August 16, 2023 Meeting Agenda

Meeting Objectives:

1) Learn about the methods for evaluating surface water availability and the Saluda River basin water quantity model (SWAM)
2) Visit the Laurens County Water and Sewer Commission Water Treatment Plant

1.	Call the Meeting to Order (K.C. Price) a. Review of Meeting Objectives b. Approval of Agenda c. Approval of July 19th Minutes and Summary d. Housekeeping Items and Announcements	10:00–10:10
2.	Public[1] and Agency Comment (John Boyer)	10:10–10:15
3.	July RBC Meeting Review (John Boyer)	10:15–10:30
4.	Hydrology 101 (Kirk Westphal, CDM Smith)	10:30–10:45
5.	Methodologies for Evaluating Water Availability (Scott Harder, SCDNR)	10:45–11:15
	Break	*11:15–11:25*
6.	Introduction to the SWAM Model (John Boyer)	11:25–11:45
7.	Demand Projections Update (Alex Pellett, SCDNR)	11:45–11:55
8.	Upcoming Meeting Schedule and Topics (John Boyer)	11:55–12:00
	Lunch	*12:00–12:30*
9.	Visit to LCWSC Water Treatment Plant	12:30–2:00

Agenda Item 2

Quorum Determination

Review Meeting Objectives

1. Learn about the methods for evaluating surface water availability and the Saluda River basin water quantity model (SWAM)
2. Visit the Laurens County Water and Sewer Commission Water Treatment Plant

Approval of Agenda

Approval of July 19th Meeting Minutes and Summary

Saluda River Basin Council

Meeting #6

August 16, 2023

Housekeeping Items

New RBC Member (Pending PPAC Approval)

Kaleigh Simms

Regulatory Services Manager

Renewable Water Resources

Water and Sewer Utilities interest category

Public Comment

Agenda Item 2

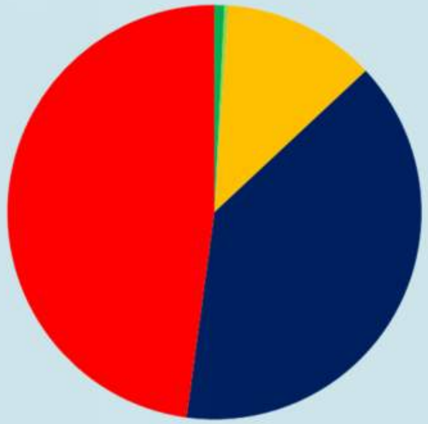
July RBC Meeting Review

John Boyer

Agenda Item 3

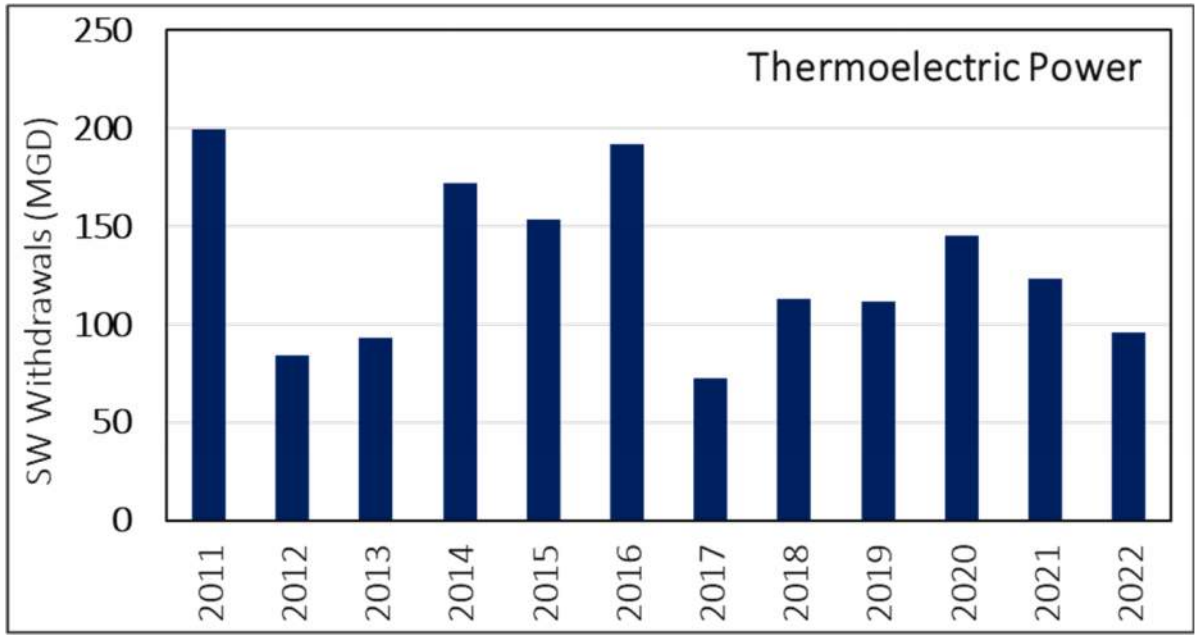
Water Use and Water Demands – Alex Pellett, SCDNR

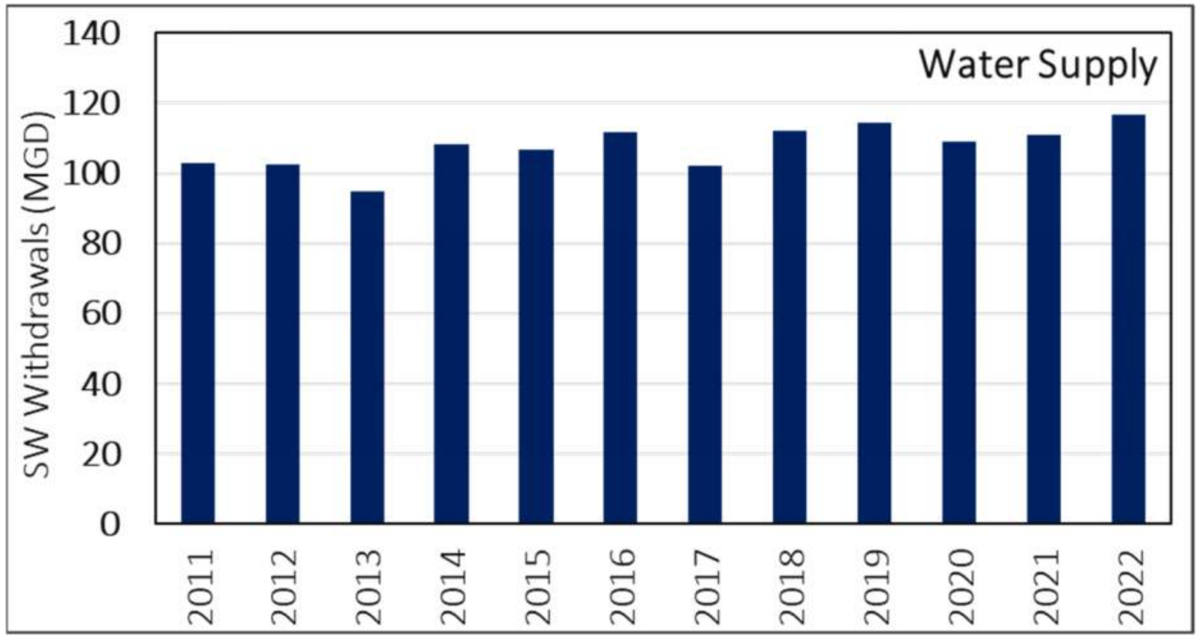
2022 Reported Surface Water Withdrawals



- Thermoelectric (39%)
- Water Supply (48%)
- Industry (12%)
- Agr. Irrigation (< 1%)
- Golf Course (< 1%)

Surface Water Withdrawals by Categories (2011-2022)





Middle and Lower Saluda Scenic Rivers – Bill Marshall, SCDNR

Purpose -- S.C. Scenic Rivers Act:

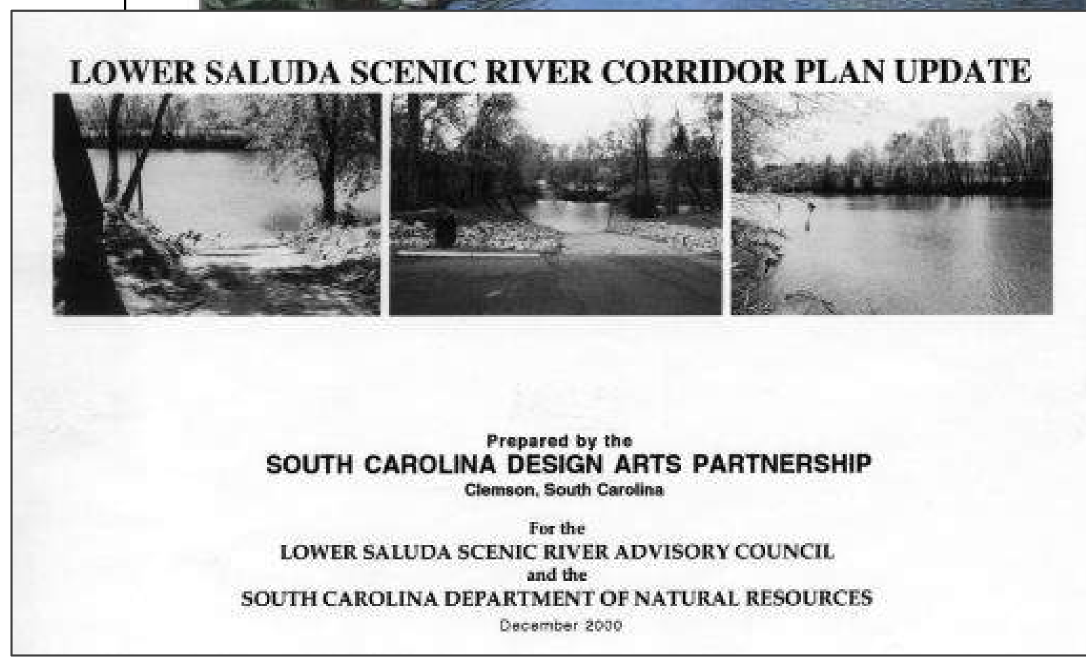
- Protect unique, outstanding resource values of S.C. rivers -- scenic, recreational, geologic, botanical, fish, wildlife, historic, and cultural

Approach:

- Non-regulatory. Community-based partnerships for river conservation & stewardship
- Advisory councils & management plans

Lower Saluda Resource Protection Interests:

- Protection of riparian lands, habitat
- Protect, enhance recreational fishery
- Enhance instream flows
- Reduce, eliminate pollution sources


LOWER SALUDA SCENIC RIVER CORRIDOR PLAN UPDATE

Prepared by the
SOUTH CAROLINA DESIGN ARTS PARTNERSHIP
Clemson, South Carolina

For the
LOWER SALUDA SCENIC RIVER ADVISORY COUNCIL
and the
SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
December 2000

FERC Licensing of Hydroelectric Projects – Elizabeth Miller, SCDNR

1 Saluda Hydroelectric Project

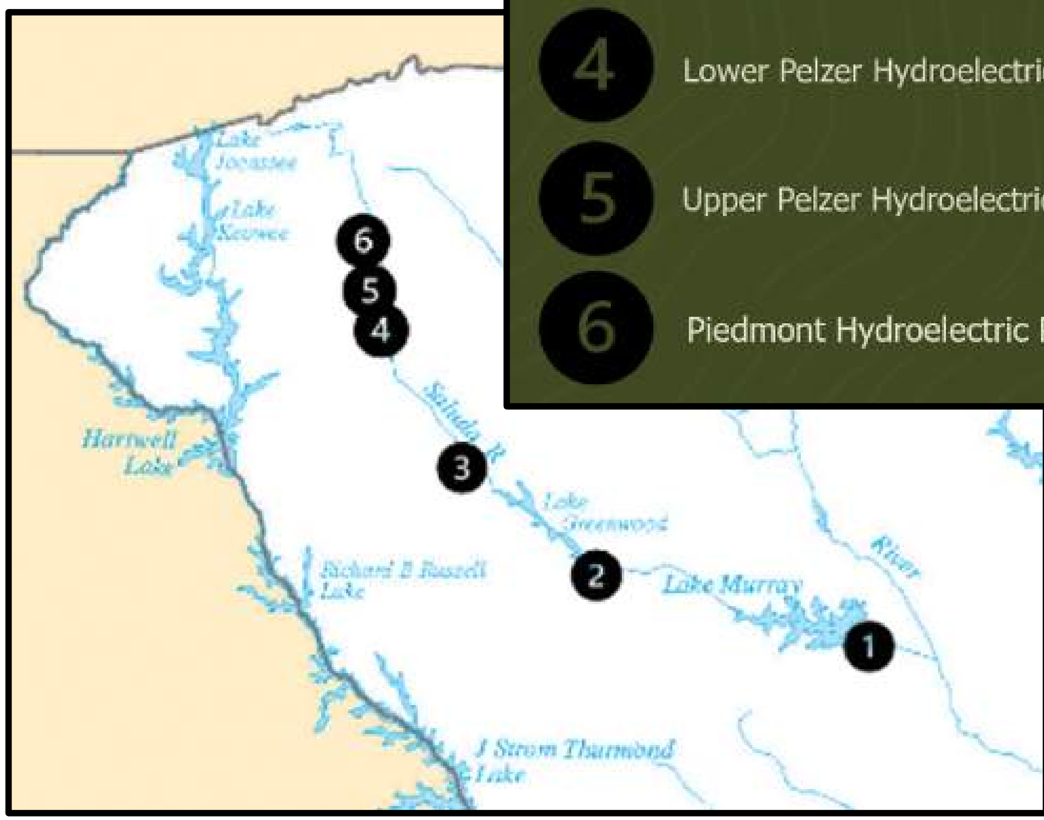
2 Buzzards Roost Hydroelectric Project

3 Ware Shoals Hydroelectric Project

4 Lower Pelzer Hydroelectric Project

5 Upper Pelzer Hydroelectric Project

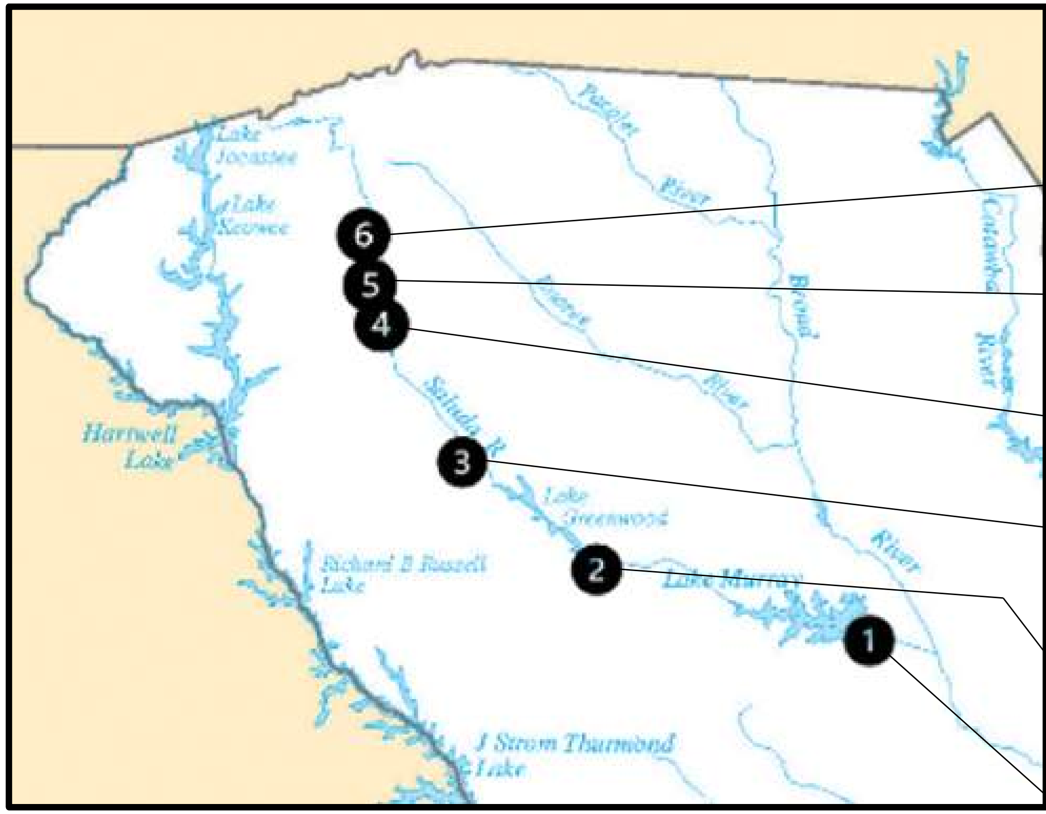
6 Piedmont Hydroelectric Project



SCDNR Interests & Objectives in Hydro Project Licensing

- Recognize the river and reservoir as important public trust resources
- Manage the project to achieve public benefits
- Maintain & enhance water quality to meet State standards
- Provide downstream flows consistent with the State Water Plan
- Establish a Drought Plan or Low-inflow Protocol
- Protect & enhance fish and wildlife populations and habitats
- Protect & enhance public opportunity for outdoor recreation
- Prevent impairment of water uses by invasive, exotic aquatic plants
- Improve recreational safety at the project
- Protect cultural & historic resources

FERC Licensing of Hydroelectric Projects – Elizabeth Miller, SCDNR



Project	Term	Operation
6. Piedmont	2020-2060	Run of river
5. Upper Pelzer	2020-2060	Run of river
4. Lower Pelzer	2020-2060	Run of River
3. Ware Shoals	2002-2032	Modified Run of River
2. Buzzards Roost	1995-2035	Seasonal Flows
1. Saluda	Relicensing	STB Releases Minimum Flows Low Inflow Pr. Other measures

Greenville Water Reservoir Release Criteria– Jeff Boss

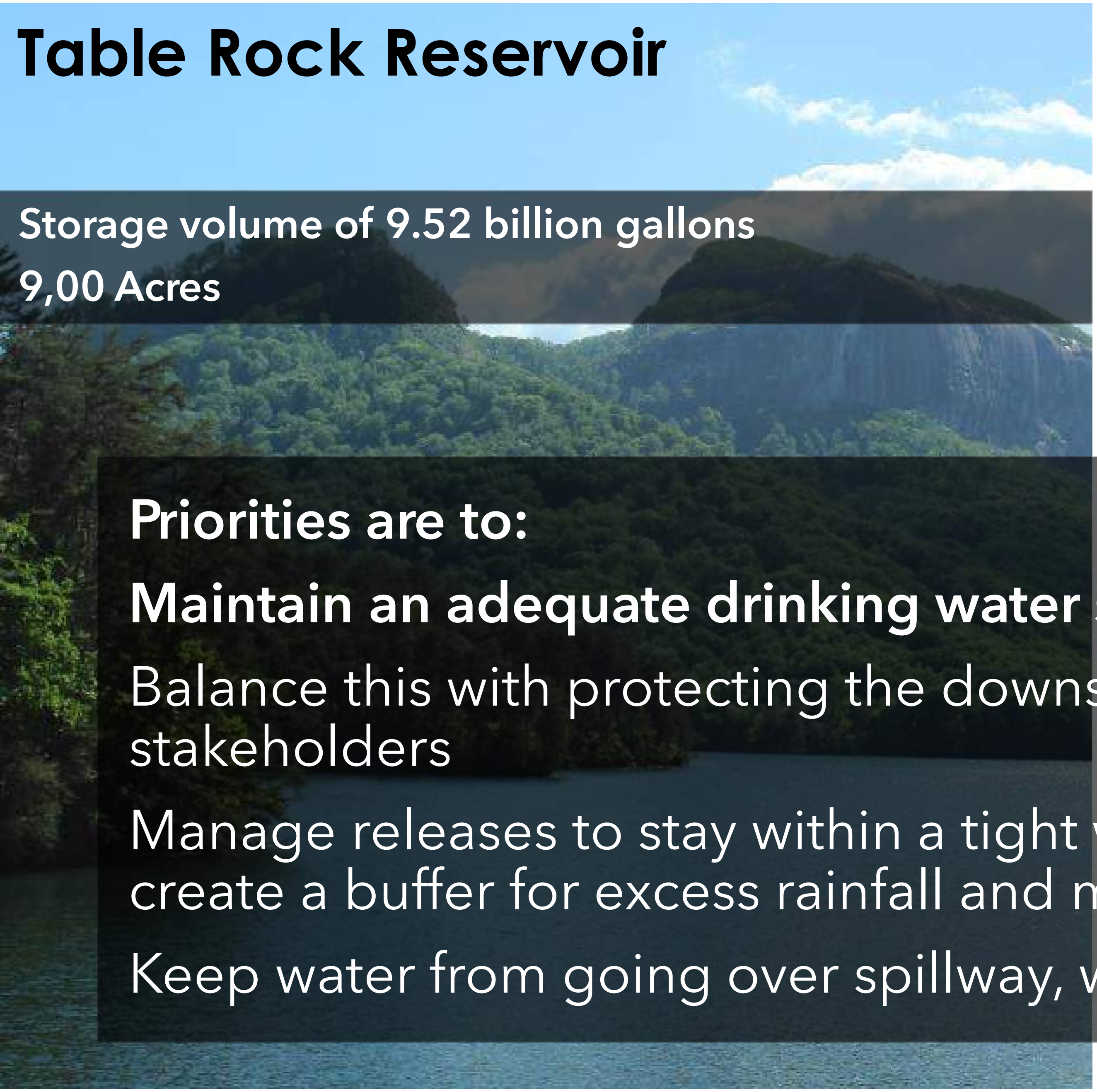
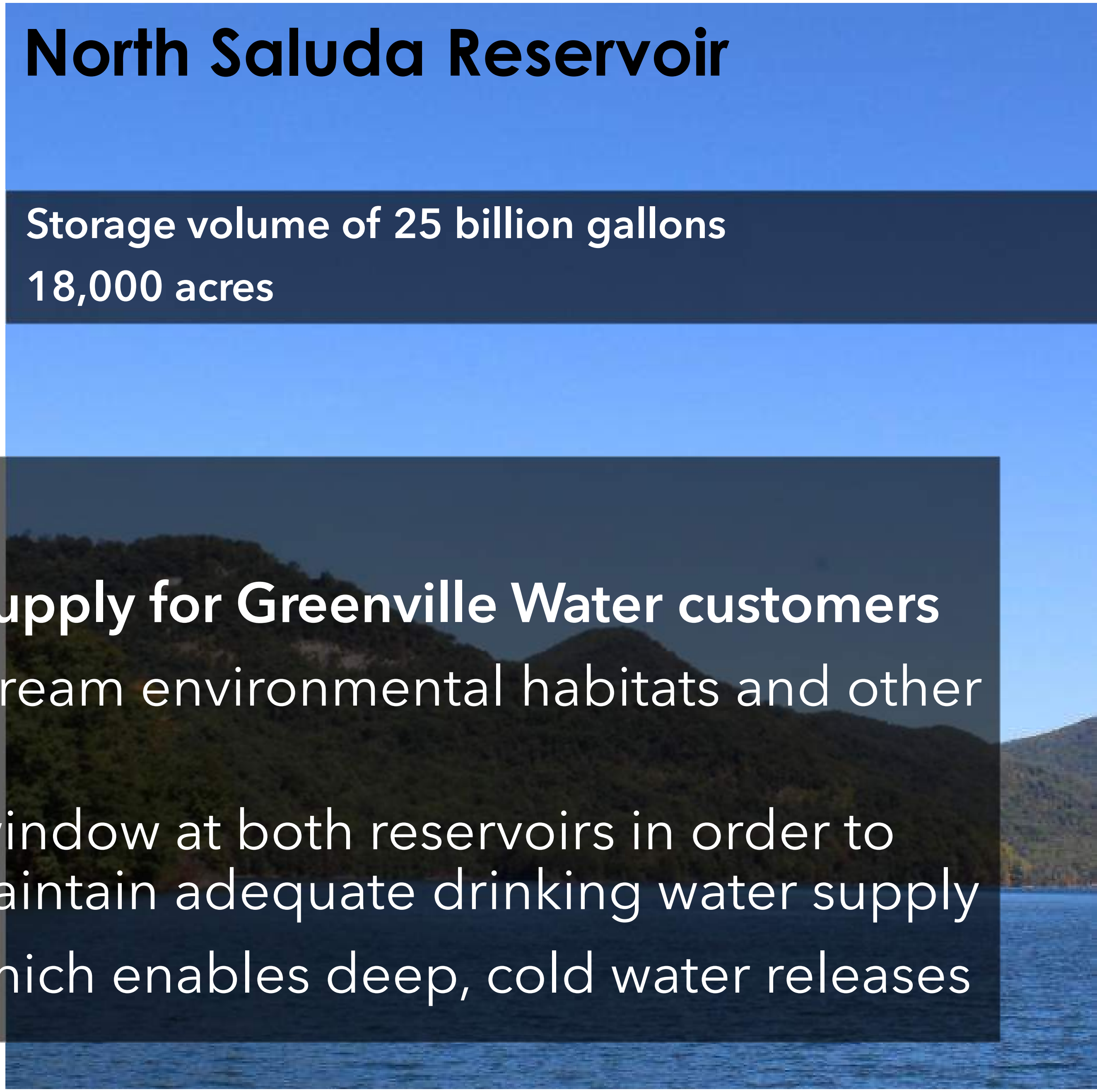


Table Rock Reservoir

Storage volume of 9.52 billion gallons

9,00 Acres



North Saluda Reservoir

Storage volume of 25 billion gallons

18,000 acres

Priorities are to:

Maintain an adequate drinking water supply for Greenville Water customers

Balance this with protecting the downstream environmental habitats and other stakeholders

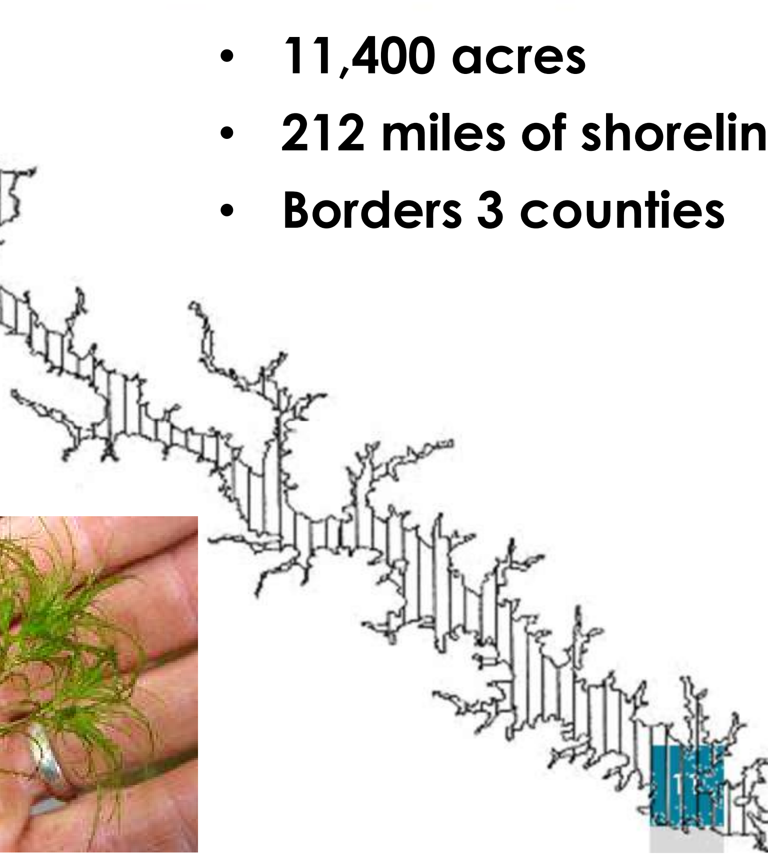
Manage releases to stay within a tight window at both reservoirs in order to create a buffer for excess rainfall and maintain adequate drinking water supply

Keep water from going over spillway, which enables deep, cold water releases

Lake Greenwood Management – Julie Davis, Greenwood Co.

