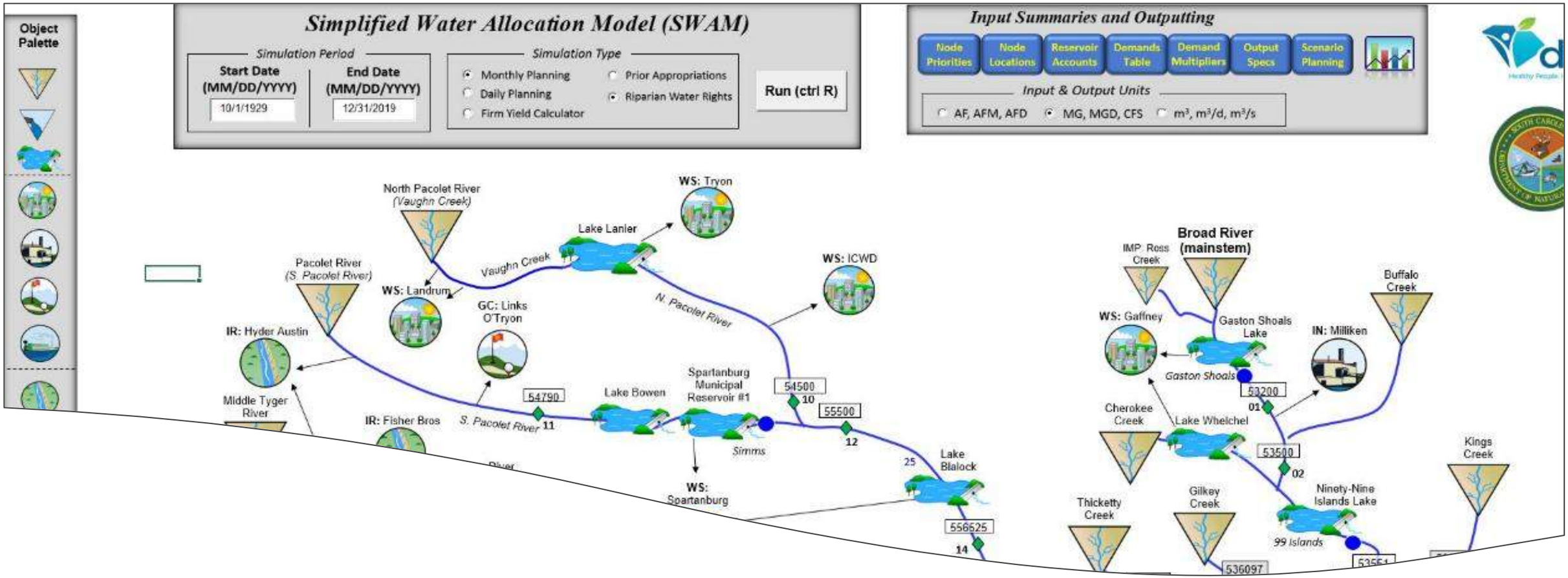
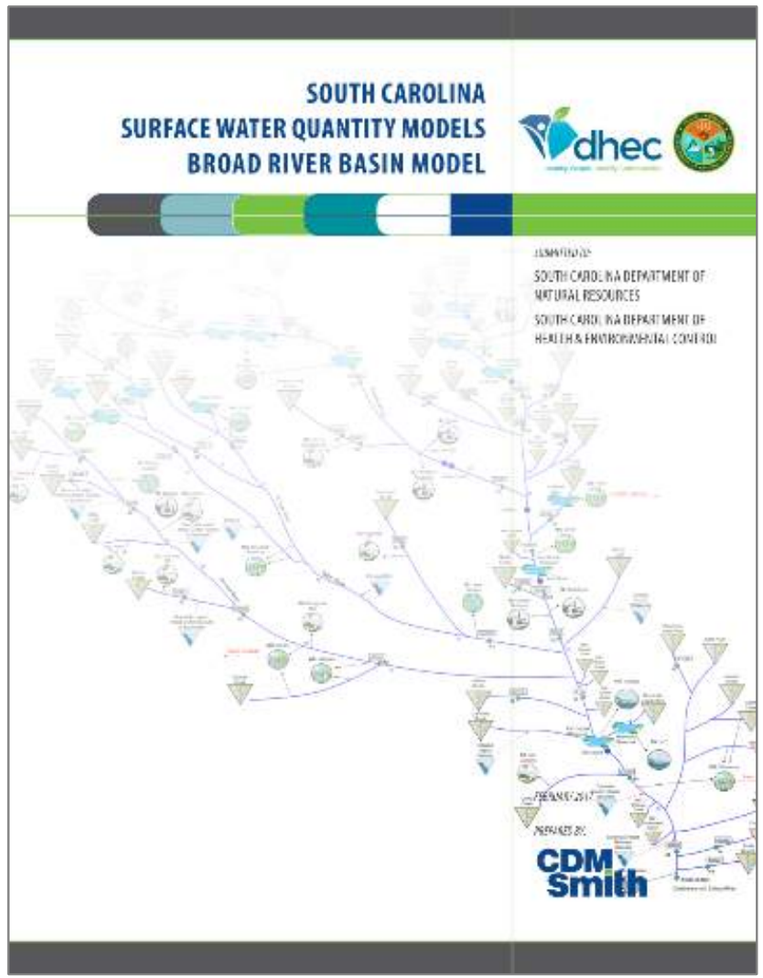


Overview of the Broad Basin Surface Water Quantity Model

Agenda Item 7

Simplified Water Allocation Model (SWAM)

- Developed as a desktop tool to facilitate regional and statewide water planning and allocation
- SWAM calculates physically and legally available water, diversions, storage, consumption and return flows at user-defined nodes
- From 2014 to 2017, all eight South Carolina surface water quantity models were built in the SWAM platform
- Model updates were performed in 2020-21



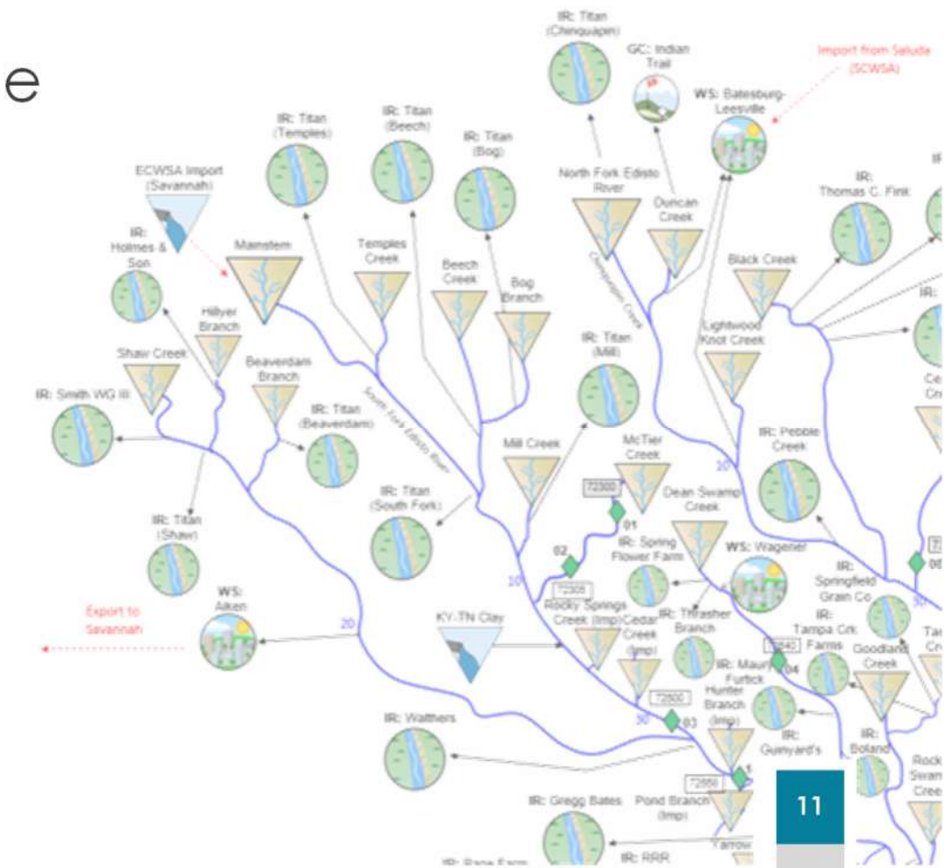
Surface Water Model Access

- Available for download at: http://hydrology.dnr.sc.gov/surface-water-models.html
- Also available for download:
  - SWAM User's Manual
  - Model reports for each basin
  - Supplementary technical memoranda

Broad Basin Surface Water Model Overview

Water Allocation Modeling ***is***:

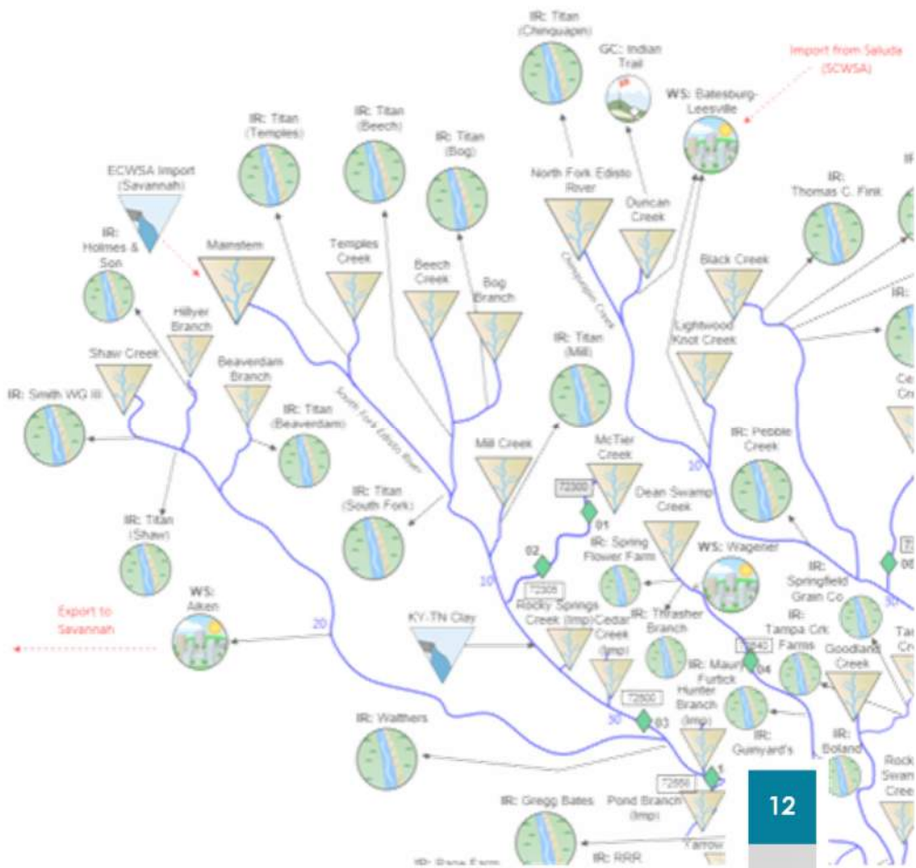
- Water balance calculations of physical flow
- Water rights calculations of legally available flow
- Demands, withdrawals, and return flows
- Reservoir storage
- Stream networks, multiple "nodes"
- Data intensive



