Development of Basinwide Surface-Water Quantity Models in South Carolina

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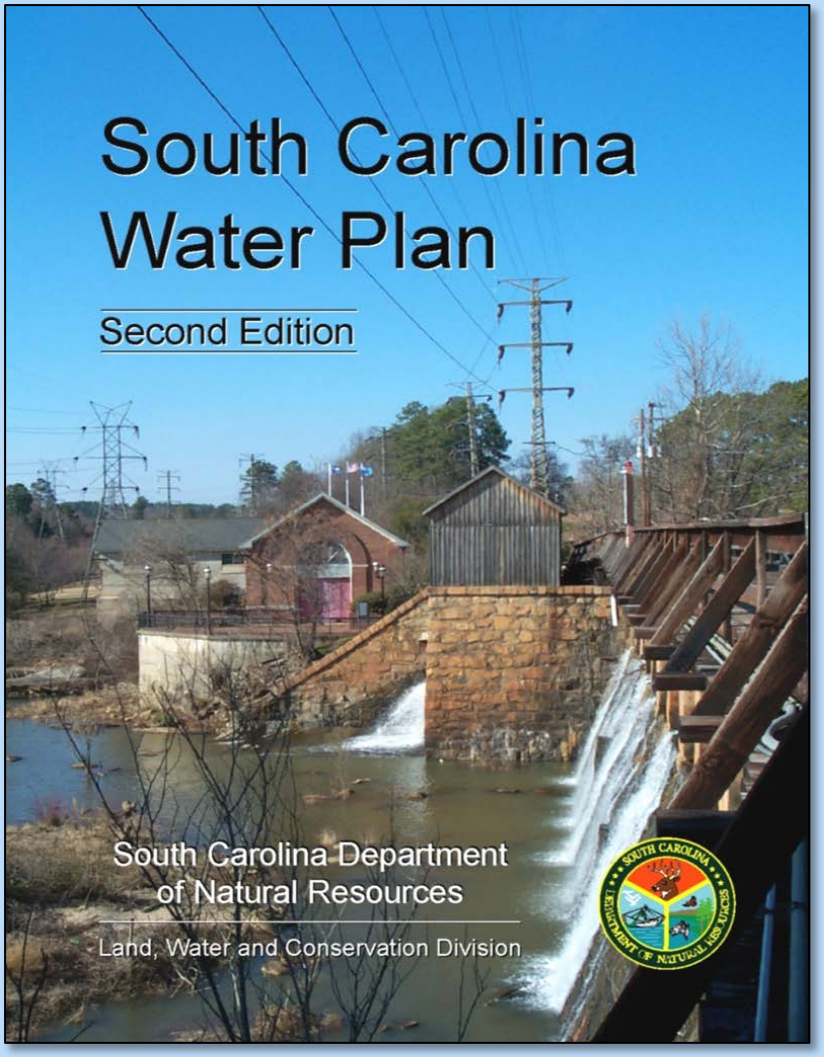


In 2004, DNR published the second edition of the South Carolina Water Plan incorporating lessons learned from the drought of 1998-2002.

One recommendation is for the development of regional water plans for each major river basin in the State.

South Carolina's 8 major river basins…

Regional water plans will be developed for each of these basins, the same basins used by DHEC for water-quality assessments and for managing interbasin transfers of water.

Before planning begins, surface-water quantity models will be developed for each basin.

Models will be used to…

- Determine surface-water availability
- Predict where and when water shortages might occur
- Test alternative water-management strategies
- Help resolve water disputes
- Evaluate interbasin transfers and withdrawal permits
- Support development of drought management plans

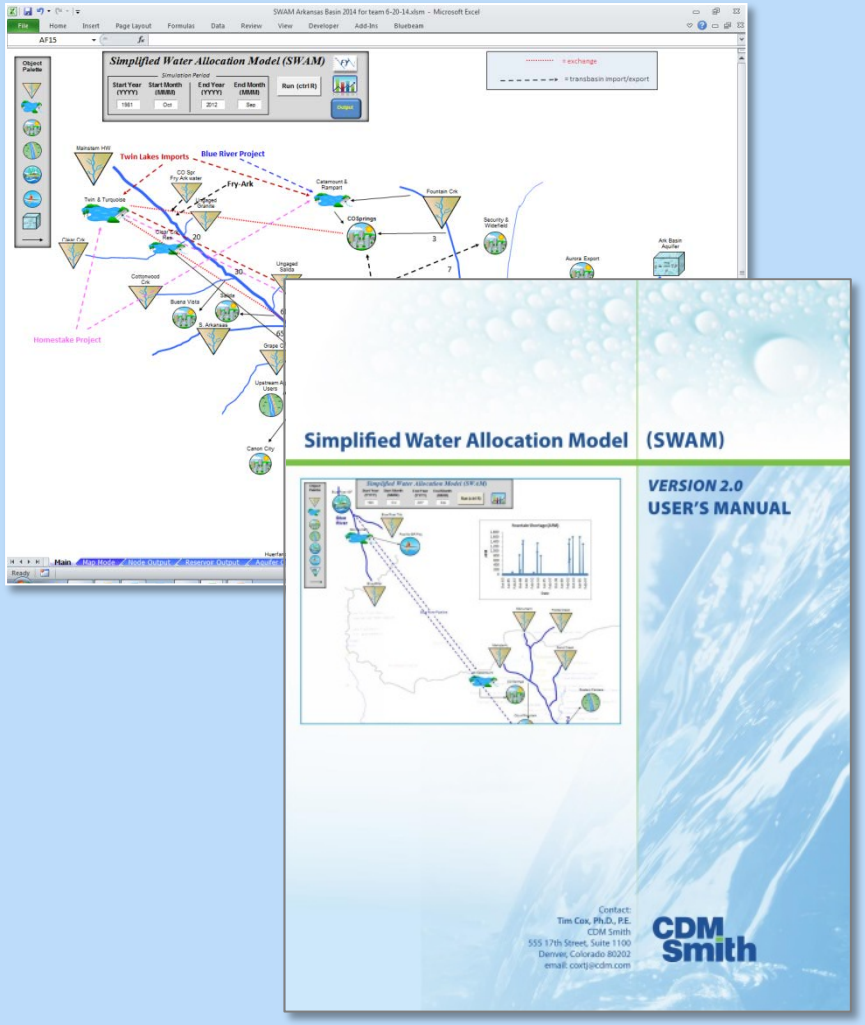
Surface-water quantity models

- CDM Smith, Inc. was awarded a contract to develop these models using its *Simplified Water Allocation Model* (SWAM) modeling tool.

- A stakeholder process will be facilitated by Clemson University with support from DNR, DHEC, and CDM Smith.

Simplified Water Allocation Model (SWAM)

- The model tracks streamflow and reservoir storage at points of interest (nodes) in the basin on a daily or monthly time-step
- At withdrawal nodes, water is removed from the river or reservoir; at discharge nodes, water is added to the river or reservoir



Major Steps in Model Development

Step 1

Data Collection

Compile all hydrologic and water-use data for each basin

All USGS streamflow records are compiled, along with historic water-use data, reservoir operations and levels, and meteorological data in the basin. All of these data will be part of the model.

