

Drought Climatology, Management, & Response in South Carolina

SC Association for
Hazard Mitigation
Conference 2024

Hope Mizzell

South Carolina State Climatology Office

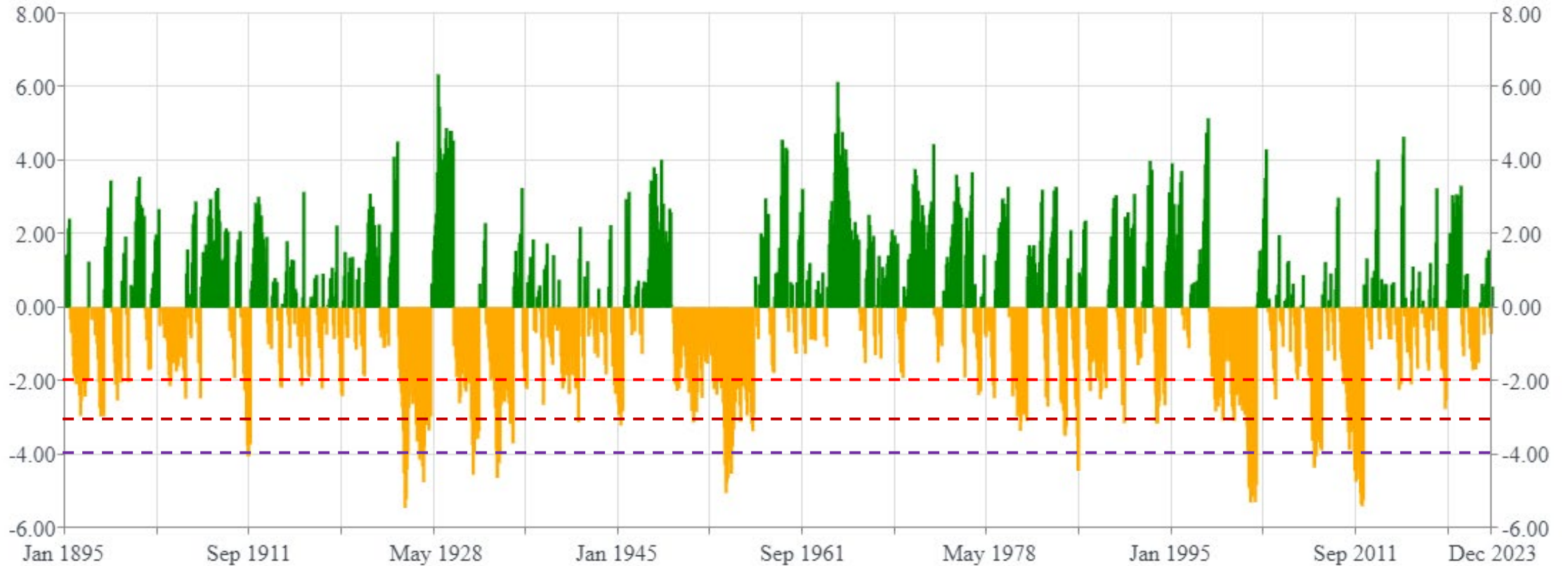
SC Department of Natural Resources

March 18th, 2024



Past Droughts in South Carolina

Palmer Drought Severity Index (PDSI) 1895 - 2023



Near Normal: -1.9 to +1.9

Moderate Drought: -2.00 to -2.99

Severe Drought: -3.00 to -3.99

Extreme Drought: -4.00 or less

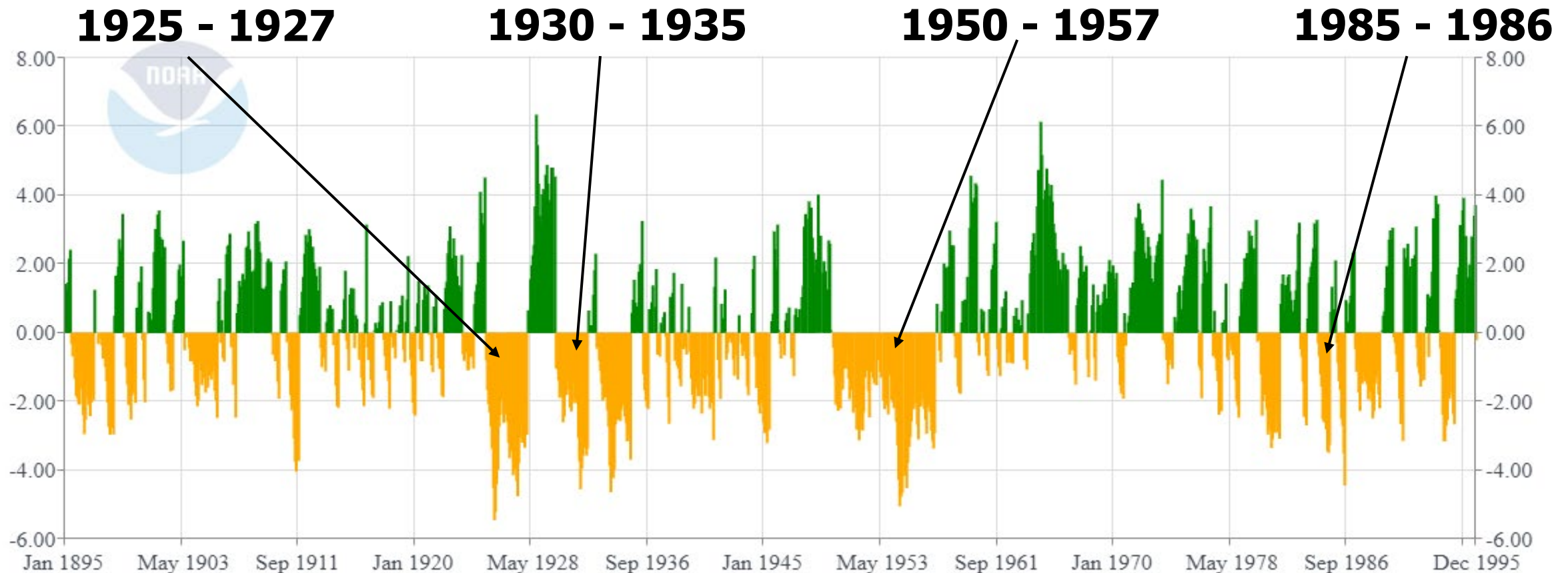
Historical Drought Events in South Carolina (pre-1995)

- Hydropower was limited, impacting industry
- Agriculture suffered, 16% of all farms abandoned
- Quarter-million people left the state for other employment

- Limited soil moisture severely impacted agriculture
- Agricultural losses were widespread

- 1954 SC's driest year on record
- Tens of thousands of forest acres burned
- Streamflows dropped with some streams going dry, straining water supplies for towns and industry