Broad Surface Water Model Overview

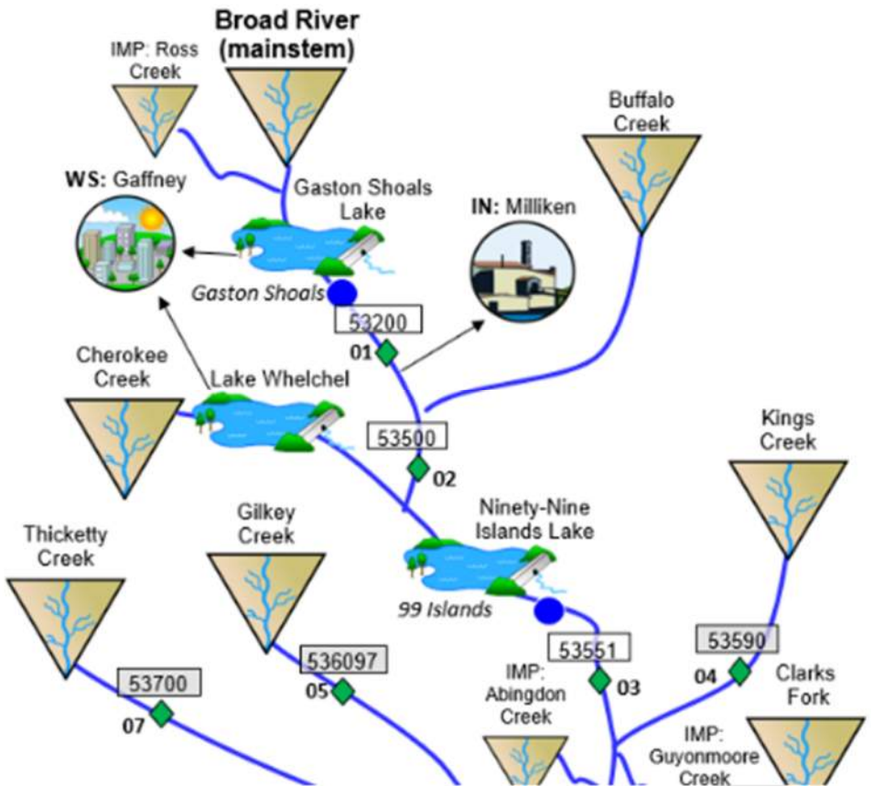
Water Allocation Modeling ***is not***:

- Rainfall-runoff calculations
- Hydrologic routing calculations
- Groundwater hydrology modeling
- Water quality modeling



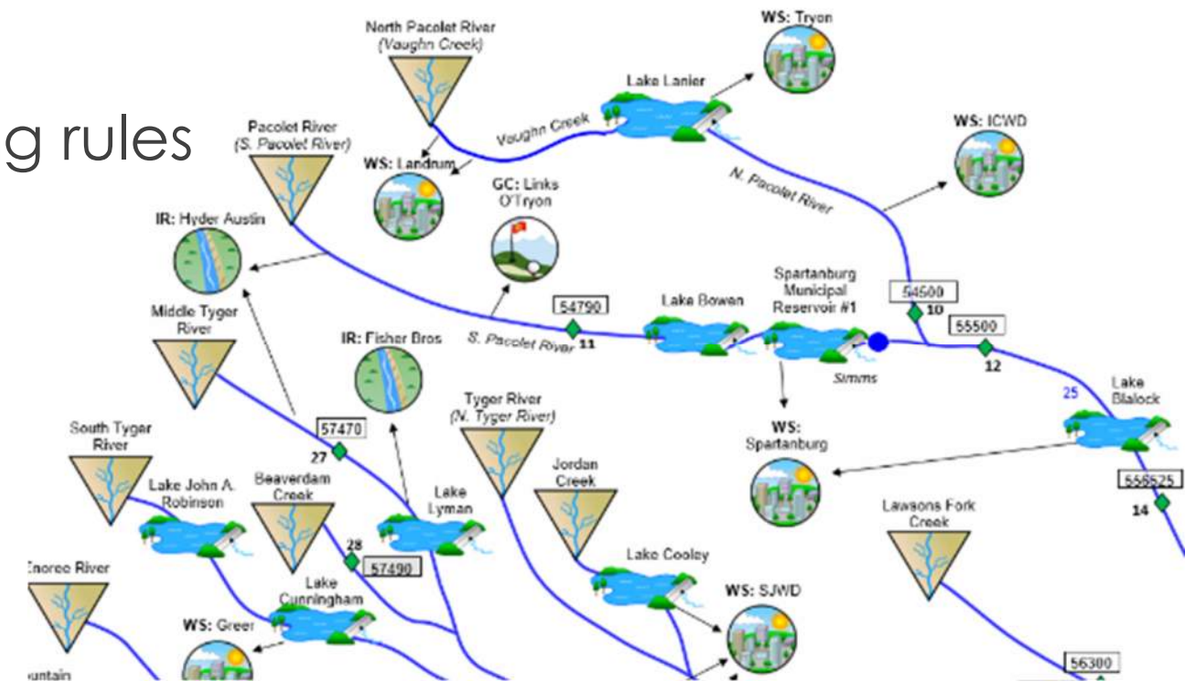
In Support of Broad River Basin Planning, the Model Will be Used to:

- Assess current supply availability and shortages across a range of hydrologic conditions (1929 through 2019)
- Assess potential impacts of a "full allocation" scenario
- Assess a range of future potential scenarios with respect to changes in growth and climate (as they influence water demand)
- Evaluate and help prioritize water management strategies