Major Steps in Model Development

Step 1

Data Collection

Compile all hydrologic and water-use data for each basin

Step 2

Unimpaired Flow Development (UIF)

Remove all human alterations to flow

UIFs (unimpaired flows) represent the natural flows in a river after removing human alterations.

Withdrawals are added back into the flow record and discharges are subtracted out of the flow record. Evaporation is added back into a reservoir and precipitation is removed.

UIFs provide a baseline for evaluating impacts of human use.

Major Steps in Model Development

Step 1

Data Collection

Compile all hydrologic and water-use data for each basin

Step 2

Unimpaired Flow Development (UIF)

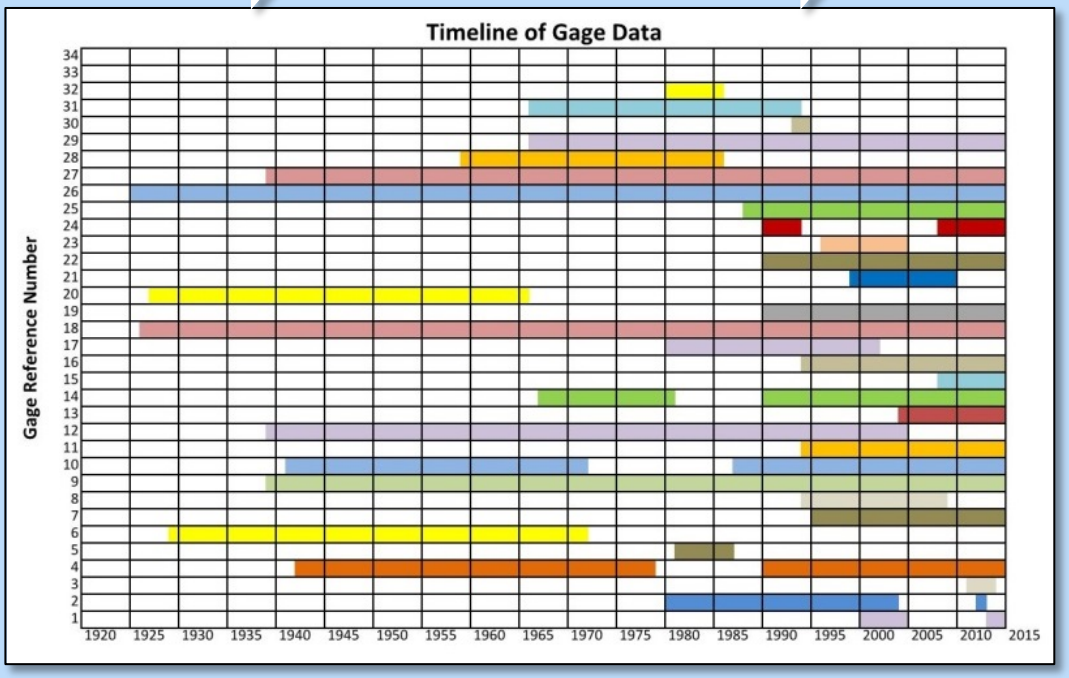
Remove all human alterations to flow

Step 3

Data Analysis

Gap fill and extend all USGS streamgages

All USGS gages will be gap-filled and extended. This chart shows the period of record for 34 streamgages in the Saluda River basin. The longest dates back to 1925.

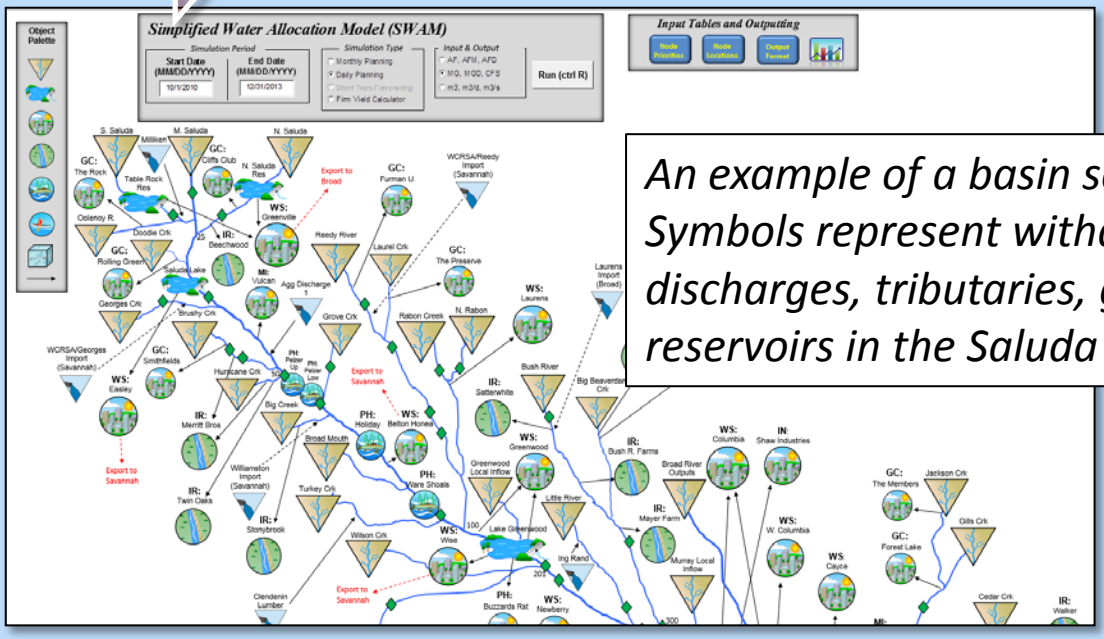


Major Steps in Model Development

Step 4

Basin Schematic

Develop model framework



An example of a basin schematic. Symbols represent withdrawals, discharges, tributaries, gages, and reservoirs in the Saluda River basin.

