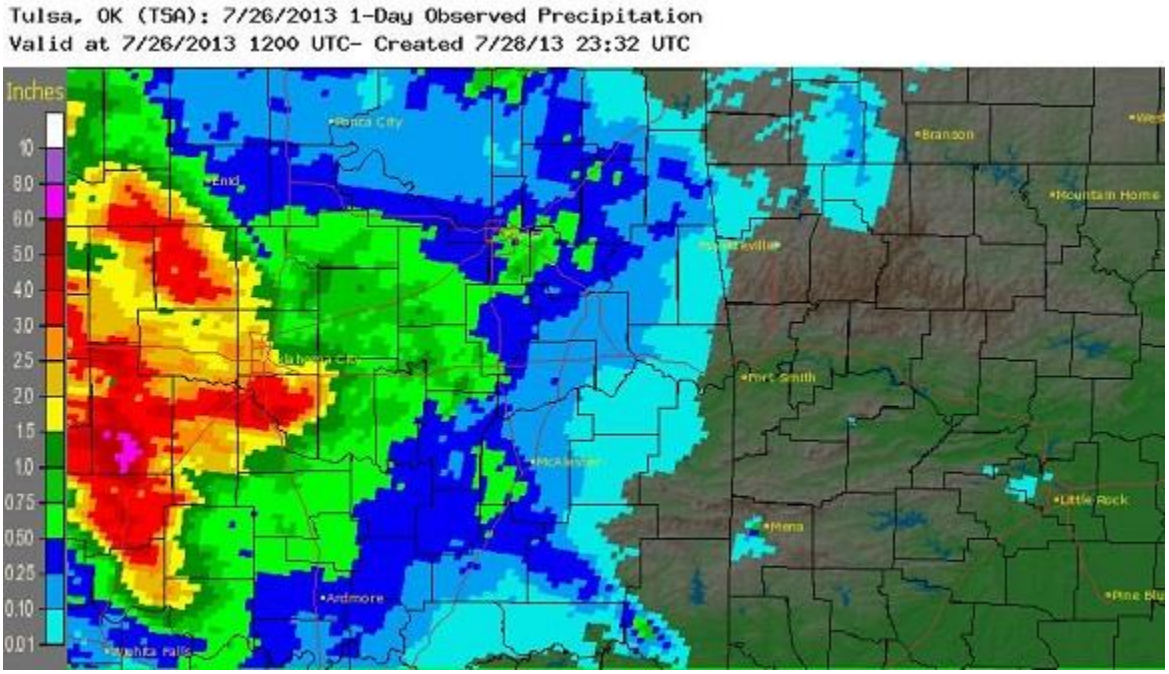


Fig. 14. Estimated Observed 24-hr Rainfall ending 7am 7/26/2013.

