Drought Tabletop/ Water Shortage Exercise

September 27th, 2017

Acknowledgements

- Planning Committee
  - Hope Mizzell – Department of Natural Resources, State Climatology Office
  - Ekaterina Altman, Amanda Farris, Kirsten Lackstrom – Carolinas Integrated Sciences & Assessments (CISA), University of South Carolina
  - Robert Burton, Marshall Sykes – Emergency Management Division
  - Jeff Allen, Dawn White – SC Water Resources Center, Clemson University

South Carolina Emergency Management Division

SCEMD

- SCEMD leads the state emergency management program to minimize the loss of life and property from all-hazard events
- Multi Agency Coordination Center

Emergency Support Functions (ESFs)

SCEMD

- Upon activation of the Emergency Operations Plan (EOP), the State Emergency Response Team (SERT) comprised of ESFs and other personnel assemble in the SEOC to coordinate the State's emergency Response

ESF Missions and Primary Agencies

SCEMD

- ESF 1- Transportation (SCDOT)
- ESF 2- Communications (DOA)
- ESF 3- Public Works and Engineering (SFAA)
- ESF 4- Firefighting (LLR)
- ESF 5- Information and Planning (SCEMD)
- ESF 6- Mass Care (DSS)
- ESF 7- Resource Support (SCEMD)
- ESF 8- Health and Medical Services (DHEC)
- ESF 9- Search and Rescue (LLR)
- ESF 10- Hazardous Materials (DHEC)
- ESF 11- Food Services (DSS)
- ESF 12- Energy (ORS)
- ESF 13- Law Enforcement (SLED)
- ESF 14- Recovery and Mitigation (SCEMD)
- ESF 15- Public Information (SCEMD)
- ESF 16- Emergency Traffic Management (DPS)
- ESF 17- Animal and Agriculture Emergency Response (CULPH)
- ESF 18- Donated Goods and Services (DOA)
- ESF 19- Military Support (SCNG)
- ESF 24- Business and Industry (DOC)

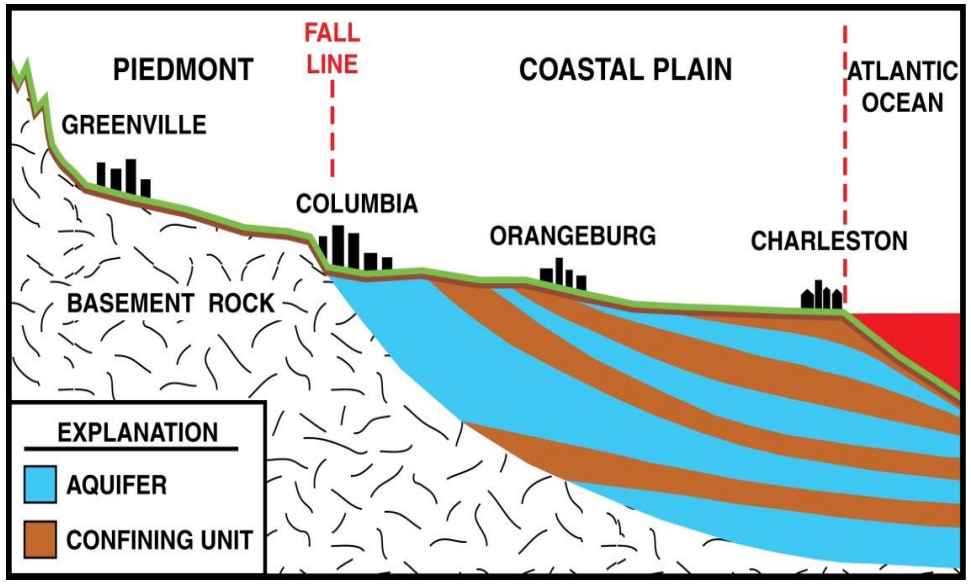
Objectives

1. Identify and understand the strengths and 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

Water-Resource Distribution

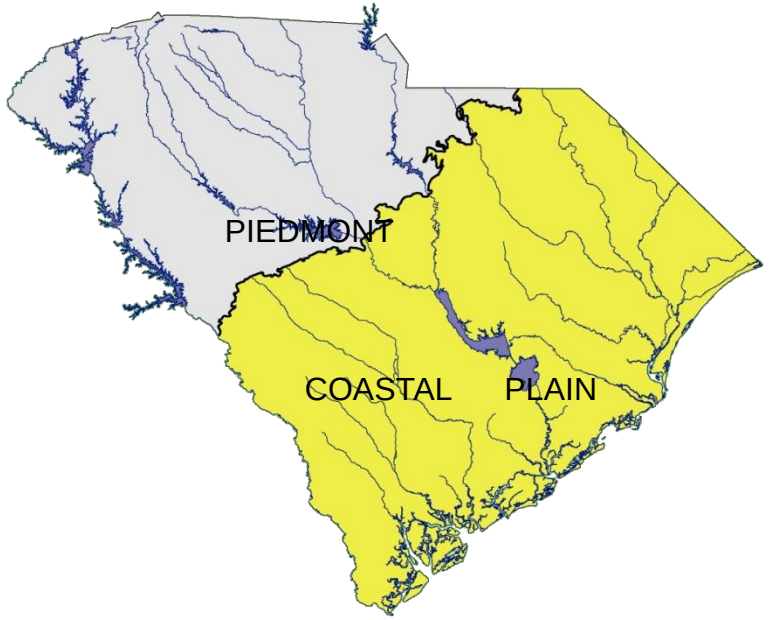
Ground water

- 99% of S.C.’s water is underground
- 390,000 billion gallons
- Coastal Plain aquifers (95% of GW)
- Bedrock fractures/saprolite (5% of GW)



Surface water

- 1% of S.C.’s water is on surface
- Lakes (4,900 billion gallons)
- Rivers (33 billion gallons/day)



Water Use in South Carolina

2006 water use, in billions of gallons (source: SCDHEC)

Water-use category	Surface water	Ground water	Total water	Percent of total
Nuclear power	2,980	0.36	2,980	74.7
Thermoelectric power	580	5	586	14.7
Water supply	187	39	226	5.7
Industrial	138	11	149	3.7
Agricultural irrigation	11	18	29	0.7
Golf-course irrigation	9	3	12	0.3
Mining	0.5	3.2	3.7	0.1
Aquaculture	0.17	0.15	0.32	0.01
Other	0	0.05	0.054	0.001
Total use	3,910	81	3,990	100.0