Major Steps in Model Development

Step 4

Basin Schematic

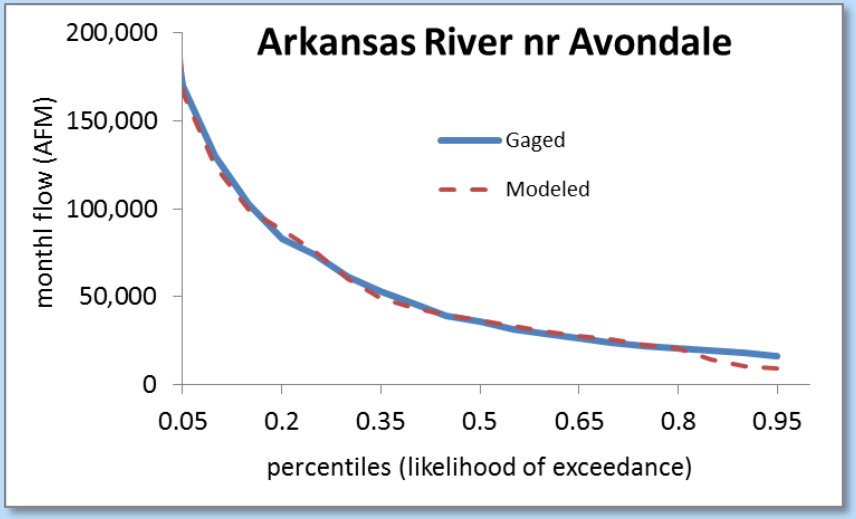
Develop model framework

Step 5

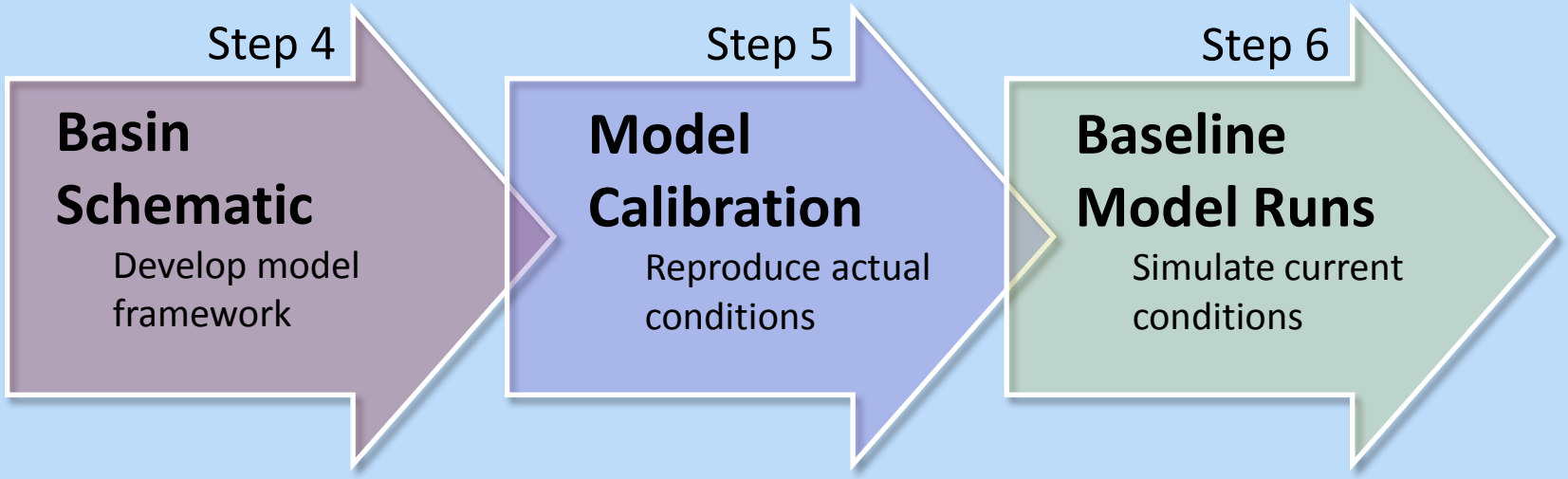
Model Calibration

Reproduce actual conditions

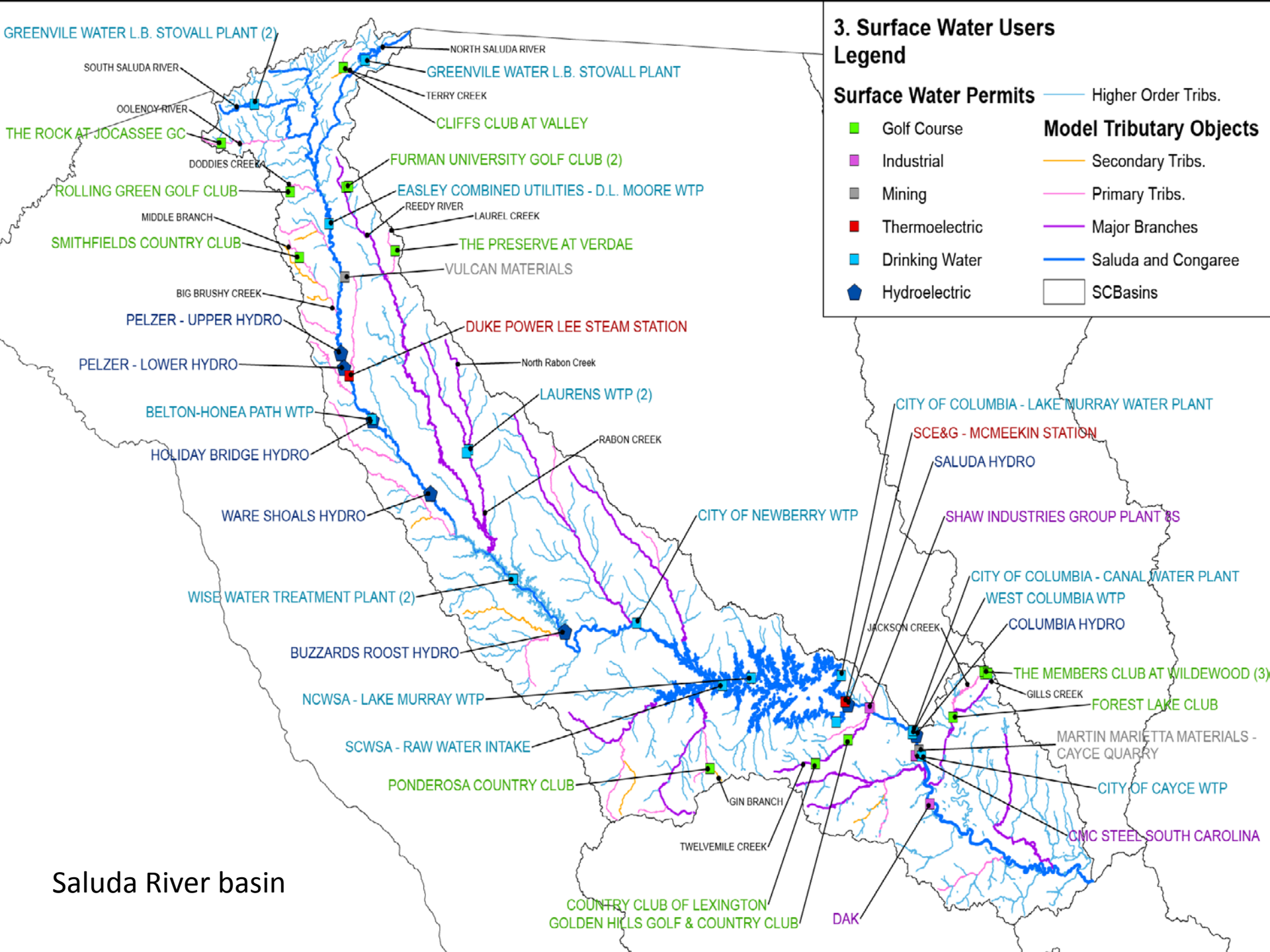
Models are calibrated by comparing simulated streamflows and reservoir levels to actual flows and levels.



