

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:	YEAR
		MONTH October	2021
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 November 4, 2021	

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.

A large portion of eastern OK and northwest AR had above normal rainfall in October 2021, which was a welcome sight after the very dry September. The average temperature this month was well above normal. Normal rainfall for October ranges from 2.9 inches in Pawnee County to 4.4 inches in Sequoyah County. 3.7 inches is normal across the Ozark region of northwest Arkansas. West central Arkansas averages just under 4 inches, while southeast Oklahoma averages slightly higher amounts of 4.5 inches. This report, past E-5 reports, and monthly hydrology and climatology summaries can be found at <http://www.weather.gov/tsa/hydro-monthly-summary>.

Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 1a), rainfall totals for October 2021 ranged from 2" to 12" across eastern OK and northwest AR, with much of the area receiving 4"-6". These rainfall totals correspond to 25% to around 250% of the normal October rainfall, with the below normal rainfall confined primarily to southeast OK (Fig. 1b).

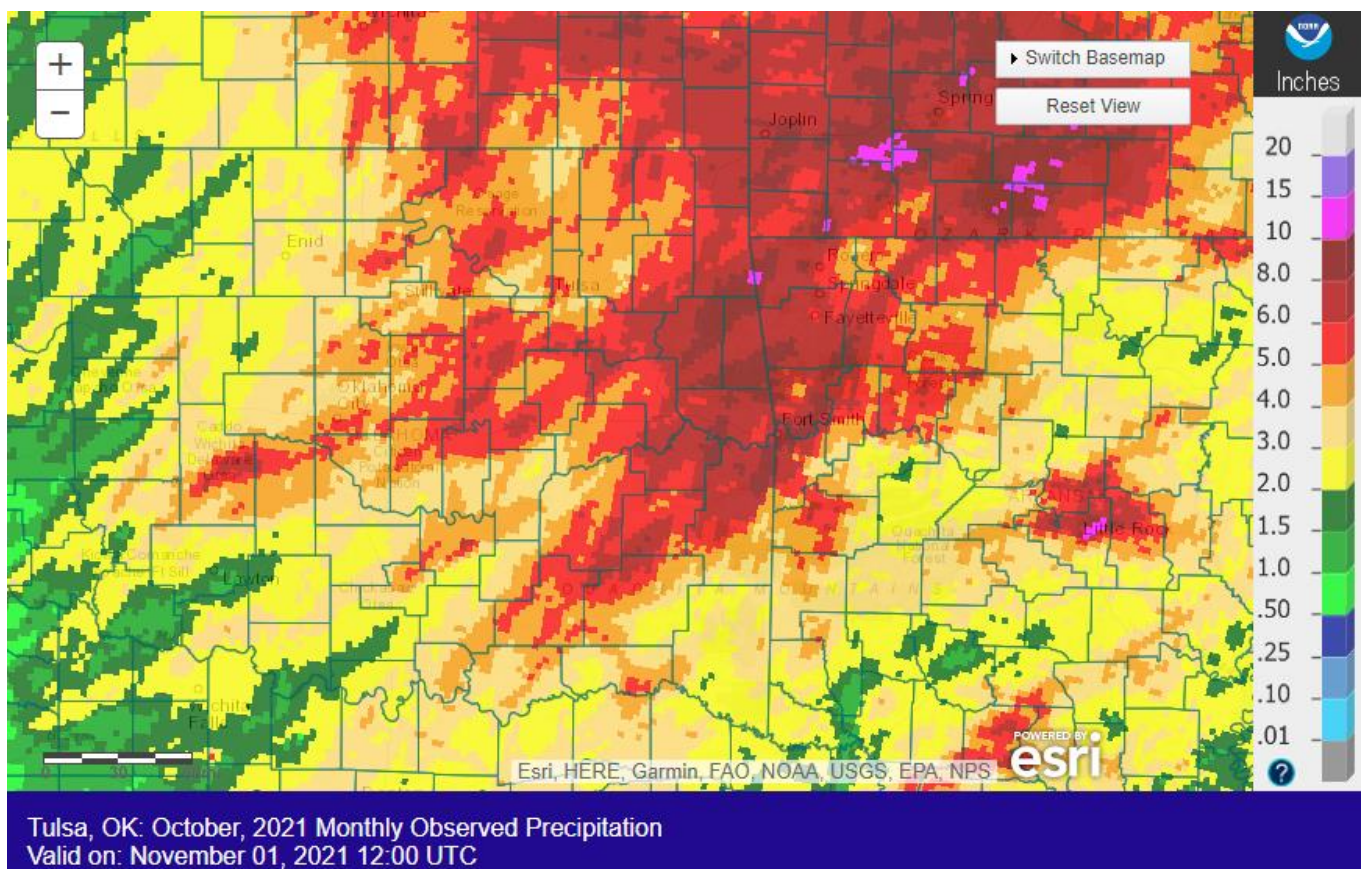
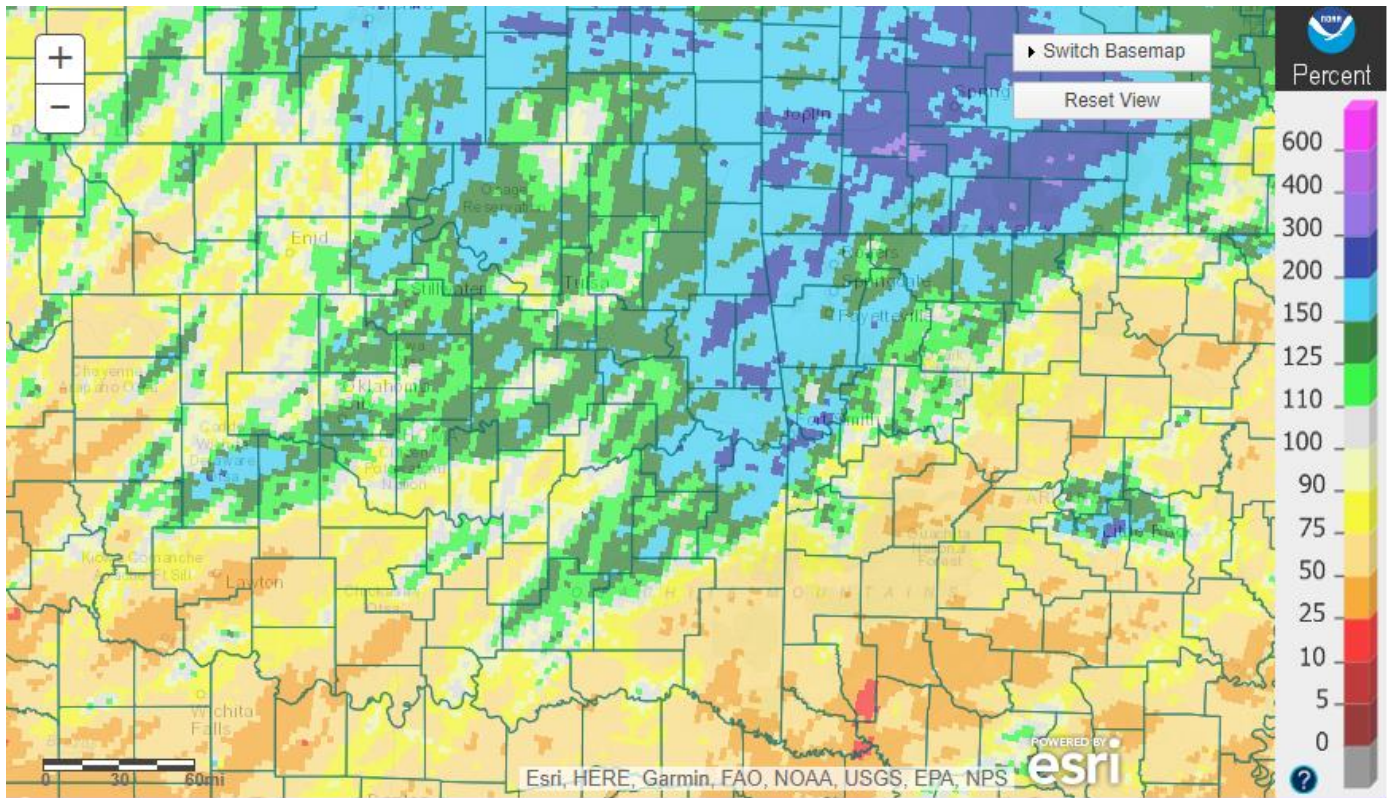


Fig. 1a. Estimated Observed Rainfall for October 2021



Tulsa, OK: October, 2021 Monthly Percent of Normal Precipitation
 Valid on: November 01, 2021 12:00 UTC

Fig. 1b. Estimated % of Normal Rainfall for October 2021

In Tulsa, OK, October 2021 ranked as the 18th warmest October (65.4°F, tied 1946; since records began in 1905) and the 36th wettest October (5.01”; since records began in 1888). Fort Smith, AR had the 21st warmest October (66.6°F, tied 1924, 1918; since records began in 1882) and the 8th wettest October (8.90”; since records began in 1882). Fayetteville, AR had the 8th warmest (62.0°F) and the 14th wettest (6.10”) October since records began in 1949.

Some of the larger precipitation reports (in inches) for October 2021 included:

Centerton 1.0E, AR (coco)	11.65	Watts 7.2WSW, OK (coco)	10.95	Siloam Springs 1.8N, AR (coco)	10.25
Van Buren 2.1NNW, AR (coco)	10.19	Centerton 2.1SE, AR (coco)	9.95	Decatur 2.6ESE, AR (coco)	9.75
Pea Ridge 0.2WSW, AR (coco)	9.72	Uniontown 2.1ESE, AR (coco)	9.63	Gentry 5.6ENE, AR (coco)	9.57

Some of the lowest precipitation reports (in inches) for October 2021 included:

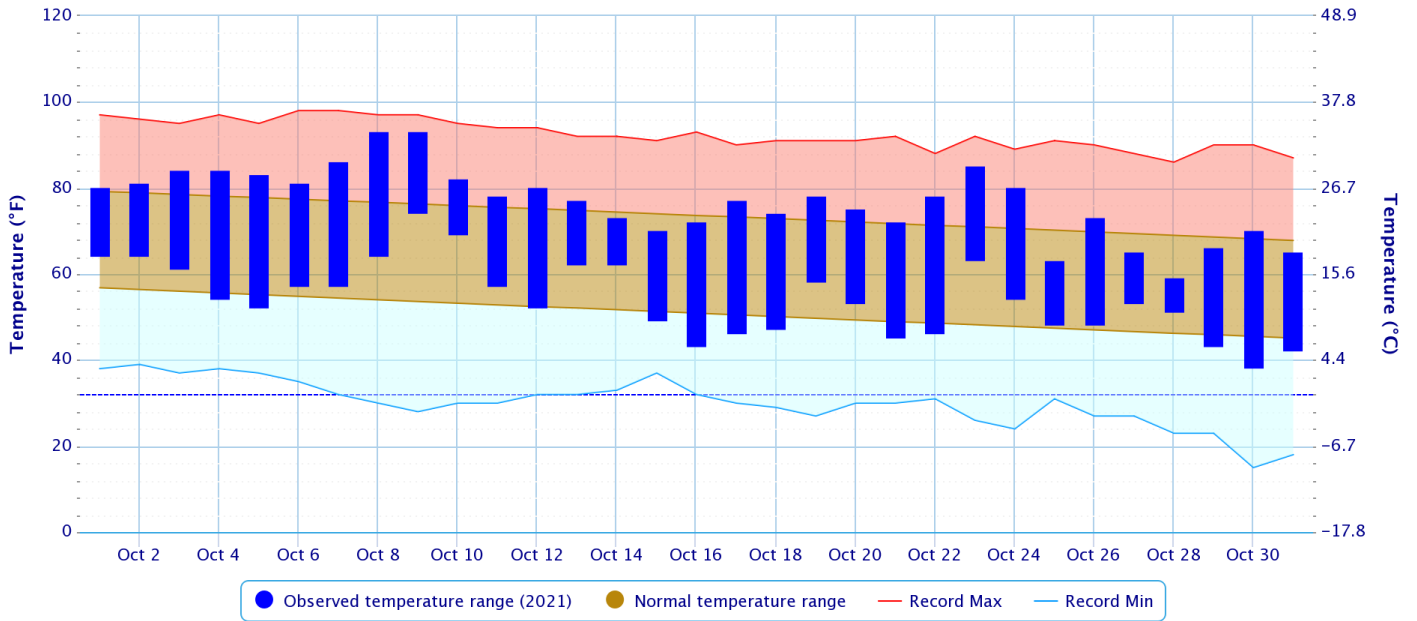
Cloudy, OK (meso)	2.75	Bartlesville, OK (ASOS)	3.68	Stuart, OK (meso)	3.75
Jenks Riverside Arpt, OK (ASOS)	3.93	Copan, OK (meso)	4.10	Hugo, OK (meso)	4.20
Skiatook, OK (meso)	4.34	Talala, OK (meso)	4.37	Pawnee, OK (meso)	4.42