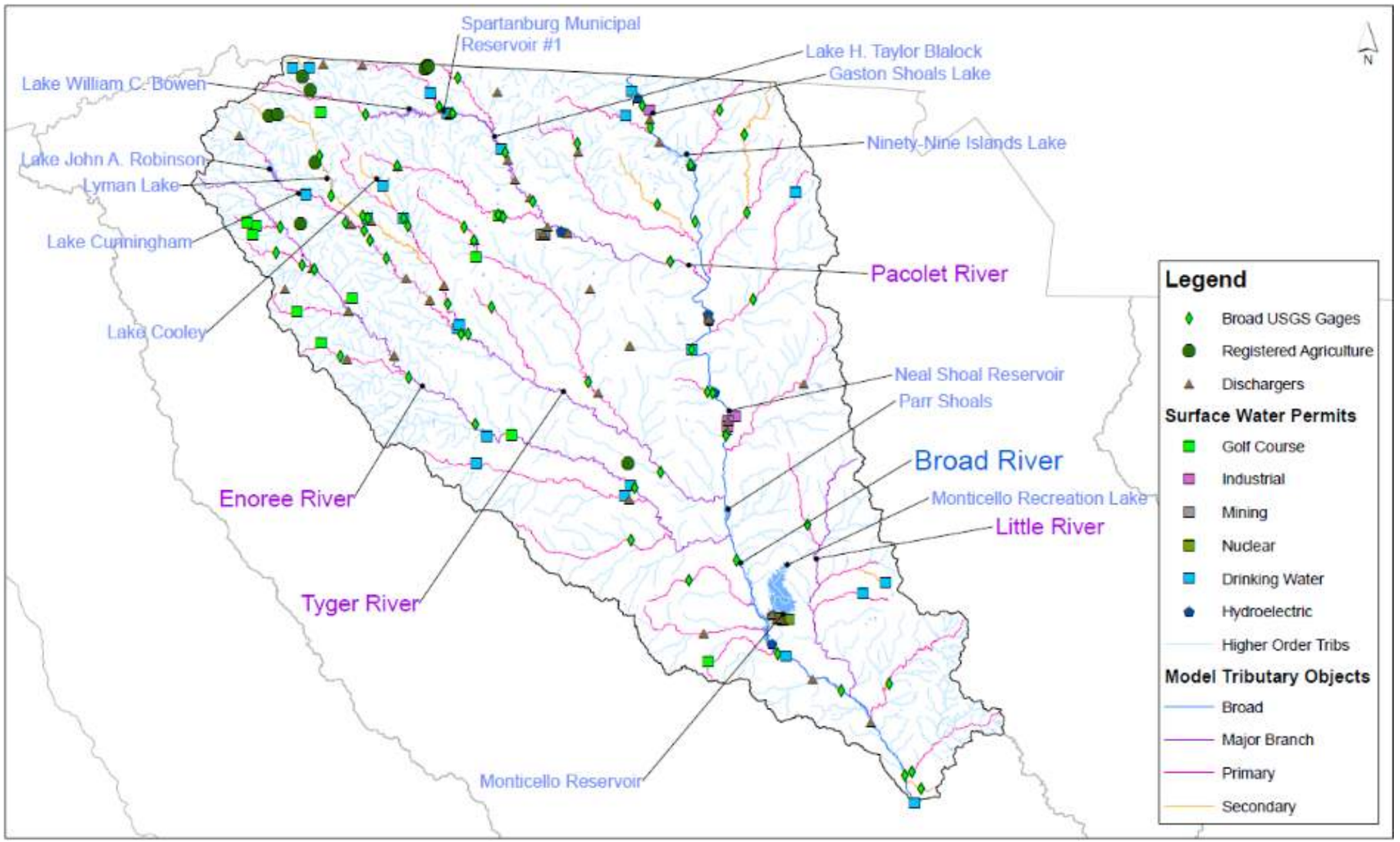


Broad Model Inputs and Supporting Information

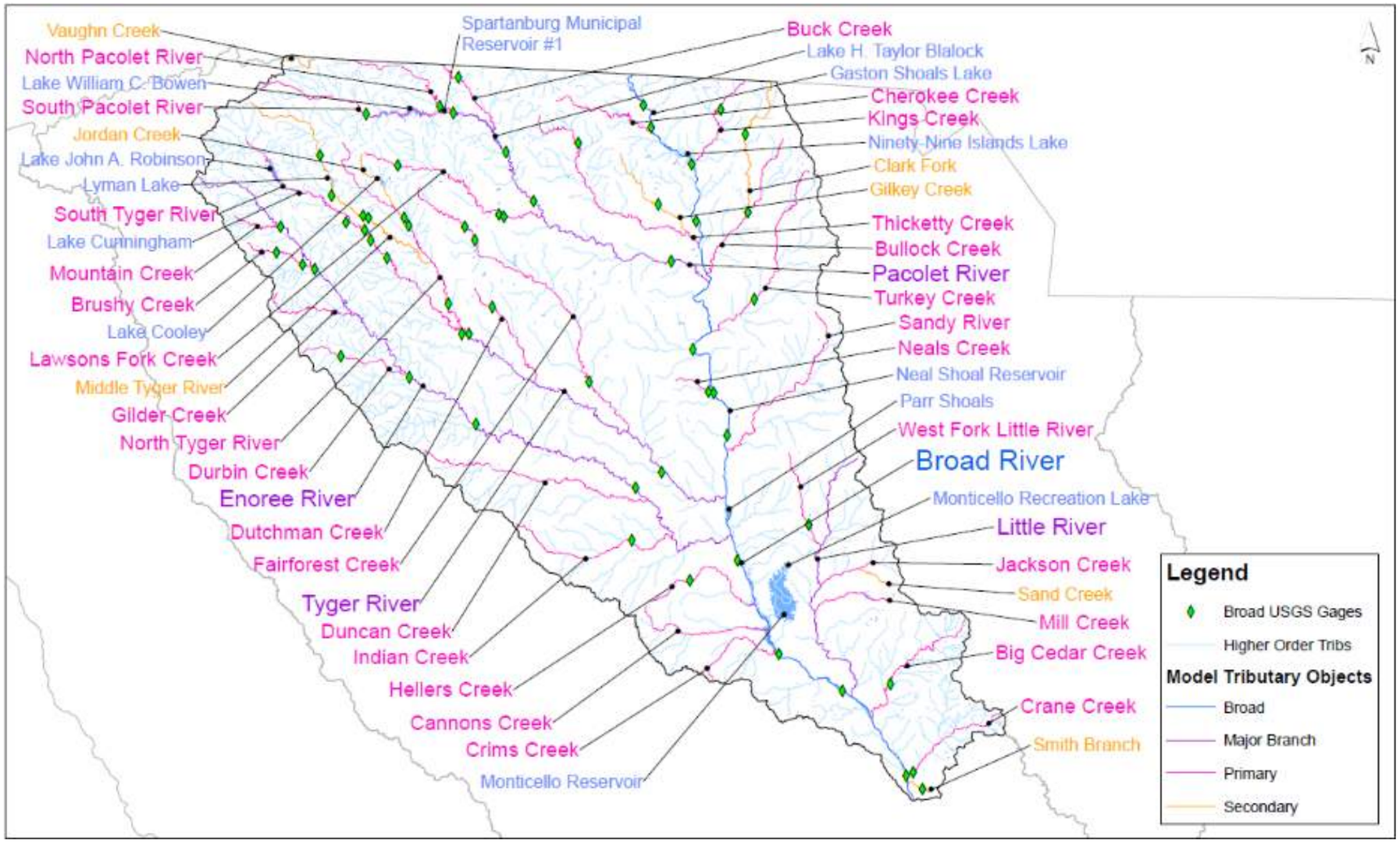
- USGS daily flow records
- Historical operational data
  - Withdrawals (municipal, industrial, thermoelectric, agricultural, golf courses, hatcheries)
  - Wastewater discharges and return flows
  - Transfers in and out of the basin
- Reservoir characteristics and operating rules
- Subbasin characteristics (from GIS)
  - Drainage area
  - Land use
  - Basin slope