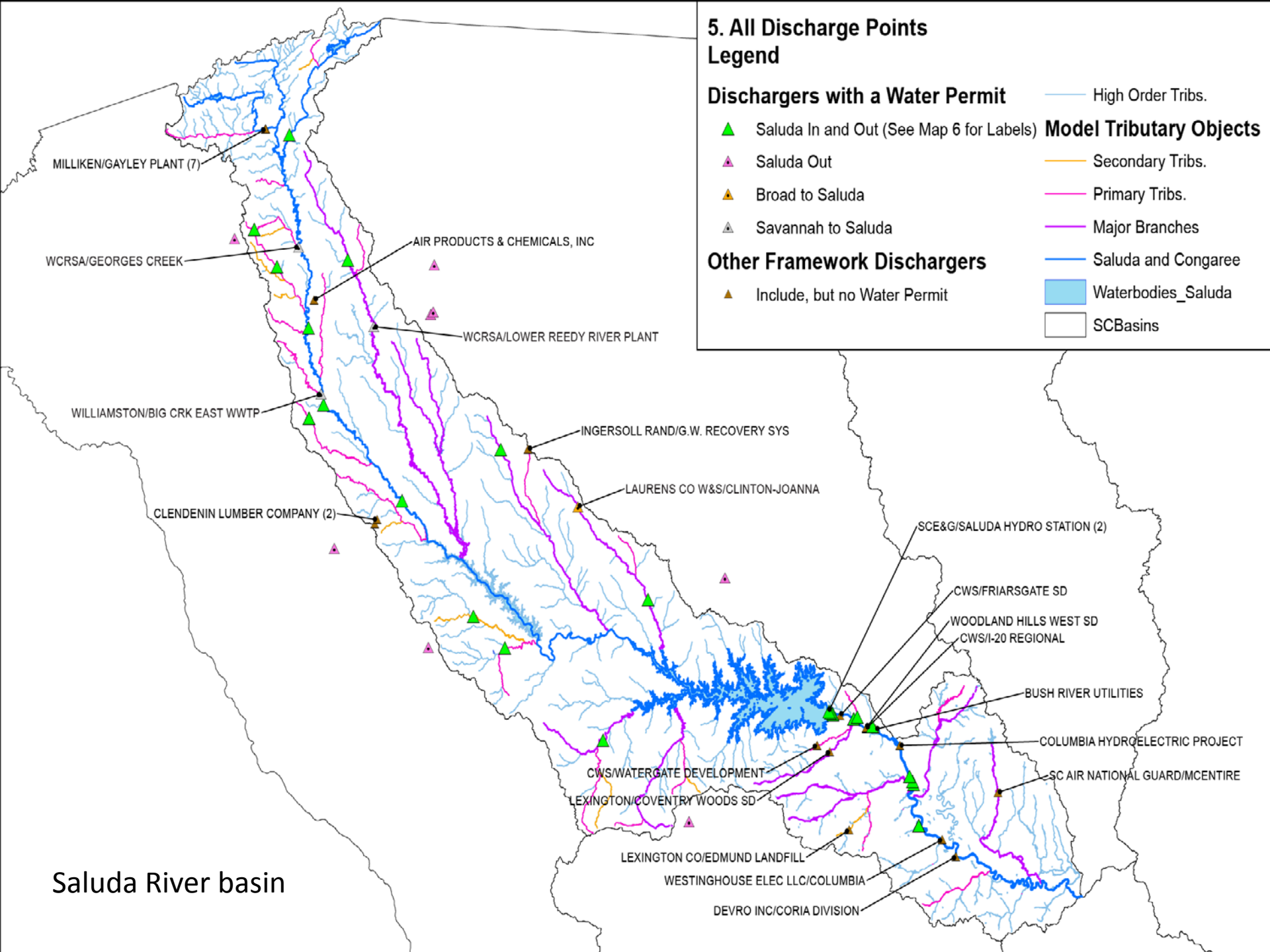
Major Steps in Model Development



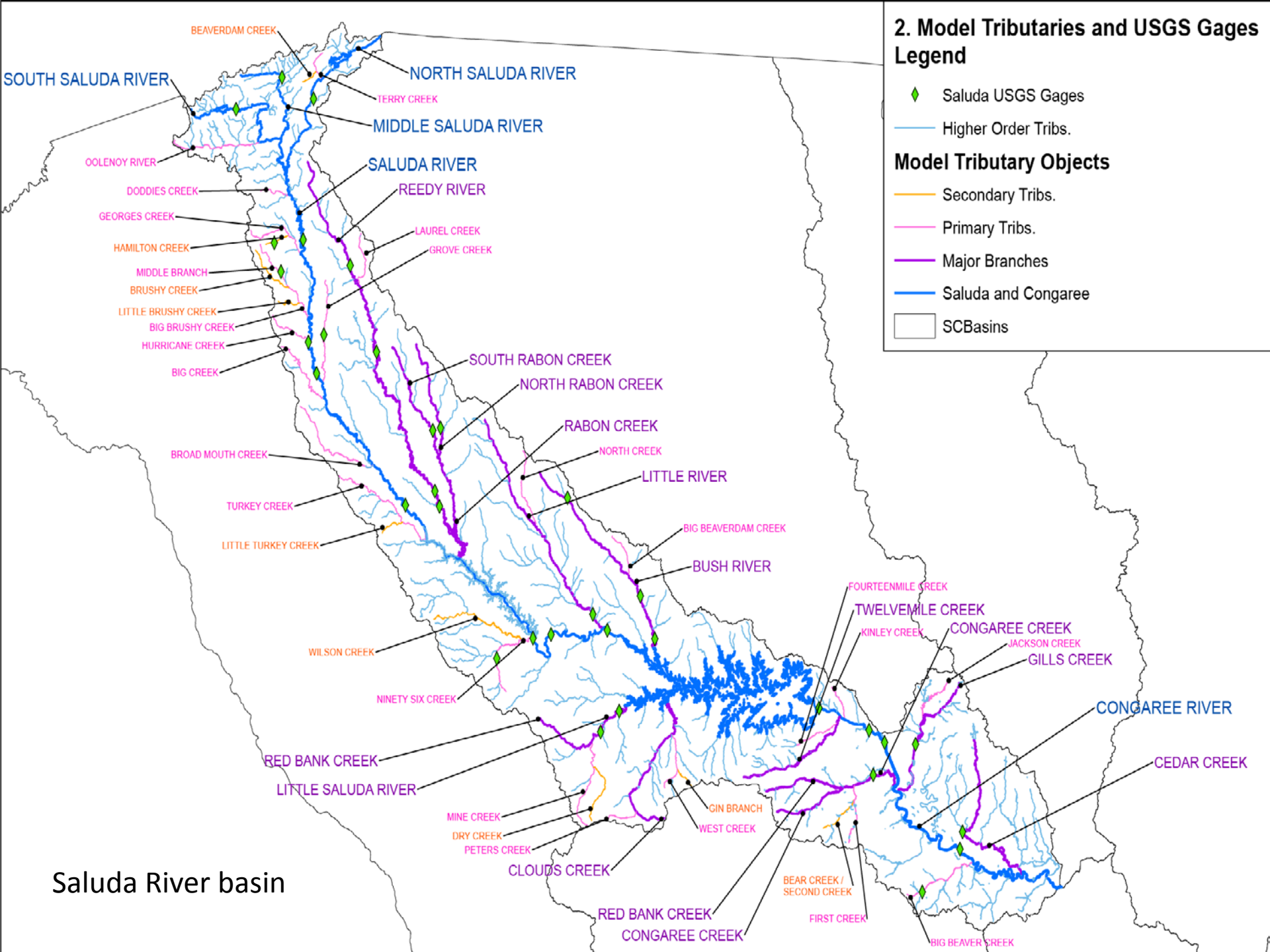
A model run is made using current management conditions (withdrawals, discharges, and reservoir rules) and the historic unimpaired flows as input.