County Lake Management Responsibilities:

- encroachment permits and inspections
- lake log removal
- mosquito spraying
- aquatic weed management
- cultural resources management plan
- public boat ramp and access maintenance
- island camping
- maintenance of earthen dam
- homeowner education

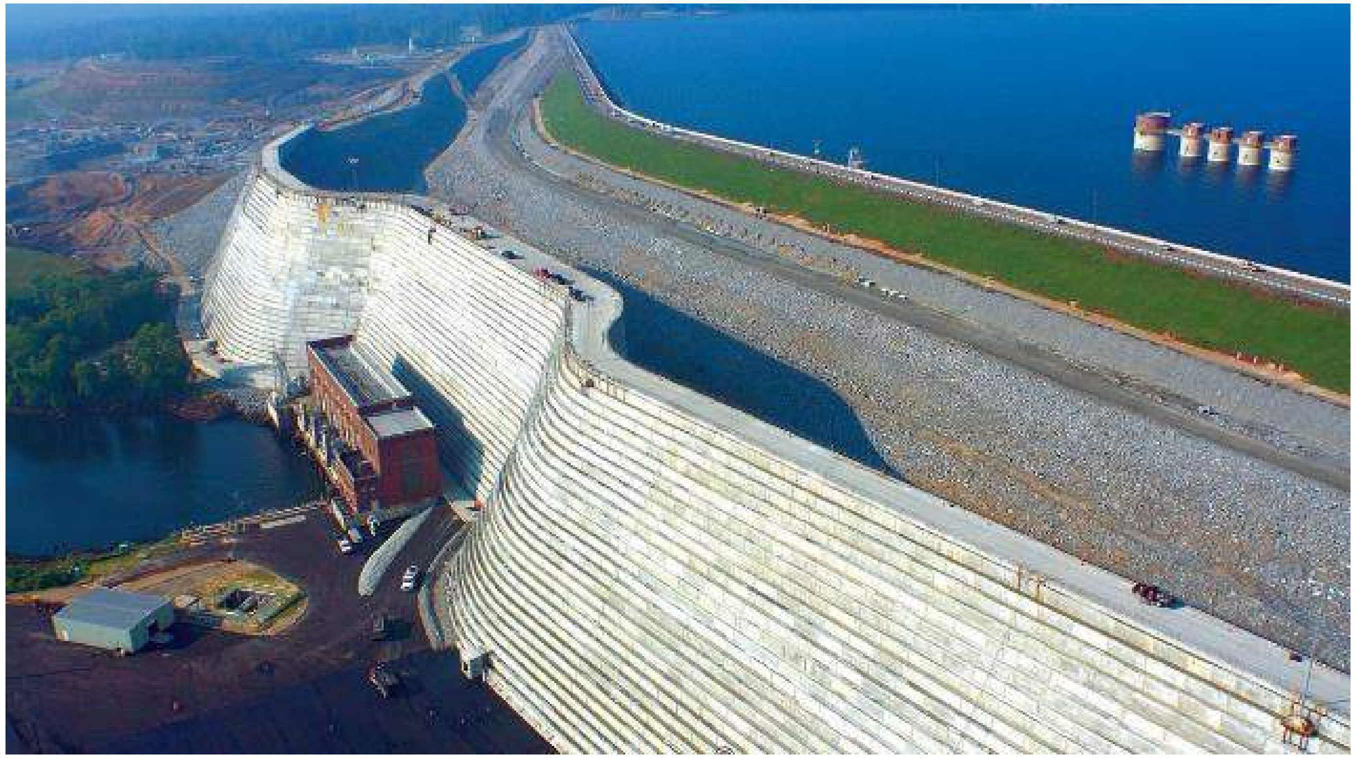


- **11,400 acres**
- **212 miles of shoreline**
- **Borders 3 counties**

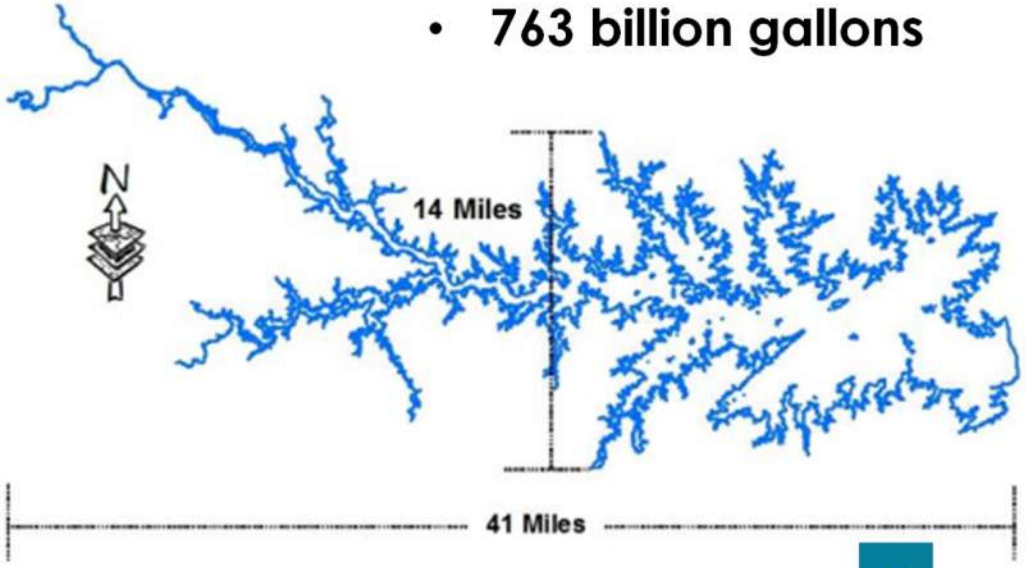
Lake Murray Management – Brandon McCartha, Dominion Energy

Lake Management Responsibilities:

- Shoreline Management Plan
- Shoreline permitting and inspections
  - Docks, boat lifts, ramps, irrigation water withdrawals, brushing, erosion control, excavations, and geothermal



- **48,239 acres**
- **650 miles of shoreline**
- **763 billion gallons**



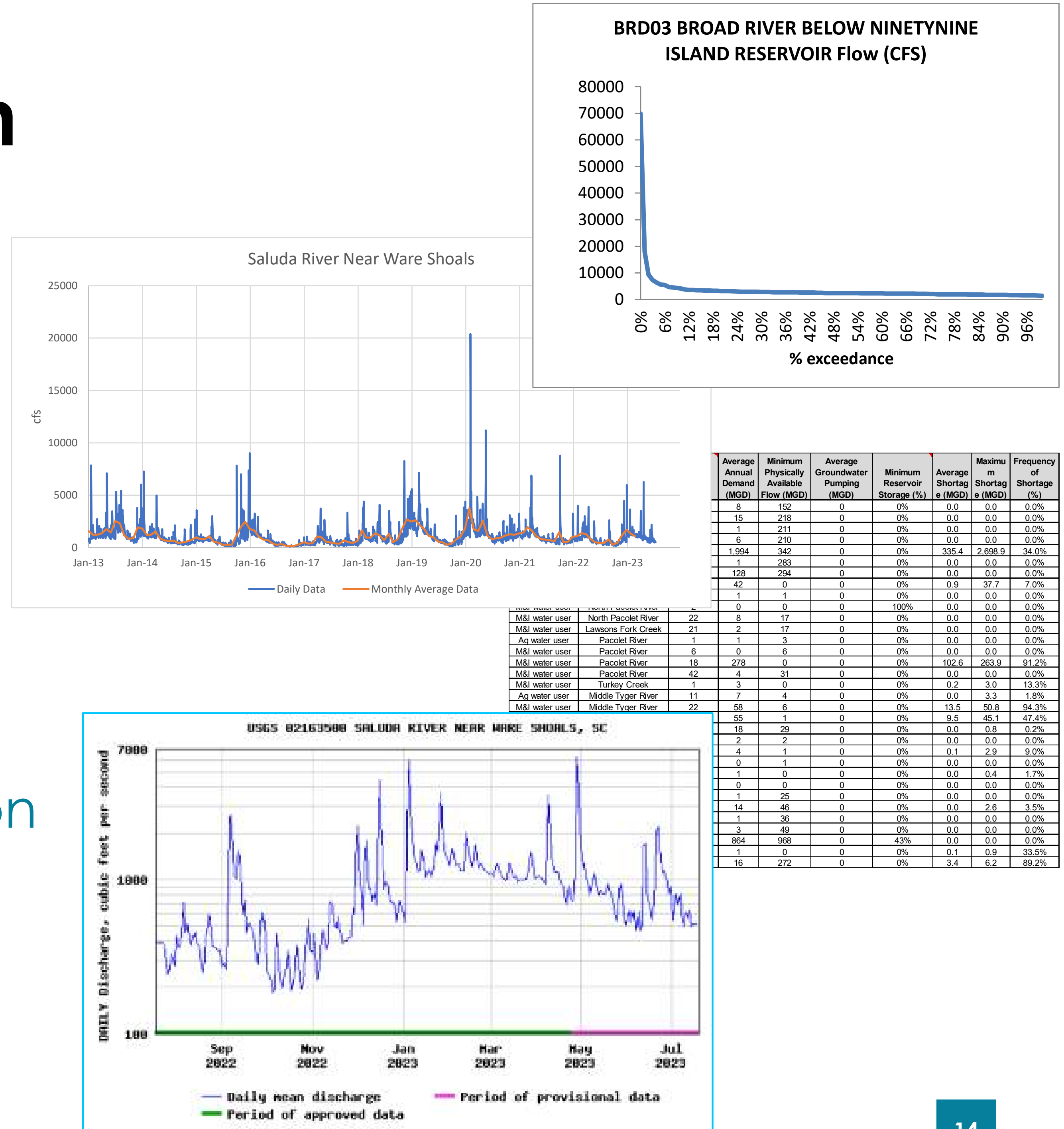
"Hydrology 101"
Fundamentals of Surface Water Hydrology and Hydrologic Data

Kirk Westphal, CDM Smith

Agenda Item 4

Purpose of this information

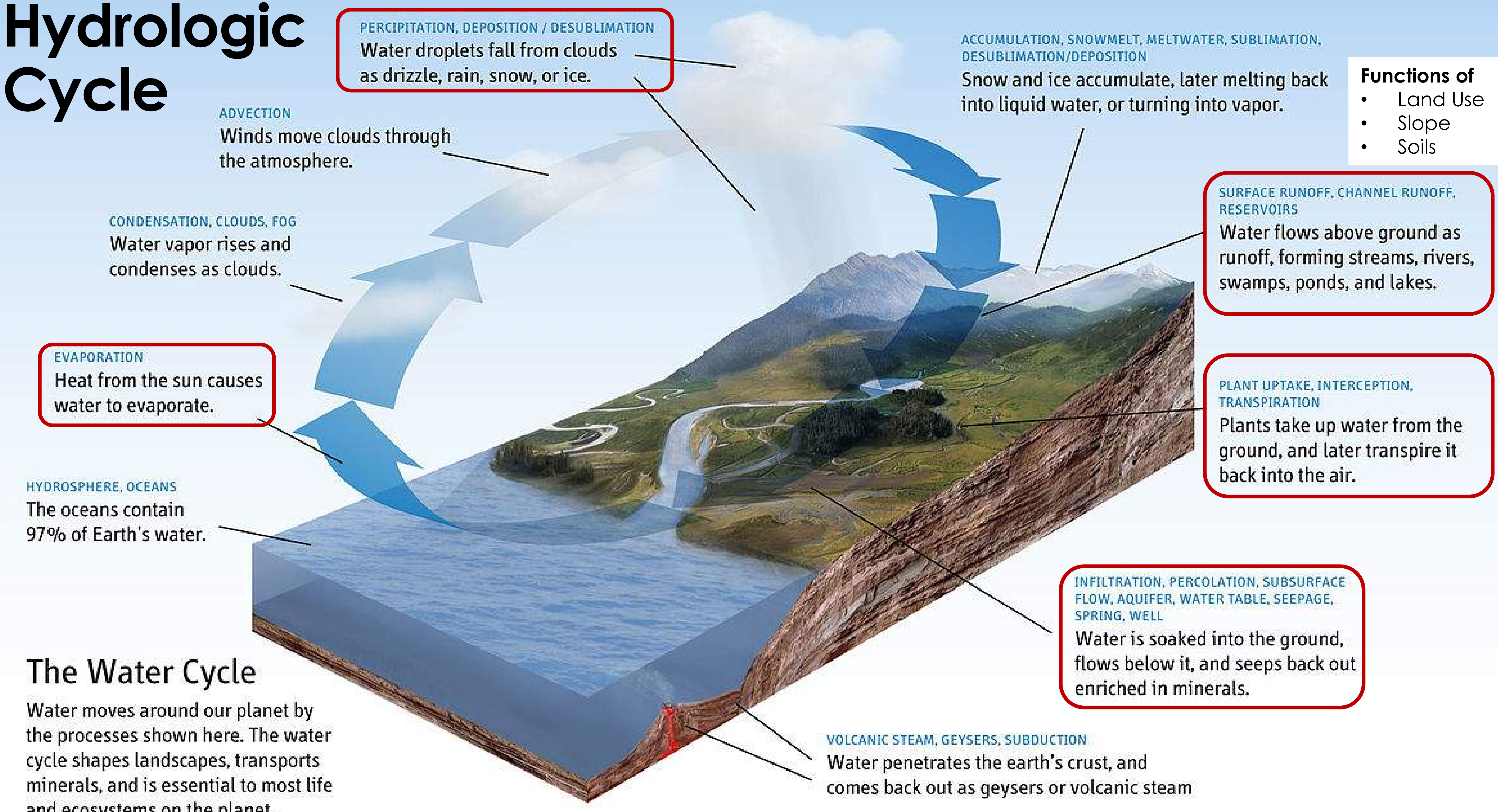
- For the next 12 months, you will be viewing a lot of hydrologic data in various formats, and for many purposes
- Other RBCs have noted that a brief introduction to hydrologic information would be helpful
- We can refer back to this information at any time throughout the process



Hydrologic Cycle

Functions of

- Land Use
- Slope
- Soils

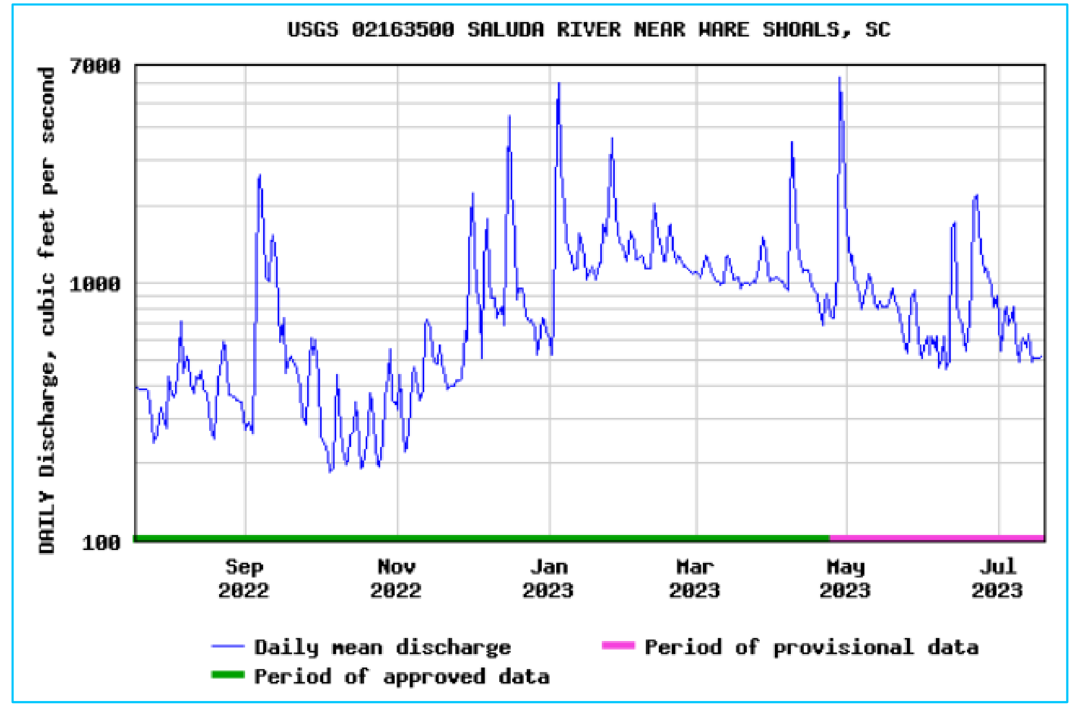


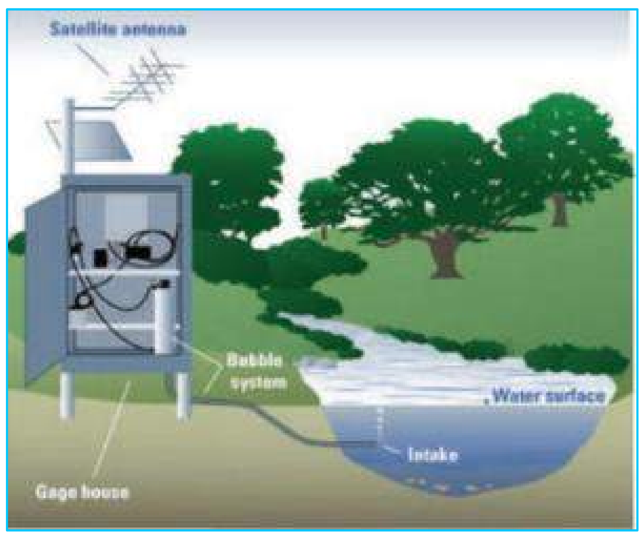
The Water Cycle

Water moves around our planet by the processes shown here. The water cycle shapes landscapes, transports minerals, and is essential to most life and ecosystems on the planet.

Measuring Hydrologic Data

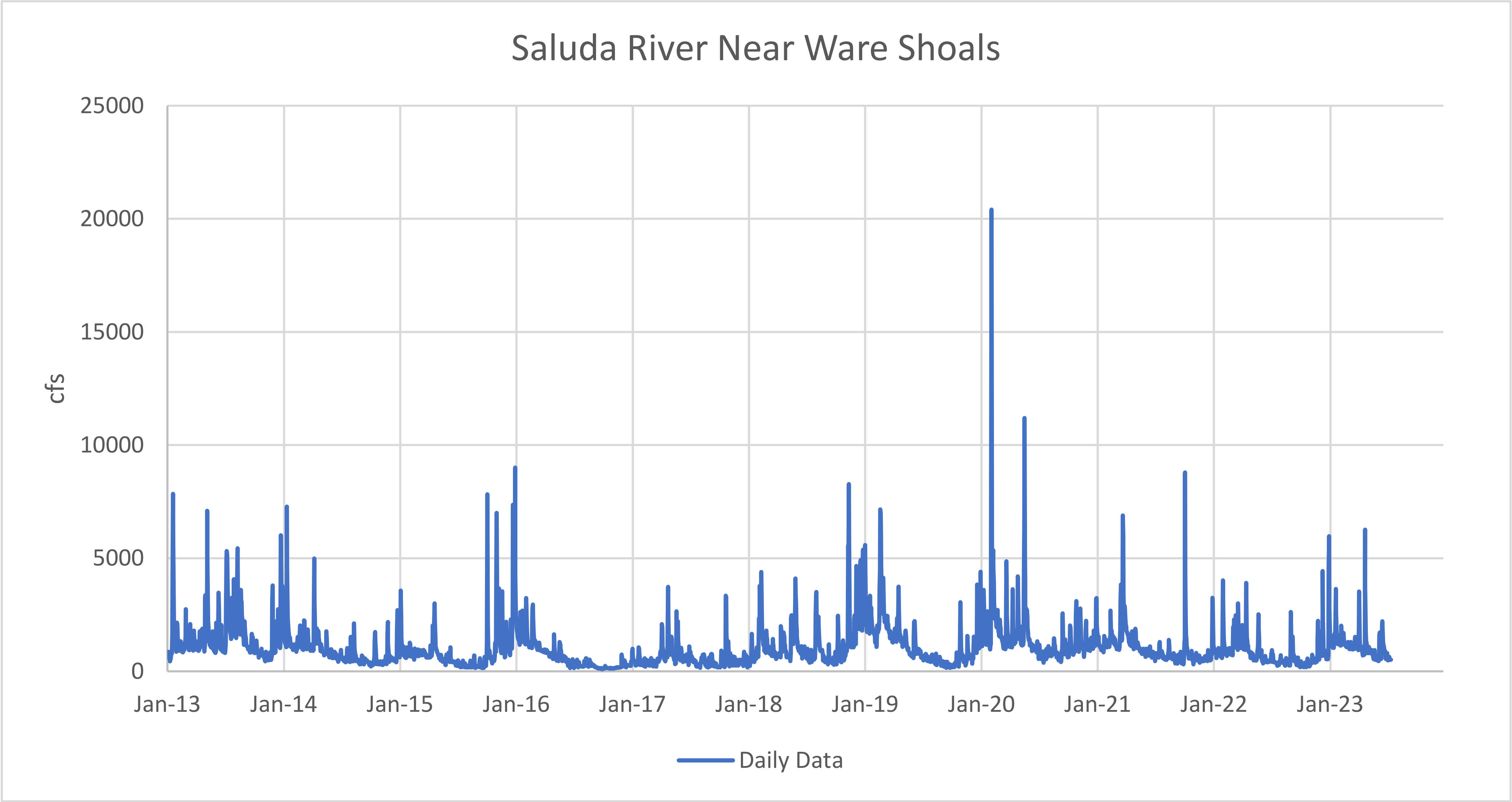
waterdata.usgs.gov



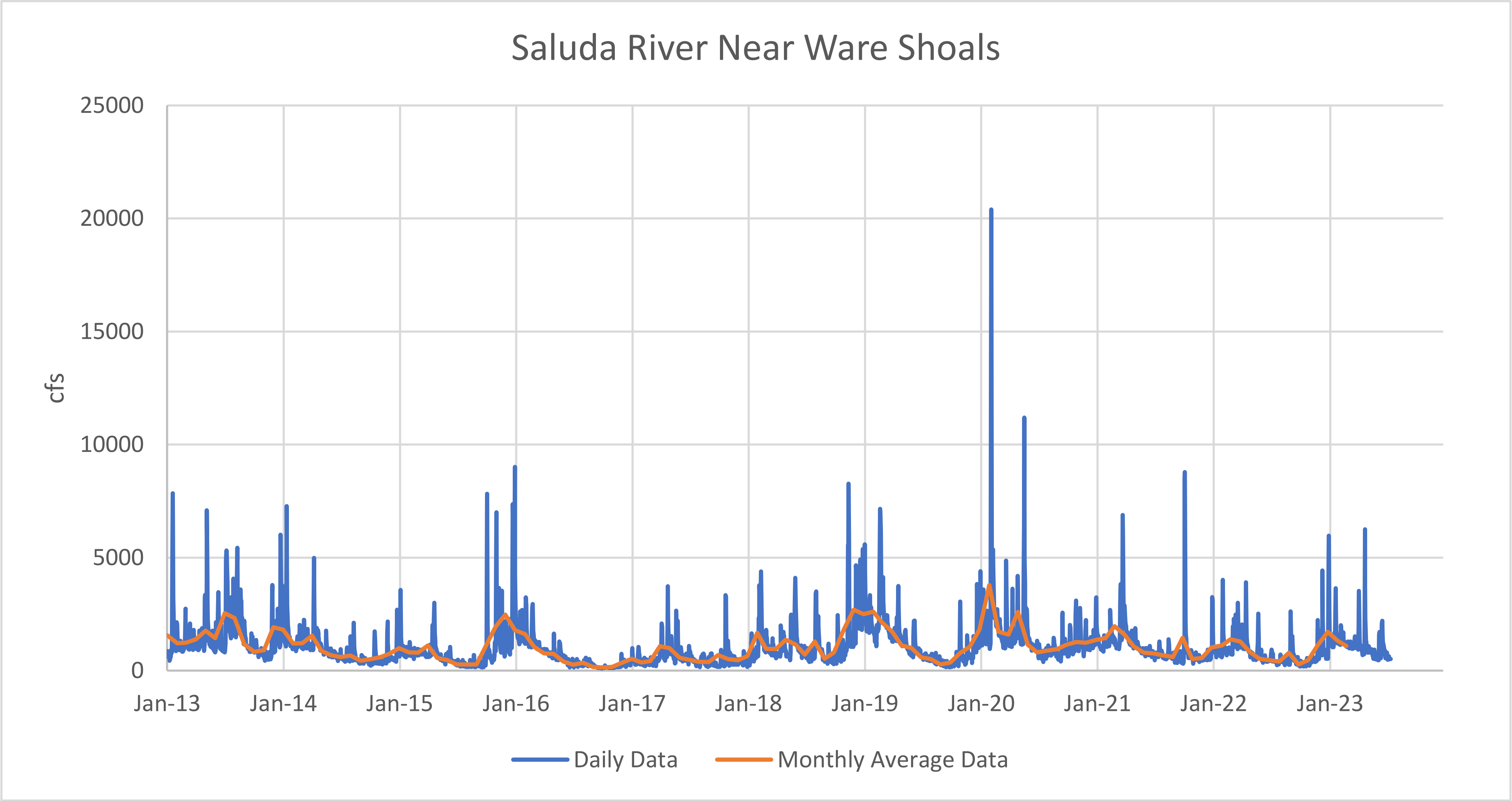


[Streamgaging Basics | U.S. Geological Survey (usgs.gov)]

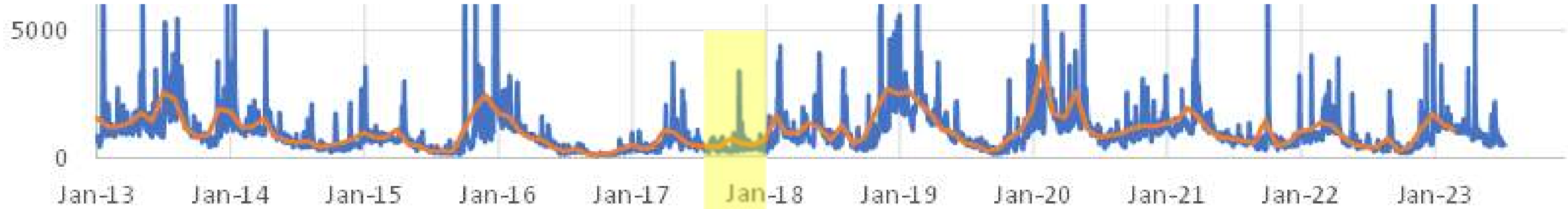
Displaying Hydrologic Data:
Basic Streamflow Hydrograph



