Improving Climate Information in Hydropower Dam Relicensing

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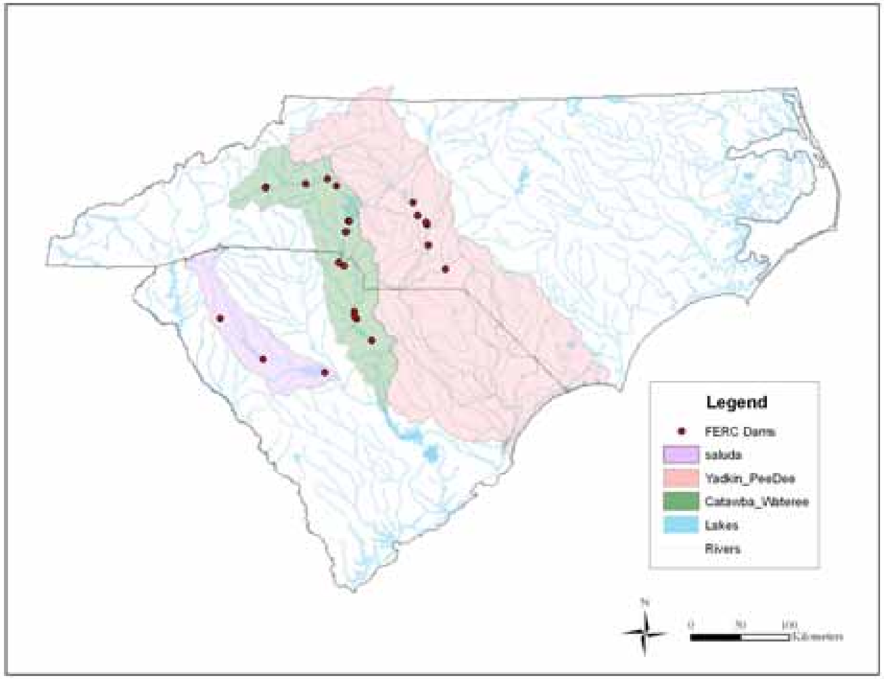
Significance of Relicensing Agreements

