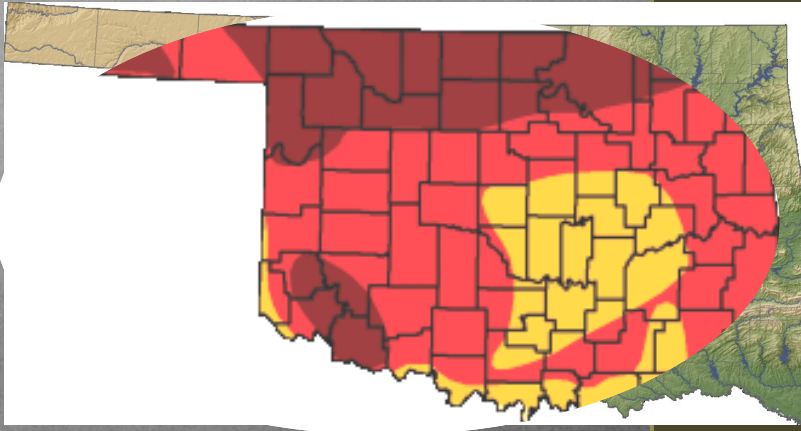
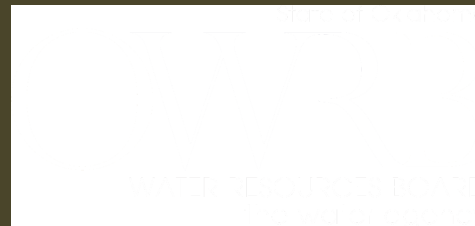




Drought-Proofing Oklahoma: *Forecasting Needs*

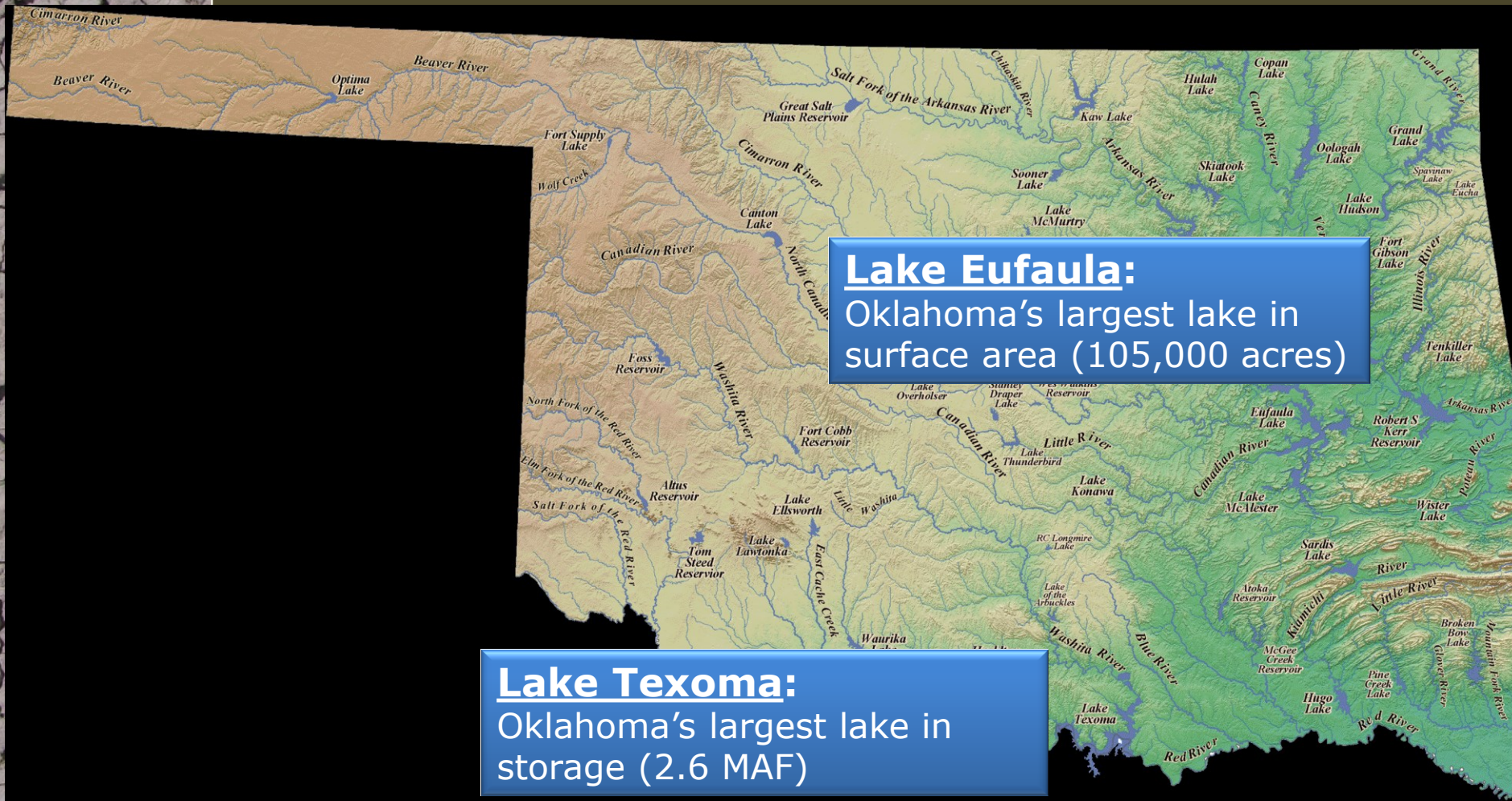
WSWC-CDWR Workshop
San Diego, CA
May 27-29, 2015



J. D. Strong
Executive Director

Oklahoma's Water Resources

- 34 major reservoirs store 13 MAF of water
- 4,300 public/private & watershed protection lakes

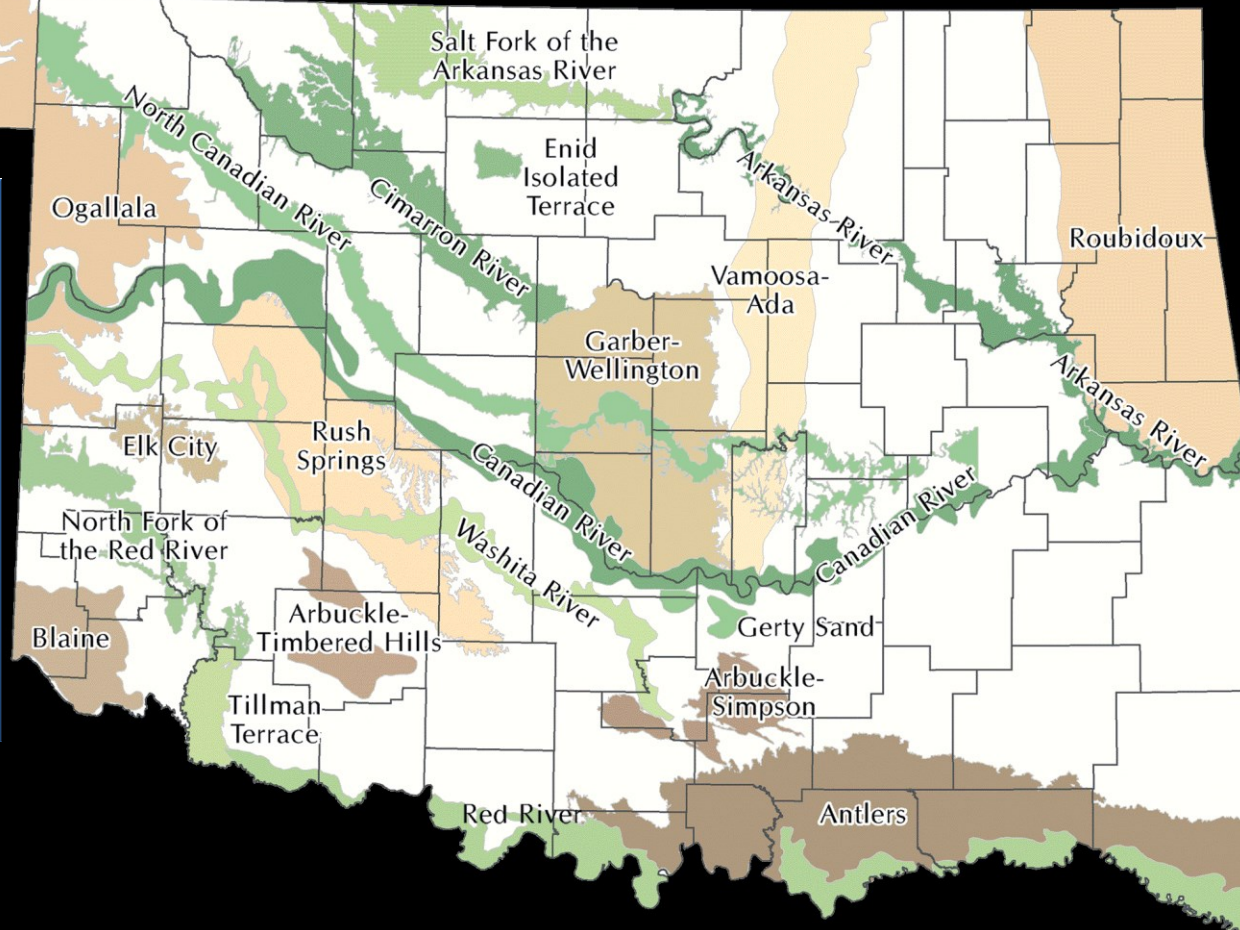


Oklahoma's Water Resources

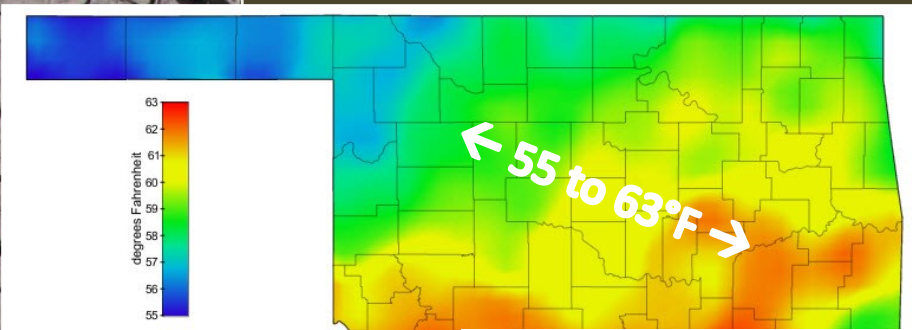
- 23 major groundwater aquifers store 320 MAF of water

Ogallala Aquifer:

- state's largest GW basin
- # high capacity wells
= 3,200
- irrigated land
= 206,000 acres
- 86.6 million acre-feet in storage (enough to cover the entire state 2 ft deep)