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

Rank since 1921	October 2021	Autumn-to-Date (Sep 1 – Oct 31)	Last 90 Days (Aug 3 – Oct 31)	Last 120 Days (Jul 4 – Oct 31)	Last 180 Days (May 5 – Oct 31)	Year-to-Date (Jan 1 – Oct 31)	Last 365 Days (Nov 1, 2020 – Oct 31, 2021)
Northeast OK	20 th wettest	46 th driest	27 th driest	38 th driest	41 st wettest	33 rd wettest	33 rd wettest
East Central OK	17 th wettest	48 th wettest	49 th wettest	43 rd driest	47 th driest	45 th wettest	47 th wettest
Southeast OK	42 nd wettest	36 th driest	50 th driest	49 th driest	28 th wettest	33 rd wettest	42 nd wettest
Statewide	31 st wettest	30 th driest	23 rd driest	26 th driest	48 th wettest	50 th wettest	50 th wettest

Daily Temperature Data – Tulsa Area, OK (ThreadEx)

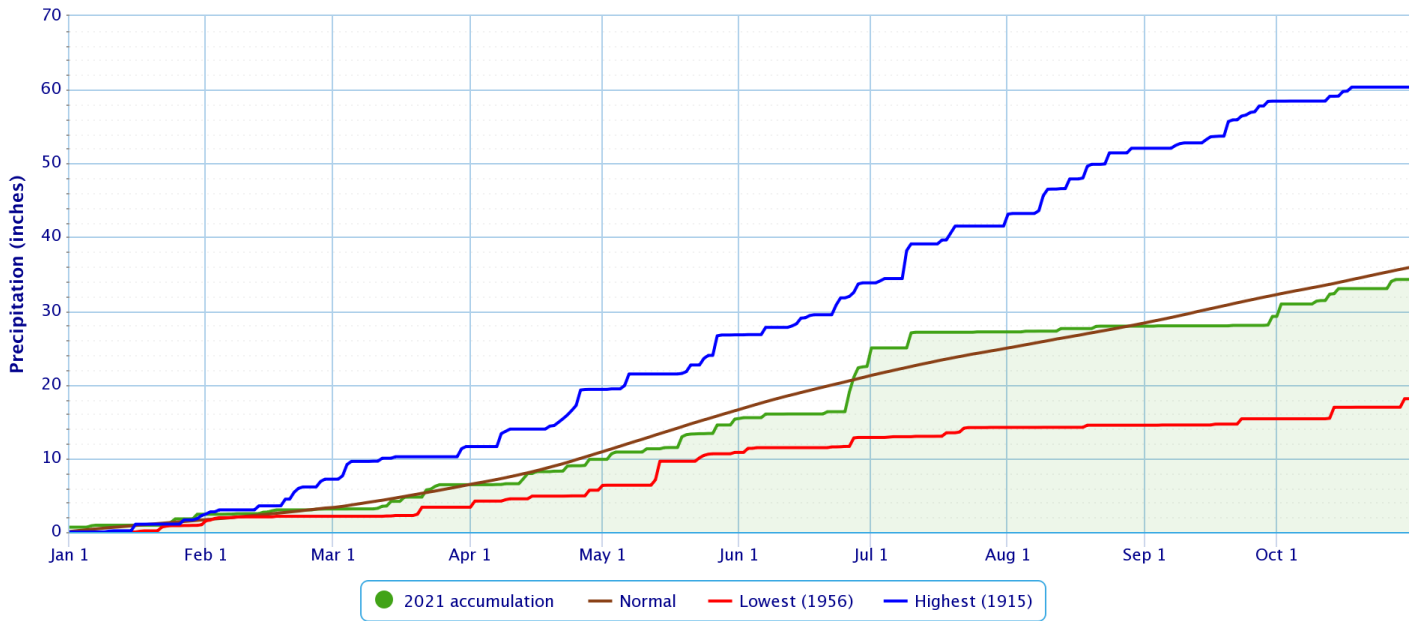
Period of Record – 1905-01-06 to 2021-10-31. Normals period: 1991-2020. Click and drag to zoom chart.



Powered by ACIS

Accumulated Precipitation – Tulsa Area, OK (ThreadEx)

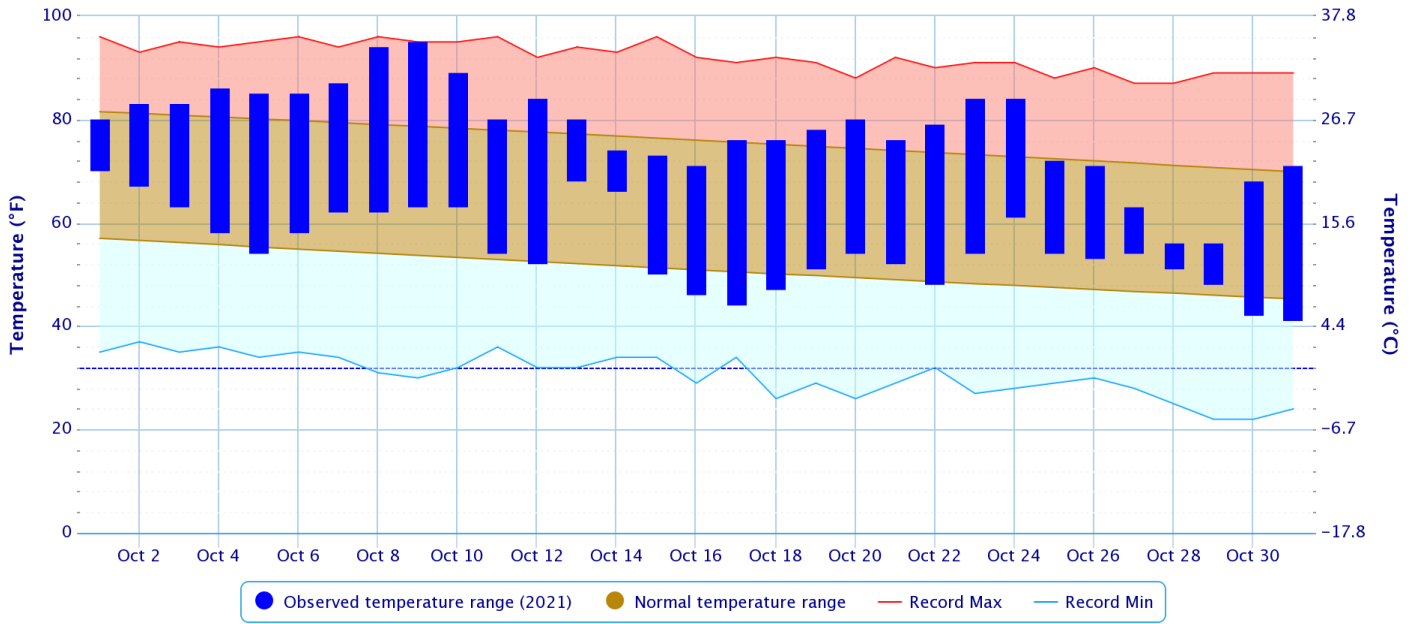
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



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Daily Temperature Data – Fort Smith Area, AR (ThreadEx)

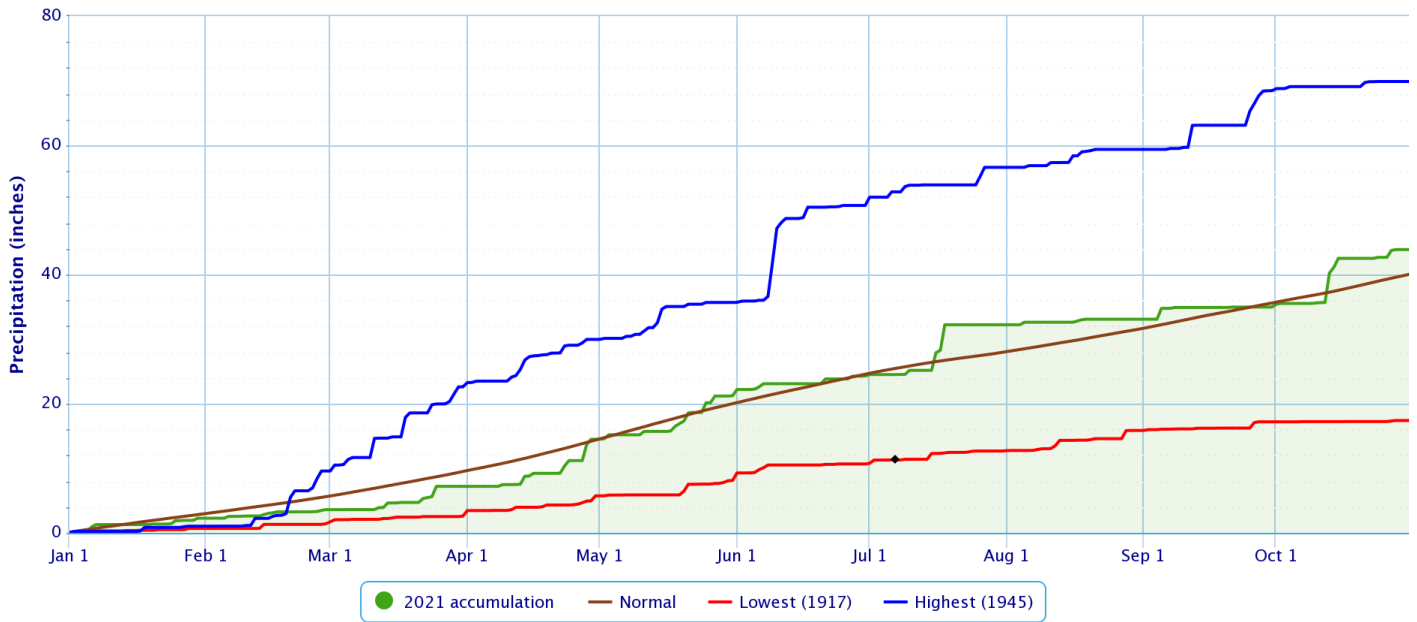
Period of Record – 1882-06-01 to 2021-10-31. Normals period: 1991-2020. Click and drag to zoom chart.