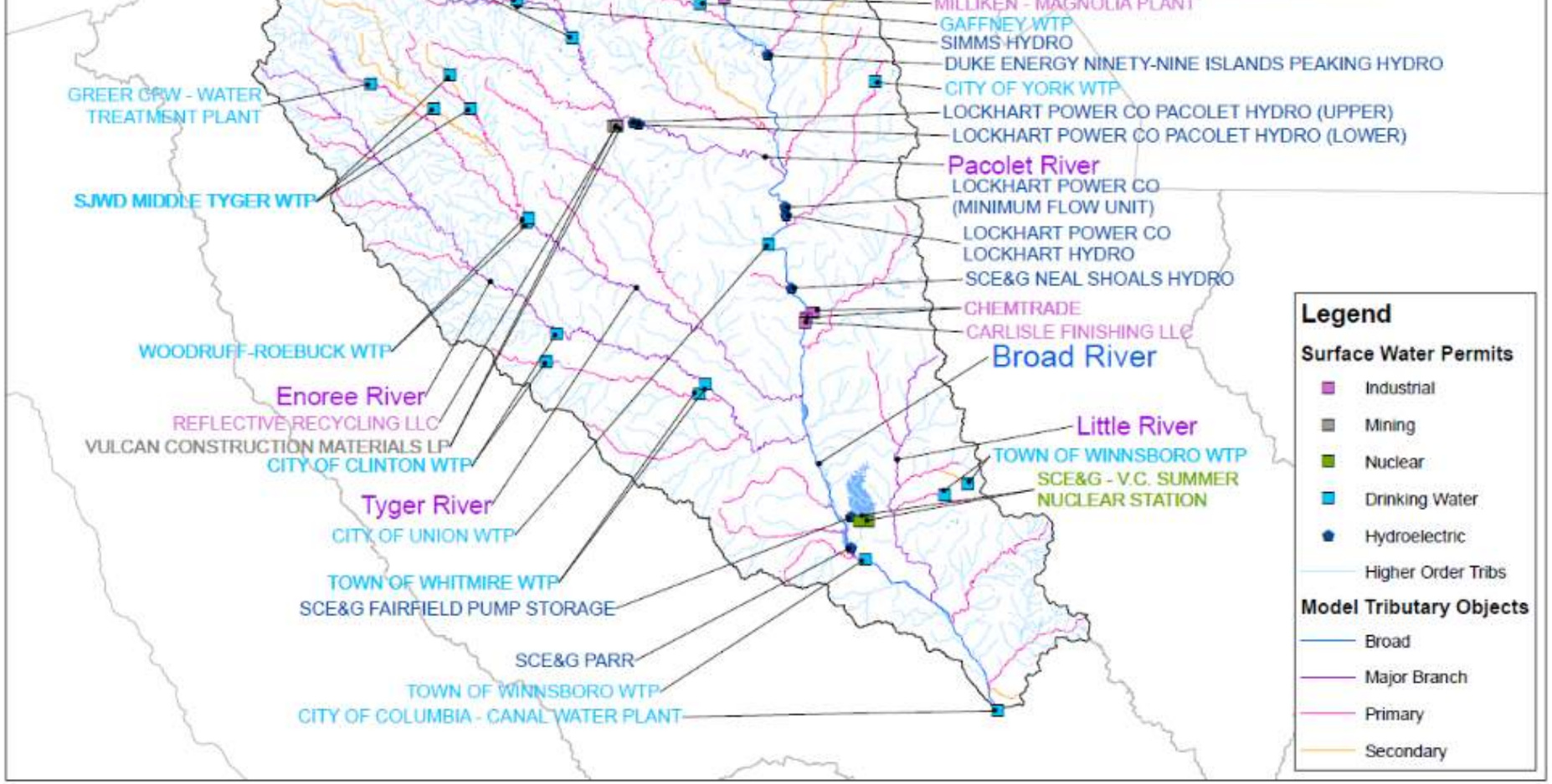
Main Stem and Major Branches



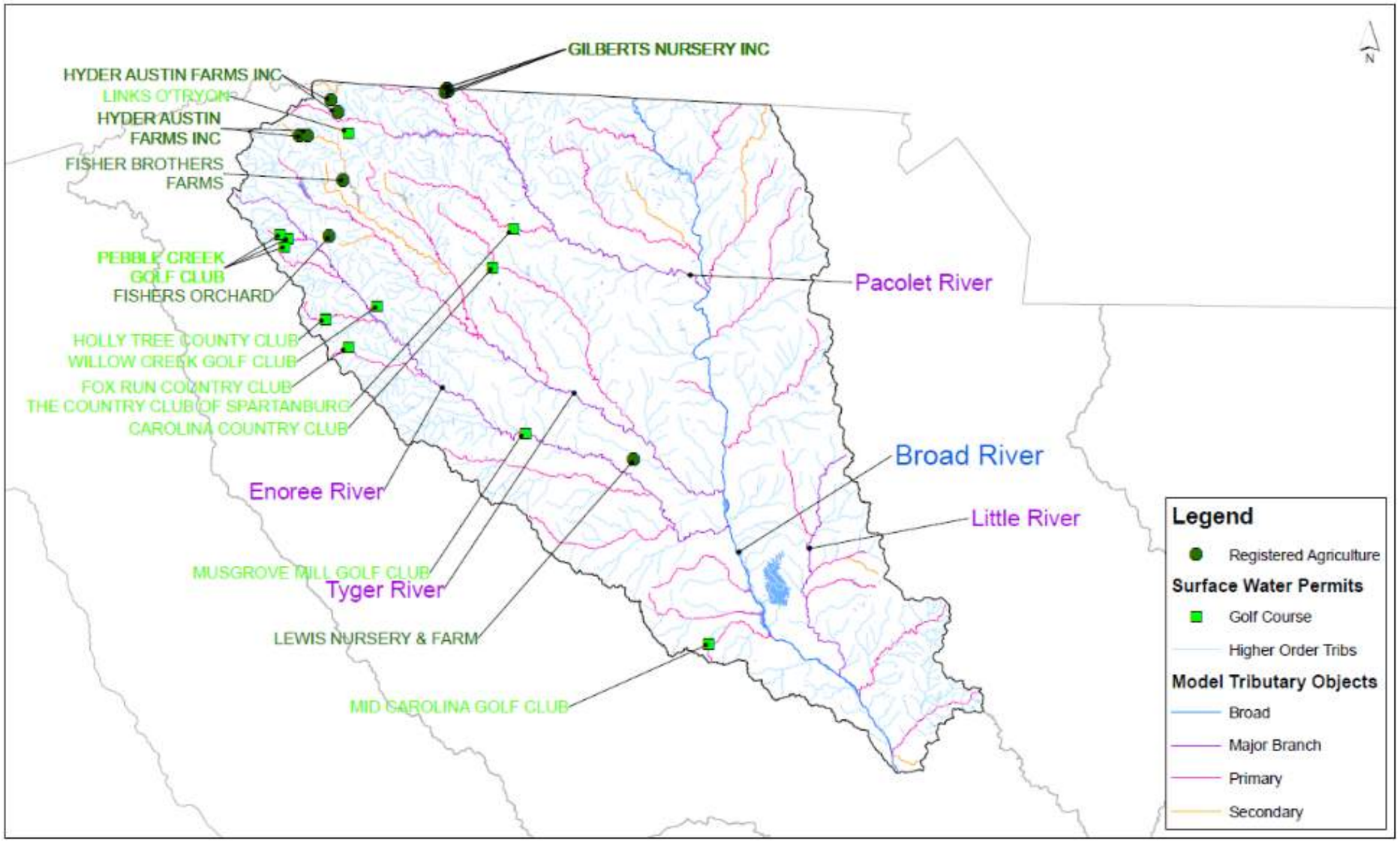
Primary Tributaries



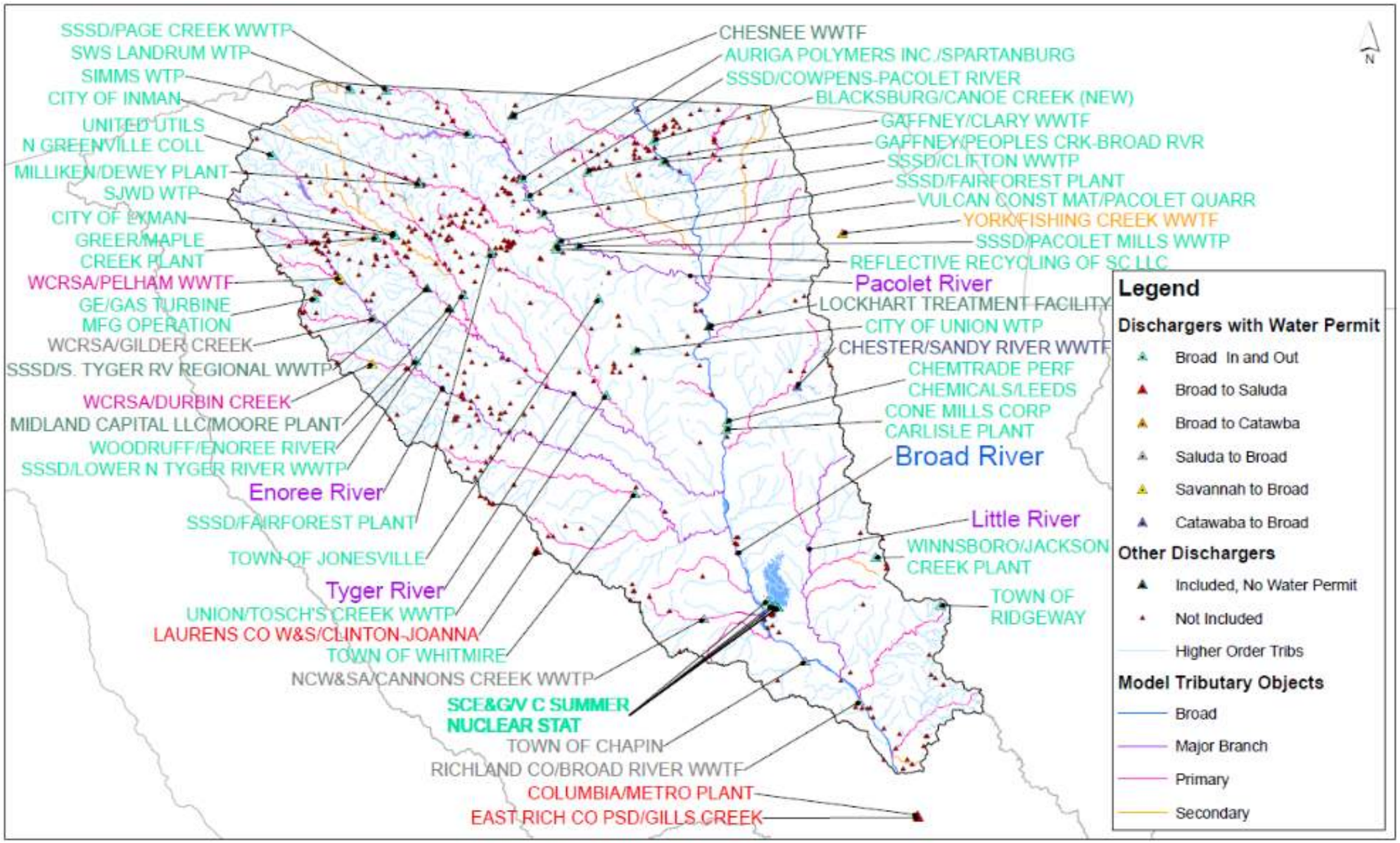
Municipal, Industrial, and Thermoelectric Withdrawals



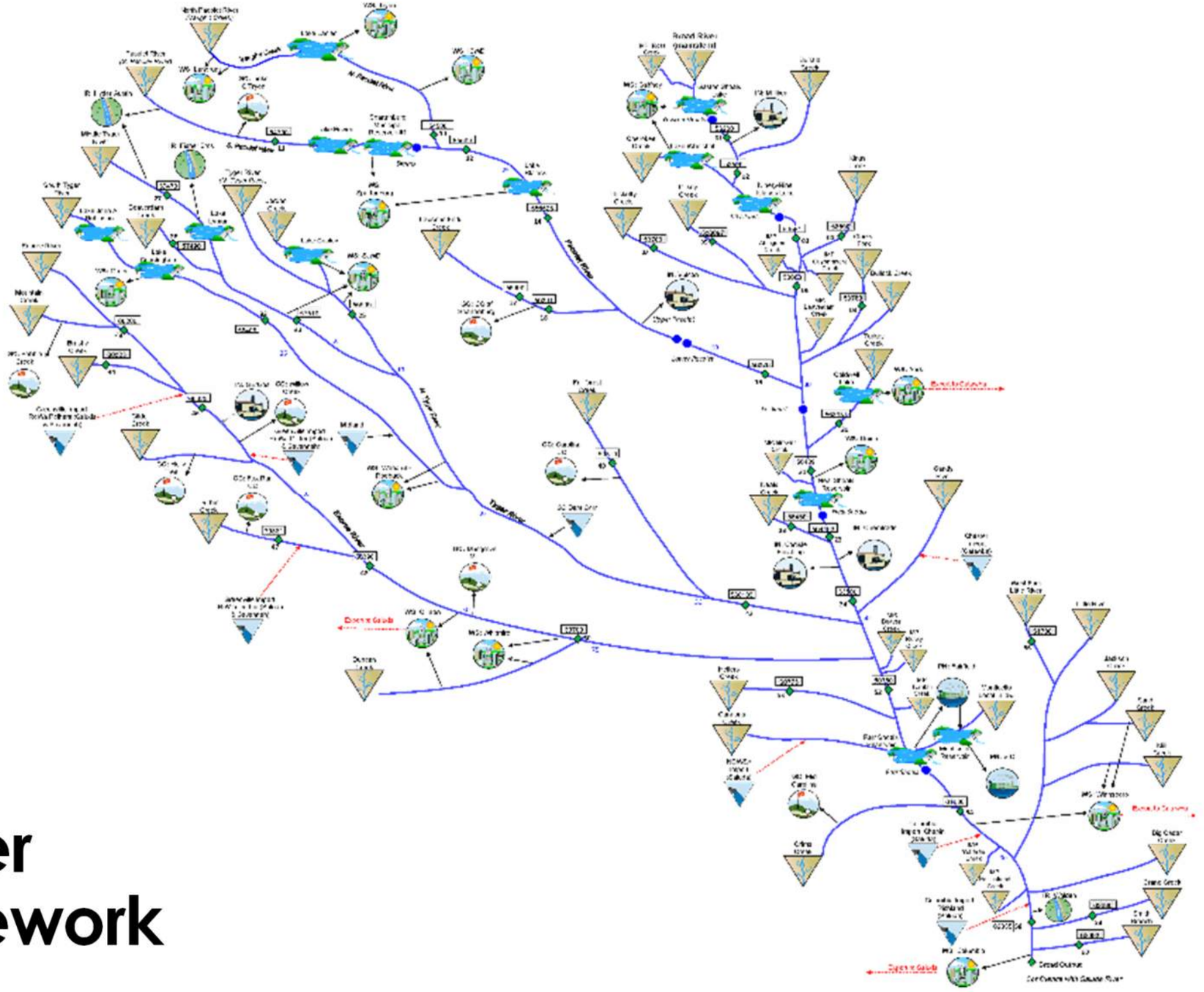
Agriculture and Golf Course Irrigation Withdrawals



Wastewater Discharges and Returns



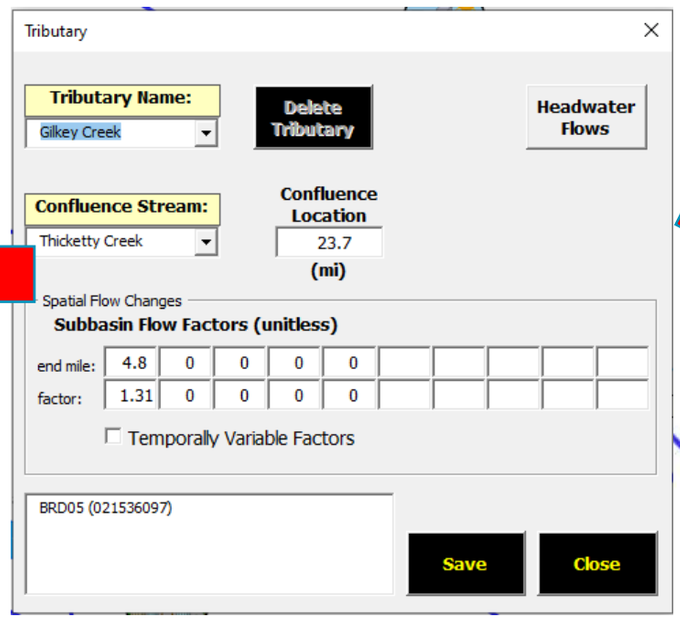
Broad River Surface Water Model Framework