Federal Energy Regulatory Commission (FERC) licenses

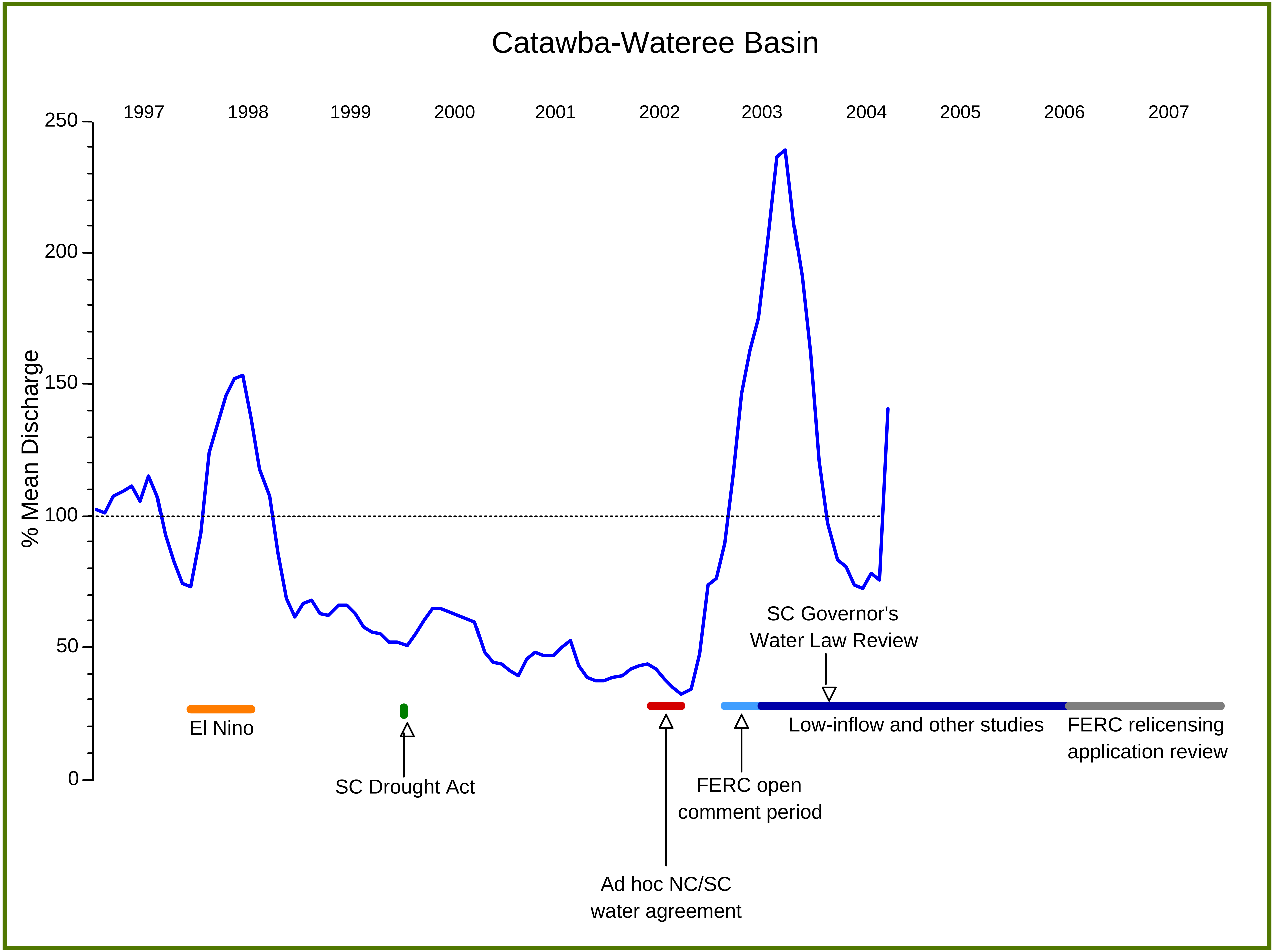
- more than 1,000 private and non-federal, public dams used for hydroelectric power generation
- Dams are located in 44 states and Puerto Rico
- 25% of licenses are up for renewal before 2020
- 30-50 year licenses terms that set management standards, *e.g.*
  - Minimum flows for downstream water usage needs
  - Low inflow protocols
  - Emergency condition protocols
  - Normal operating ranges for lake levels
  - In-stream flows for wildlife habitats and water quality
  - Public information systems
  - Hydro Station operations
  - Various management plans for cultural resources, public recreation, species protection, shoreline management, etc.
- Many existing licenses were granted before the major environmental laws of the 1970s came into full force and implementation *e.g.,*
  - National Environmental Policy Act (1970); Endangered Species Act (1973); Clean Water Act (1977)

In the Carolinas

- FERC dams control major river basins
- Economic and population growth are expected to place further pressures on water resource supplies and allocation
- A recent 4-year drought has heightened sensitivity to drought impacts
- Interstate water agreements do not yet exist, but policy makers are aware of the need



Dams and basins managed under FERC licenses



Catawba-Wateree Basin
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
250
200
150
100
50
0
% Mean Discharge
El Nino
SC Drought Act
Ad hoc NC/SC water agreement
FERC open comment period
SC Governor's Water Law Review
Low-inflow and other studies
FERC relicensing application review

Agencies and Interests in the FERC Relicensing Process

Federal Agencies

United States Environmental Protection Agency

U.S. Fish & Wildlife Service
Department of the Interior

The Licensee

Duke Power
A Duke Energy Company

Non-Agency Stakeholders

Catawba Riverkeeper®

Catawba-Wateree CWRC Relicensing Coalition

Charlotte.