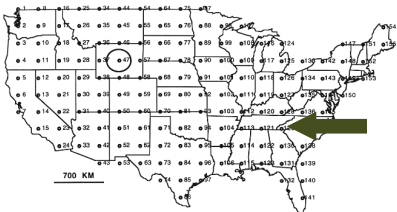
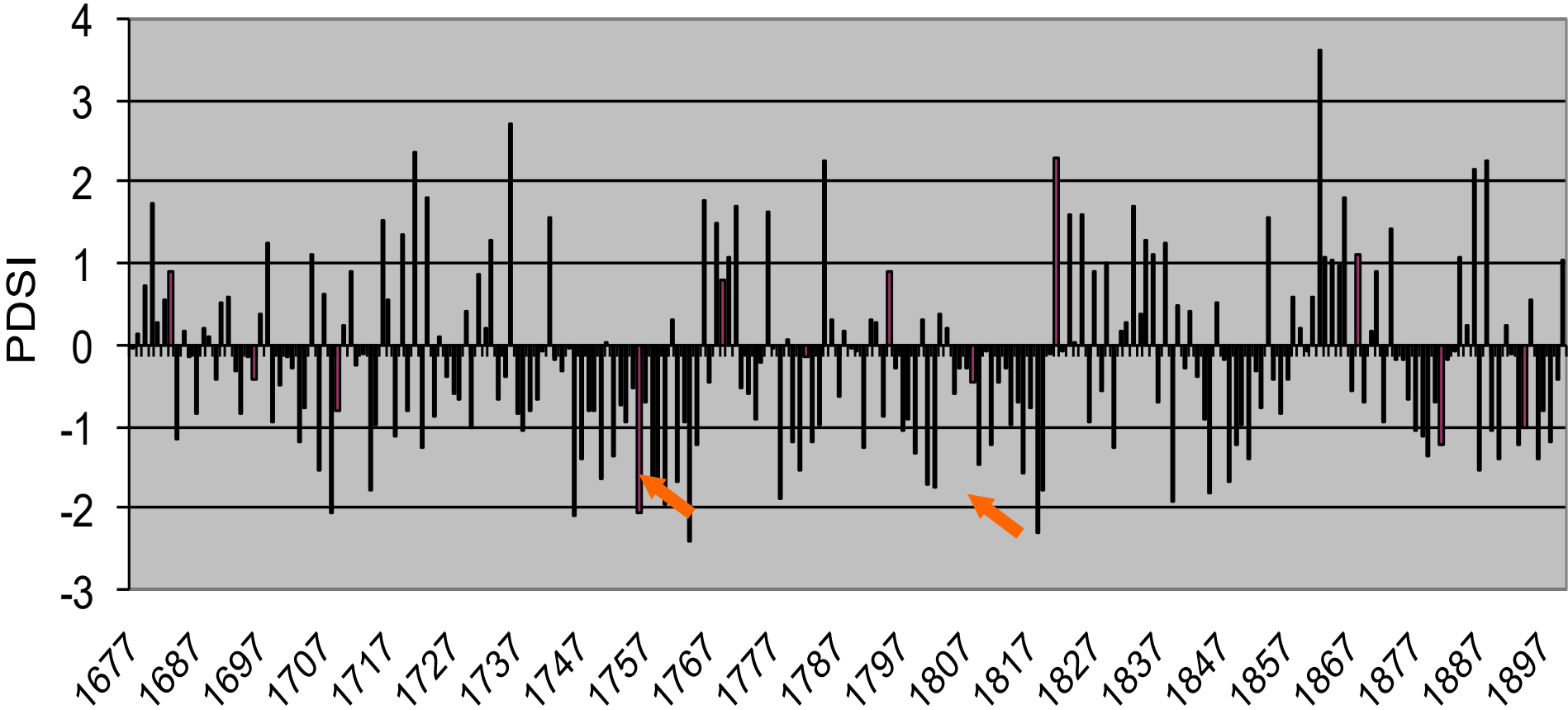
- \$219.9 million in Agricultural Losses
- \$8.1 million in forestry losses
- 29 drought-related deaths due to extreme heat





NOAA Paleoclimatology Program
Dr. Edward Cook,
Dr. David Meko,
Dr. David Stahle
Dr. Malcolm Cleaveland

Reconstructed Palmer Drought Severity Index Based on Tree Rings



Historical Drought Events in South Carolina (post-1995)



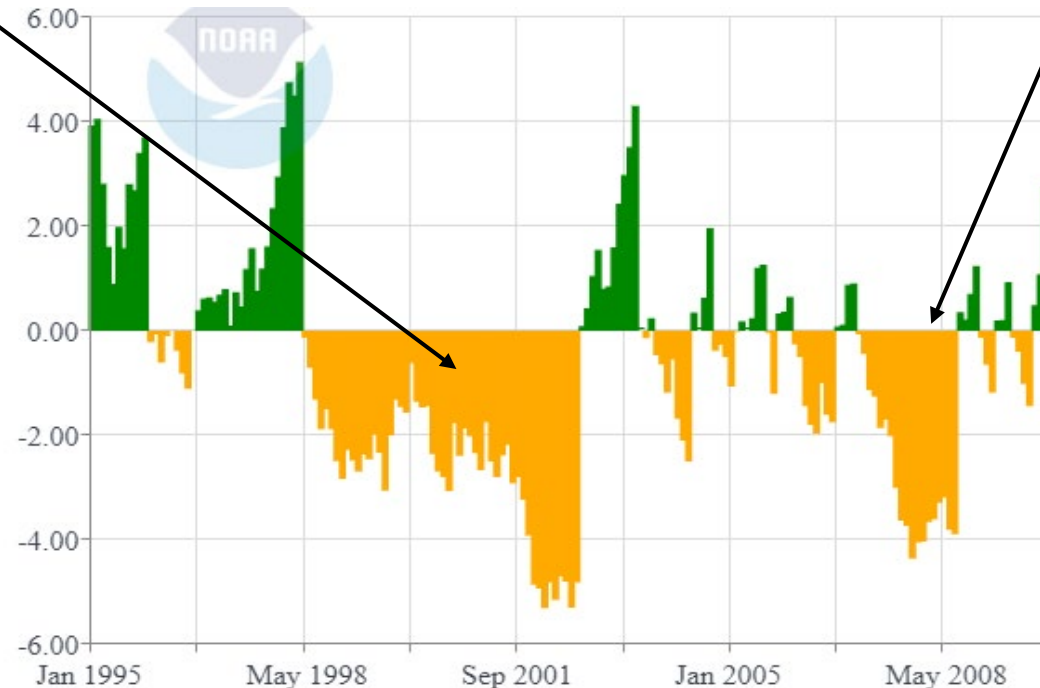
Rocks Pond Marina, Lake Marion, 11-07



Lake Marion, 11-07

1998-2022

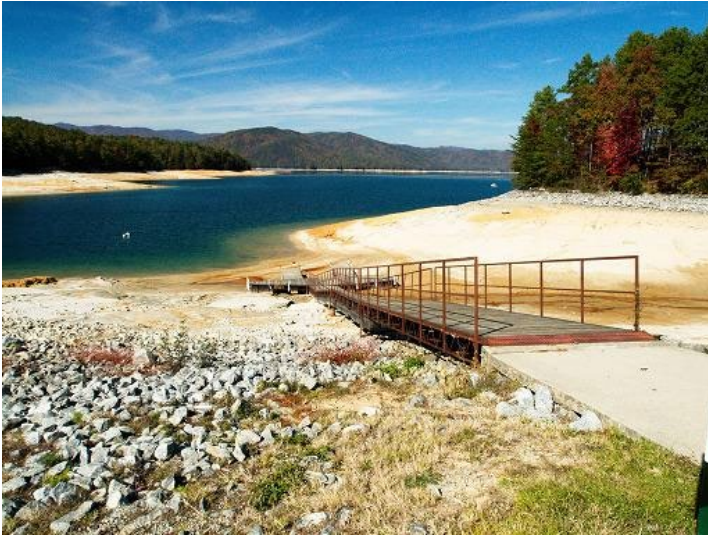
- Reduced crop yields, costs for new well drilling, inability of pastures to support livestock.
- Forestry lost \$1.3 billion in timber to fires and Southern Pine Beetle infestation.
- Hydrologic systems became stressed, leading to many municipalities implementing voluntary or mandatory restrictions.