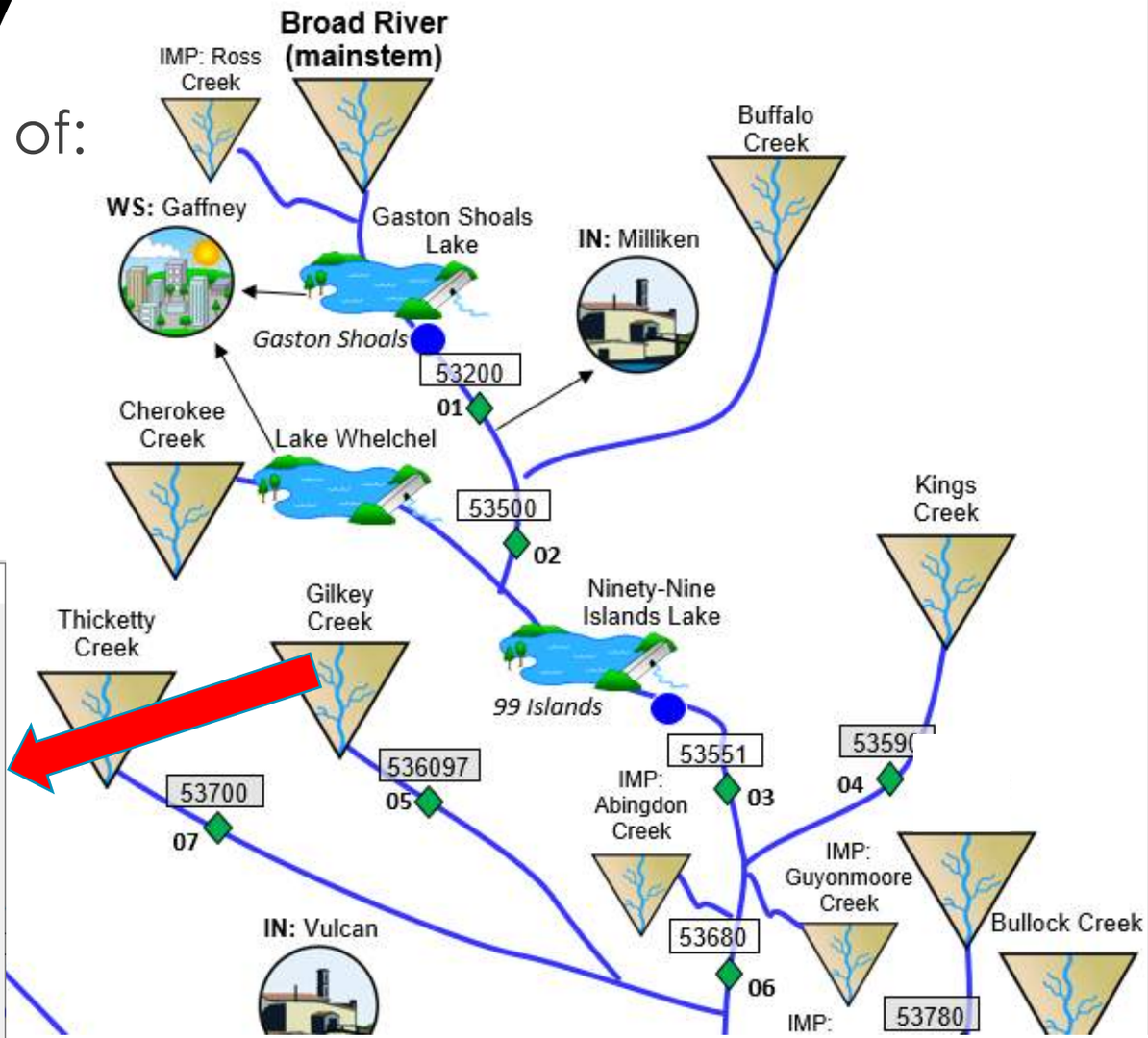


SWAM Calculations: Supply

- **Physically available** flow is a function of:
  - upstream tributary inflows,
  - reach gains and losses,
  - upstream diversions, withdrawals, returns, and storage

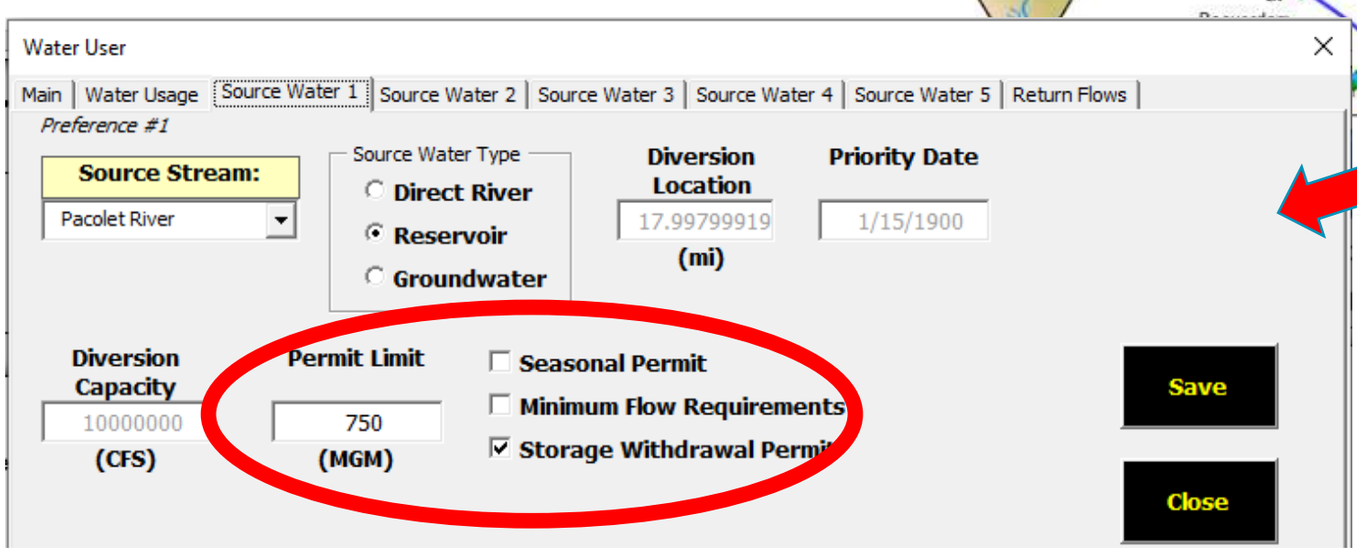
Year (YYYY)	Month (MMM)	Monthly Flow (CFS)
1929	Oct	130
1929	Nov	56
1929	Dec	38
1930	Jan	35
1930	Feb	37
1930	Mar	34
1930	Apr	13
1930	May	9
1930	Jun	8
1930	Jul	4
1930	Aug	4
1930	Sep	3
1930	Oct	3
1930	Nov	11
1930	Dec	19
1931	Jan	14
1931	Feb	7
1931	Mar	15
1931	Apr	26

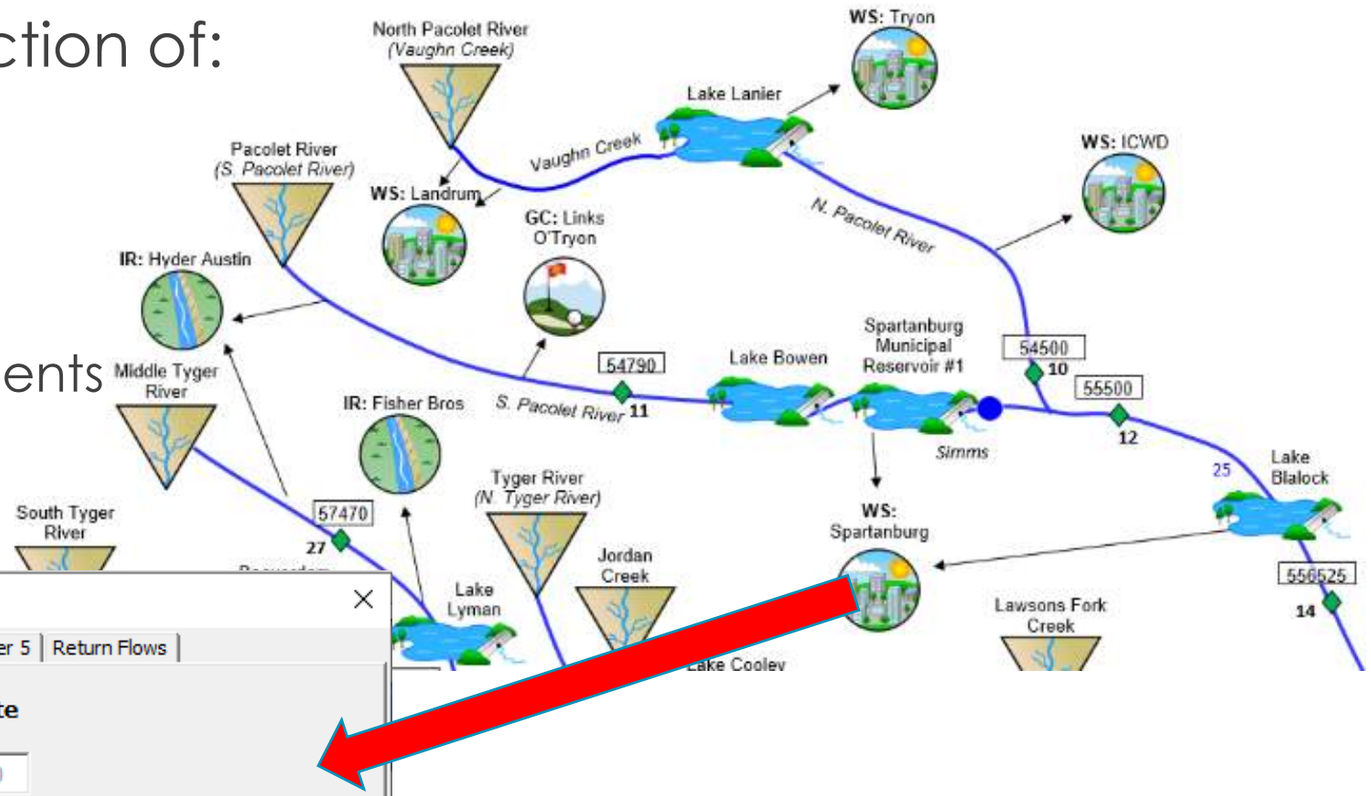




SWAM Calculations: Supply

- **Legally available** flow is a function of:
  - Water rights / permit limits
  - Storage rights
  - Minimum Instream flow requirements
  - Downstream priority water uses

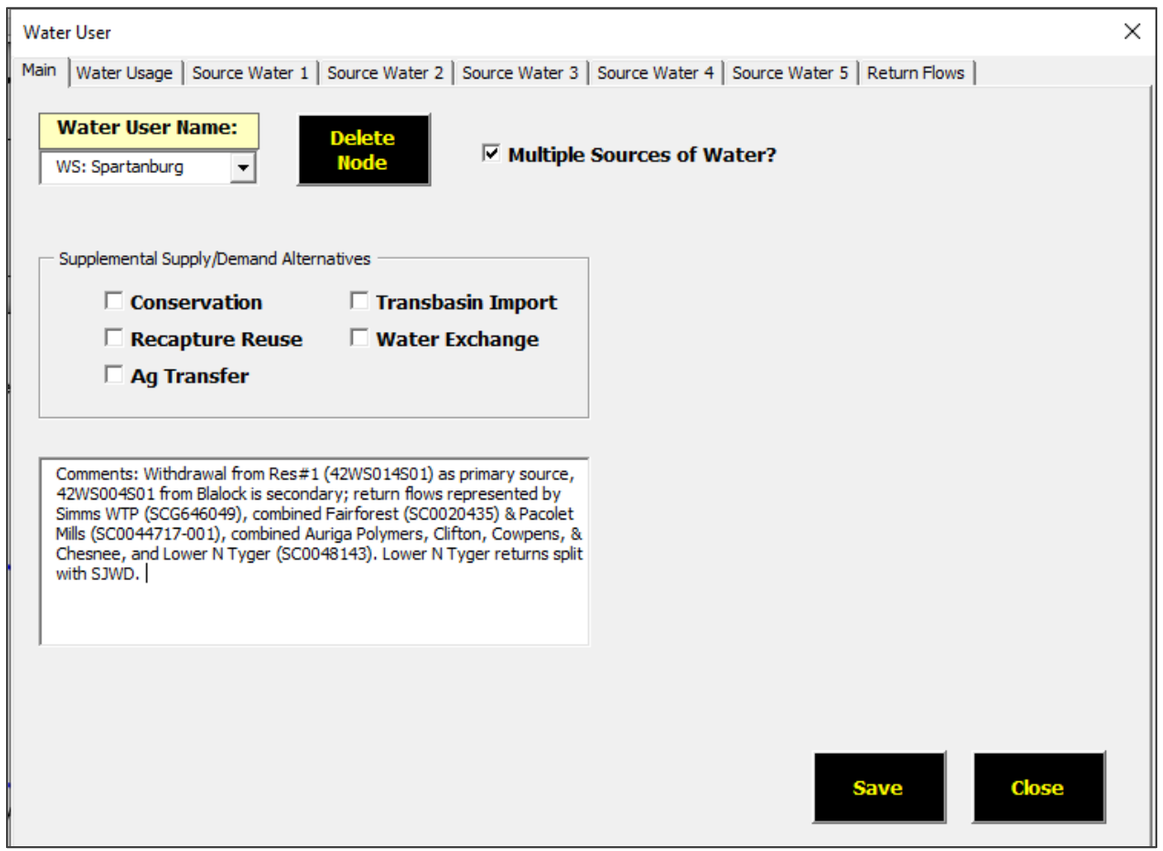




SWAM Calculations: Demand

- **Water User Object:**
  - Node-based demand, use and returns

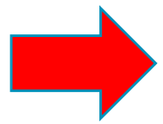
WS: Spartanburg



SWAM Calculations: Demand

- **M&I User Object:**
  - Municipal and industrial water demands (prescribed monthly mean)