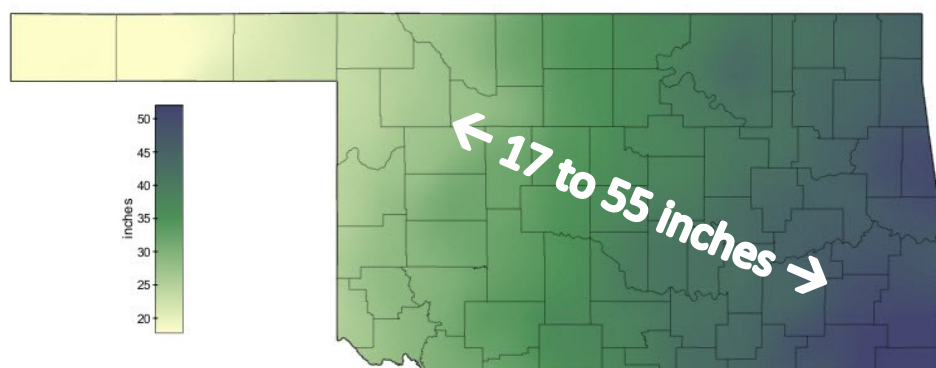
Oklahoma Climate



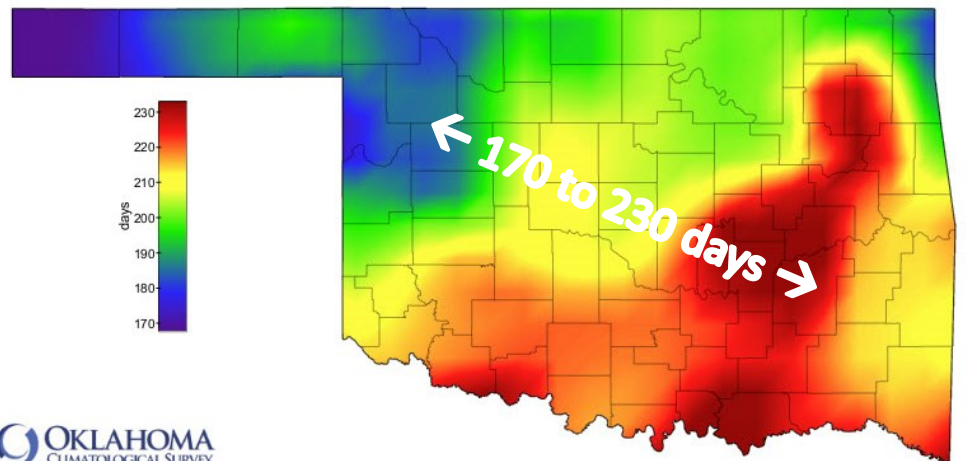
OKLAHOMA
CLIMATOLOGICAL SURVEY
Normal Annual Temperature

Calculated using no

Extremes: -27 to 120°F



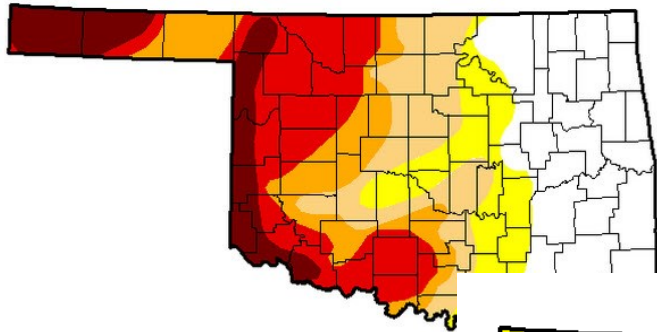
OKLAHOMA
CLIMATOLOGICAL SURVEY
Normal Annual Precipitation



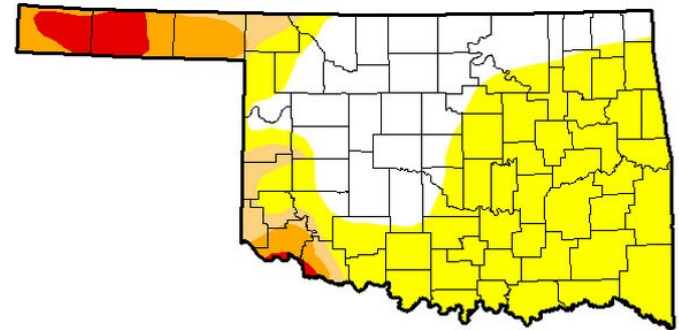
OKLAHOMA
CLIMATOLOGICAL SURVEY
Average Length of Growing Season

1981-2010
Calculated using data archived at OCS. Created 3:48:35 PM September 27, 2012 CDT. © Copyright 2012

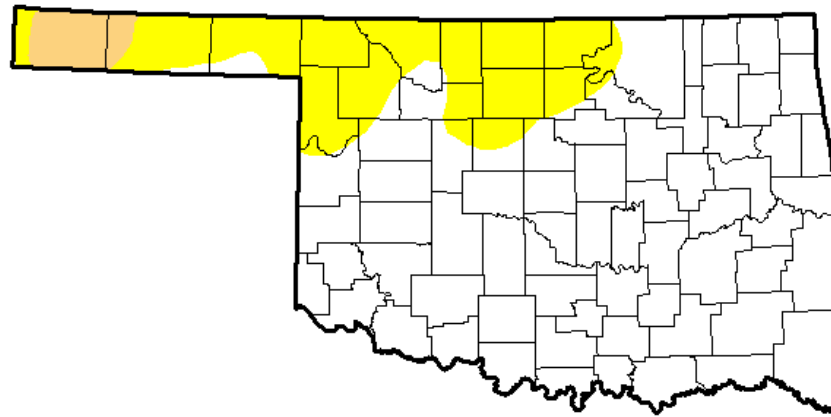
A Tale of 5 Mays



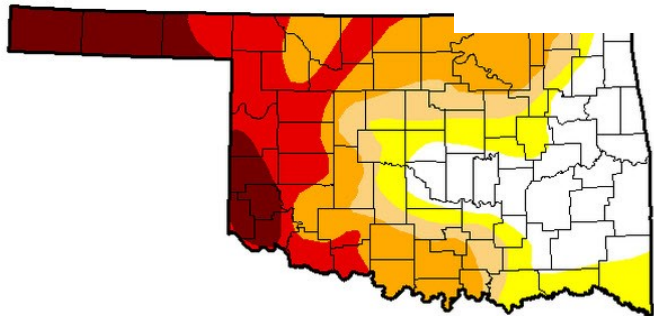
May 2011



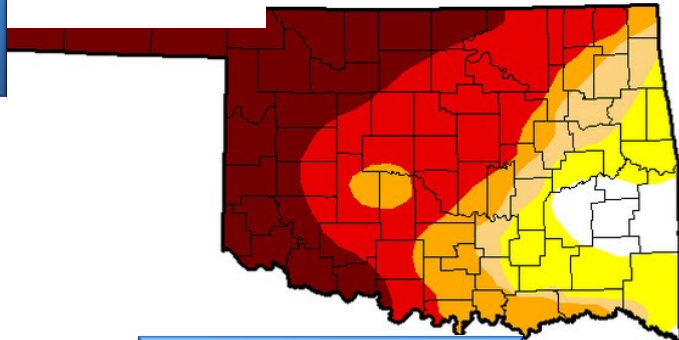
May 2012



May 2015



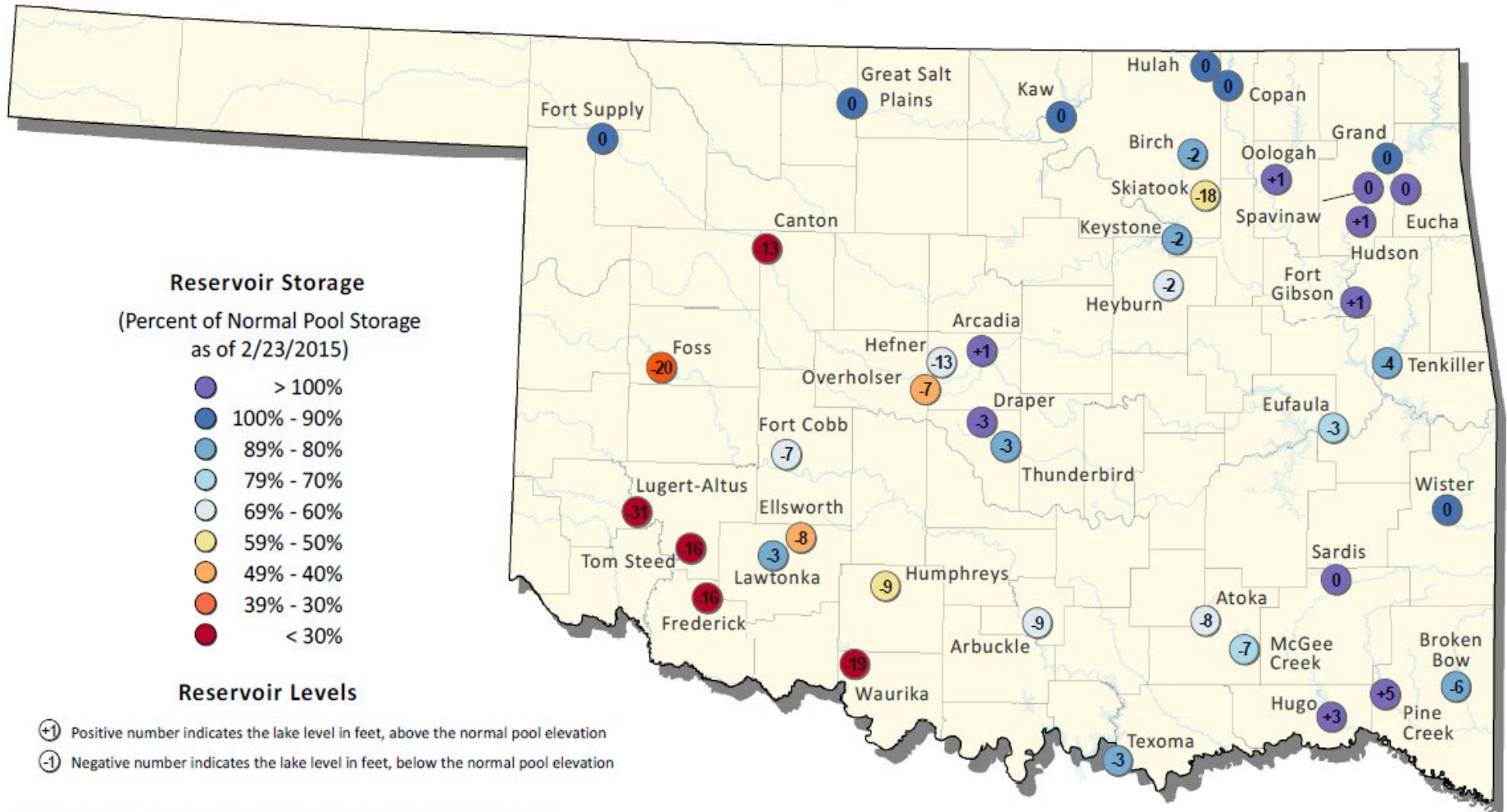
May 2013



May 2014

Oklahoma Surface Water Resources

Reservoir Levels and Storage as of 2/23/2015



This map shows reservoir storage as a percentage of normal pool storage capacity. The source information was collected from real-time lake gages monitored by the U.S. Army Corps of Engineers (http://www.swt-wc.usace.army.mil/old_resvrep.htm), and the U.S. Geological Survey (http://waterdata.usgs.gov/ok/nwis/current/?type=lake&group_key=basin_cd) For more information please visit the OWRB's website at: (<http://www.owrb.ok.gov>)

