

# From Raindrop to River: National Weather Service Flood Forecasting + Warning Services

---

*Nicole McGavock*

*Service Hydrologist / Meteorologist*

*National Weather Service Tulsa, OK*

OFMA Annual Conference  
September 24, 2025



# Who We Are

---

Weather Forecast Offices

River Forecast Centers

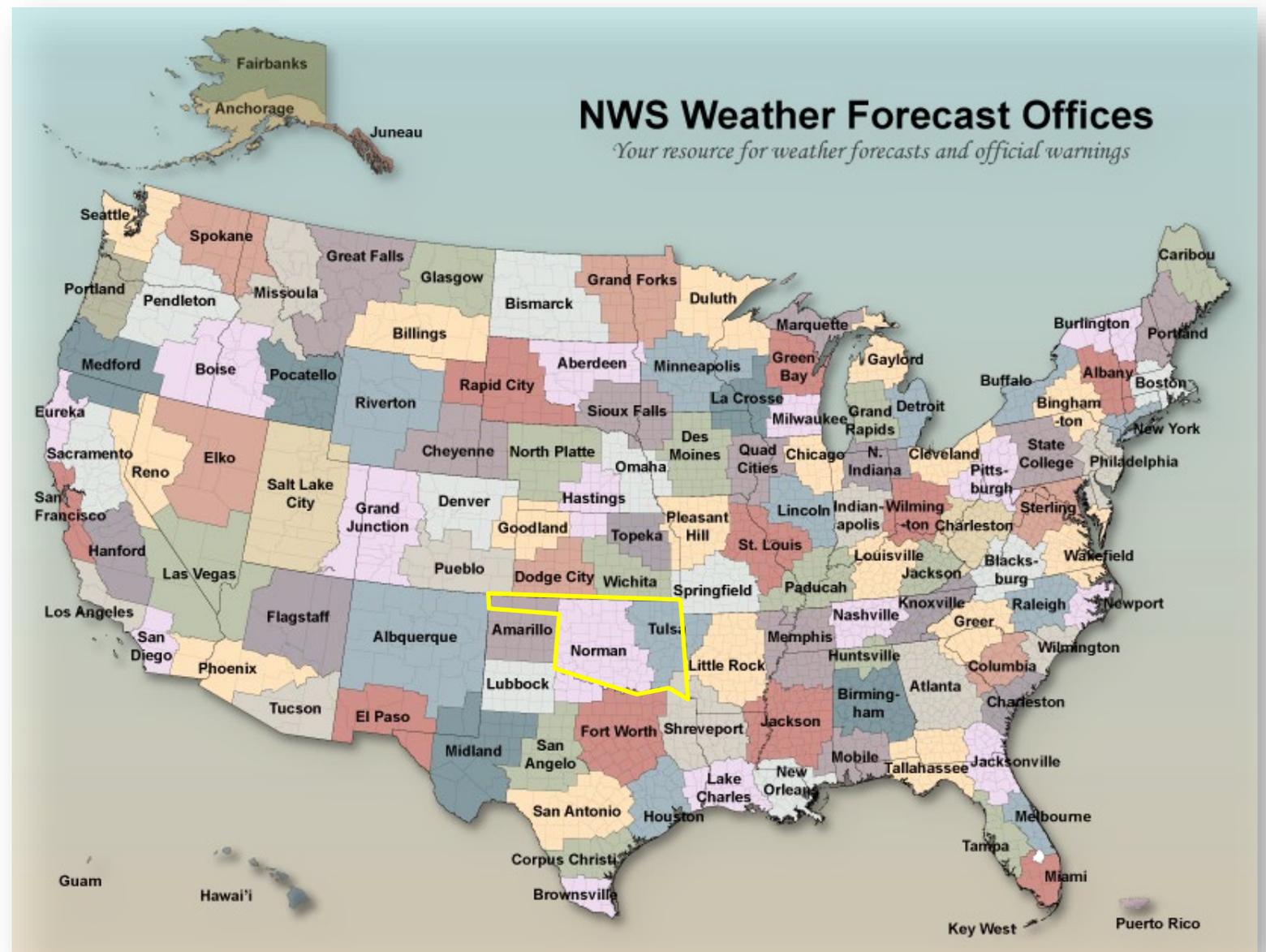
National Centers

NWS Flood Classification

# NATIONAL WEATHER SERVICE: WEATHER FORECAST OFFICES (WFO)

- 122 WFOs
- Staffed 24/7/365
- 7-day weather forecast and warning services
- **Issue all Flood, Flash Flood, River Flood, and Dam Break watches, warnings, and advisories**
- Work closely with local, state, tribal, and federal officials

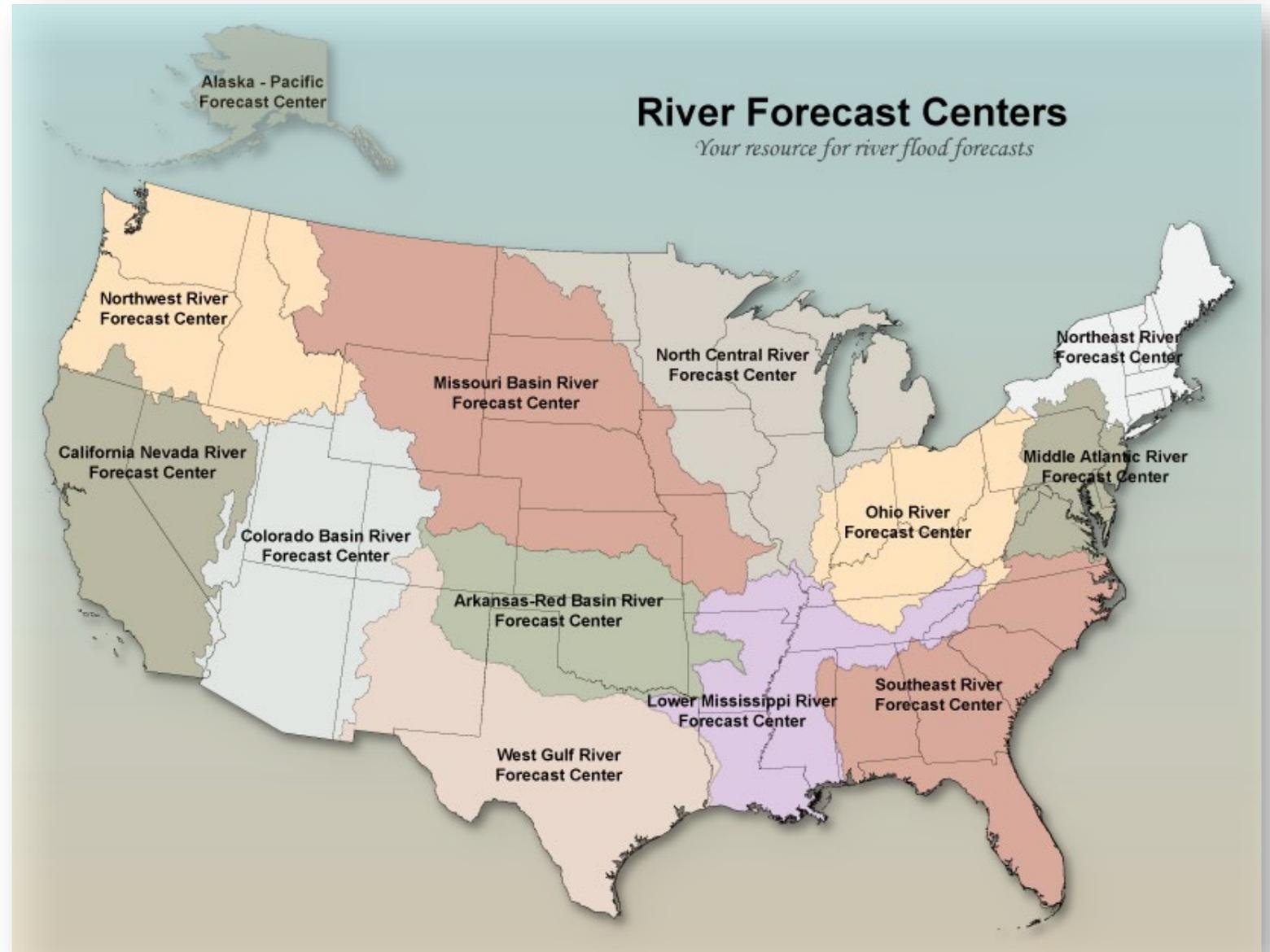
4 WFOs cover OK: Amarillo, Norman, Tulsa, Shreveport



# NATIONAL WEATHER SERVICE: RIVER FORECAST CENTERS (RFC)

- 13 river forecast centers
- Staffed 16/7/365, 24-hr operations during flooding
- **Issue official river forecasts and flash flood guidance, modeling**
- The primary roles: hydrologic forecasting and hydrometeorological analysis and support (HAS) functions to monitor and quality control precipitation datasets.

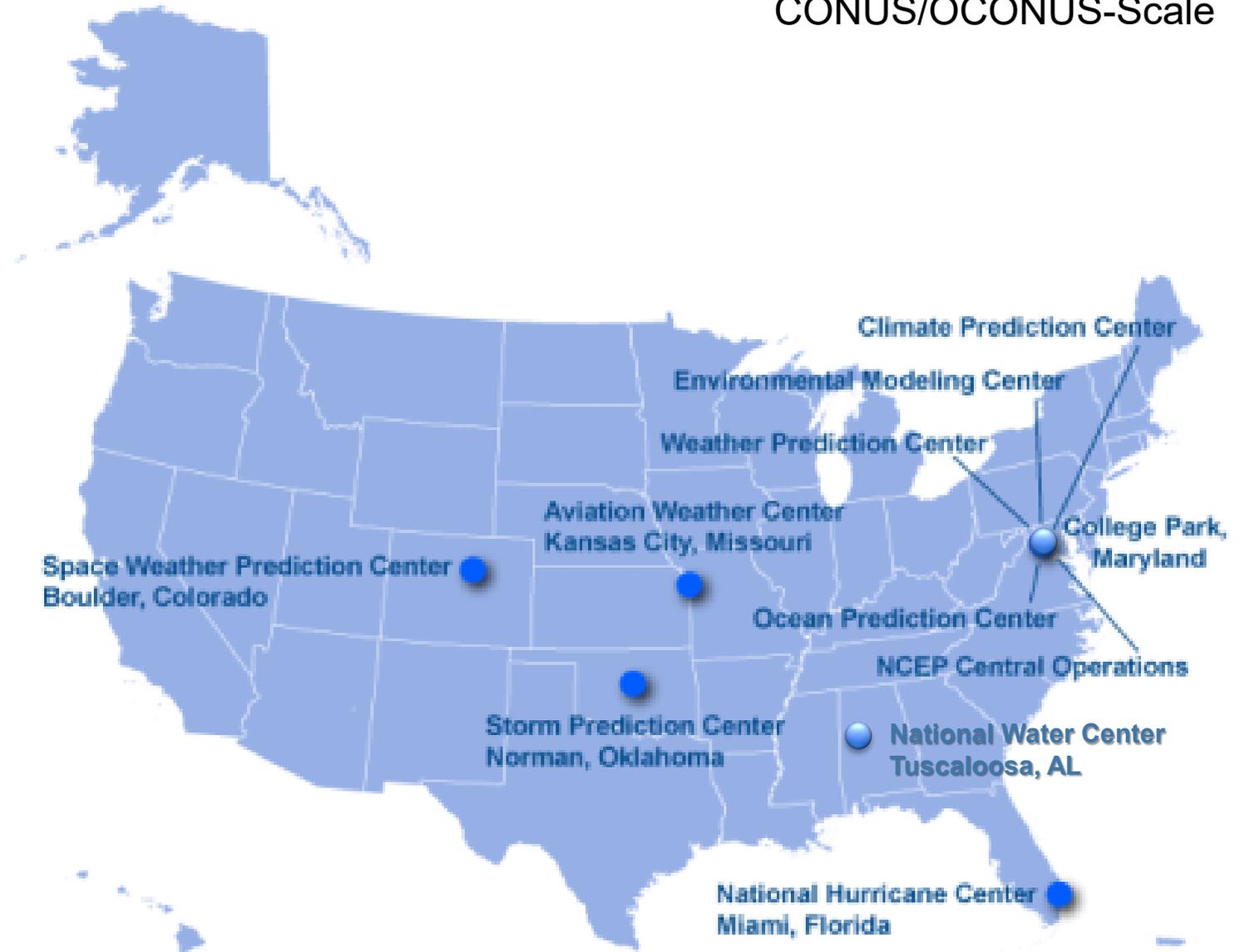
1 RFC covers OK: Arkansas-Red Basin RFC

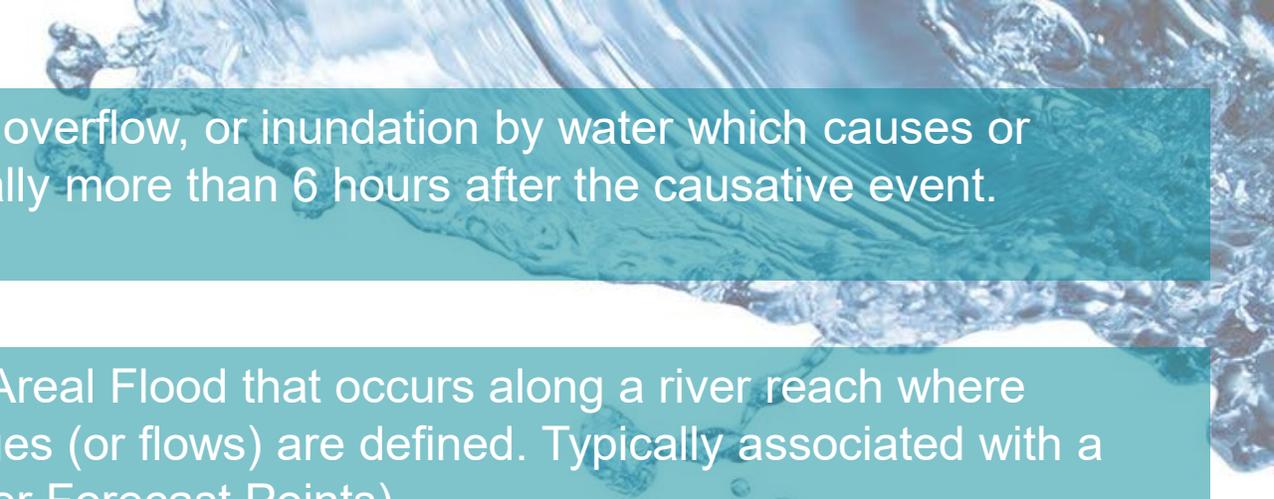


# NATIONAL WEATHER SERVICE: NATIONAL CENTERS

- National Water Center (NWC)
  - NOAA Atlas 14/15
  - National Water Model
  - Flood Inundation
- Weather Prediction Center (WPC)
  - Rainfall forecast
  - Excessive Rainfall Outlook
- Climate Prediction Center (CPC)
  - Odds for above, near, below median rainfall 8-14 days through 1 year

CONUS/OCONUS-Scale





**Areal Flooding**: high flow, overflow, or inundation by water which causes or threatens damage, typically more than 6 hours after the causative event.

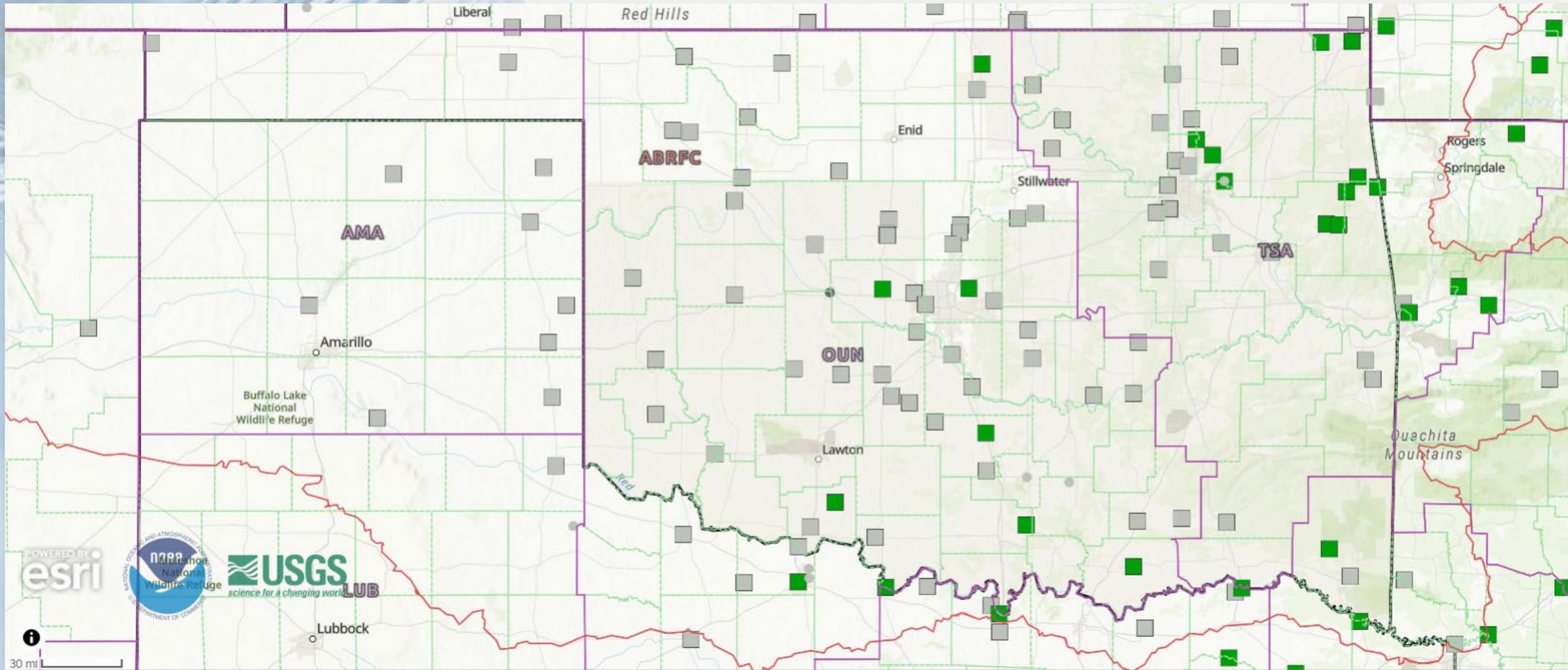
**River Flooding**: a type of Areal Flood that occurs along a river reach where specific flood impact stages (or flows) are defined. Typically associated with a gaging station (NWS River Forecast Points)

**Flash Flooding**: caused by excessive rainfall in a short period of time, generally less than six hours, and characterized by raging torrents that rip through river beds, urban streets, or mountain canyons. They can occur within minutes or a few hours of excessive rainfall.

**Dam/Levee Breach or High Release Flooding**: a type of Flash Flooding that occurs due to a rapid rise in water due to a dam or levee breach (or large change in dam gate release).

**Urban and Small Stream Flooding**: flooding of small rural streams or urban streams, streets, and low-lying places, and is typically not life-threatening. “Nuisance” or “typical” flooding.