2007-2009

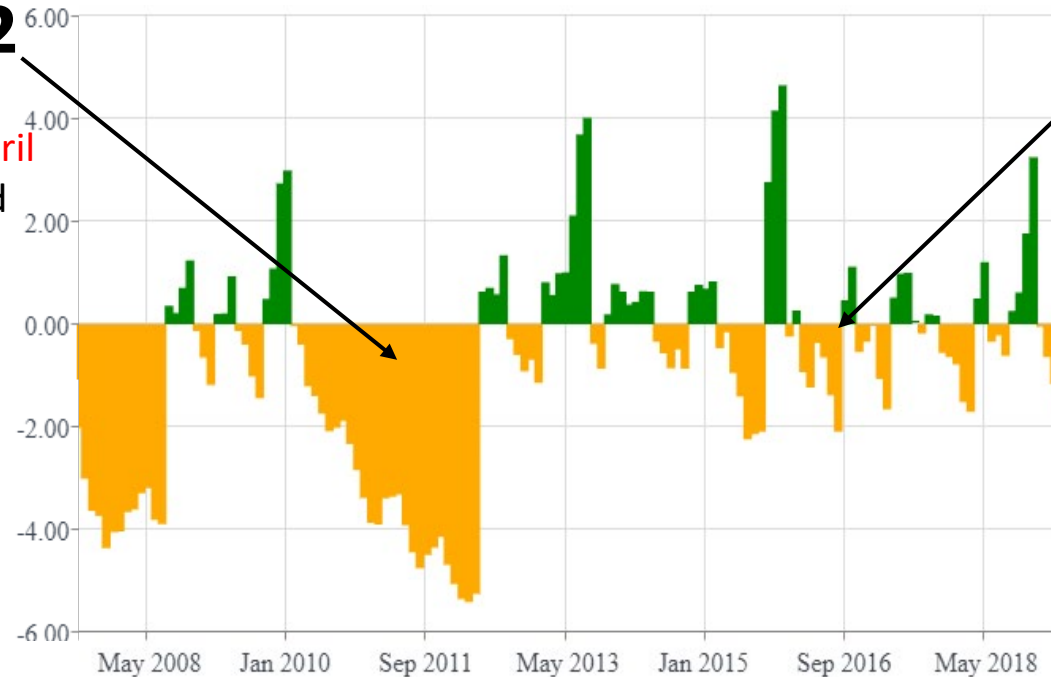
- Reduced crop yields and inability of pastures to support livestock.
- Lake levels were severely impacted, affecting water supply and recreation
- By **January 2008**, 191 water systems had enacted restrictions, with 45 systems having mandatory restrictions.

Historical Drought Events in South Carolina (post-1995)



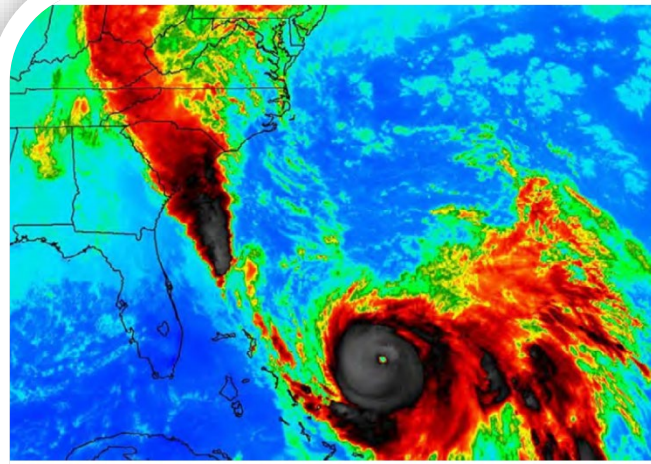
2010-2012

- Mainly affected Savannah River **April and June 2012**, Lake Thurmond had lowest inflows since **1954**
- Declining hydrologic conditions affected shallow and deep groundwater aquifers.



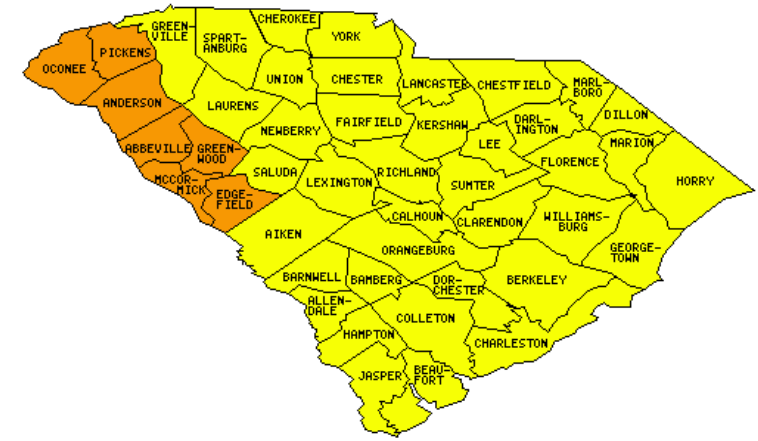
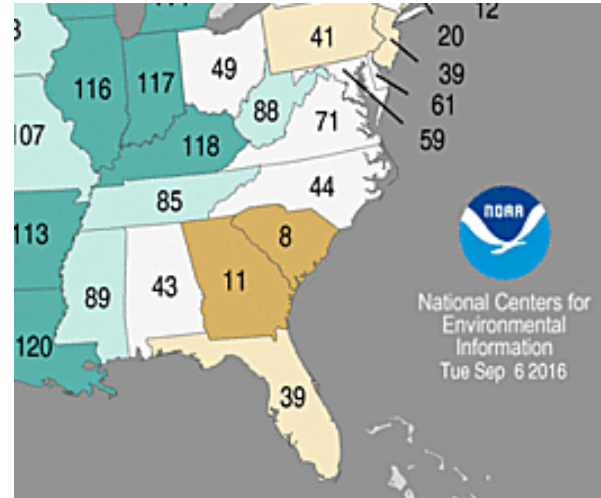
2015-2016

- Late summer entire state in drought
- **October 2016**, Hurricane Matthew “busted” drought in Coastal Plain provided limited relief to Upstate.
- **November 2016**, the Pinnacle Mountain Fire burned more than 10,000 acres.



ellite image of the intense rainfall being funneled into South Carolina during the morning of
)

2016 Summer Precipitation

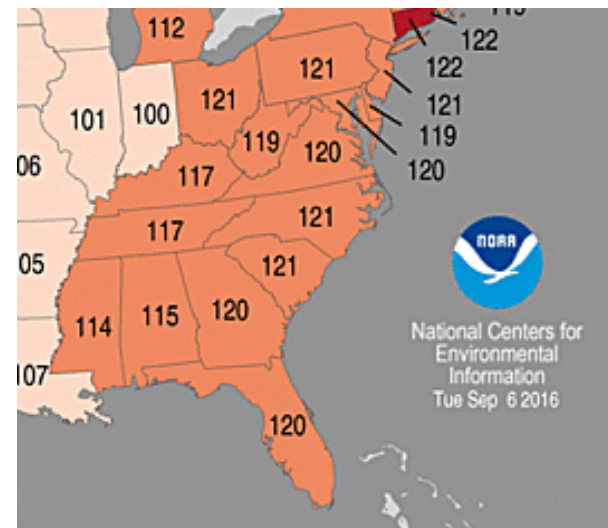


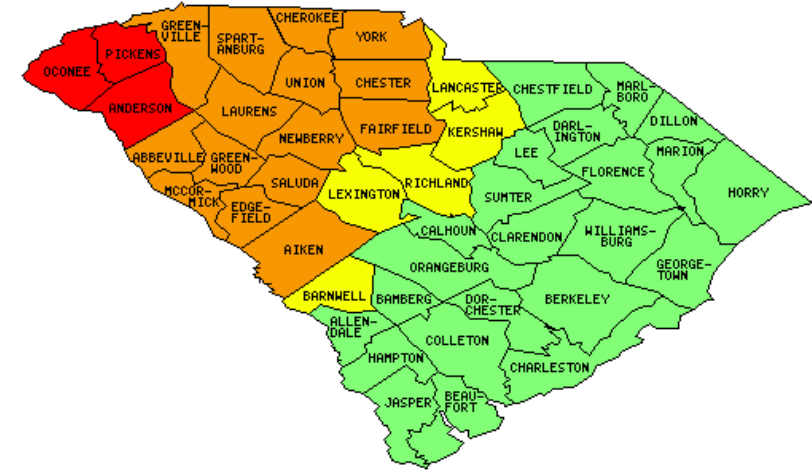
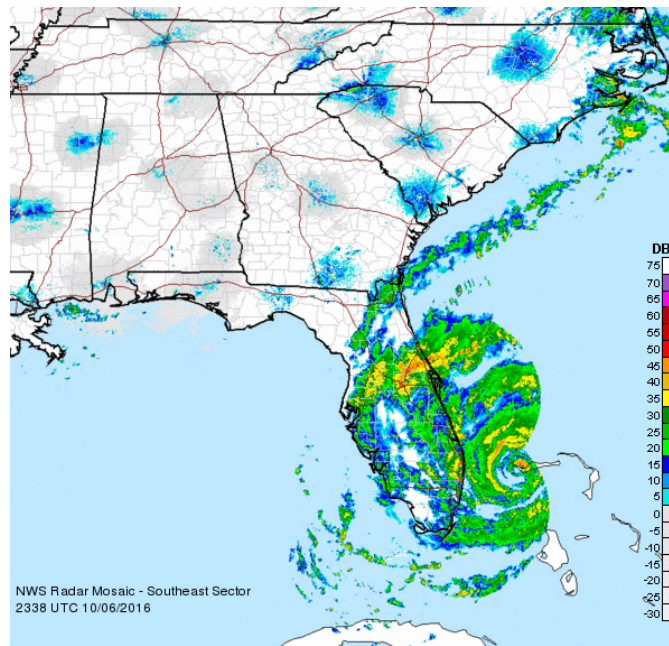
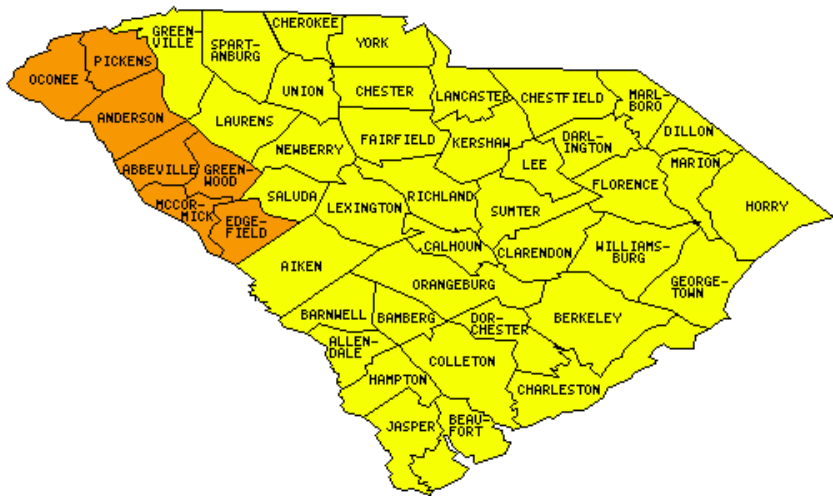
Oct 2015 Flood