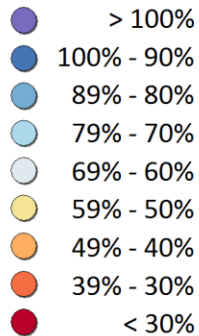


Oklahoma Surface Water Resources

Reservoir Levels and Storage as of 5/26/2015

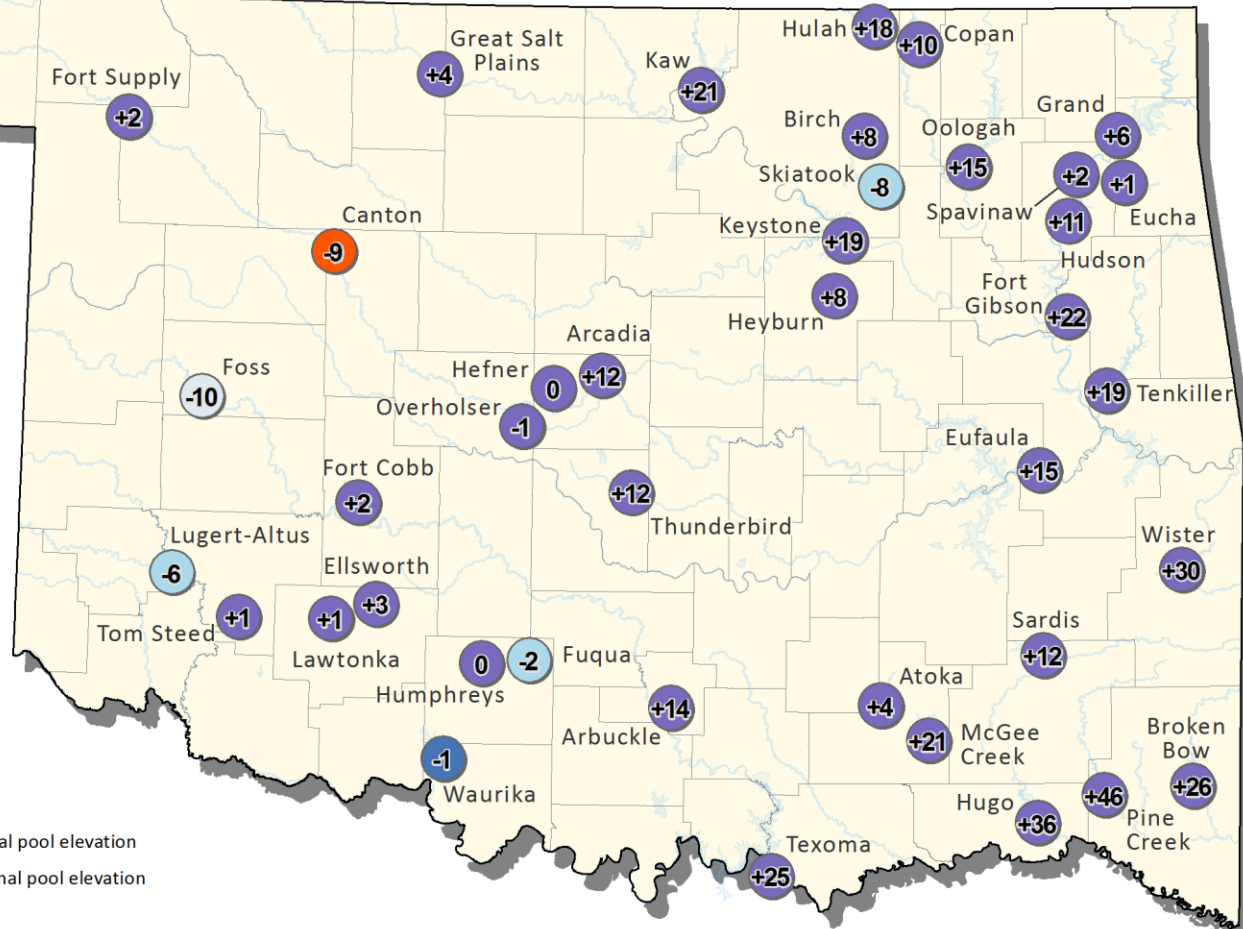
Reservoir Storage

(Percent of Normal Pool Storage
as of 5/26/2015)

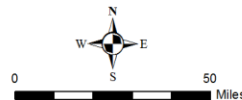


Reservoir Levels

- ⊕ Positive number indicates the lake level in feet, above the normal pool elevation
- ⊖ Negative number indicates the lake level in feet, below the normal pool elevation



This map shows reservoir storage as a percentage of normal pool storage capacity. The source information was collected from real-time lake gages monitored by the U.S. Army Corps of Engineers (http://www.swt-wc.usace.army.mil/old_resvrepr.htm), and the U.S. Geological Survey (http://waterdata.usgs.gov/ok/nwis/current/?type=lake&group_key=basin_cd). For more information please visit the OWRB's website at: (<http://www.owrb.ok.gov>)



Proposal would target political calls

BY BARBARA HOBEROCK

Tulsa World
barbara.hoberock@tulsa-world.com

A Chickasha lawmaker has filed a bill targeting automated political calls.

House Bill 1038 would remove the exemption for automated political calls on the state's No Call List.

While the language appears to remove the exemption for all political calls, Rep. David Perryman, D-Chickasha, said his intent is to remove automated political calls.

"What we are seeing is an inundation of political calls that use the same type of dialing system where they are automated," Perryman said. "It has evolved into basically a drive-by message."

He said it is cheap for candidates to use automated messaging, which can be done at the last minute.

"Because it is so inexpensive, it is a real nuisance," Perryman said.

The bill would classify automated political calls in the same category as prohibited commercial calls on the No Call List, Perryman said.

Fount Holland, a well-known political consultant and founding partner of AH Strategies, said his firm does not do a tremendous



A fish habitat made of tires lies June 30 in a dried-up area of Lake Altus-Lugert at the Quartz Mountain Conference Center near Altus. A report by the National Oceanic and Atmospheric Administration predicts improvement in some areas of the state, but drought conditions are expected to persist or intensify across nearly all of the western half of the state.

PHOTO BY DAVID MCDANIEL, THE OKLAHOMAN ARCHIVE

Oklahoma's drought outlook forecasts little hope for relief

BY SILAS ALLEN

Staff Writer
sallen@opubco.com

precipitation across the Oklahoma Panhandle, but no indication of increased moisture elsewhere in the state.

Oklahoma state climatologist Gary McManus said average rainfall wouldn't be enough to reverse the dry conditions that have continued unabated in western Oklahoma for more than four years — particularly in areas that have had 30 to 50 inches less rainfall over the past few years than they might normally expect.

Winter tends to be the driest time of year in Oklahoma, McManus said. Although, cold

the past three months, according to a U.S. Drought Monitor report released Thursday. About 59 percent of the state was listed in some form of drought in Thursday's report, down from about 64.5 percent on Oct. 14.

But the situation remains dire in much of western Oklahoma. Thursday's report shows portions of eight counties in north-west and southwest Oklahoma listed in exceptional drought, the report's most severe category.

Even sparse rains aid crops

manager at Co-Op Services in Grandfield, which was listed in extreme drought in Thursday's report.

Although the drought is a serious issue everywhere in southwest Oklahoma, how things look depends on where you're standing, Fourkiller said. East of Grandfield, farmers have gotten rain, he said. But to the west, things look quite a bit drier.

"We're kind of right on the line," he said.

Grandfield has gotten about .7 inches of rain over the past two weeks, according to the Okla-

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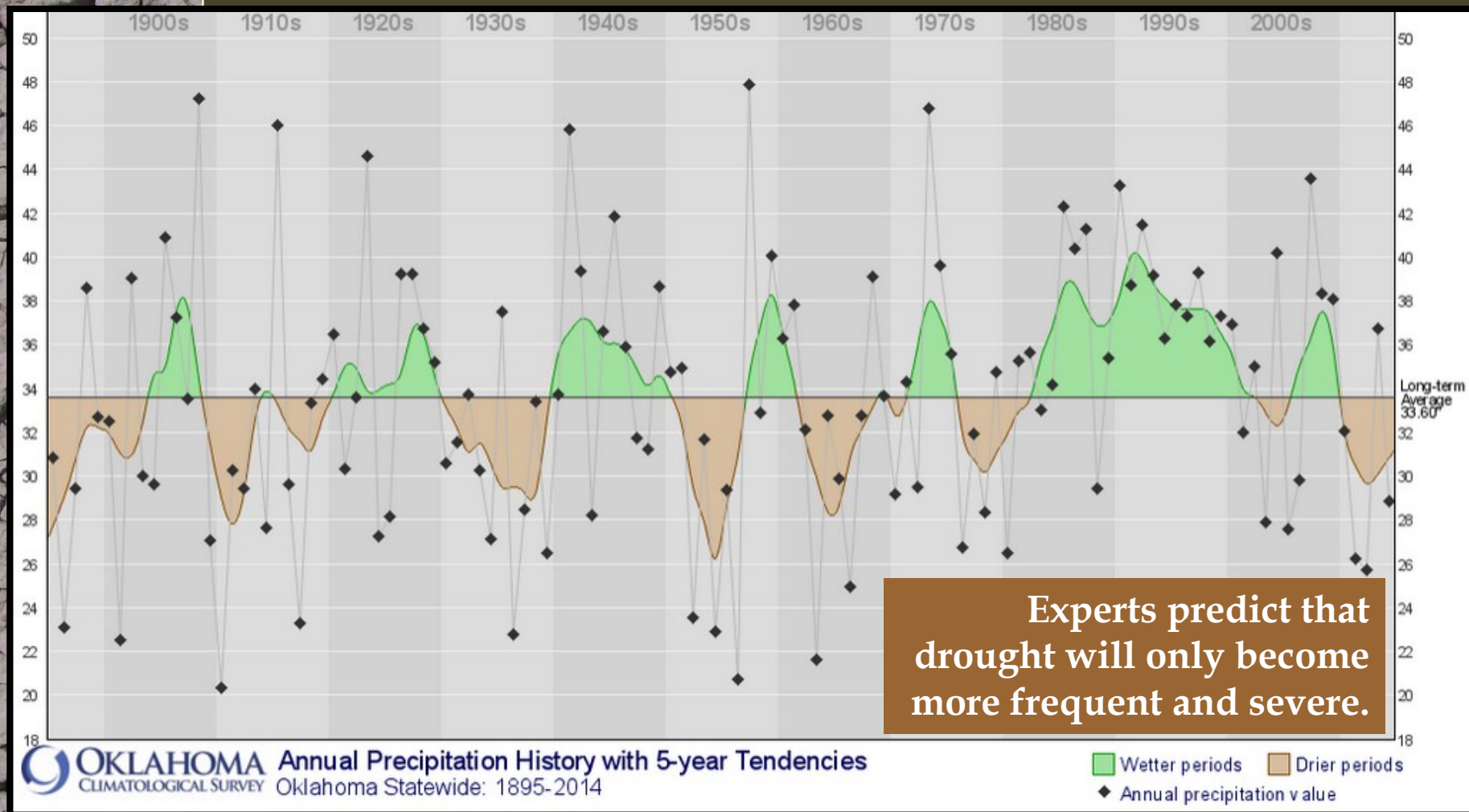
OWAN.COM

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After almost five years... Is Oklahoma's drought over?





State of Oklahoma

OWRB
WATER RESOURCES BOARD
the water agency

Oklahoma Water Resources Board

Mission

The mission of the Oklahoma Water Resources Board is to protect and enhance the quality of life for Oklahomans by managing and improving the state's water resources to ensure clean and reliable water supplies, a strong economy, and a safe and healthy environment.