# NWS River Forecast Points



 = Forecasts issued daily

 = Forecasts issued for flooding only



# Rain, Rain, Go Away

---

Long-Range: Planning + Mitigation

Website: <https://www.weather.gov/owp/hdsc>

Email: [hdsc.questions@noaa.gov](mailto:hdsc.questions@noaa.gov)

Locations: *Tuscaloosa, AL – Silver Spring, MD – Chanhassen, MN*



**OWP** | OFFICE OF  
WATER  
PREDICTION

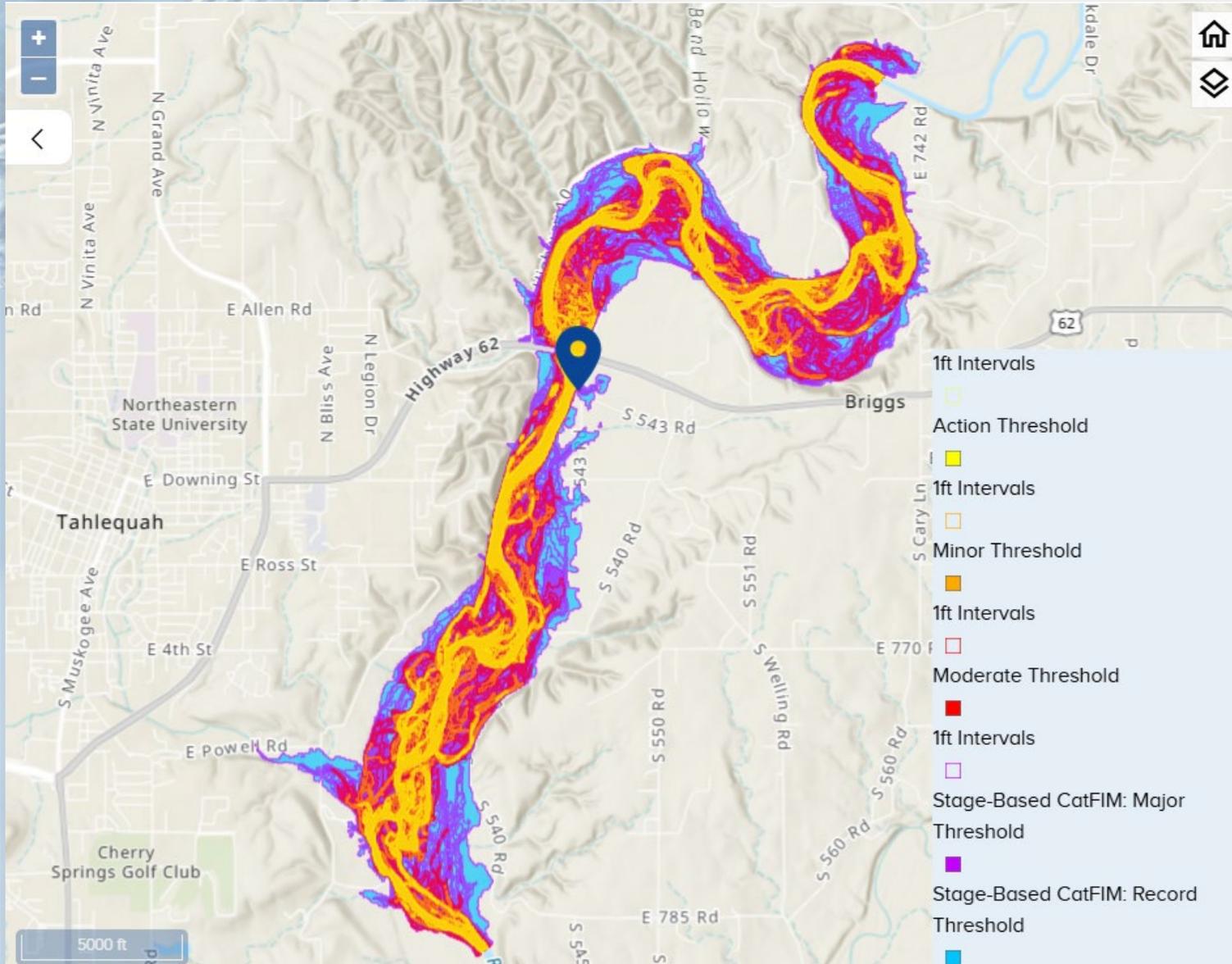
## NOAA ATLAS 15:

### Update to the National Precipitation Frequency Standard



- Spatially independent estimates of expected precipitation depth (or intensity) for a specified storm duration at a particular location of interest.
- The statistically expected precipitation estimates will be presented as exceedance probabilities ranging from 50% average annual exceedance to 0.1%, and will cover storm durations ranging from 5 minutes to 60 days.
- NOAA Atlas 15 Volume 1 will provide a snapshot of current estimates that account for temporal changes in historical observations. When published, NOAA Atlas 15 Volume 1 will supersede the current NOAA Atlas 14 precipitation frequency estimates.
- NOAA Atlas 15 Volume 2 will provide model-based precipitation frequency estimates projected into the future (through 2100). Volume 2 estimates will be developed by applying adjustment factors to Volume 1 estimates (i.e. future relative changes obtained from downscaled climate model data).

# Static Flood Inundation Mapping



- Available at NWS River Forecast Points
- Limited availability now, but additional sites will be added in the future
- Useful for planning purposes
- Computed using the HAND method in the National Water Model

# Make Your Community StormReady

NATIONAL WEATHER SERVICE



Emergency workers and citizens sift through tornado wreckage.

Americans live in the most severe weather-prone country on earth. Each year a startling 10,000 thunderstorms, 2,500 floods, 1,000 tornadoes, and 10 hurricanes impact the United States. Potentially deadly severe weather impacts every American. Communities can now rely on the National Weather Service's StormReady program to help them guard against the ravages of Mother Nature.

## What Is StormReady?

Ninety percent of all presidentially declared disasters are weather related. Through the StormReady program, NOAA's National Weather Service gives communities the skills and education needed to survive severe weather -- before and during the event. StormReady helps community leaders and emergency managers strengthen their local hazardous weather operations.

## StormReady Does Not mean Storm Proof

StormReady communities are better prepared to save lives from the onslaught of severe weather through better planning, education and awareness. Communities have fewer fatalities and property damage if they plan before dangerous weather arrives. No community is storm proof, but StormReady can help communities save lives.



**StormReady**  
NATIONAL WEATHER SERVICE

**We Are  
StormReady**

**Be Prepared**



[www.weather.gov/stormready](http://www.weather.gov/stormready)

- StormReady was first developed at NWS Tulsa!
- Latimer County was the first StormReady Community in 1999.
- As of June 20, 2024, there were 3,474 StormReady and/or TsunamiReady Sites in 50 states, Puerto Rico, and the U.S. Pacific Islands

## StormReady Eligibility Requirements

- Establish a 24-hour warning point and emergency operations center
- Have more than one way to receive weather warnings/ forecasts and to alert the public
- Promote the importance of public readiness through community programs
- Develop a formal hazardous weather plan encompassing all components of the operation

## StormReady Benefits

- Opportunity to review and improve your hazardous weather plans
- You receive a certificate and formal recognition
- Gain confidence and public recognition
- You can qualify for rate reductions in the National Flood Insurance Program (NFIP), which includes the Community Rating System (CRS)

NWS StormReady® Program

Working Toward a Weather-Ready Nation



Radford University, VA, StormReady Supporter Ceremony

- StormReady Home
- How to Become StormReady
- Why Become StormReady
- StormReady Communities
- StormReady Supporters
- StormReady Logos, Signs, Flyers
- Frequently Asked Questions
- TsunamiReady
- StormReady Resource Toolkit
- Weather-Ready Nation
- Get More Information

Being part of a [Weather-Ready Nation](#) is about preparing for your community's increasing vulnerability to extreme weather and water events. Americans live in the most severe weather-prone country on Earth. You can make sure your community is StormReady®. Some 98 percent of all Presidentially declared disasters are weather related, leading to around 500 deaths per year and nearly \$115 billion in damage. The StormReady program helps arm America's communities with the communication and safety skills needed to save lives and property—before, during and after the event. StormReady helps community leaders and emergency managers strengthen local safety programs. [Share Your Story](#)

StormReady communities, counties, Indian nations, universities and colleges, military bases, government sites, commercial enterprises and other groups are better prepared to save lives from the onslaught of severe weather through advanced planning, education and awareness. No community is storm proof, but StormReady can help communities save lives.

StormReady uses a grassroots approach to help communities develop plans to handle all types of extreme weather—from tornadoes to winter storms. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. Applying is easy. To be officially StormReady, a community must:



# Flood Safety Education + Outreach



## JetStream

[JetStream home](#)

[Topic](#) ▼

[Learning Lessons](#)

[NWS Info](#)

[About](#) ▼

JetStream - An Online School for Weather

Welcome to JetStream, the National Weather Service Online Weather School. This site is designed to help educators, emergency managers, or anyone interested in learning about weather and weather safety.

Questions or comments? Please email [JetStream@noaa.gov](mailto:JetStream@noaa.gov).

[JetStream Topics](#)

<https://www.noaa.gov/jetstream>

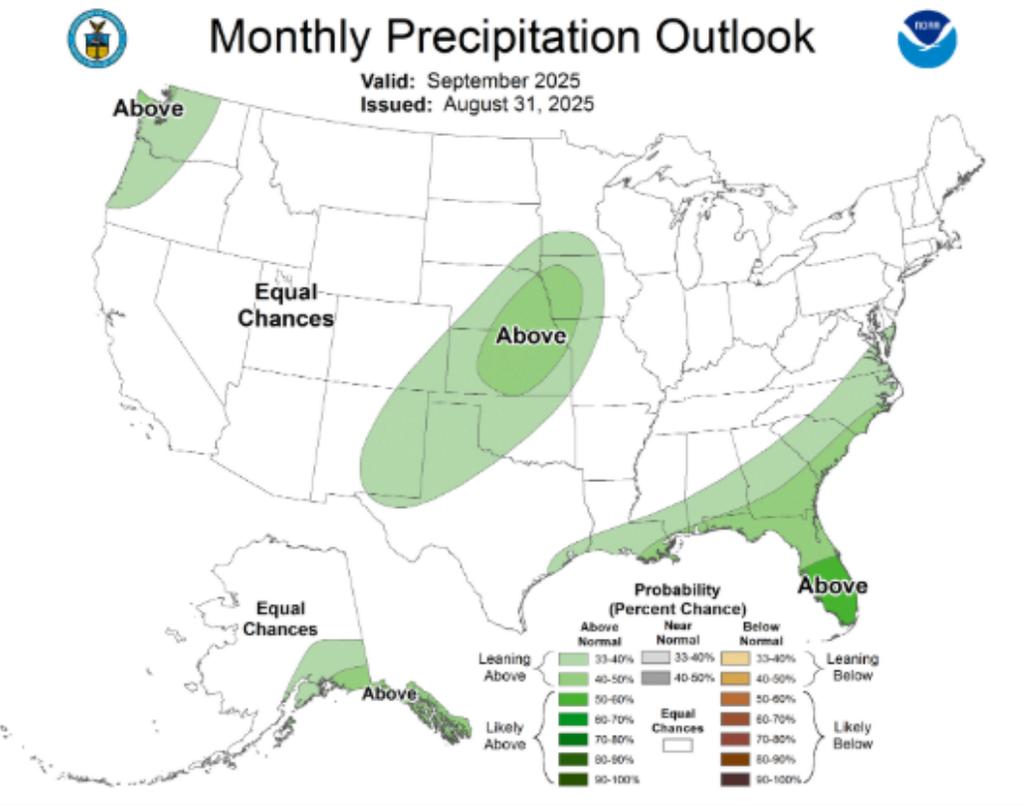
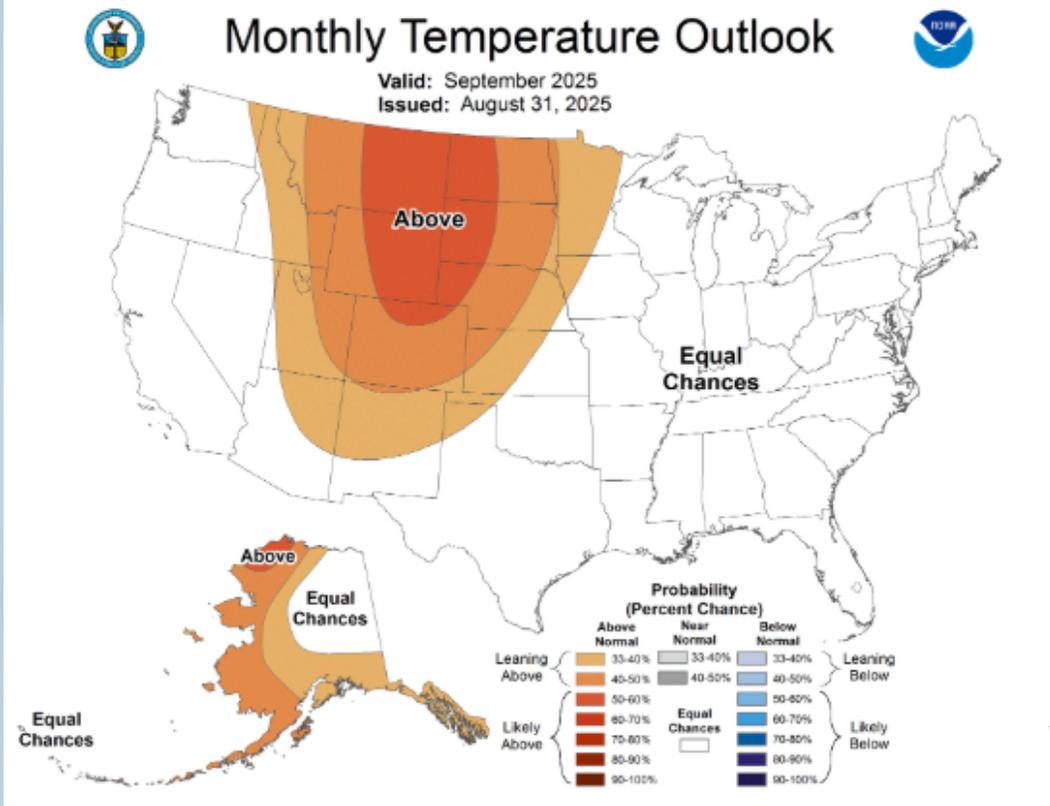


[The Atmosphere >](#)

# Climate Prediction Center Outlooks: <https://www.cpc.ncep.noaa.gov/>

<b>6-10 Day Outlook (Interactive)</b> Temperature      Precipitation	<b>One Month Outlook (Interactive)</b> Temperature      Precipitation
<b>8-14 Day Outlook (Interactive)</b> Temperature      Precipitation	<b>Three Month Outlook (Interactive)</b> Temperature      Precipitation
<b>Week 3-4 Outlooks</b> Temperature      Precipitation	<b>8-14 Day U.S. Hazards Outlook</b> Composite      Probabilistic: Temp      Precip      Snow      Wind
<b>U.S. Drought Information</b> Monitor      Monthly Outlook      Seasonal Outlook	<b>Global Tropics Hazards Outlook</b> Weeks 2 and 3

3-Month Outlooks available for up to 12 months into the future



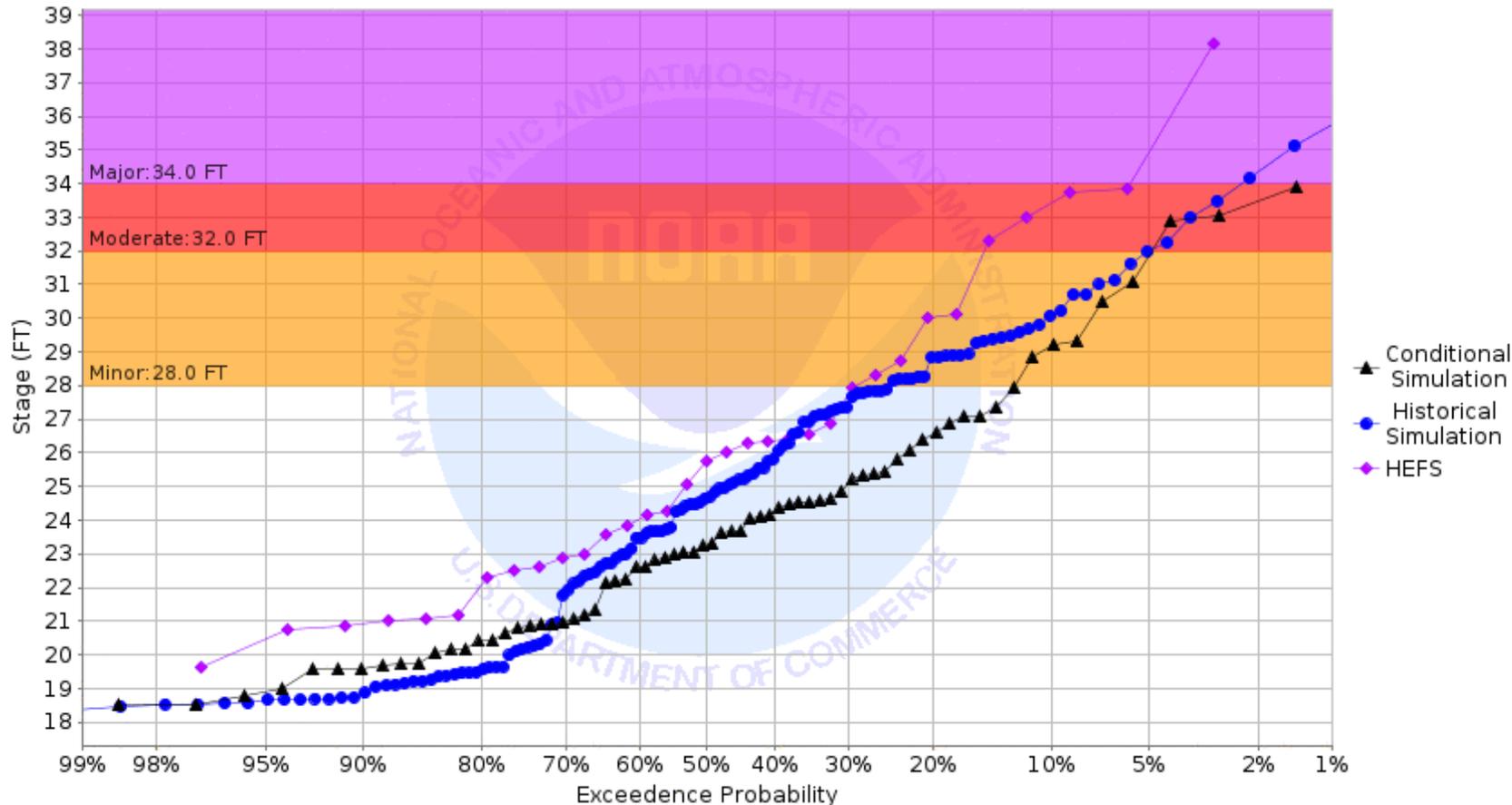
# RFC Long Range (90-day) River Flood Probabilities

Chance of Exceeding Levels During Entire Period

▲ CS = Conditional Simulation

● HS = Historical Simulation

Chance of Exceeding River Stage at MKG02  
Forecast for the period 02/07/2023 - 05/08/2023  
This is a conditional simulation based on the conditions as of 02/07/2023



The blue line indicates the historical probability of flooding.

The black line shows the probabilities using historical rainfall but using current hydrologic conditions.

The purple line uses current hydrologic conditions plus forecast rainfall from the short- to medium-range weather models + long-range climate models.