Aug 17, 2016



2016 Summer Temperature





Aug 17, 2016

Oct 9, 2016

Nov 2016

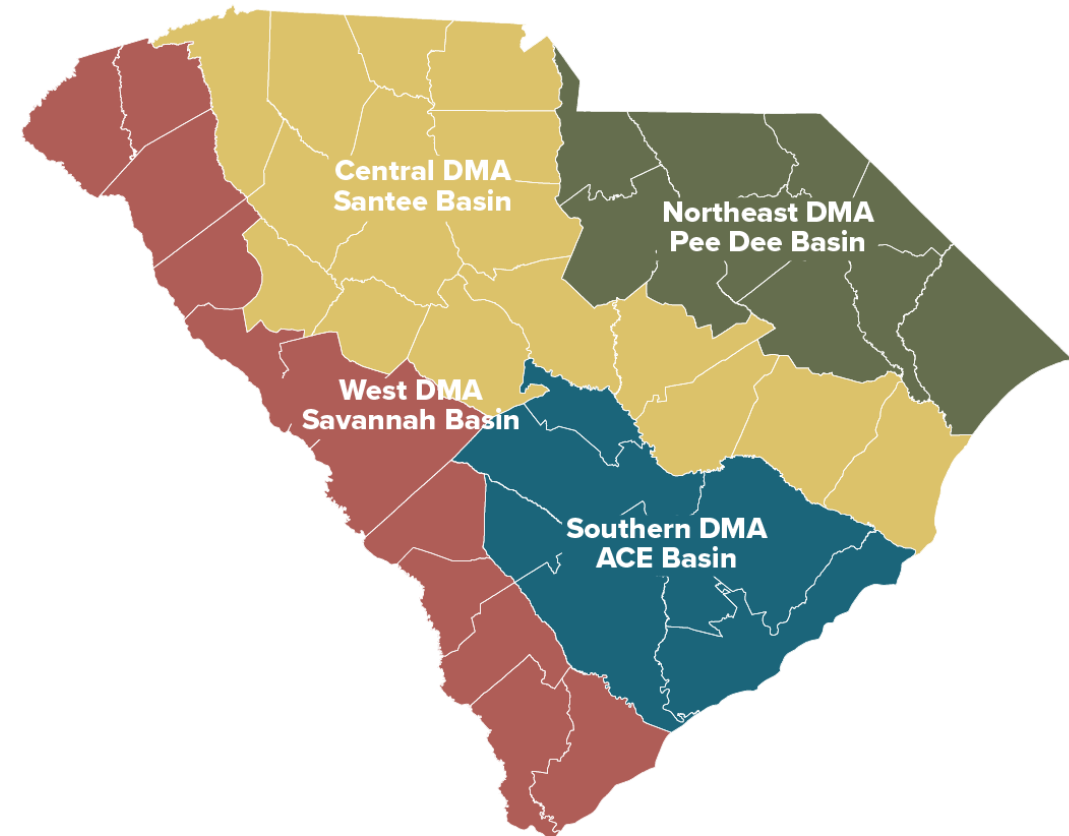


Drought Monitoring and Response in SC

South Carolina Drought Response

Program consists of legislation, regulations, and procedures that establish recommended and required response.

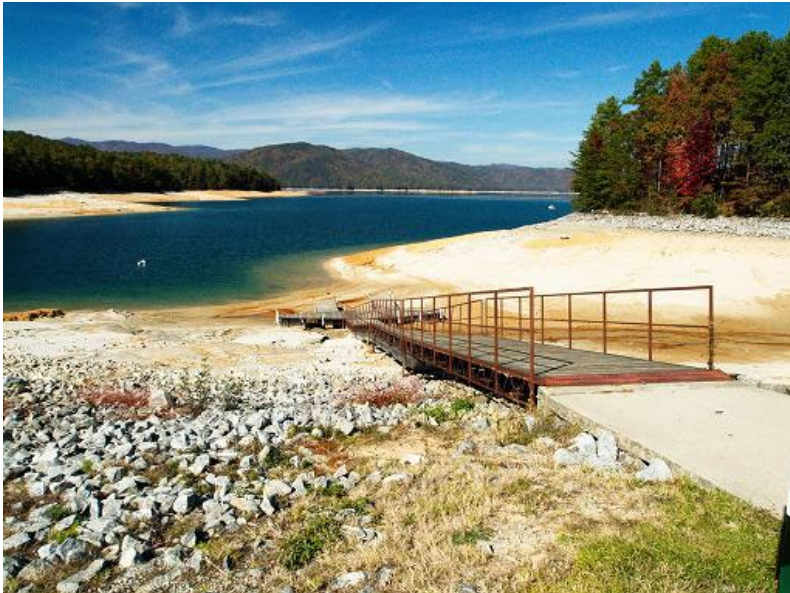
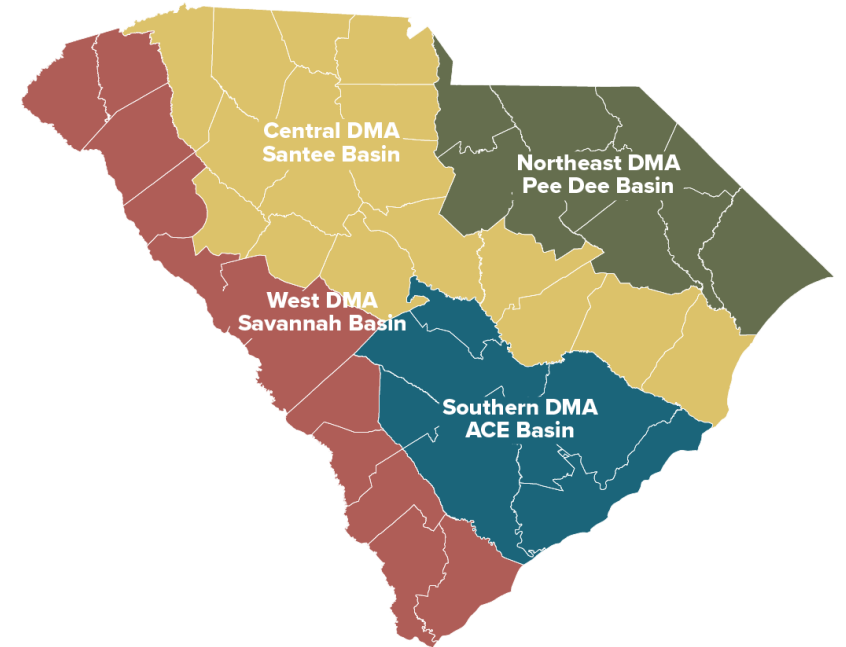
The **South Carolina Drought Response Act (2000)** and the **supporting regulations** formally establish and describe the responsibilities of the South Carolina State Climatology Office and the South Carolina Drought Response Committee, the major drought decision-making entities in the State.