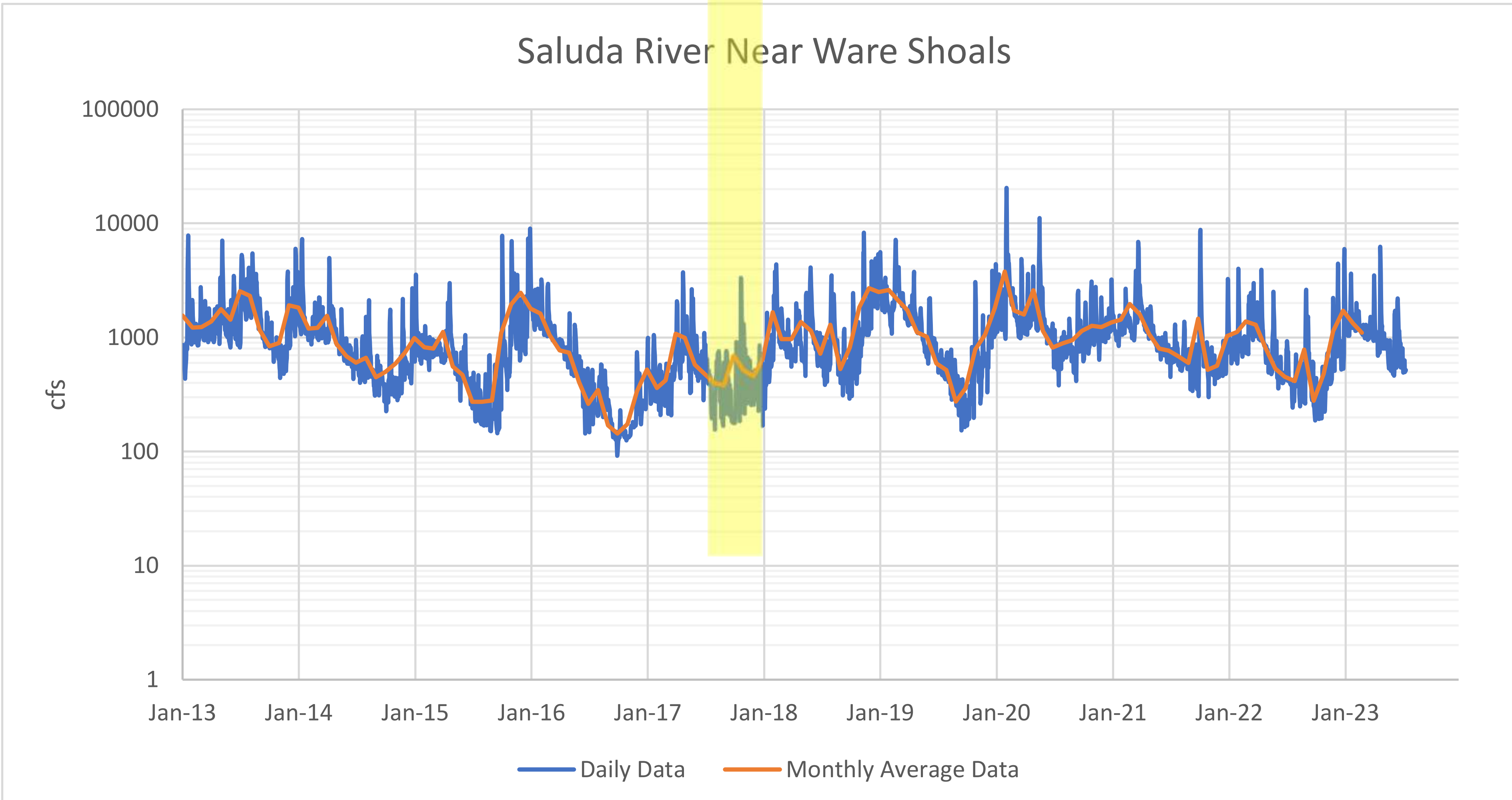
Daily vs. Monthly Flow



Visualizing Small Differences:
Log Scale

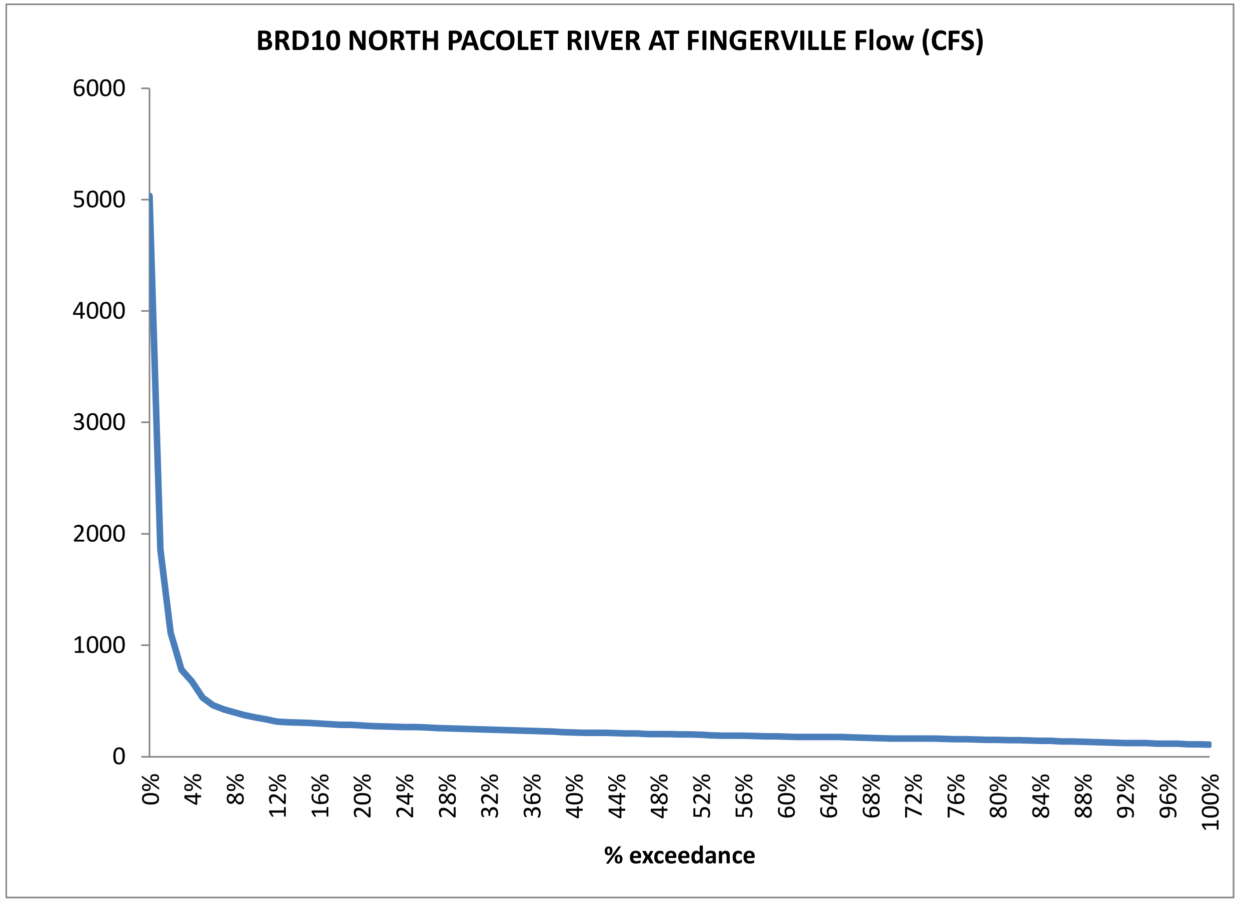


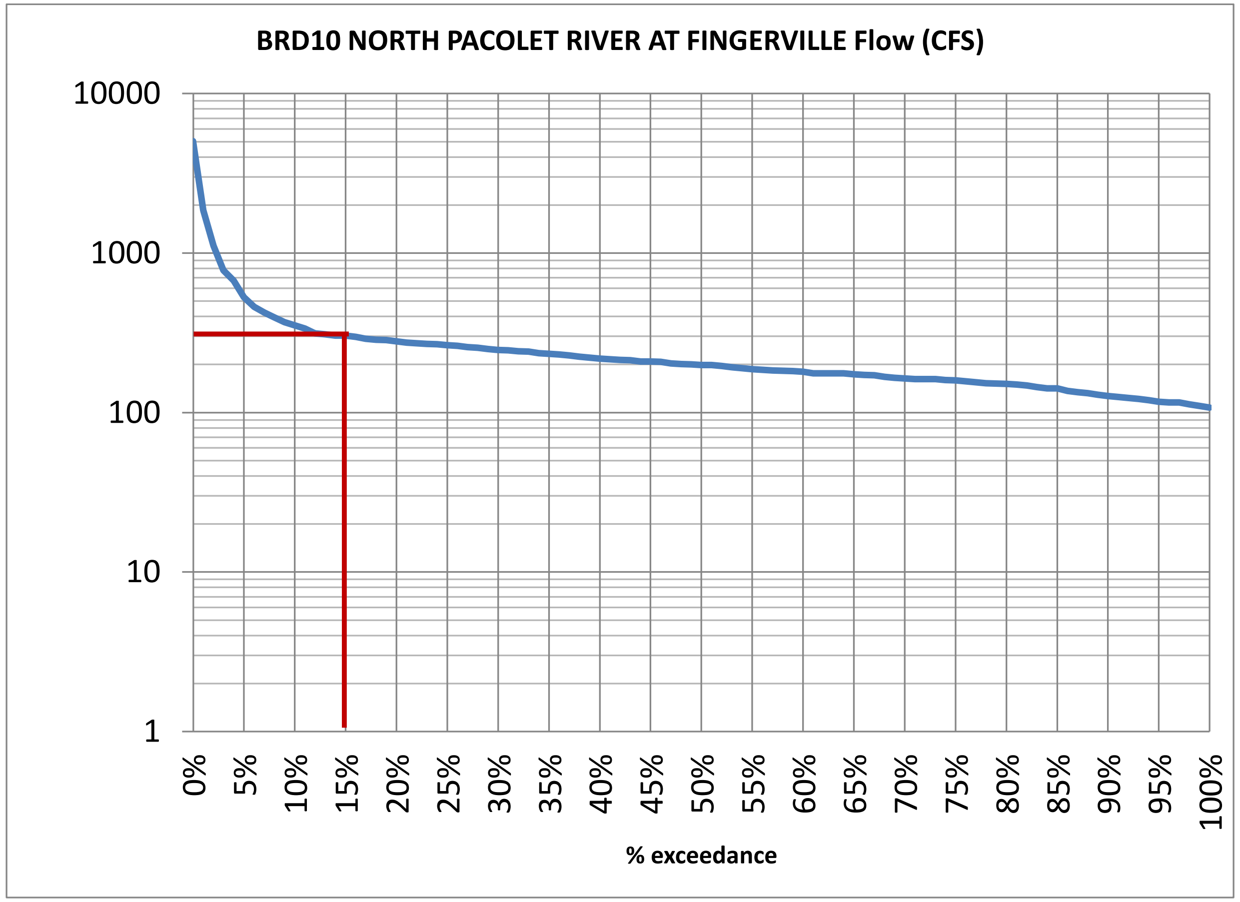
Standard Scale



Log Scale

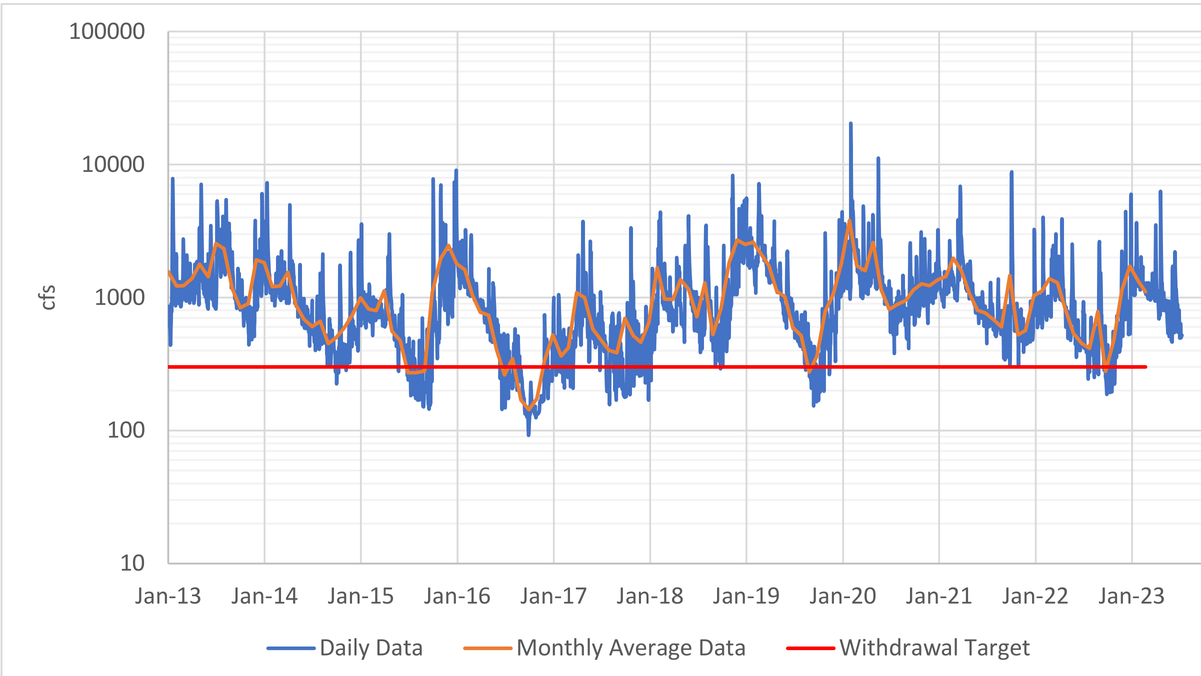
Displaying Hydrologic Data:
Flow Exceedance Curve / Flow Duration Curve





River flow is higher than 300 cfs 15 % of the time

Frequency and Magnitude of Shortage



User Type	Source Water	Location (mi)	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Average Groundwater Pumping (MGD)	Minimum Reservoir Storage (%)	Average Shortage (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
M&I water user	Mainstem	6	9	152	0	0%	0.0	0.0	0.0%
M&I water user	Mainstem	41	7	232	0	0%	0.0	0.0	0.0%
M&I water user	Mainstem	52	1	231	0	0%	0.0	0.0	0.0%
M&I water user	Mainstem	52	3	230	0	0%	0.0	0.0	0.0%
M&I water user	Mainstem	78	1,994	401	0	0%	300.0	2,640.1	31.6%
Ag water user	Mainstem	101	0	346	0	0%	0.0	0.0	0.0%
M&I water user	Mainstem	105	67	358	0	0%	0.0	0.0	0.0%
M&I water user	Cherokee Creek	2	26	0	0	0%	0.2	27.8	1.3%
M&I water user	North Pacolet River	1	1	1	0	0%	0.0	0.0	0.0%
M&I water user	North Pacolet River	2	0	0	0	100%	0.0	0.0	0.0%
M&I water user	North Pacolet River	22	11	18	0	0%	0.0	0.0	0.0%
M&I water user	Lawsons Fork Creek	21	0	23	0	0%	0.0	0.0	0.0%
Ag water user	Pacolet River	1	0	3	0	0%	0.0	0.0	0.0%
M&I water user	Pacolet River	6	0	7	0	0%	0.0	0.0	0.0%
M&I water user	Pacolet River	18	64	0	0	0%	0.1	36.7	0.4%
M&I water user	Pacolet River	42	0	41	0	0%	0.0	0.0	0.0%
M&I water user	Turkey Creek	1	5	0	0	0%	0.9	5.6	31.1%
Ag water user	Middle Tyger River	11	0	4	0	0%	0.0	0.0	0.0%
M&I water user	Middle Tyger River	22	26	9	0	0%	0.1	18.3	0.6%
M&I water user	South Tyger River	11	23	1	0	0%	0.5	17.9	7.4%

In this generic example, the frequency that river flow is less than the withdrawal target is difficult to count.

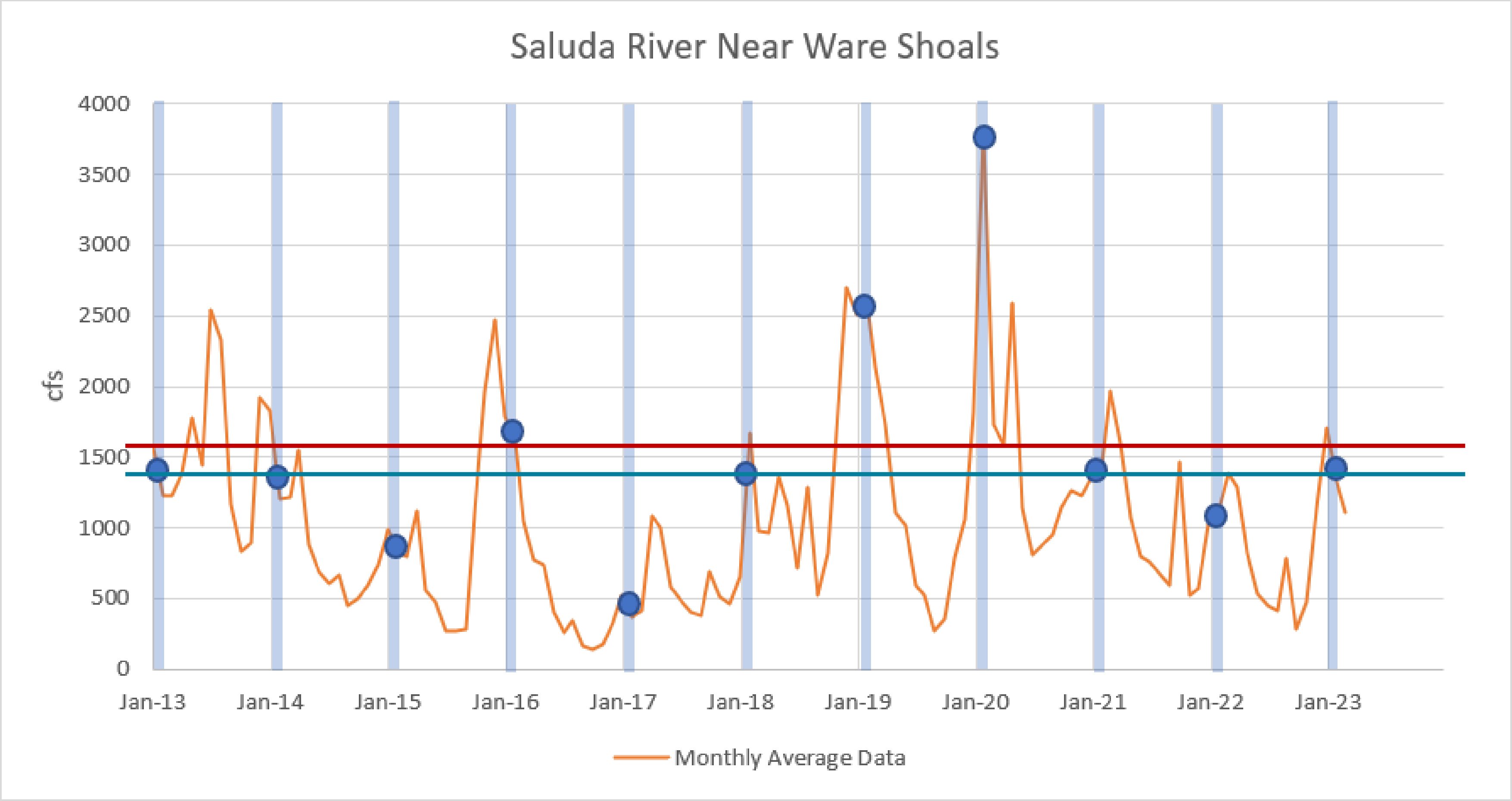
The answer is different with monthly vs. daily data.

(Note that this example does not include storage)

You will have the benefit of summary tables that can be developed for daily and monthly data.

Important Hydrologic Statistics

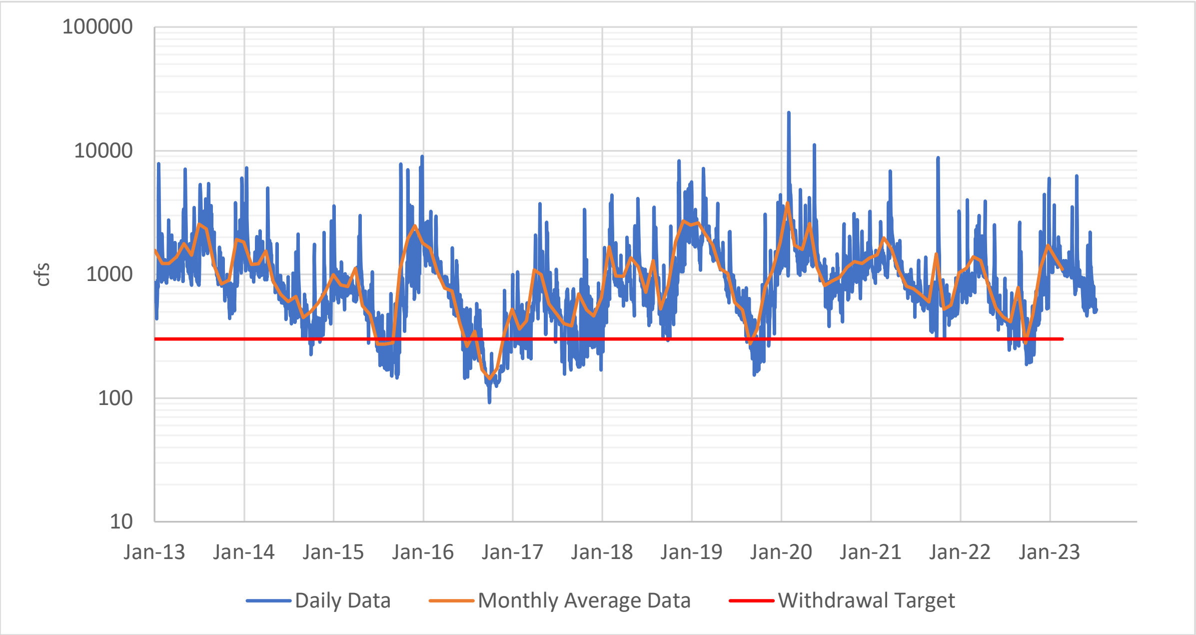
- **7Q10:** Low flow metric, representing the lowest 7-day average flow that occurs once every 10 years.
- **Median Monthly Flow:** Median value of all monthly average flows for a given month (Jan illustrated by blue dots):
  - *Half the points higher, half lower*
- **Mean Monthly Flow:** Average value of all monthly average flows for a given month (Jan illustrated by blue dots)
  - *Usually higher than the median, since high points "stretch" the average.*



Mean and median estimated visually

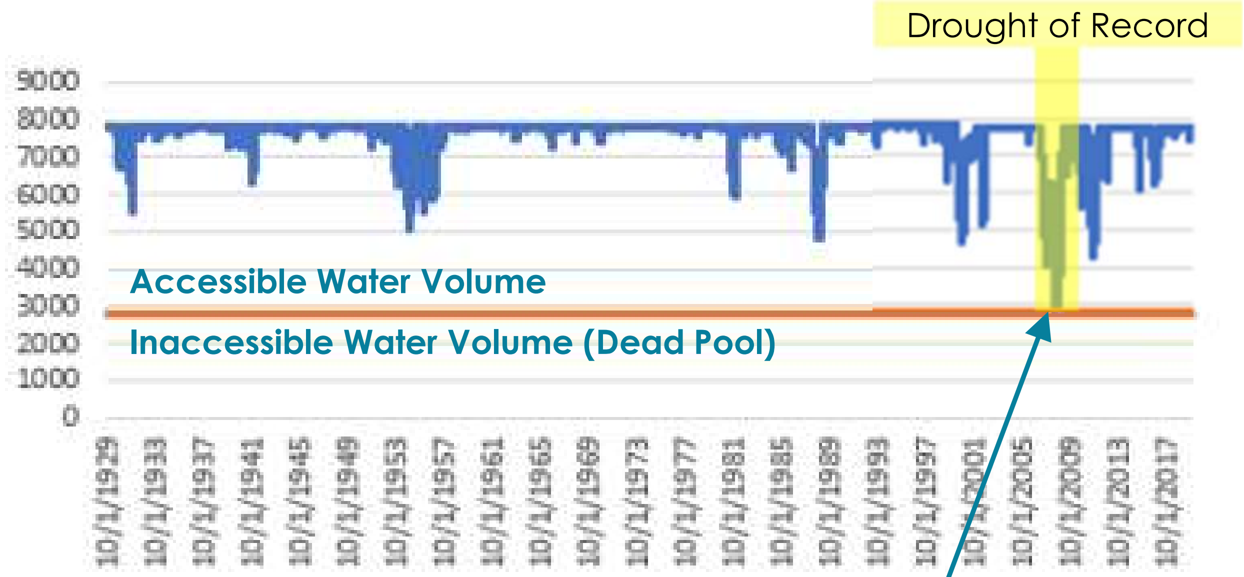
Water Availability

Direct River Withdrawal



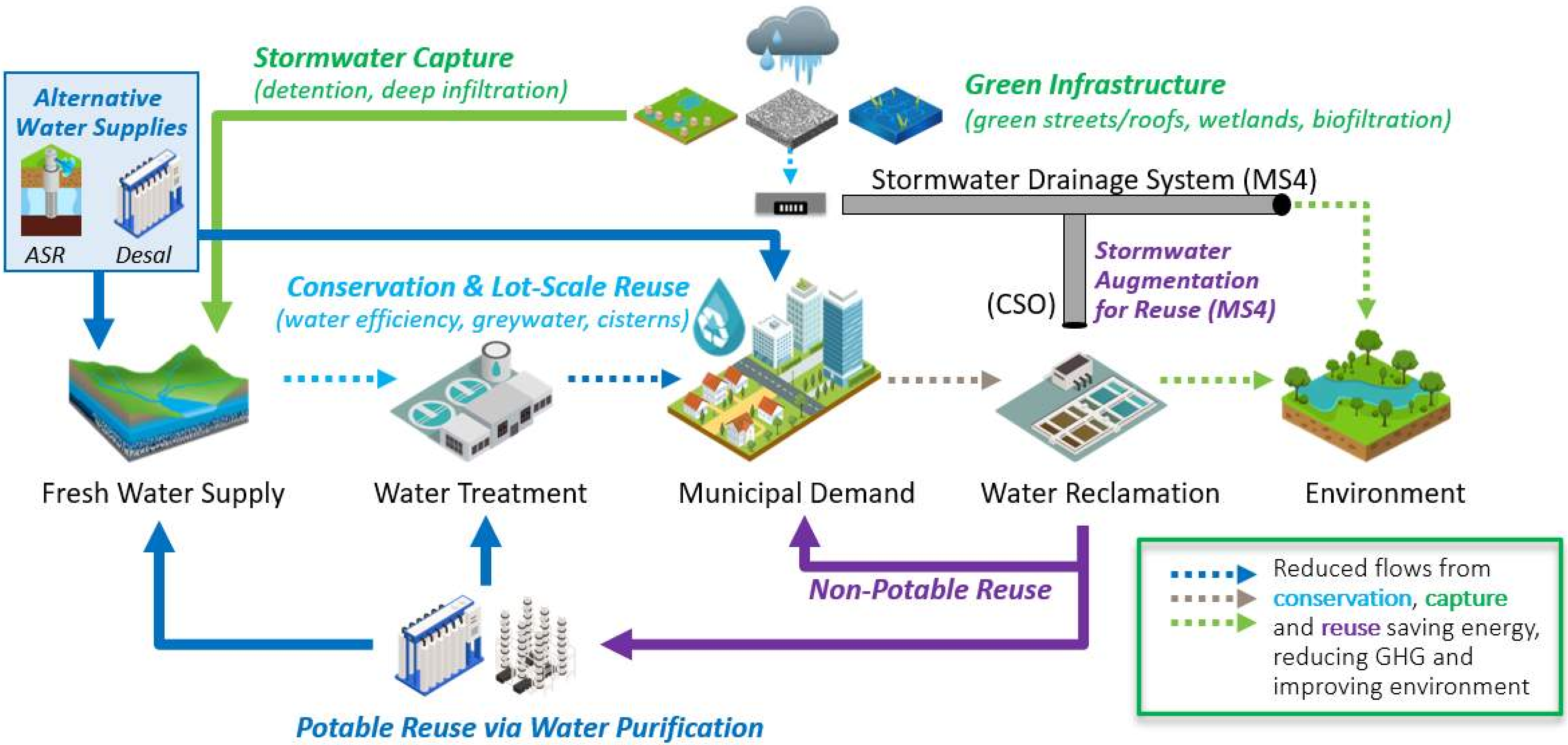
Water is limited to the flow in the stream at any point in time

Reservoir Withdrawal



"Safe Yield" is the amount of water that can be continuously withdrawn from a reservoir through the period or record without depletion. Generally higher than river withdrawals because storage buffers low flows.