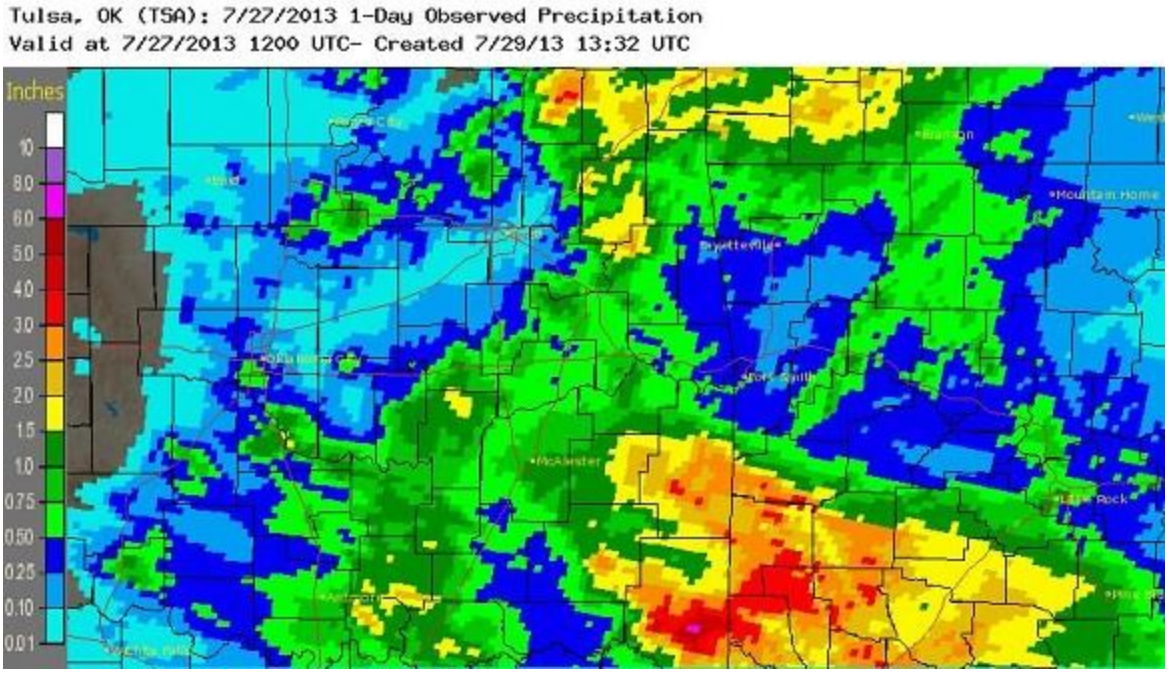


Fig. 15. Estimated Observed 24-hr Rainfall ending 7am 7/27/2013.

A complex of storms once again developed over southwest KS/northwest OK late on the 29th and moved southeast into northeast OK and northwest AR during the early morning hours. However, by this time, the storm complex began to decay, with all of the activity ending by late morning. Most of the rain fell north of an Okemah, OK to Fayetteville, AR line, brining 0.50"-1.5". Higher totals of 1.5"-3.5" occurred over portions of Creek, Ottawa, Delaware, and Benton Counties (Fig. 16). Rainfall totals of 6"-8" fell in southeast KS/southwest MO in the Spring River and Neosho River basins. This lead to significant rises, with minor flooding occurring downstream along the Neosho River near Commerce, and near bankfull conditions along the Spring River near Quapaw (see E-3 report for details).

Measured 24-hr rainfall totals (inches) ≥2.5" ending at 7am CDT July 30, 2013:

Garfield 3.9E, AR (CoCoRaHS)	3.36	Pea Ridge 0.2WSW, AR (CoCo)	3.18	Centerton 0.8SW, AR (CoCo)	3.04
Drumright 0.6SW, OK (CoCo)	2.92	Drumright 7ENE, OK (Mesonet)	2.60	Beaver Lake, AR (DCP)	2.57
Wyandotte 7.3NE, OK (CoCo)	2.56				