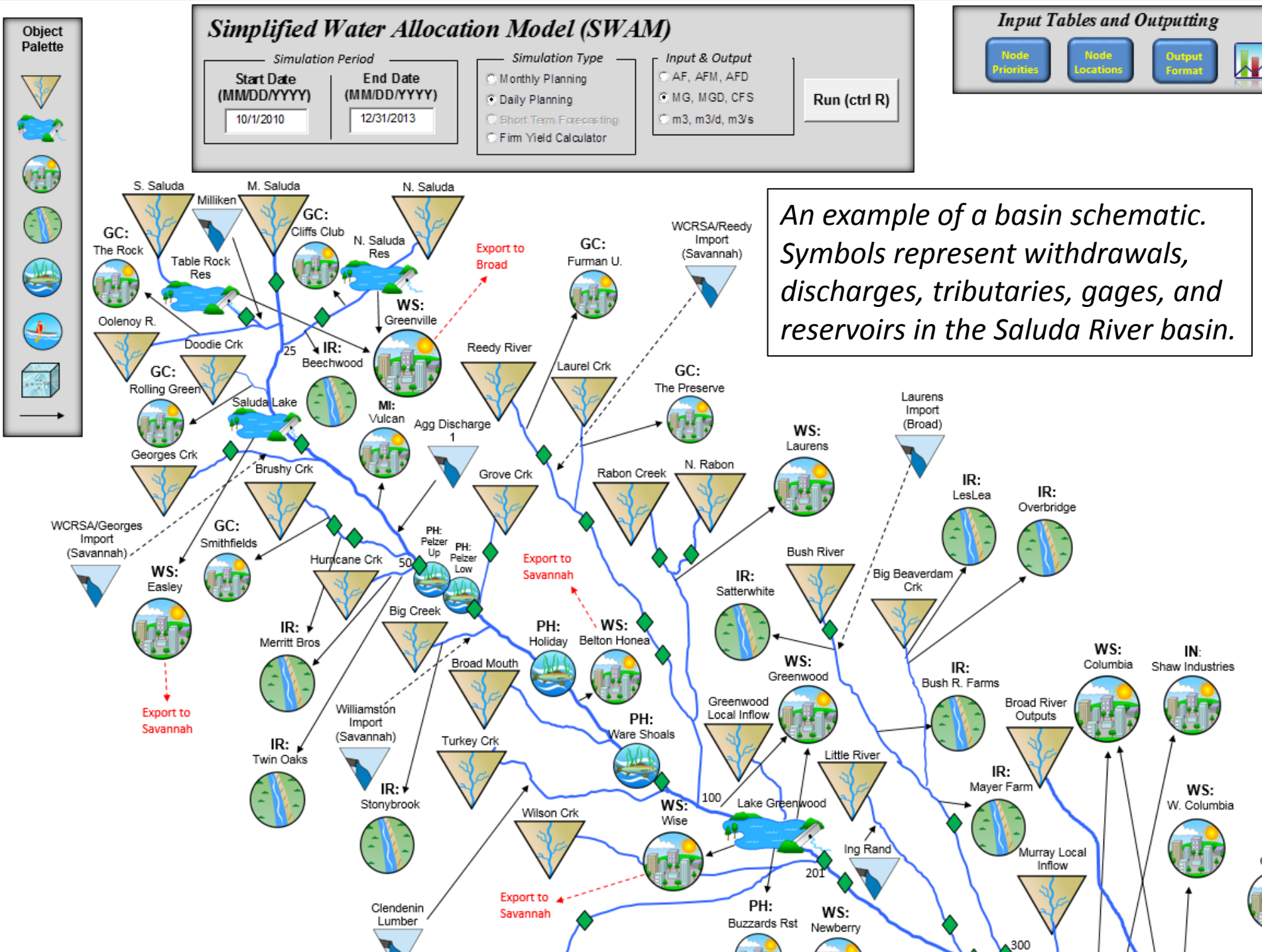
Saluda River basin



Saluda River basin



Saluda River basin


Object Palette
Simplified Water Allocation Model (SWAM)
Simulation Period
Start Date (MM/DD/YYYY)
10/1/2010
End Date (MM/DD/YYYY)
12/31/2013
Simulation Type
Monthly Planning
Daily Planning
Short Term Forecasting
Firm Yield Calculator
Input & Output
AF, AFM, AFD
MG, MGD, CFS
m3, m3/d, m3/s
Run (ctrl R)
Input Tables and Outputting
Node Priorities
Node Locations
Output Format
An example of a basin schematic. Symbols represent withdrawals, discharges, tributaries, gages, and reservoirs in the Saluda River basin.
S. Saluda
M. Saluda
N. Saluda
Milliken
GC: Cliffs Club
GC: The Rock
Table Rock Res
N. Saluda Res
Export to Broad
GC: Furman U.
WCRSA/Reedy Import (Savannah)
WS: Greenville
Oolenoy R.
Doodie Crk
25
IR: Beechwood
Reedy River
Laurel Crk
GC: Rolling Green
GC: The Preserve
Saluda Lake
MI: Vulcan
Agg Discharge 1
Laurens Import (Broad)
WS: Laurens
Georges Crk
Brushy Crk
Grove Crk
Rabon Creek
N. Rabon
IR: LesLea
IR: Overbridge
WCRSA/Georges Import (Savannah)
GC: Smithfields
PH: Pelzer Up
PH: Pelzer Low
Hurricane Crk
50
Export to Savannah
Bush River
IR: Satterwhite
Big Beaverdam Crk
WS: Easley
Big Creek
PH: Holiday
WS: Belton Honea
WS: Columbia
IN: Shaw Industries
IR: Merritt Bros
Broad Mouth
WS: Greenwood
IR: Bush R. Farms
Export to Savannah
Williamston Import (Savannah)
Greenwood Local Inflow
Broad River Outputs
PH: Ware Shoals
IR: Twin Oaks
Turkey Crk
Little River
IR: Mayer Farm
IR: Stonybrook
100
Lake Greenwood
WS: W. Columbia
Wilson Crk
WS: Wise
Murray Local Inflow
Ing Rand
201
Clendenin Lumber
Export to Savannah
PH: Buzzards Rst
WS: Newberry
300