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Accumulated Precipitation – Fort Smith Area, AR (ThreadEx)

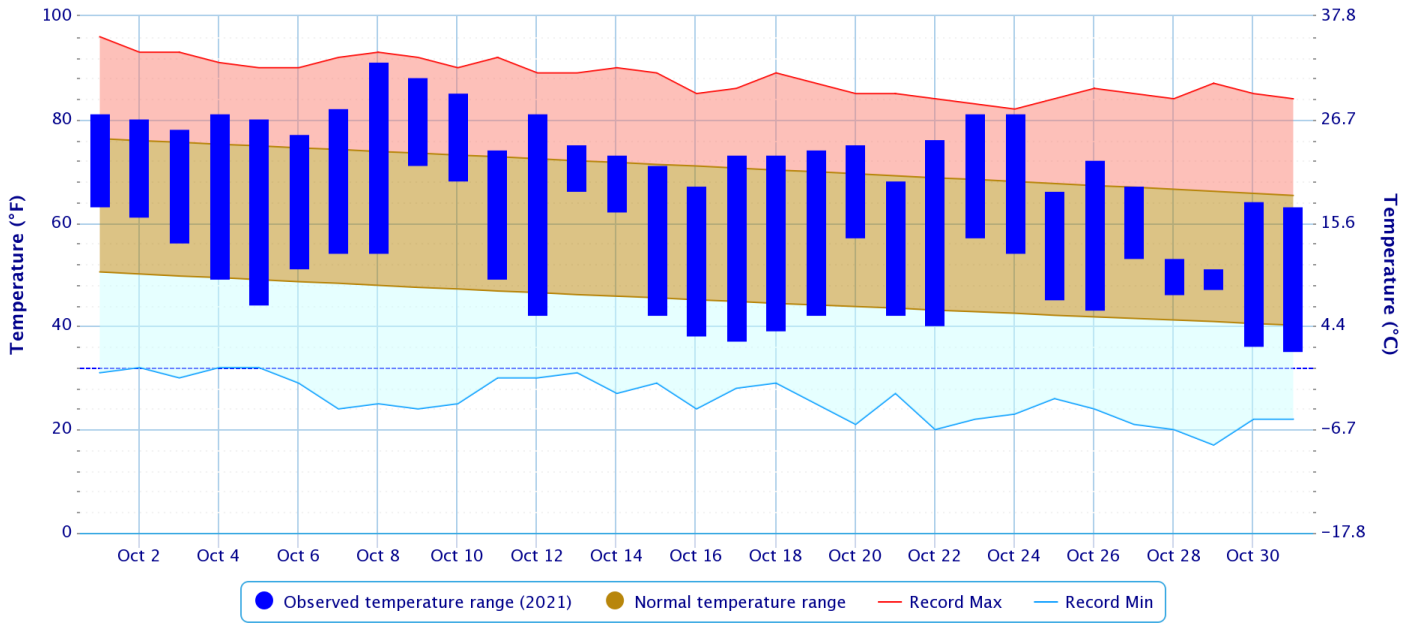
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



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Daily Temperature Data – FAYETTEVILLE DRAKE FIELD, AR

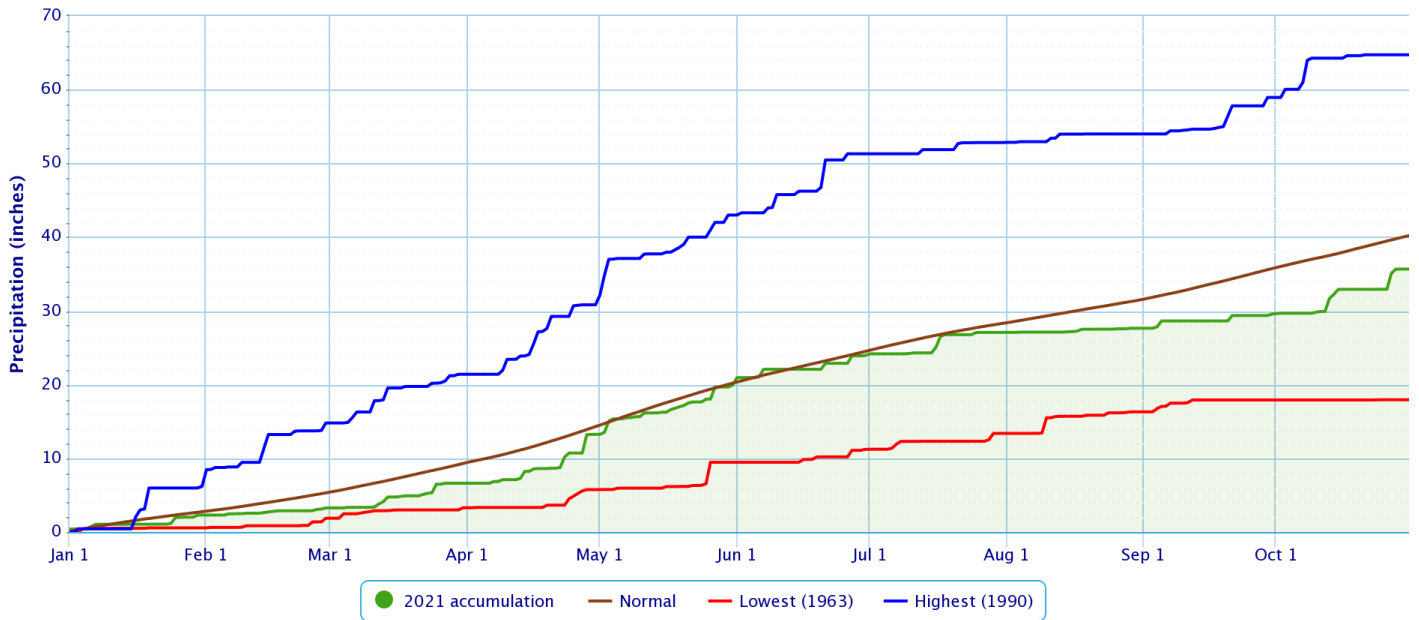
Period of Record – 1949-07-14 to 2021-10-31. Normals period: 1991-2020. Click and drag to zoom chart.



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Accumulated Precipitation – FAYETTEVILLE DRAKE FIELD, AR

Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values

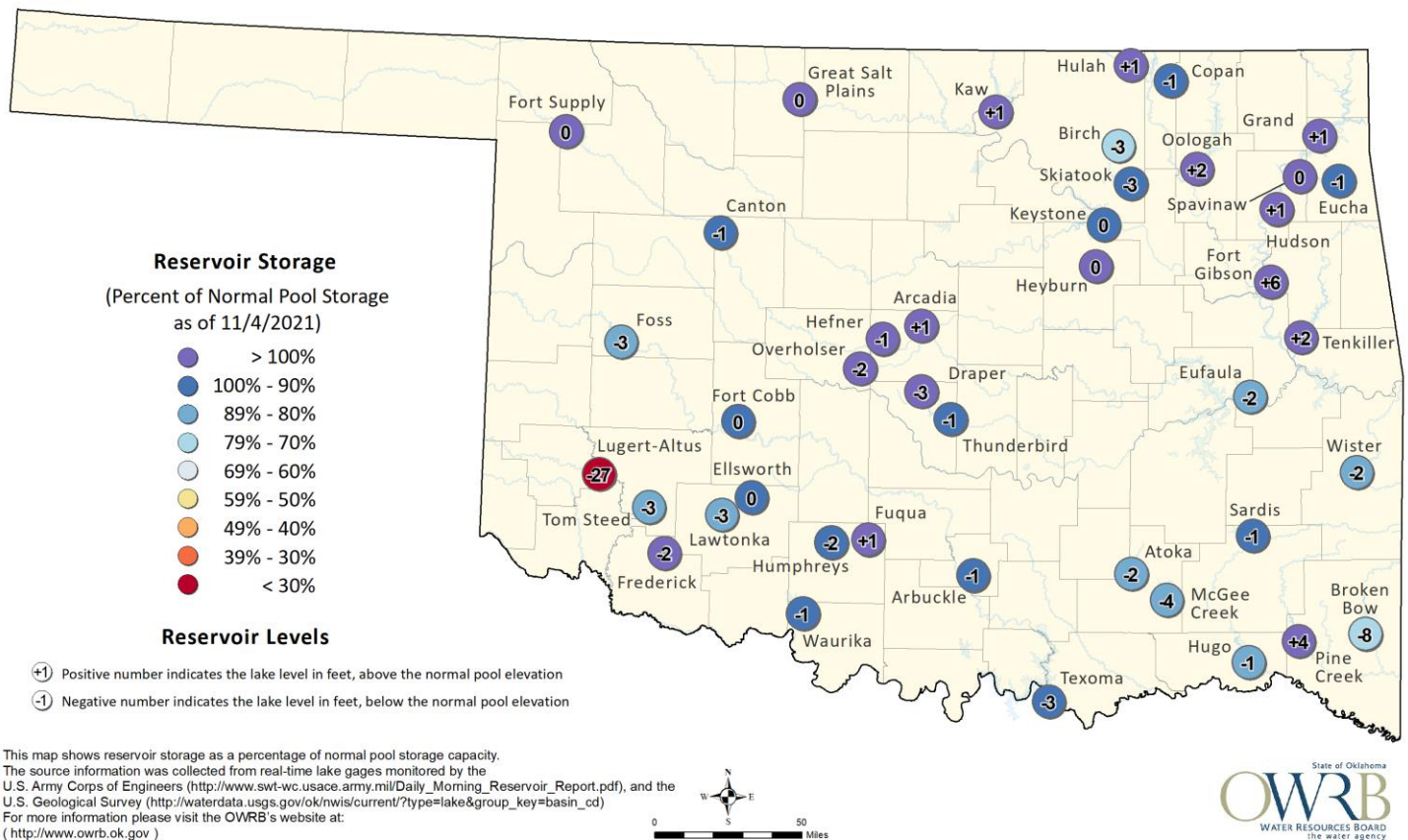


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Reservoirs

Oklahoma Surface Water Resources

Reservoir Levels and Storage as of 11/4/2021



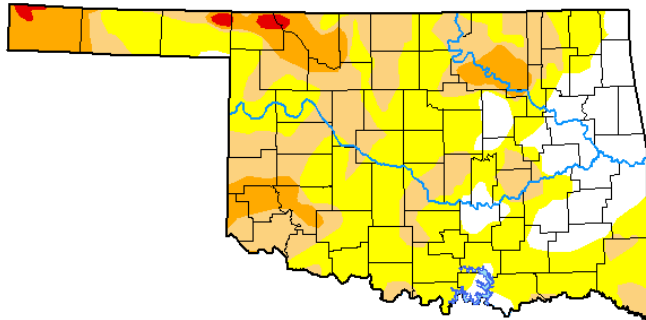
According to the USACE, several lakes in the HSA were below 3% of top of their conservation pools as of 11/01/2021: Wister Lake 79%, Birch Lake 80%, Lake Eufaula 89%, Hugo Lake 91%, Skiatook Lake 91%, Copan Lake 92%, Sardis Lake 96%, and Beaver Lake 96%. A few lakes were more than 3% above the top of their conservation pools: Fort Gibson Lake 13%, Grand Lake 11%, Oologah Lake 6%, Hudson Lake 6%, and Tenkiller Lake 5%.