Goals

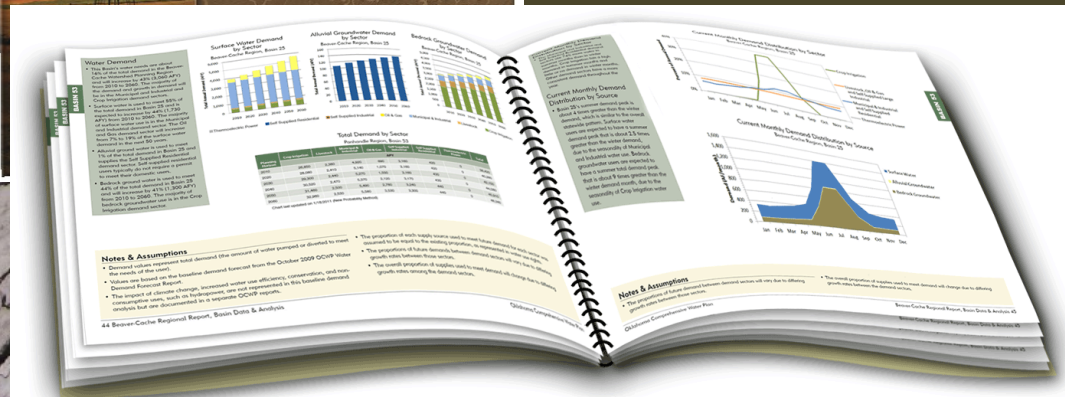
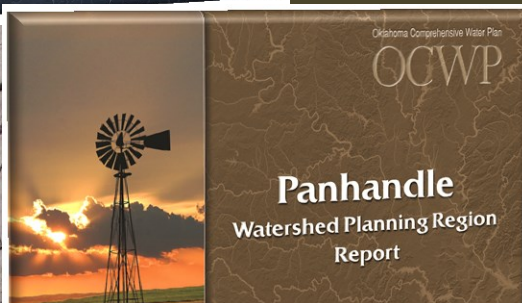
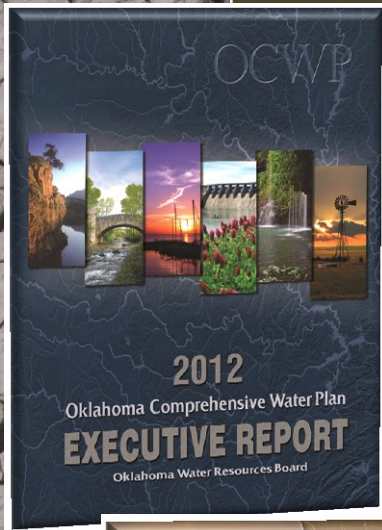
- Developing, implementing, and promoting sound water policies, programs, and plans to protect lives, property, and Oklahoma's water resources.
- Building partnerships and increasing public awareness to encourage responsible stewardship of Oklahoma's water resources.
- Improving service to the public by maximizing agency efficiency and innovation, and through promotion of a healthy, safe, productive, and inclusive working environment.

Vision

- Resolving Oklahoma's increasingly complex water issues through

2012 Update of the Oklahoma Comprehensive Water Plan

- Submitted to Governor and Legislature in 2012
- Most technically sound, extensively vetted Plan
- Executive Report & 13 Watershed Planning Region Reports



Overriding goal to provide safe, reliable water supplies to meet needs of all Oklahomans.



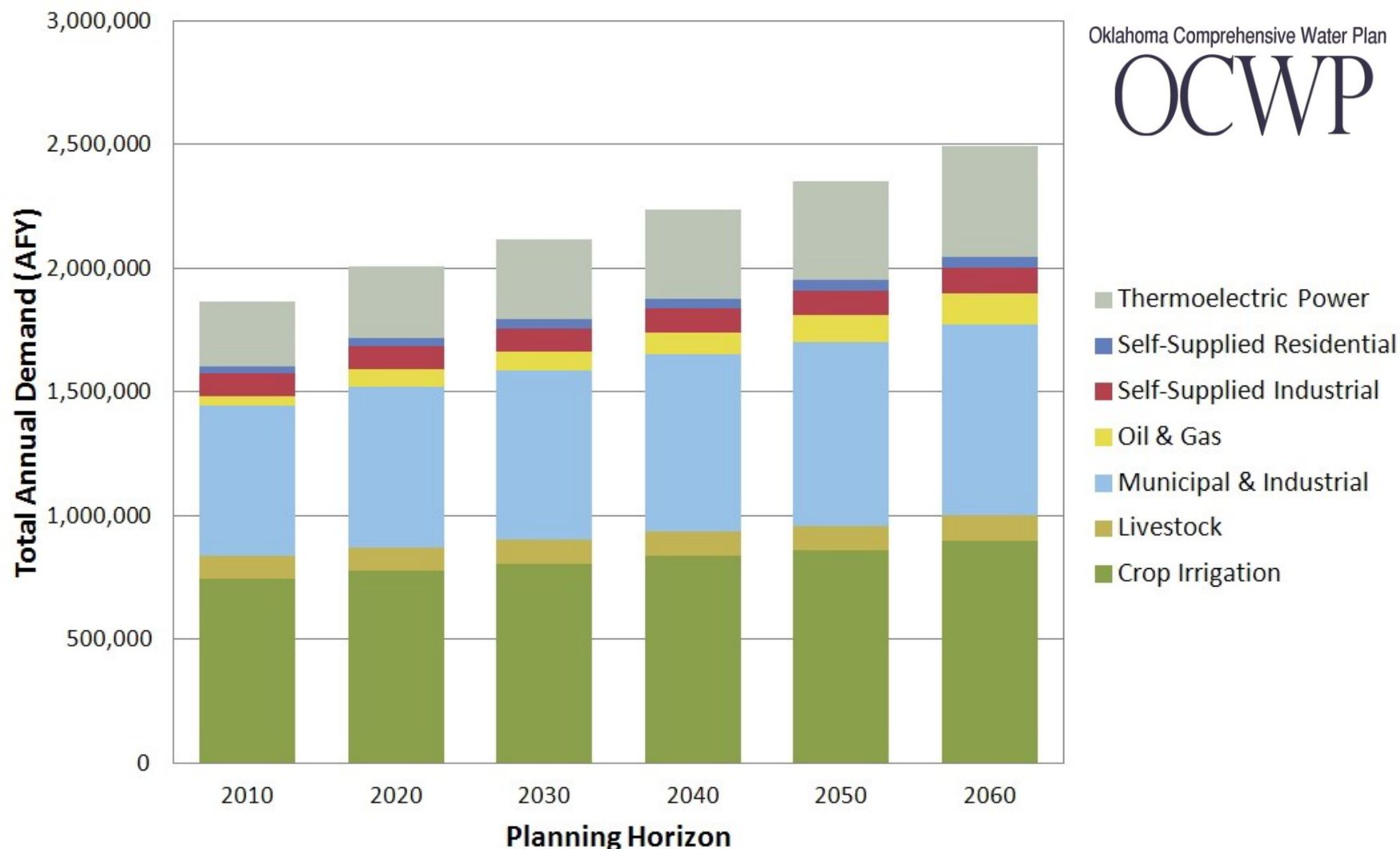
2012 Update of the OCWP

Drought-Proofing Oklahoma

- 1. Assess Vulnerability (Supply vs. Demand)**
- 2. Anticipate Climate Impacts**
- 3. Quantify Infrastructure Requirements**
- 4. Conservation & Augmentation of Supplies**
- 5. Enhance Data and Studies**
- 6. Encourage Regional/Local Planning**

2012 Update of the OCWP

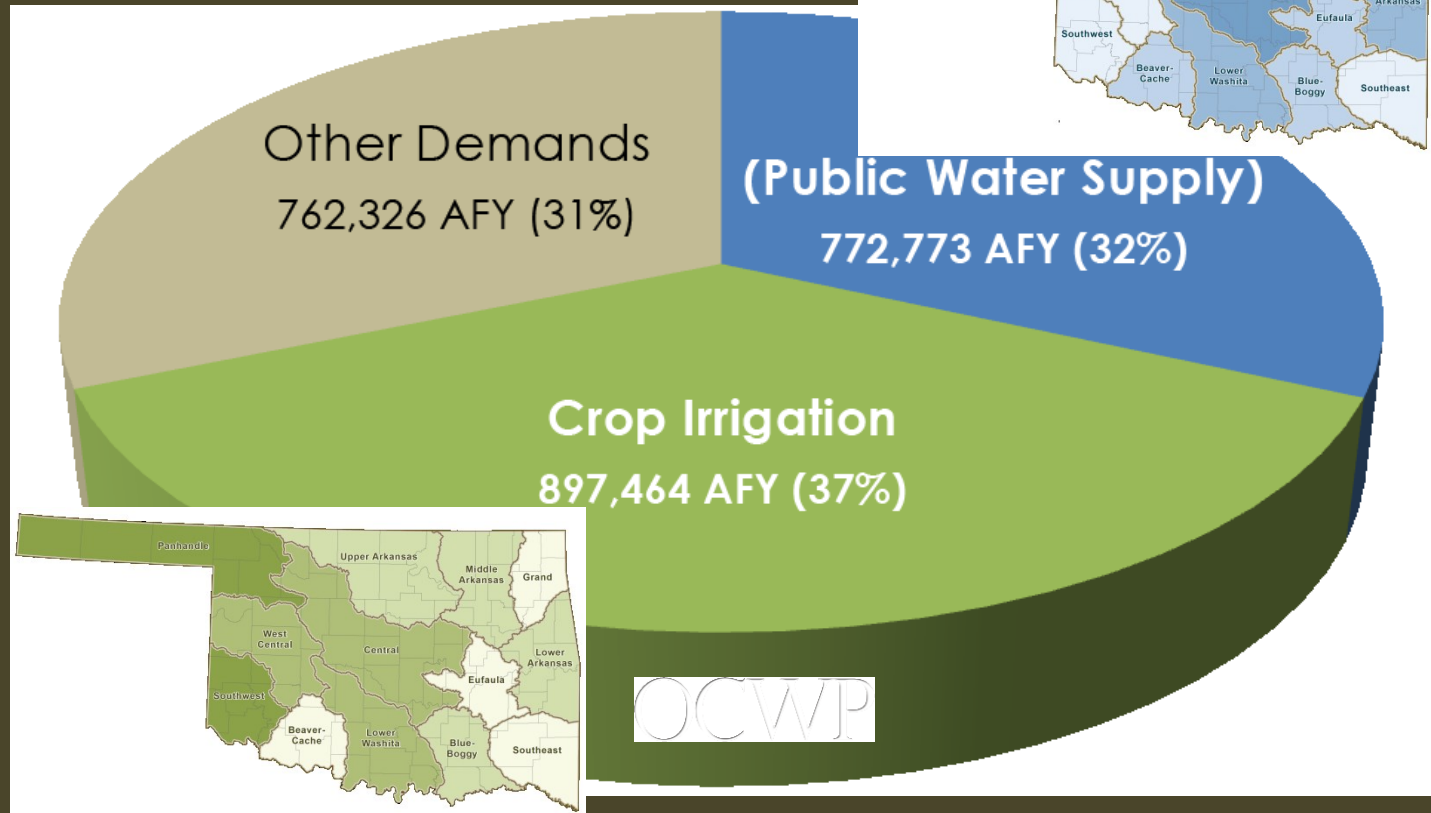
Assessing Demands



Water Demand Projections: The Core of the OCWP

2012 Update of the OCWP

Assessing Demands



Other Demands:

Thermoelectric Power - 450,227 AF (18%)