Drought Monitoring and Response in SC

Why: To carefully and closely monitor, conserve, and manage the State's water resources in the best interest of all South Carolinians.

Who: Drought Response Committee and
Department of Natural Resources – State Climatology
Office



Statewide members

- Forestry Commission
- Department of Agriculture
- Emergency Management Division
- Department of Health and Environmental Control
- Department of Natural Resources

Local members (12 per DMA)

- Water Utilities
- Regional Council of Governments
- Power Generation Facilities
- Soil and Water Conservation Districts
- Agriculture

Central Drought Management Area

Group	Committee Member	County
Agriculture	John Irwin	Laurens
Commission of Public Works	Ken Tuck	Spartanburg
Counties	Peggy Swearingen	Fairfield
Domestic User	Christy Jones	Richland
Industry	Ed Holder	Greenville
Municipalities	James G. Bagley	York
Power Generation Facilities	Alan Stuart	York
Private Water Supplier	Brad C. Powers	Spartanburg
Public Service District	Vacant	
Regional Council of Gov.	Gregory Sprouse	Richland
Soil and Water Conservation District	John T. Rivers	Sumter
Special Purpose District	Fred Castles	Chester



Counties: Greenville, Spartanburg, Cherokee, York, Laurens, Union, Chester, Greenwood, Saluda, Newberry, Fairfield, Lexington, Richland, Calhoun, Sumter, Clarendon, Williamsburg, Georgetown

Drought Monitoring and Response in SC

How: The State uses multiple indicators and indices to monitor drought and determine drought severity levels.

Percent of Normal Rainfall		• Cumulative dryness or wetness compared to long-term averages
Crop Moisture Index (CMI)		• Agricultural growing season short-term (up to 4 weeks) dryness or wetness
Palmer Drought Severity Index (PDSI)		• Prolonged (month, years) abnormally dry or wet conditions
 Water Resources		• Streamflow levels • Lake levels • Groundwater levels
Keetch-Byram Drought Index (KBDI)		• Daily forest fire potential
U.S. Drought Monitor for South Carolina		• General areas of drought, labeled by intensity on a weekly basis

Conditions and Response	SC Drought Response Act and Regulations			
	Incipient	Moderate	Severe	Extreme
	- Drier than normal - Soil moisture declines - Water demand increases	- Water levels decrease - Crops and plants wither - Irrigation increases	- Water levels continue to drop - Number of wildfires increases - Poor grazing and agricultural conditions	Widespread impacts to agriculture, forestry, water utilities, and water-dependent businesses
	- SCDNR, SCO and DRC monitor conditions, share information, and make recommendations to manage drought. - State and federal agencies, water utilities, and reservoir managers monitor conditions.			
	Water utilities review drought plans and ordinances.	- Water utilities implement drought plans and ordinances. - DRC may recommend voluntary or mandatory water conservation.		
	As drought conditions and impacts become more severe, response actions increase accordingly. 		- State agencies increase monitoring and communications. - Citizens may see local notices for burn bans, boat ramp closings, and water use restrictions. - The Governor may: - request voluntary or mandatory water conservation. - assist with managing impacts, including requesting disaster declarations by the US Dept. of Agriculture and activating the National Guard to assist with wildfire suppression.	
State Emergency Operations Plan	 - Water systems and citizens are without, or losing access to, water. - Public safety, health, and welfare are threatened. - The State Emergency Response Team (SERT) is activated to lead state-level response to the water shortage emergency.			

SC Drought and Water Shortage Tabletop Exercise

September 2017 and 2019 – SC Emergency Operations Center



2017

80

40

Attendees

Organizations

2019

93

48



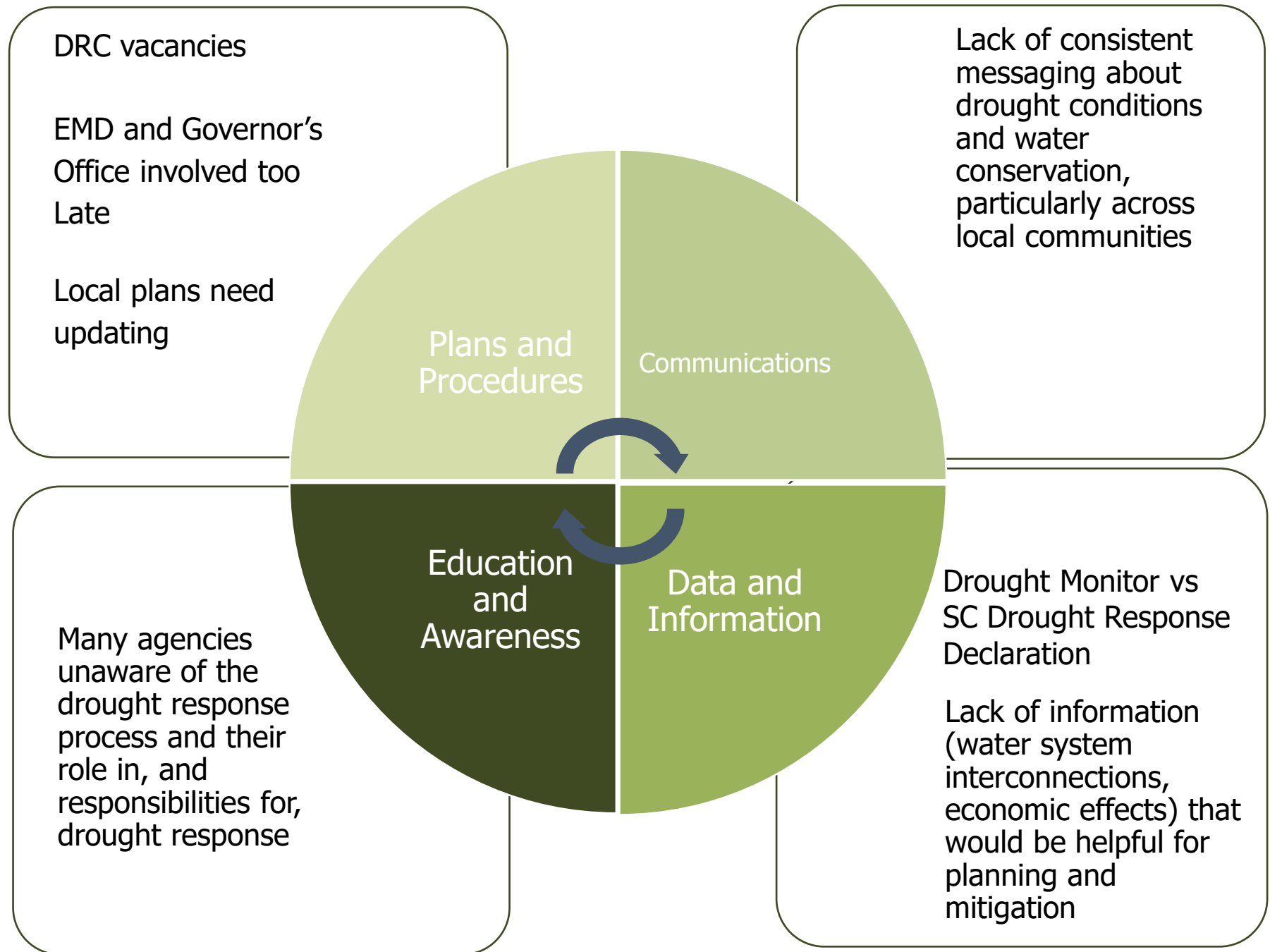
SCEMD

Objectives of the Tabletop Exercise



1. Identify and understand the breaking points in the *SC Drought Response Act*, *SC Drought Regulations*, *SC Emergency Response Plan Drought Annex*, and local drought plans and procedures.
2. Improve awareness of local, state, and federal players in South Carolina's drought response.
3. Identify key mission areas for Each State Emergency Support Function.
4. Collect ideas and strategies for future exercises.