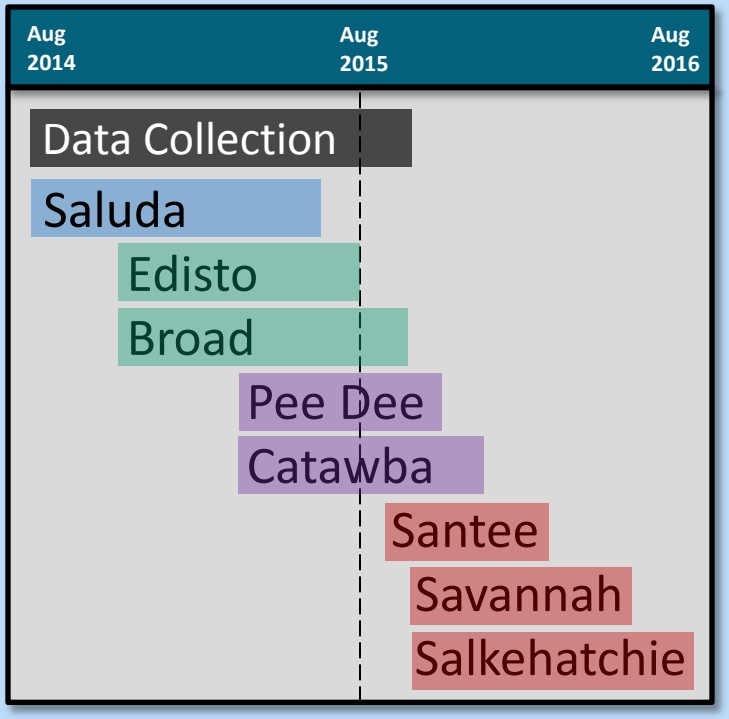
“Do we have enough water in our basins to meet both instream and offstream demands 50 years into the future?”

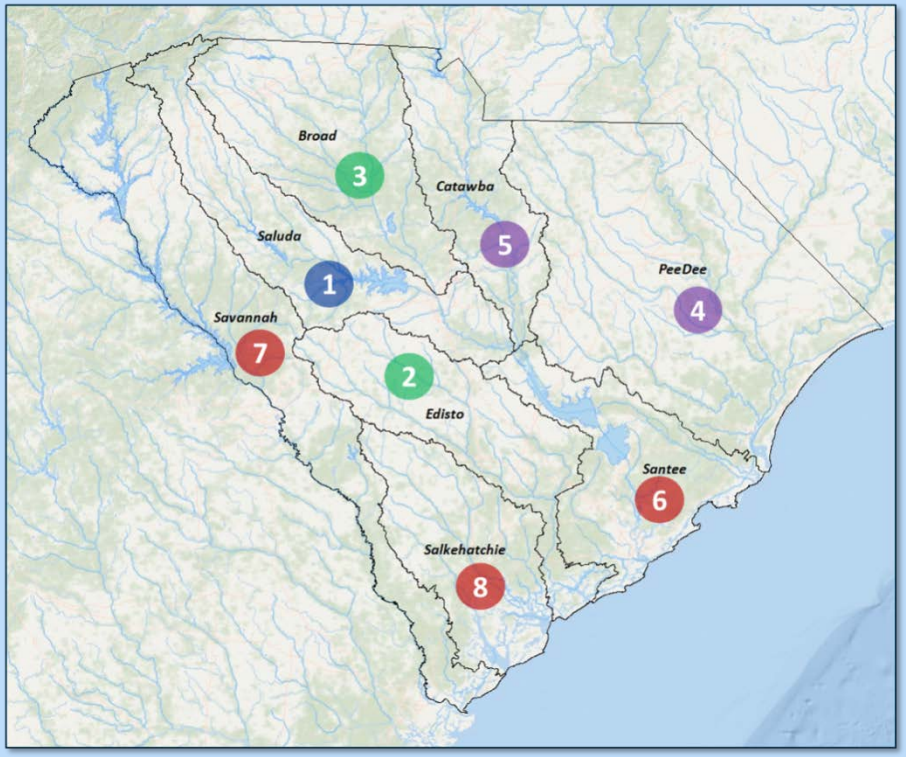
The model works by evaluating future demands in relation to hydrologic conditions (flows) that occurred in the Saluda basin from 1925-2013.

If demands cannot be met, the model can be used to test alternative management strategies, such as changing reservoir operating rules or introducing conservation plans.

Schedule for Developing the Models

- ***Pilot Model*** of the Saluda River Basin
- Other models to follow, with order based on data availability
- 2-year schedule requires that groups of models be constructed in parallel