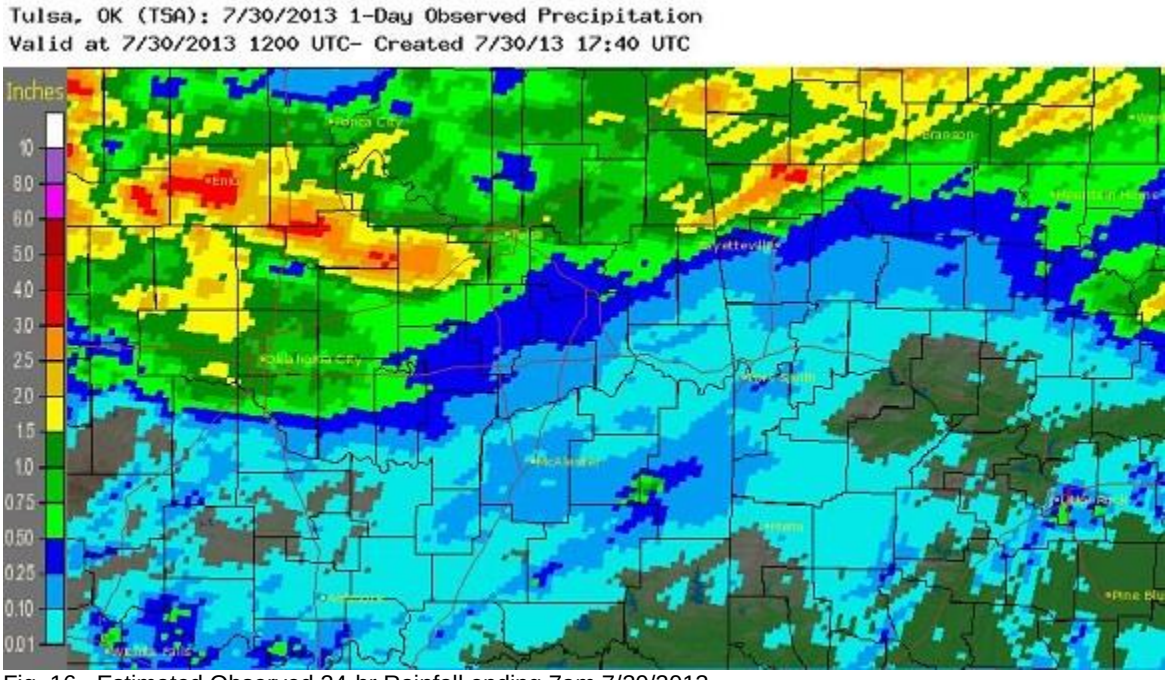


Fig. 16. Estimated Observed 24-hr Rainfall ending 7am 7/30/2013.

Isolated showers and thunderstorms developed later in the afternoon of the 30th along a surface boundary in eastern OK, brining 0.25" to around 1" to the affected locations. Then, during the late night hours, storms fired up over northwest AR. This activity brought isolated 1"-4" of rain to a few locations in Washington, Carroll, Crawford, and Franklin Counties (Fig. 17). The heavy rain in Johnson, AR (Washington Co.) led to the evacuation of a retirement center. The CoCoRaHS observer 4.2 miles east of Riverdale, AR measured 3.80" of rain. A few terrain induced showers and thunderstorms developed on the 31st in far southeast OK and west central AR, with generally lighter rainfall totals.

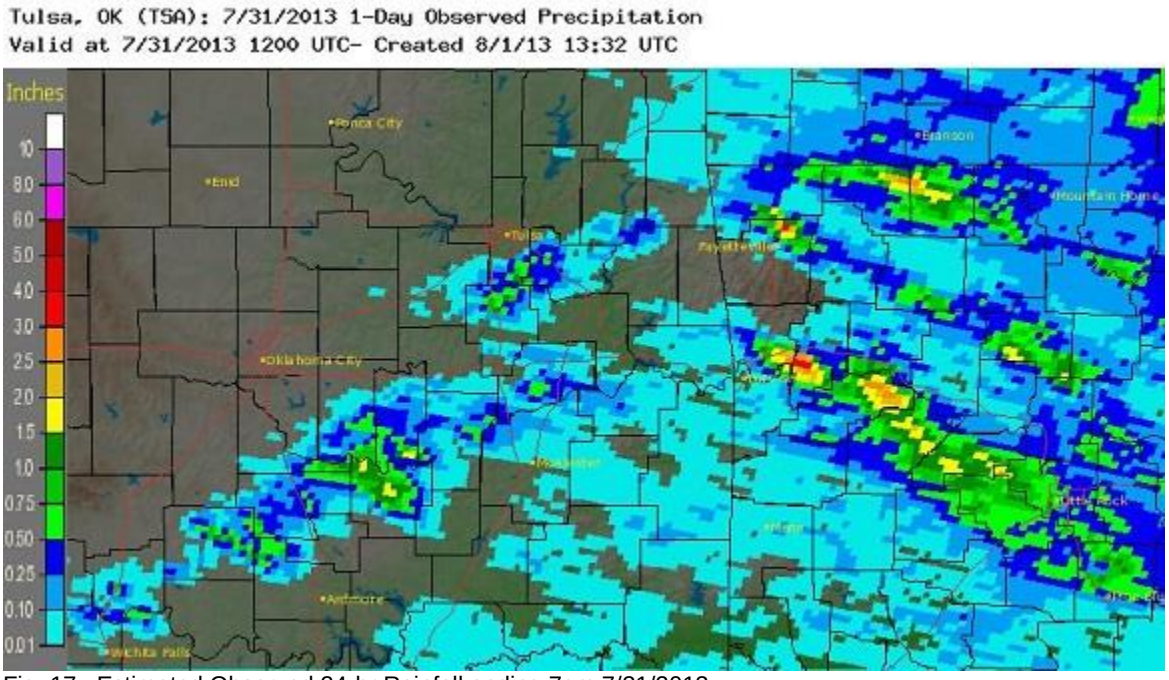


Fig. 17. Estimated Observed 24-hr Rainfall ending 7am 7/31/2013.