Hydroelectric power	12,409	0.001	12,409

Source: SC Department of Natural Resources

Instream (non-consumptive) water uses:

Hydro and Nuclear-electric power

Navigation

Waste Assimilation

Fish and Wildlife Habitat

Recreation

Offstream (consumptive) water uses:

Thermo and Nuclear-electric power

Public/Municipal supply

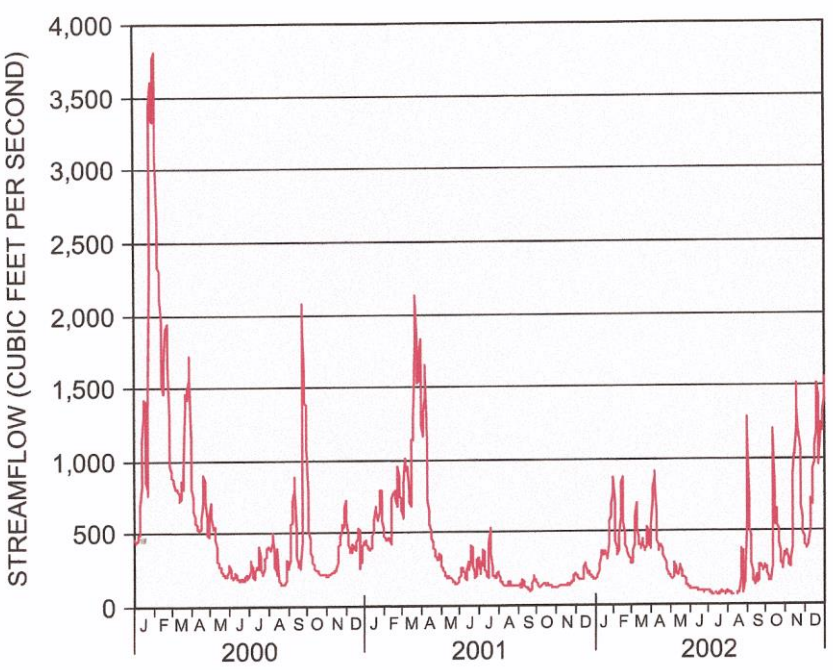
Industrial supply

Irrigation – Agricultural and Golf Courses

Factors Affecting Water Availability

Most of our rivers are shared with North Carolina and Georgia

Flows that vary seasonally with precipitation, ET, and ground-water storage



Surface Water Withdrawal Permitting, Registration and Use and Reporting Act

Beginning January 1, 2011, anyone withdrawing more that 3 million gallons or more in any 1 month from surface waters of South Carolina must obtain a surface water withdrawal permit or, for agricultural withdrawals, register their withdrawal with the Department unless exempt under the Act.

Groundwater Use and Reporting Act Capacity Use Areas

The Groundwater Use and Reporting Program issues Groundwater Use Withdrawal Permits to all groundwater systems located in a designated Capacity Use Area.

CUA's: **Low Country** (Beaufort, Colleton, Hampton, and Jasper counties), **Pee Dee** (Darlington, Dillon, Florence, Marion, Marlboro, Williamsburg counties), **Trident** (Berkeley, Charleston, and Dorchester) and **Waccamaw** (Georgetown and Horry counties).

Groundwater withdrawal permits are required to withdraw and use groundwater equal to or greater than three million gallons in any month in the counties in these areas.

Drought

"A period of diminished precipitation which results in negative impacts upon the hydrology, agriculture, biota, energy, and economy of the State."

(SC Drought Response Act)

Meteorological

- an extended period of departure from average precipitation for a specific location or region