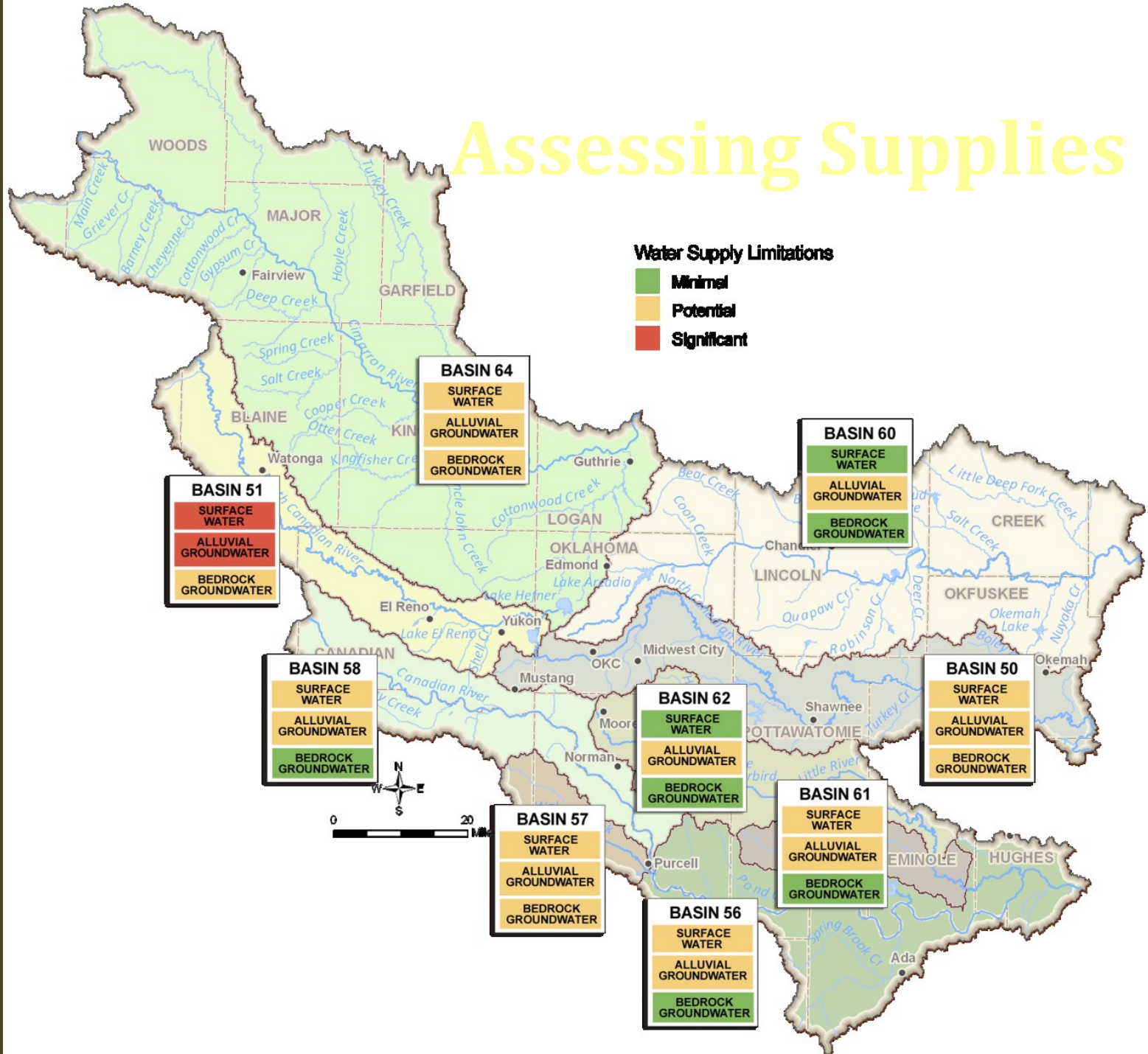
Self-Supplied Industrial - 54,334 AF (2%)

Oil & Gas - 115,570 AF (5%)

Self-Supplied Residential - 41,155 AF (2%)

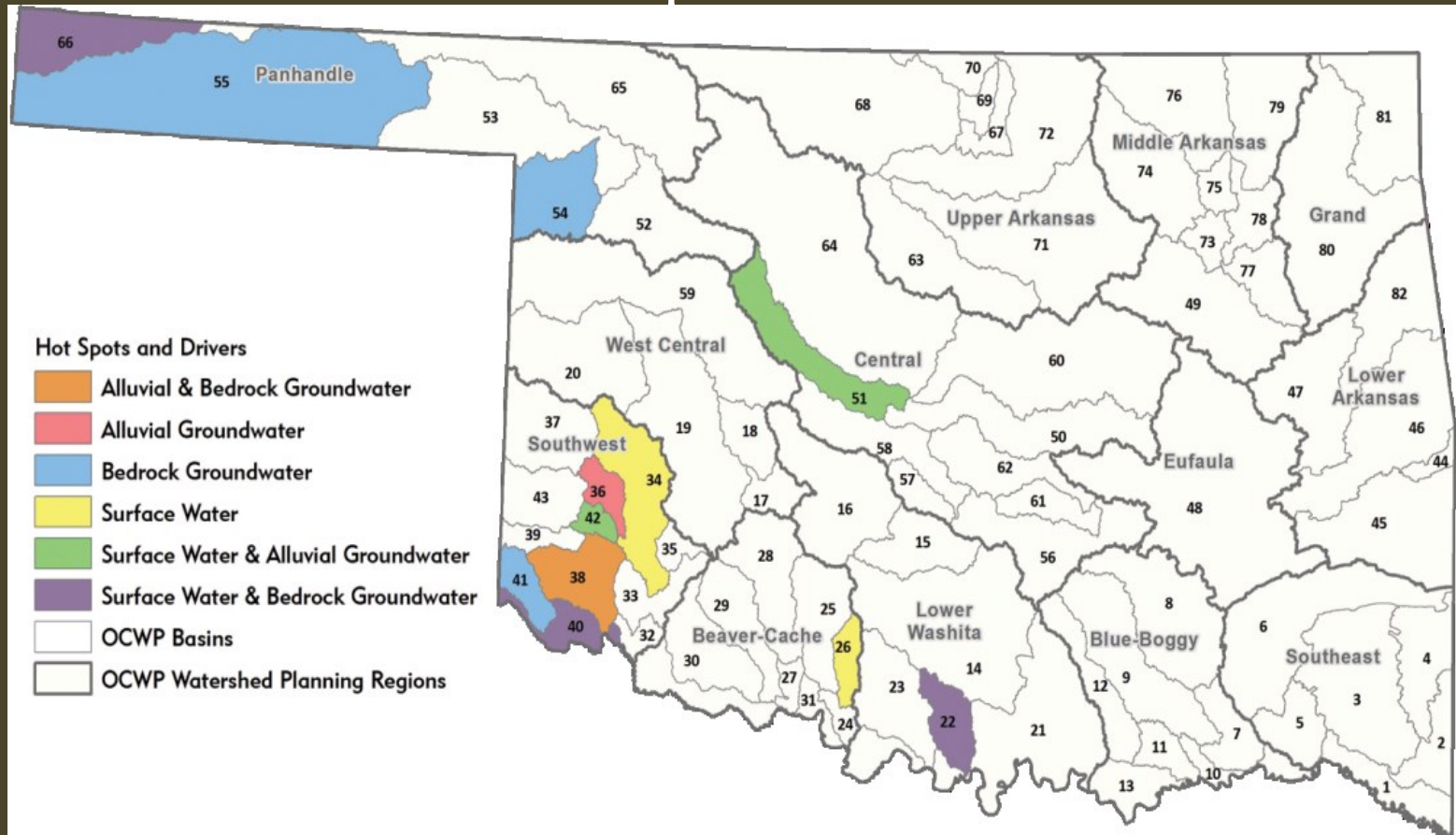
Livestock - 101,040 AF (4%)