New View of the Hydrologic Cycle



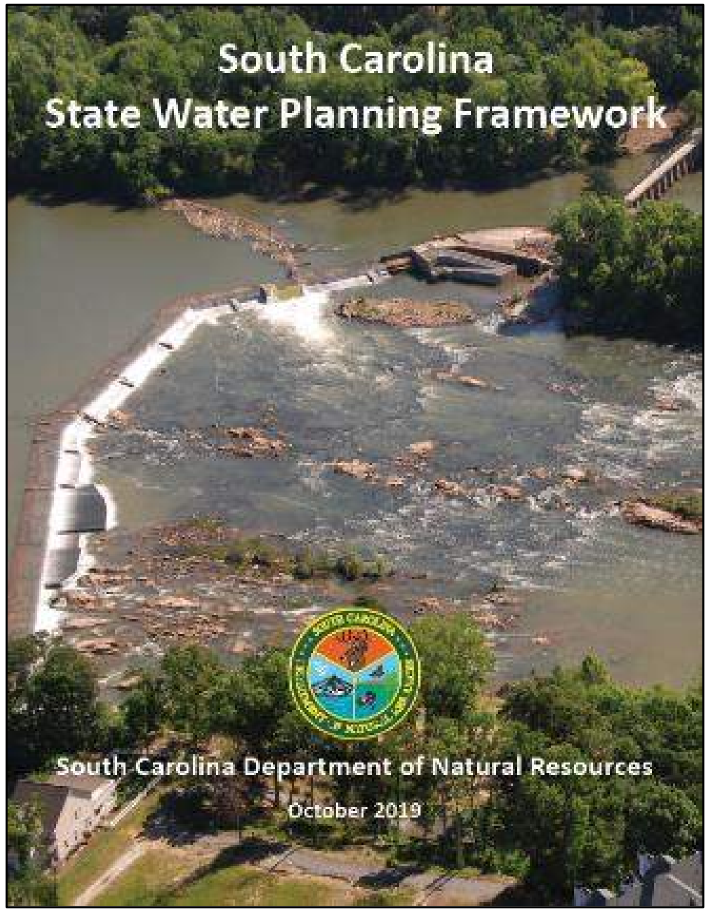
Methodologies For Evaluating Water Availability

Saluda River Basin Council – Meeting #6, August 16, 2023

Scott Harder
Hydrology Section Chief
SC Department of Natural Resources

Methods for Evaluating Water Availability

- Formal approach described in Planning Framework (Section 4).
- Based, in part, on methodologies used in Texas for evaluating water availability.
- Provides consistency – designates a common set of definitions and processes to use across the State.

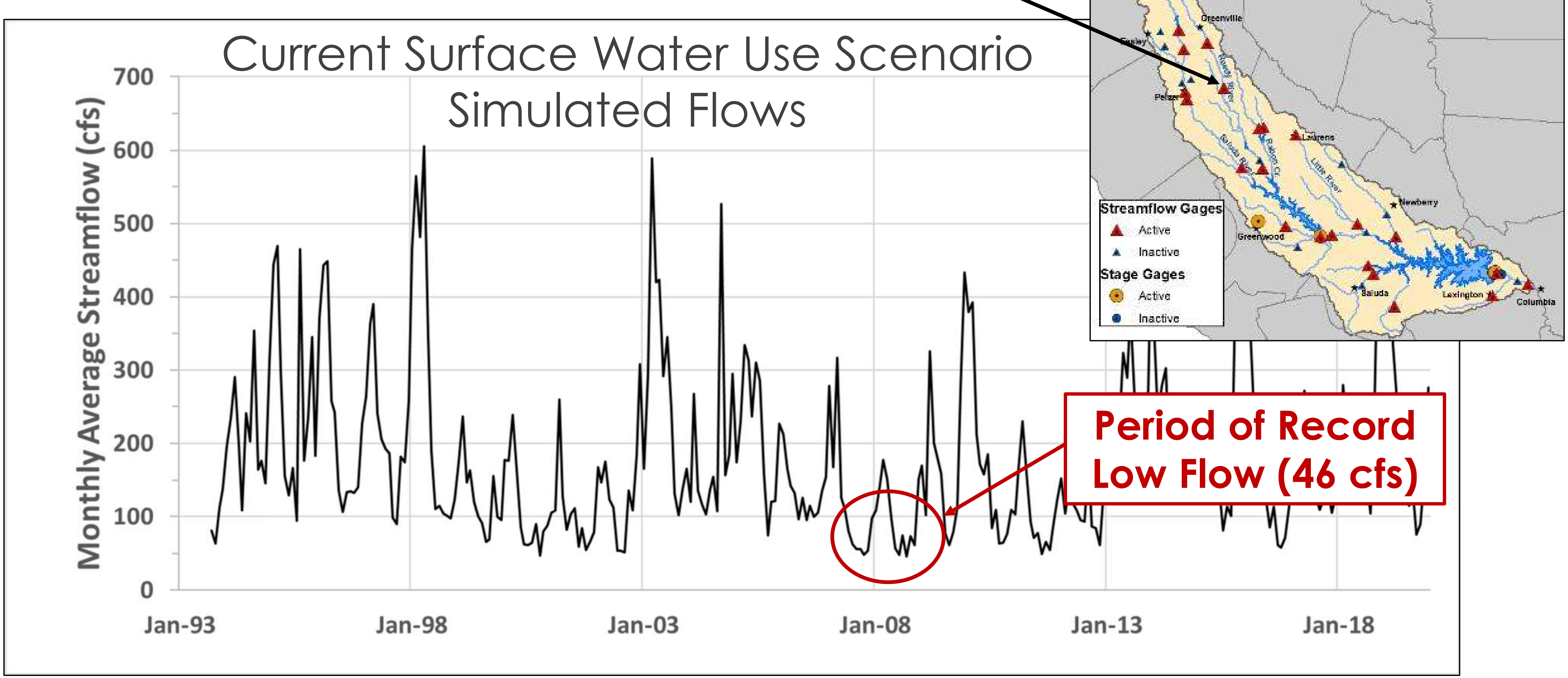


Big Picture – this is a gap analysis; the RBC will be determining where and when demand exceeds supply under varying demand scenarios and deciding how to manage water to close the gaps.

Methods for Evaluating Water Availability

- Definitions:
  - **Physically Available Surface Water Supply** – maximum amount of water occurring 100% of the time at a location on a surface water body, with no defined conditions applied on the surface water body.
  - **Surface Water Condition** – a physical limitation on the amount of water that can be withdrawn from a surface water source and is independent of water demand.
  - **Surface Water Supply** – maximum amount of water available for withdrawal 100% of the time at a location on a surface water body without violating any applied *Surface Water Conditions* on the surface water source and considering upstream demands.
  - **Surface Water Shortage** – occurs when the water demand exceeds the *Surface Water Supply* for any water user in the basin.
  - **Reach of Interest** – a specific stream reach that has no identified *Surface Water Shortage* but experiences undesired impacts, environmental or otherwise, determined from current or future water-demand scenarios or proposed water management strategies.

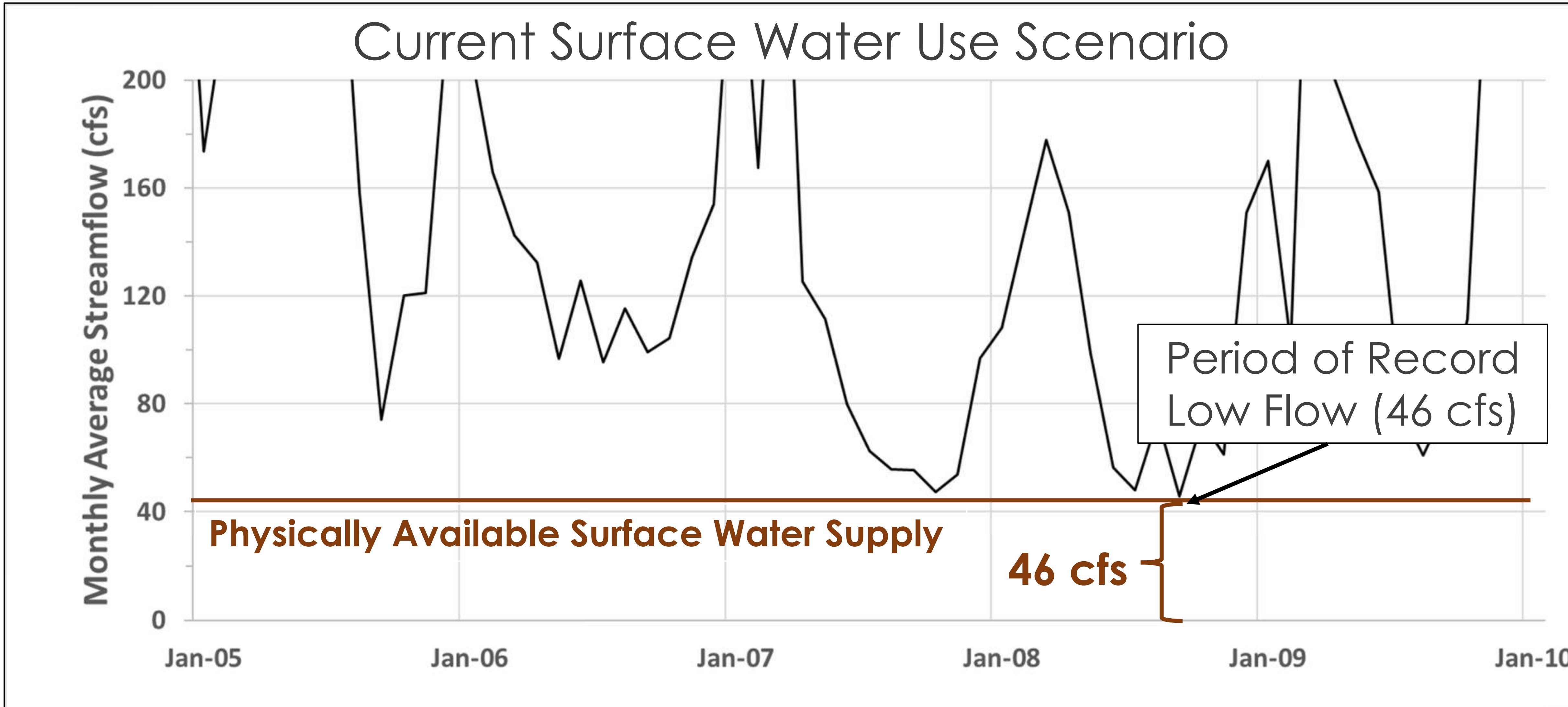
Example – Reedy River at Fork Shoals



Surface water volumes highlighted in the following hydrographs are for illustrative purposes only.

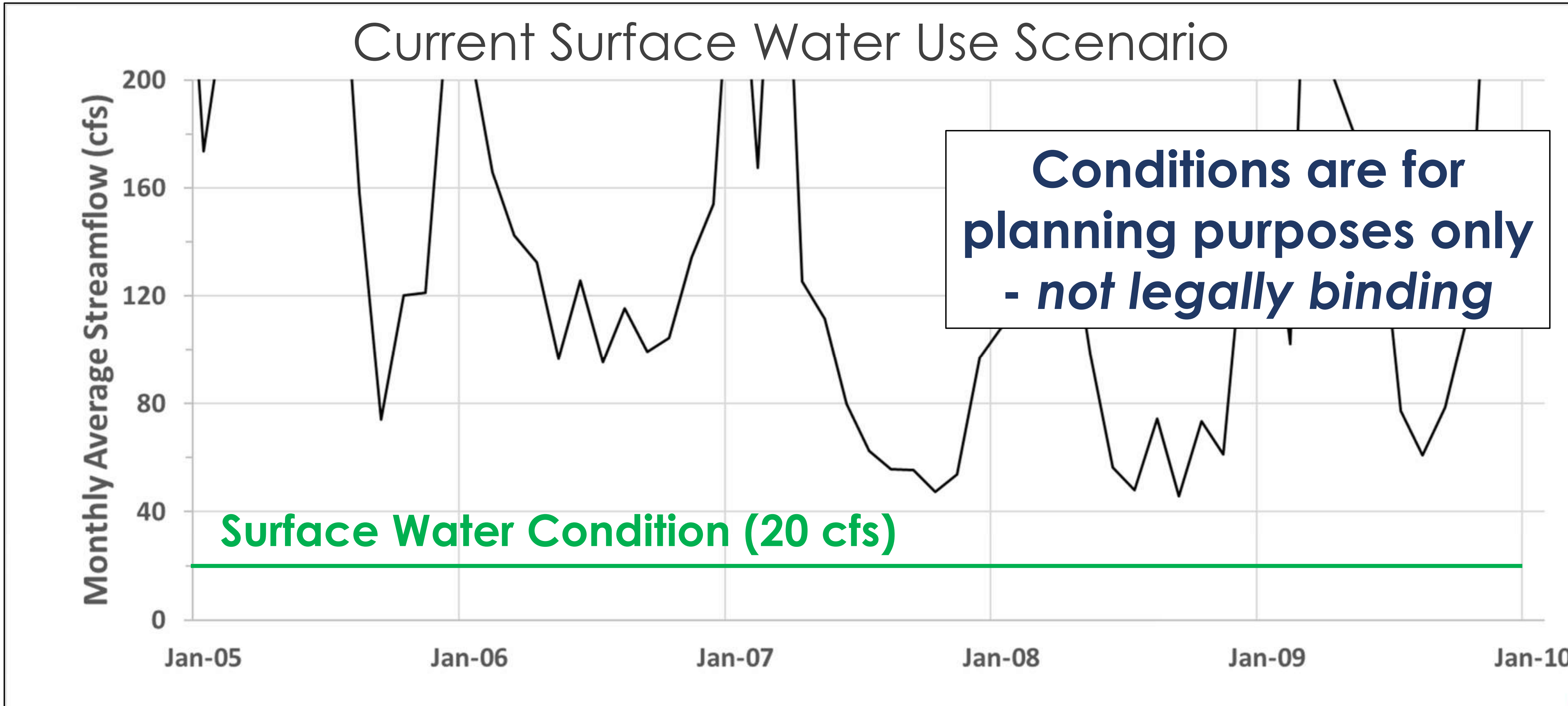
Physically Available Surface Water Supply

Maximum amount of water occurring 100% of the time at a location on a surface water body, with no defined conditions applied on the surface water body.



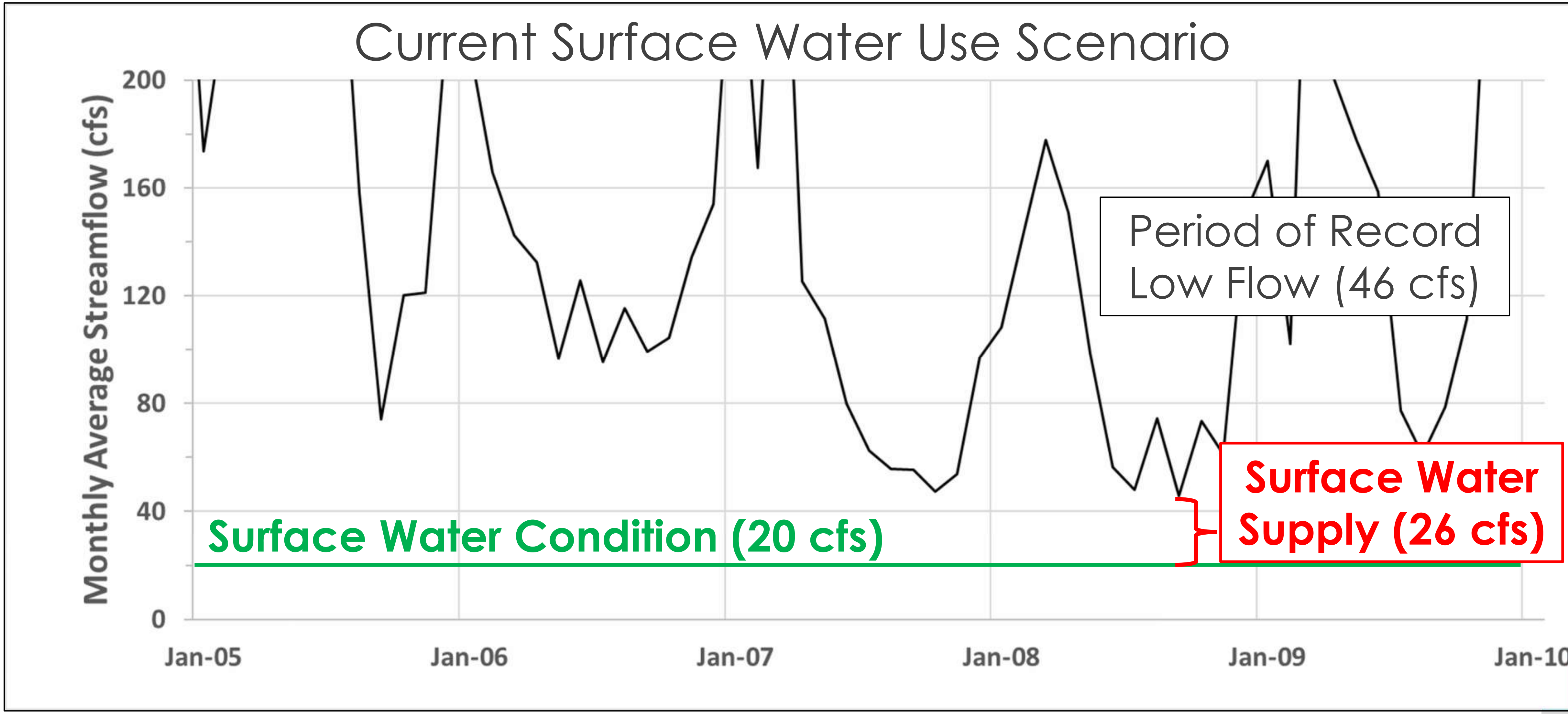
Surface Water Conditions

Conditions which physically limit the amount of water that can be withdrawn from a surface water source and are independent of water demand.

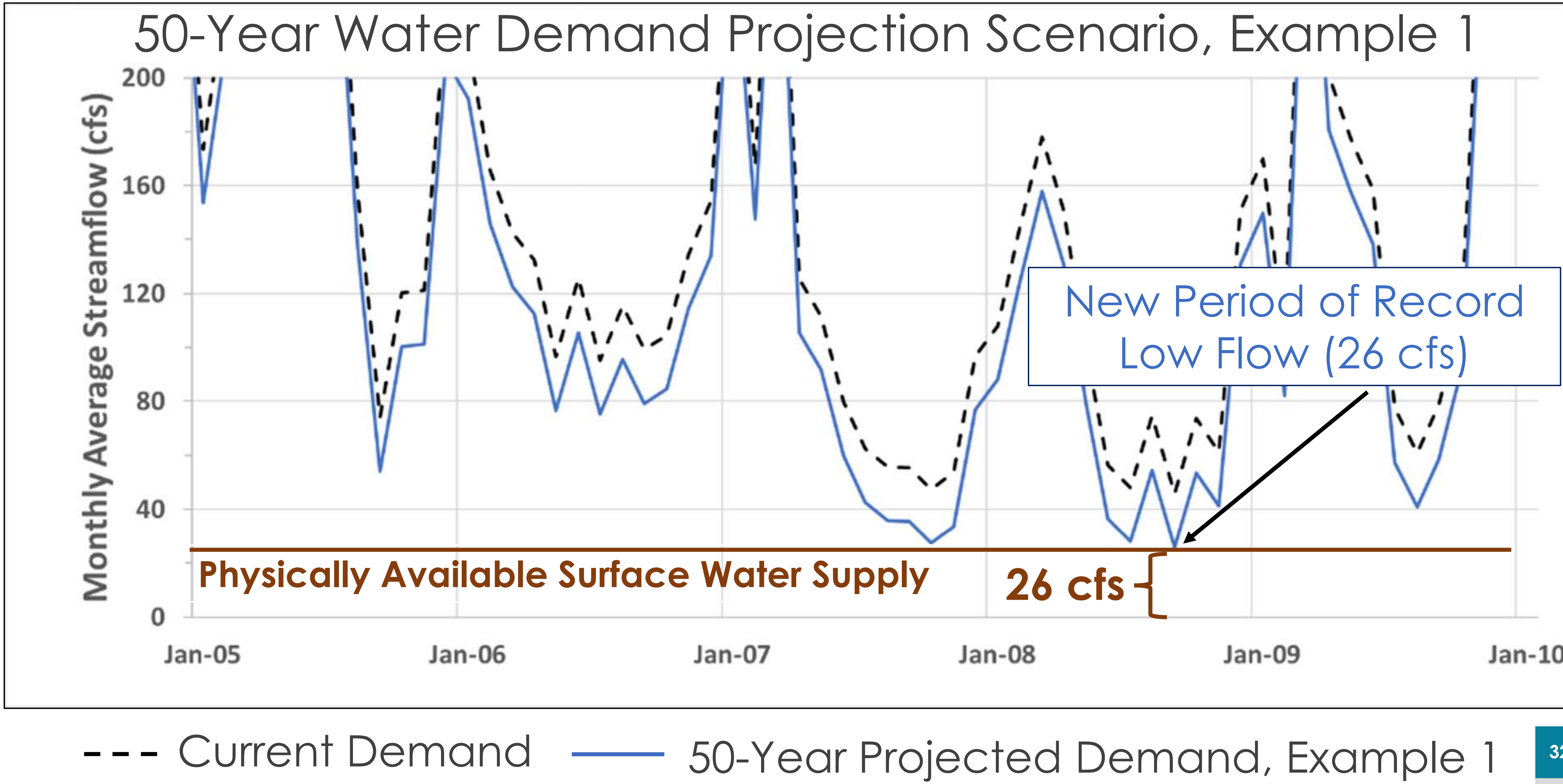


Surface Water Supply

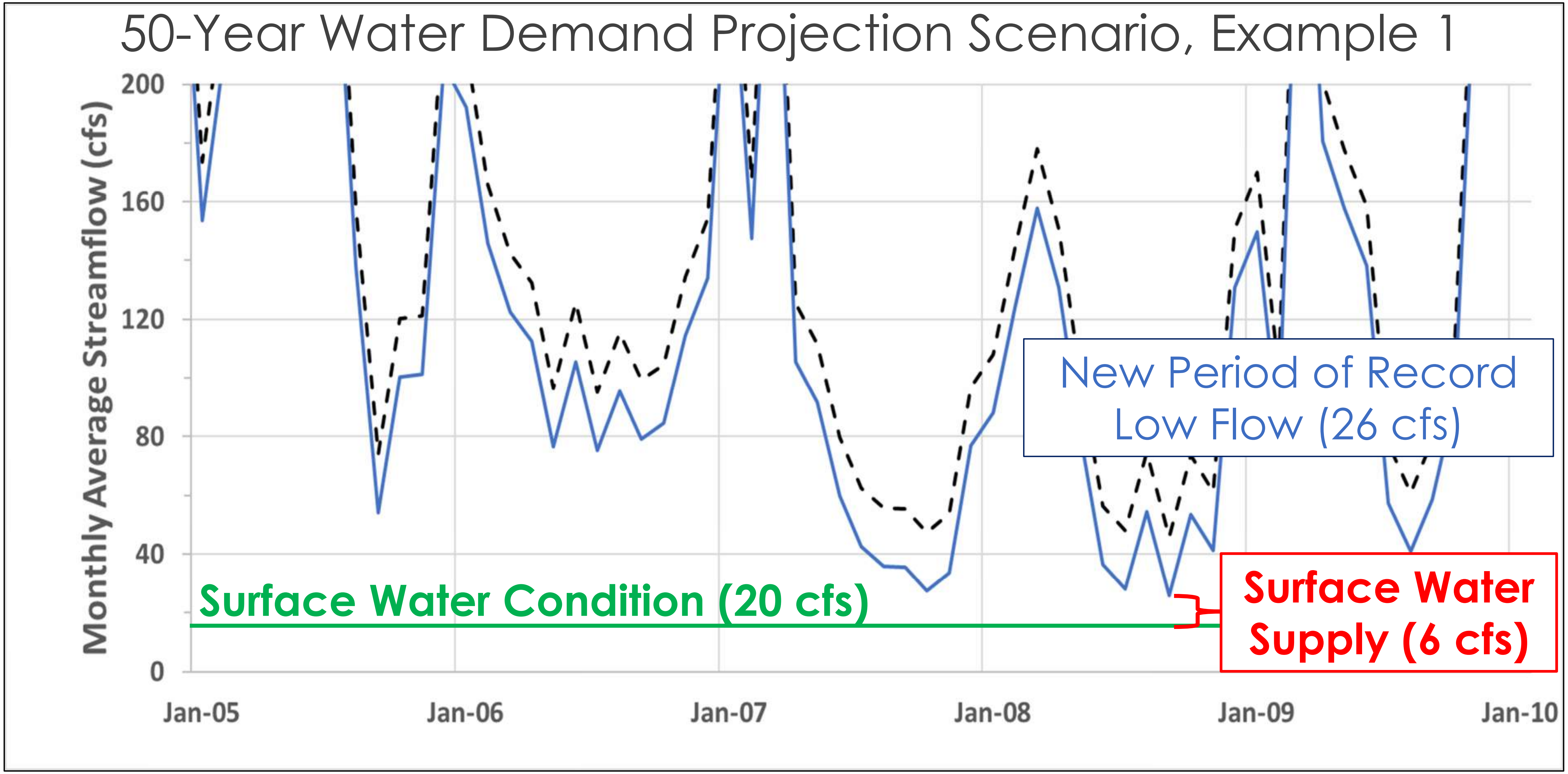
Maximum amount of water available for withdrawal 100% of the time at a location on a surface water body without violating any applied Surface Water Conditions on the surface water source and considering upstream demands.