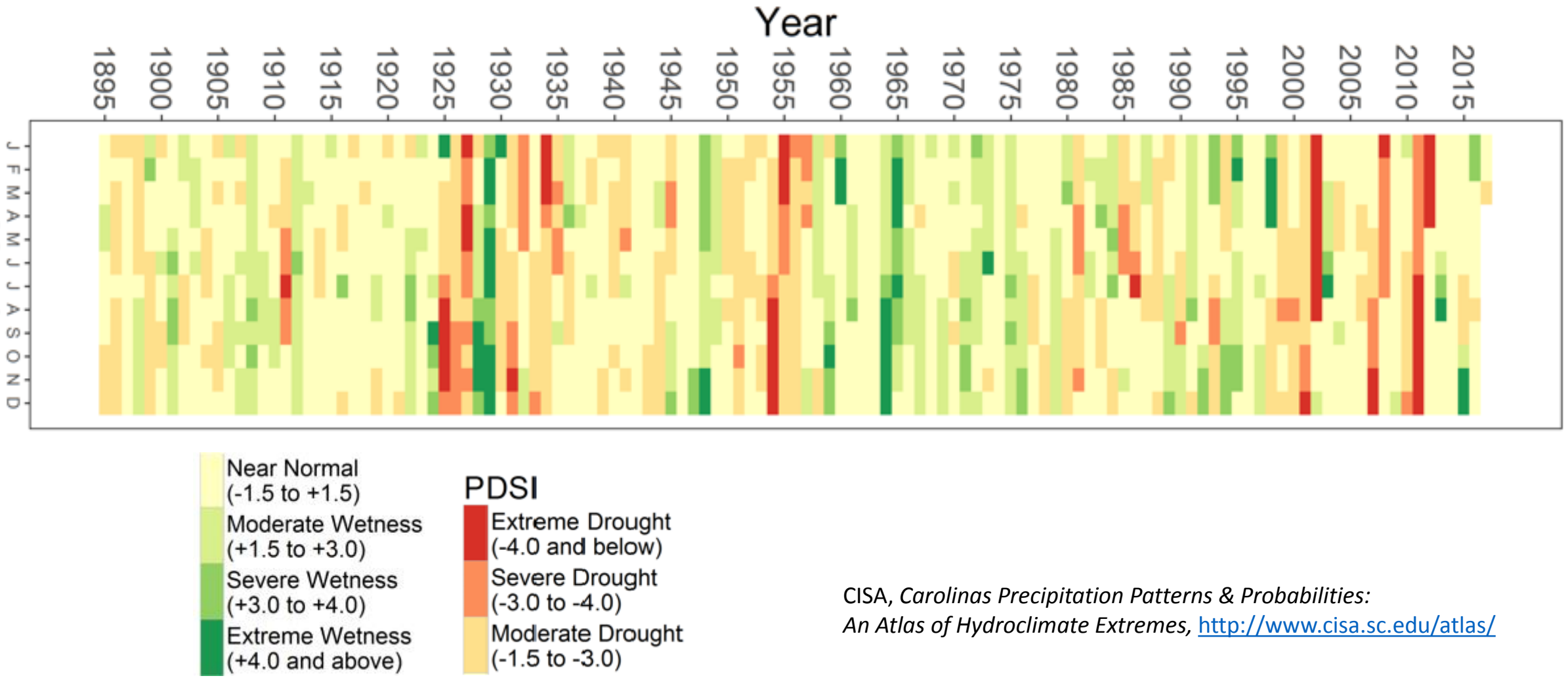
Agricultural

- lack of adequate moisture to sustain plant growth and development

Hydrological

- measured by effects on streamflow, reservoirs, lakes, and groundwater

SC Palmer Drought Severity Index



CISA, *Carolinas Precipitation Patterns & Probabilities: An Atlas of Hydroclimate Extremes*, http://www.cisa.sc.edu/atlas/

Measuring Drought

- Drought are hard to measure due to various temporal and spatial scales
- Drought indicators are used to measure and assess droughts
- A **drought index** value is typically a single number and is more useful than raw data for decision-making
- Some indices are sector-specific
  - Crop Moisture Index (CMI) – agriculture
  - Keetch-Byram Drought Index (KBDI) – forestry, fire
- **Indicators are not anticipated to be a perfect match**

SC Drought Indicators and Drought Alert Phases

Indicator	Description	Drought Phase			
		Incipient	Moderate	Severe	Extreme
Palmer Drought Severity Index	Depicts prolonged (months, years) abnormal dryness or wetness; incorporates temperature, precipitation, and soil moisture data	-0.50 to -1.49	-1.50 to -2.99	-3.00 to -3.99	≤ -4.00
Crop Moisture Index	Depicts short-term (up to 4 weeks) abnormal dryness or wetness affecting agriculture	0.00 to -1.49	-1.50 to -2.99	-3.00 to -3.99	≤ -4.00
Standard Precipitation Index	Compares observed precipitation amount (from (1- to 24-month periods) with long-term averages for the same period	0.00 to -0.99	-1.00 to -1.49	-1.50 to -1.99	≤ -2.00
Keetch-Byram Drought Index	Depicts moisture deficiencies in the upper layers of the soil; used to monitor fire danger	300 to 399	400 to 499	500 to 699	≥ 700
U.S. Drought Monitor	A weekly product that uses a variety of drought, climatological, hydrological, soil moisture and other indicators and indices as inputs	D0	D1	D2	≥ D3
Average daily streamflow	*CW – consecutive weeks	111%-120% of the minimum flow for 2 CW*	101%-110% of the minimum flow for 2 CW*	between the minimum flow and 90% of the minimum for 2 CW*	≤ than 90% of the minimum for 2 CW*
Ground Water, Static water level in an aquifer	**CM – consecutive months	between 11 - 20 ft above trigger level for 2 CM**	between 1-10 ft above trigger level for 2 CM**	between the trigger level and 10 ft below for 2 CM**	>than 10 ft below the trigger level for 2 CM**

Drought Response Plans in South Carolina

- Drought Response Act
- Drought Regulations
- Emergency Operations Plan (Appendix 10, SC Drought Response Plan)

South Carolina Drought Response Committee

- **Statewide Committee Members**
  - SC Dept. of Natural Resources
  - SC Emergency Management Division
  - SC Dept. of Health and Environmental Control
  - SC Department of Agriculture
  - SC Forestry Commission

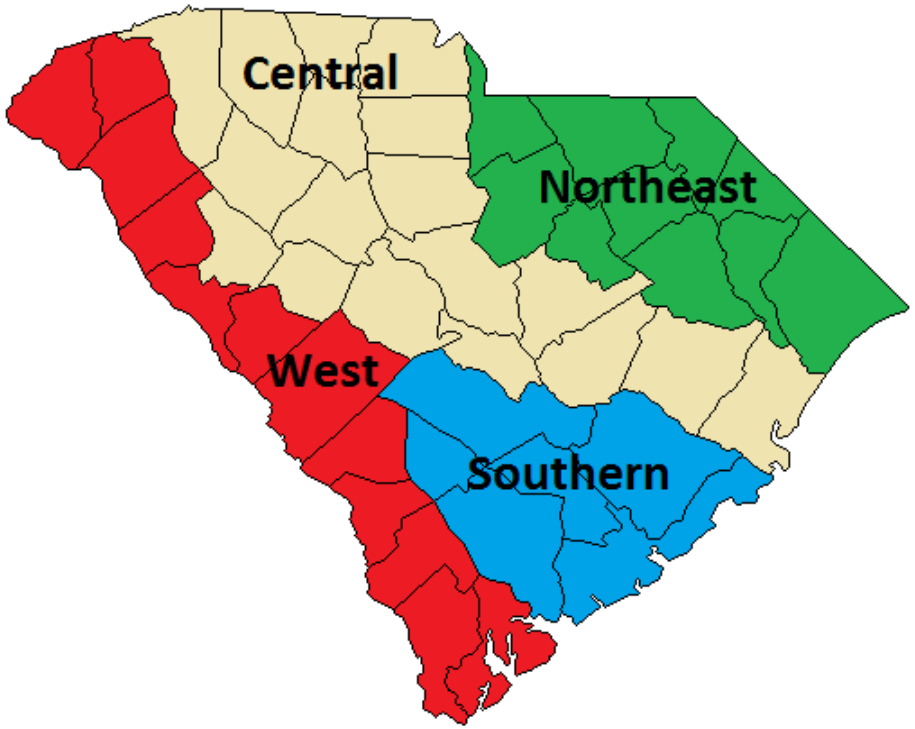
- **Local Committee Members**

Agriculture
Counties
Commissions of Public Works
Power Generation Facilities
Regional Councils of Government
Soil & Water Conservation Districts
Industry
Municipalities
Domestic users
Private water suppliers
Public service districts
Special Purpose Districts

- **Invited Participants**

Farm Service
United States Dept. of Agriculture
National Weather Service
US Geological Survey