Assessing Supplies



2012 Update of the OCWP Assessing Vulnerabilities

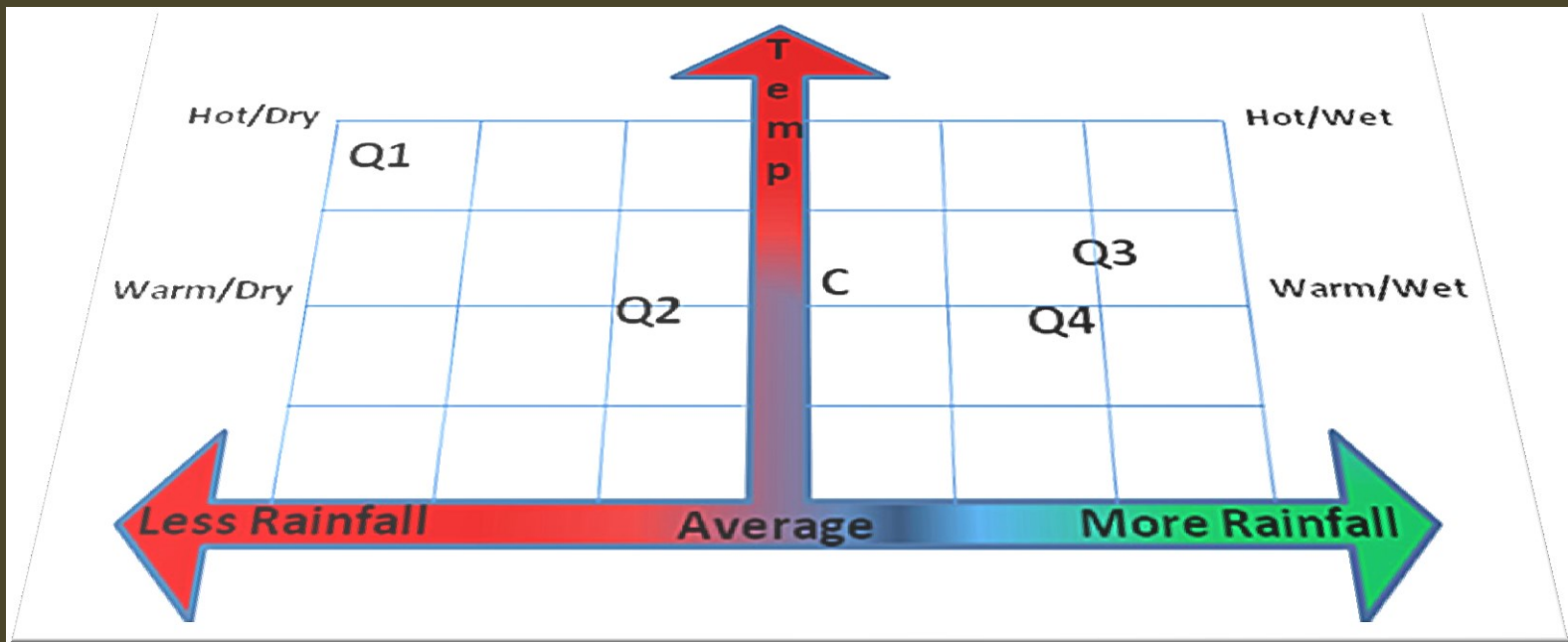
Hot Spot Basins



2012 Update of the OCWP

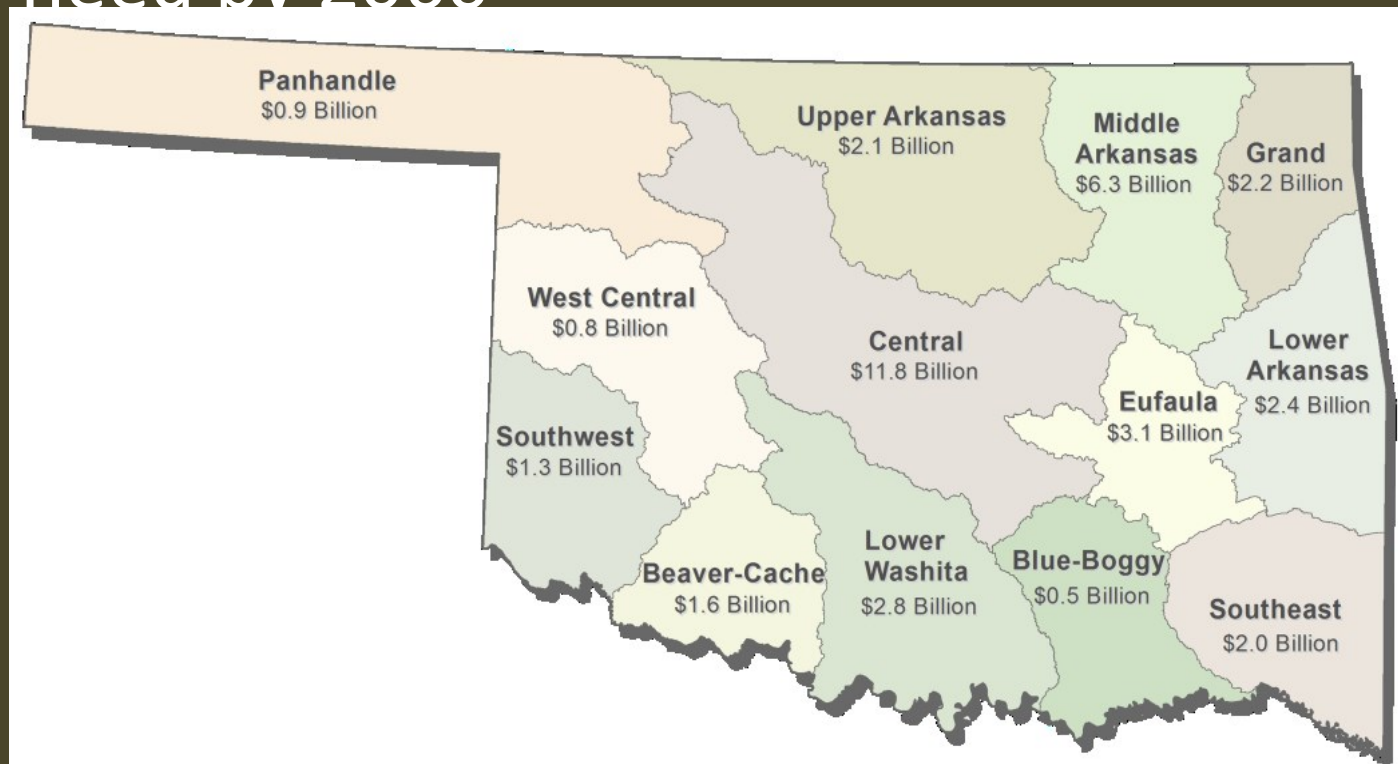
Anticipating Climate Impacts

Assessed potential future climate
variability impacts on water supply
and demand



2012 Update of the OCWP Infrastructure Financing

\$82 billion projected water infrastructure need by 2060



2060 Drinking Water System Need



2012 Update of the OCWP **Conservation & Recycling**

“Water For 2060” Act sets statewide goal of consuming no more fresh water in 2060 than we consume today

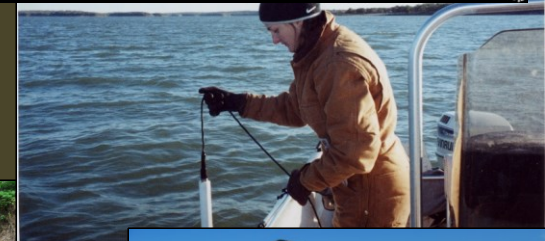
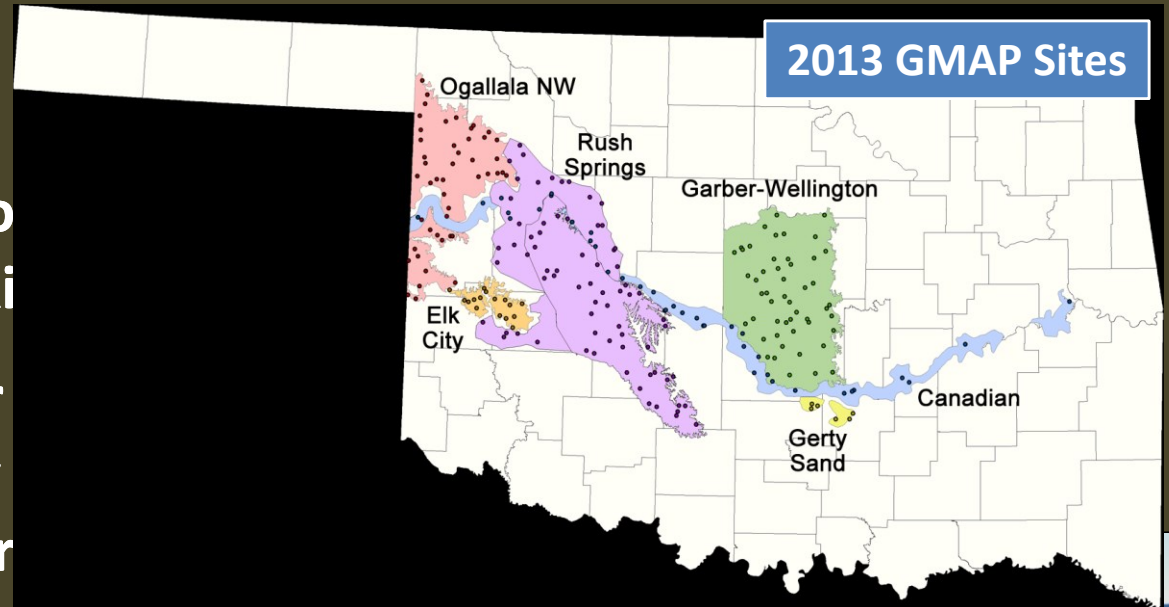
- Advisory Council studying innovative solutions to forecasted water shortages



2012 Update of the OCWP

Enhanced Data & Studies

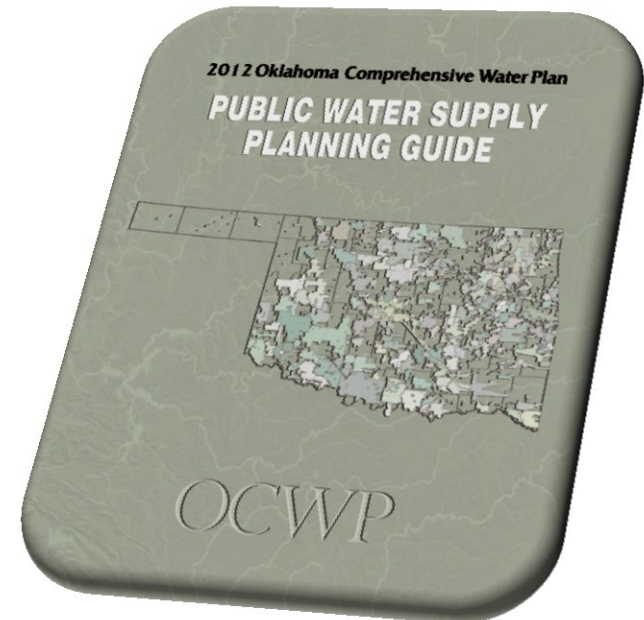
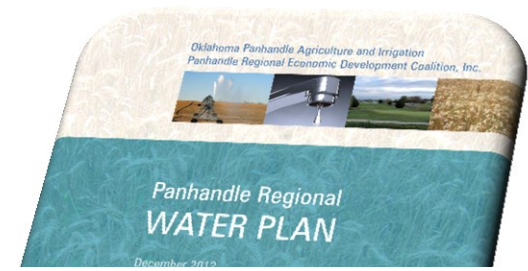
- Better data for decision-making
- \$1.5 M/yr for water quality monitoring program
- First comprehensive groundwater monitoring program ("GMAP")



2012 Update of the OCWP

Local/Regional Planning

- “Bottom-up” water planning
- Implementing solutions at the regional and local scale
- Consist of local stakeholders representing unique interests of each region



2012 Update of the OCWP

“Big 8” Priority Recommendations



Conservation, Reuse, Recycling



Infrastructure Financing



Monitoring



Supply Reliability



Fish & Recreation Flows



Regional Planning



Excess/Surplus



State/Tribal Resolution

 Tweet  Reco

ABOUT STATEIMPACT OKLAHOMA

StateImpact Oklahoma is a collaboration of KGOO, KOSU, KWGS and KCCU. Joe Wertz and Logan Layden travel the state to report on the intersection of government, industry, natural resources and the Oklahoma workforce. Read our reports and hear our stories on NPR member stations.

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Eastern Oklahoma Coal Mining Comeback Shifts as Demand From China Falls



Debate About Competition and Cost at Senate Panel on Wind Incentives



How a Wind Farm is Helping Save the Family Farm in Western Oklahoma



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Southwest Oklahoma Cities Wreathed With How To Ration Water Amid Plenty

Oil Executive Says He Didn't Try to Get Earthquake Scientists Fired

Oil Executive Told University Dean He Wanted Earthquake Scientists Fired

Rain's Help Quench Oklahoma's Drought, But Officials Warn Dry Days Could Return

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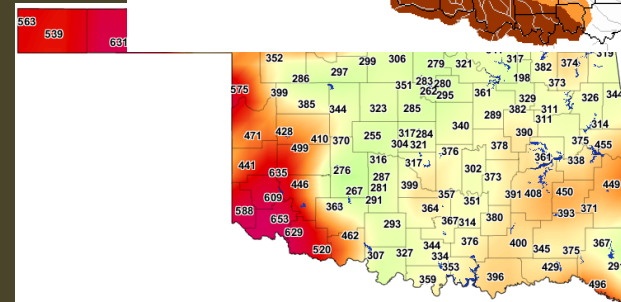
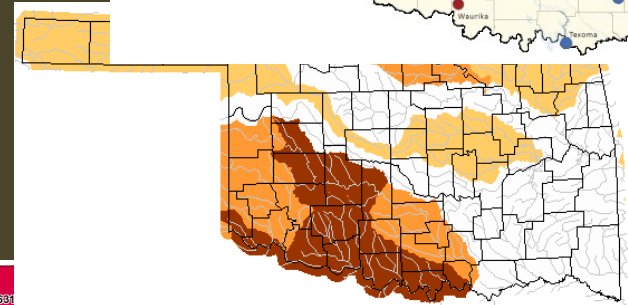
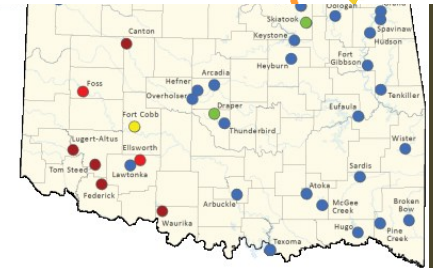
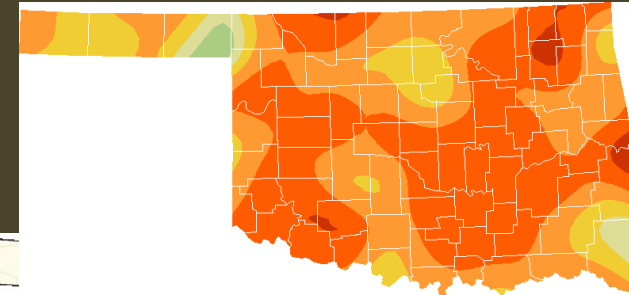
Forecasting for Drought

Weight of Evidence Approach

Forecasts only part of the equation; don't expect perfection

Numerous other types of data/information used

- Precipitation
- Streamflows
- Reservoir Levels
- Soil Moisture
- Fire Danger



Water Use Permitting

Financial Assistance

Well Drilling

Water Quality Standards

Monitoring & Assessment

Groundwater Studies

Surface Water Studies

Dam Safety

Floodplain Management

Drought Monitoring

Data & Maps

Oklahoma Drought
Management PlanOKLAHOMA
Drought Tool

Oklahoma Drought Tool

Drought Monitoring

A number of valuable resources to monitor drought conditions in Oklahoma are available from state and federal organizations and agencies.