# Rain, Rain, Go Away

---

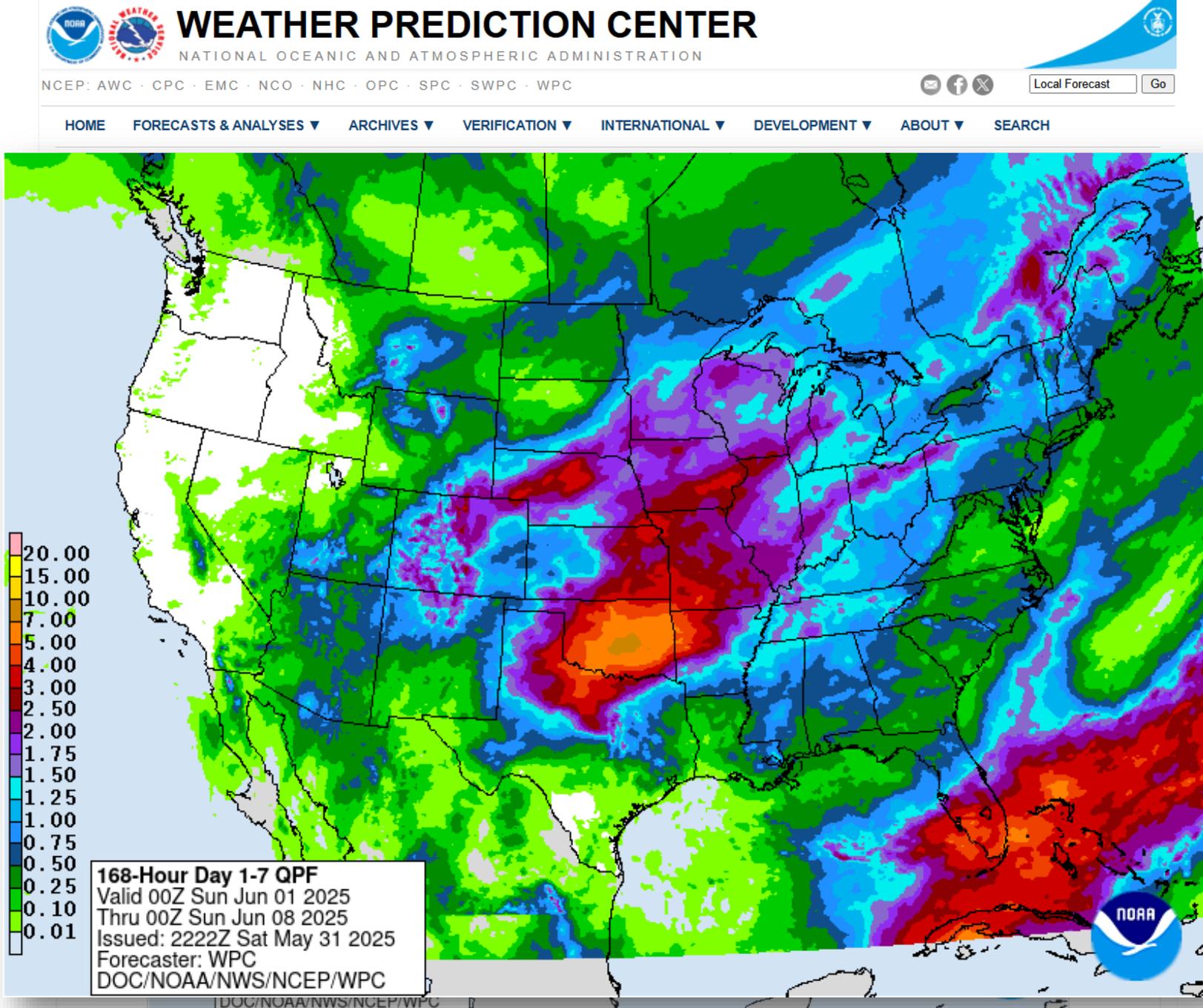
Days 4-7: Planning + Resource Assessment

# WPC Rainfall Forecasts (QPF)

Deterministic – one value, what forecasters think is the most likely to occur

Available for the next 7 days

[www.wpc.ncep.noaa.gov/](http://www.wpc.ncep.noaa.gov/)



## Understanding WPC Excessive Rainfall Risk Categories

Excessive  
 Probable  
 excessive  
 with  
 mile  
 Available

<p><b>No Area/Label</b></p> <p>Flash floods are generally not expected.</p> <p><a href="http://www.wpc.ncep.noaa.gov">www.wpc.ncep.noaa.gov</a> @NWSWPC</p>	<p><b>MARGINAL (MRGL)</b></p> <p>Isolated flash floods possible</p> <p>Localized and primarily affecting places that can experience rapid runoff with heavy rainfall.</p>	<p><b>SLIGHT (SLGT)</b></p> <p>Scattered flash floods possible</p> <p>Mainly localized. Most vulnerable are urban areas, roads, small streams and washes. Isolated significant flash floods possible.</p>	<p><b>MODERATE (MDT)</b></p> <p>Numerous flash floods likely</p> <p>Numerous flash flooding events with significant events possible. Many streams may flood, potentially affecting larger rivers.</p>	<p><b>HIGH (HIGH)</b></p> <p>Widespread flash floods expected</p> <p>Severe, widespread flash flooding. Areas that don't normally experience flash flooding, could. Lives and property in greater danger.</p>
---	---	---	---	---



Flash flooding near me?

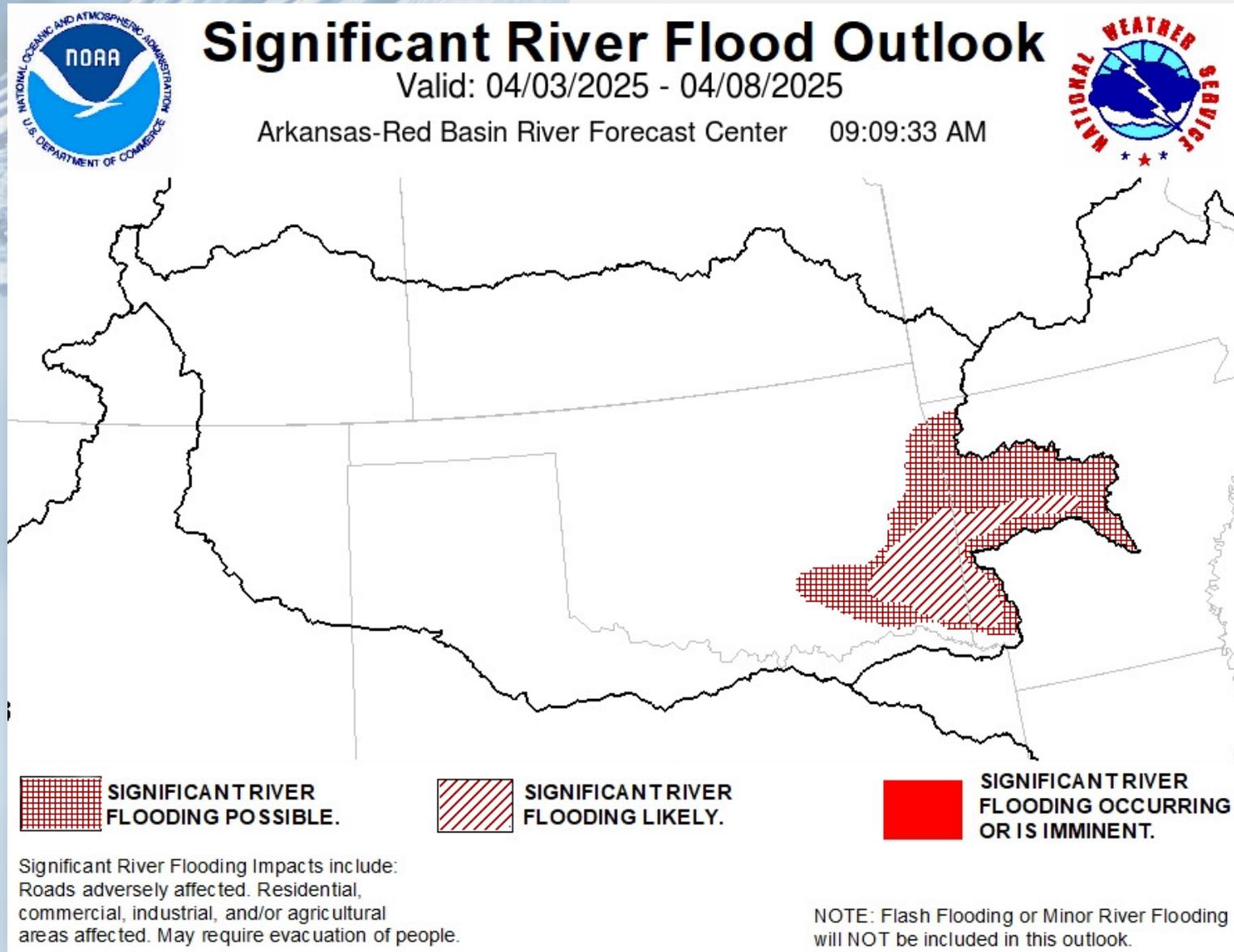
Flash Flooding  
NO Flash Flooding




WEATHER PREDICTION CENTER



# RFC 5-Day Significant River Flood Outlook



Highlights areas where moderate to major level river flood impacts are Possible, Likely, or Occurring/Imminent.

Issued daily by the Arkansas-Red Basin River Forecast Center

[www.weather.gov/abrfc/abrfcfop](http://www.weather.gov/abrfc/abrfcfop)

# NWC Flood Hazard Outlook: <https://water.noaa.gov/operations/fho>



## Flood Hazard Outlook (Experimental)

Issued: 06-01-2025 07:00 AM CDT valid through 06-08-2025 07:00 AM CDT | Next Issuance: 06-01-2025 04:00 PM CDT



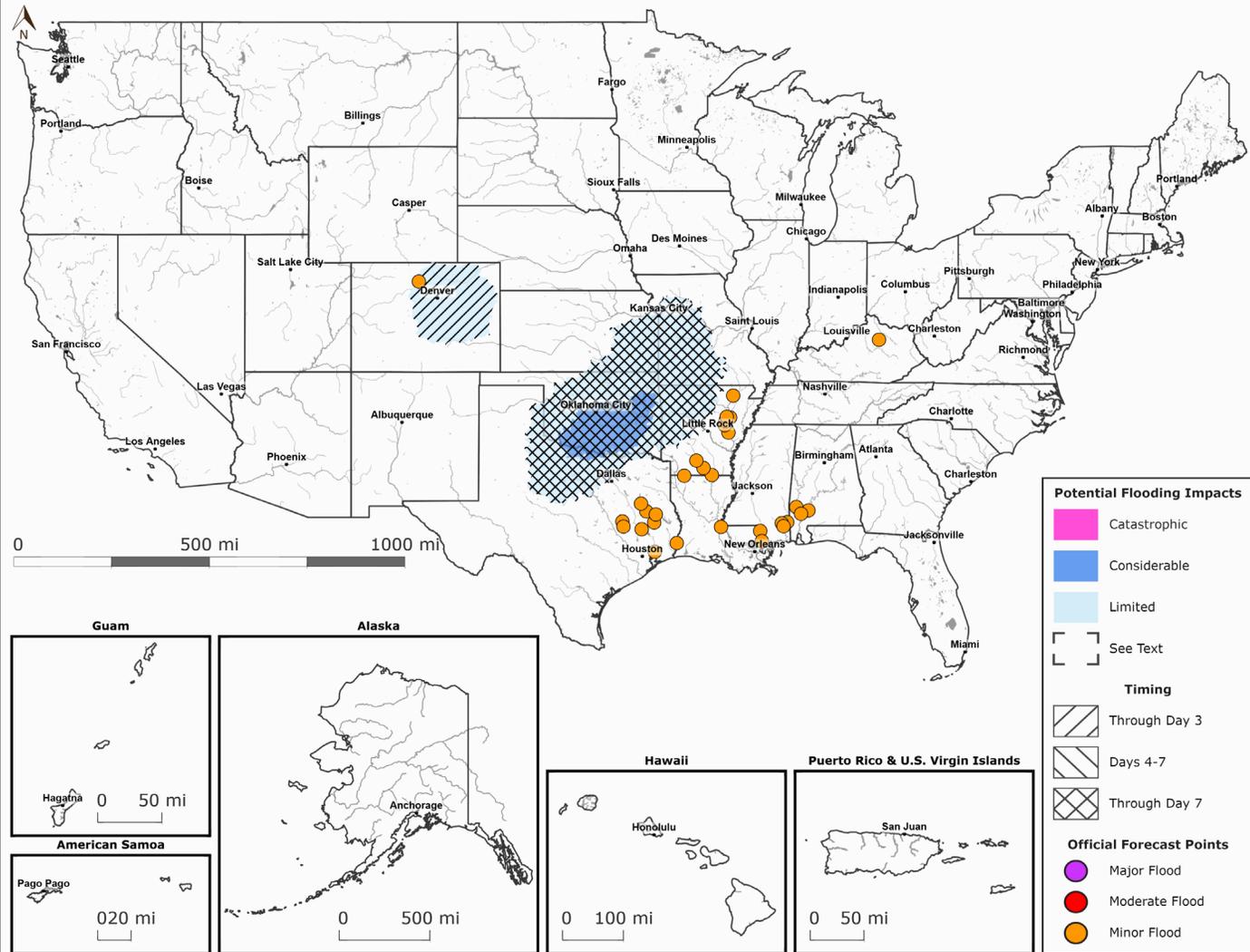
### Flood Hazard Messages

#### Southern Plains into the Middle Mississippi Valley

- Considerable flash and river flooding may be possible over portions of Oklahoma and northern Texas Tuesday and Wednesday.
- Flash and river flooding is possible mid-to-late next week with multiple days of heavy rain expected across the already wet and vulnerable region.

#### Colorado

- Isolated flash and small stream flooding will be possible Monday into Tuesday.



This experimental product combines a depiction of current flood conditions based on the latest river level observations with an assessment of flood risk, leveraging various sources of NWS water resources forecast information.

Issued twice daily, at 12Z and 21Z.

Disclaimer: This 7-day outlook provides an overview of potential flash, river and tidal flood hazards. Please refer to detailed products issued by local National Weather Service offices for official forecasts and warnings. ([www.weather.gov](http://www.weather.gov))

# 10-day River Flood Probabilities:

<https://www.cbrfc.noaa.gov/dbdata/station/ensgraph/map/ensmap.html>



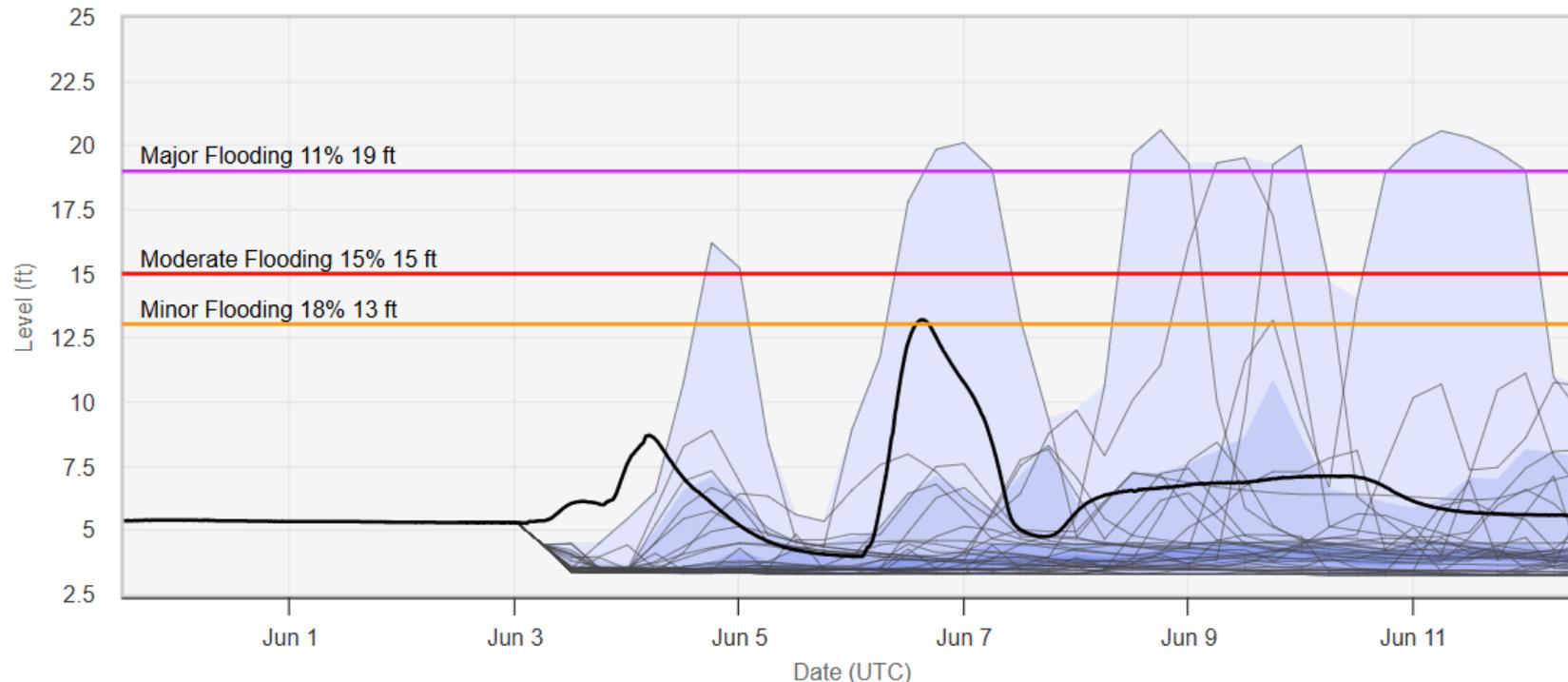
National Weather Service  
River Forecast Centers  
National Oceanic and Atmospheric Administration

## Caney River at Bartlesville (BVLO2) - 10-Day River Level Probabilities

Based on Hydrologic Ensemble Forecasting Service - Arkansas Basin River Forecast Center

Forecast Period ▾ Show/Hide ▾ Scale To ▾ Select Traces ▲ Downloads ▾ Help ▾ **Level** Flow GEFS Forecast Date ▾

Caney River at Bartlesville (BVLO2) Guidance Period: 6/2 12:00 - 6/12 12:00



Indicates the chance of exceeding a river level at a particular date + time.

Chance of exceeding an impact level over the entire 10-day period.

Takes into account past rainfall forecast performance for similar events.

Online training available for how to interpret.

Note: These are not hydrograph time series plots



# Rain, Rain, Go Away

---

Days 1-3: Planning + Resource Activation

# WPC Rainfall Forecasts (QPF)

**Deterministic** – one value, what forecasters think is the most likely to occur

Available for the next 7 days

**Probabilistic** – range of values based on the chance of occurrence

Available for the next 3 days



## National Weather Service

# Weather Prediction Center

Site Map
News
Organization

DOC NOAA NWS
NCEP Centers: AWC CPC EMC NCO NHC OPC SPC SWPC WPC

### WPC 24-Hour Probabilistic Precipitation Guidance for Days 1-3

[Information about this product suite](#)

Read the official [Product Description Document \(PDD\)](#) for this guidance  
(Note: The PDD is a pdf file and requires [Adobe Acrobat Reader](#) to view)

6-Hour Forecasts

Probability of Precipitation of at Least a Specific Amount
Precipitation Amount by Percentile

24-Hour Forecasts

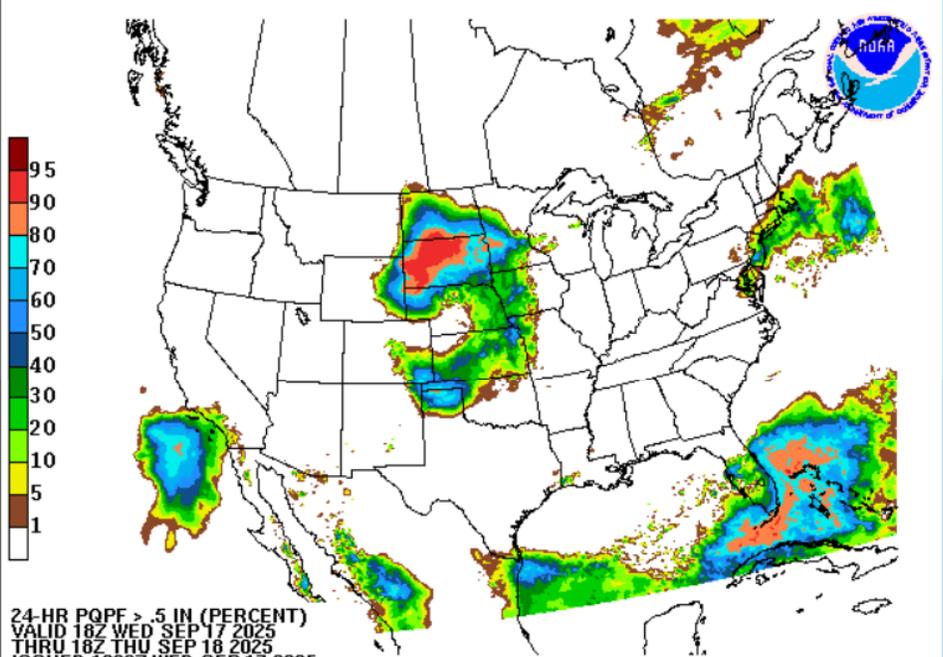
Probability of Precipitation of at Least a Specific Amount
Precipitation Amount by Percentile

**24-Hour PQPFs ≥ 0.50"**

Forecasts valid 12Z September 16, 2025 - 12Z September 20, 2025

	Day 1				Day 2				Day 3				
Valid 24 hours ending:	12Z Sep 17	18Z Sep 17	00Z Sep 18	06Z Sep 18	12Z Sep 18	18Z Sep 18	00Z Sep 19	06Z Sep 19	12Z Sep 19	18Z Sep 19	00Z Sep 20	06Z Sep 20	12Z Sep 20