SC Drought Management Areas



West	Central	Northeast	Southern
• Abbeville	• Calhoun	• Chesterfield	• Bamberg
• Aiken	• Cherokee	• Darlington	• Berkeley
• Allendale	• Chester	• Dillon	• Charleston
• Anderson	• Clarendon	• Florence	• Colleton
• Barnwell	• Fairfield	• Horry	• Dorchester
• Beaufort	• Georgetown	• Kershaw	• Orangeburg
• Edgefield	• Greenville	• Lancaster	
• Hampton	• Greenwood	• Lee	
• Jasper	• Laurens	• Marion	
• McCormick	• Lexington	• Marlboro	
• Oconee	• Newberry		
• Pickens	• Richland		
	• Saluda		
	• Spartanburg		
	• Sumter		
	• Union		
	• Williamsburg		
	• York		

Drought Declarations

Drought committee reviews drought related variables such as:

PDSI = Palmer Drought Severity Index

CMI = Crop Moisture Index

SPI = Standard Precipitation Index

KDBI = Keetch-Byram Forest Fire Drought Index

DM = US Drought Monitor

Streamflow = Average streamflow for two consecutive weeks

Aquifer Level= Static water level for two consecutive months

Specific numerical values for the indices that define each level of drought are established through regulation.

4 levels of drought:

Incipient

Moderate

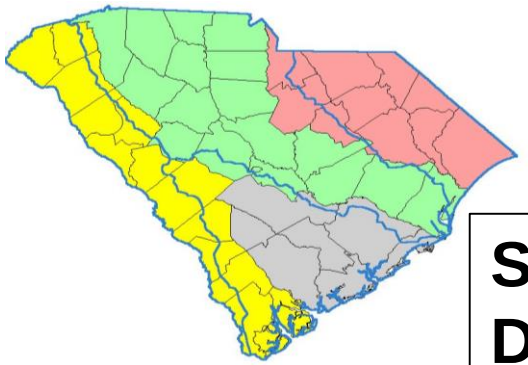
Severe

Extreme

South Carolina's Hydro-Logical Cycle

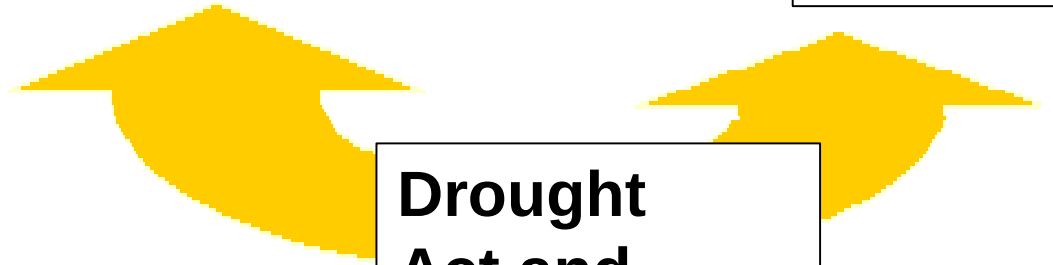
Local Drought Plans and Ordinances

State Drought Program



Local Drought Committee (12)

State Agency Drought Committee (5)



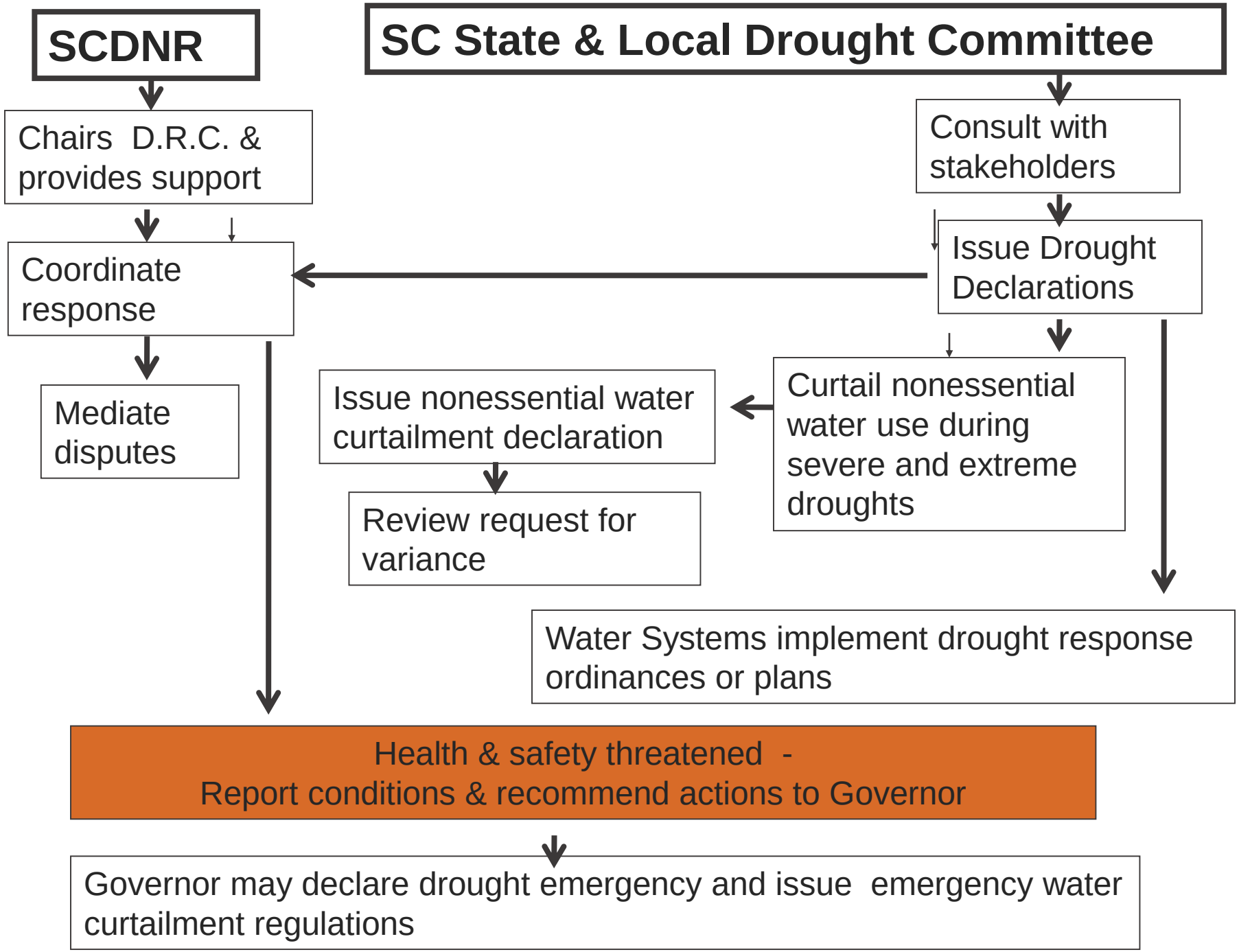
Drought Act and Regulations

South Carolina Model Drought Mitigation Ordinance/Plan

- SC Drought Response Act of 2000 requires that all municipalities, counties, public service districts, special purpose districts, and commissions of public works engaged in business or activity of supplying water for any purpose develop and implement drought response ordinances or plans.