Drought

According to the [U.S. Drought Monitor](#) (USDM) from November 2, 2021 (Figs. 2, 3), drought conditions were present across a portion of eastern OK, and no drought was occurring in northwest AR. Severe (D2) Drought conditions were present over parts of Osage, Pawnee, and Tulsa Counties in eastern OK. Moderate (D1) Drought conditions were occurring across portions of eastern Kay, Osage, Pawnee, Washington, Nowata, Creek, Rogers, Tulsa, Okfuskee, Okmulgee, McIntosh, Pittsburg, Choctaw, and Le Flore Counties in eastern OK. Abnormally Dry (D0) but not in drought conditions were found in portions of Osage, Nowata, Craig, Ottawa, Rogers, Mayes, Tulsa, Creek, Wagoner, Okmulgee, Okfuskee, McIntosh, Pittsburg, Le Flore, Pushmataha, and Choctaw Counties in eastern OK, and Sebastian County in west central AR.

U.S. Drought Monitor Oklahoma

November 2, 2021
(Released Thursday, Nov. 4, 2021)
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	17.84	82.16	36.86	10.80	0.77	0.00
Last Week 10-26-2021	5.05	94.95	40.74	10.90	0.77	0.00
3 Months Ago 08-03-2021	91.12	8.88	1.82	0.00	0.00	0.00
Start of Calendar Year 12-29-2020	56.83	43.17	25.21	7.75	1.45	0.00
Start of Water Year 09-26-2021	6.45	93.55	73.23	23.72	2.65	0.00
One Year Ago 11-03-2020	73.87	26.13	10.65	5.19	1.44	0.00

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

Author:

Adam Hartman
NOAA/NWS/NCEP/CPC

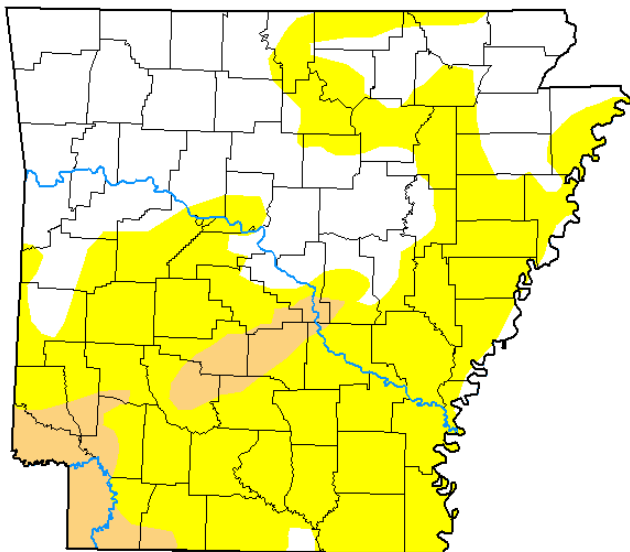


droughtmonitor.unl.edu

Fig. 2. Drought Monitor for Oklahoma

U.S. Drought Monitor Arkansas

November 2, 2021
(Released Thursday, Nov. 4, 2021)
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	39.44	60.56	7.35	0.00	0.00	0.00
Last Week 10-26-2021	33.13	66.87	7.61	0.00	0.00	0.00
3 Months Ago 08-03-2021	97.34	2.66	0.00	0.00	0.00	0.00
Start of Calendar Year 12-29-2020	16.45	83.55	6.87	0.00	0.00	0.00
Start of Water Year 09-28-2021	51.41	48.59	5.17	0.00	0.00	0.00
One Year Ago 11-03-2020	99.63	0.37	0.00	0.00	0.00	0.00

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

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Adam Hartman
NOAA/NWS/NCEP/CPC



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Fig. 3. Drought Monitor for Arkansas

Outlooks

The [Climate Prediction Center](#) (CPC) outlook for November 2021 (issued October 31, 2021) indicates a slightly enhanced chance for above normal temperatures across eastern OK and an equal chance for above, near, and below normal temperatures across northwest AR. This outlook also indicates an equal chance for above, near, and below median precipitation across all of eastern OK and northwest AR. This outlook was largely based on dynamical model output and La Niña impacts. Below normal temperatures are more likely in the central U.S. early in the month and above normal temperatures are more likely later in the month; hence November overall doesn't have a strong signal for a tilt in the probabilities for warmer or colder.

For the 3-month period November-December-January 2021-22, CPC is forecasting an enhanced chance for above normal temperatures across all of eastern OK and northwest AR, a slightly enhanced chance for below median precipitation across far southeast OK, and an equal chance for above, near, and below median precipitation across the remainder of eastern OK and northwest AR (outlook issued October 21, 2021). This outlook is based on long-term trends, La Niña impacts, and incorporates both statistical and dynamical forecast tools. According to CPC, the combined effect of the ocean-atmosphere system is now consistent with La Niña conditions. There is an 87% chance that La Niña conditions will continue through winter 2021-22. CPC issued a La Niña Advisory.

Summary of Heavy Precipitation Events Daily quality-controlled rainfall maps can be found at: http://water.weather.gov/precip/index.php?location_type=wfo&location_name=tsa

Scattered showers and thunderstorms affected far eastern OK and northwest AR from late morning on the 1st through the morning of the 2nd as a mid-level low moved across the Plains. While overall coverage was limited, slow storm motion combined with precipitable water (PWAT) values of 1.5"-2" resulted in isolated rainfall totals of 0.25" to around 2.5" (Fig. 4). An upper-level low then ejected into the Plains, with broadly diffluent upper-level flow over the region on the 2nd. This enhanced forcing resulted in an area of showers and thunderstorms that moved northeast across northeast OK during the morning hours. Some additional development occurred along a cold front across far east central OK and northwest AR during the early afternoon. A few isolated showers and thunderstorms occurred during the evening hours as the main upper-level low moved through. Rainfall totals ranged from a few hundredths to 2.5" across all but southeast OK (Fig. 5). The highest rainfall impacted Creek, Tulsa, Rogers, and Benton Counties. This rainfall was not enough to alleviate the Extreme (D3) Drought conditions across northeast OK.

Severe thunderstorms developed over central OK during the afternoon of the 10th, along a cold front that was moving into the area. A strong upper-level disturbance translating into the Southern Plains resulted in strengthening wind fields across eastern OK during the evening, as the storms approached from the west. Very strong wind shear combined with moderately strong instability resulted in some supercells, which then evolved into a squall line as the storms moved through eastern OK. One of the supercells produced a tornado in east central OK during the late evening, and the squall line produced several tornadoes during the evening, as low-level circulations developed along its leading edge (see <https://noaa.maps.arcgis.com/apps/MapJournal/index.html?appid=6c67ff81e9a742039e8a15888d9c02b5> for details). A total of 5 tornadoes occurred (4 were EF-1 and one was EF-0). The line moved into western AR around midnight and quickly moved east. Some wrap around showers and thunderstorms occurred across northeast OK and northwest AR during the overnight through early morning hours of the 11th. Rainfall totals across northeast OK were around 0.50" to around 5", with widespread 1.5"-3" across Osage, Pawnee, Okfuskee, Okmulgee, and western Muskogee Counties (Figs. 6, 7). Elsewhere, rainfall totals were around 1" or less. This rainfall did help to improve the drought conditions across northeast OK, though a small area of Extreme (D3) Drought remained.

A line of showers and thunderstorms moved southeast into northeast OK during the pre-dawn hours of the 13th. This line, as well as scattered showers and storms ahead of it, continued to move southeast through the morning. The bulk of this rain came to an end during the early afternoon. Deep-layered southwesterly flow ahead of a strong upper-level cyclone that was lifting into the Plains drew deep moisture and the remains of Pamela across TX and into southeast OK/western AR. Large-scale ascent in association with the entrance region of a 100+ knot upper-level jet allowed a broad band of convection to develop starting mid-afternoon on the 13th, stretching from central TX into MO. With PWATs running at or above 2", the storms had efficient rainfall rates. This activity continued through the evening and overnight hours before finally shifting east of the

region by sunrise on the 14th. The majority of eastern OK and northwest AR received 0.75"-6" of rain, with widespread 2"-5" from southeast OK into northwest AR (Fig. 8).

Shortly after midnight on the 15th, a cluster of thunderstorms over central OK moved into northeast OK. These storms quickly moved east across northeast OK and northwest AR during the overnight through mid-morning hours. A bow echo developed within this cluster, and an EF-1 tornado developed in the comma head portion as it moved across southeast Washington and southwest Madison Counties in northwest AR (see <https://noaa.maps.arcgis.com/apps/MapJournal/index.html?appid=6c67ff81e9a742039e8a15888d9c02b5> for details). This activity brought 0.25"-2.5" of rain to northeast OK and northwest AR (Fig. 9).

The rainfall total from these last two rain events ranged from 0.50"-7" across eastern OK and northwest AR, with much of southeast OK, east central OK, and northwest AR seeing over 2" of rain (Fig. 10). This rainfall was finally enough to improve the drought conditions some, with Extreme (D3) drought conditions no longer observed in northeast OK.

During the early morning hours of the 27th, a weakening line of showers and thunderstorms moved into eastern OK. This line of convection broadened and slowed as it continued to push east through eastern OK during the morning hours. By late morning, the showers and thunderstorms began to move into northwest AR. The main body of the rain exited the area by late afternoon; however, lingering showers continued across far eastern OK and northwest AR during the evening. The center of an upper-level low pressure system then moved across northeast OK and northwest AR during the early morning hours of the 28th, bringing additional wrap around precipitation to the area. Rain persisted through the afternoon hours before moving east of the area. In addition to the rain, wind gusts in excess of 50 mph were observed across eastern OK due to a large atmospheric wind tunnel effect from a deepening surface low drifting slowly to the east across northern AR and strong high pressure located over the central Rockies. The Oklahoma Mesonet station near Talala, OK measured a 64 mph non-thunderstorm wind gust, and the station near Hectorville, OK measured a 59 mph non-thunderstorm wind gust. The rainfall total from this event ranged from 0.75" to around 5" (Figs. 11-15).