24-hour forecast valid 18Z September 17, 2025 through 18Z September 18, 2025



24-HR PQPF > .5 IN (PERCENT)  
VALID 18Z WED SEP 17 2025  
THRU 18Z THU SEP 18 2025  
ISSUED 1006Z WED SEP 17 2025  
WEATHER PREDICTION CENTER  
NOAA/NWS/NCEP/WPC

**Viewing Options**

Choose an amount for the specified time:

- ≥ 0.25"
- ≥ 0.50"
- ≥ 1.00"
- ≥ 1.50"
- ≥ 2.00"
- ≥ 2.50"
- ≥ 3.00"
- ≥ 4.00"
- ≥ 5.00"
- ≥ 6.00"

**OR**

Choose a time for the specified amount:

- 12Z Sep 17
- 18Z Sep 17
- 00Z Sep 18
- 06Z Sep 18
- 12Z Sep 18
- 18Z Sep 18
- 00Z Sep 19
- 06Z Sep 19
- 12Z Sep 19
- 18Z Sep 19
- 00Z Sep 20
- 06Z Sep 20
- 12Z Sep 20

Local forecast by "City, St" or Zip Code  
City, St  Go

Search WPC  Go

WPC Home  
Analyses and Forecasts  
National Forecast Charts  
National High & Low  
WPC Discussions  
Surface Analysis  
Days 1/2-2 1/2 CONUS  
Days 3-7 CONUS  
Days 4-8 Alaska  
QPF  
PQPF  
Excessive Rainfall  
Mesoscale Precip Discussion  
Flood Outlook  
Winter Weather  
Storm Summaries  
Heat Index  
Tropical Products  
Daily Weather Map  
GIS Products

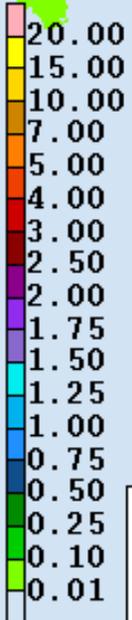
Current Watches/Warnings  
Satellite and Radar Imagery  
GOES-East Satellite  
GOES-West Satellite  
National Radar

Product Archive  
WPC Verification  
QPF  
Medium Range  
Model Diagnostics  
Event Reviews  
Winter Weather

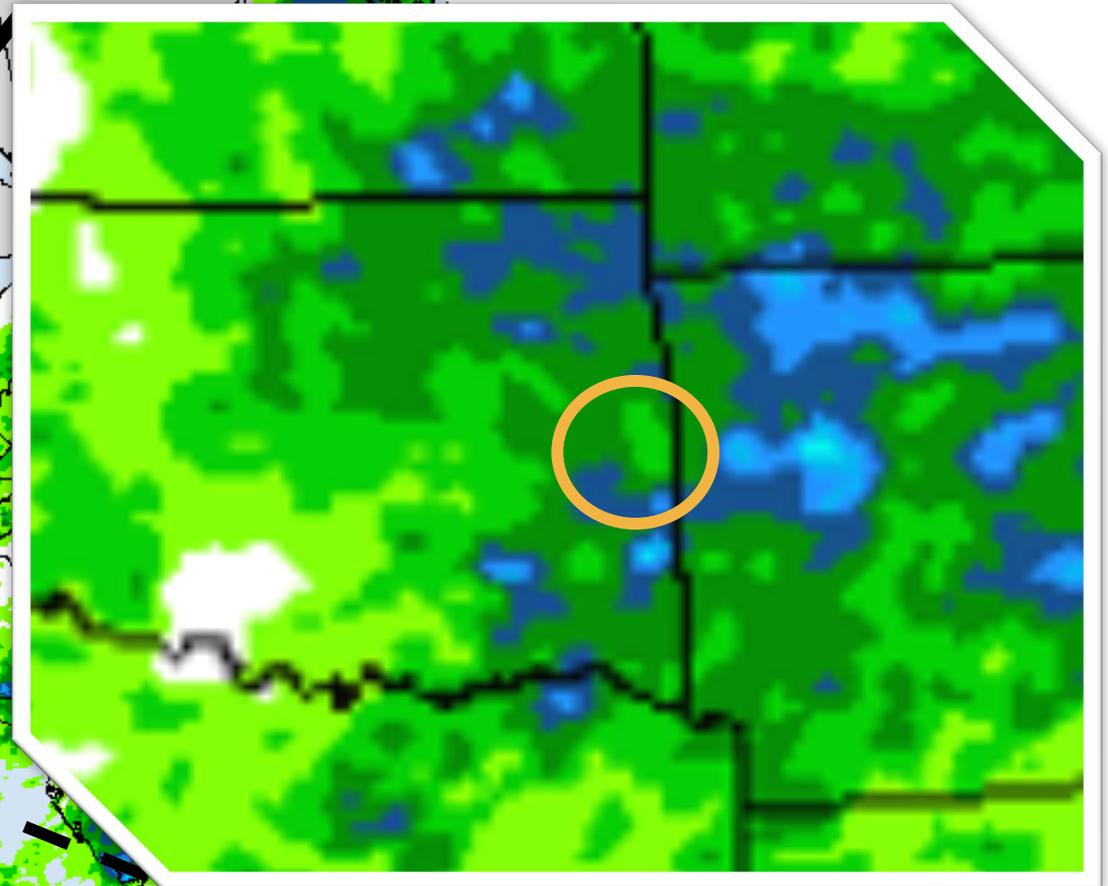
International Desks  
Development and Training  
WPC HydroMet  
Testbed  
Development

# Why look at both deterministic + probabilistic forecast rainfall?

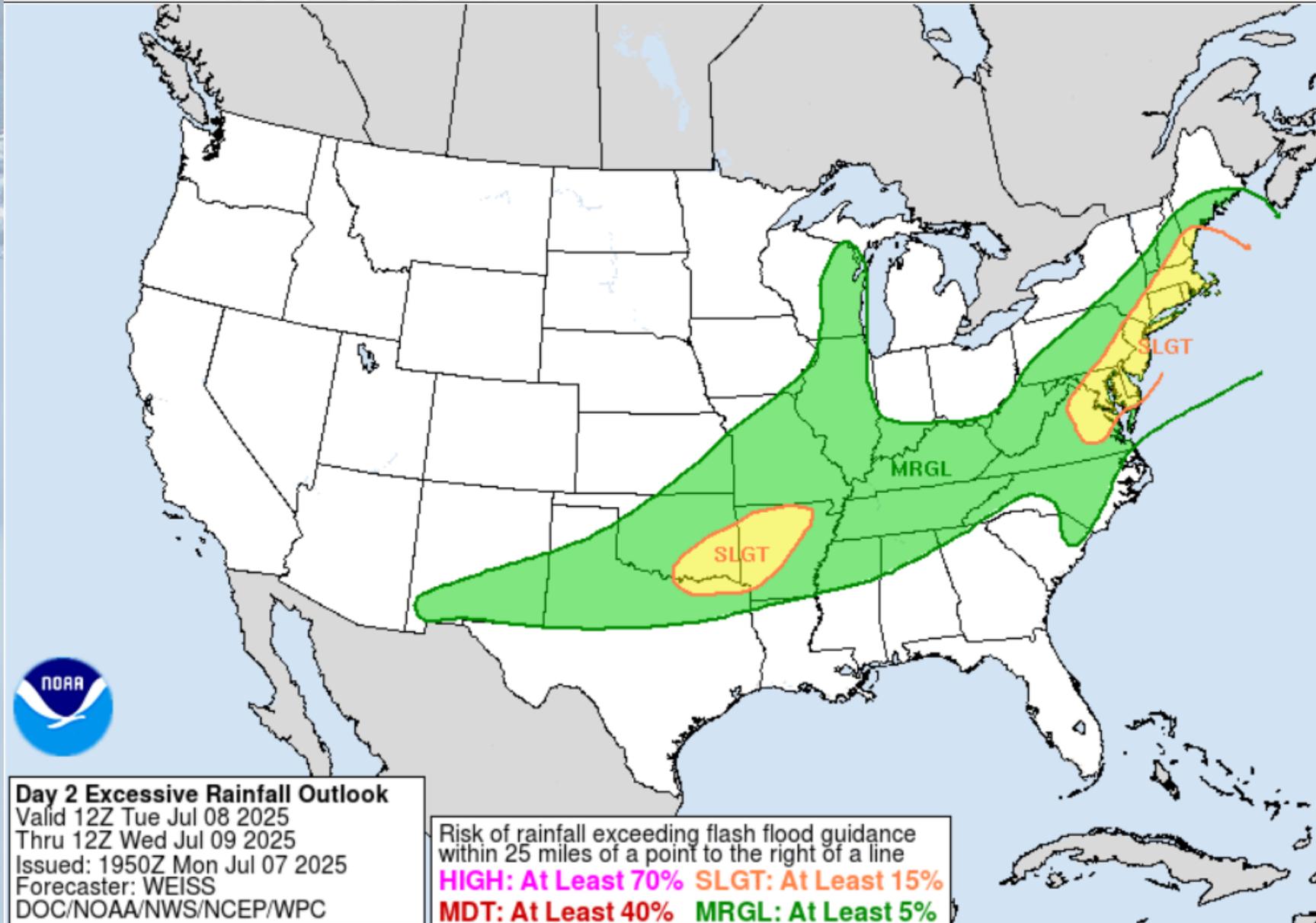
24-hour rainfall forecast  
issued 7pm July 7, 2025:  
0.10" – 1.25"



**24-Hour Day 1 QPF**  
Valid 00Z Tue Jul 08 2025  
Thru 00Z Wed Jul 09 2025  
Issued: 2355Z Mon Jul 07 2025  
Forecaster: NWS/ROTH  
DOC/NOAA/NWS/NCEP/WPC



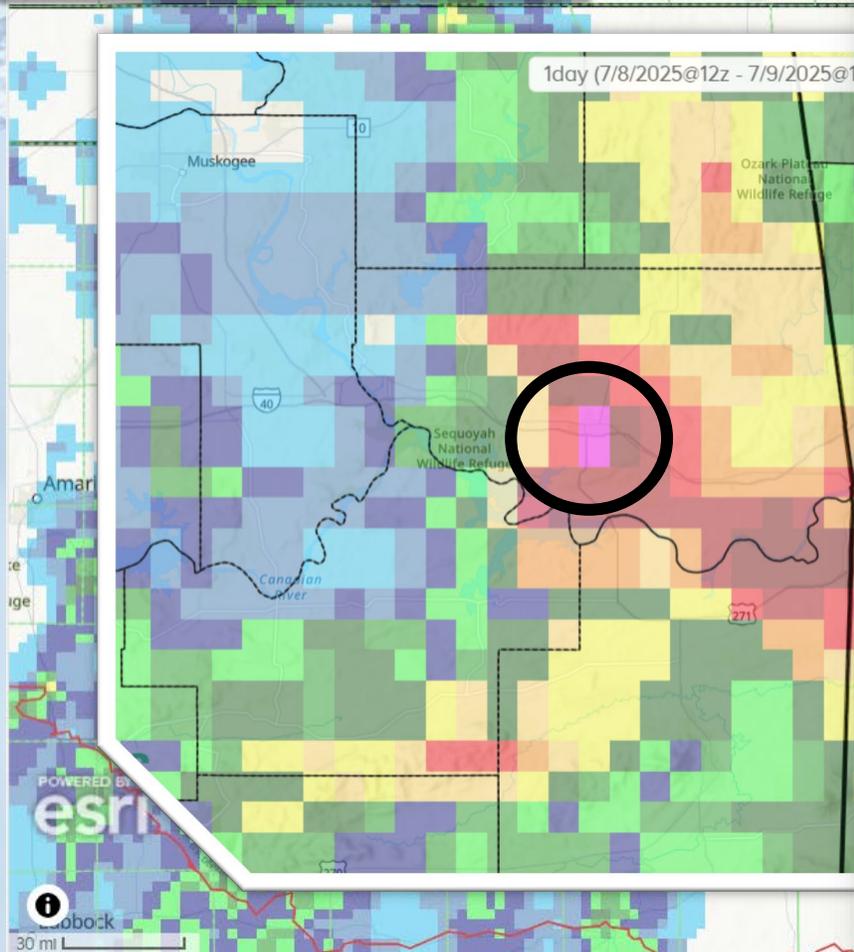
# Why look at both deterministic + probabilistic forecast rainfall?



<b>MARGINAL (MRGL)</b>	<b>SLIGHT (SLGT)</b>
<b>Isolated flash floods possible</b>	<b>Scattered flash floods possible</b>
Localized and primarily affecting places that can experience rapid runoff with heavy rainfall.	Mainly localized. Most vulnerable are urban areas, roads, small streams and washes. Isolated significant flash floods possible.
	
	

# Why look at both deterministic + probabilistic forecast rainfall?

24-hour actual rainfall  
ending 7 am July 9, 2025:  
3" – 7"



## Flooding forces Sequoyah County Boys and Girls Club evacuation; officials urge caution

by Alexandra Sharfman | Tue, July 8th 2025 at 11:46 AM

Updated Tue, July 8th 2025 at 12:19 PM



Flooding forces Sequoyah County Boys and Girls Club evacuation; officials urge caution (Photo: City of Sallisaw)

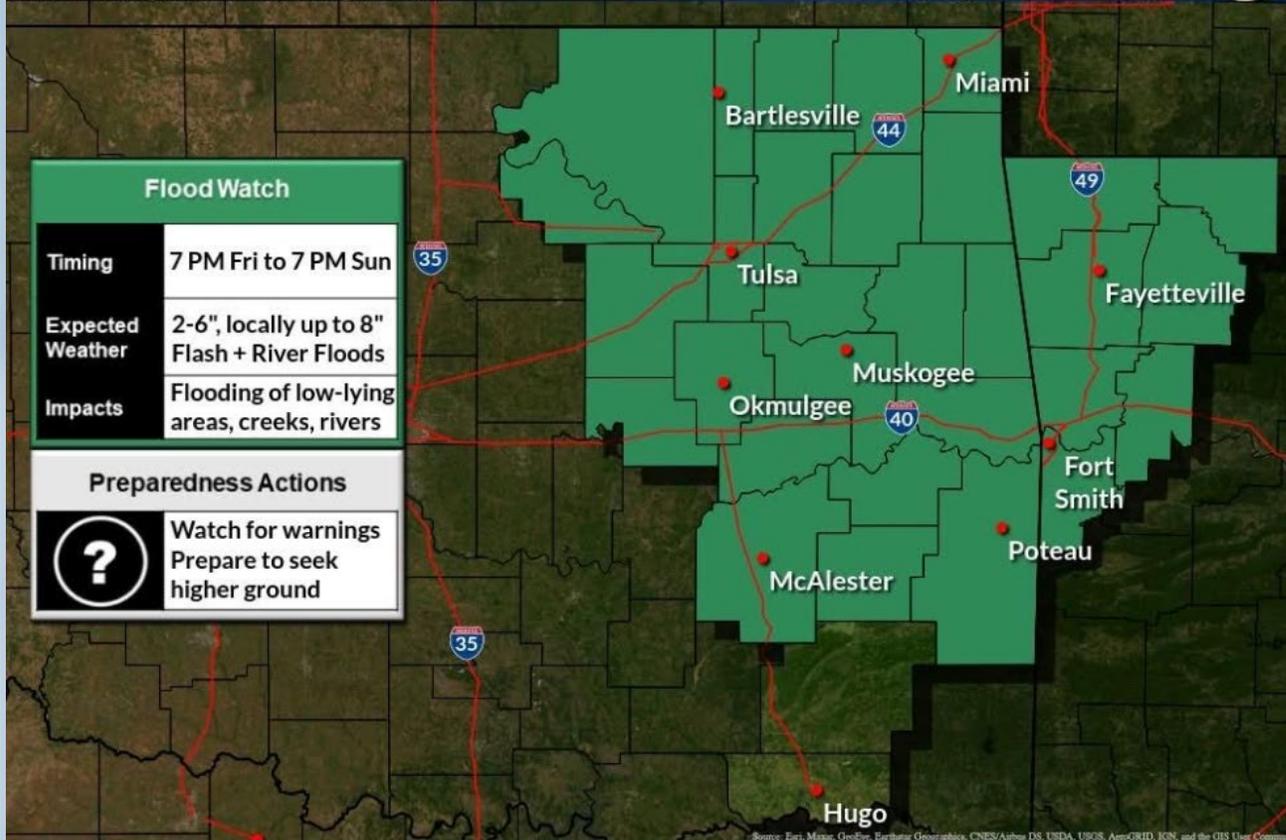
# Flood Watch

- Conditions are favorable for flooding
- Highlights broad area
- Issued 1-3 days in advance by WFO

## High Chance of Flooding This Weekend

Flash Flooding and River Flooding Probable

Weather Forecast Office  
Tulsa, OK  
Issued Apr 17, 2025 2:30 PM CDT



URGENT - IMMEDIATE BROADCAST REQUESTED

Flood Watch

National Weather Service Tulsa OK

121 PM CDT Thu Apr 17 2025

ARZ001-002-010-011-019-020-029-OKZ054>076-181930-  
/O.NEW.KTSA.FA.A.0003.250419T0000Z-250421T0000Z/  
/000000.0.ER.000000T0000Z.000000T0000Z.000000T0000Z.00/  
Benton-Carroll-Washington AR-Madison-Crawford-Franklin-Sebastian-  
Osage-Washington OK-Nowata-Craig-Ottawa-Pawnee-Tulsa-Rogers-Mayes-  
Delaware-Creek-Okfuskee-Okmulgee-Wagoner-Cherokee-Adair-Muskogee-  
McIntosh-Sequoyah-Pittsburg-Haskell-Latimer-Le Flore-  
Including the cities of Rogers, Berryville, Vinita, Stigler,  
Tulsa, Sapulpa, Stilwell, Wagoner, Okemah, Fayetteville, Fort  
Smith, Jay, Nowata, Bentonville, Claremore, Muskogee,  
Bartlesville, Okmulgee, Pawnee, Tahlequah, Miami, Poteau,  
Pawhuska, Wilburton, Huntsville, Checotah, Sallisaw, Grove,  
Springdale, Pryor, Van Buren, Charleston, Ozark, McAlester, and  
Eureka Springs

121 PM CDT Thu Apr 17 2025

...FLOOD WATCH IN EFFECT FROM FRIDAY EVENING THROUGH SUNDAY  
EVENING...