- Ordinances and plans must be consistent with model water system ordinance and plan developed by SCDNR, SCDHEC, and SC Water Utility Council

- DHEC checking for this during Sanitary Surveys starting in July

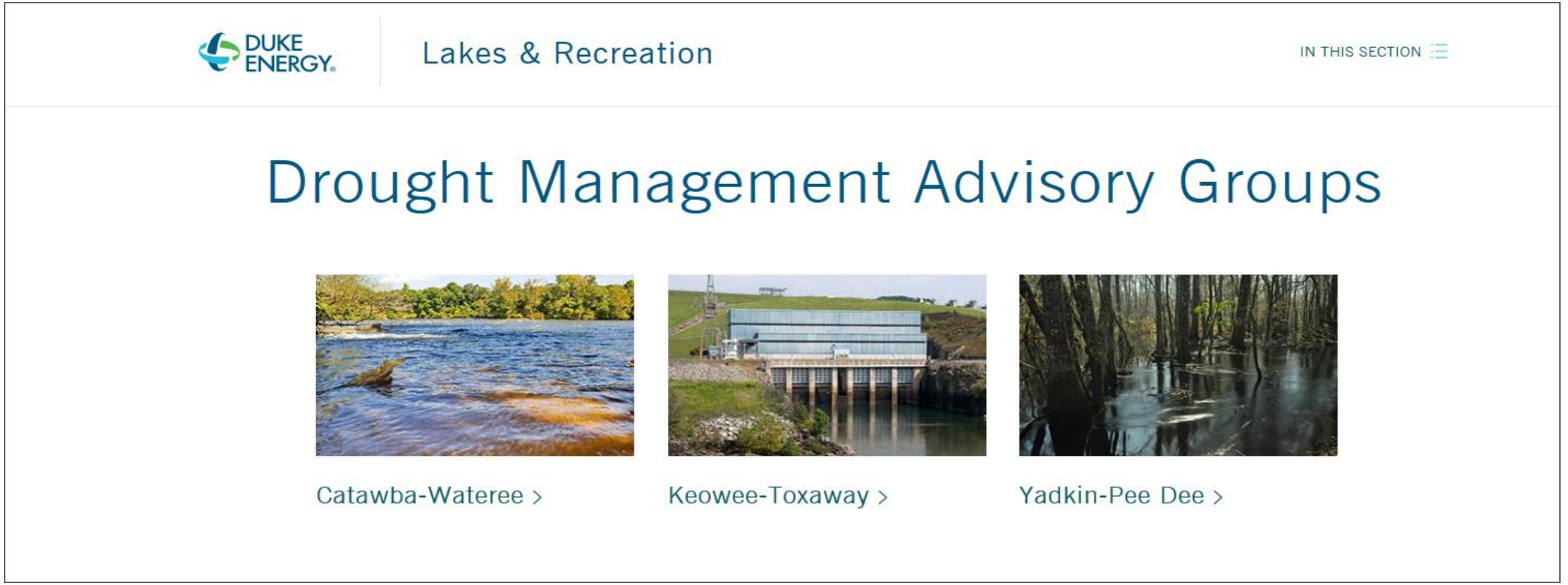

SCDNR
SC State & Local Drought Committee
Chairs D.R.C. & provides support
Consult with stakeholders
Coordinate response
Issue Drought Declarations
Mediate disputes
Issue nonessential water curtailment declaration
Curtail nonessential water use during severe and extreme droughts
Review request for variance
Water Systems implement drought response ordinances or plans
Health & safety threatened -
Report conditions & recommend actions to Governor
Governor may declare drought emergency and issue emergency water curtailment regulations

Examples of Basin/regional plans

- Low Inflow Protocols (LIPs) for Duke Energy reservoirs
  - Catawba-Wateree
  - Keowee-Toxaway
  - Yadkin-Pee Dee
- US Army Corps of Engineers
  - Savannah River Basin
- Santee Cooper

Low Inflow Protocols (LIPs)

- Developed during FERC relicensing processes
- Plans used by Duke Energy and others to manage water quantities in, and releases from, reservoirs during drought