Increased Demand Reduces Physically Available Surface Water Supply



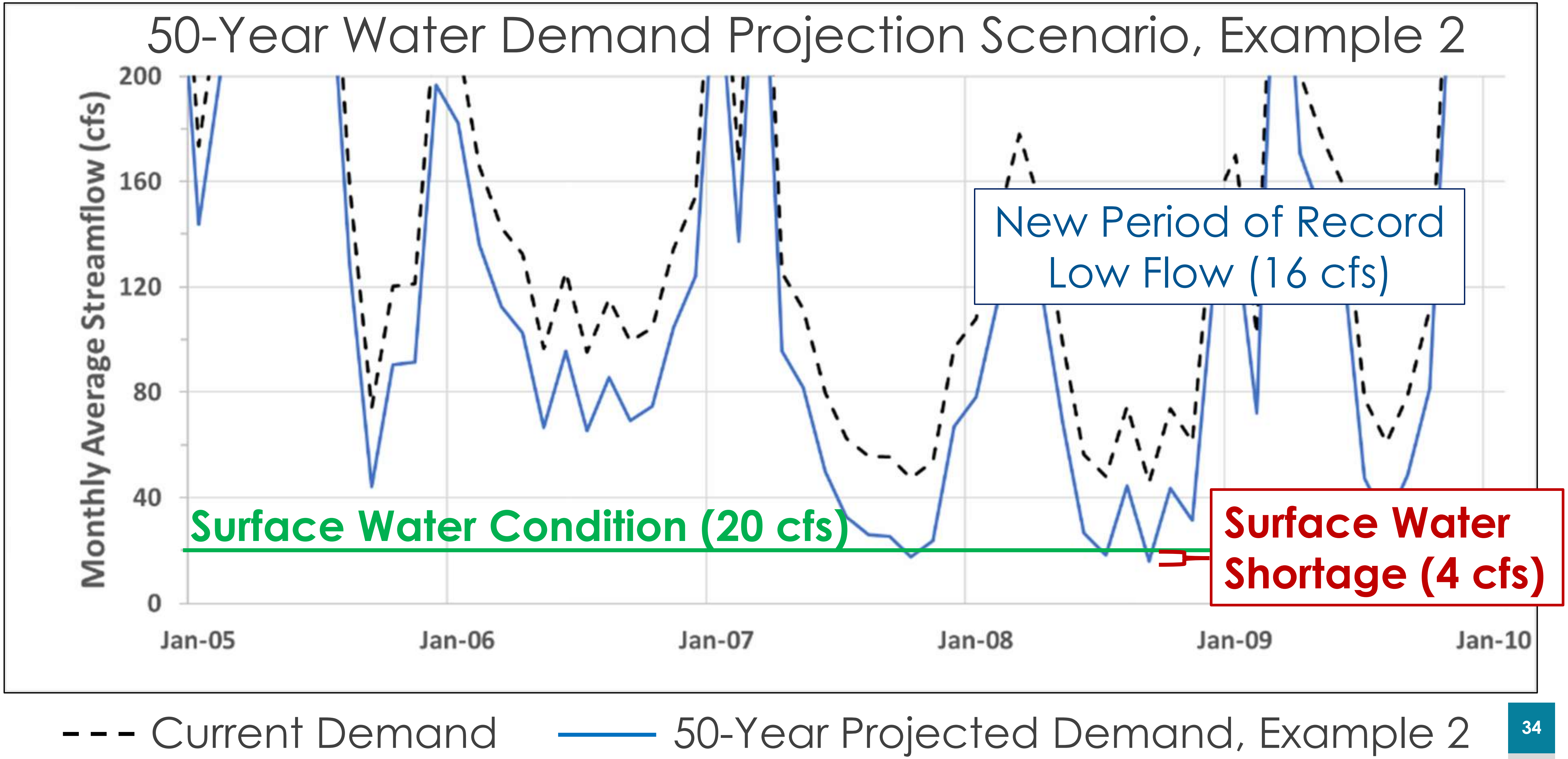
Increased Demand Reduces Surface Water Supply



- - - Current Demand —— 50-Year Projected Demand, Example 1

Surface Water Shortage

Occurs when the water demand exceeds the Surface Water Supply for any water user in the basin.



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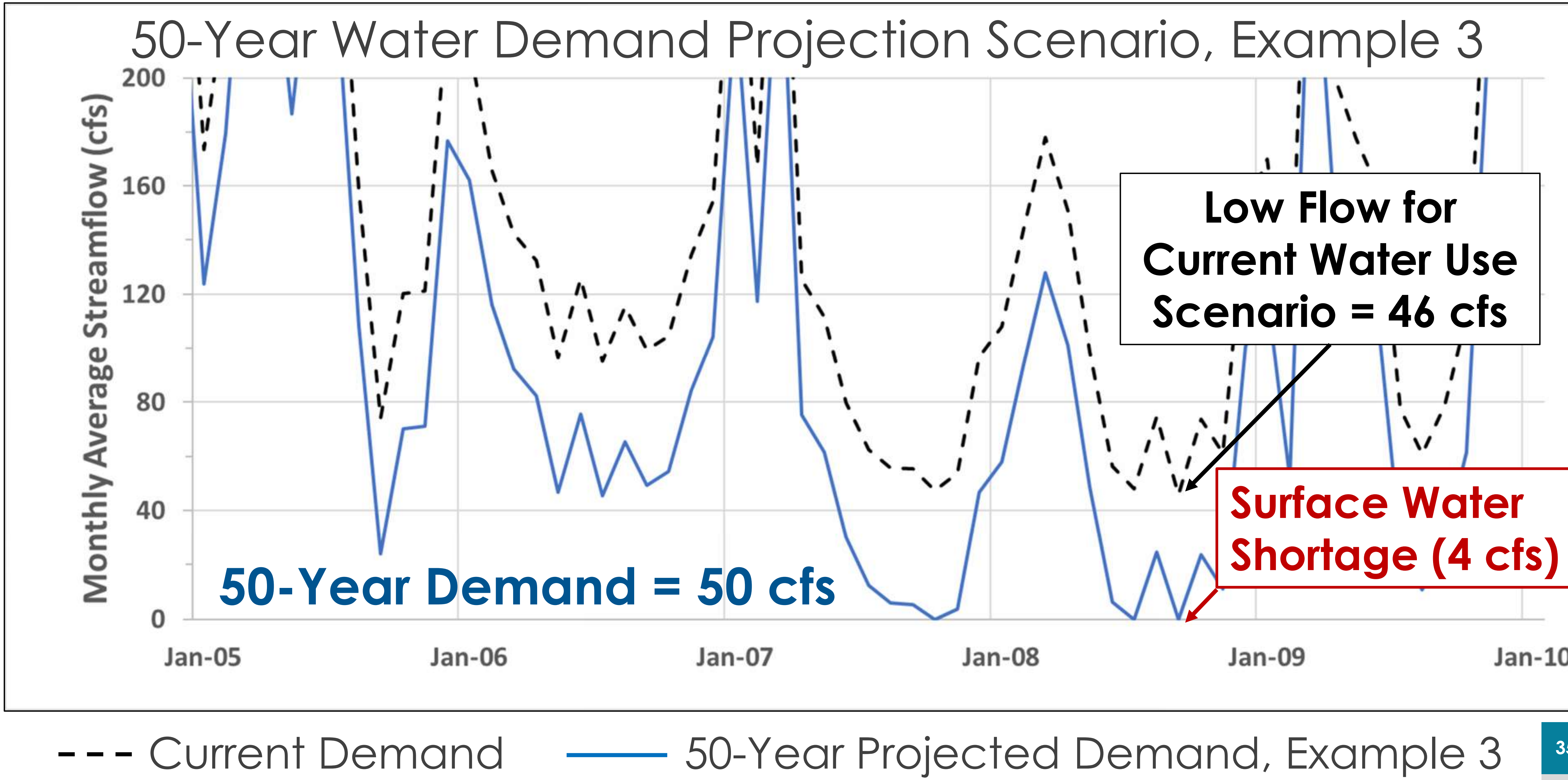
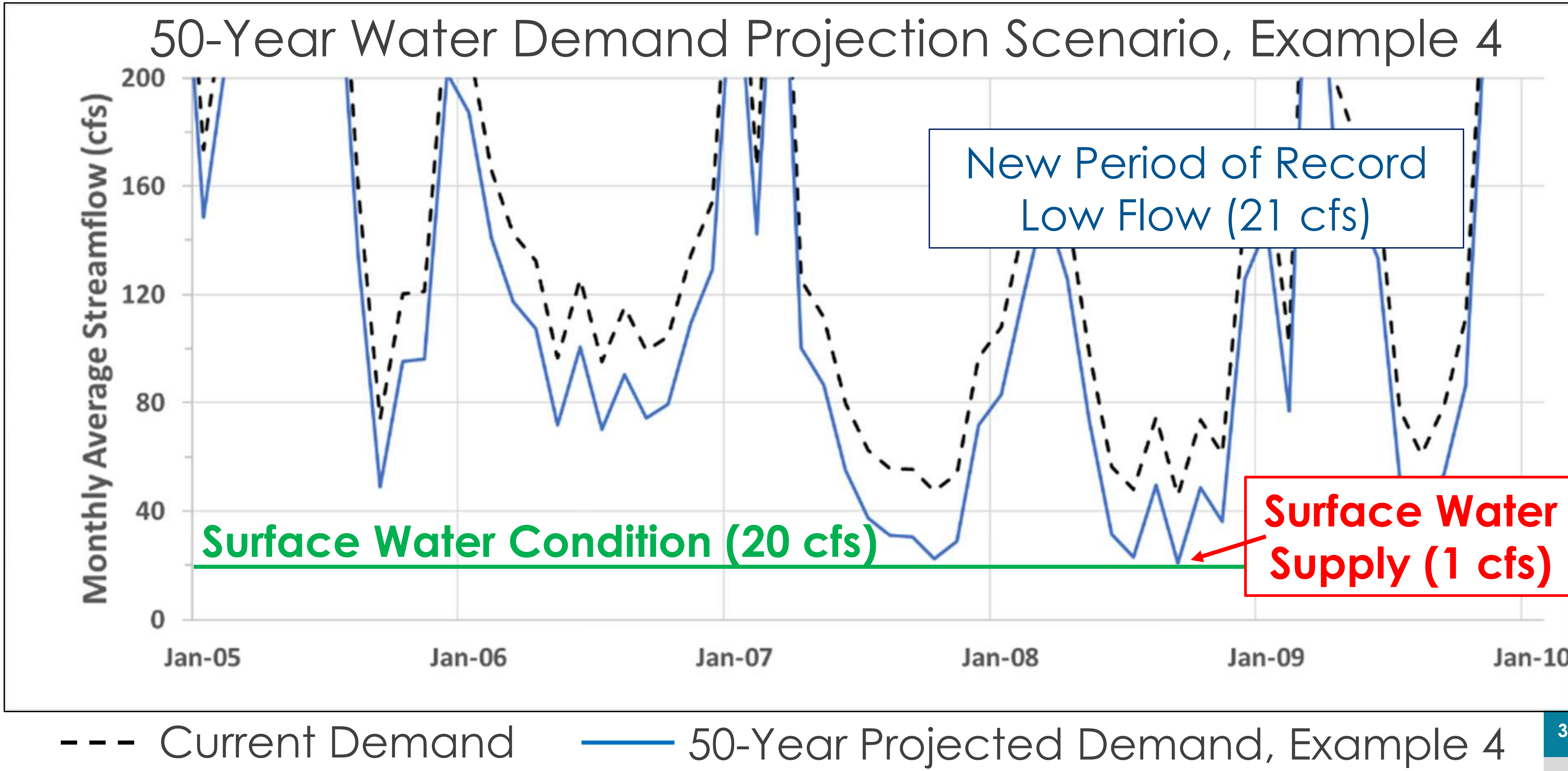


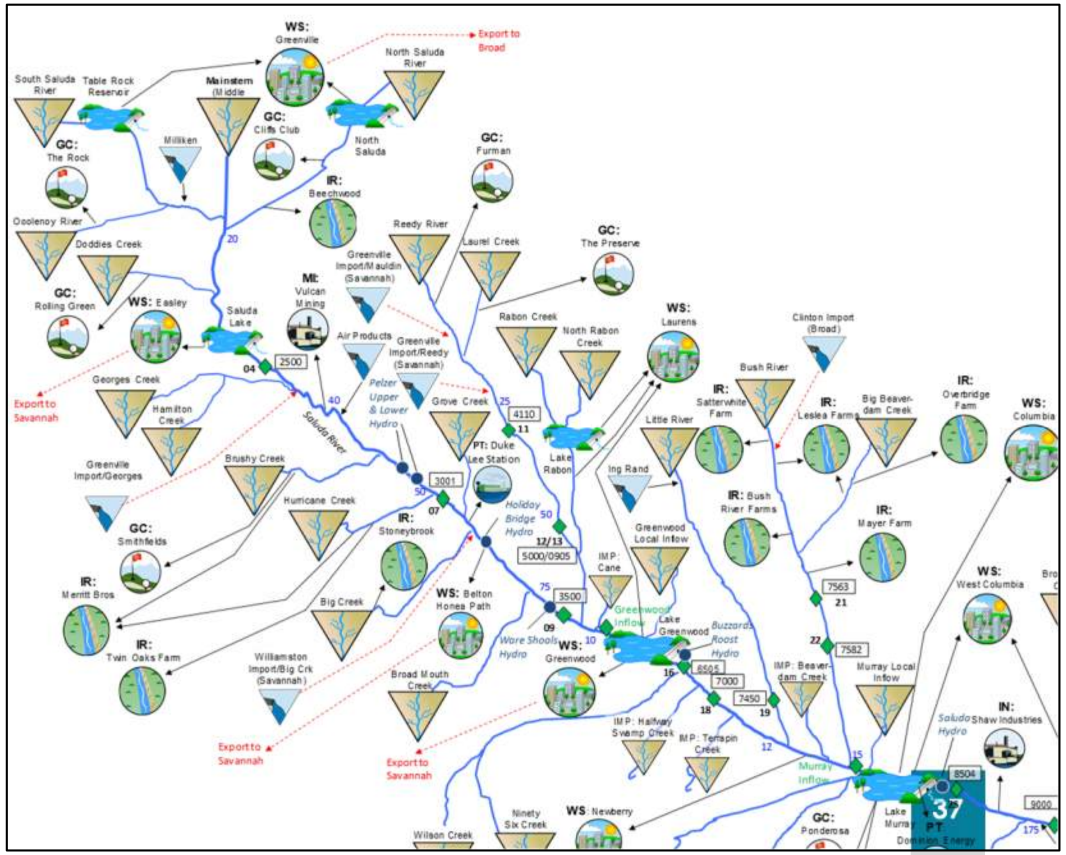
Reach of Interest

A specific stream reach that has no identified Surface Water Shortage but experiences undesired impacts, environmental or otherwise, determined from current or future water-demand scenarios or proposed water management strategies.



Reservoir Safe Yield

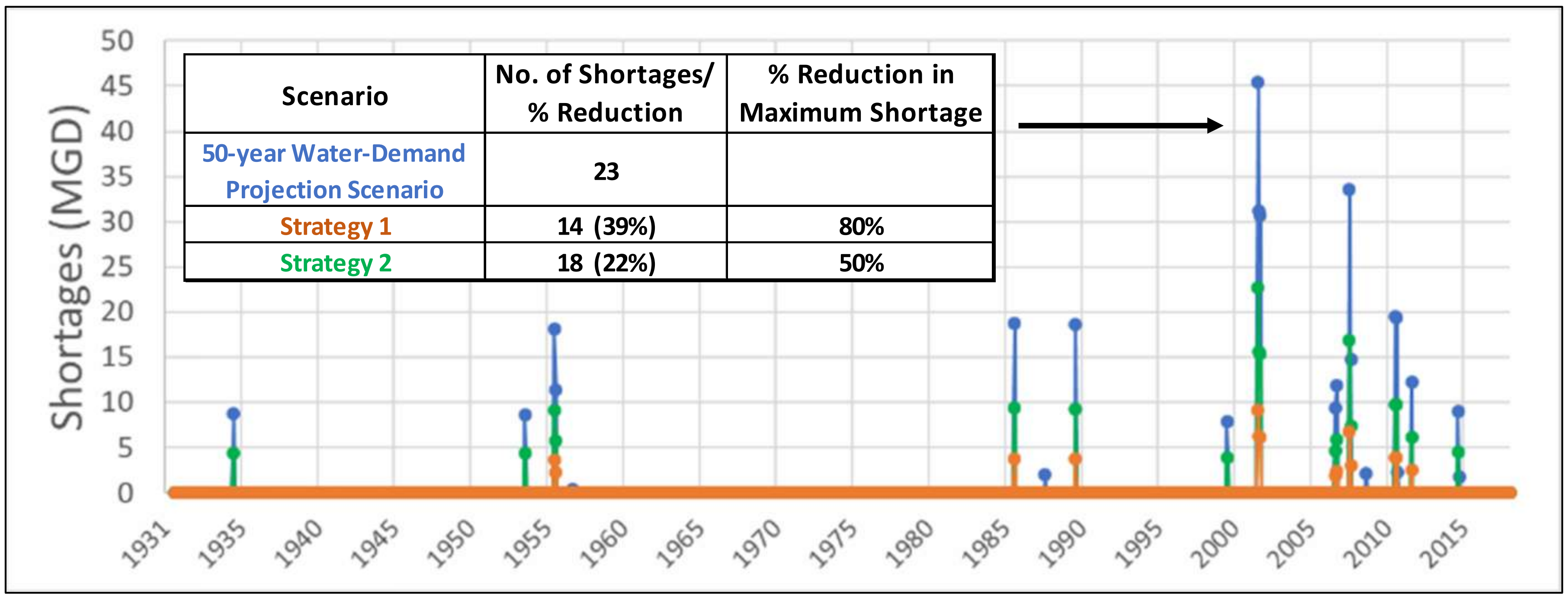
- Defined as "*the Surface Water Supply for a reservoir or system of reservoirs over the simulated hydrologic period of record*".
- Reservoir Safe Yield computations subject to requirements listed in Section 4.3.4 of Planning Framework:
  - Based on shallowest intake (Surface Water Condition) for an essential water use.
  - Based on current reservoir operating rules.
  - Should consider any historical safe yield studies.
- Reservoir Safe Yield should be estimated for Lake Greenwood and Lake Murray.
  - Estimates for smaller reservoirs may considered as well but will depend on available streamflow gage data.



Performance Measures

To facilitate analyses, RBCs may also:

- Develop **Performance Measures** – quantitative measures of change in user-defined conditions used to assess the performance of a proposed water management strategy or combination of strategies or to compare two water use scenarios.
  - % Change in monthly minimum flow or 5th percentile flow.
  - % Change in Surface Water Supply.
  - % Change in number and/or magnitude of Surface Water Shortages.
  - Impacts on Regulatory Minimum Instream Flow (20-30-40% MDF).

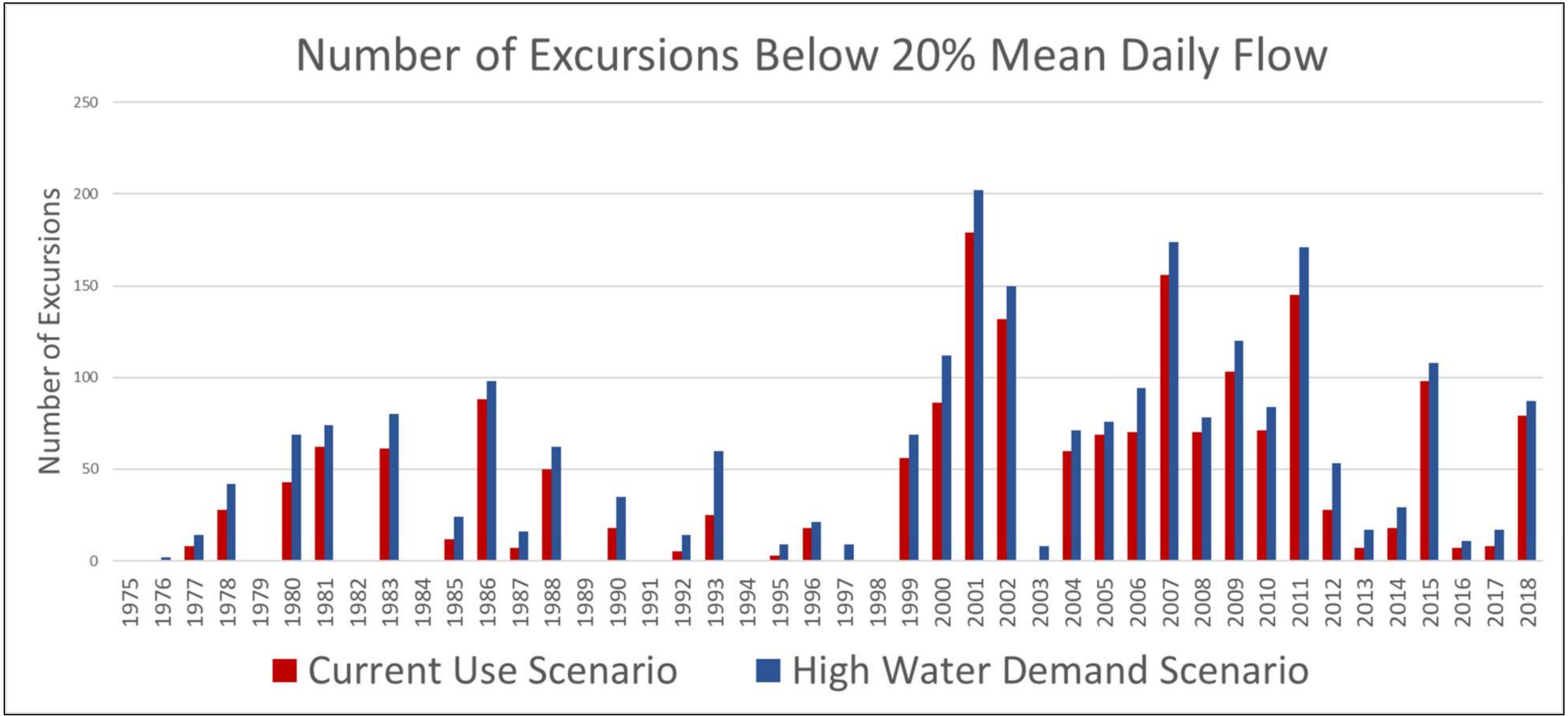


Scenario	No. of Shortages/ % Reduction	% Reduction in Maximum Shortage
50-year Water-Demand Projection Scenario	23	
Strategy 1	14 (39%)	80%
Strategy 2	18 (22%)	50%

Performance Measures – 20/30/40 Example

- SCDNR Instream flow policy:
  - Based on studies completed in the 1980s by Water Resources Commission and updated by SCDNR in 2009.
  - Coastal Plain:
    - 20% Mean Daily Flow (MDF): July – November
    - 40% MDF: May, June, December
    - 60% MDF: January – April
  - Piedmont:
    - 20% Mean Daily Flow (MDF): July – November
    - 30% MDF: May, June, December
    - 40% MDF: January – April
- Minimum Instream Flow defined as the 20-30-40 MDF in Surface Water Withdrawal, Permitting, Use and Reporting Act (applies statewide).

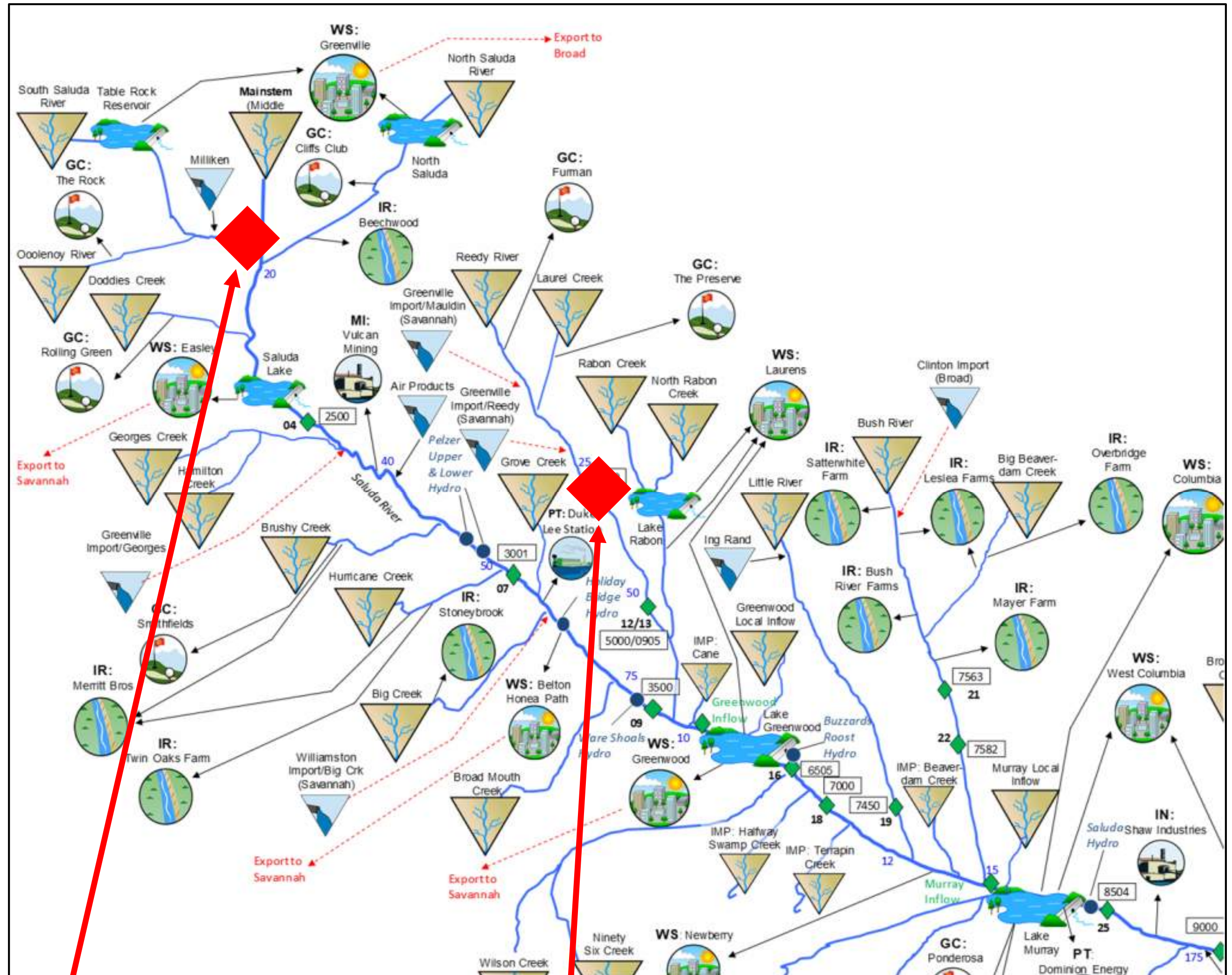
Performance Measures Example



Plot is for illustrative purposes only!

Strategic Nodes

- Definition: a location on a surface water body or aquifer designated to evaluate the cumulative impacts of water management strategies for a given model scenario and serves as a primary point of interest from which to evaluate a model scenario's *Performance Measures*.
- Designated by RBC and designed to facilitate analyses.
- Examples:
  - USGS streamflow gage locations.
  - Outlets of tributaries of interest.



South Saluda River Outlet

Reedy River above Fork Shoals Gage

Surface Water-Demand Scenarios

Surface Water-Demand Scenarios

- Planning Framework requires 4 scenarios to be reviewed by each RBC:
  1. Current Surface Water Use.
  2. Permitted and Registered Water Use Scenario.
  3. Moderate Water-Demand Projection.
  4. High Water-Demand Projection.
- Optional scenario – simulation of unimpaired surface water hydrology.
- Scenarios focus on "water-demand" side as opposed to "water- supply" side.
- RBC can recommend additional water-demand scenarios:
  - Based on different assumptions used in existing projections (more aggressive growth rates, for example).
  - New water-demand projection scenarios must be submitted to SCDNR in writing by the RBC for consideration.

Current Surface Water Use Scenario

- Demand based on "current" water use defined as recent 10-year average (2010-2019) of reported water use.
- Simulates Surface Water Supply and Shortages resulting from a repeat of the historic drought of record under current withdrawals.
- Shortages would highlight the need for *short-term planning*.