WS: Spartanburg



Water User

Main | Water Usage | Source Water 1 | Source Water 2 | Source Water 3 | Source Water 4 | Source Water 5 | Return Flows

Monthly User Distribution
- Manual
- M&I
- Agriculture

Annual Baseline Usage
Total Use [ ] Distribute
(MGY)

Input Format
- monthly means
- timeseries

Monthly Baseline Usage

Month	Monthly Usage	% Indoor Use	% CU Indoor	% CU Outdoor
Jan	23.9	100	72.2	0
Feb	23.6	100	71.7	0
Mar	23.8	100	70.7	0
Apr	24.2	100	74	0
May	26.8	100	76.5	0
Jun	28.9	100	79	0
Jul	30.3	100	79.8	0
Aug	29.3	100	80	0
Sep	29.1	100	81.3	0
Oct	26.8	100	78.3	0
Nov	24.6	100	76.9	0
Dec	23.4	100	72.3	0
	(MGD)			

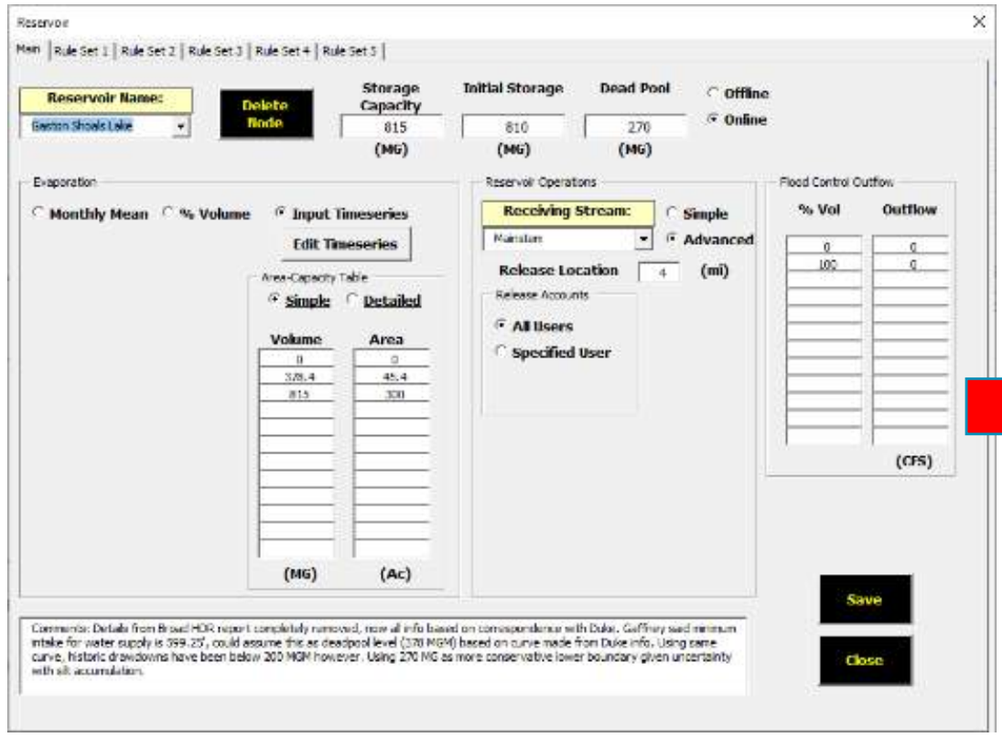
Save Close

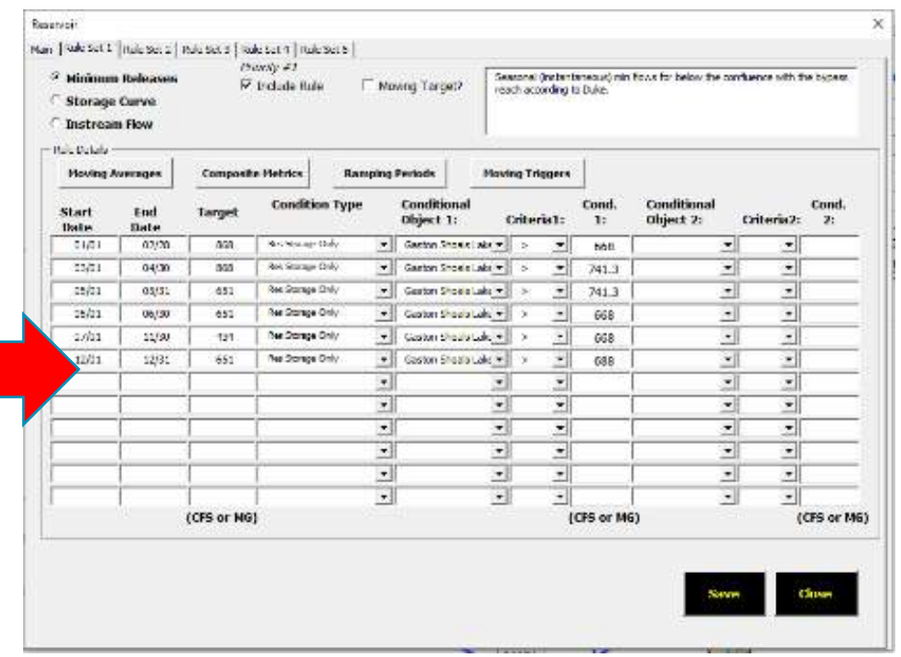
SWAM Calculations: Reservoirs

- **Reservoir Object:**
  - Dynamic water balance, water supply pool, customized operating rules

WS: Gaffney

Gaston Shoals Lake

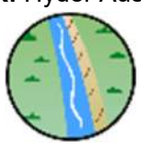


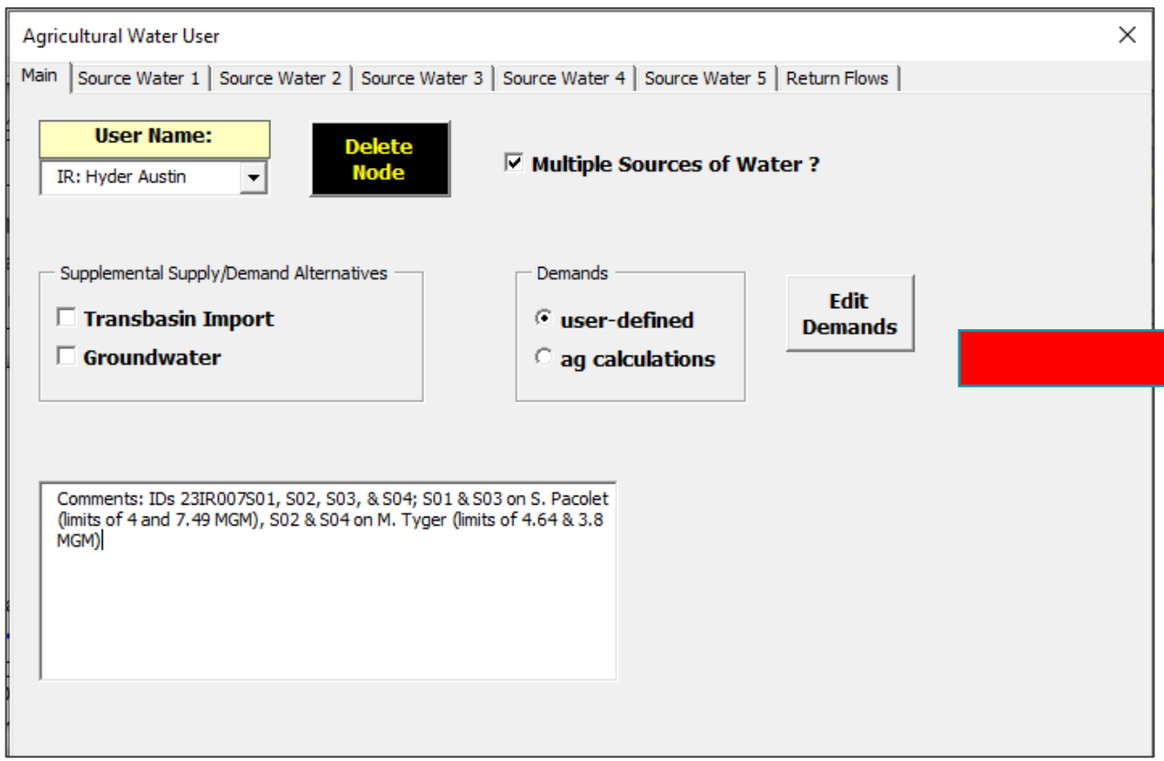


SWAM Calculations: Demand

- **Ag User Object:**
  - Agricultural water demands (prescribed monthly mean – repeated time series)