Source: https://www.duke-energy.com/community/lakes/drought-management-advisory

Catawba-Wateree River Basin

- 11 reservoirs
- Managed by Duke Energy

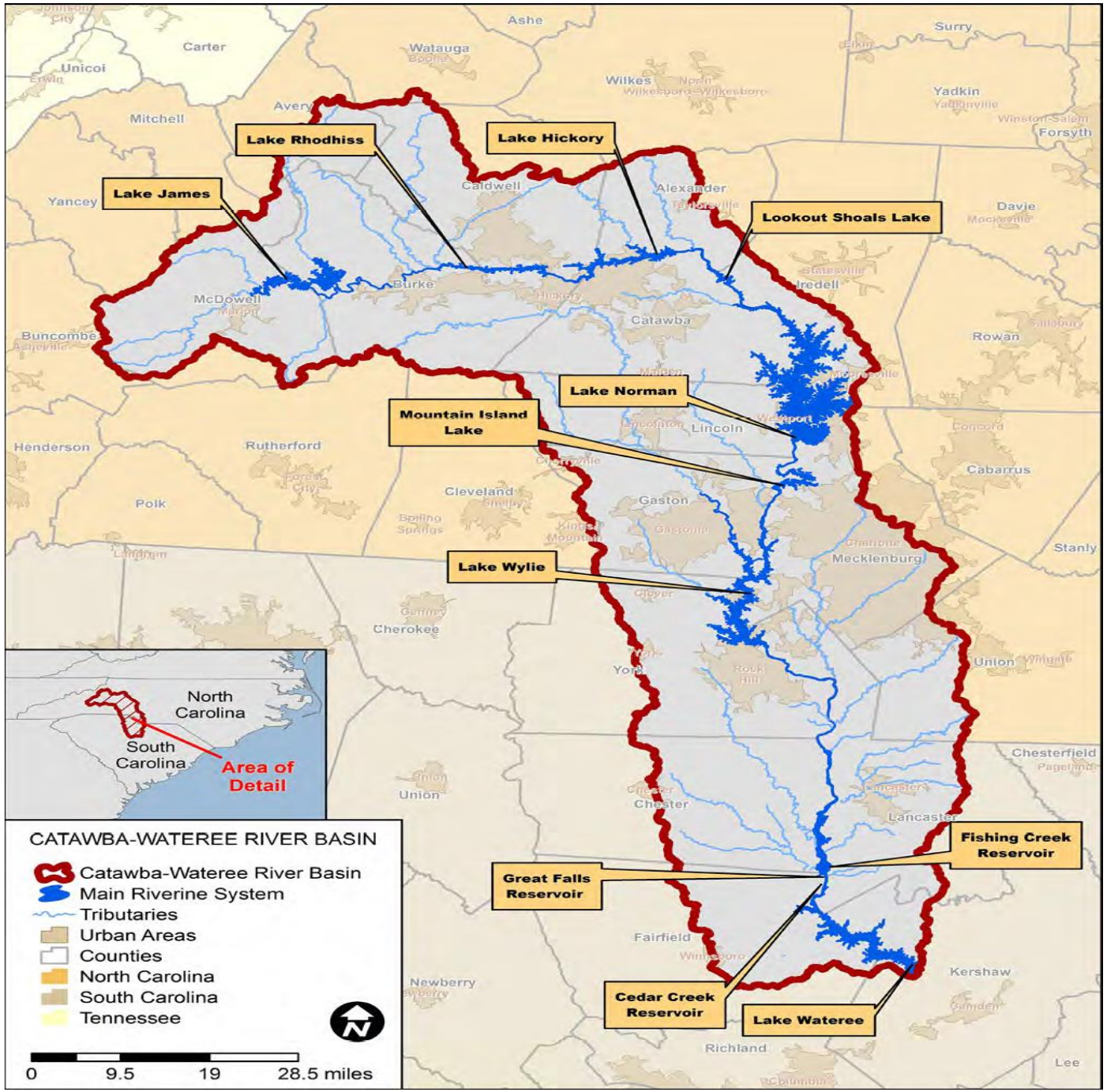


Figure source: [Catawba-Wateree River Basin Water Supply Master Plan](), 2014

Catawba-Wateree LIP

Summary of LIP Trigger Points

Stage	Storage Index [1]		Drought Monitor [2] (3-month average)		Monitored USGS [3] Streamflow Gages
0[4]	90% < SI < TSI		0 = DM		AVG = 85%
1	75% < SI = 90%TSI	**and**	1 = DM	**or**	AVG = 78%
2	57% < SI = 75%TSI	**and**	2 = DM	**or**	AVG = 65%
3	42% < SI = 57%TSI	**and**	3 = DM	**or**	AVG = 55%
4	SI = 42%TSI	**and**	DM = 4	**or**	AVG = 40%

[1] The ratio of Remaining Useable Storage to Total Usable Storage at a given point in time.

[2] The three-month numeric average of the published U.S. Drought Monitor.

[3] The sum of the rolling sixth-month average for the monitored streamflow gages as a percentage of the period of record rolling average for the same six-month period for the monitored streamflow gages.

[4] Stage 0 is triggered when any two of the three trigger points are reached.

Details actions to be taken by Duke and water utilities during different stages of drought

- Progressive reduction of flows released from dams and reductions to minimum lake levels
- Progressive water use restrictions
- Increased communications with customers and between Duke Energy and water utilities

South Carolina water utility members and participants include:

- City of Rock Hill; Catawba River WTP (Union County, NC/Lancaster County, SC); Chester Metropolitan District; City of Camden; Lugoff-Elgin Water Authority; Town of Fort Mill; York County

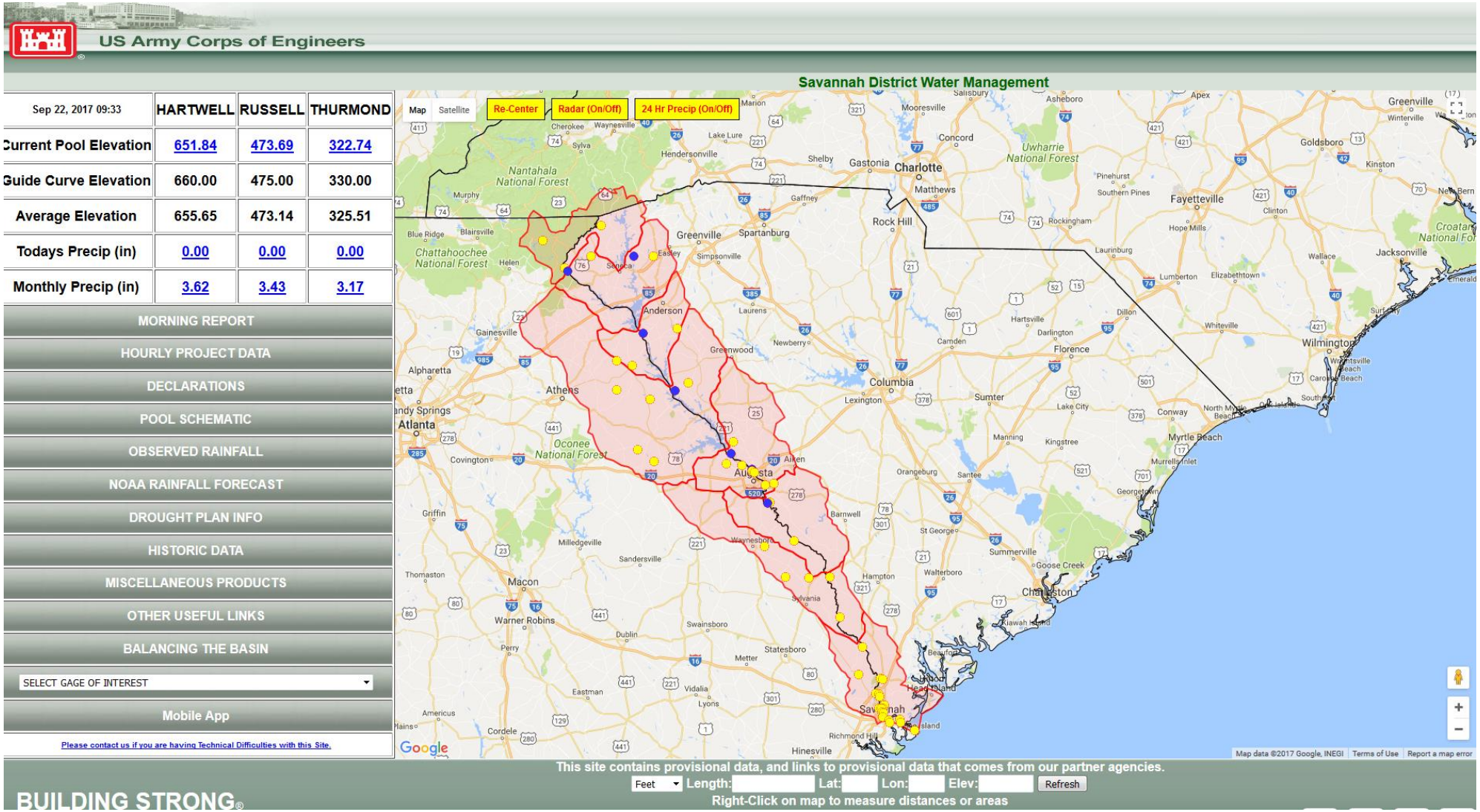
Catawba-Wateree LIP Trigger Status Summary for 01/03/17 and Changes Compared to 12/01/16