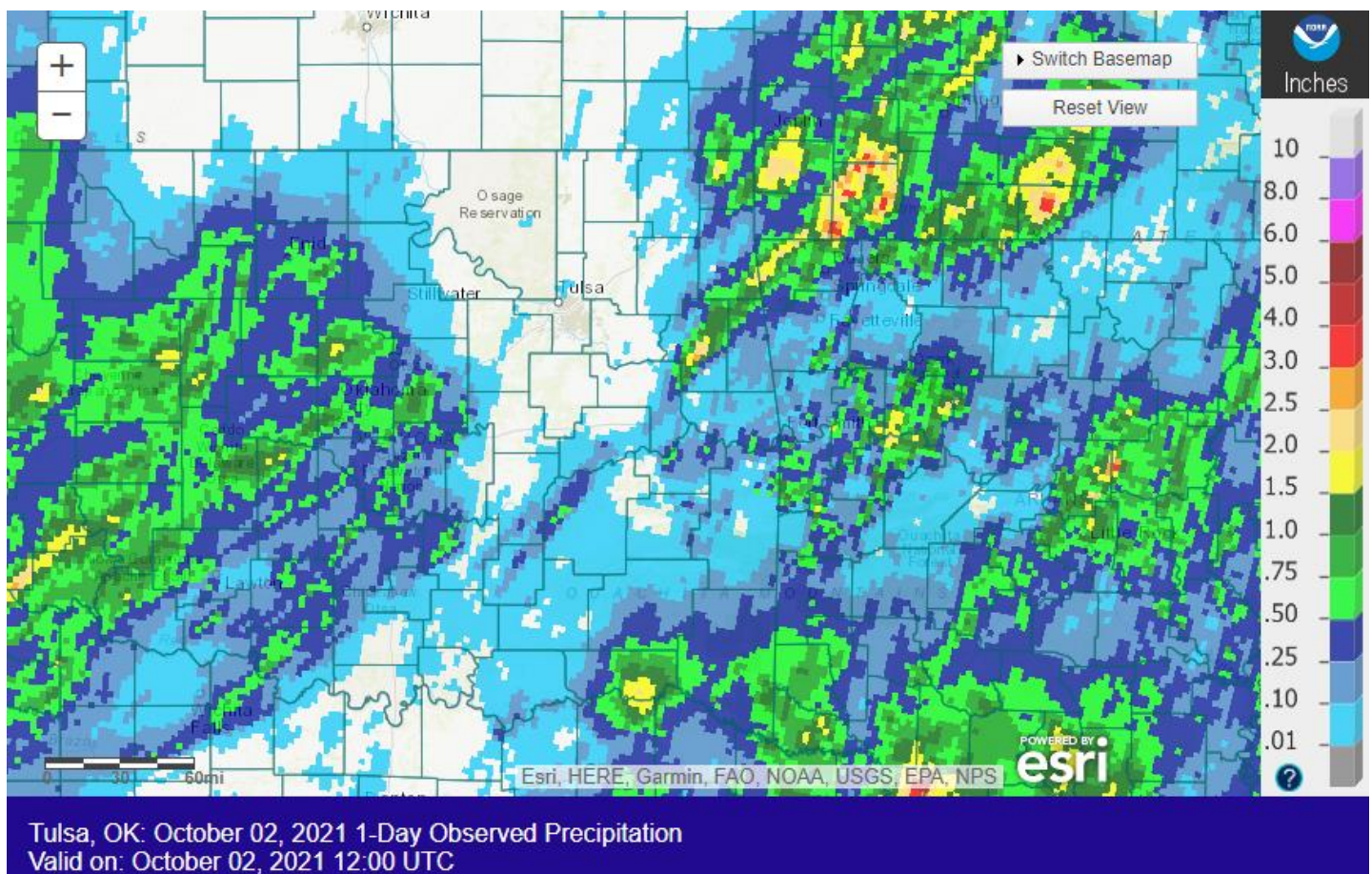
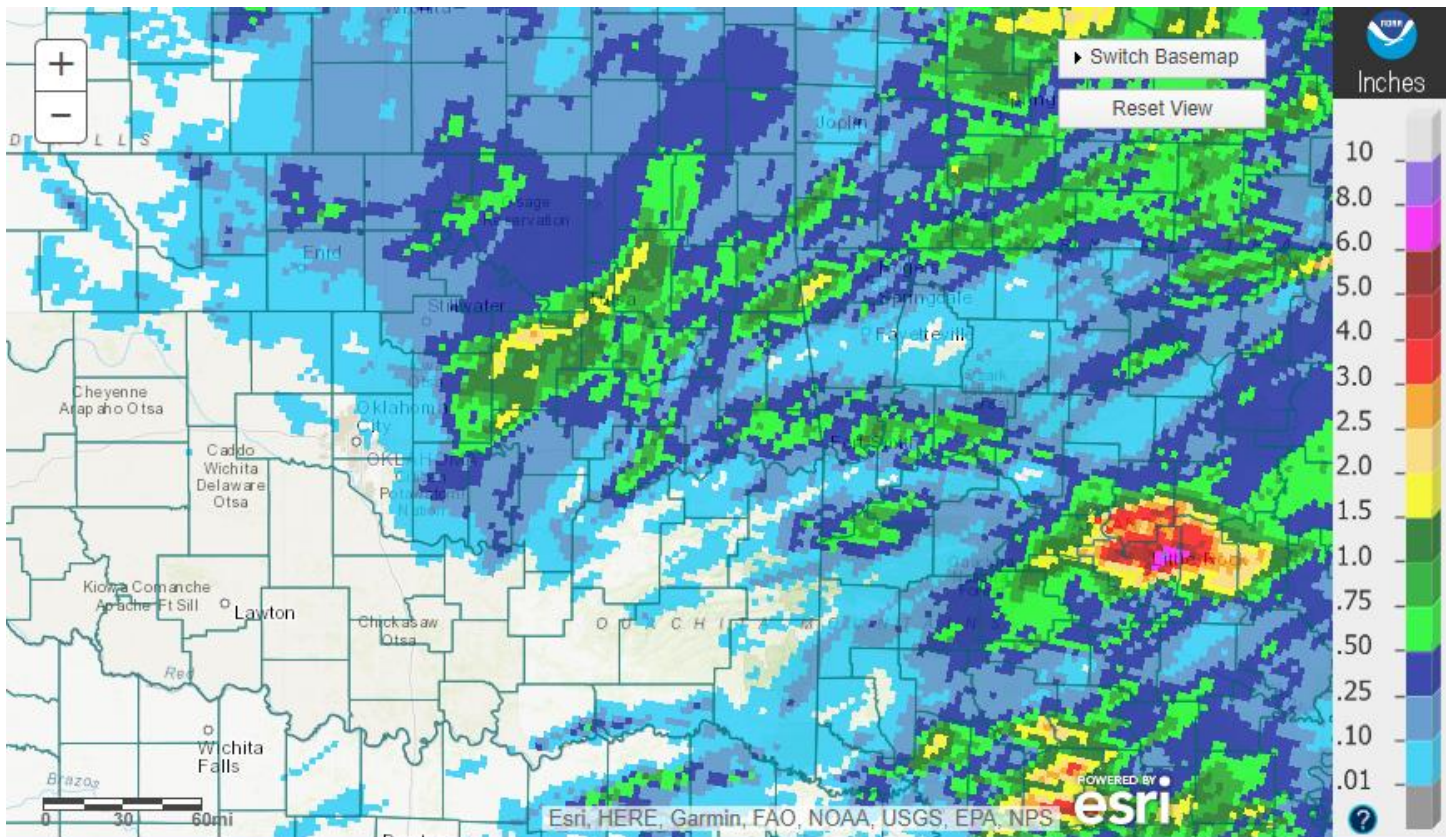
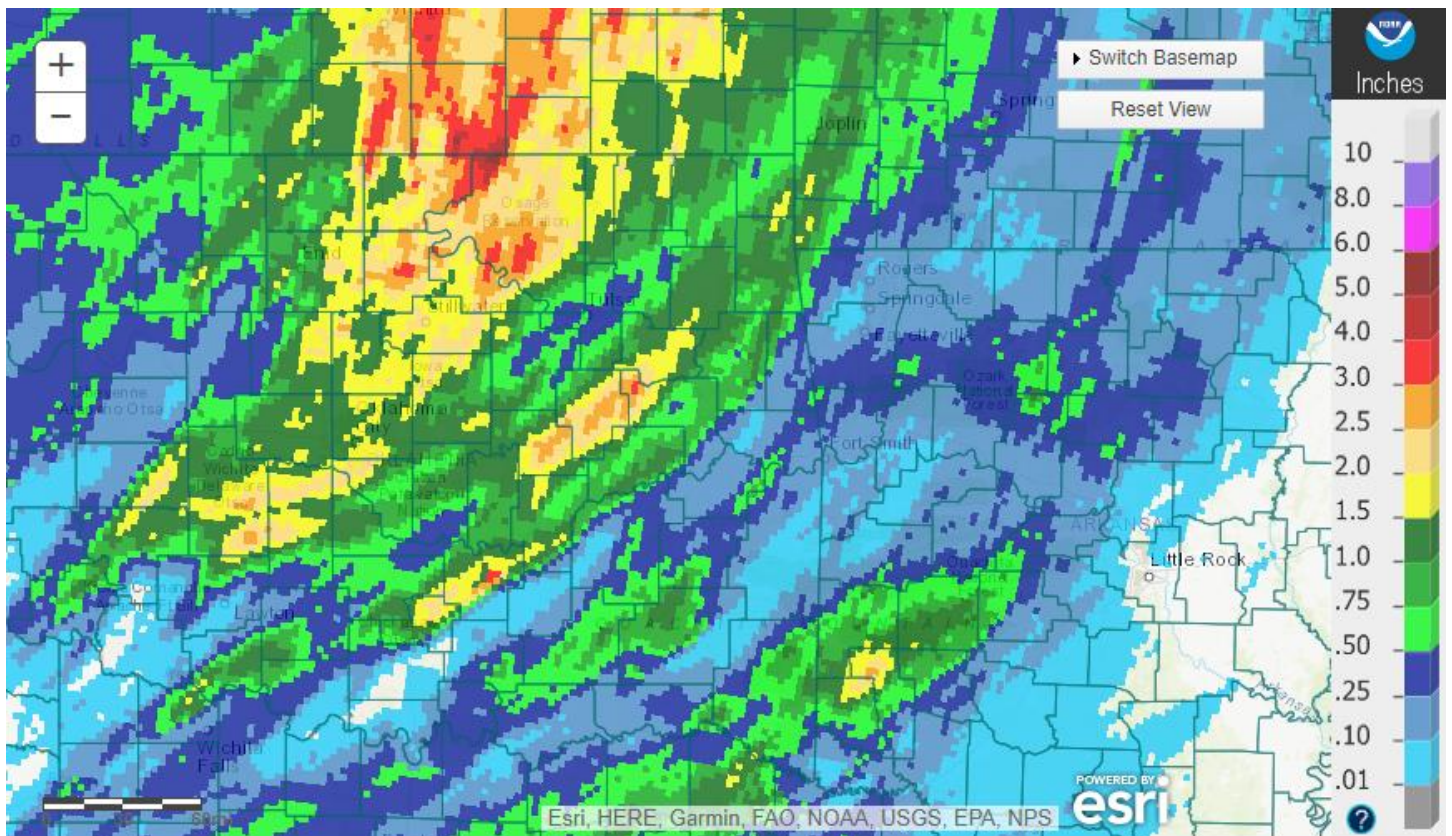


Fig. 4. 24-hour Estimated Observed Rainfall ending at 7am CDT 10/02/2021.



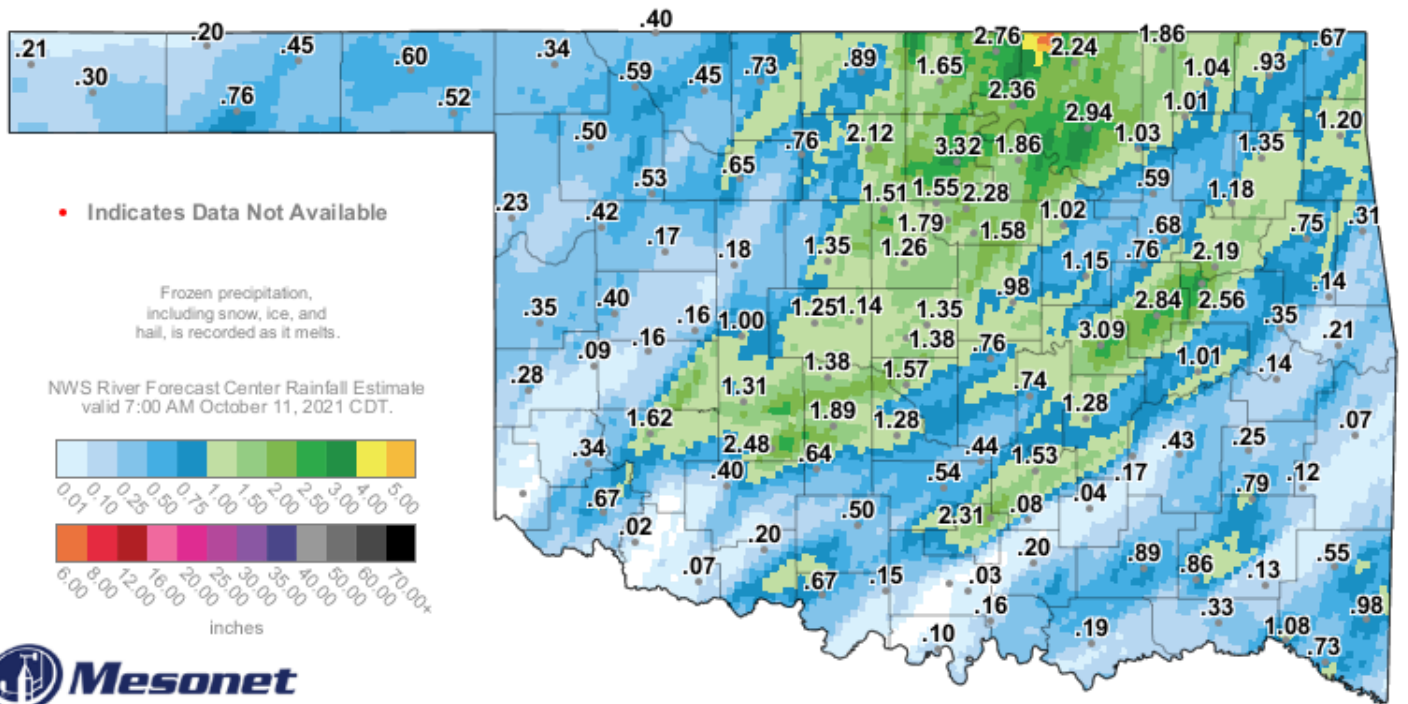
Tulsa, OK: October 03, 2021 1-Day Observed Precipitation
 Valid on: October 03, 2021 12:00 UTC

Fig. 5. 24-hour Estimated Observed Rainfall ending at 7am CDT 10/03/2021.