IR: Hyder Austin

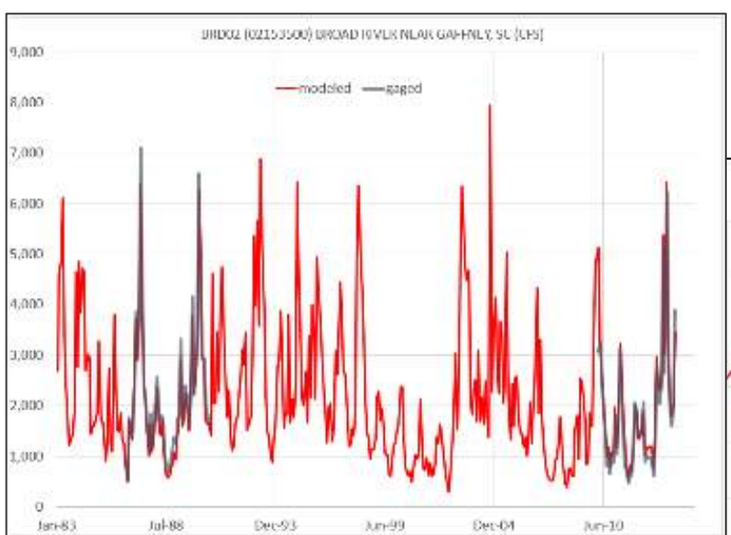


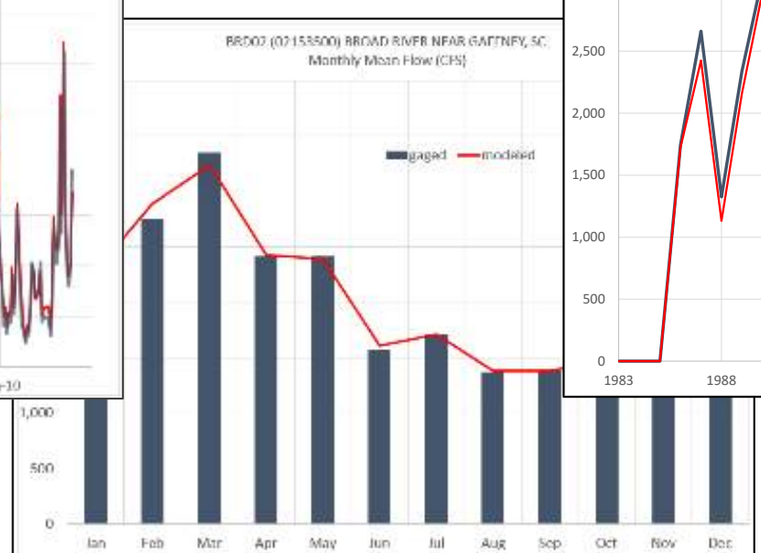


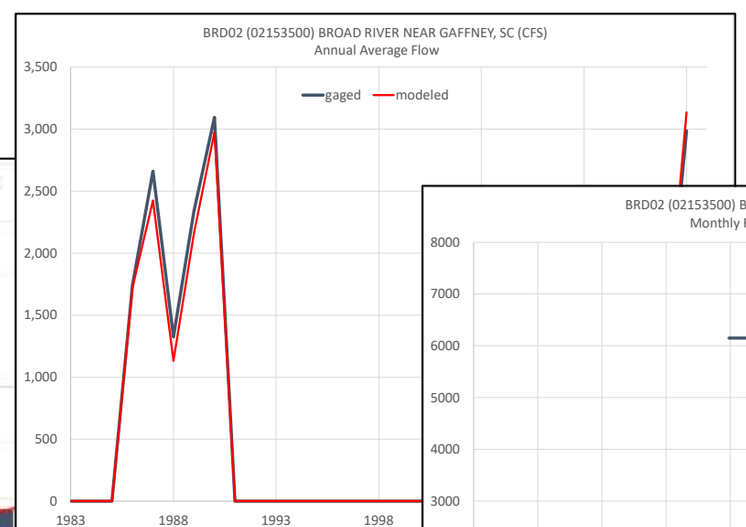
Year (YYYY)	Month (MMM)	Monthly Demand (MGD)
1929	Oct	0.00
1929	Nov	0.00
1929	Dec	0.00
1930	Jan	0.00
1930	Feb	0.00
1930	Mar	0.00
1930	Apr	0.00
1930	May	0.00
1930	Jun	0.01
1930	Jul	0.01
1930	Aug	0.00
1930	Sep	0.00
1930	Oct	0.00
1930	Nov	0.00
1930	Dec	0.00
1931	Jan	0.00
1931	Feb	0.00

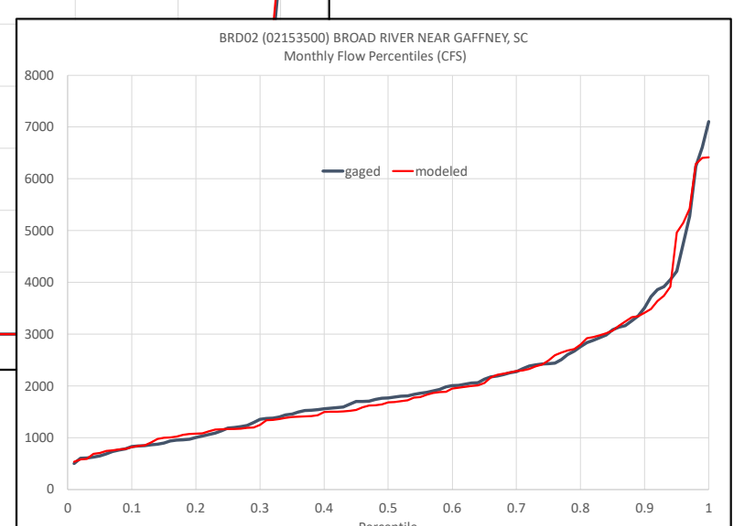
Model Calibration

- Calibration performed for multiple sites across wide range of hydrologic conditions
- Key calibration parameters = reach gain/loss factors (hydrology)



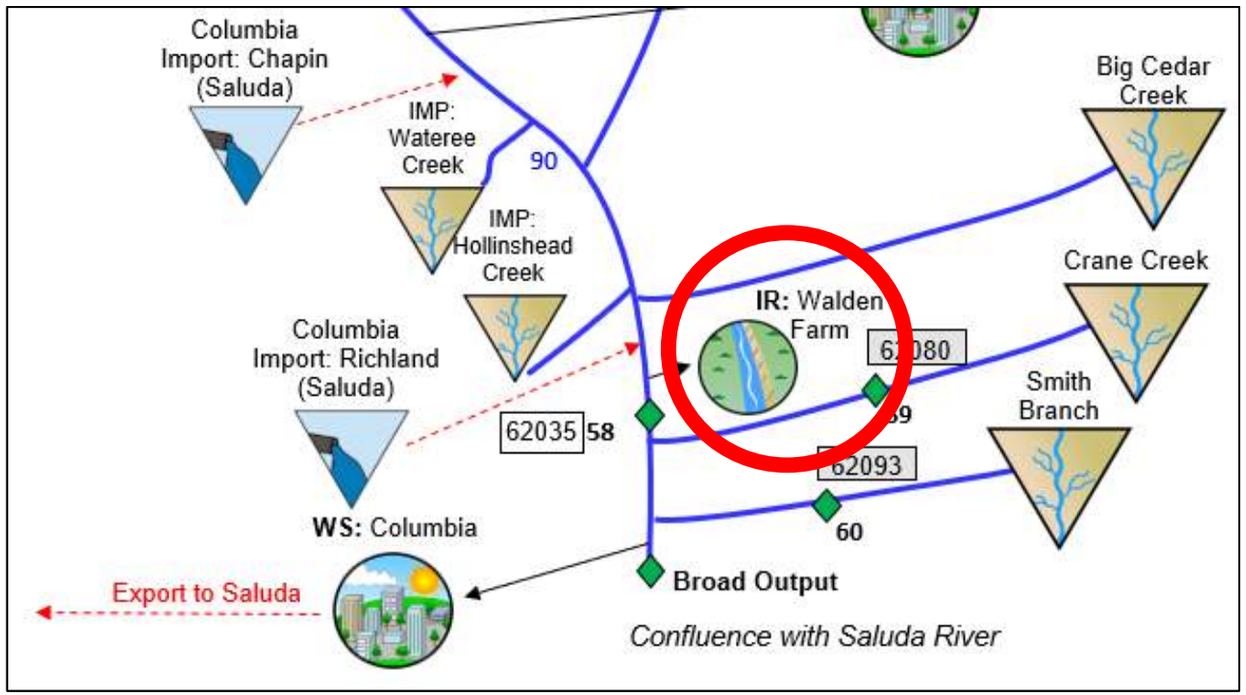






2021 Surface Water Model Updates

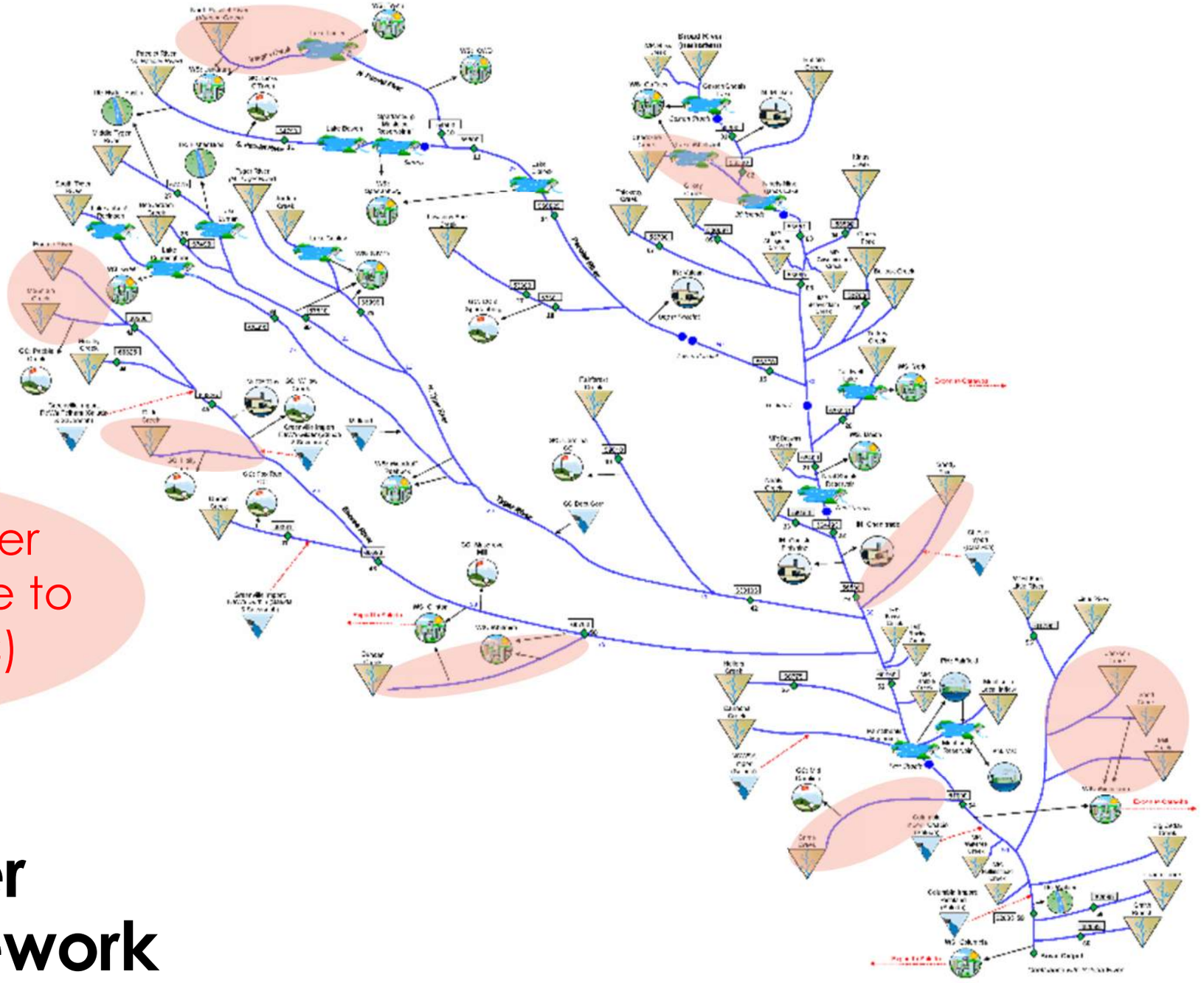
- Extended baseline hydrology through 2019 (added 6 years)
- Updated monthly mean water demands based on recent water use data
- Updated permit and intake location information
- Removed inactive permittees
- Added new permittee: S.C. Dept. of Corrections – Walden Farm
- Software update