Trout Unlimited

Coastal Conservation League

Mountain Island Lake Marine Commission

State Agencies

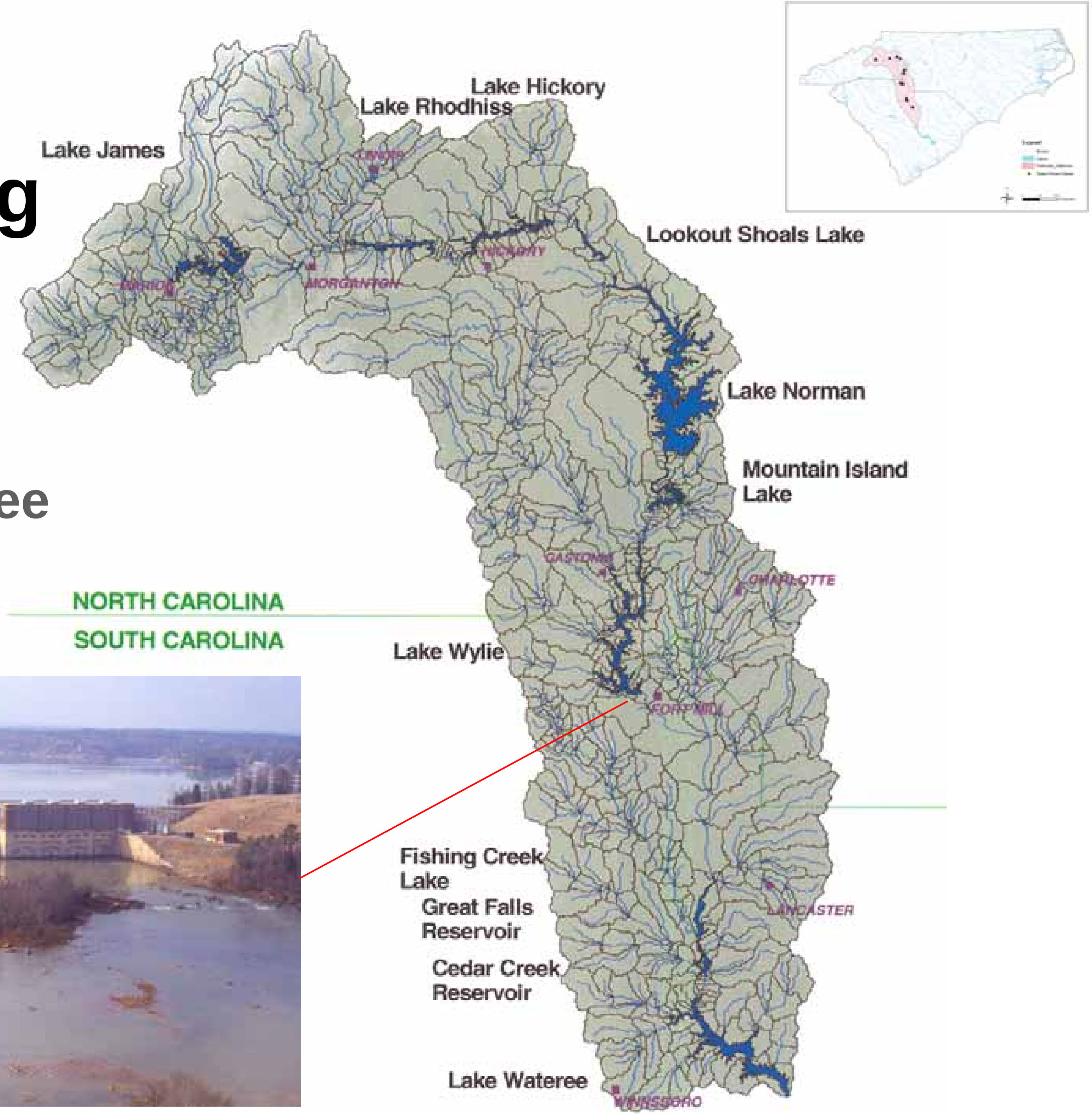
North Carolina Wildlife Resources Commission