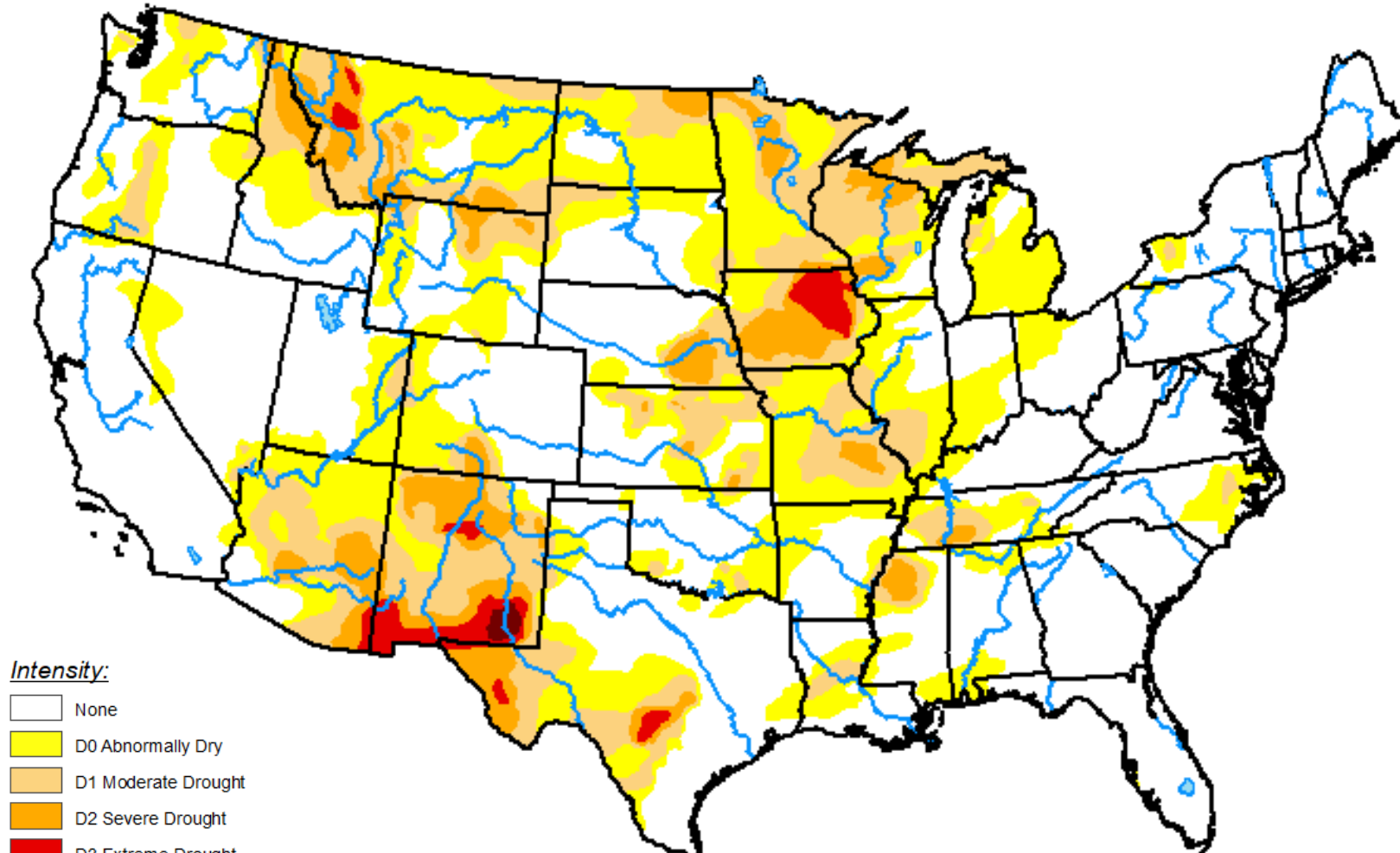
"Breaking Points"



The U.S. Drought Monitor (USDM)

U.S. Drought Monitor Contiguous U.S. (CONUS)

March 5, 2024
(Released Thursday, Mar. 7, 2024)
Valid 7 a.m. EST



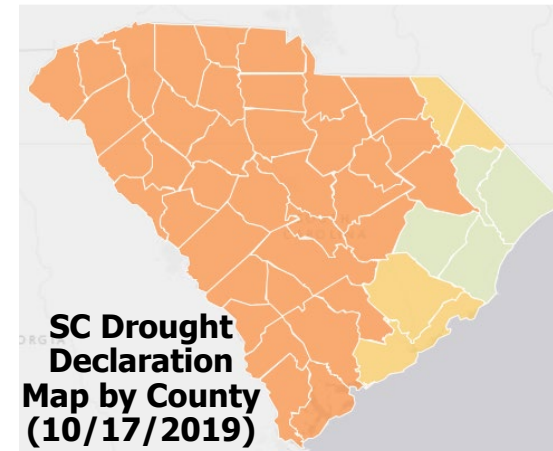
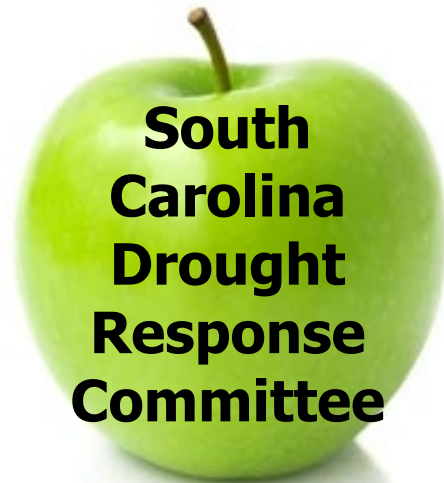
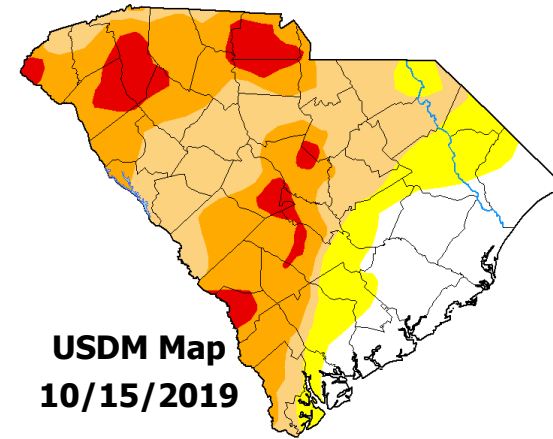
Intensity:

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

A weekly product that maps drought severity and extent across the United States.

The SC State Climatology Office takes the lead for providing state recommendations to the USDM process.

The U.S. Drought Monitor and the South Carolina Drought Response Committee





Comparing the USDM and SC DRC Apples



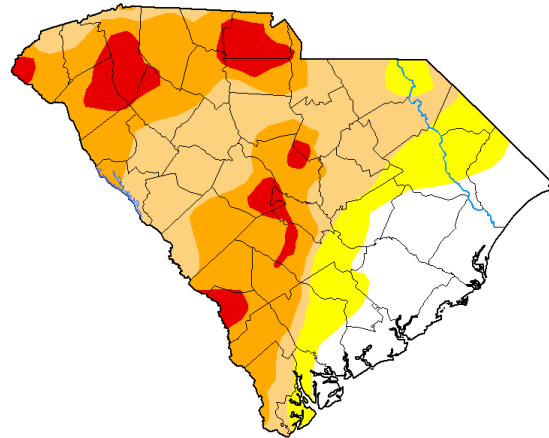
	USDM	SC DRC
Agency Leads	Authors are from Federal Agencies (NDMC, NOAA, and USDA)	Five State Agencies (DNR, DHEC, SCDA, EMD, SCFC)
Participants	Federal and State Agencies, as well as universities and other entities that monitor conditions	Local stakeholders (Water suppliers, agriculture, conservation districts, power generation, local gov.)
Frequency	Weekly product	Committee convenes as needed when conditions warrant discussion.
Severity Levels	Abnormally dry, Moderate, Severe, Extreme, & Exceptional Drought	Incipient, Moderate, Severe, and Extreme Drought
Allows for	Federal disaster declarations and loans for agriculture	Used to determine non-essential water use curtailment recommendations for public water suppliers in South Carolina.
Indicators...		