Model Limitations

- Greater uncertainty in predictions for ungaged reaches compared to gaged
- Model not designed for reach routing of flow changes at a daily or sub-daily timestep
- Greater uncertainty in supply availability (and "shortage") predictions associated with small stream withdrawals compared to larger river and reservoir withdrawals
  - e.g. offline irrigation ponds
- Baseline model assumes past hydrologic variability is representative of future hydrologic variability (stationary climate)

Areas of greater uncertainty (due to lack of gages)



Broad River Surface Water Model Framework

Surface Water Scenarios

Base Scenarios

- Current Surface Water Use Scenario
  - *Uses most recent 10-yr average withdrawals (as reported by month)*
- Permitted and Registered Surface Water Use Scenario
  - *Uses current fully-permitted and registered amounts*
- Business-as-Usual Water Demand Projection Scenario
  - *Future water demand projection based on moderate growth and normal climate*
- High Water-Demand Projection Scenario
  - *Future water demand projection based on high growth and hot/dry climate*

Additional scenarios may be identified and requested by the RBC

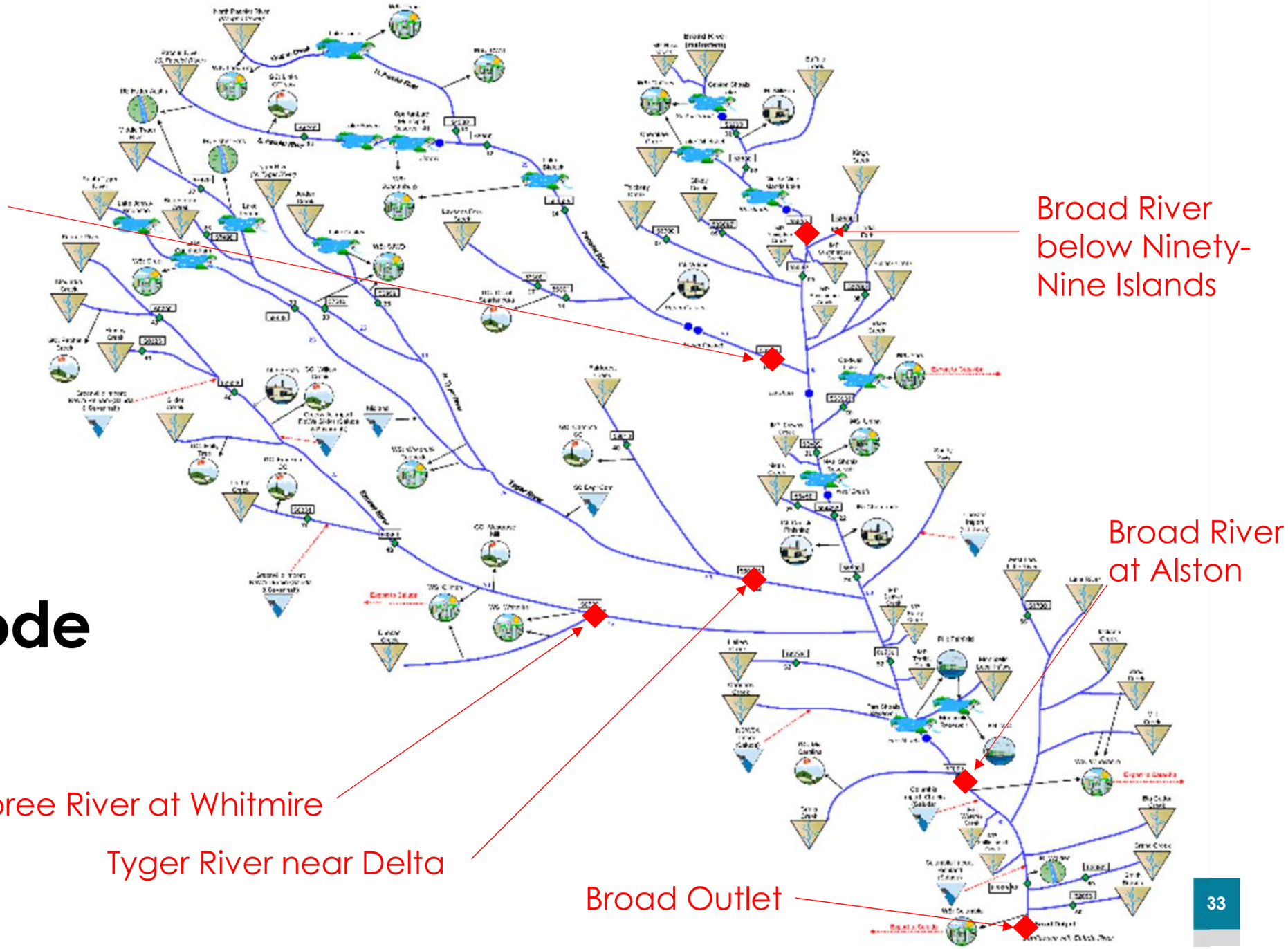
Performance Measures

Assessment of simulation results will focus on quantifying key performance measures for multiple reaches of interest across the basin.

Example / Suggestions:

- Percent change in a monthly minimum flow, 5th percentile flow, mean, and/or median flow
- Percent change in seasonal or monthly flows
- Percent change in surface water supply
- Percent change in mean annual shortage or mean percent shortage
- Change in the number and magnitude of excursions below 20, 30 and 40 percent mean annual daily flows and/or 7Q10 flow
- Change in number of water users experience a shortage
- Change in the average frequency of shortage
- Percent of time recreational facilities were unavailable on a stream reach

Strategic Node Possibilities

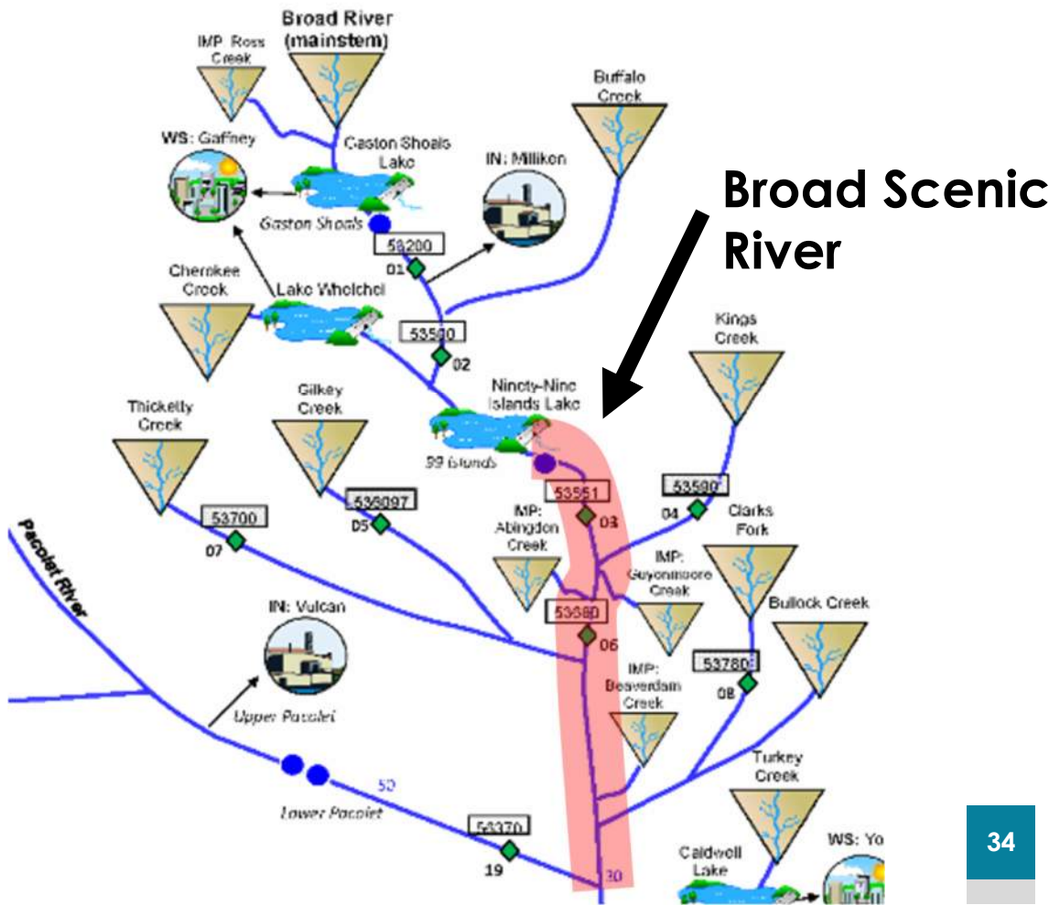


Reaches of Interest

Specific stream reaches that may have no identified *Surface Water Shortage* but experience undesired impacts, environmental or otherwise, determined from current or future water-demand scenarios or proposed water management strategies.

Could be related to:

- Recreational flows
- Ecological / in-stream flows
- Designation as a Scenic River



Upcoming Meeting Schedule, Topics and October Field Trip

Agenda Item 8

Tentative Itinerary for October 13 RBC Field Trip

9:00 am	Lake Blalock Park – Kick-off & Safety briefing – 1925 Sandy Ford Rd, Chesnee, SC 29323
9:15 am	Paddle / Pontoon Excursion from Lake Blalock Boat Landing to Lake Blalock Dam
10:45 am	Overview of Lake Blalock Dam and Intake Area
11:15 am	Board Bus (from 5401 Old Griffin Rd, Chesnee, SC 29323) – Travel to RB Simms Plant
11:30 am	Arrive at RB Simms Plant (390 Spartanburg Waterworks Rd, Chesnee, SC 29323)
11:35 am	Overview of dam, new Water Supply Intake & Advanced Oxidation System
12:10 pm	Board Bus - Lunch at SWS Pavilion #1 (183 Chigger Creek Rd, Chesnee, SC 29323)
12:50 pm	Board Bus for travel to Strawberry Hill USA (3097 Hwy 11 W, Chesnee, SC 29323)
1:05 pm	*Arrive at Strawberry Hill USA (Cooley Farms) for overview of Agricultural Irrigation (Tentative)
2:05 pm	Board Bus - Return travel to Lake Blalock Park (1925 Sandy Ford Rd, Chesnee, SC 29323)
2:35 pm	Adjourn

Tentative Phase 1 Meeting Schedule and Topics

Meeting	Date	Topics	Location
Field Trip	Oct 13	**Lake Blalock Paddling and RB Simms Plant**	
Training	Oct 27, 28, 31 or Nov 1	**SWAM Training for interested RBC Members**	**Columbia**
RBC Meeting	Nov 10	**Proposed flow –ecology relationships** **Review of surface water modeling planning scenario results**	**TBD**