South Carolina Department of Natural Resources

D H E C
Promote Protect Prosper

FERC Relicensing

Duke Power and the Catawba/Wateree River



Motivating Climate Adaptation through FERC Relicensing

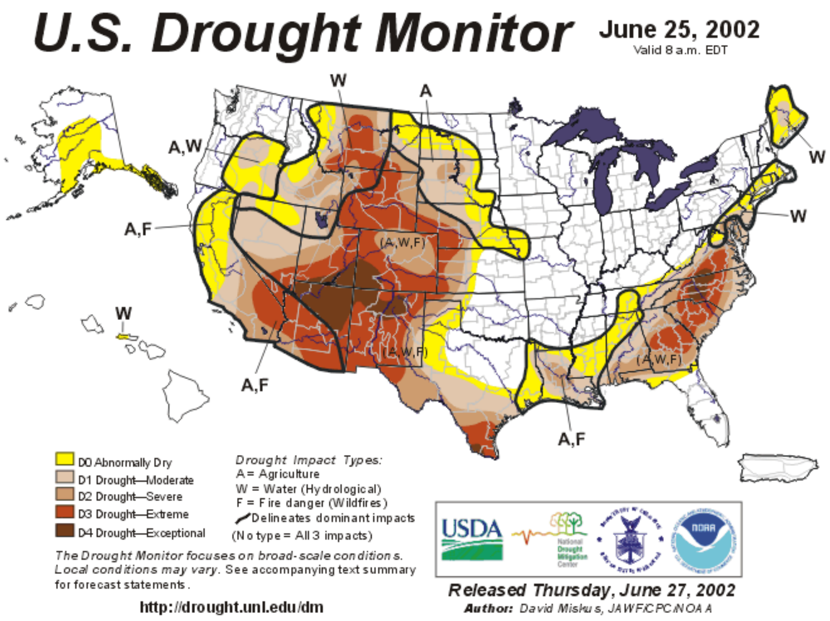
Water resources stakeholders

- Are very sensitive to drought impacts and committed to addressing management shortcomings
- Want better information on variability to anticipate and manage drought and low inflow periods
- Asked CISA and NC/SC State Climatologists to develop a climate-based low inflow management tool

Existing Low Inflow Protocol Tools

- On the Catawba-Wateree, Duke Power uses set management triggers based on streamflow levels
- Streamflow measured at 4 gages with unregulated flow

Some relicensing working group participants are aware of the U.S. Drought Monitor from other regulatory processes



Creating the Next Generation Low Inflow Protocol Tools

Stakeholder interests

- Better understanding of the range of variability and associated probabilities
- Increasing the spatial resolution of the drought monitor
- Providing the ability for stakeholders to investigate the way different drought indices represent the sensitivity of their systems – by management unit

Dynamic Drought Indices Webpage

- Available for review at drought.dnr.sc.gov
- During development, CISA team has presented regular updates to the FERC working group
- Addresses stakeholder interests
- Regulatory use of this tool is still under discussion in the relicensing process