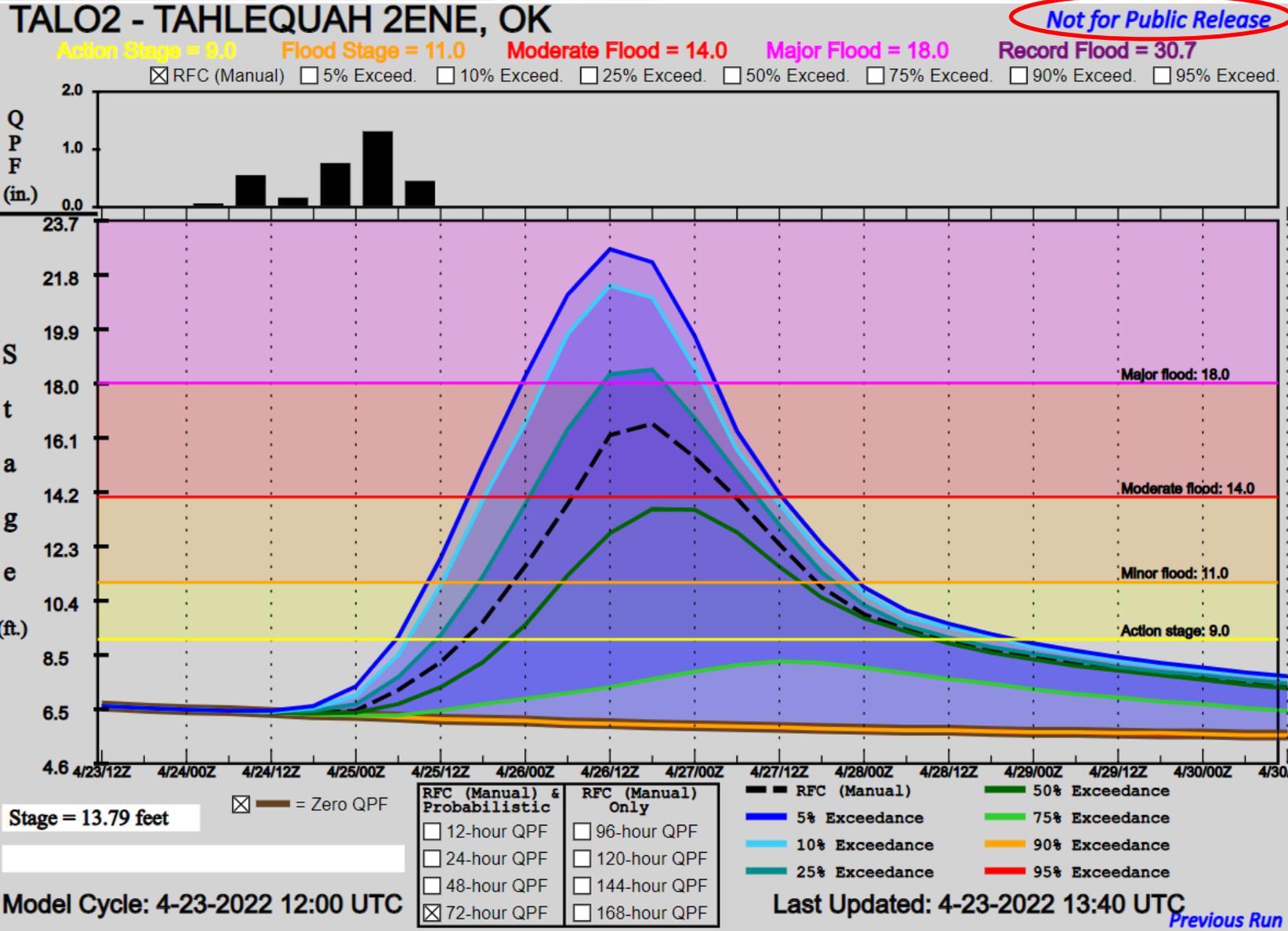
- \* WHAT...Flooding caused by excessive rainfall is possible.
- \* WHERE...Portions of Arkansas, including the following counties, Benton, Carroll, Crawford, Franklin, Madison, Sebastian and Washington AR and Oklahoma, including the following counties, Adair, Cherokee, Craig, Creek, Delaware, Haskell, Latimer, Le Flore, Mayes, McIntosh, Muskogee, Nowata, Okfuskee, Okmulgee, Osage, Ottawa, Pawnee, Pittsburg, Rogers, Sequoyah, Tulsa, Wagoner and Washington OK.
- \* WHEN...From Friday evening through Sunday evening.
- \* IMPACTS...Excessive runoff may result in flooding of rivers, creeks, streams, and other low-lying and flood-prone locations.
- \* ADDITIONAL DETAILS...
  - Areas of heavy rainfall will begin in northeast Oklahoma Friday evening, spreading across the area for Saturday and Sunday. Storm total rainfall of 2-6" is expected. This will result in areas of flash flooding and main stem river flooding.
  - <http://www.weather.gov/safety/flood>

PRECAUTIONARY/PREPAREDNESS ACTIONS...

You should monitor later forecasts and be alert for possible Flood Warnings. Those living in areas prone to flooding should be prepared to take action should flooding develop.

# Hydrographs based on Probabilistic Rainfall (pQPF)

Note: For Official Use Only!



- Various river level scenarios based on different future rainfall amounts.
- Available for NWS River Forecast Points
- No human QC.
- Probabilities provided for the next 72 hours.
- River level forecast based on deterministic rainfall available for next 7 days.

# WFO Briefings



## Hazardous Weather Briefing

For Eastern Oklahoma and Northwest and West Central Arkansas

June 5, 2025

10:02 AM

### Decision Support Briefing

→ As of 10:00 AM Thursday, June 5, 2025

#### Highlights

- Multiple rounds of storms this week
  - ◆ Elevated Severe Weather Threat Tonight, Late Friday and Saturday
  - ◆ Additional rounds of heavy rainfall and increasing flooding concerns from Thursday night thru Saturday night
  - ◆ Storm chances continue through Monday with some heavy rain and severe threat

Hazard	Thu	Fri	Sat	Sun	Mon	Tue	Wed
SEVERE TSTORM	Red	Red	Red	Yellow	Green	Green	Green
LIGHTNING	Red	Red	Red	Yellow	Green	Green	Green
RAIN	Red	Red	Red	Yellow	Green	Green	Green
FLASH FLOOD	Red	Red	Red	Yellow	Green	Green	Green
RIVER FLOOD	Red	Red	Red	Yellow	Green	Green	Green



National Oceanic and Atmospheric Administration  
U.S. Department of Commerce

National Weather Service  
Tulsa, OK

Live Webinar Briefings

Deployed Meteorologist / Hydrologist briefings at EOCs

Briefing slides posted in NWSChat

Email Briefings sent to Emergency Managers + Core Partners



# Social Media Messaging

**Prepare For Flooding Before It Happens**

Are you located in a floodplain?

What is the fastest way to higher ground?

What roads nearby are most likely to flood?

weather.gov/flood

## Flood Watch Through Sunday

weather.gov/Tulsa  
Updated: Sun Jul 13, 2025 3:51 AM

### Flash Flooding Can Develop Quickly



### Flood Watch

Timing	Through 7 PM Sunday
Expected Weather	<ul style="list-style-type: none"> <li>Additional Locally Heavy Rainfall between 2" and 4" possible</li> </ul>
Impacts	<ul style="list-style-type: none"> <li>Excessive runoff</li> <li>Flooding of low-lying areas, creeks and streams</li> <li>Rises on mainstem rivers</li> </ul>
Actions	<ul style="list-style-type: none"> <li>Monitor forecasts</li> <li>Have 3 ways to receive warnings</li> <li>Seek higher ground if warnings issued</li> </ul>

## Rain Through the Weekend

weather.gov/Tulsa  
Updated: Sat Jul 12, 2025 3:05 AM

### Key Messages

- Locally heavy rainfall amounts likely through the weekend
- Impacts may include both flash and mainstem river flooding.

### Amounts

- Widespread 1 to 2 inches Isolated 3-5 inch amounts

### What We're Watching

- Recent heavy rains will allow quick runoff with any localized heavy rains. Flood impacts could develop quickly.

### Forecast Rainfall: Saturday - Sun. Night

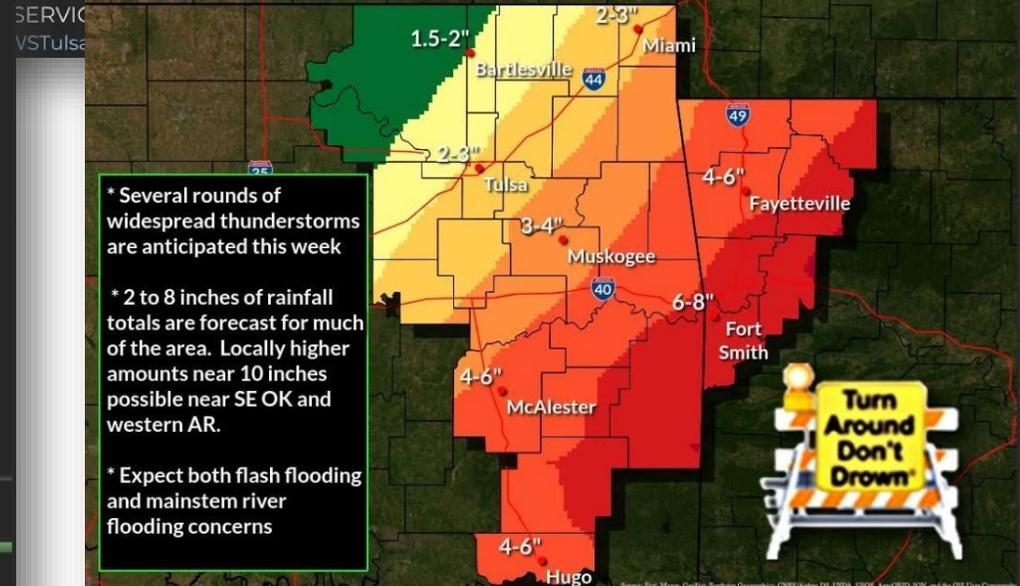


Keep Checking Updated Forecasts

### Significant Flooding Possible This Weekend

Weather Forecast Office  
Tulsa, OK  
Issued Apr 02, 2025 1:34 PM CDT

Pictured: Forecast Rainfall Through Saturday





# Rain, Rain, Go Away

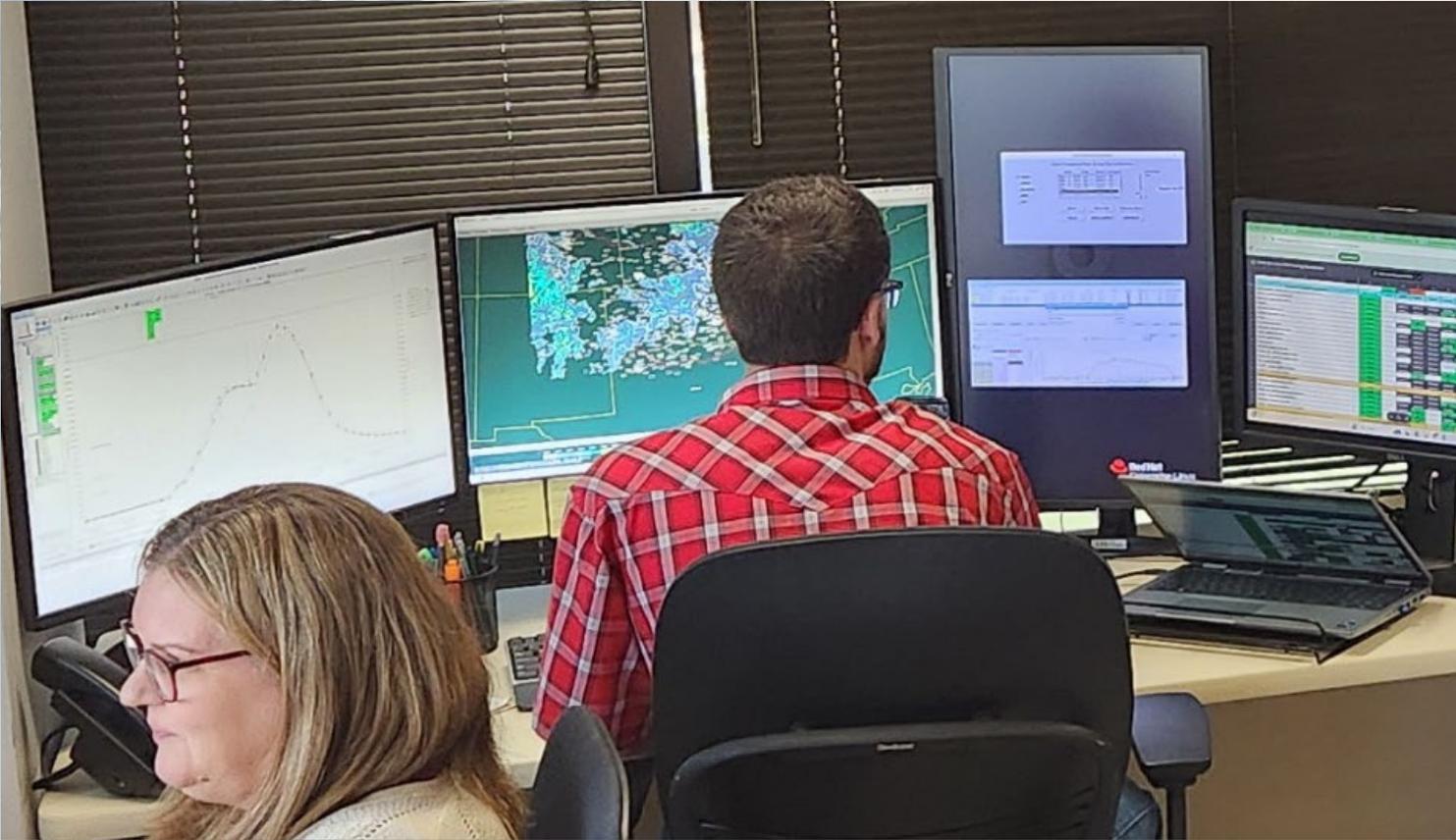
---

Hours 0-24: Action

# RFC River Flood Forecasts

The ABRFC uses the Sacramento Soil Moisture Accounting rainfall-runoff model (SAC-SMA).

- conceptual model that determines total runoff based on the interaction of two soil zones.
- To determine downstream routing, the ABRFC uses the Lag/K method.
- Local runoff from the SAC-SMA is run through a Unit Hydrograph operation to determine local flow. The local flow is added to routed flows for each upstream site to determine the total flow for each forecast period. Total flow is converted to a stage forecast using a rating curve.



Incorporate actual rainfall, current streamflow, reservoir releases (current + scheduled), and next 24-hours of forecast rainfall

31 - devastating flooding occurs along the Illinois River from near Hanging Rock to the headwaters of Lake Tenkiller. Impacts will be similar to the record flood of 30.7 feet in December 2015. State Highway 10 is closed northeast of its intersection with Highway 51. Many cabins and parks are severely flooded or are totally isolated for an extended duration. This is a very dangerous and life threatening situation.

29 - devastating flooding occurs along the Illinois River from near Hanging Rock to the headwaters of Lake Tenkiller. State Highway 10 is closed northeast of its intersection with Highway 51. Many cabins and parks are severely flooded or are totally isolated for an extended duration. This is a very dangerous and life threatening situation. This will exceed the April 2011 flood of 26 feet and approach the May 1950 flood of 27.9 feet.

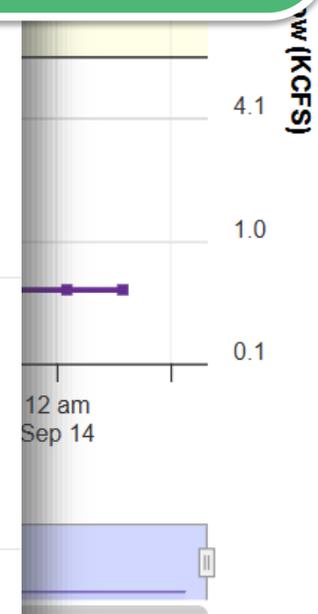
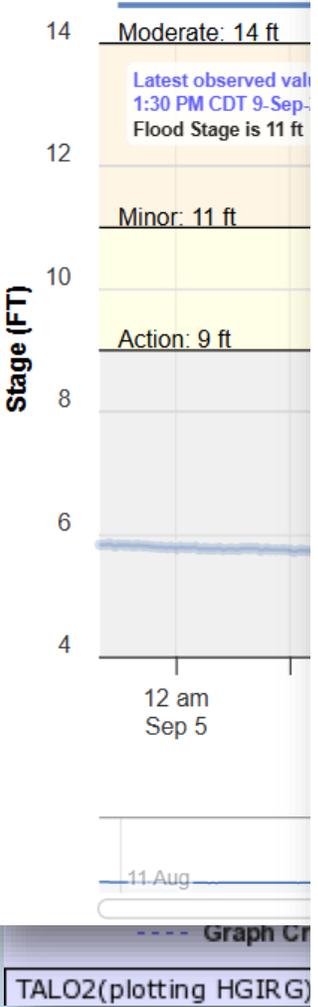
27 - devastating flooding occurs along the Illinois River from near Hanging Rock to the headwaters of Lake Tenkiller. State Highway 10 is closed northeast of its intersection with Highway 51. Many cabins and parks are severely flooded or are totally isolated for an extended duration. This is a very dangerous and life threatening situation. This will exceed the April 2011 flood of 26 feet and approach the May 1950 flood of 27.9 feet.

25 - devastating flooding occurs along the Illinois River from near Hanging Rock to the headwaters of Lake Tenkiller. State Highway 10 is closed northeast of its intersection with Highway 51. Many cabins and parks are severely flooded or are totally isolated for an extended duration. This is a very dangerous and life threatening situation. This will approach the April 2011 flood, which reached 26 feet.

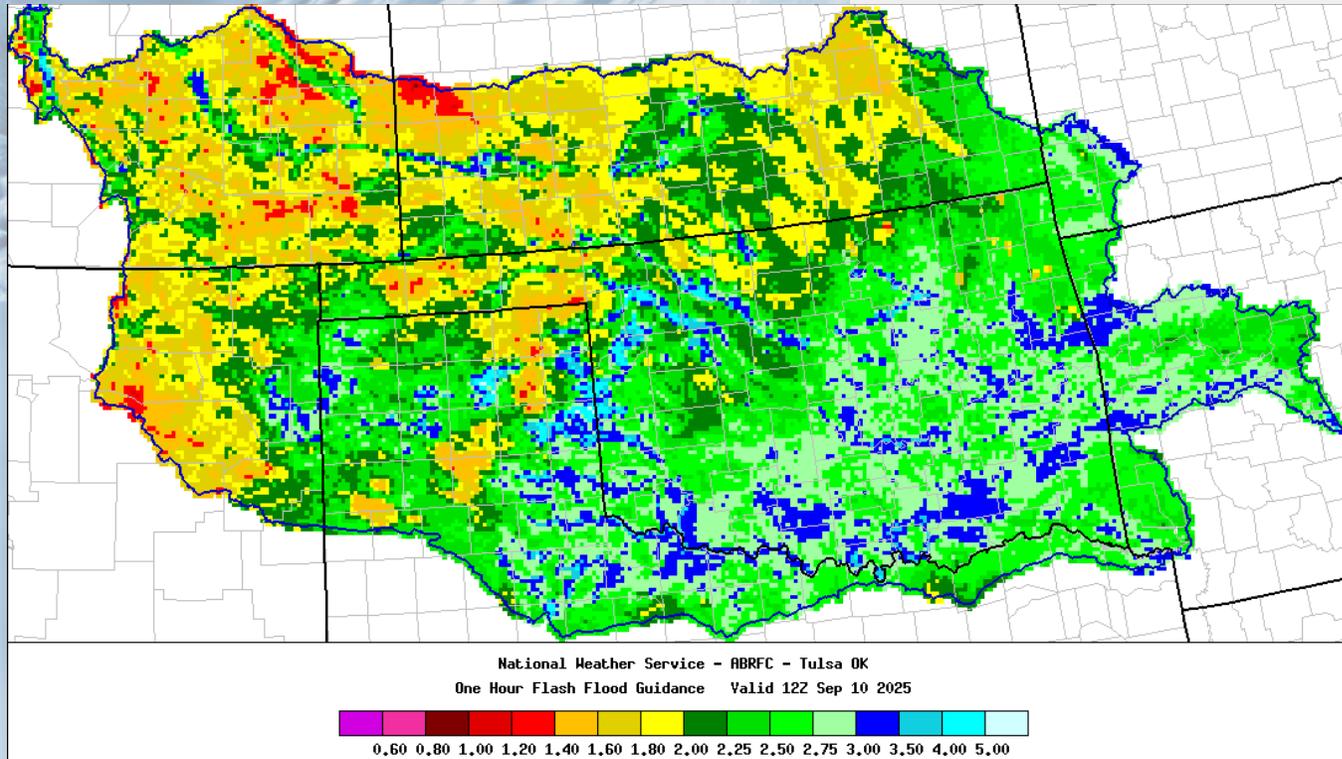
23 - extremely severe flooding occurs along the Illinois River from near Hanging Rock to the headwaters of Lake Tenkiller. State Highway 10 is closed northeast of its intersection with Highway 62. Several cabins and parks are severely flooded and many others are isolated for an extended duration. This is a very dangerous and life threatening situation.

### Impact Statements:

- description of what is flooded at different river levels
- **EM & Floodplain Administrator input is vital!**
- appear in River Flood Warnings.