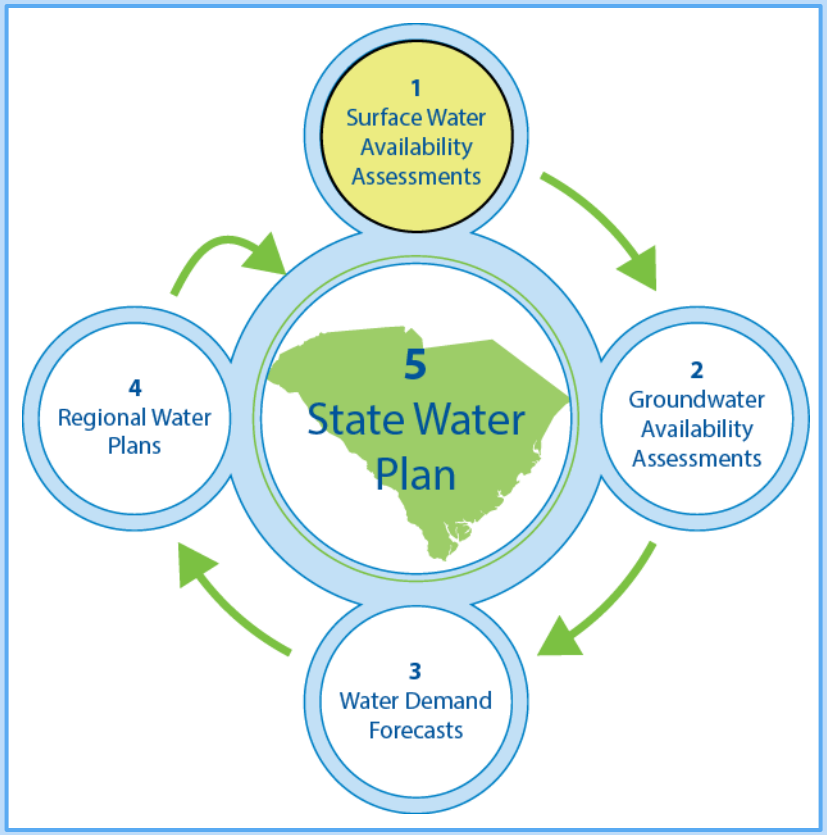




Step 1…

Surface water quantity models

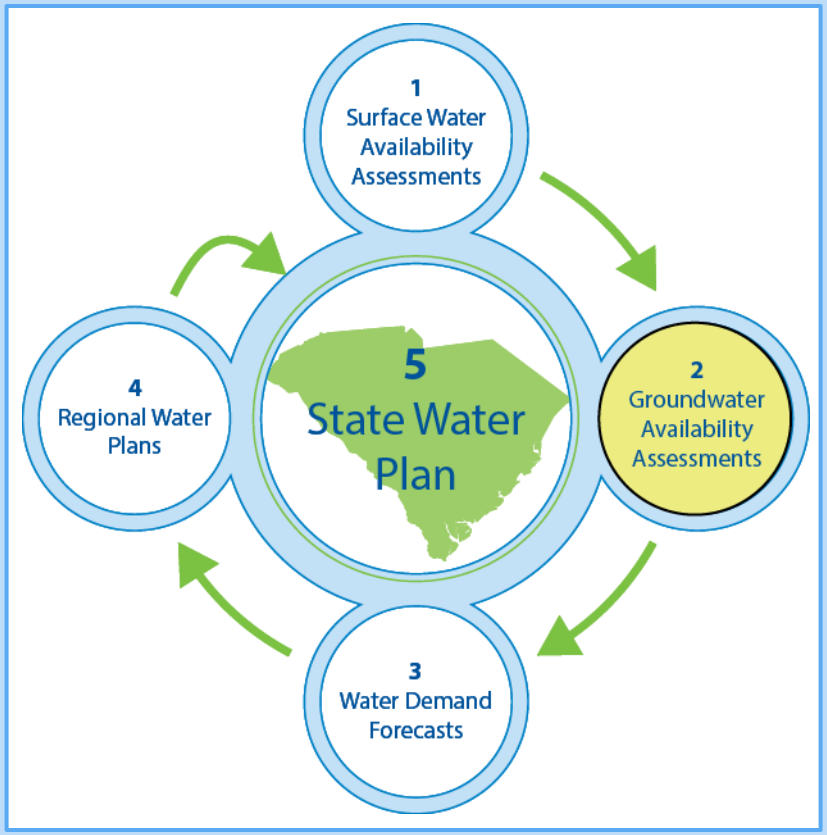
Development of the surface water models is just the first step in the development of regional and statewide water plans.



Step 2…

Groundwater flow models

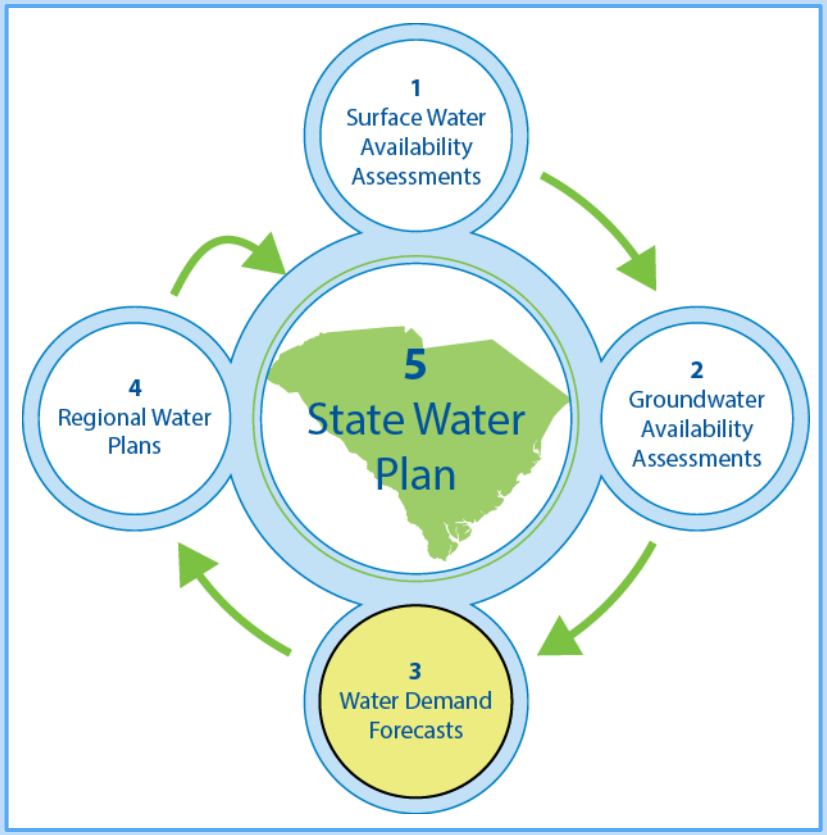
Groundwater models will be used to predict water-level declines, recharge rates, and impacts of groundwater withdrawals on aquifers, streamflows, and on other users in the basin.



Step 3…

Water-demand forecasts

Water-demand forecasts will be made for agriculture, energy, industry, and public-supply at 5-10 year intervals over a 50-year planning period.

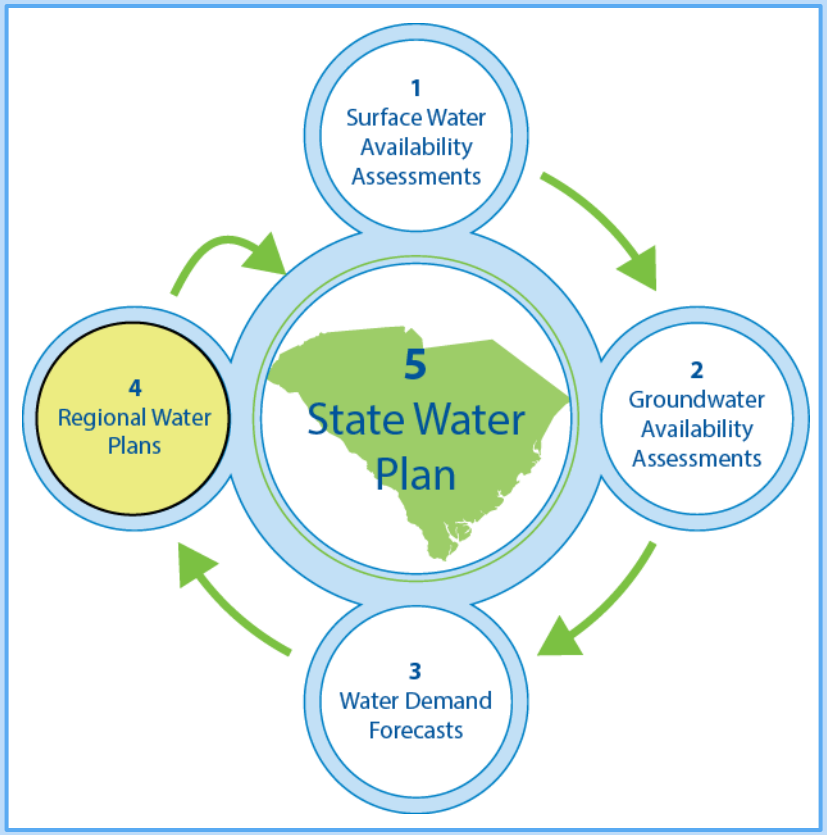


Step 4…

Regional (basinwide) water plans

Using the models and forecasts, and with oversight from State agencies, stakeholders will begin the process of developing regional water plans for each basin.