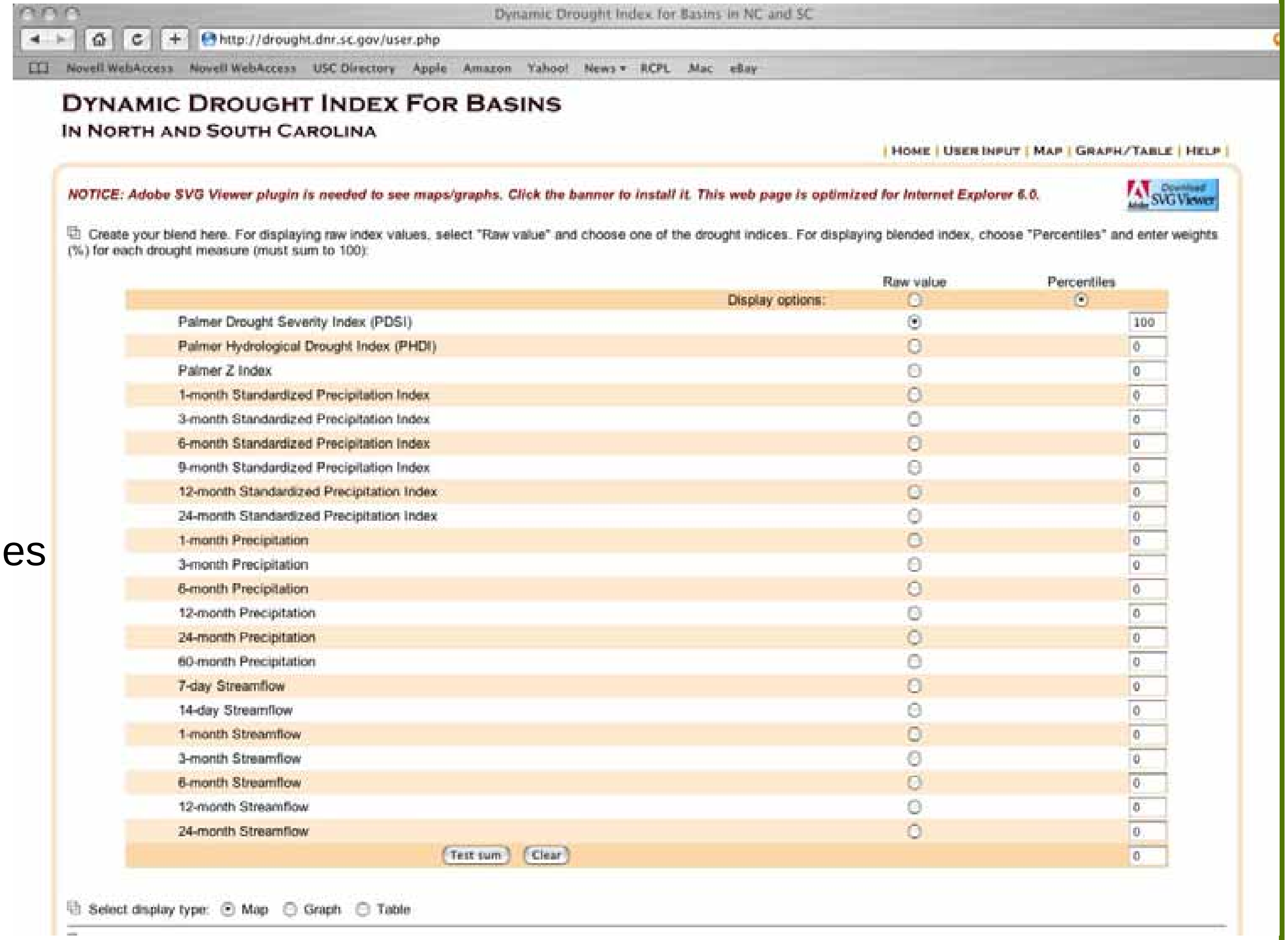
Allows Comparison of Drought Indices, Blends, and Streamflow