# RFC Flash Flood Guidance

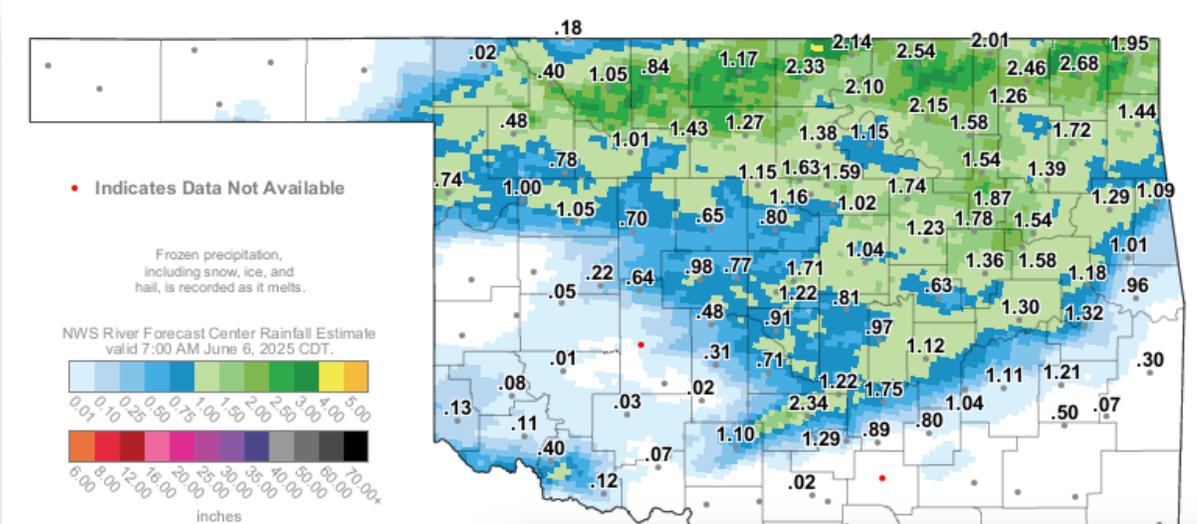


Available for 1-, 3-, and 6-hour durations

<https://www.weather.gov/abrfc/gffg>

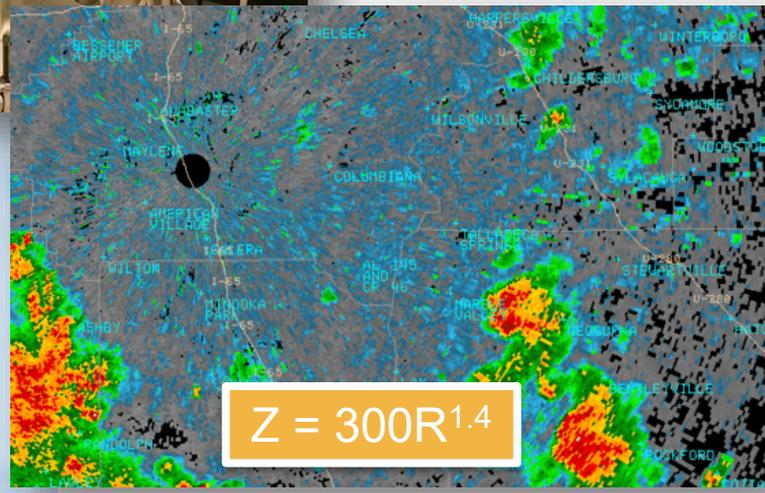
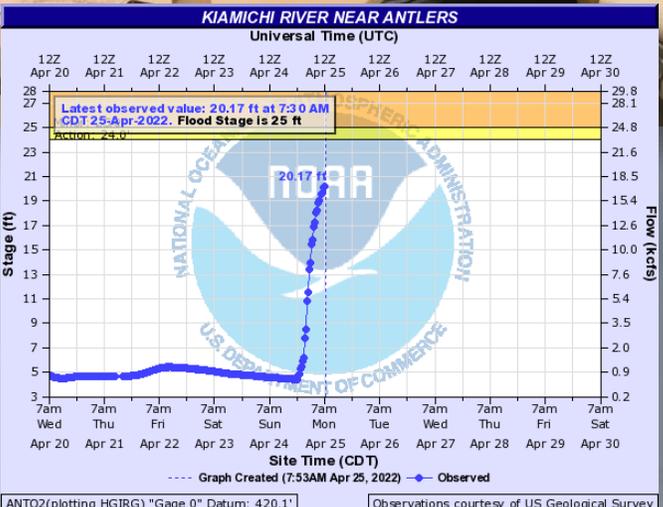
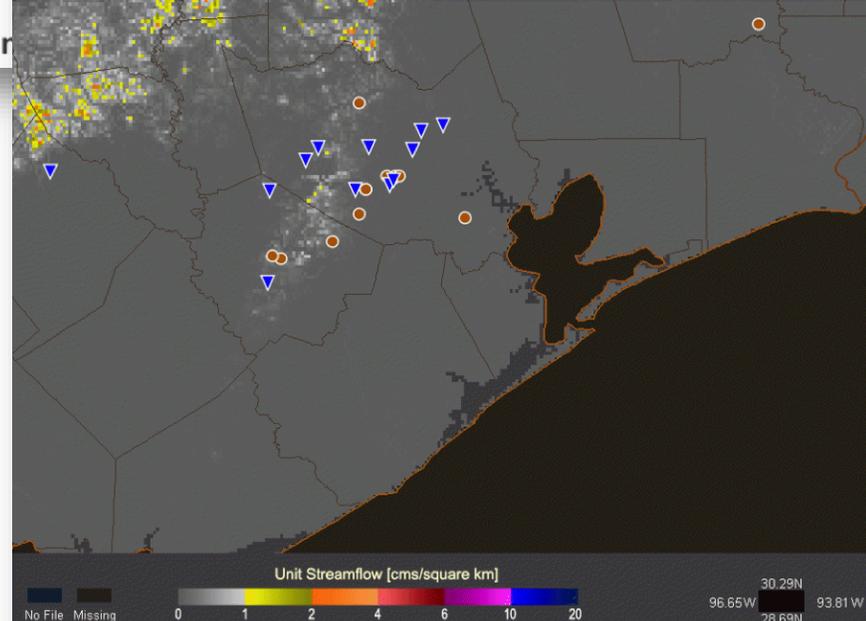
- Provides a general indication of the amount of rainfall evenly distributed over various durations necessary to cause small streams to overflow their natural banks.
- During heavy rainfall, accurate interpretation of the guidance consists of the combination of rainfall that has already occurred plus any additional rainfall that can be confidently expected to fall over the same location in the immediate future.
- It should be noted that Gridded Flash Flood Guidance (GFFG) values represent estimates of average soil moisture and stream flow conditions over 4km x 4km grids.
- Flooding may occur with less rainfall than indicated in areas of high rainfall intensities, impervious surfaces, or steep slopes.

# WFO Radar Analysis / Observations (rain + river gages)



Mesonet  
6-Hour Rainfall Accumulation (in)

CREST Maximum Unit Streamflow  
Integrated From -30Min to +6Hr  
Valid: 05/26/2015 02:00:00 UTC



# Warnings + Advisories – issued by local NWS WFOs

## Flash Flood Warning

- **Take Action Immediately!** A Flash Flood Warning is issued when a flash flood is imminent or occurring and is a threat to life and/or property.
- Issued for rapid water rise in a short period of time and for dam or levee breach.
- Activates the Emergency Alert System (EAS)

## Flood Warning

- **Take Action!** A Flood Warning is issued when flooding is imminent or occurring and is a threat to life and/or property.
- Issued for areal flooding or river flooding at specific River Forecast Points.

## Flood Advisory

- **Be Aware!** A Flood Advisory is issued when flooding is not expected to be bad enough to issue a warning.
- However, it may cause significant inconvenience, and if caution is not exercised, it could lead to situations that may threaten life and/or property.

# Impact-Based Flash Flood Warnings

Flash Flood Statement  
National Weather Service Tulsa OK  
1024 AM CDT Tue Jul 8 2025

ARC033-OKC001-061-135-081800-  
/O.CON.KTSA.FF.W.0054.000000T0000Z-250708T1800Z/  
/00000.0.ER.000000T0000Z.000000T0000Z.000000T0000Z.00/  
Crawford AR-Adair OK-Haskell OK-Sequoyah OK-  
1024 AM CDT Tue Jul 8 2025

...FLASH FLOOD WARNING REMAINS IN EFFECT UNTIL 1 PM CDT THIS  
AFTERNOON FOR WEST CENTRAL CRAWFORD, SEQUOYAH, SOUTHERN ADAIR AND  
NORTHEASTERN HASKELL COUNTIES...

At 1024 AM CDT, Doppler radar indicated thunderstorms producing  
heavy rain across the warned area. Between 4 and 7 inches of rain  
have fallen. Additional rainfall amounts up to 1 inch are possible  
in the warned area. Flash flooding is ongoing or expected to begin  
shortly.

HAZARD...Life threatening flash flooding. Thunderstorms producing  
flash flooding.

SOURCE...Radar.

IMPACT...Life threatening flash flooding of creeks and streams,  
urban areas, highways, streets and underpasses.

Some locations that will experience flash flooding include...

Sallisaw...	Muldrow...
Vian...	Keota...
Gans...	Marble City...
Tamaha...	Brushy...
Brushy Lake State Park...	Short...
Lake Tenkiller State Park...	Mc Key...
BOX...	Uniontown...

PRECAUTIONARY/PREPAREDNESS ACTIONS...

Turn around, don't drown when encountering flooded roads. Most flood  
deaths occur in vehicles.

&&

LAT...LON 3564 9494 3564 9481 3567 9481 3575 9446  
3548 9443 3535 9472 3535 9477 3533 9479  
3532 9481 3530 9481 3521 9501 3561 9504

FLASH FLOOD...RADAR INDICATED  
FLASH FLOOD DAMAGE THREAT...CONSIDERABLE

\$\$

**Headline: Warning type, time, and counties affected**

**Reason for warning, including rainfall amounts**

**Specific information on the degree of expected  
flash flooding impacts**

**Specific towns and locations that are within the  
warning polygon**

**Specific tags used for Wireless Emergency Alerts**

# EAS – Emergency Alert System (<https://www.ready.gov/alerts>)

- A national public warning system commonly used by state and local authorities to deliver important emergency information, such as weather and AMBER alerts, to affected communities.
- The EAS is sent through broadcast TV and radio, satellite digital audio services, direct broadcast satellite providers, cable television systems and wireless cable systems.
- The NOAA Weather Radio All Hazards(NWR) network, the only federally-sponsored radio transmission of warning information to the public, is part of the EAS.



# WEA – Wireless Emergency Alerts (<https://www.weather.gov/wrn/wea>)

The NWS specially marks our most critical NWS alerts for WEA distribution and pushes them to IPAWS.

## Tags

Tags will appear at the bottom of FFWs and in Flash Flood Statements (FFSs), which provide supplemental information on active FFWs.



```

life-threatening situation. Do not attempt to travel unless you are
fleeing an area subject to flooding or under an evacuation order.

**

LAT...LON 2904 9515 2905 9527 2932 9536 2916 9543

FLASH FLOOD...OBSERVED
FLASH FLOOD DAMAGE THREAT...CATASTROPHIC
EXPECTED RAINFALL...2-3 INCHES PER HOUR
    
```

Flash Flood Damage Threat Tag	Explanation
"Base" (No Tag)	Use most of the time, when flash flood impact damage is possible.
CONSIDERABLE*	Use rarely, when there are indications flash flooding capable of unusual severity or impact is imminent or ongoing and urgent action is needed to protect lives and property.
CATASTROPHIC*+	Use exceedingly rarely, when a flash flood threat to life and catastrophic damage is occurring or is imminent, and floodwaters have risen or will rise to levels rarely if ever seen. <b>Flash Flood Emergency</b>

Trigger WEA (cell phone alerts)

# WEA – Wireless Emergency Alerts (<https://www.weather.gov/wrn/wea>)

The NWS specially marks our most critical NWS alerts for WEA distribution and pushes them to IPAWS.

The Integrated Public Alert and Warning System (IPAWS) pushes them to commercial wireless carriers.

**WIRELESS  
EMERGENCY  
ALERTS  
CAPABLE**



## Do I Need to Sign Up for WEA?

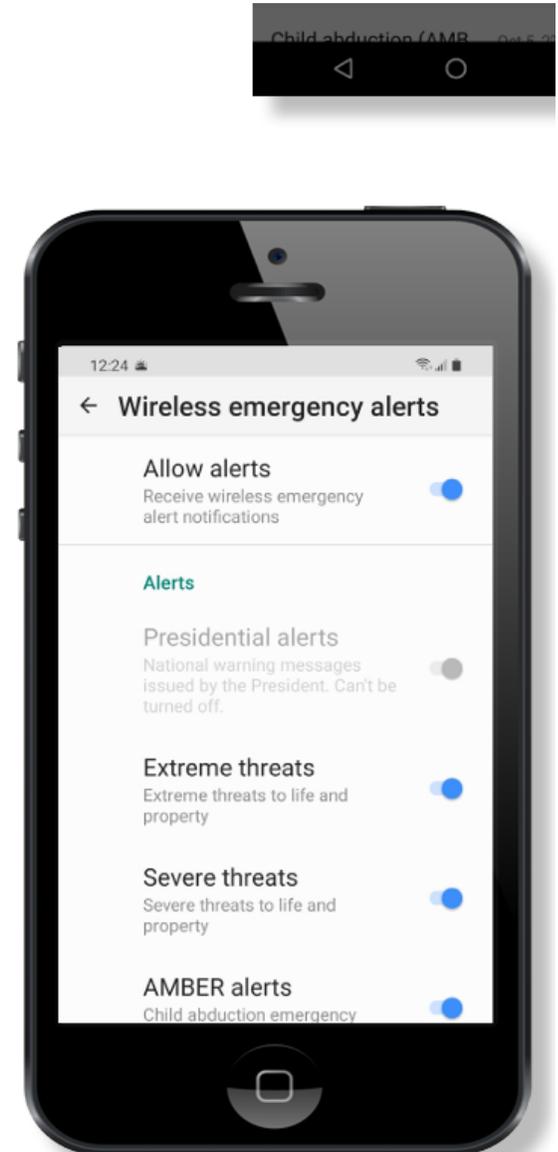
NO! No signup is required! Alerts are sent automatically to WEA-capable phones during an emergency. WEA is free! No need to download an app.

## How Do I Know WEA is Enabled on My Phone?

Many new cell phones are WEA-capable. Prepaid mobile devices may also be WEA-capable. For information about which mobile devices are WEA-capable and carrier participation, please contact your wireless carrier. And don't turn them off! Keep them on to ensure that you receive alerts for severe weather and other emergencies.

## For More Information

More than 100 mobile carriers, including all of the largest carriers, participate in the WEA program. For information, contact your wireless carrier.



# WEA – Wireless Emergency Alerts (<https://www.weather.gov/wrn/wea>)

The NWS specially marks our most critical NWS alerts for WEA distribution and pushes them to IPAWS.

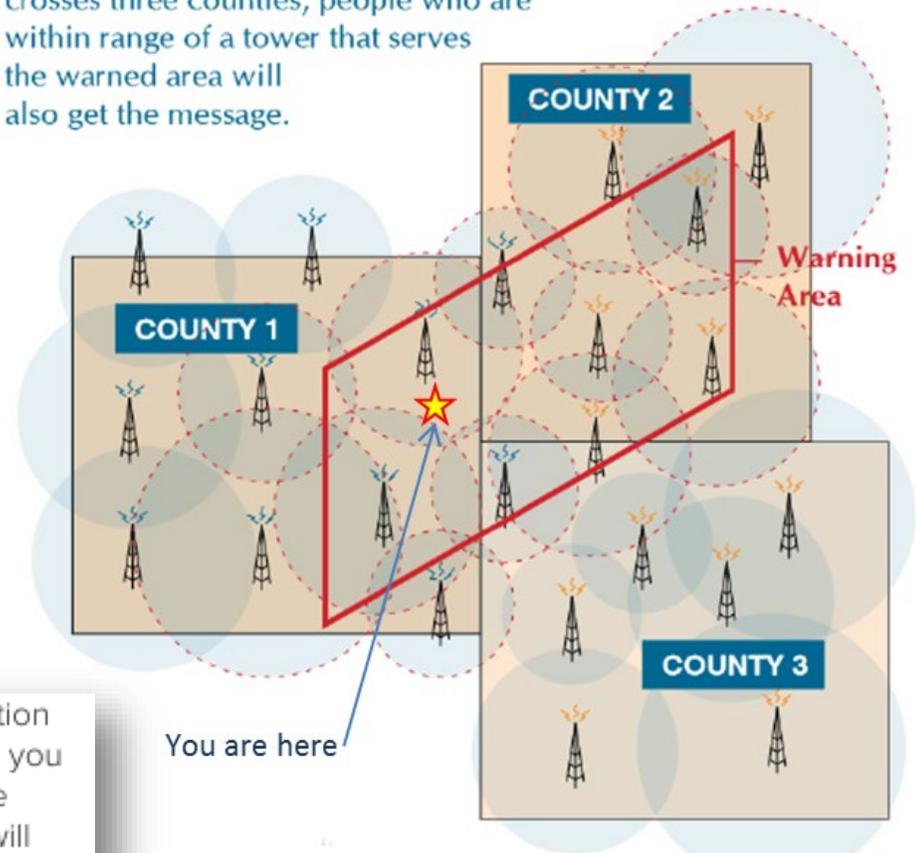
The Integrated Public Alert and Warning System (IPAWS) pushes them to commercial wireless carriers.

The wireless carriers broadcast the alert from cell towers in the threat area to your cell phone.



WEA messages are relevant to your location – you only receive WEA messages when you and your cell phone are in the area of the emergency. If you visit another city, you will only receive alerts for that location and not your home town.

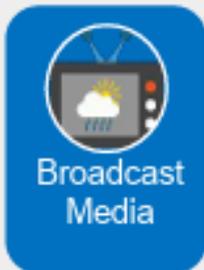
As this simplified illustration shows, when a warning is issued for a polygon that crosses three counties, people who are within range of a tower that serves the warned area will also get the message.



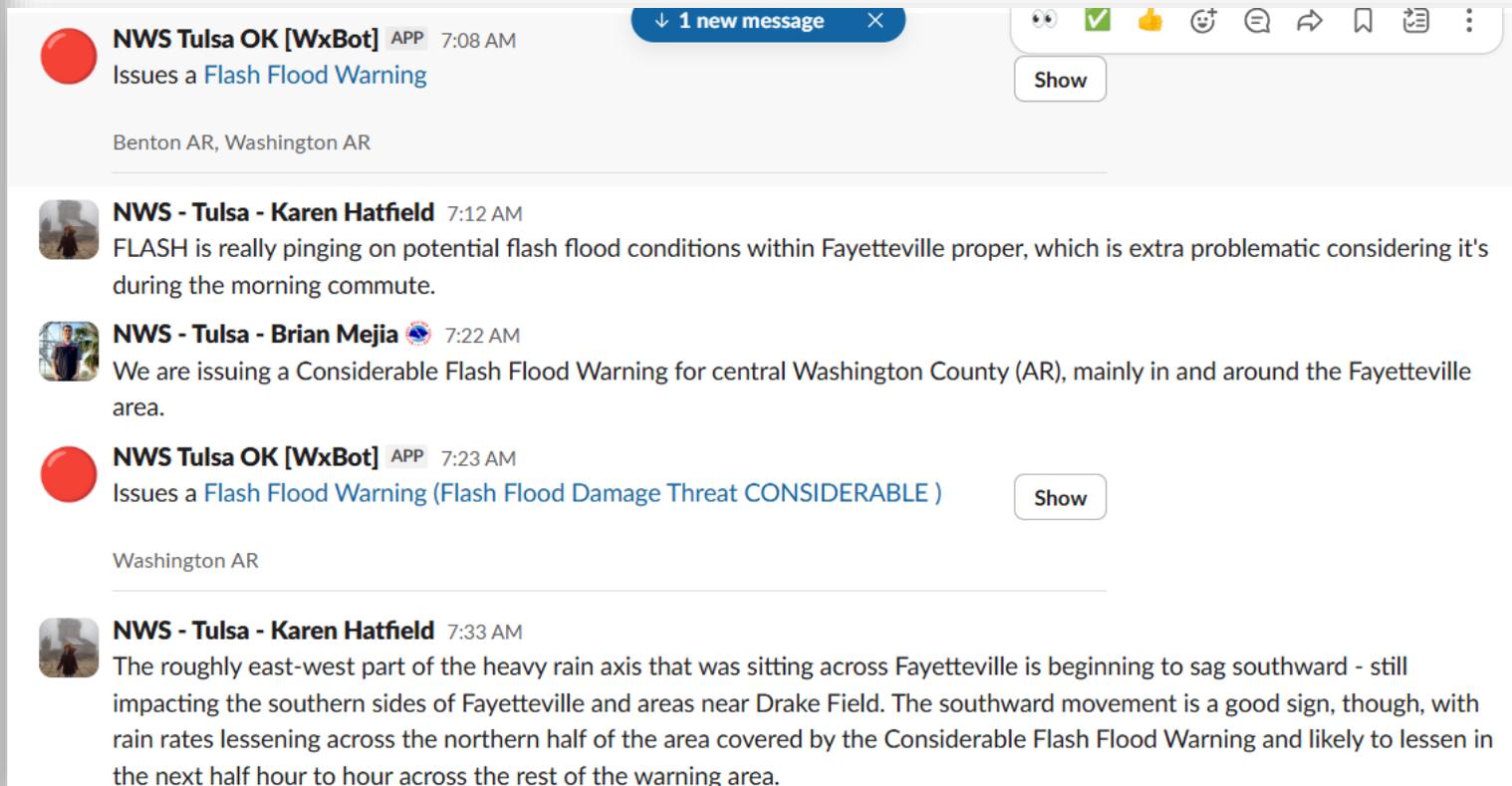
# NWSChat/Slack

## Who can use NWSChat 2.0?

- ✓ Members of the **emergency management community** including public safety officials from federal, state, tribal or local governments.
- ✓ Safety and emergency personnel from **universities or other large-population** entities.
- ✓ Members of the **news media** can relay weather information such as flood watches, advisories, and warnings to a significant part of the population served by an NWS office.
- ✓ **Government partners** of a NWS office including (but not limited to) the FAA, DHS, USGS, military and water and land management officials.