- An analysis to determine if any water deficits will occur
- Management strategies to meet the future demands
- Water conservation and drought management recommendations

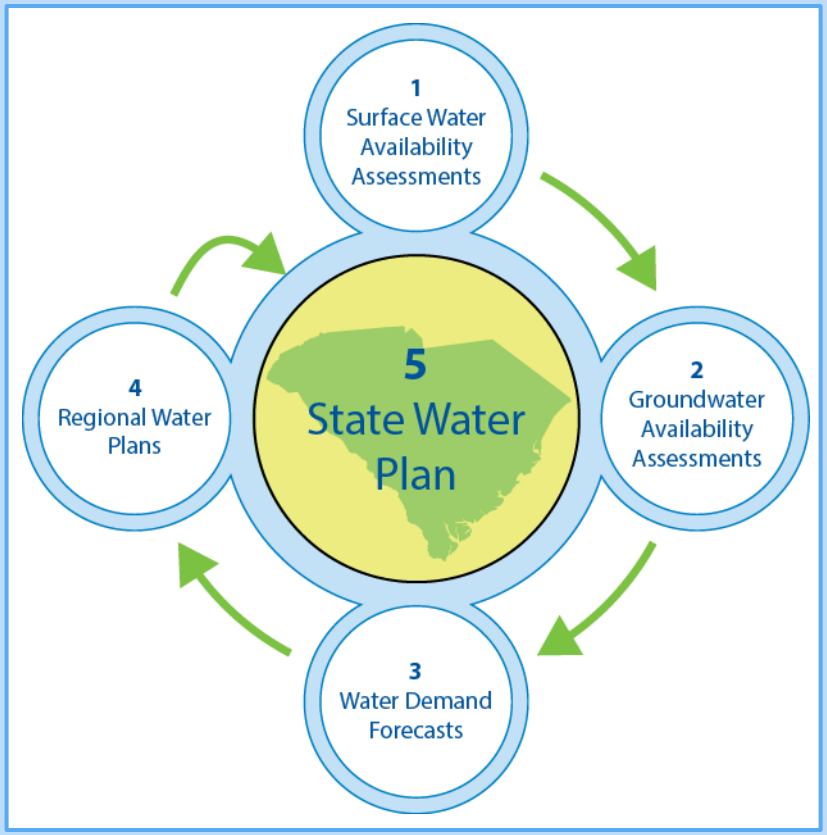


Step 5…

State water plan

Upon completion of the regional water plans, the State water plan will be updated by DNR.

- Assess the overall condition of water resources in the State
- Evaluate statewide trends in water use and availability
- Offer water-resource policy and program recommendations
- Introduce innovative practices



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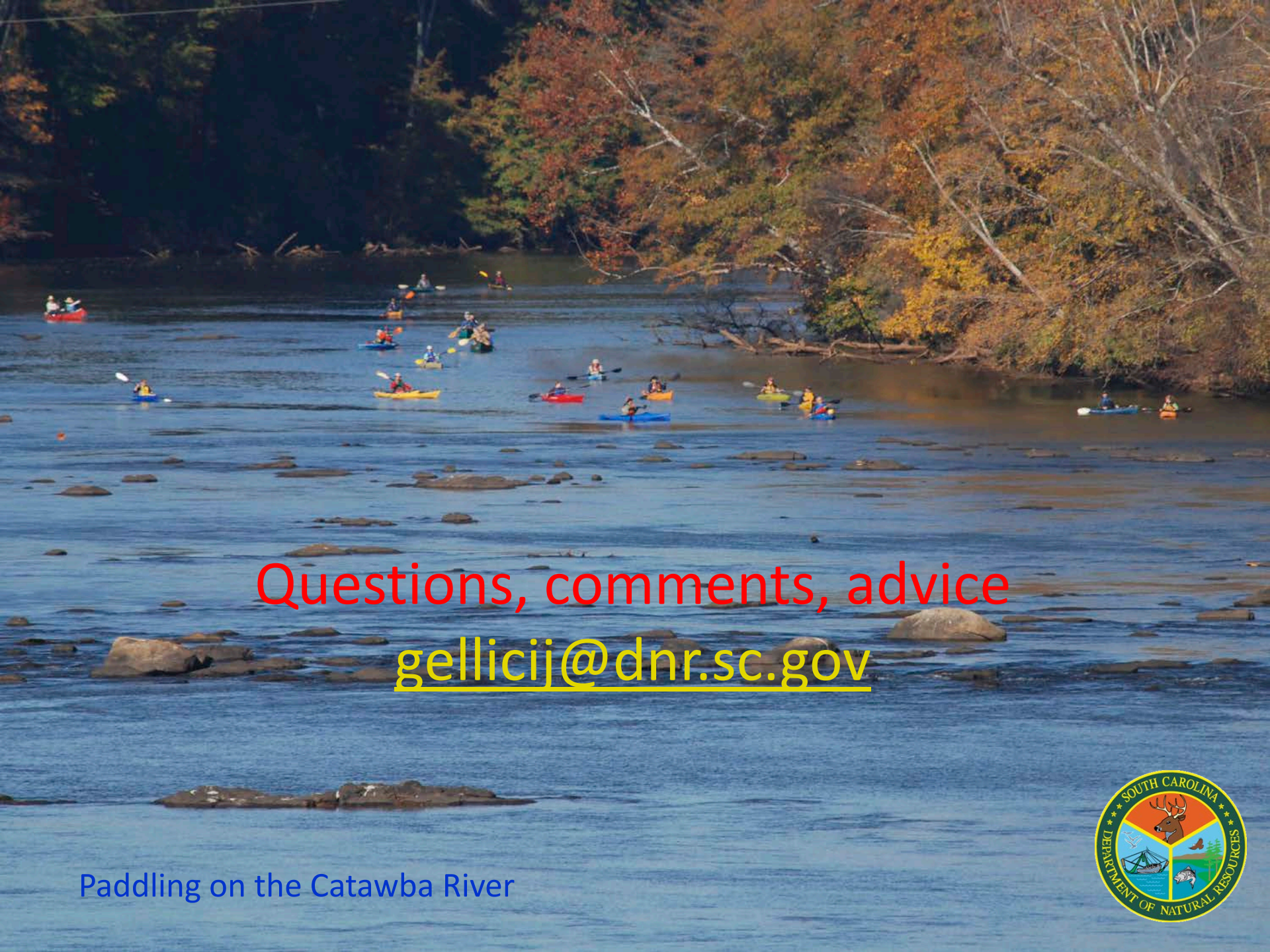
- Water Plan (2004 Report)
- White Papers
- Hydrology Section

Water Planning in South Carolina

The South Carolina Water Resources Planning and Coordination Act of 1967 assigned the overall responsibility for developing a comprehensive water resources policy for the State, including coordination of policies and activities among State departments and agencies, to the South Carolina Water Resources Commission. As part of government restructuring, this act was amended in 1993, and these responsibilities were placed with the South Carolina Department of Natural Resources (DNR).

The water resources policy plan consists of two parts. Phase I—an overall assessment of the water resources of the State—was published as Water Resources Commission Report No. 140, South Carolina State Water Assessment. The Assessment describes the State's stream, lake, and aquifer systems and provides information relating to the occurrence and availability of water in South Carolina. Phase II outlines guidelines and procedures for managing the State's water resources, and was first published in 1998 by the Department of Natural Resources as the South Carolina Water Plan.

http://www.dnr.sc.gov/water/waterplan/index.html



Questions, comments, advice

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Paddling on the Catawba River