Permitted and Registered Water Use Scenario

- Water demand based on maximum legally allowable water use for surface water permits and registrations.
- Identifies shortages that would occur under a repeat of the drought of record under maximum legally allowable withdrawals.
- Addresses whether surface water source is currently over-allocated.
- Surface Water Supply estimated under this scenario denotes unallocated available water.

Water-Demand Projection Scenarios

- Provide information on when and where shortages are likely to occur.
  - 50-year Planning Horizon.
  - Simulations completed in 5- to 10-year intervals.
- Two Scenarios:
  - **Moderate Water-Demand Projection Scenario** – demand based on projection of water use assuming normal climate and moderate population and economic growth.
  - **High Water-Demand Projection Scenario** – demand based on projection of water use assuming drier conditions and high population and economic growth.
- High Water-Demand Scenario – **Planning Scenario**:
  - Set of water use data for the Planning Horizon used to develop management strategies.
  - Defines Surface Water Supply when no Surface Water Shortages are identified.
  - RBC must consider shortages under this scenario when developing Surface Water Management Strategies.

Process for Evaluating Surface Water Availability

- With the support CDM Smith (SW Technical Support Contractor), RBC will designate:
  - Surface Water Conditions, if any
  - Performance Measures
  - Strategic Nodes
- For each future water use scenario, run the SWAM model with support from CDM Smith to:
  - Determine Surface Water Supply at nodes of interest and major reservoirs
  - Identify Surface Water Shortages
  - Designate Reaches of Interest, if any
- Develop Surface Water Management Strategies and use the SWAM model to evaluate each strategy or combination of strategies.
  - **Surface Water Management Strategy** – any *water management strategy proposed to eliminate a Surface Water Shortage, reduce a Surface Water Shortage, or generally increase Surface Water Supply*.
    - Examples: conservation measures, new supplies, conjunctive use etc.
    - Effectiveness and feasibility of each strategy will be evaluated.

River Basin Plan will document Surface Water Supply, Shortages, Reaches of Interest, and recommended Surface Water Management Strategies.

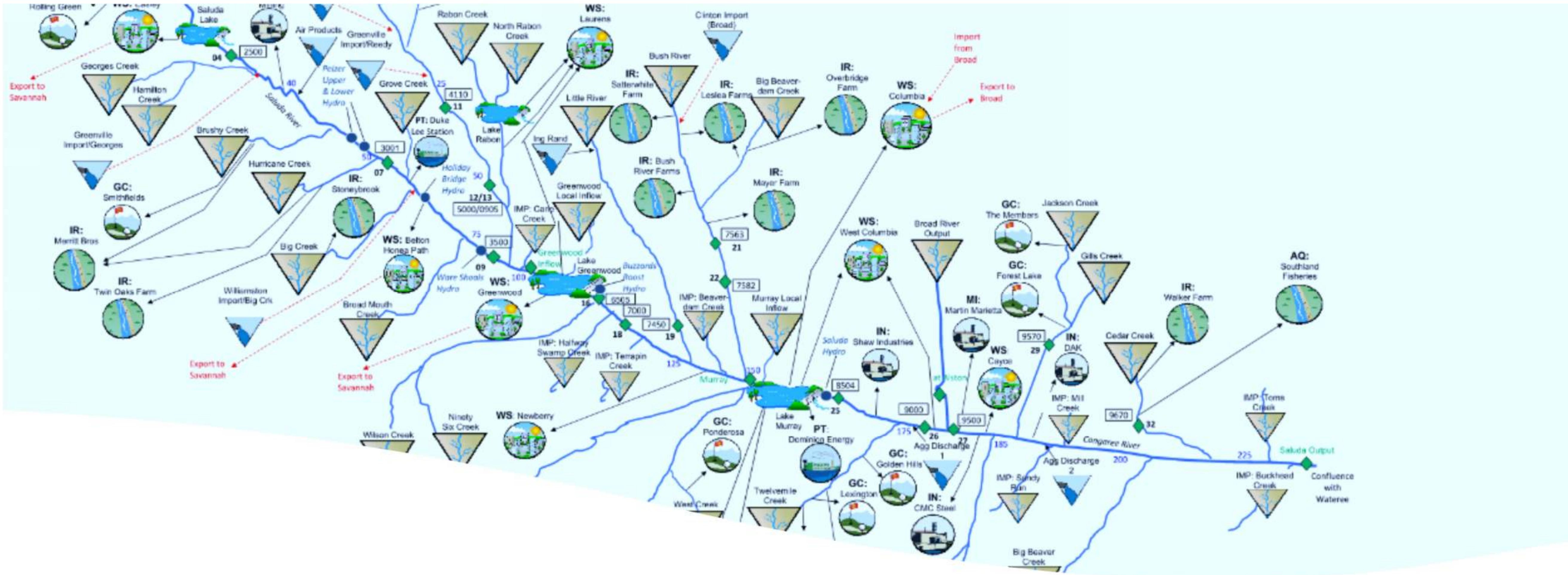
Summary

- Reviewed key terms and definitions associated with surface water availability analyses:
  - Physically Available Surface Water Supply
  - Surface Water Condition
  - Surface Water Supply
  - Surface Water Shortage
  - Reaches of Interest
- As part of water availability analysis, RBCs will need to determine:
  - Surface Water Conditions, if any
  - Performance Measures
  - Locations of Strategic Nodes
  - Identify shortages, quantify surface water supply, and designate reaches of interest
- Four future water use scenarios will be evaluated by the RBC:
  - Current Water Use
  - Permitted and Registered Water Use
  - Moderate Water Demand Projection
  - High Water Demand Projection

Questions?

Scott Harder
harders@dnr.sc.gov

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES



Introduction to the Saluda River Basin Surface Water Quantity Model

John Boyer

Agenda Item 6

What is a Model?

A ***numerical model*** is a representation of a real-world system that can be solved with computation methods

Numerical models allow us to explore and consider **possible futures**

Models should be as **simple** as possible and as **complex** as needed.

"All models are wrong, some are useful"

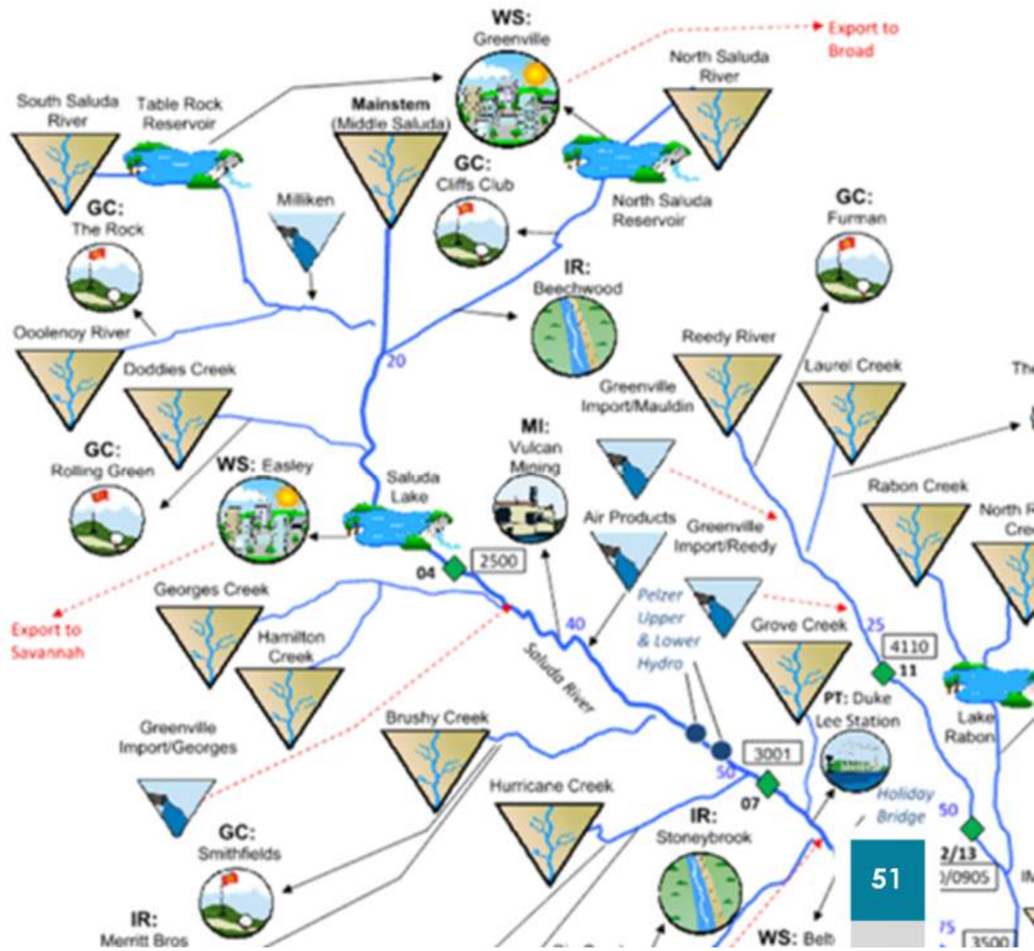
George Box, 1976
British Statistician

Box's point was that we should focus more on whether something can be applied in a useful manner rather than debating endlessly if an answer is correct in all cases

Saluda River Basin Surface Water Model Overview

Water Allocation Modeling ***is***:

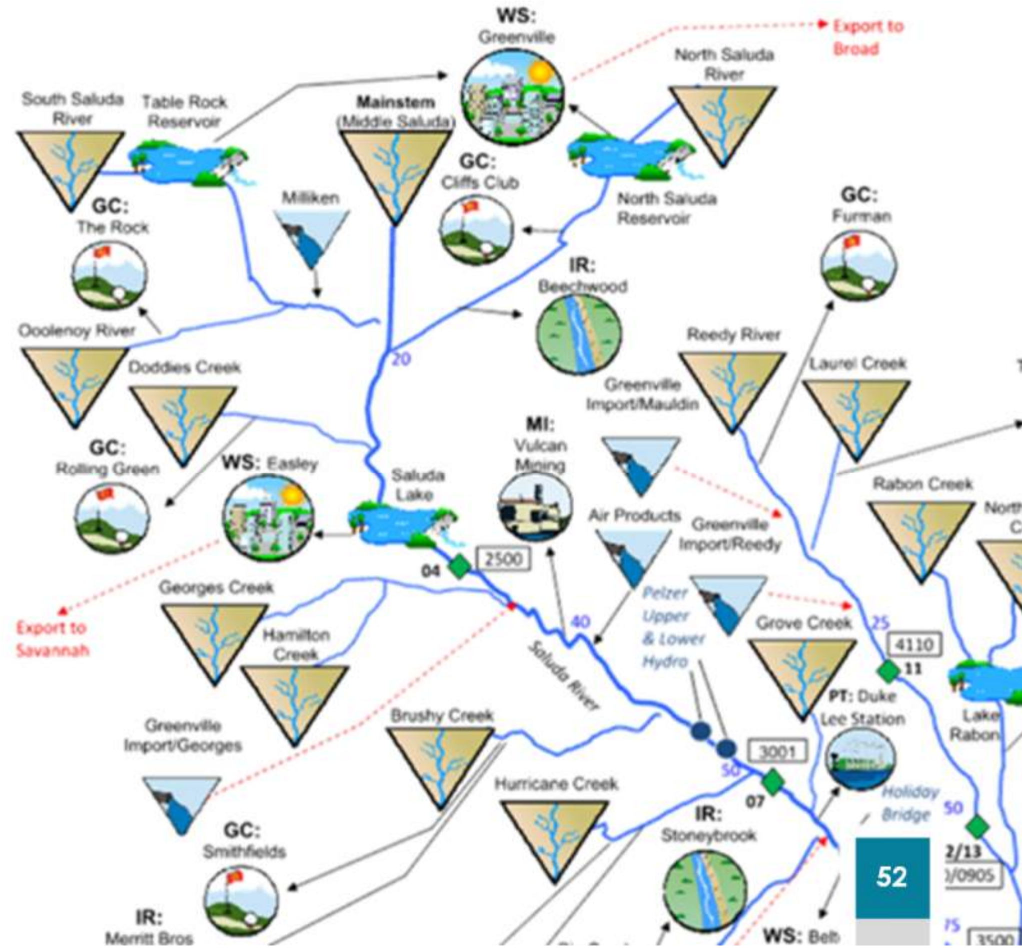
- Water balance calculations of physical flow
- Water rights calculations of legally available flow
- Accounting of water demands, withdrawals, and return flows
- Accounting of reservoir storage and loss to evaporation
- A representation of stream networks, multiple "nodes"
- Data intensive



Saluda River Basin Surface Water Model Overview

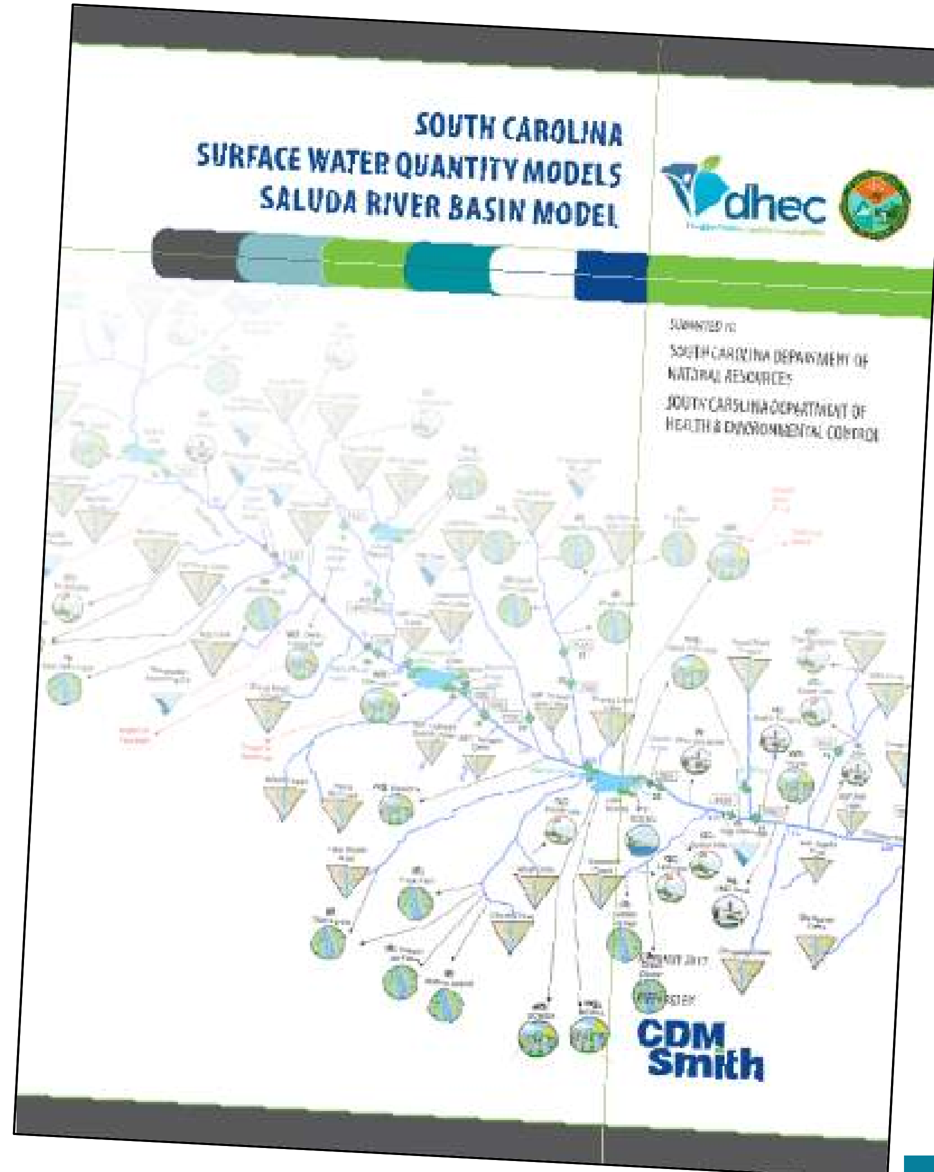
Water Allocation Modeling ***is not***:

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



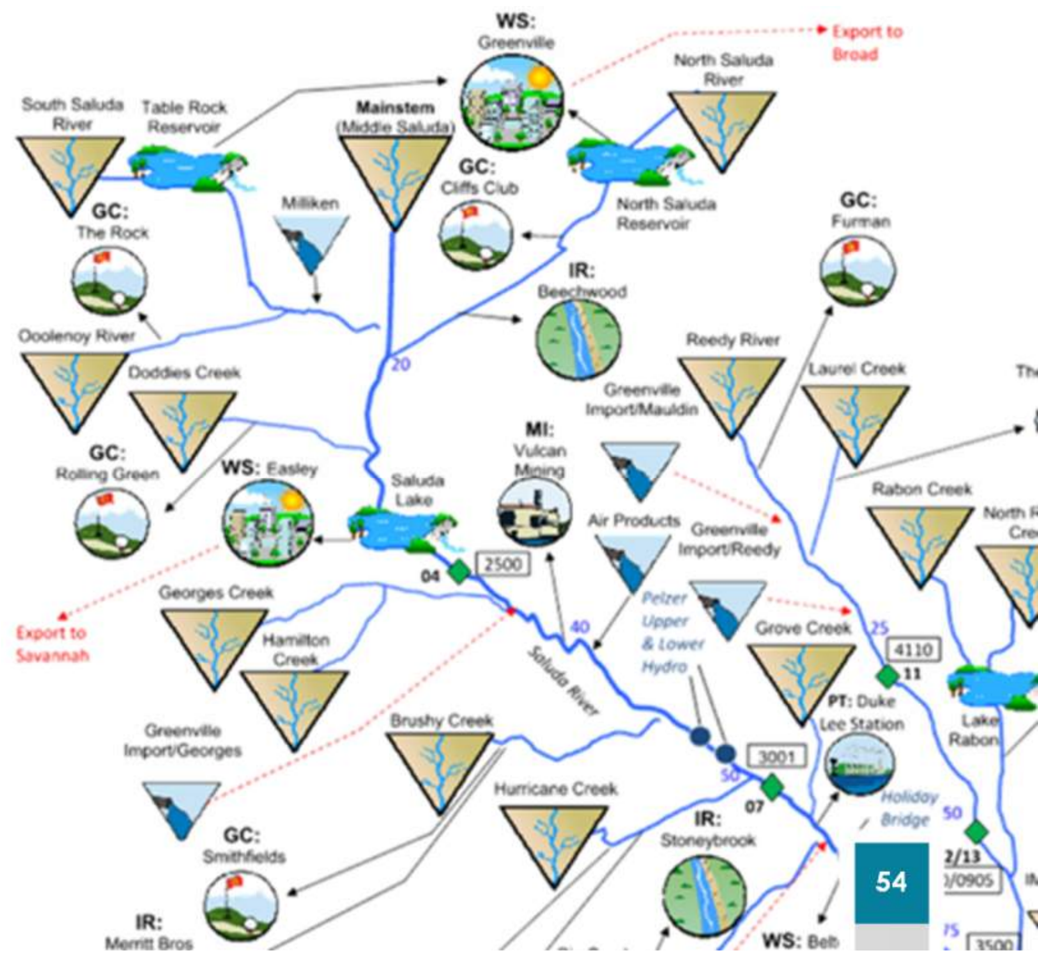
Simplified Water Allocation Model (SWAM)

- 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 2021and further updates are being completed now



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

- Assess current supply availability and shortages across a range of hydrologic conditions (1925 through 2019 – **94 years**)
- Assess a range of future potential scenarios with respect to changes in water demand
- Assess potential impacts of a "full allocation" scenario
- Compare managed flows to natural flows
- Evaluate drought management plans
- Test, evaluate and help prioritize water management strategies



Model Inputs and Supporting Information

Model Inputs

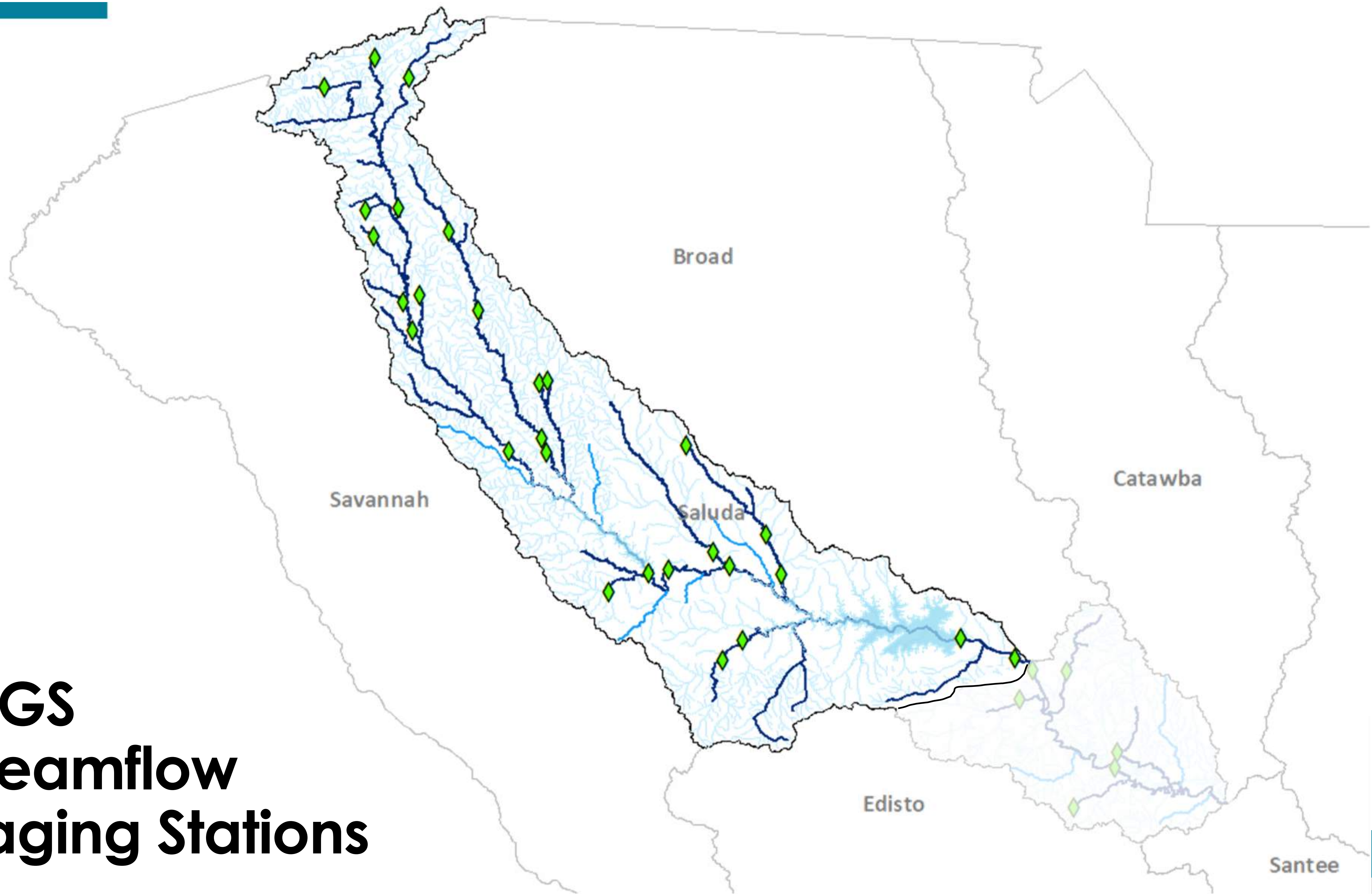
- USGS daily flow records
- Historical operational data
    - Withdrawals (municipal, industrial, thermoelectric, agricultural, golf courses, hatcheries)
    - Wastewater discharges and return flows
    - Transfers in and out of the basin
- Reservoir characteristics and operating rules

Supporting Information

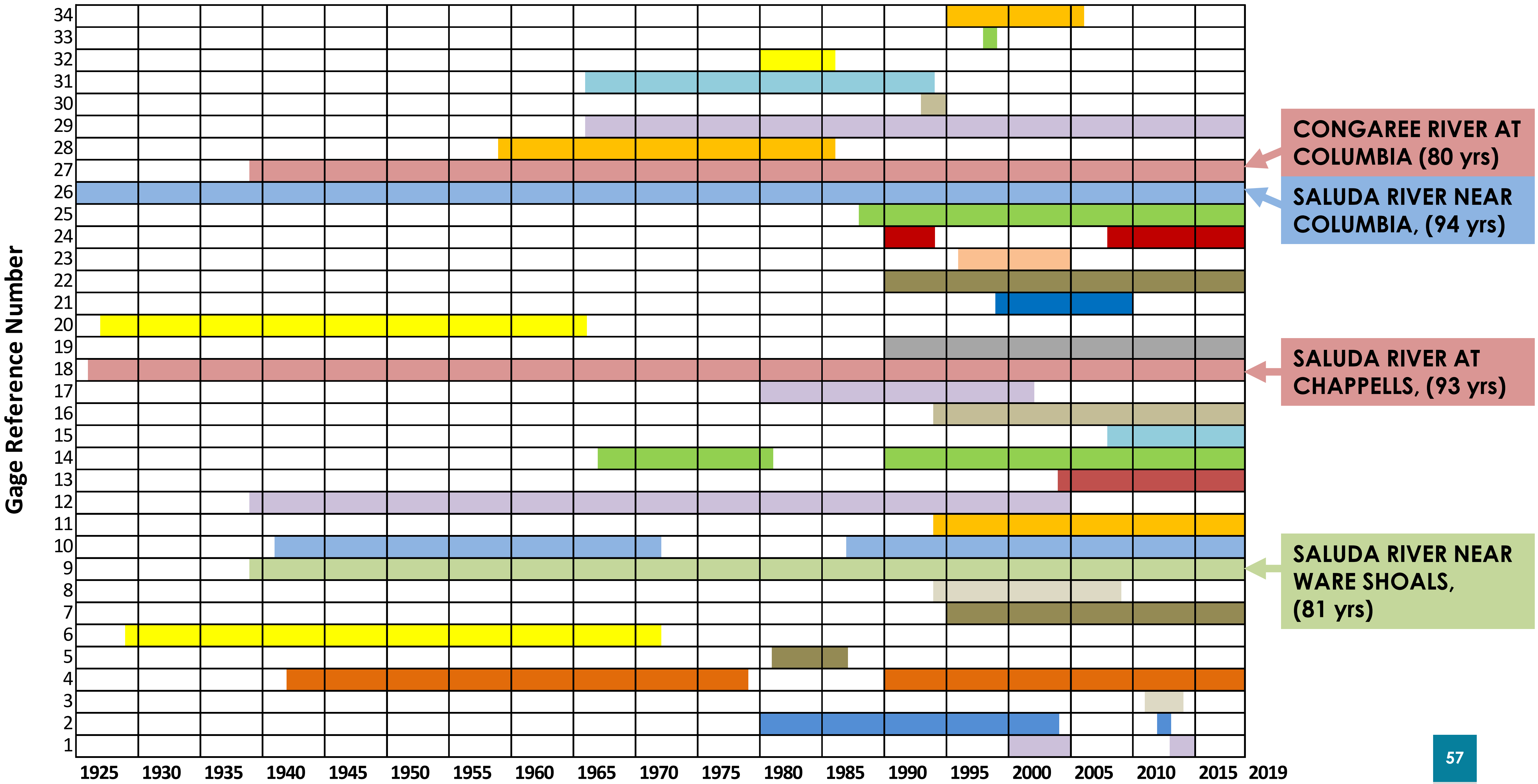
- Subbasin characteristics
    - Drainage area, land use, and slope