- Allows local NWS offices to communicate weather and flood information directly with key partners during incidents. 2-way street!
- It's an important situational awareness tool, leveraged by all members of the Integrated Warning Team: emergency management, news media, + the NWS.



The screenshot shows a Slack chat interface. At the top, a blue notification bubble says "1 new message". The chat history includes:

- A red circular profile picture for "NWS Tulsa OK [WxBot] APP" with a timestamp of 7:08 AM. The message text is "Issues a [Flash Flood Warning](#)". A "Show" button is visible to the right.
- A location separator: "Benton AR, Washington AR".
- A profile picture for "NWS - Tulsa - Karen Hatfield" with a timestamp of 7:12 AM. The message text is "FLASH is really pinging on potential flash flood conditions within Fayetteville proper, which is extra problematic considering it's during the morning commute."
- A profile picture for "NWS - Tulsa - Brian Mejia" with a timestamp of 7:22 AM. The message text is "We are issuing a Considerable Flash Flood Warning for central Washington County (AR), mainly in and around the Fayetteville area."
- A red circular profile picture for "NWS Tulsa OK [WxBot] APP" with a timestamp of 7:23 AM. The message text is "Issues a [Flash Flood Warning \(Flash Flood Damage Threat CONSIDERABLE\)](#)". A "Show" button is visible to the right.
- A location separator: "Washington AR".
- A profile picture for "NWS - Tulsa - Karen Hatfield" with a timestamp of 7:33 AM. The message text is "The roughly east-west part of the heavy rain axis that was sitting across Fayetteville is beginning to sag southward - still impacting the southern sides of Fayetteville and areas near Drake Field. The southward movement is a good sign, though, with rain rates lessening across the northern half of the area covered by the Considerable Flash Flood Warning and likely to lessen in the next half hour to hour across the rest of the warning area."

# Partner Relay + Public Receiving Warnings + Taking Action



Have multiple ways to get warnings  
[weather.gov](http://weather.gov)



INTERNET



LOCAL TV  
AND RADIO



OUTDOOR  
SIRENS



WIRELESS EMERGENCY ALERTS  
AND WEATHER APPS



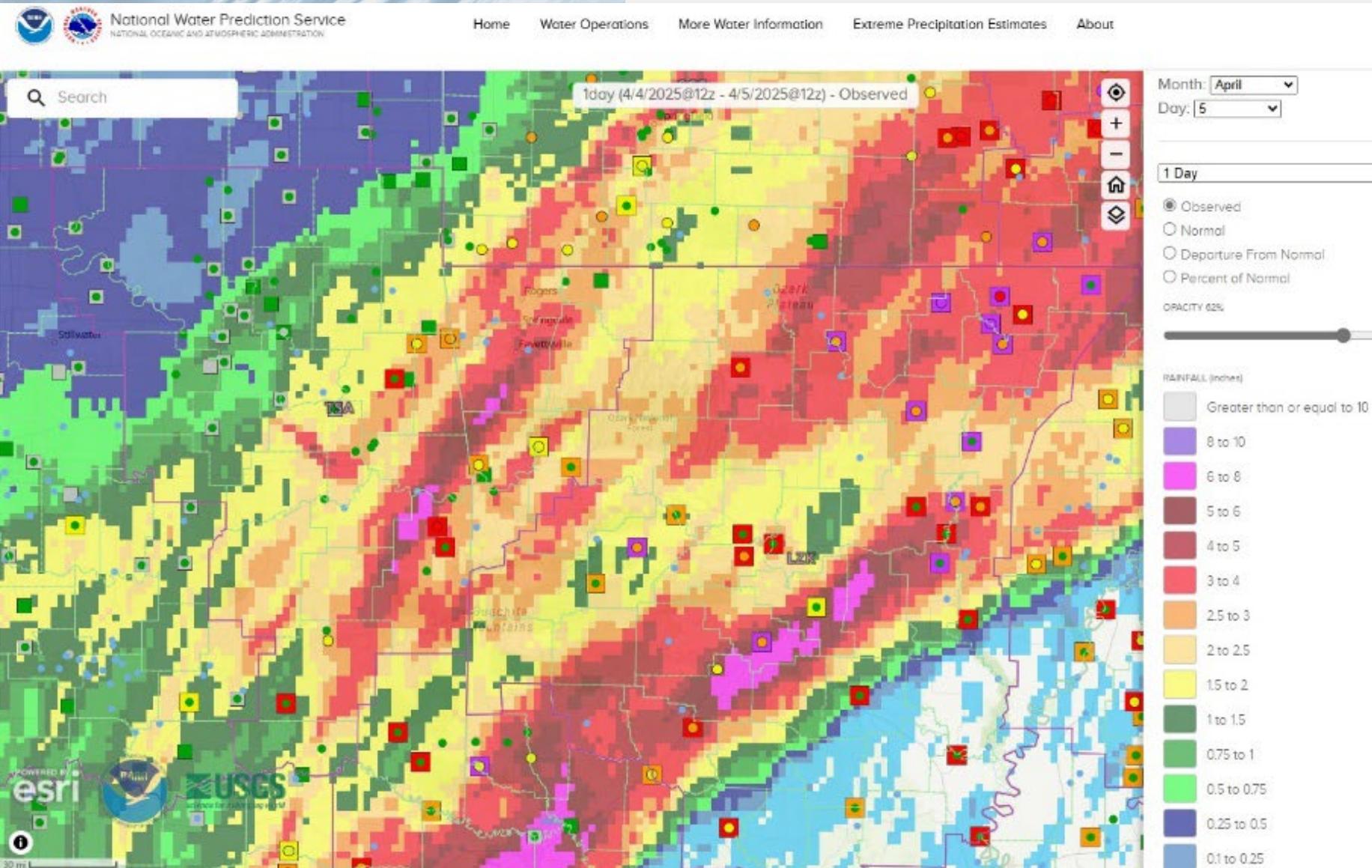
NOAA  
WEATHER  
RADIO



FROM YOUR FAMILY,  
FRIENDS, AND COWORKERS



# Observed Rainfall - RFC



- Based on radar estimates + rain gauge measurements
- QC done by NWS RFC hydrologists hourly
- Quantitative Precipitation Estimate (QPE)
- “Daily” = 24-hours ending at 6am CST / 7am CDT on the date selected



Local forecast by  
"City, St" or ZIP code

[Location Help](#)

### News Headlines

- [2023 NWS Tulsa Spotter Training Calendar](#)

**Customize  
Your  
Weather.gov**

Enter Your City, ST or  
ZIP Code

Remember Me

## NWS Forecast Office Tulsa, OK

[Weather.gov](#) > Tulsa, OK

**Tulsa, OK**  
Weather Forecast Office

[Current Hazards](#)   [Current Conditions](#)   [Radar](#)   [Forecasts](#)   **[Rivers and Lakes](#)**   [Climate and Past Weather](#)   [Local Programs](#)

Wind Advisory  
Tuesday

Severe  
Potential  
Wednesday

Today

Tonight

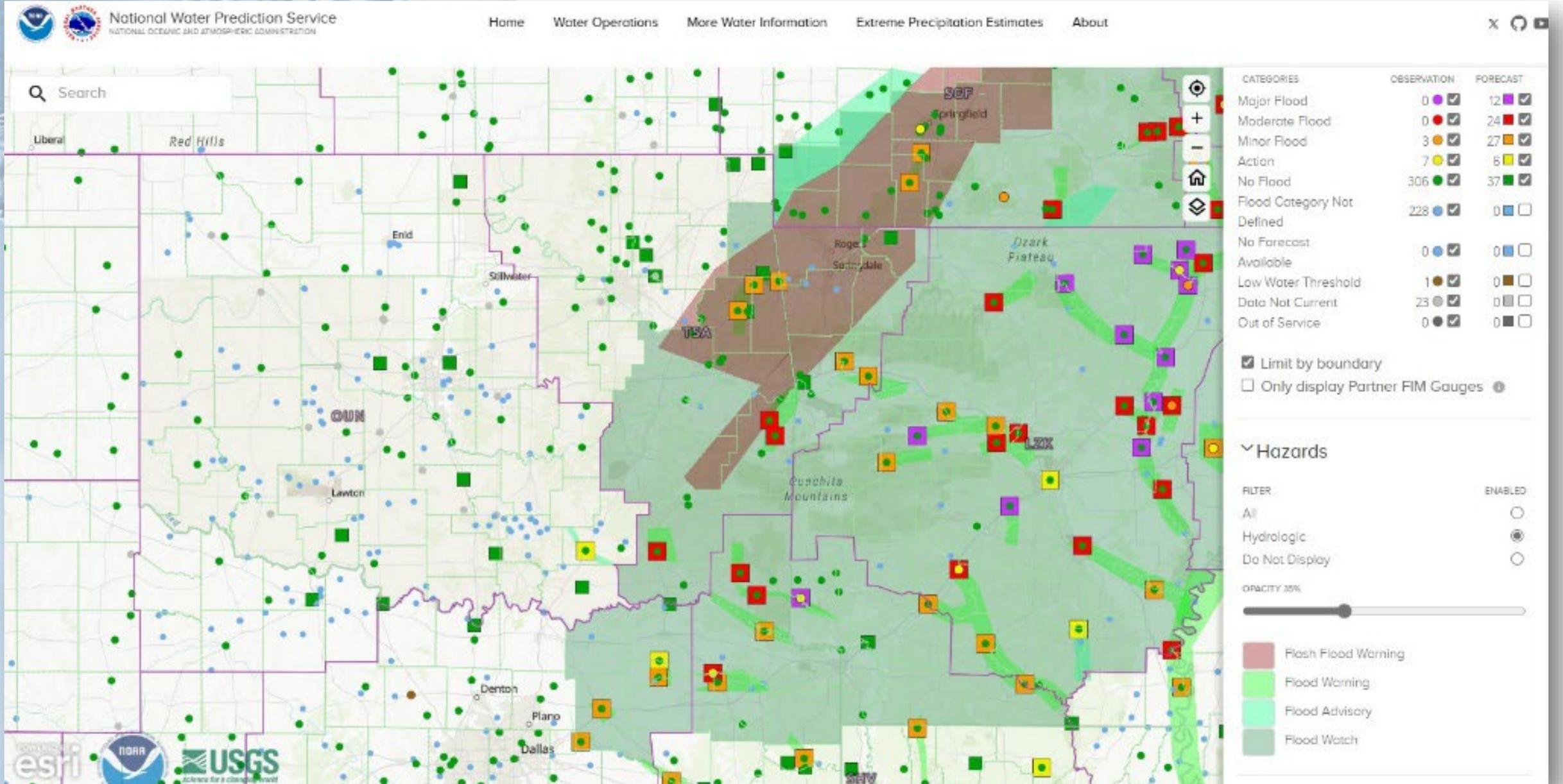
Tue

**Severe Storm Threat Wednesday**

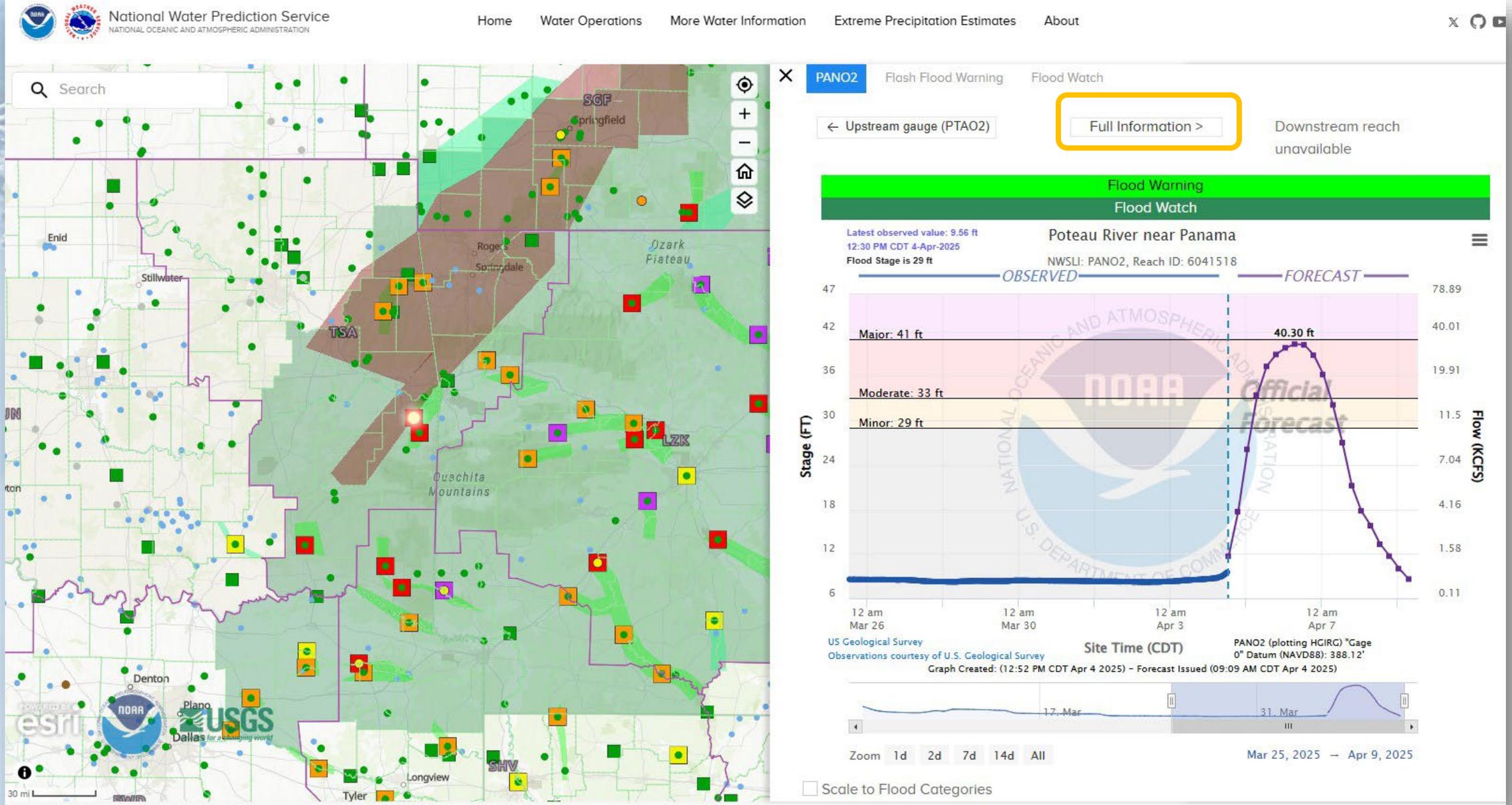
Weather Forecast Office



# National Water Prediction Service (NWPS): <https://water.noaa.gov>



# National Water Prediction Service (NWPS): <https://water.noaa.gov>



# National Water Prediction Service (NWPS): <https://water.noaa.gov>



National Water Prediction Service  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Home

Water Operations

More Water Information

Extreme Precipitation Estimates

About



Search



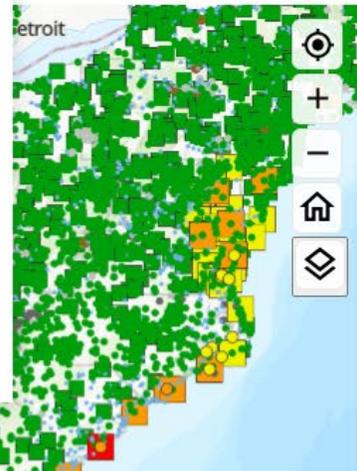
Precipitation Estimate

Flood Inundation  
Mapping (FIM)

Data and Web Services  
Catalog

NWPS API

Drought/Low Water



Map

Topographic

Layers

River Gauge

- Observations & Forecasts
- Long Range Flood Outlook



National Water Prediction Service  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Home

Water Operations

More Water Information

Extreme Precipitation Estimates

About



Search



Precipitation Frequency  
Estimates

Probable Maximum  
Precipitation (PMP)  
Estimates

Map

Topographic

Layers

# New! National Water Model (NWM) + Flood Inundation Mapping (FIM)

3 FIM Options

## NWM Latest Analysis

- Observation-based
- Updated hourly
- To be used as a snapshot of the most recent modeled flooding
- Generated where NWM analysis indicates flows exceed the high flow threshold

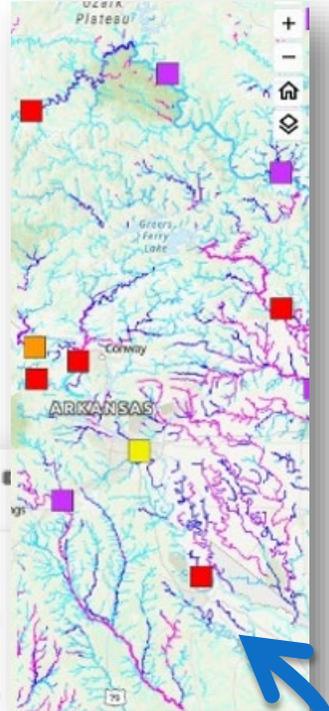
## RFC 5-Day Max Forecast

- Based on up-to-5-day RFC forecasts
- National Water Prediction Service (NWPS) forecast points
- To be used where and when an RFC forecast is available
- Generated when RFC forecast reaches "action stage"

## NWM 5-Day Max Forecast

- Based on 5-day weather forecast
- Updated every 6 hours
- To be used for rivers and streams not covered by an RFC forecast
- Generated only where NWM forecast indicates flows exceed the high flow threshold