Tulsa, OK: October 11, 2021 1-Day Observed Precipitation
 Valid on: October 11, 2021 12:00 UTC

Fig. 6. 24-hour Estimated Observed Rainfall ending at 7am CDT 10/11/2021.



24-Hour Rainfall Accumulation (inches)

8:05 AM October 11, 2021 CDT

Created 8:10:51 AM October 11, 2021 CDT. © Copyright 2021

Fig. 7. OK Mesonet (values) and NWS RFC rainfall estimate (image) 24-hour rainfall ending at 08:05 am CDT 10/11/2021.

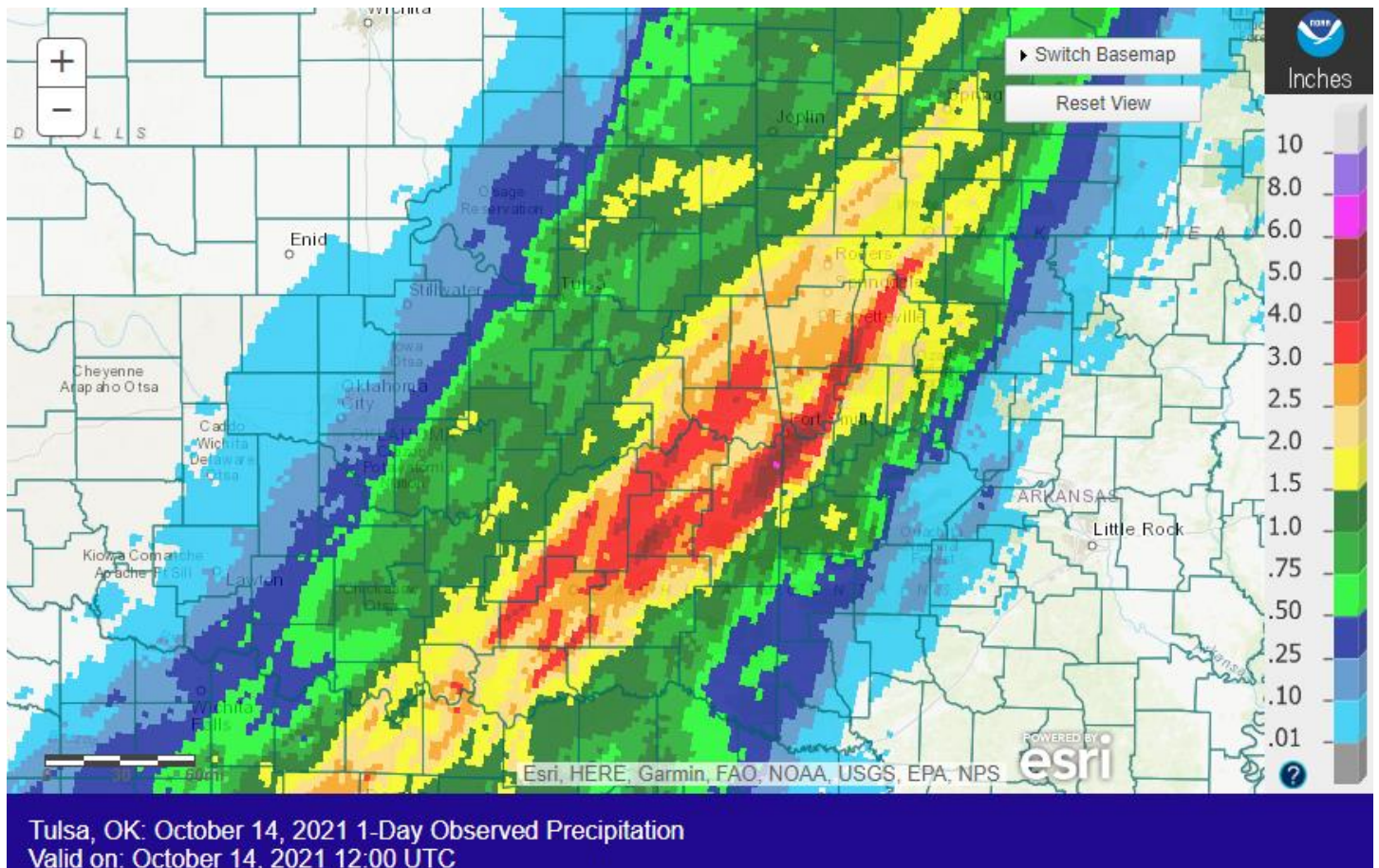
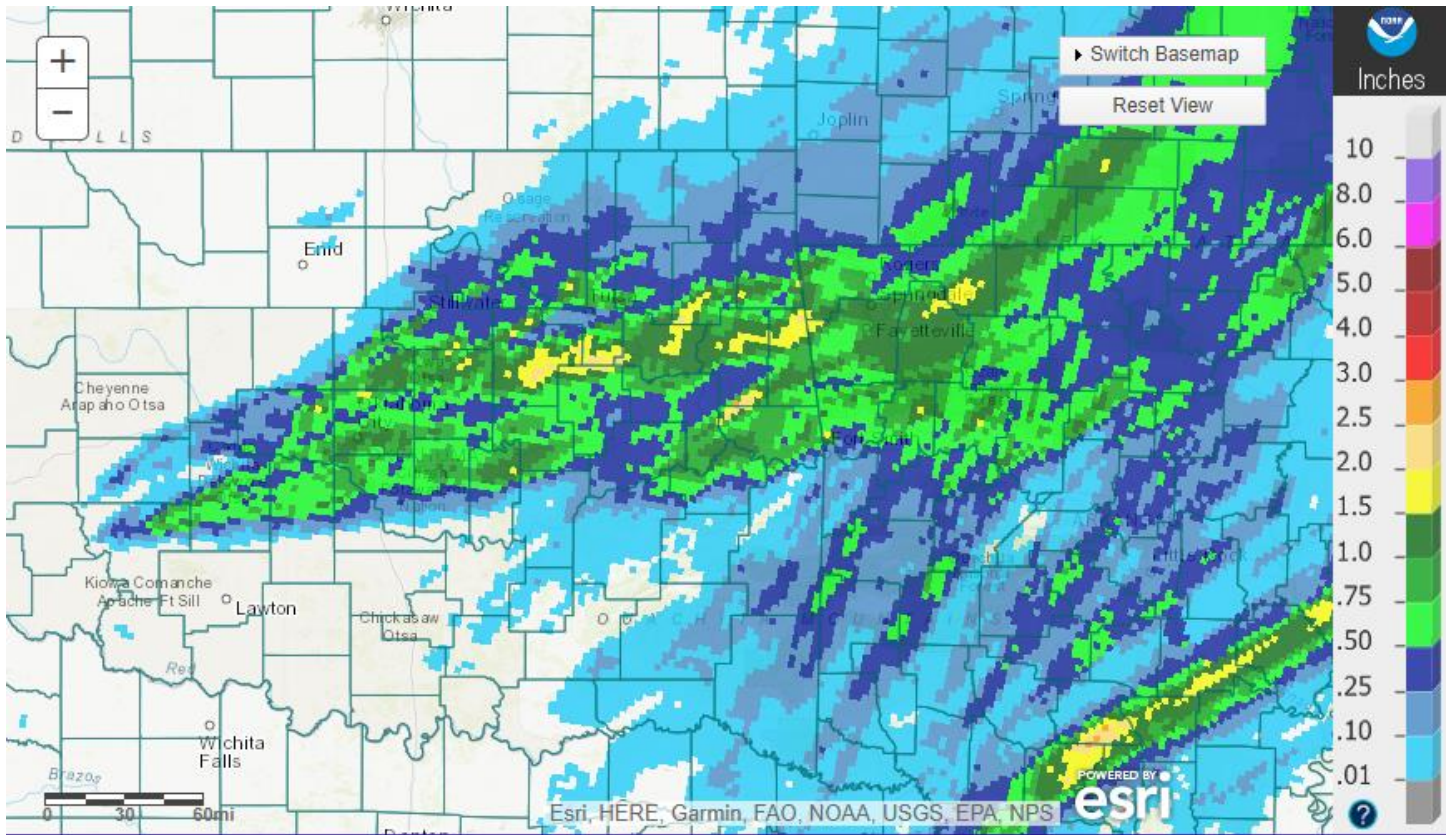
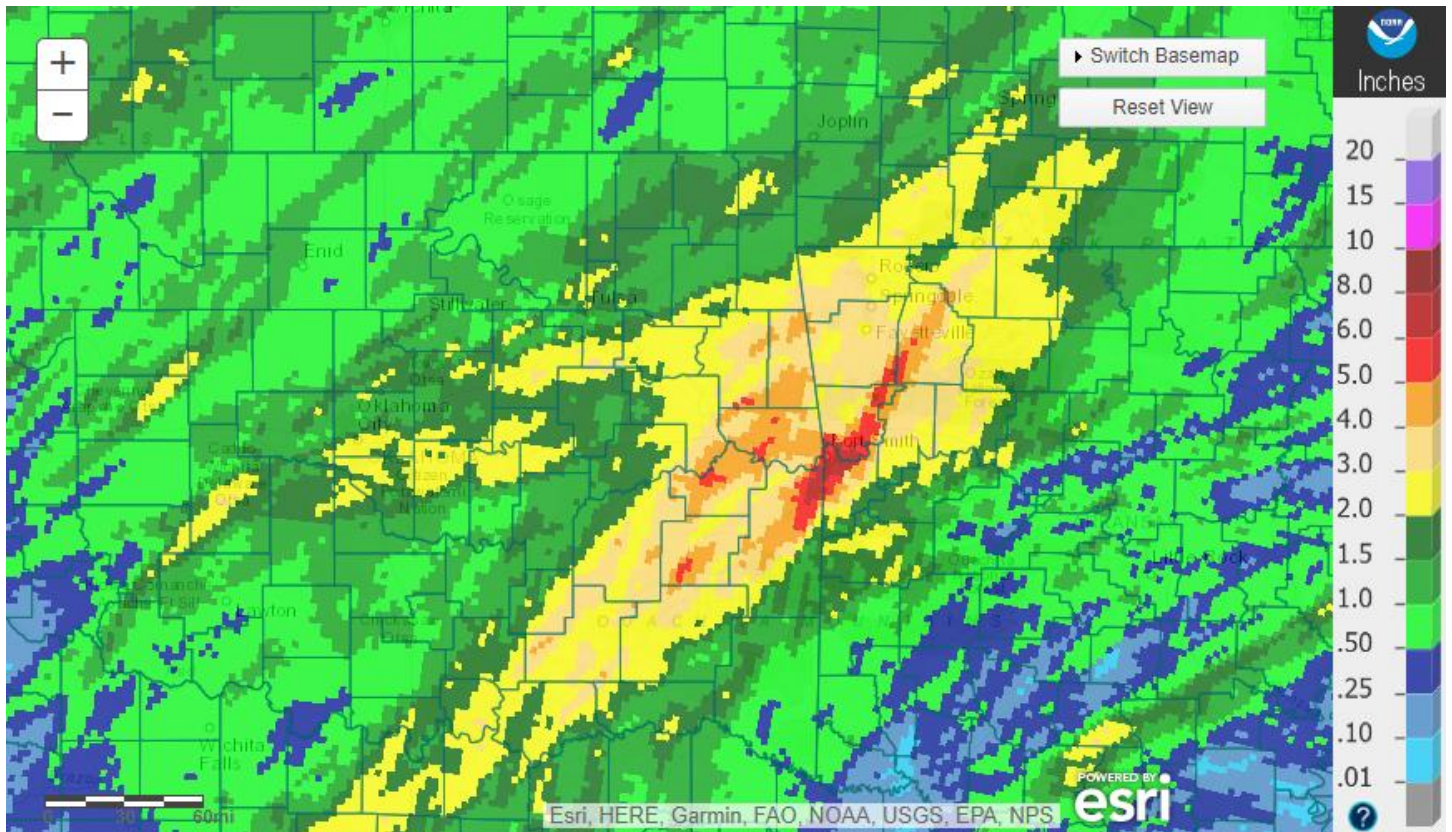