Drought indices

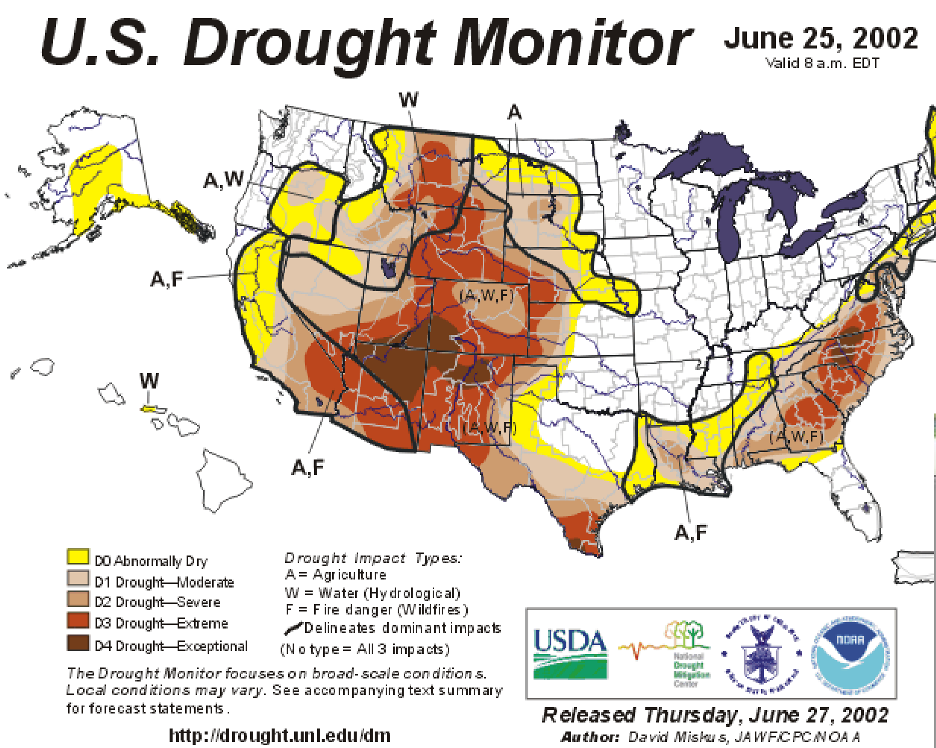
- Palmer
  - PDSI
  - PHDI
  - Z index

At several time scales

- SPI
- Preciptation
- Streamflow

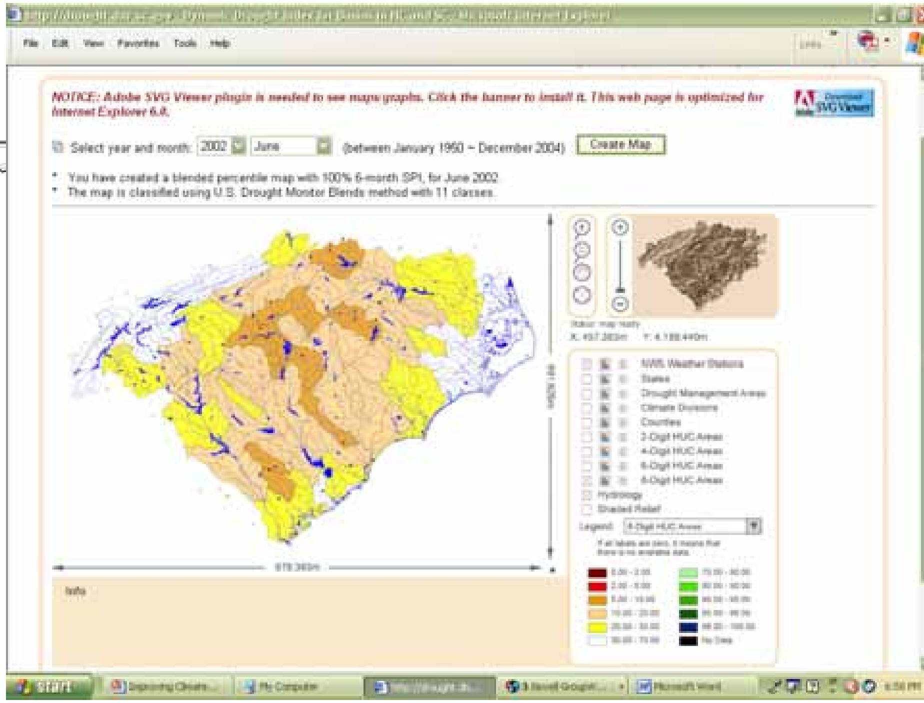


Offers Increased Spatial Resolution



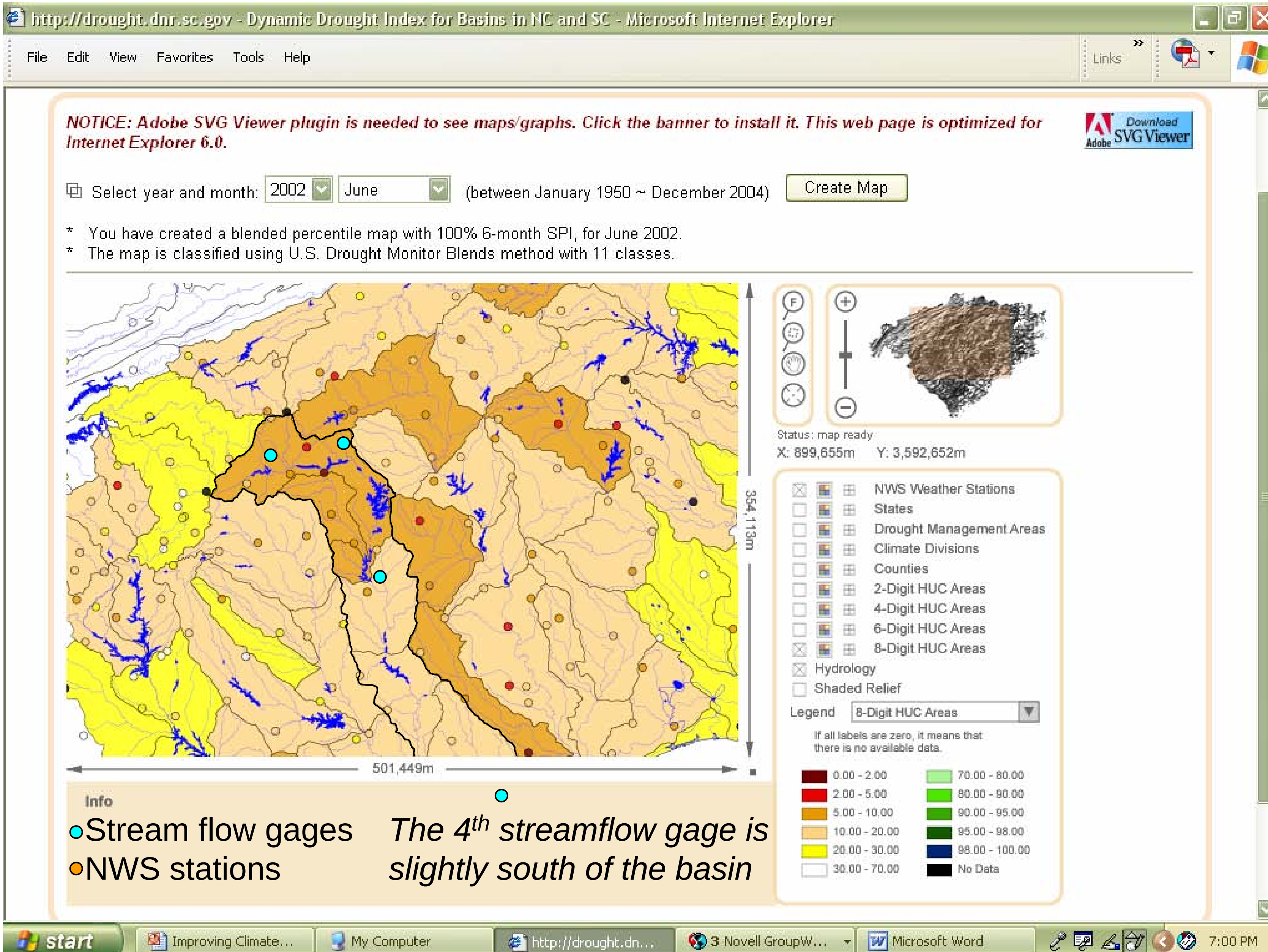
Based on Climate Divisions

Based on 8 digit Hydrologic Unit Codes



Both figures represent June 2002,
the height of the recent drought

Uses a Denser Monitoring Network



- Stream flow gages
- NWS stations

The 4th streamflow gage is slightly south of the basin

Climate Awareness and Adaptation with Dynamic Drought Indices Tool

- Allows stakeholders to compare drought indices and blends
- Increased spatial resolution for multiple management units
- Based on a more robust monitoring network – improved spatial and temporal record to support streamflow gages

Additional Options For Better Climate Integration and Adaptation

- More holistic view of the hydrologic cycle
- Relies on a continuously updated database in calculations
- Stakeholders all use the same climate record for management decision making
- Potential for percentile-based rather than fixed low inflow protocol triggers
- Depending on the index or blend, can provide an earlier warning signal

Next Steps

- Catawba-Wateree stakeholders consider how to use tool
  - Experimentation, evaluation, identification of uncertainties
  - Debate and determine -- Which drought index blend?
  - Consider -- Percentile-based versus fixed trigger points for management stages?
- Hydropower management protocols that anticipate climate variability and potential impacts
  - Influence major river basins and downstream uses
  - Integrated with major federal environmental regulations over 30-50 year license period
- Foundation for learning, adaptation, and adaptive management that integrates climate information
- Investigate potential uses in other sectors and other basins