**Use With Caution!**



NWM Streamflow

NWM FIM

# New! WFO Decision Support for Flood Inundation Mapping (FIM)

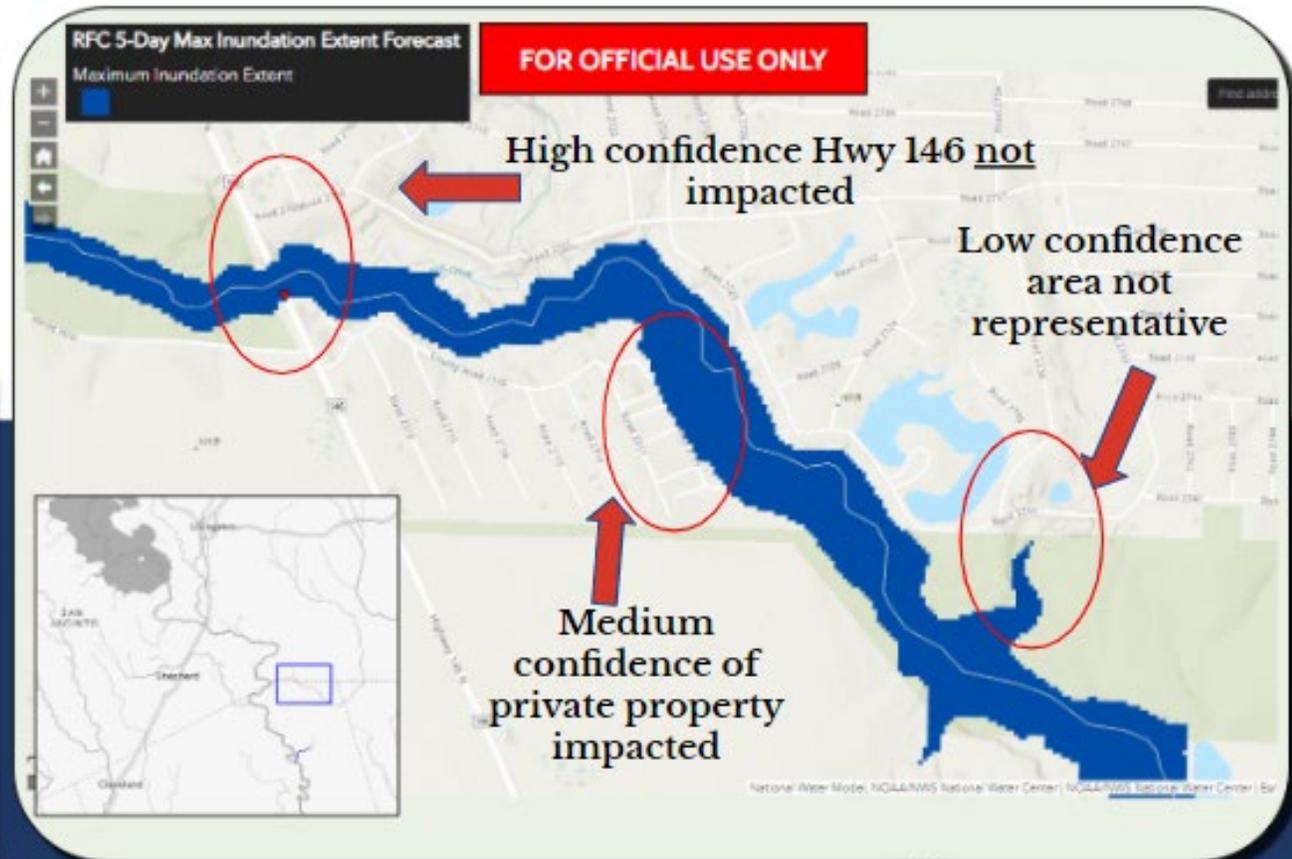


## NWS Flood Inundation Mapping Services

*Disclaimer: This map shows the flood extent based on a river crest of 24.8 feet. This is an approximate-based FIM which should be used more conservatively.*

### Mernard Creek Rye, TX (RYET2)

Forecast Crest Height: 24.8 Feet  
Map Height Shown: 24.8 Feet  
FIM Source: NWC RFC R&R  
FIM Type: Dynamic (Depth NOT Included)  
FIM Creation Time: 1/9/22 @ 6:30am



Link: N/A, additional screen captures are available upon request



1/9/22 @ 9:30am

## Questions, Comments, Feedback

---

*Nicole McGavock*

*Service Hydrologist / Meteorologist*

*National Weather Service Tulsa, OK*

*nicole.mcgavock@noaa.gov*

<https://water.noaa.gov>

Panhandle: [www.weather.gov/ama](http://www.weather.gov/ama)

Western/Central: [www.weather.gov/oun](http://www.weather.gov/oun)

Eastern: [www.weather.gov/tsa](http://www.weather.gov/tsa)

McCurtain Co: [www.weather.gov/shv](http://www.weather.gov/shv)





COMMUNITY COLLABORATIVE RAIN, HAIL & SNOW NETWORK  
"Because every drop counts"

[Home](#) | [Countries](#) | [States](#) | [View Data](#) | [Maps](#) | [My Data Entry](#) | [Login](#)



Welcome to CoCoRaHS! "Volunteers working together to measure precipitation across the United States"

### Main Menu

- [Home](#)
- [About Us](#)
- [Join CoCoRaHS](#)
- [Contact Us](#)
- [Donate](#)

### Resources

- [FAQ / Help](#)
- [Education](#)
- [Training Slide-Shows](#)
- [Videos](#)
- [Condition Monitoring](#)
- [Evapotranspiration](#)
- [Soil Moisture](#)
- [NCEI Normals](#)
  
- [Volunteer Coordinators](#)
- [Hail Pad](#)
- [Distribution/Drop-off](#)
- [Help Needed](#)
- [Printable Forms](#)
  
- [The Catch](#)
- [Message of the Day](#)
- [Publications](#)
- [CoCoRaHS Blog](#)
- [Web Groups](#)
- [State Newsletters](#)
- [Master Gardener Guide](#)
- [State Climate Series](#)
- [March Madness](#)
- [WxTalk Webinars](#)

- [Sponsors](#)
- [Links](#)
- [CoCoRaHS Store](#)



**CoCoRaHS Testimonials**  
**Tell us your story!**  
*Celebrating 25 years*

CoCoRaHS Testimonials  
**Tell us your story!**  
*Celebrating 25 years*

**JOIN**  
**CoCoRaHS**

**TRAINING SLIDE-SHOW**

**Training Animations**

**Things to know about...**

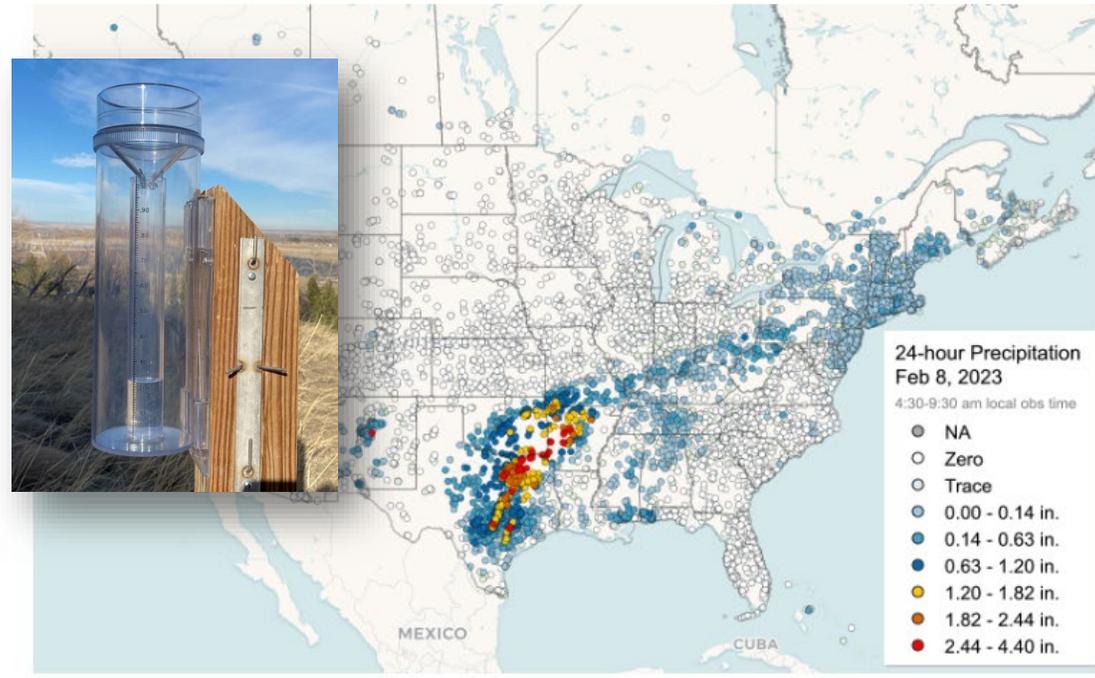
- Rain**
- Hail**
- Snow**

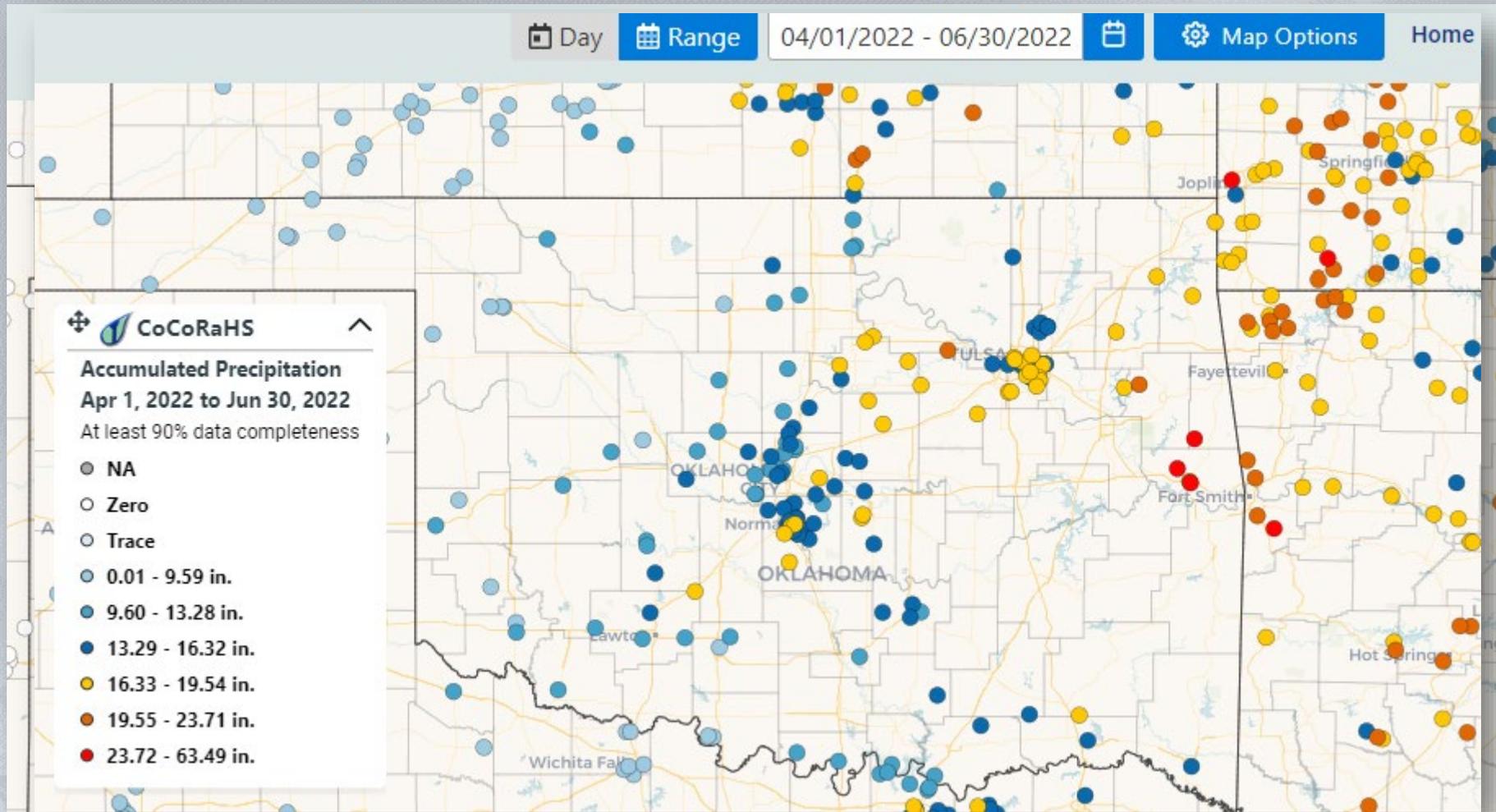
Download on the  
**App Store**

ANDROID APP ON  
**Google Play**

Reports received today 2/08/2023 as of 1:01 PM EST

Daily	Multi-day	SigWx	Hail	Condition	ET
9,868	100	3	0	6	4







NOAA's National Weather Service  
**Hydrometeorological Design Studies Center**  
 Precipitation Frequency Data Server (PFDS)

Home Site Map Organization

**NOAA ATLAS 14 POINT PRECIPITATION**

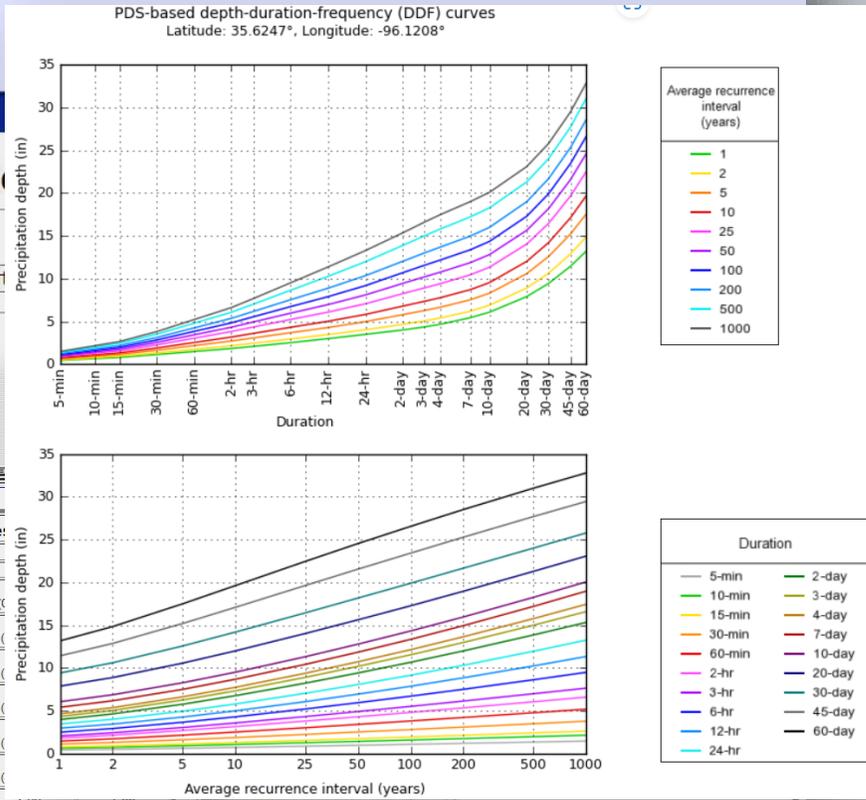
Data description  
 Data type:  Units:  Time series type:

Select location

**POINT PRECIPITATION FREQUENCY (PF) ESTIMATES**  
 WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION  
 NOAA Atlas 14, Volume 8, Version 2

PF tabular PF graphical Supplementary information

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.440 (0.354-0.543)	0.512 (0.412-0.632)	0.632 (0.507-0.781)	0.733 (0.585-0.908)	0.873 (0.677-1.10)	0.983 (0.747-1.25)	1.09 (0.807-1.41)	1.21 (0.859-1.57)	1.33 (0.91-1.79)	1.45 (0.99-2.06)
10-min	0.644 (0.518-0.794)	0.750 (0.603-0.926)	0.926 (0.742-1.14)	1.07 (0.856-1.33)	1.28 (0.991-1.61)	1.44 (1.09-1.83)	1.60 (1.18-2.06)	1.77 (1.26-2.30)	1.95 (1.42-2.51)	2.16 (1.53-2.81)
15-min	0.785 (0.632-0.969)	0.915 (0.736-1.13)	1.13 (0.905-1.40)	1.31 (1.04-1.62)	1.56 (1.21-1.97)	1.76 (1.33-2.23)	1.95 (1.44-2.51)	2.16 (1.53-2.81)	2.38 (1.74-3.13)	2.63 (1.92-3.42)
30-min	1.12 (0.901-1.38)	1.31 (1.05-1.62)	1.62 (1.30-2.01)	1.89 (1.51-2.34)	2.25 (1.74-2.84)	2.53 (1.92-3.21)	2.82 (2.08-3.62)	3.11 (2.21-4.05)	3.42 (2.44-4.51)	3.75 (2.67-4.84)
60-min	1.48 (1.19-1.82)	1.74 (1.40-2.14)	2.17 (1.74-2.68)	2.53 (2.02-3.13)	3.03 (2.35-3.82)	3.42 (2.60-4.34)	3.82 (2.82-4.91)	4.23 (3.01-5.51)	4.66 (3.32-6.02)	5.11 (3.65-6.57)
2-hr	1.83 (1.49-2.24)	2.16 (1.76-2.64)	2.71 (2.19-3.31)	3.17 (2.55-3.88)	3.81 (2.99-4.76)	4.31 (3.32-5.42)	4.83 (3.60-6.15)	5.35 (3.85-6.92)	5.91 (4.28-7.54)	6.51 (4.66-8.36)
3-hr	2.07 (1.70-2.51)	2.44 (2.00-2.96)	3.06 (2.50-3.72)	3.59 (2.92-4.37)	4.34 (3.43-5.39)	4.92 (3.81-6.16)	5.53 (4.15-7.01)	6.15 (4.46-7.92)	6.81 (4.91-9.15)	7.51 (5.24-10.1)
6-hr	2.51 (2.08-3.01)	2.94 (2.43-3.53)	3.67 (3.03-4.41)	4.31 (3.54-5.19)	5.22 (4.18-6.44)	5.96 (4.67-7.40)	6.72 (5.12-8.46)	7.52 (5.53-9.62)	8.33 (6.13-11.2)	9.50 (6.58-12.4)
12-hr	2.98 (2.50-3.54)	3.46 (2.89-4.10)	4.28 (3.57-5.08)	5.01 (4.16-5.96)	6.08 (4.94-7.45)	6.95 (5.53-8.57)	7.88 (6.06-9.85)	8.87 (6.60-11.3)	10.2 (7.37-13.2)	11.3 (7.96-14.7)
24-hr	3.48 (2.95-4.07)	4.02 (3.40-4.71)	4.96 (4.19-5.83)	5.81 (4.88-6.84)	7.05 (5.80-8.56)	8.08 (6.50-9.86)	9.16 (7.16-11.4)	10.3 (7.78-13.0)	12.0 (8.71-15.3)	13.3 (9.41-17.0)
2-day	3.99 (3.42-4.63)	4.65 (3.98-5.39)	5.78 (4.94-6.71)	6.78 (5.76-7.89)	8.23 (6.86-9.88)	9.43 (7.67-11.4)	10.7 (8.43-13.1)	12.0 (9.15-15.0)	13.9 (10.2-17.6)	15.3 (11.0-19.6)
3-day	4.35 (3.76-5.01)	5.05 (4.36-5.82)	6.27 (5.40-7.23)	7.34 (6.29-8.49)	8.91 (7.47-10.6)	10.2 (8.36-12.2)	11.6 (9.19-14.1)	13.0 (9.97-16.1)	14.9 (11.1-18.9)	16.6 (12.0-21.1)
4-day	4.66 (4.04-5.33)	5.38 (4.67-6.17)	6.64 (5.74-7.62)	7.75 (6.67-8.93)	9.39 (7.91-11.1)	10.7 (8.84-12.8)	12.2 (9.72-14.8)	13.7 (10.5-16.9)	15.8 (11.8-19.8)	17.4 (12.7-22.1)
7-day	5.42 (4.75-6.15)	6.18 (5.42-7.02)	7.51 (6.56-8.55)	8.69 (7.56-9.92)	10.4 (8.87-12.3)	11.9 (9.86-14.0)	13.4 (10.6-16.1)	15.0 (11.7-18.3)	17.2 (13.0-21.5)	19.0 (13.9-23.9)
10-day	6.07 (5.36-6.85)	6.88 (6.07-7.77)	8.28 (7.28-9.37)	9.52 (8.32-10.8)	11.3 (9.68-13.2)	12.8 (10.7-15.1)	14.3 (11.6-17.2)	16.0 (12.9-19.5)	18.3 (13.8-22.7)	20.1 (14.8-25.1)



**Location information:**  
 Name: Okmulgee, Oklahoma, USA\*  
 Latitude: 35.6247°  
 Longitude: -96.1208°  
 Elevation: \*\*