USDM vs SC DRC Drought Indicators

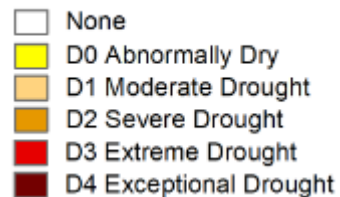
USDM Inputs

Precipitation
Soil Moisture
Vegetation Health
Surface Water
Evaporation
Groundwater
Impacts & Condition Monitoring reports

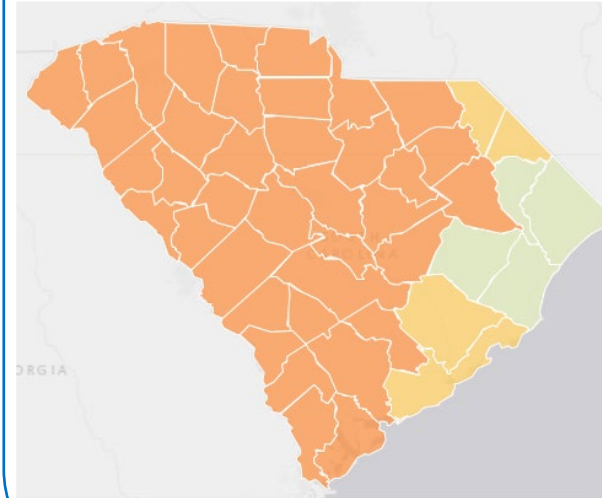
**USDM Map
10/15/2019**



Intensity:



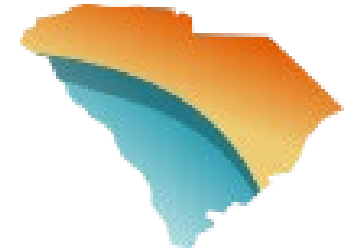
**SC Drought
Declaration
Map by County
(10/17/2019)**



Other Indicators used for SC

Palmer Drought Severity Index (PDSI)
Crop Moisture Index (CMI)
Standard Precipitation Index (SPI)
Keetch-Byram Drought Index (KBDI)
Average daily streamflow
Groundwater Levels

scdrought.com



Home Page

6 Main Tabs:

- Conditions
- Resources
- Impacts
- Conditions
- Planning
- FAQ's

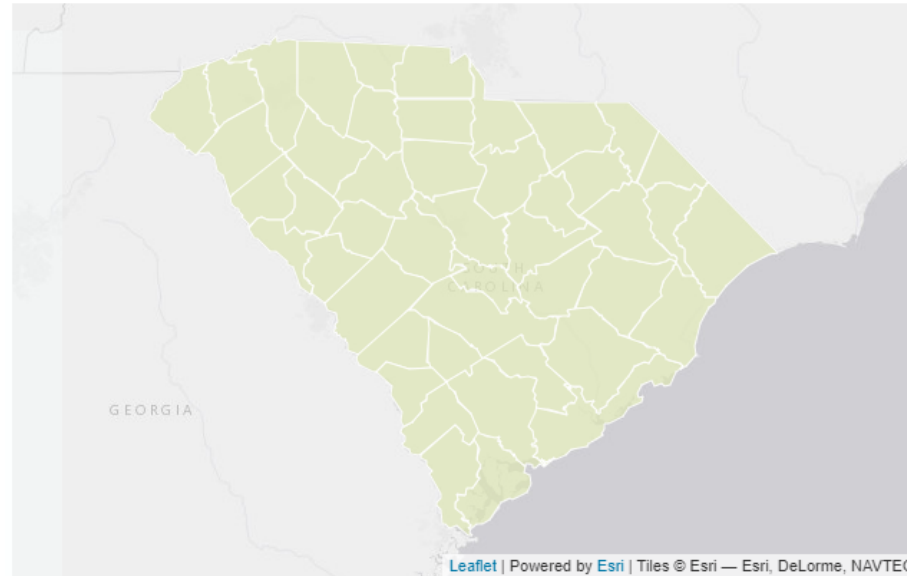
South Carolina Drought

SC State Climate Office



[Conditions](#) [Resources](#) [Impacts](#) [Committee](#) [Planning](#) [FAQ's](#)

Drought in South Carolina



Current Status

Normal		46
Incipient		0
Moderate		0
Severe		0
Extreme		0

Number of Counties in Each Category

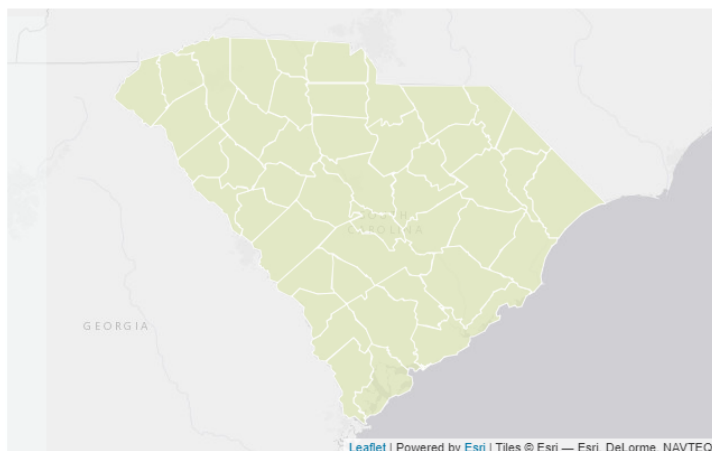
Latest Drought Committee Meeting: 01-11-2024

[Drought Conditions >>>](#) Find out more about current drought conditions, how drought status is determined in South Carolina, and view archived drought condition reports.

The Drought Response Committee convened on January 11th, 2024 and declared all counties in normal status. The committee will continue to monitor conditions regularly.

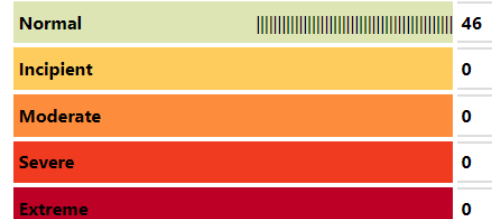


Drought Conditions in South Carolina


[Table View](#)
[Save Map as Image](#)
[Drought Status Report](#)

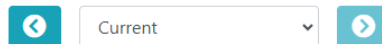
Current Status as of 01-11-2024 [?]

Last Drought Response Meeting: 01-11-2024



Number of Counties in Each Category

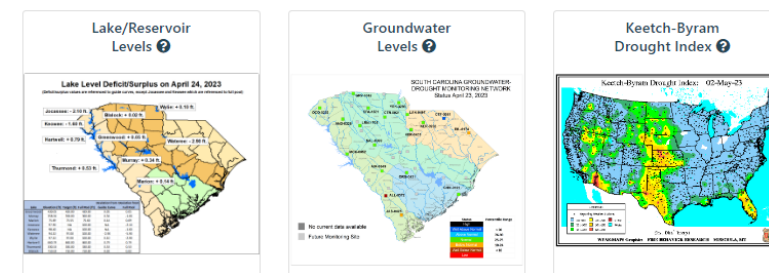
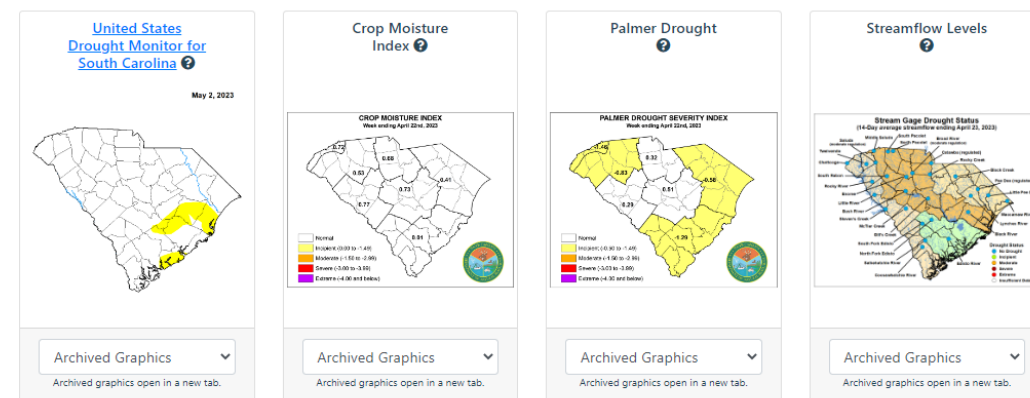
Archived Drought Status



The Top Seven

South Carolina Drought Response Committee uses these seven indices and indicators to determine the current drought status.