	Reservoir Storage as % of Target	% of 6-Month Long-Term Avg Streamflow	3-Month Avg of US Drought Monitor	Groundwater Levels
Normal	>=100%	>85%	<0	
LIP Stage 0	▲ 97.8% >90%	<=85%	>=0	
LIP Stage 1 — Jan 3, 2017	>75%	<=78%	>=1	— Langtree
LIP Stage 2	>57%	<=65%	▼ 2.33 >=2	
LIP Stage 3	>42%	▼ 50.0% <=55%	>=3	▼ Glen Alpine
LIP Stage 4	<=42%	<=40%	4	

To recover to a less restrictive LIP Stage, all four triggers must support that Stage or lower.

https://www.duke-energy.com//_/media/pdfs/community/lakes-and-rec/2017-catawba-wateree/lip-trigger-status-01-03-17.pdf

Savannah River Basin: Water Management Page



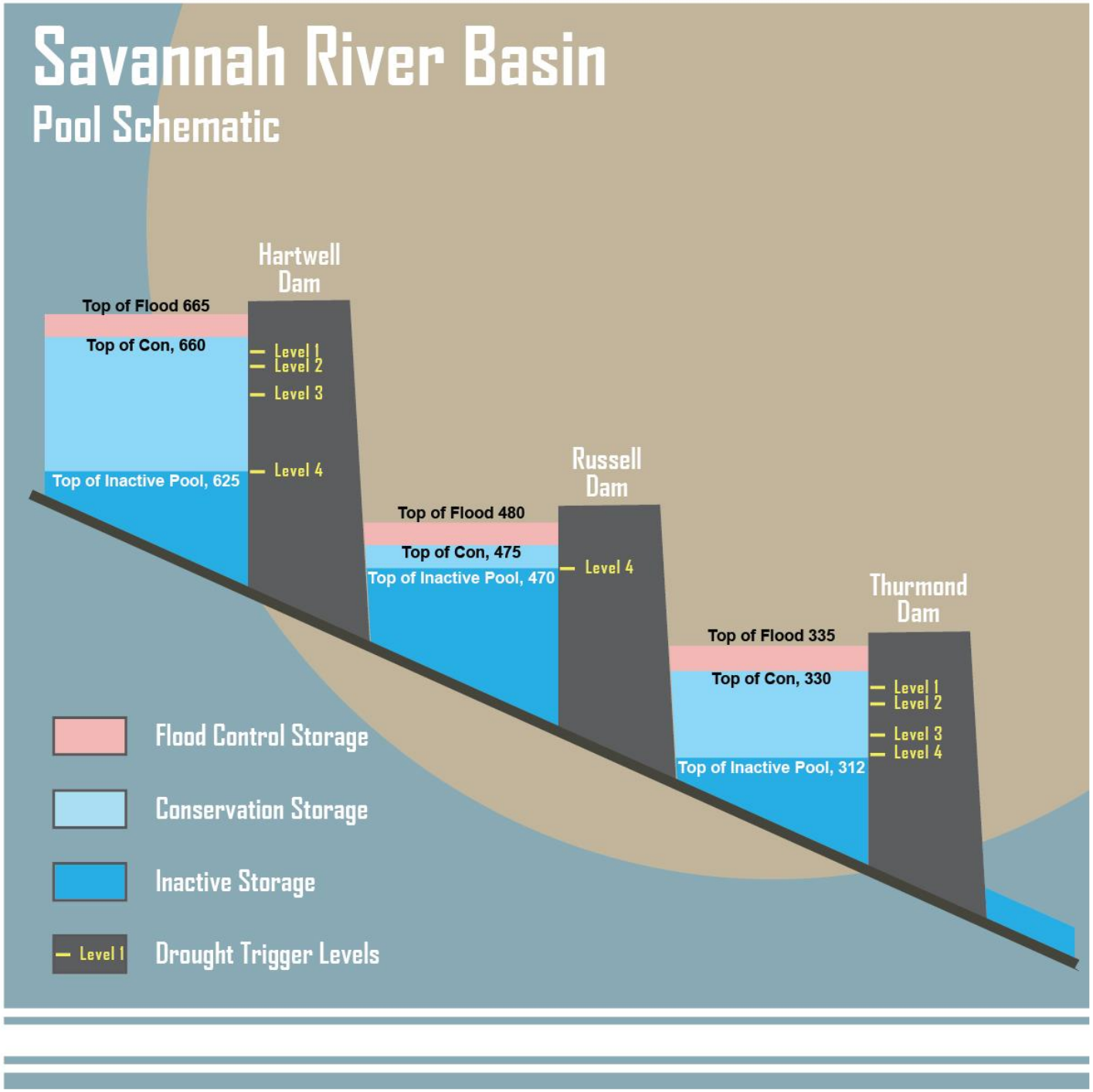
http://water.sas.usace.army.mil/gmap/

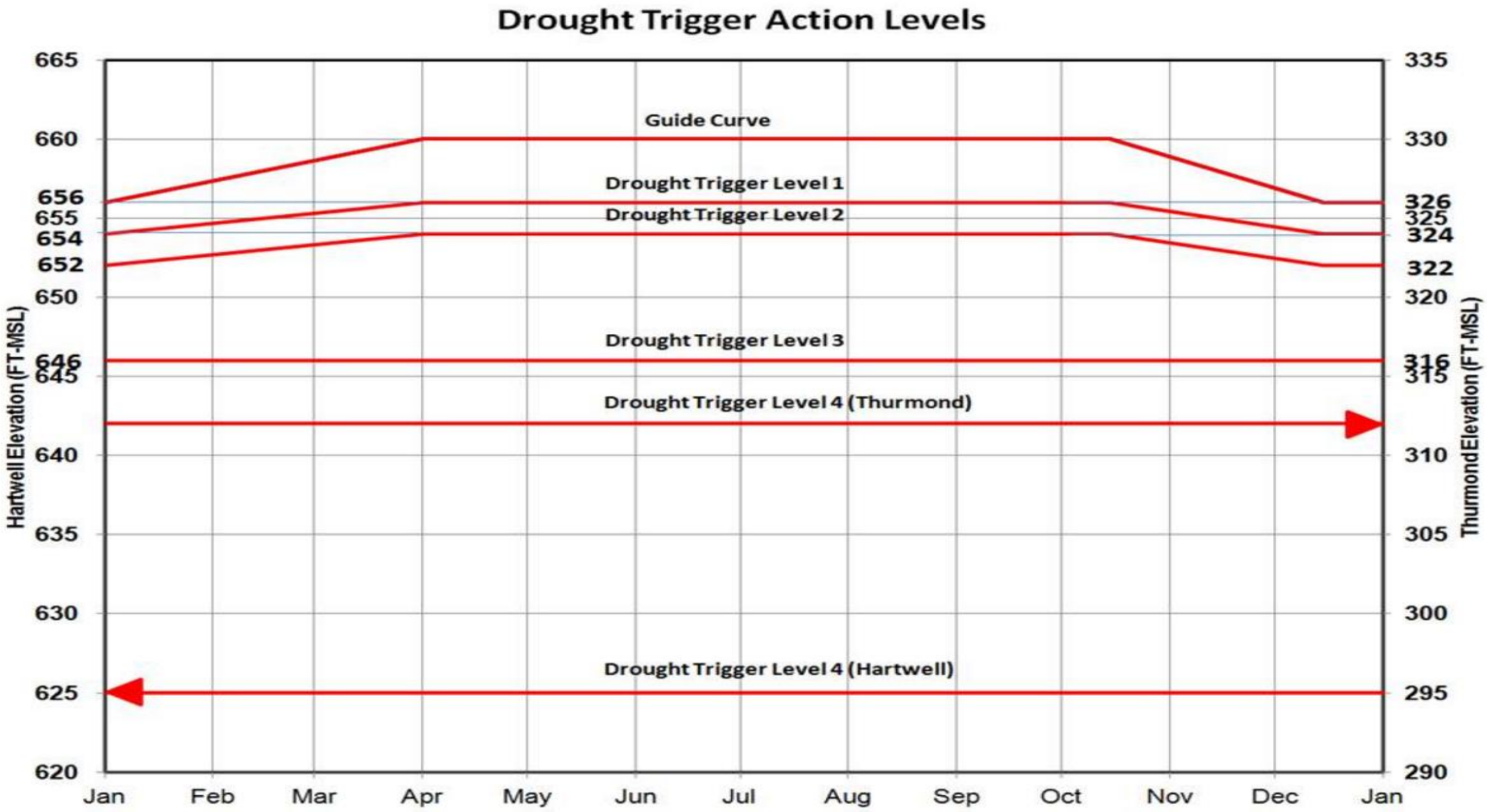
"During periods of drought, we reduce outflows from the dams according to our Drought Management Plan (last updated in September 2012, but is currently being analyzed as part of the Comprehensive Study).

The plan establishes four "levels" of drought and a protocol for reducing outflows at each level.

This plan was coordinated with Georgia and South Carolina natural resource agencies and federal resource agencies."

(http://balancingthebasin.armylive.dodlive.mil/water-management-101/)





http://water.sas.usace.army.mil/images/sets/DroughtPlan.cfm

Drought Trigger Levels and Response