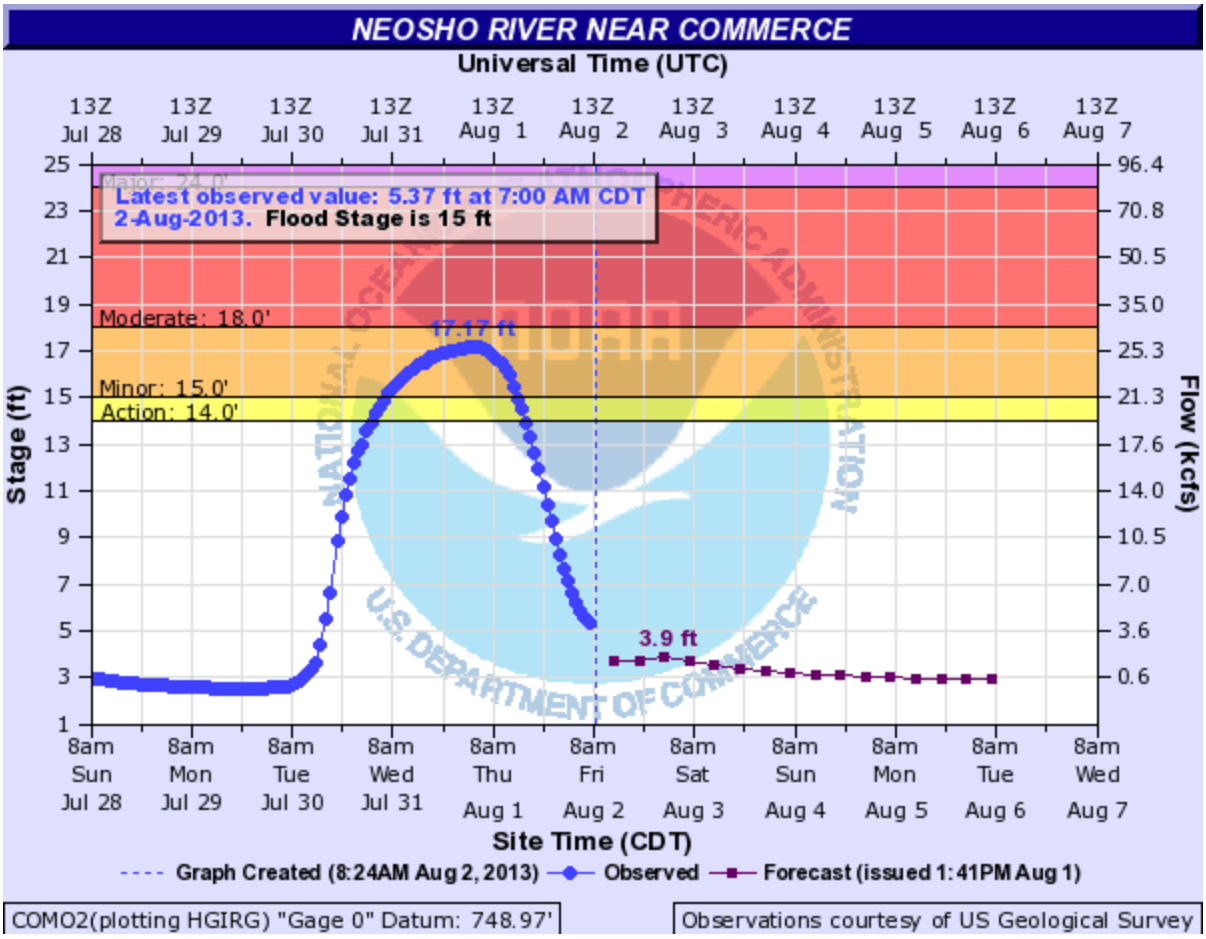
Written by:

Nicole McGavock
Service Hydrologist
WFO Tulsa

Products issued in July 2013:

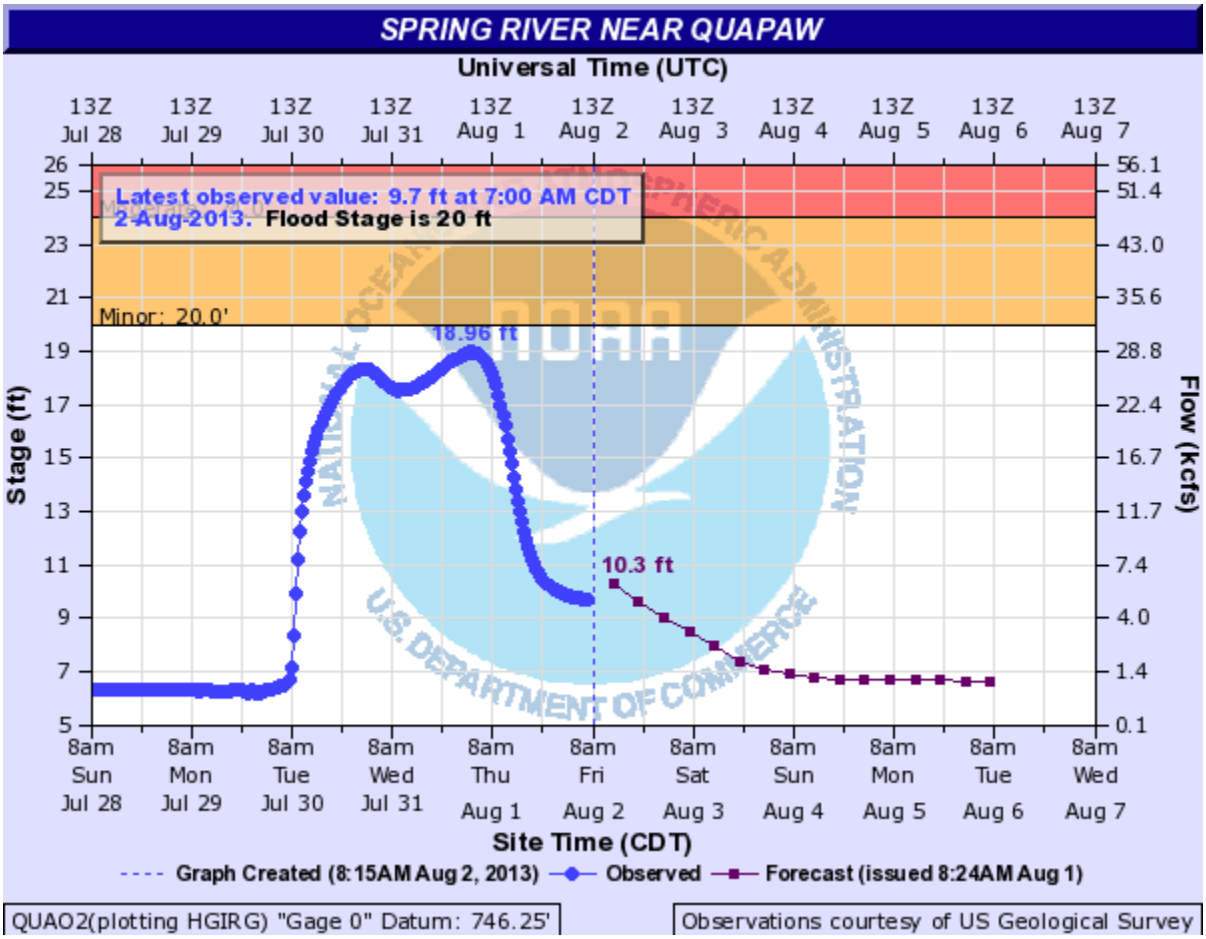
7	Flash Flood Warnings (FFW)
6	Flash Flood Statements (FFS)
4	Flash/Areal Flood Watches (FFA) (10 Watch FFA CON/EXT/CAN)
13	Urban and Small Stream Advisories (FLS)
3	Areal Flood Warnings (FLW)
3	Areal Flood Statements (FLS)
3	River Flood Warnings (FLW)
9	River Flood Statements (FLS)
0	River Flood Advisories (FLS) (0 Advisory FLS CON/EXT/CAN)
0	River Flood Watches (FFA) (0 Watch FFA CON/EXT/CAN)
0	River Statements (RVS)
0	Hydrologic Outlooks (ESF)
0	Drought Information Statements (DGT)

Preliminary Hydrographs:



COMO2(plotting HGIRG) "Gage 0" Datum: 748.97'

Observations courtesy of US Geological Survey



QUAO2(plotting HGIRG) "Gage 0" Datum: 746.25'

Observations courtesy of US Geological Survey