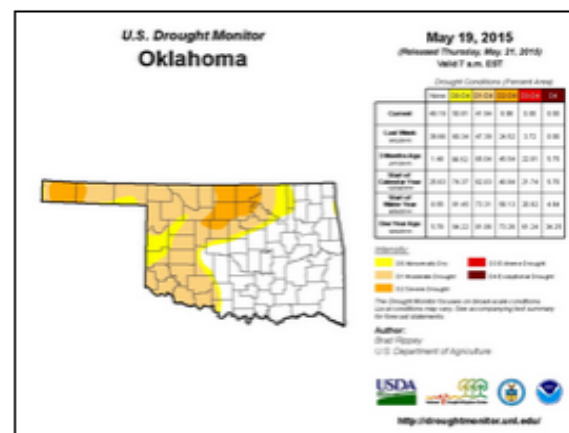
The OWRB has served as chair of the Water Availability and Outlook Committee of the state's Drought Management Team since 1996 and regularly publishes the *Oklahoma Water Resources Bulletin*, the state's official drought monitoring publication, which includes current information on reservoir storage, streamflow conditions, crop conditions, weather conditions, and related factors.

605,734

Oklahomans affected by
droughtOklahoma Water
Resources BulletinWATER FOR 2060
EFFICIENCY • CONSERVATION • RECYCLING • REUSE

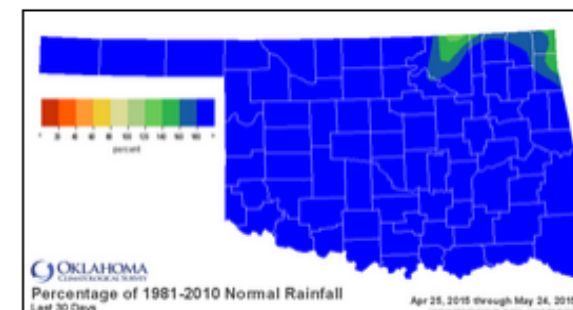
Drought Monitor

Drought Monitor for Oklahoma

U.S. Drought Monitor
(National Drought Mitigation Center)

Precipitation & Climate

Percentage of Normal Rainfall (Last 30 Days)

Current Drought & Wildfire Conditions (OK
Climatological Survey)

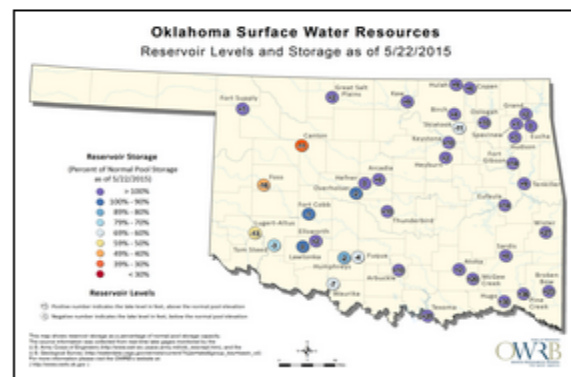
Oklahoma Mesonet [Mesonet Ticker]

Statewide Precipitation (1895-2013)

OK Water Supply Reliability and Management Challenge (Summary Report)

Reservoir Storage

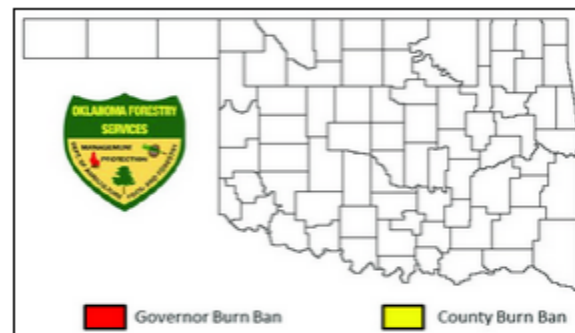
OWRB Lake Level and Streamflow Conditions Map & Data Viewer



Daily Report of Reservoir Conditions (U.S. Army Corps of Engineers)

Fire Danger

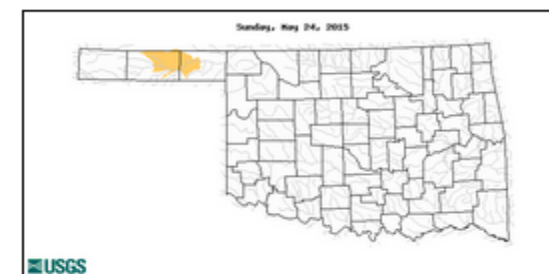
Current Burn Bans (Oklahoma Forestry Services)



Groundwater Levels

Streamflow Conditions

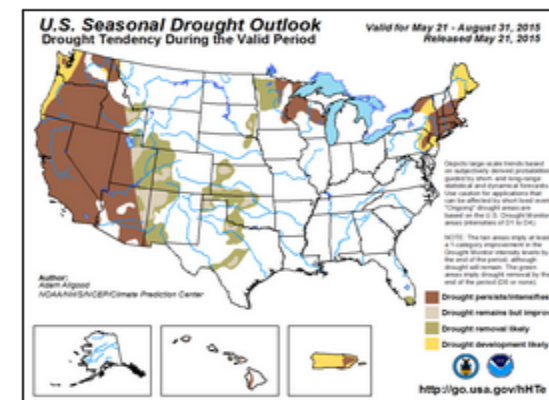
USGS Departure from Normal Streamflow



USGS U.S. Departure from Normal Streamflow

Outlooks & Indicators

CPC Seasonal Drought Outlook



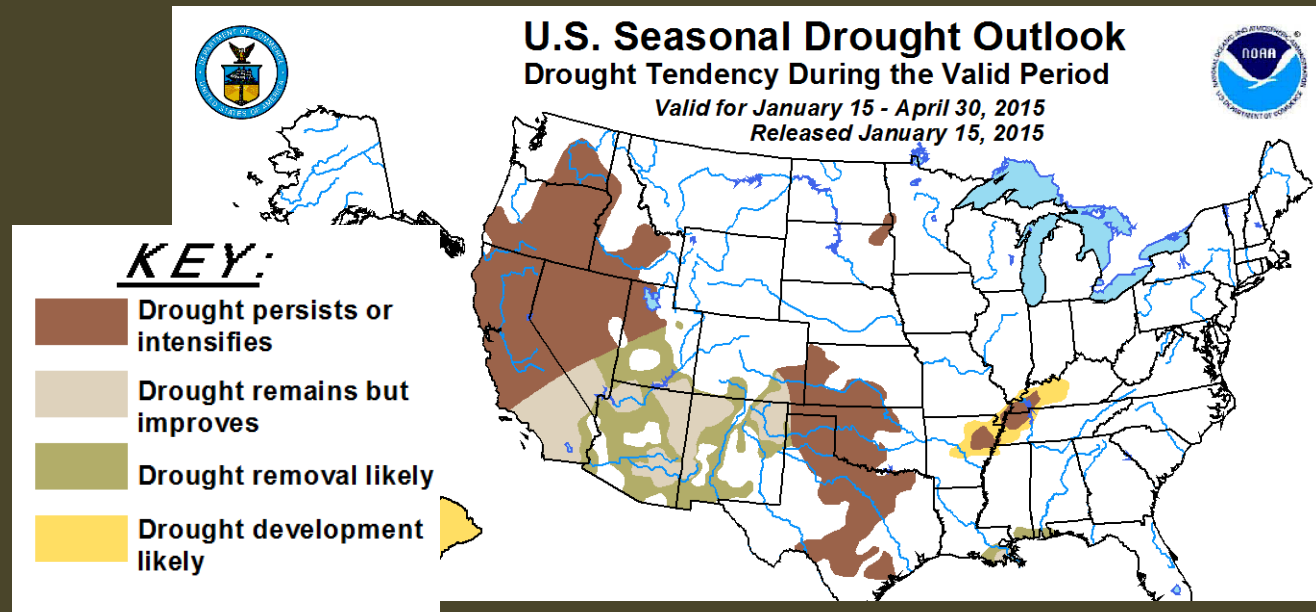
Seasonal Temperature & Precipitation Outlooks (Climate Prediction Center)

Palmer Drought Severity Index Map [PDSI Data] (CPC)

Forecasting for Drought

Resolution of the Products

- Difficult to use a 3-month forecast
- Need finer time resolution
 - Monthly out to at least 6 months
 - Weekly from 2-8 weeks
- These are easier to incorporate into decision-making processes





U.S. Seasonal Drought Outlook

Drought Tendency During the Valid Period

Valid for January 3 - March 31, 2013
Released January 3, 2013



Persistence

Some Improvement

Some Improvement

Improvement

Some Improvement

Improvement

Development

Improvement

KEY:



Drought to persist or intensify



Drought ongoing, some improvement

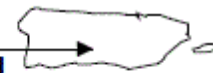


Drought likely to improve, impacts ease



Drought development likely

No Drought
Posted/Predicted



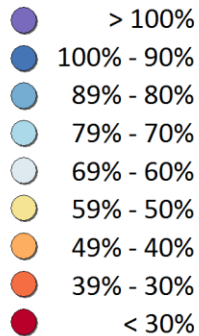
Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Short-term events -- such as individual storms -- cannot be accurately forecast more than a few days in advance. Use caution for applications -- such as crops -- that can be affected by such events. "Ongoing" drought areas are approximated from the Drought Monitor (D1 to D4 intensity). For weekly drought updates, see the latest U.S. Drought Monitor. NOTE: the green improvement areas imply at least a 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought elimination.