USGS Streamflow Gaging Station

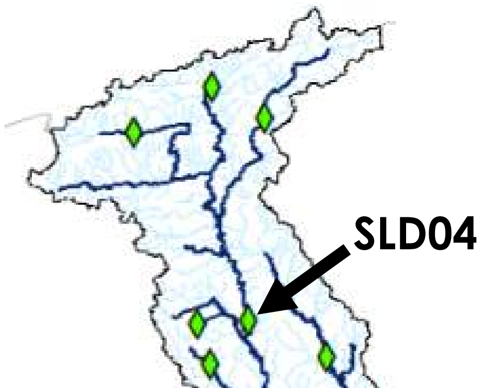
USGS Streamflow Gaging Stations



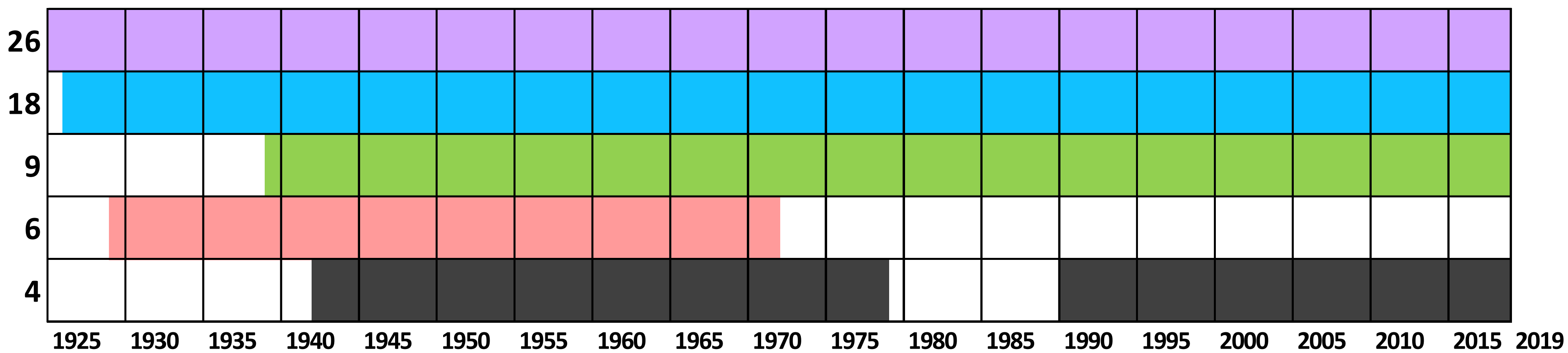
USGS Gage Timeline – Saluda River Basin



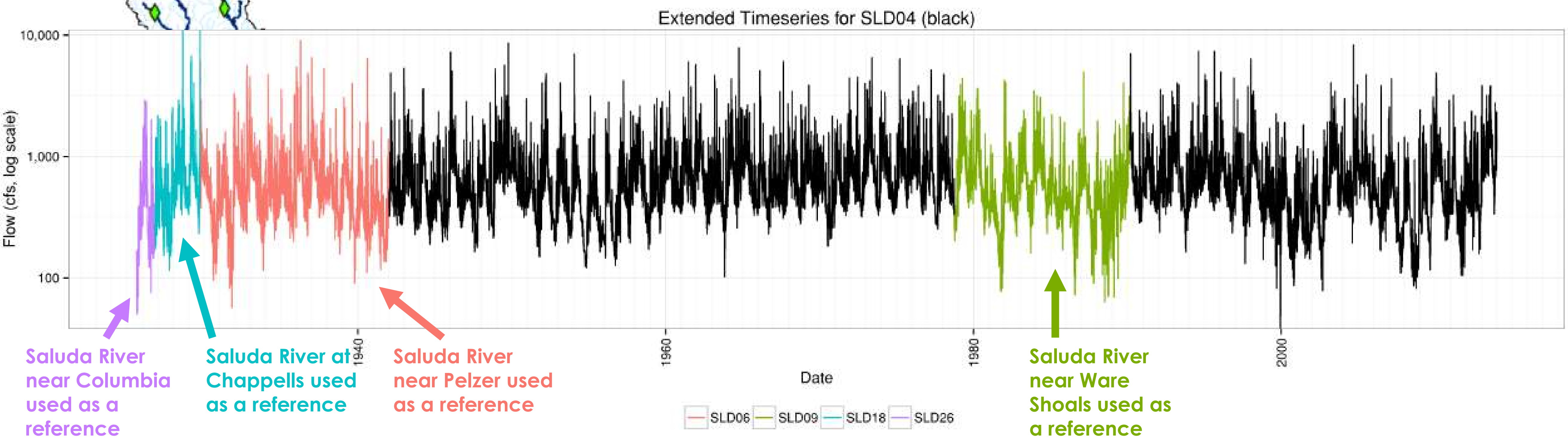
Filling in Gaps in Flow Data

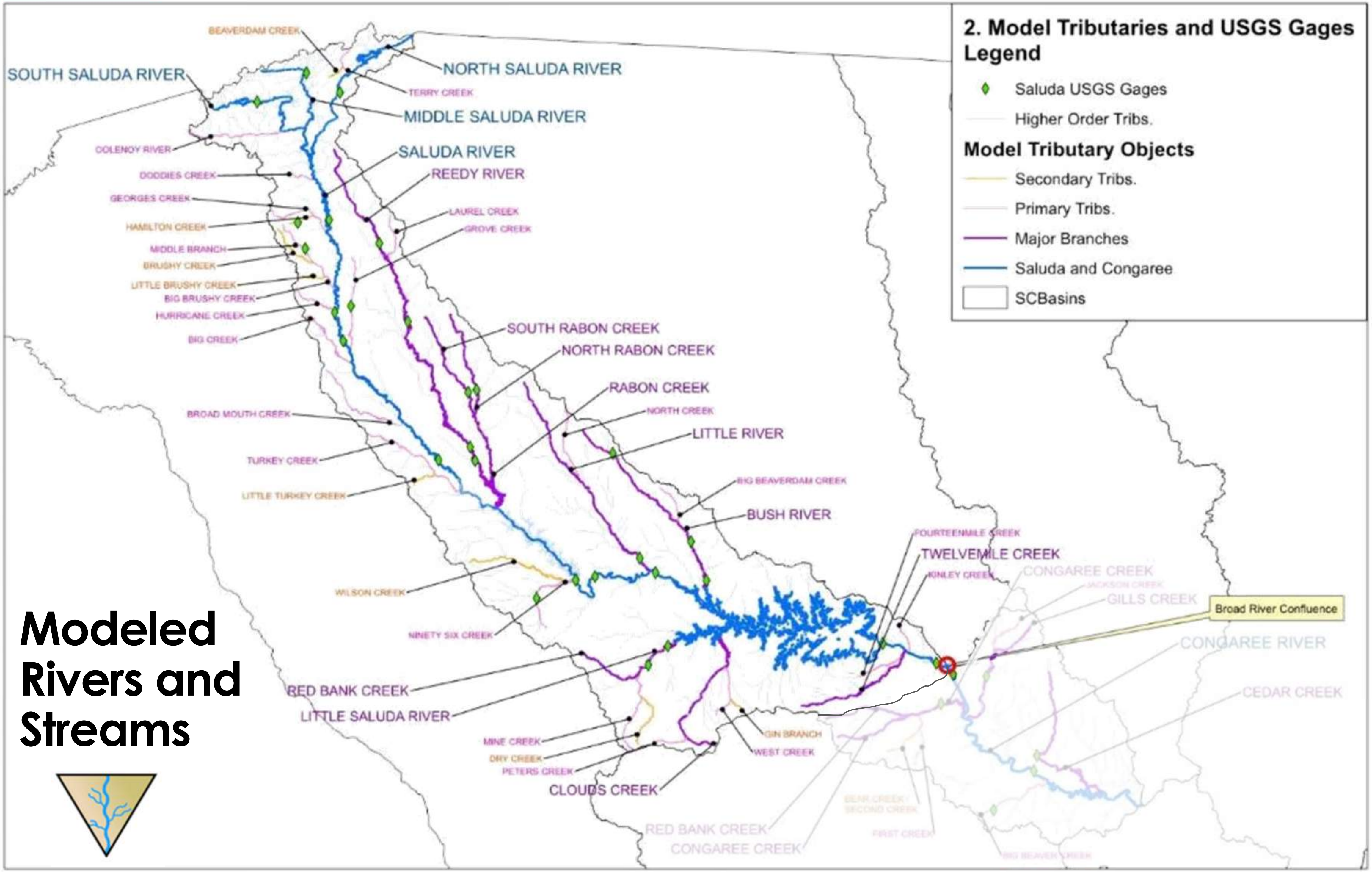


USGS Gage Timeline – Saluda River Basin



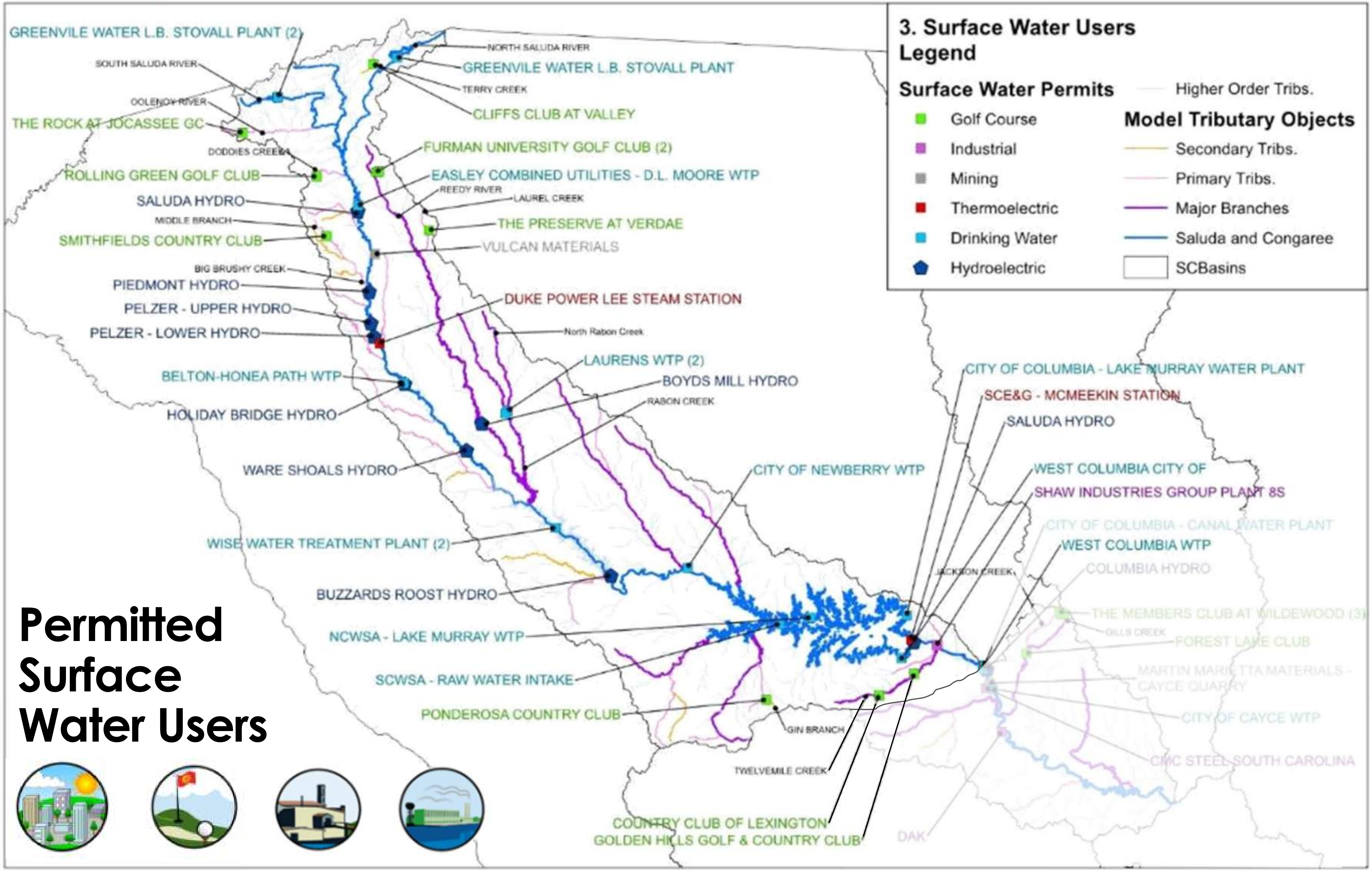
Extended Timeseries for SLD04 (Saluda River near Greenville)



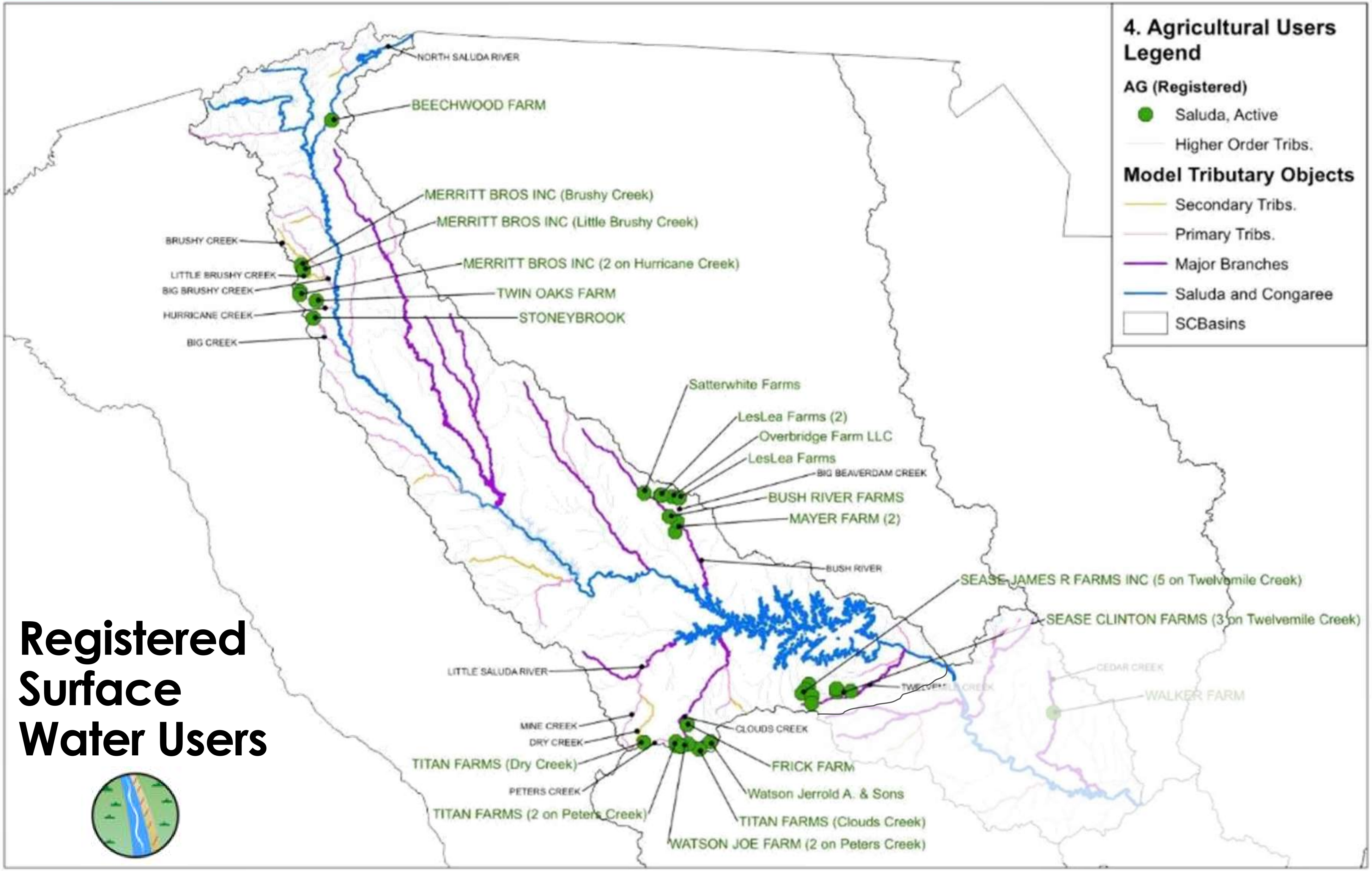


Modeled Rivers and Streams

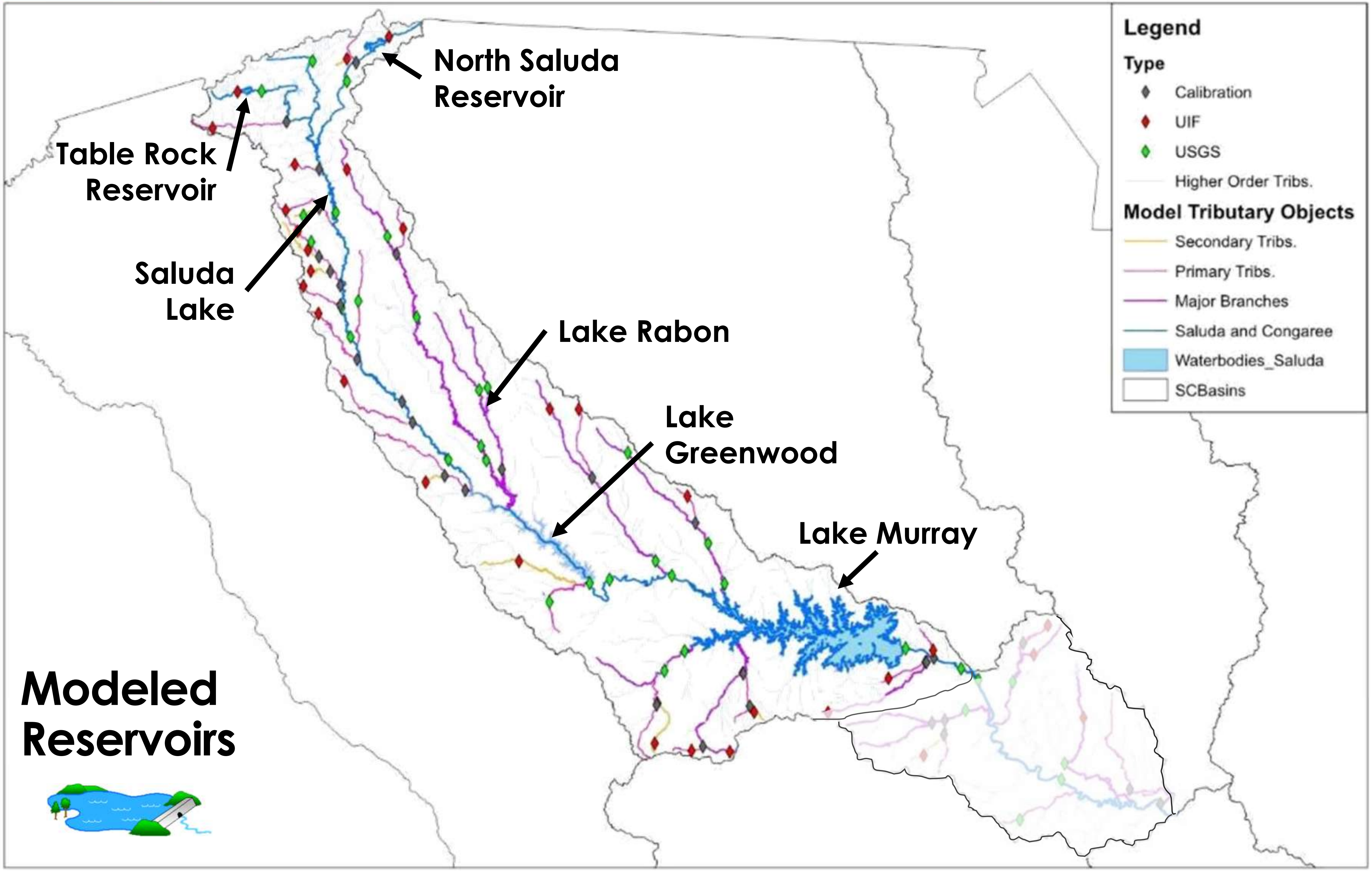
Permitted Surface Water Users



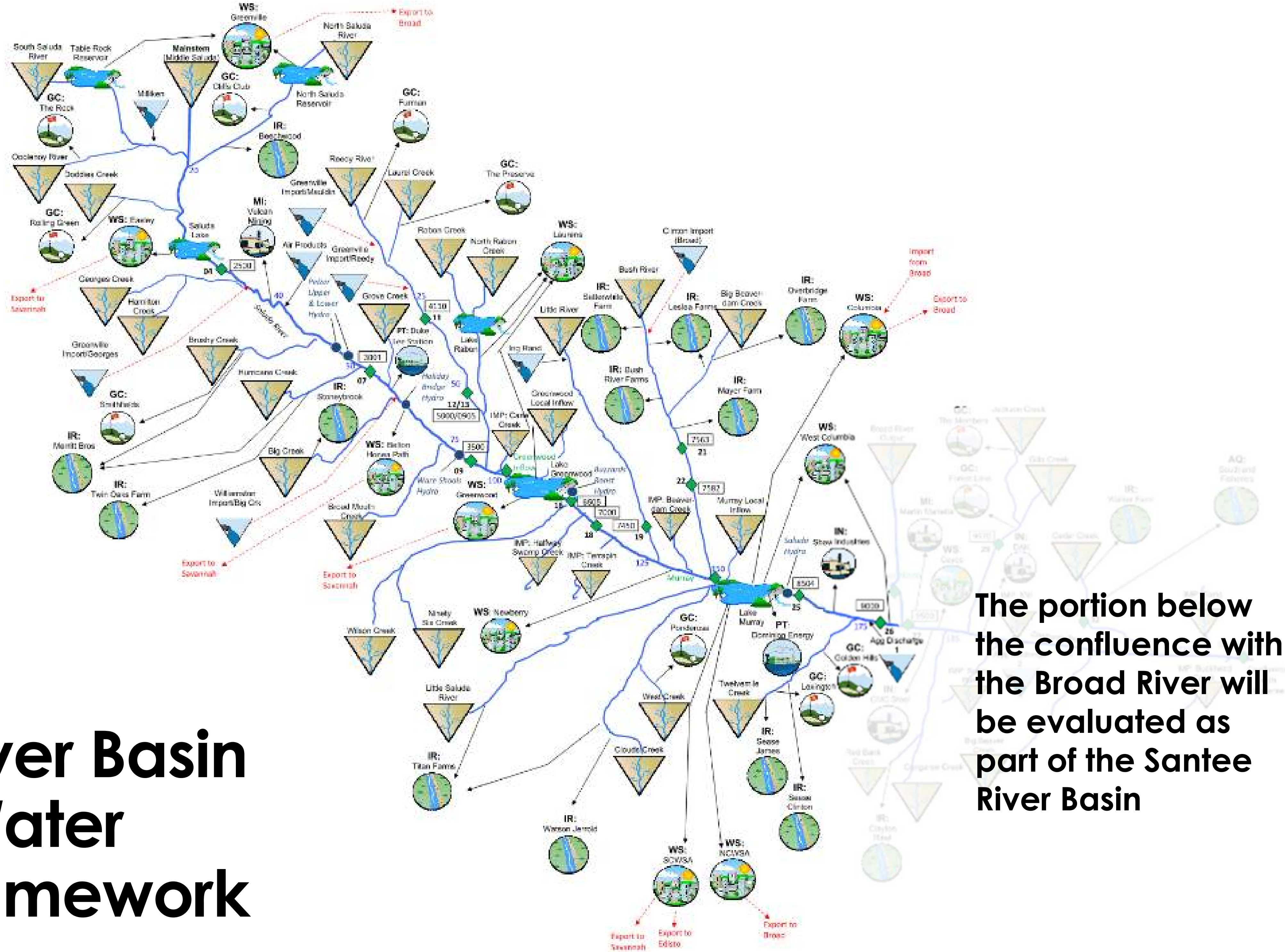
Registered Surface Water Users



Modeled Reservoirs



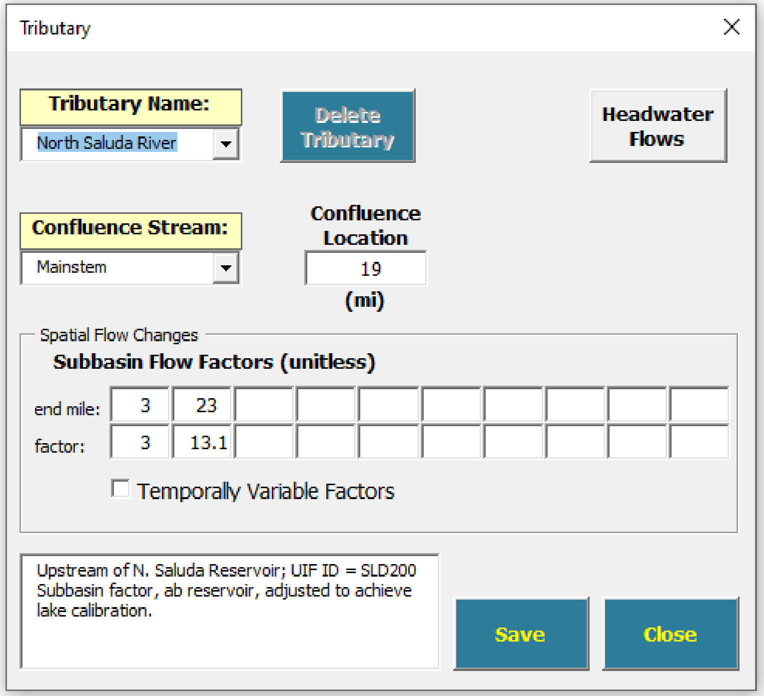
Saluda River Basin Surface Water Model Framework



The portion below the confluence with the Broad River will be evaluated as part of the Santee River Basin