The maps below are updated regularly to reflect current conditions. Data used for the following indices and indicators are released at different points during the week. To best capture current conditions, a week ranges from Saturday to Friday.



SC Drought Resources

- Learn about drought
- Water Conservation Tips and infographics
- Drought Photos from the 2007, 2008, and 2011 droughts
- Publications from both the SC SCO and Carolinas Integrated Sciences and Assessments (CISA)
- Other resources from CISA, National Drought Monitoring Center (NDMC), National Integrated Drought Information System (NIDIS), and National Centers for Environmental Information (NCEI)

SC Drought Resources

Learn about drought! ?

What is drought? How do we know when South Carolina is in drought? How does South Carolina Drought Response and Management work? Find the answers to these questions and many more with the resources below.

- [Drought 101](#)

Drought response and management in the South Carolina is directed by State law.

- [South Carolina Drought Response Act](#)
- [South Carolina Drought Regulations](#)
- [South Carolina Model Drought Management Plan and Ordinance](#)

Water Conservation 💧

Good water conservation habits are essential for drought preparation and response. Find out what you can do at home to conserve water. These PDF flyers can be printed and shared... spread the word!

- [Water Conservation Tips](#)
- [How much water can you save?](#)

Drought Photo Gallery 🖼️

Photos from past droughts are important for remembering the impact that drought conditions can have in South Carolina. They help us to compare droughts events over the years.

- [Drought Photos](#)

Publications 📄

Find research, publications, and reports related to drought in South Carolina.

- [Research, Publications, and Storm Reports from the South Carolina State Climate Office \(SCO\)](#)
- [Carolinas Integrated Sciences and Assessments \(CISA\) Library](#)

Other Resources 🔗

Carolinas Integrated Sciences and Assessments (CISA)

- [Drought Planning and Preparedness](#)
- [CISA Outreach Videos and Interviews](#)
- [Atlas of Hydroclimate Extremes](#)

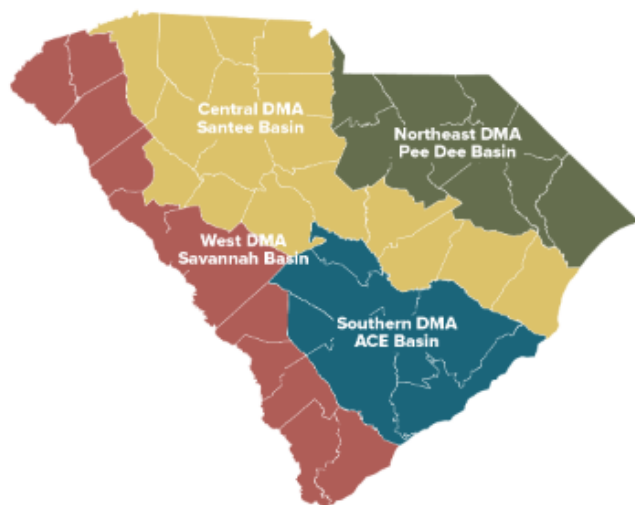
National Drought Resources

- [National Drought Mitigation Center's Condition Monitoring Tools](#)
- [National Drought Monitoring Center](#)
- [National Integrated Drought Information System \(NIDIS\)](#)
- [National Centers for Environmental Information \(NCEI\)](#)



South Carolina Drought Response Committee

The SC Drought Response Committee consists of state and local members and governs drought related issues and response in South Carolina. Local members are organized according to Drought Management Areas. The DRC is chaired and supported by the South Carolina Department of Natural Resources and the SC State Climatology Office. The DRC monitors climatic conditions, evaluates drought indicators, and consults with stakeholders to issue drought status updates. During severe or extreme drought, the DRC determines nonessential water use and issues declaration for water curtailment.



The [Drought Response Flyer](#) will guide you through the Drought Response and Management Process.

To learn more about how the committee monitors and identifies drought, visit the [South Carolina Drought 101 page](#).

West Drought Management Area



Central Drought Management Area



Northeast Drought Management Area



Southern Drought Management Area



State Agency Members





South Carolina Drought Planning

The South Carolina Drought Response Program consists of legislation, regulations, and procedures that establish recommended and required response at moderate, severe, and extreme drought alert phases. The [South Carolina Drought Response Act](#) and the [supporting regulations](#) formally establish and describe the responsibilities of the [South Carolina Drought Response Committee \(DRC\)](#), the major drought decision-making entity in the State. The DRC is composed of statewide and local members, and state agency members include:

- Emergency Management Division
- Department of Health and Environmental Control
- Department of Agriculture
- The Forestry Commission
- Department of Natural Resources

📺 [Watch an interview](#) with South Carolina State Climatologist Hope Mizzell. Dr. Mizzell discusses the State Climate Office's role in administration of the South Carolina Drought Response Act.

The Drought Response Act requires all public water suppliers to develop and implement local drought plans and ordinances. *The Drought Regulations recognize that local governments have primary responsibility for alleviating drought impacts and encourage cooperation among neighboring water systems.* DNR created a [model drought management plan and response ordinance](#) for local governments and water systems to use in developing their own documents.

From outcomes from the drought tabletop exercises, the South Carolina Climatology Office has created a [Drought Planning Guidebook](#). This guidebook is a sister document to the model drought plan and helps provide context for building a robust local drought plan for water systems. This guidebook uses case studies and best practices taken from water systems within South Carolina.



SC State Climatologist, Dr. Hope Mizzell, and SC Emergency Management Division Dam Safety Coordinator, Marshall Sykes, walk attendees through a series of intensifying drought scenarios at South Carolina's first Drought and Water Shortage Tabletop Exercise in September 2017. Photo courtesy of CISA

*Brand new
planning resource
for water systems*

Creating a Drought Planning Guide for Water Suppliers in South Carolina



The Drought Planning Guidebook



DROUGHT PLANNING GUIDEBOOK

A Resource for Water Systems
in the Palmetto State

Guidance for Reviewing and Updating Drought
Management Plans and Response Ordinances

Presented by
The South Carolina State Climatology Office within the
S.C. Department of Natural Resources



What is it?:

A sister document to
the model drought
plan

Why use it?

Helps provide context
for building a robust
local drought
response plan beyond
a “fill in the blank”
document.

The Drought Planning Guidebook



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S.C. Department of Natural Resources



Contents:

- Checklist for Reviewing & Updating A Drought Plan
- Overview of Best Practices
- 1. Why do We Need Another Drought Planning Guide?
- 2. Drought as a Natural Hazard
- 3. Getting Started: Drought Planning Frameworks
- 4. Review, Update, and Approve the Plan
- 5. Information Gathering and Drought Risk Assessment
- 6. Drought Monitoring and Early Warning
- 7. The Operations of the Drought Response Plan
- 8. Mitigation: Taking Current Steps to Reduce Future Impacts
- 9. Concluding Remarks

Case Studies

Just a minute - He's watching
His favorite comedy.



JOHNNY, YOU ONLY GOT HALF THE
ANSWERS RIGHT ON YOUR TEST!

NO
PROBLEM,
TEECH!

SKOOL

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2-23

HOW CAN YOU SAY THAT?

I'M GOING
TO BE A
METEOROLOGIST.

$$A+B=C$$
$$2+2=4$$

Thank You! Questions?

- **Contact:**
- **Mizzellh@dnr.sc.gov**
- **803-734-9568**