Fig. 8. 24-hour Estimated Observed Rainfall ending at 7am CDT 10/14/2021.



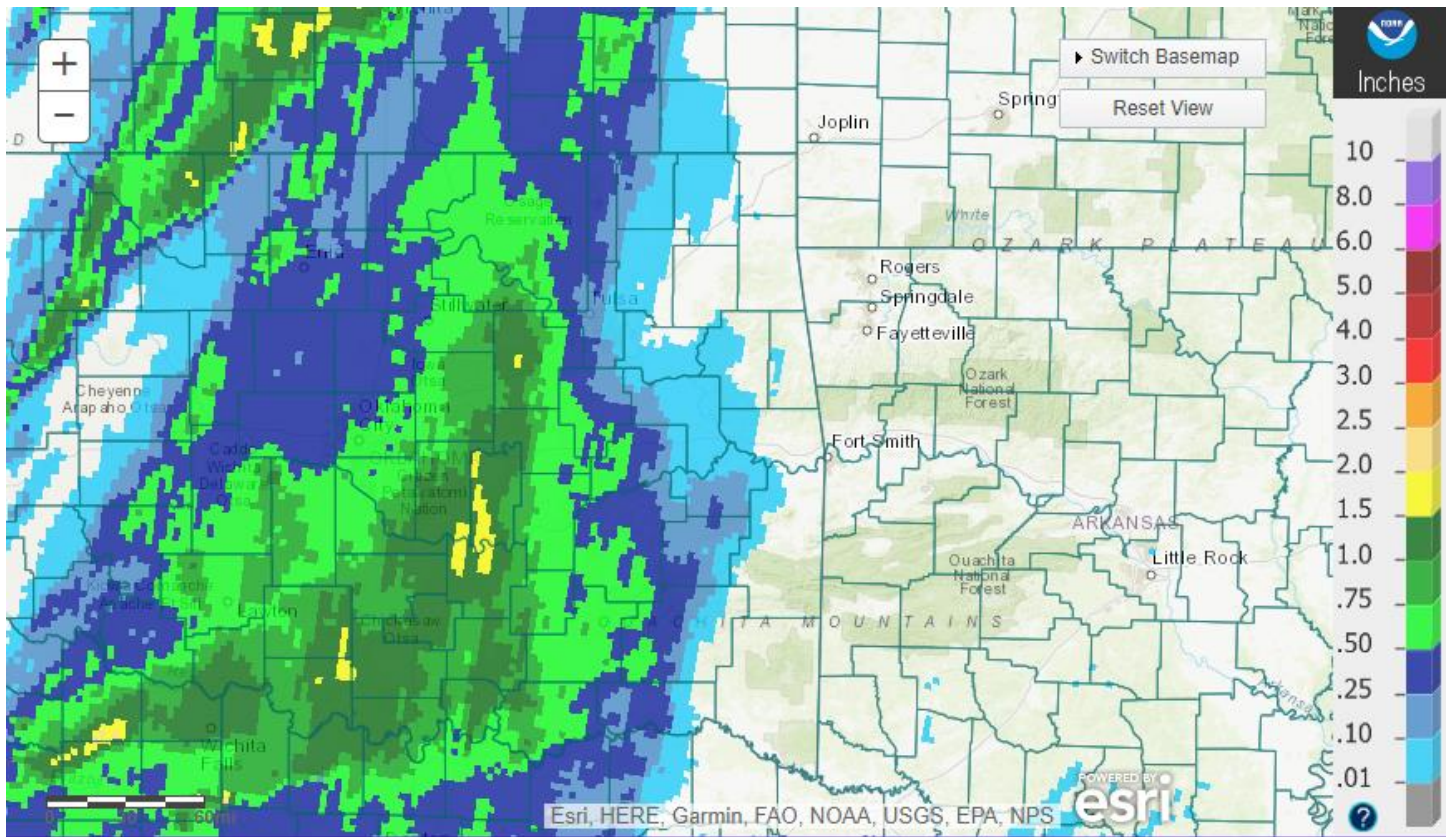
Tulsa, OK: October 15, 2021 1-Day Observed Precipitation
Valid on: October 15, 2021 12:00 UTC

Fig. 9. 24-hour Estimated Observed Rainfall ending at 7am CDT 10/15/2021.



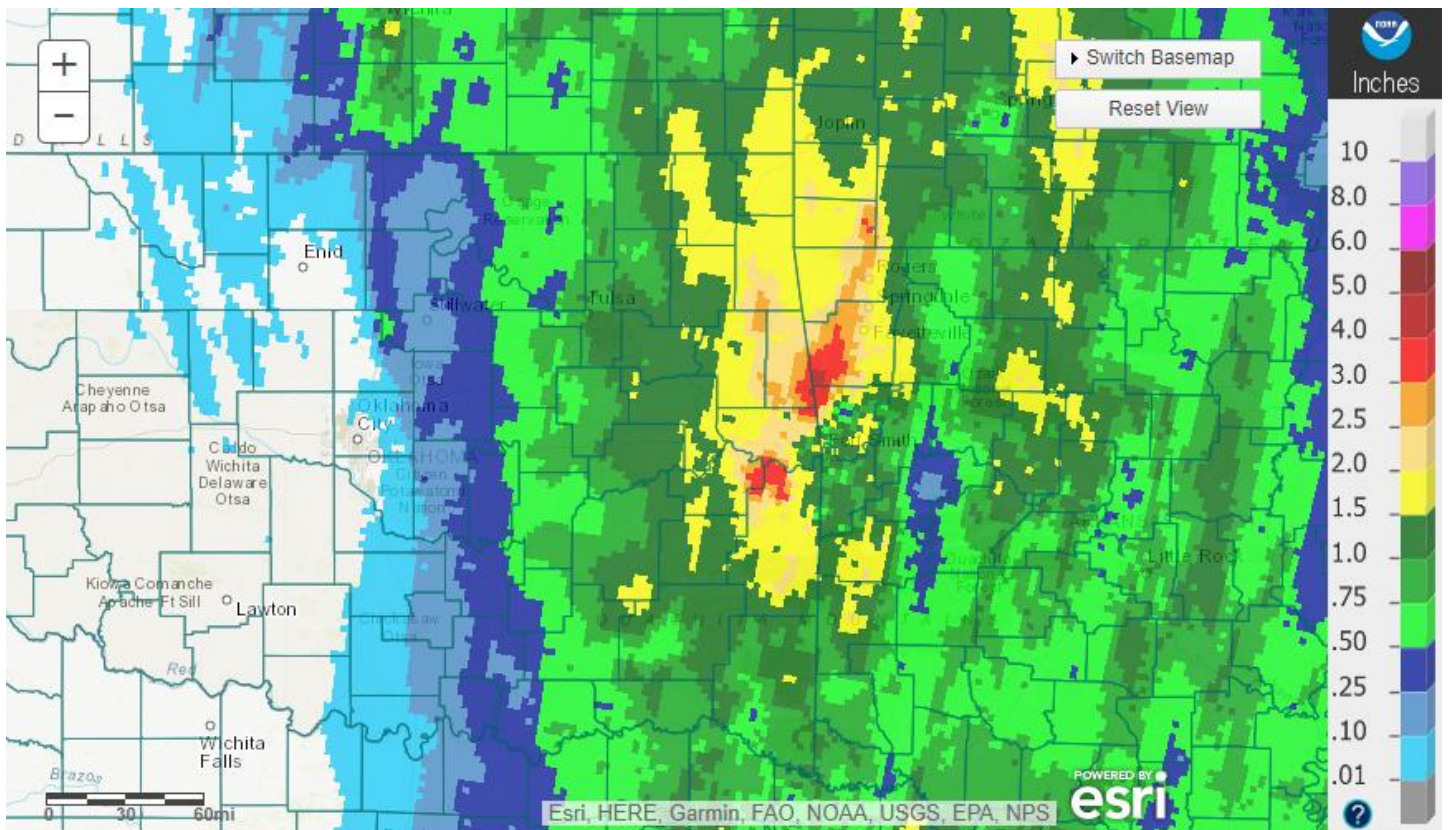
Tulsa, OK: Last 7-Day Observed Precipitation
Valid on: October 19, 2021 12:00 UTC

Fig. 10. 7-Day Estimated Observed Rainfall ending at 7am CDT 10/19/2021.