Trigger Level	Time of Year	Drought Response
1	Jan 1 - Dec 31	IF BR index >10%, Target 4200 cfs (weekly average) release at Thurmond Dam IF BR index <10%, Target 4000 cfs (weekly average) release at Thurmond Dam
2	Feb 1 - Oct 31	IF BR index >10%, Target 4000 cfs (weekly average) release at Thurmond Dam IF BR index <10%, Target 3800 cfs (daily average) release at Thurmond Dam
	Nov 1 - Jan 31	Target 3600 cfs (daily average) release at Thurmond Dam
3	Feb 1 - Oct 31	Target 3800 cfs (daily average) release at Thurmond Dam
	Nov 1 - Jan 31 (Feb 1 – Feb 28 w/NMFS approval)	Target 3100 cfs (daily average) release at Thurmond Dam
4	Feb 1 - Oct 31	Target 3600 cfs (daily average) release at Thurmond Dam
	Nov 1 - Jan 31 (Feb 1 – Feb 28 w/NMFS approval)	Target 3100 cfs (daily average) release at Thurmond Dam

There will be a 2 week delay in reducing flows from the normal unrestricted releases at Thurmond to the level 1 drought flow restriction levels.
This 2 week delay is mitigation for possible Harbor impacts implemented as part of the Storage Balance Agreement with the Duke Projects.
BR index refers to the relative percentile of the 28 day average flow for the Broad River Gage (02192000) at Bell, GA.
http://waterwatch.usgs.gov/new/index.php?m=pa28d&r=ga&w=map

http://water.sas.usace.army.mil/images/sets/DroughtPlan.cfm

Drought Timeline for today's exercise