Oklahoma Surface Water Resources

Reservoir Levels and Storage as of 5/26/2015

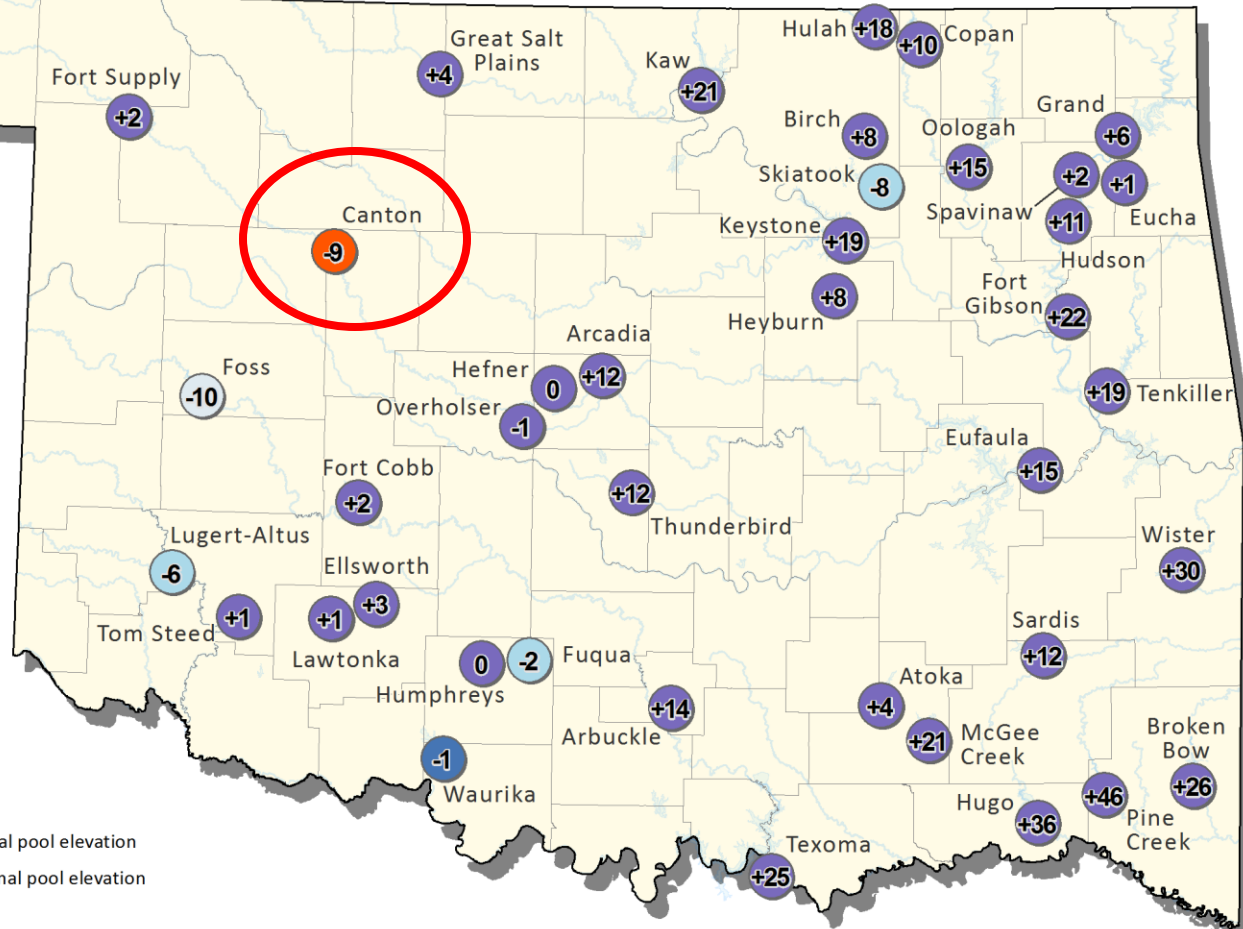
Reservoir Storage

(Percent of Normal Pool Storage
as of 5/26/2015)



Reservoir Levels

- ⊕ Positive number indicates the lake level in feet, above the normal pool elevation
- ⊖ Negative number indicates the lake level in feet, below the normal pool elevation



This map shows reservoir storage as a percentage of normal pool storage capacity. The source information was collected from real-time lake gages monitored by the U.S. Army Corps of Engineers (http://www.swt-wc.usace.army.mil/old_resvrepr.htm), and the U.S. Geological Survey (http://waterdata.usgs.gov/ok/nwis/current/?type=lake&group_key=basin_cd). For more information please visit the OWRB's website at: (<http://www.owrb.ok.gov>)



Forecasting for Drought

Forecasts of Event Likelihood

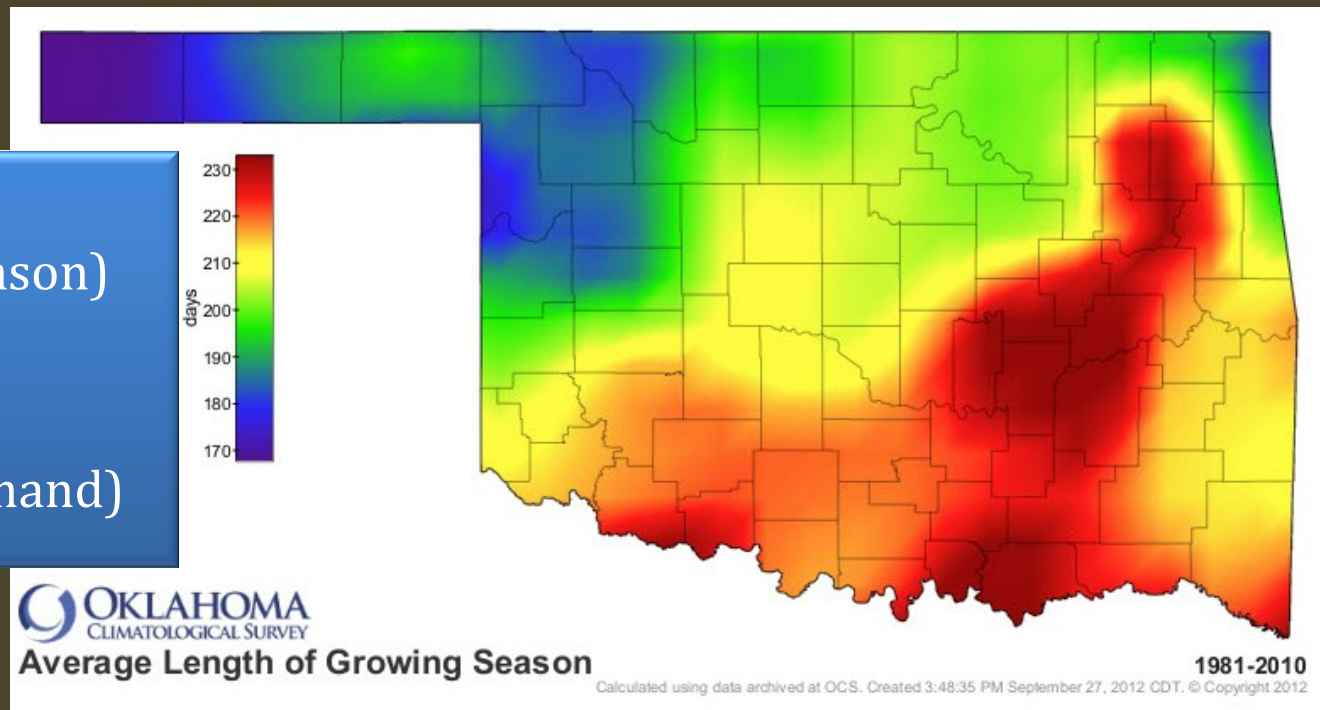
- The probability of receiving a widespread 3-inch rainfall several weeks out
- Number of heavy rainfall events or tornado days in the spring

Precipitation:

- May-June (peak season)

Temperature:

- Spring/Summer (evaporation & demand)





Forecasting for Drought

Beneficial Lead Times

- **Seasonal:** 3-6 months ahead for likelihood of exceptional wet or dry, hot or cold patterns
- **Sub-Seasonal:** weekly forecasts of the probability of events (especially heavy rainfall); better time resolution as forecast window shortens
- Oklahoma not driven by snowpack, so 12-month forecasts not as critical, but we recognize the value for other western states



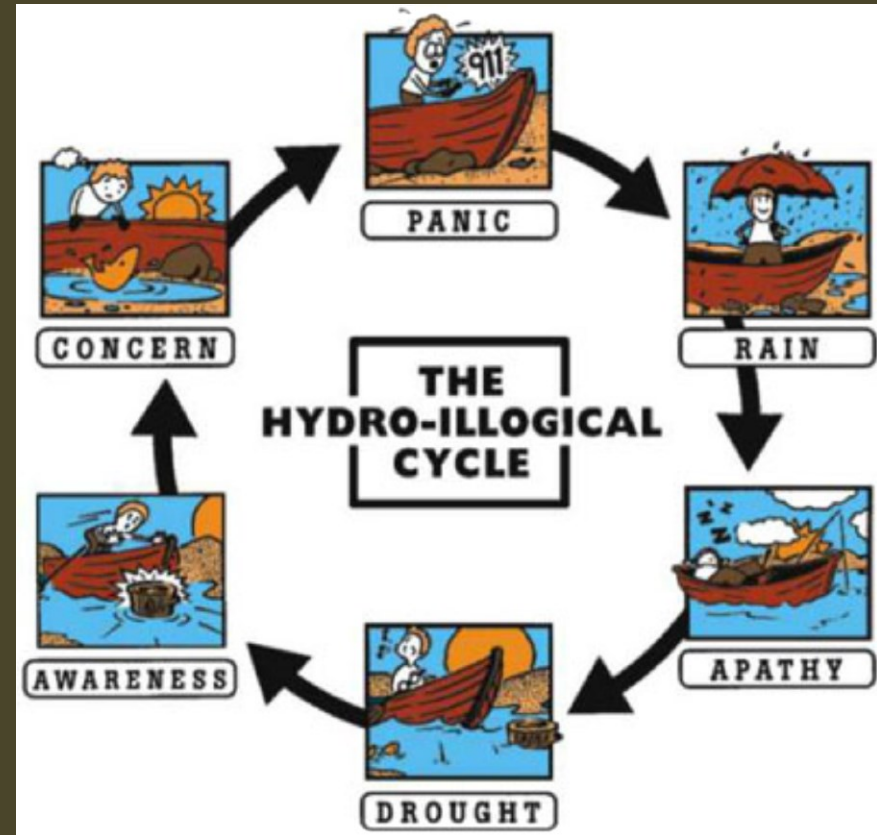
Forecasting for Drought

Beneficial Lead Times

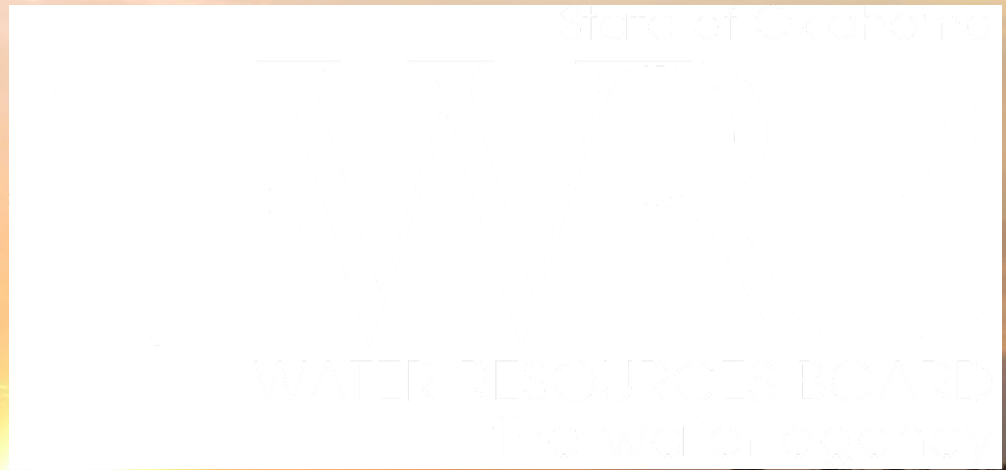
- **Spring:** Likelihood of peak rainfall and timing (weekly resolution)
- **Late Spring:** Both precipitation and temperature (evaporation & demand)
 - Anticipating whether to put water restrictions in place early to conserve water supplies if expecting a hot, dry summer (monthly temperature and precipitation departures)
- **October:** Likelihood of fall/winter recharge (monthly/ seasonal resolution)

Hydro-LOGICAL Cycle

- **Plan** ahead, and plan for the worst
- **Conserve** as if we're always in drought
- **Reuse/recycle** as much as possible
- **Innovate** – look for alternatives to freshwater for meeting every need
- **Minimize costs**, through planning, forecasting and investment



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