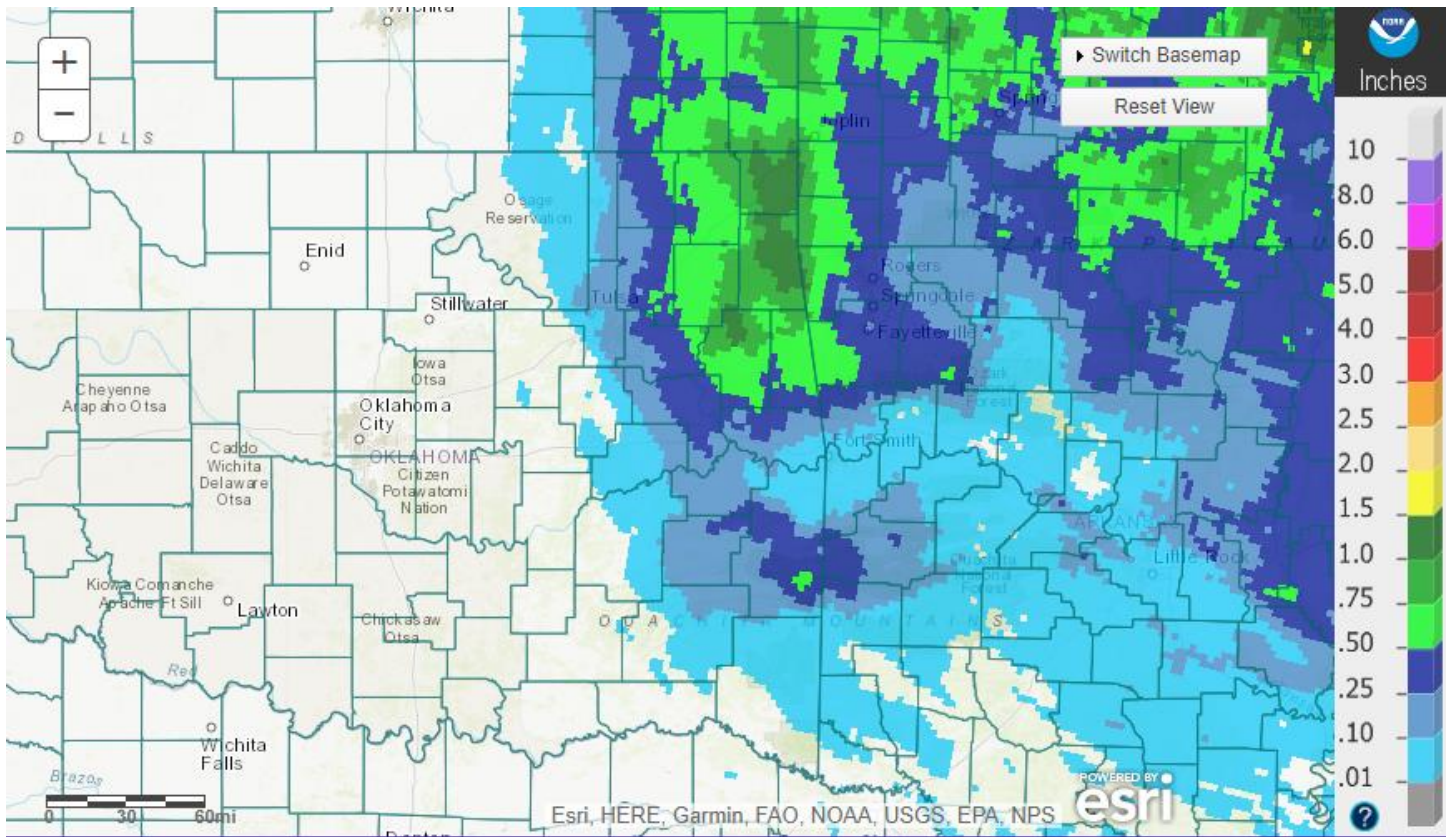
Tulsa, OK: October 27, 2021 1-Day Observed Precipitation
 Valid on: October 27, 2021 12:00 UTC

Fig. 11. 24-hour Estimated Observed Rainfall ending at 7am CDT 10/27/2021.



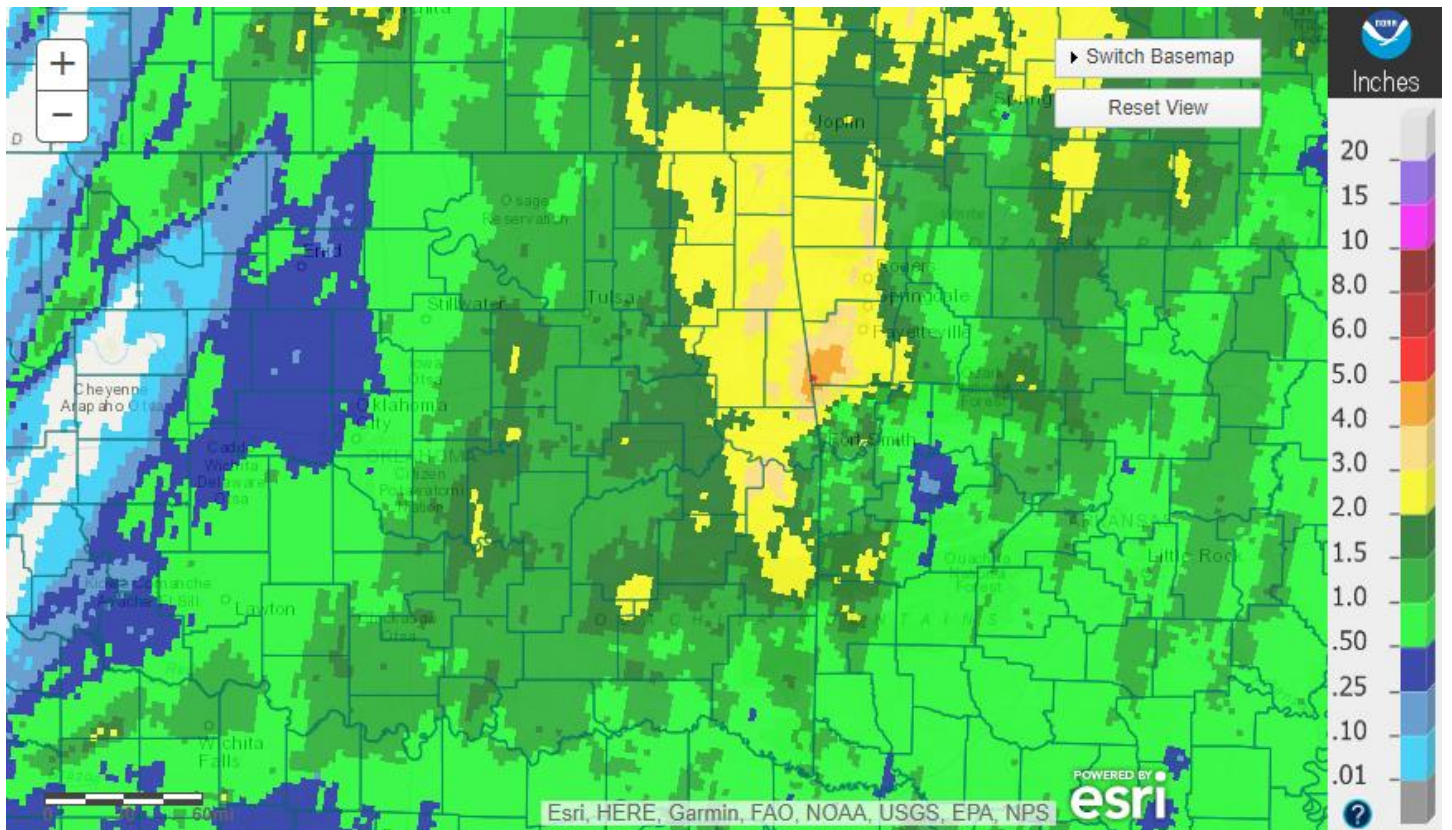
Tulsa, OK: October 28, 2021 1-Day Observed Precipitation
 Valid on: October 28, 2021 12:00 UTC

Fig. 12. 24-hour Estimated Observed Rainfall ending at 7am CDT 10/28/2021.



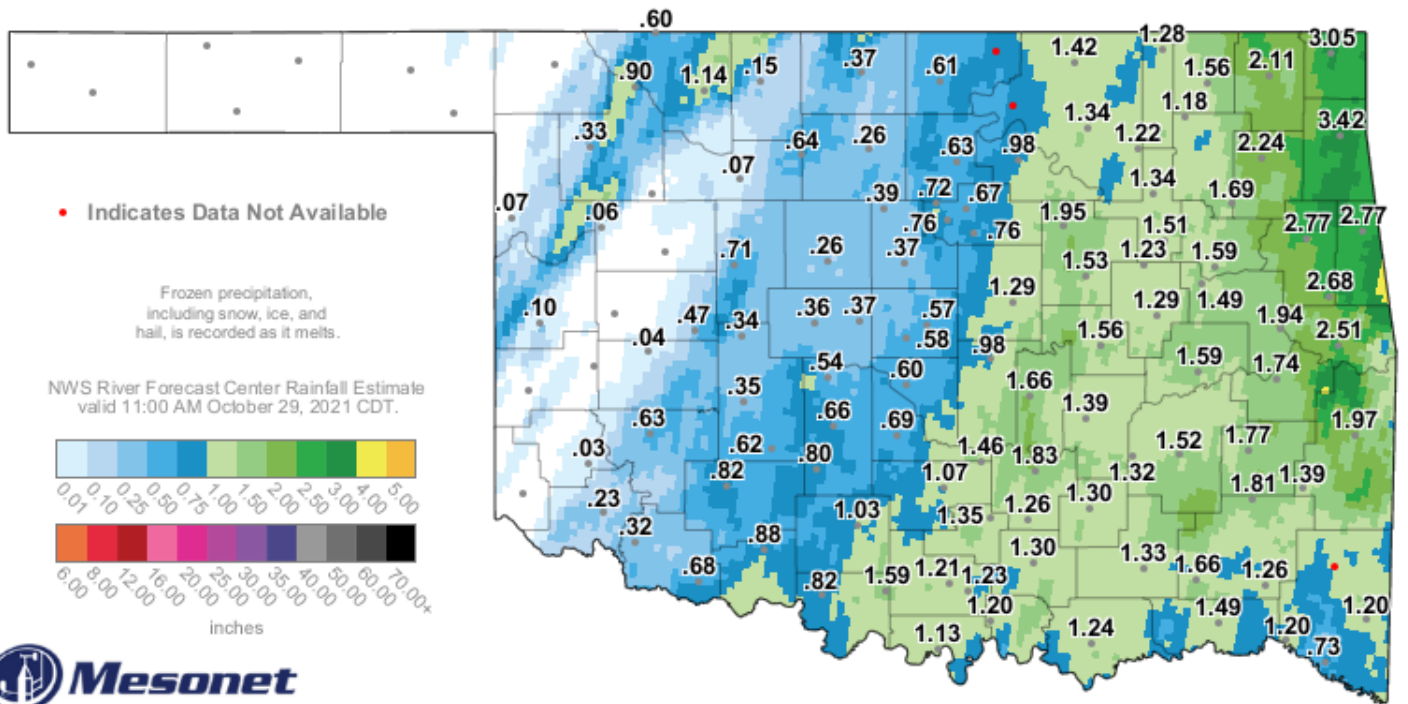
Tulsa, OK: October 29, 2021 1-Day Observed Precipitation
Valid on: October 29, 2021 12:00 UTC

Fig. 13. 24-hour Estimated Observed Rainfall ending at 7am CDT 10/29/2021.



Tulsa, OK: Last 7-Day Observed Precipitation
Valid on: November 01, 2021 12:00 UTC

Fig. 14. 7-Day Estimated Observed Rainfall ending at 7am CDT 11/01/2021.



12:35 PM October 29, 2021 CDT

Created 12:40:59 PM October 29, 2021 CDT. © Copyright 2021

Fig. 15. OK Mesonet (values) and NWS RFC rainfall estimate (image) 3-day rainfall ending at 12:35 pm CDT 10/29/2021.

Written by:

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WFO Tulsa

Products issued in October 2021:

- *CWYO2 became a daily river forecast point September 7, 2016
- *MLBA4 and OZGA4 transferred to NWS Tulsa HSA February 5, 2014
- *Mixed case River Flood products began July 31, 2013

- 1 Flash Flood Warnings (FFW)
- 2 Flash Flood Statements (FFS)
- 2 Flash/Areal Flood Watches (FFA) (7 Watch FFA CON/EXT/EXA/EXB/CAN)
- 18 Urban and Small Stream Advisories (FLS)
- 1 Areal Flood Warnings (FLW)
- 0 Areal Flood Statements (FLS)
- 0 River Flood Warnings (FLW) (includes category increases)
- 0 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)
- 1 Drought Information Statements (DGT)

Preliminary Hydrographs:

None