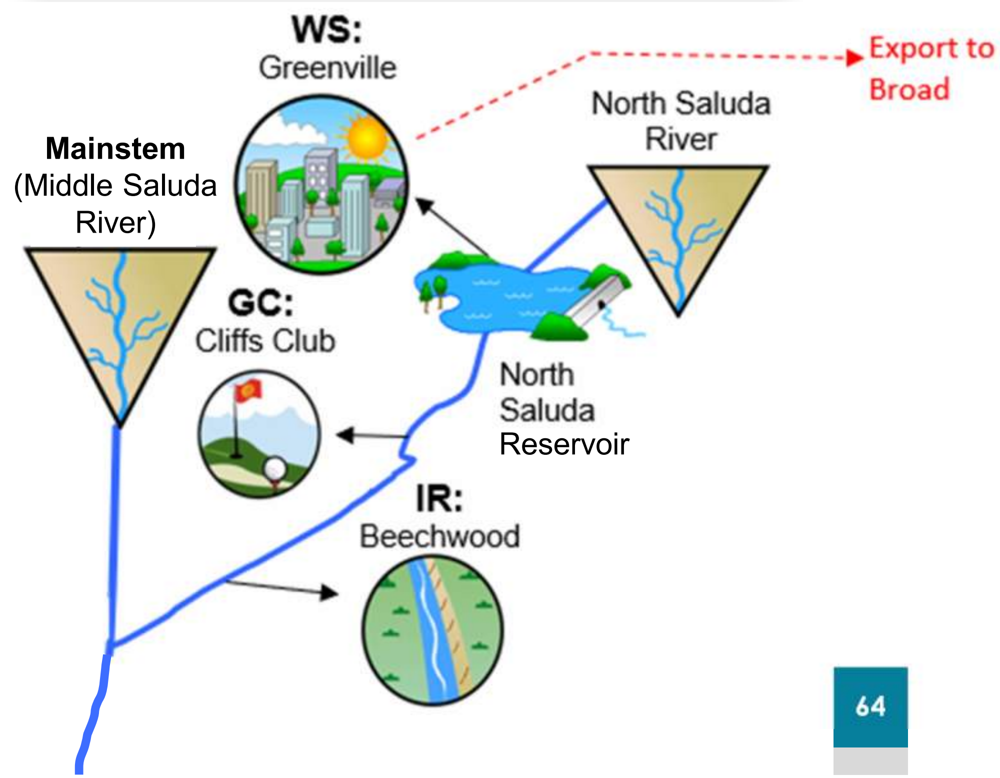
SWAM Calculations: Supply

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



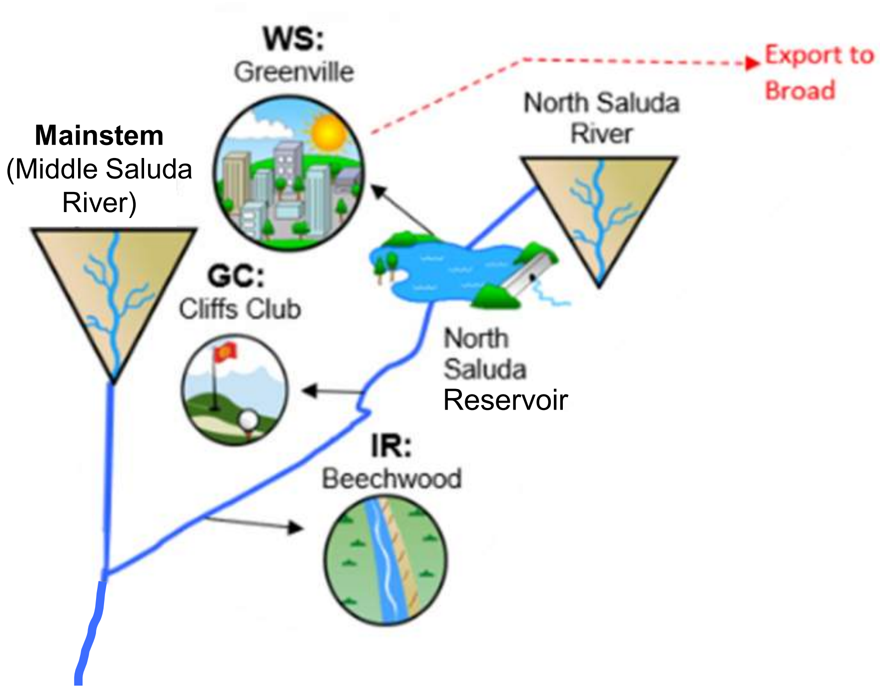
North Saluda River Headwater Flows

Year (YYYY)	Month (MMM)	Monthly Flow (CFS)
1925	Aug	3.0
1925	Sep	3.6
1925	Oct	5.2
1925	Nov	11.3
1925	Dec	9.1
1926	Jan	23.0
1926	Feb	35.4
1926	Mar	24.9
1926	Apr	24.5
1926	May	6.5
1926	Jun	5.3
1926	Jul	10.7
1926	Aug	11.7
1926	Sep	7.1
1926	Oct	5.9
1926	Nov	10.7
1926	Dec	16.4

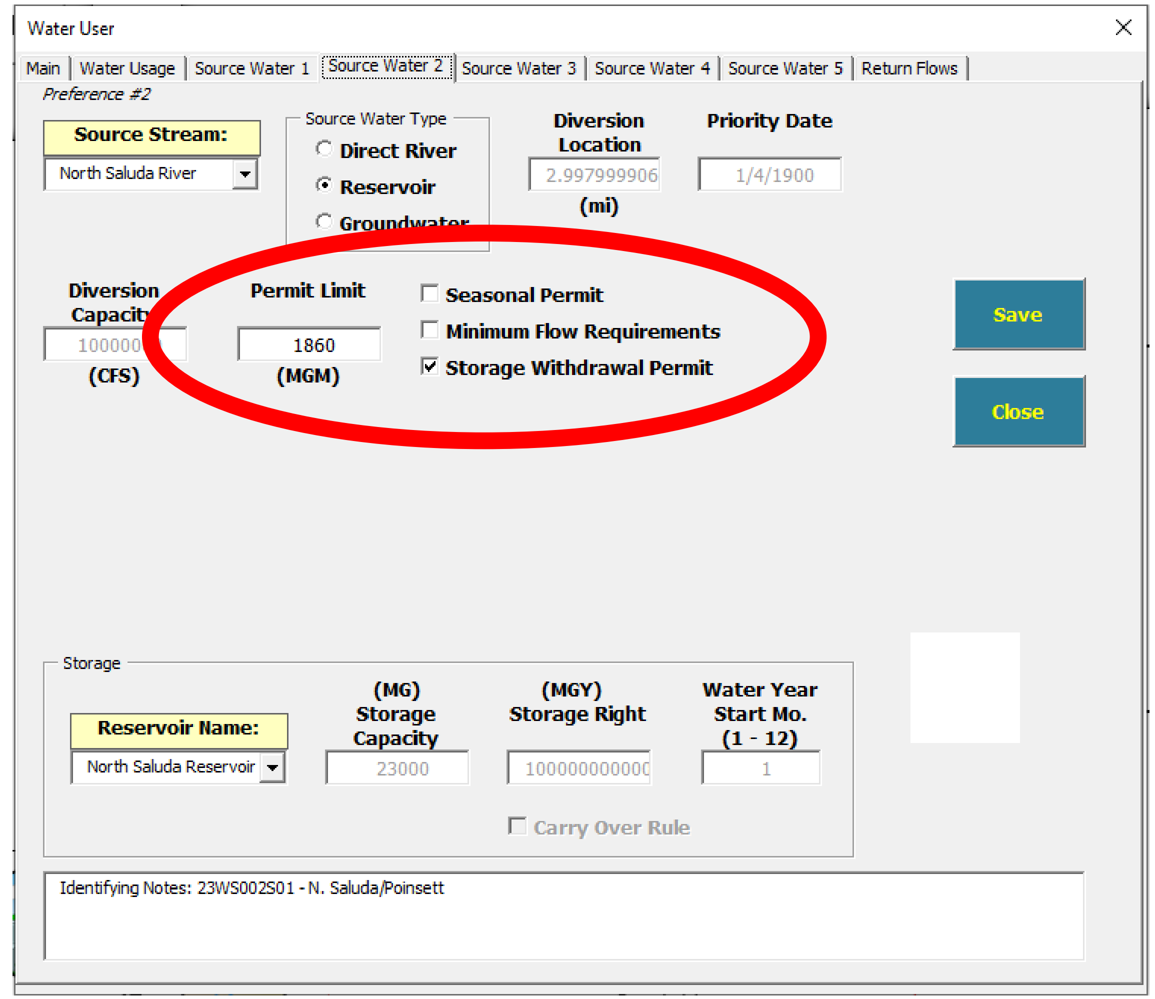


SWAM Calculations: Supply

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



WS: Greenville



SWAM Calculations: Demand

WS: Easley

- **WS: User Object:**
  - Node based withdrawals and returns
  - Municipal water demands (prescribed monthly mean)

WS: Easley

Water User

Main | Water Usage | Source Water | Return Flows

Monthly User Distribution: (•) Manual ( ) M&I ( ) Agriculture

Annual Baseline Usage: Total Use [ ] (MGY) Distribute

Input Format: (•) monthly means ( ) timeseries

Monthly Baseline Usage

Month	Monthly Usage	% Indoor Use	% CU Indoor	% CU Outdoor
Jan	7.86	100	61.25	0
Feb	7.22	100	59.59	0
Mar	7.25	100	62.04	0
Apr	7.99	100	65.74	0
May	9.41	100	72.5	0
Jun	10.03	100	74.2	0
Jul	10.27	100	75.28	0
Aug	9.77	100	73.58	0
Sep	9.56	100	74.92	0
Oct	8.89	100	72.99	0
Nov	7.93	100	66.93	0
Dec	7.48	100	60.33	0

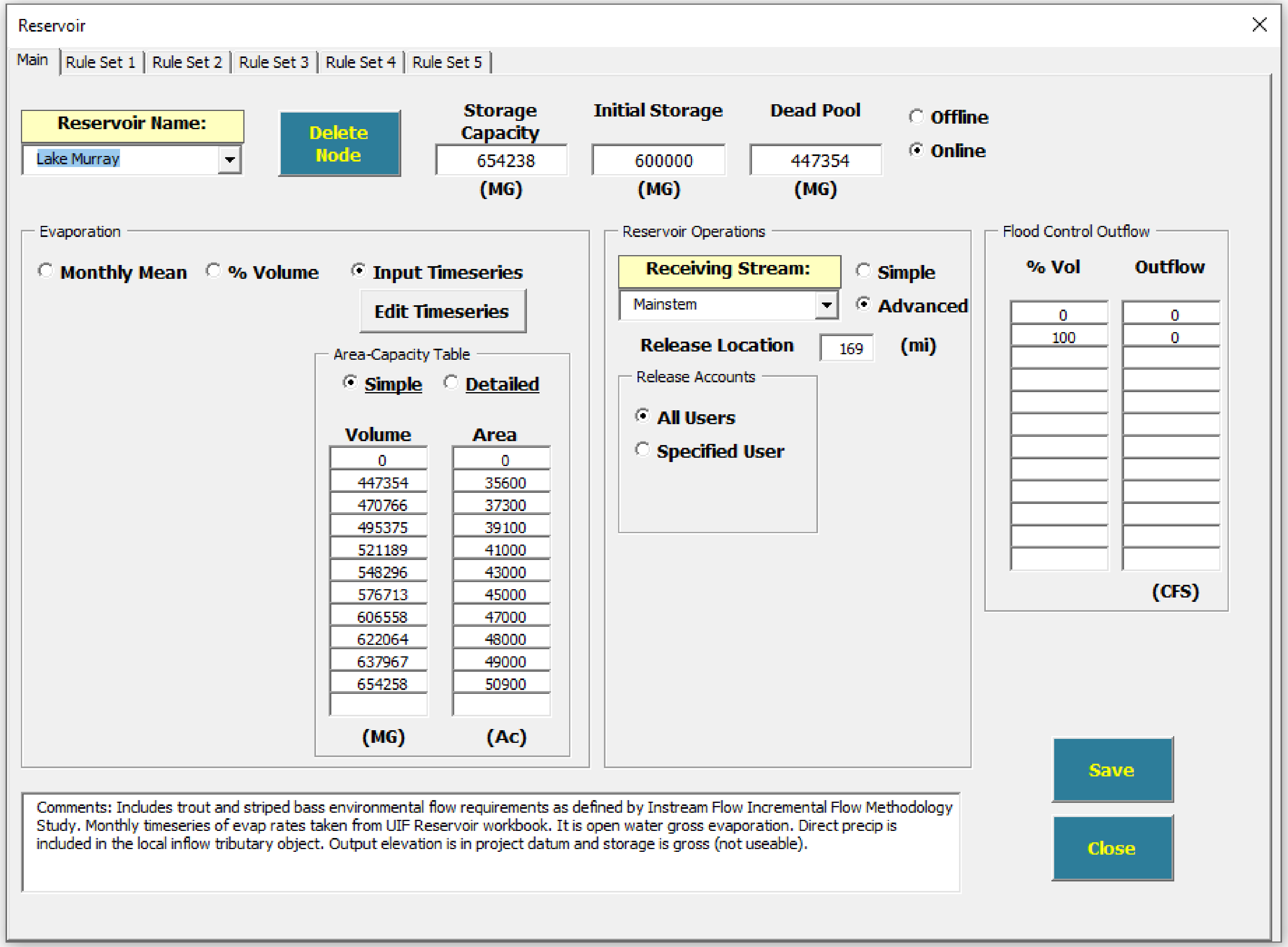
(MGD)

Save Close

SWAM Calculations: Reservoirs

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

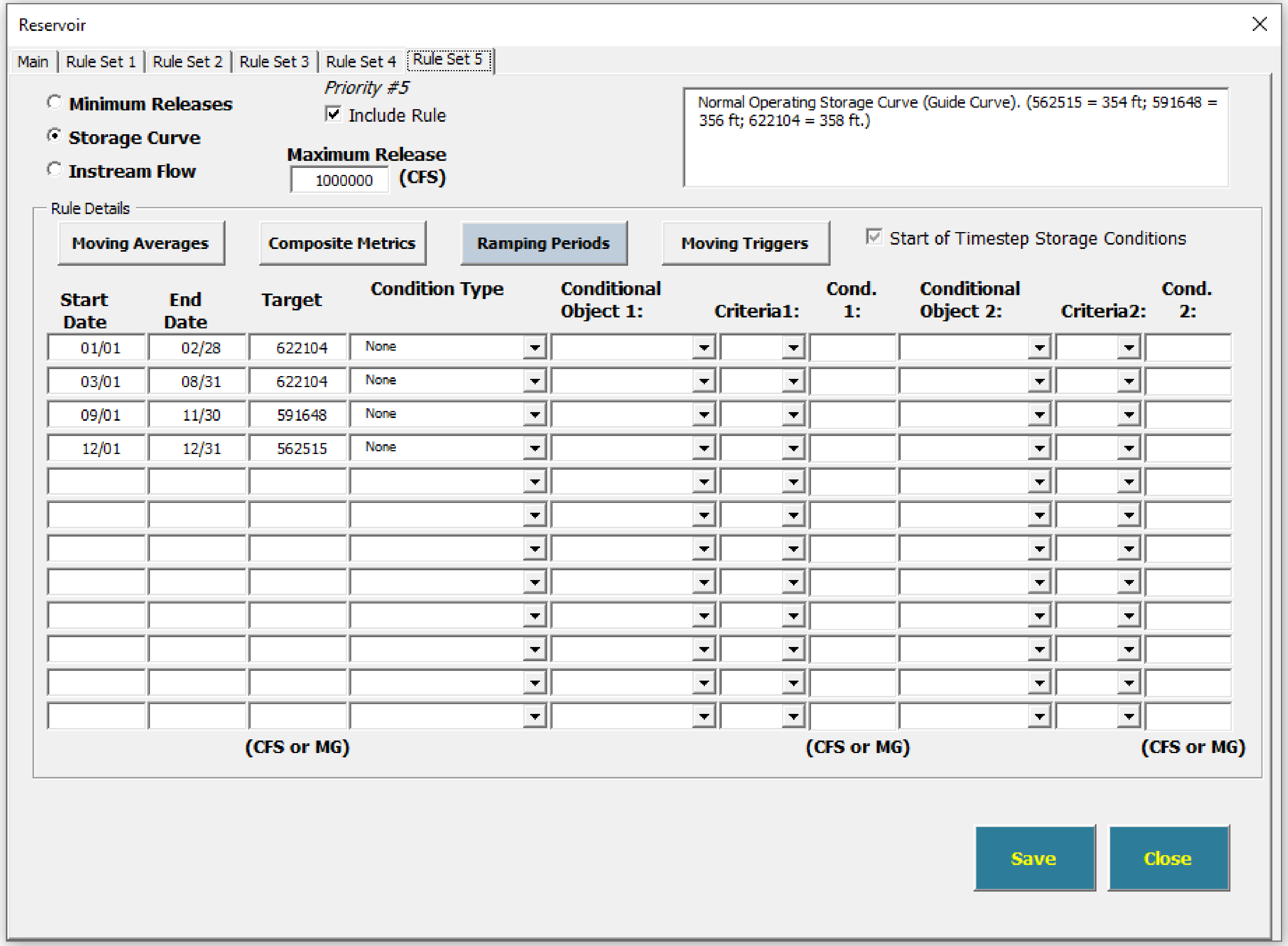
Lake Murray



SWAM Calculations: Reservoirs

- **Reservoir Object:**
  - Example operating rule: Lake Murray Normal Operating Storage Curve

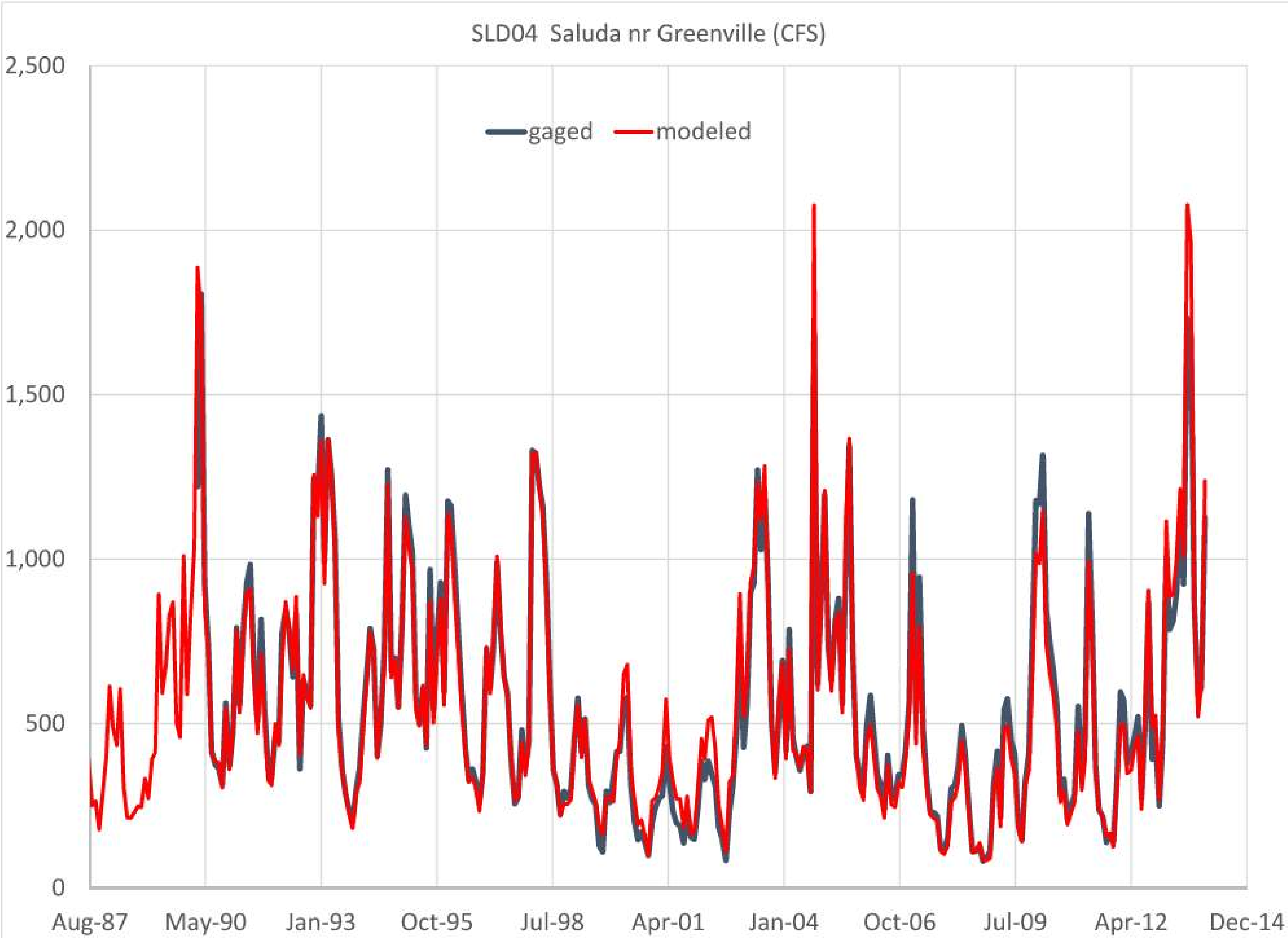
Lake Murray



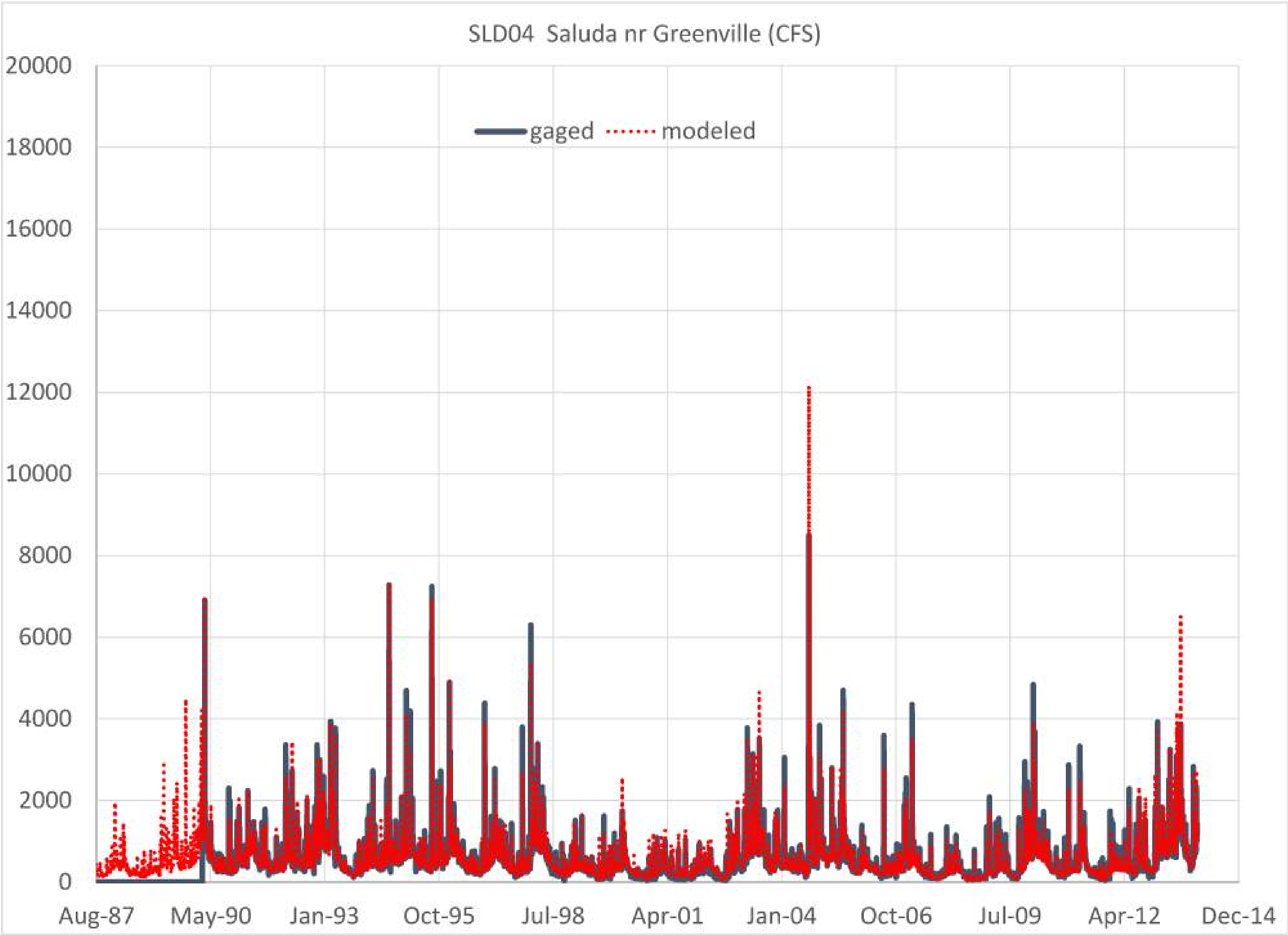
Model Calibration

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

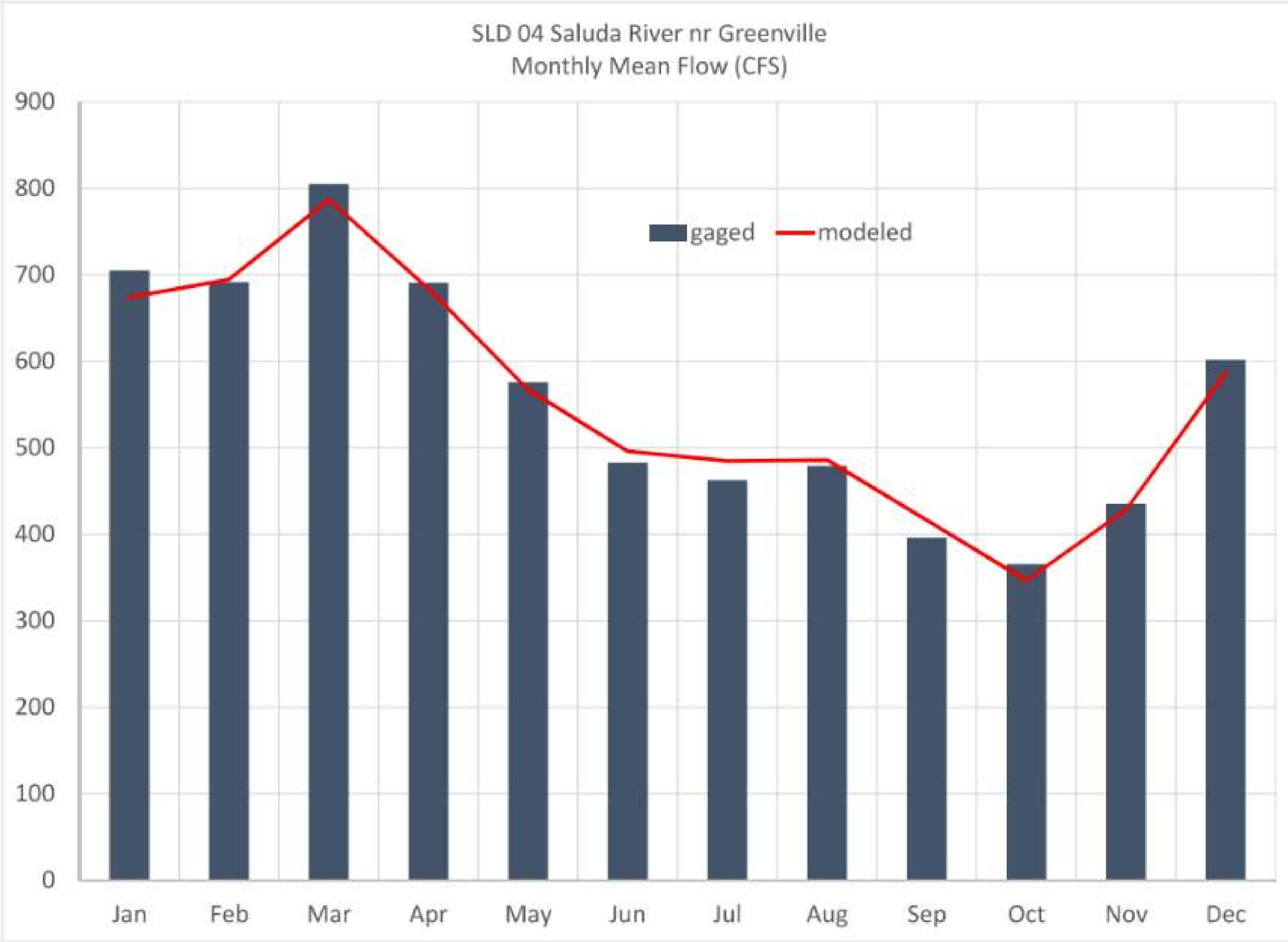
Comparison of Monthly Gaged and Modeled Flows



Comparison of Daily Gaged and Modeled Flows

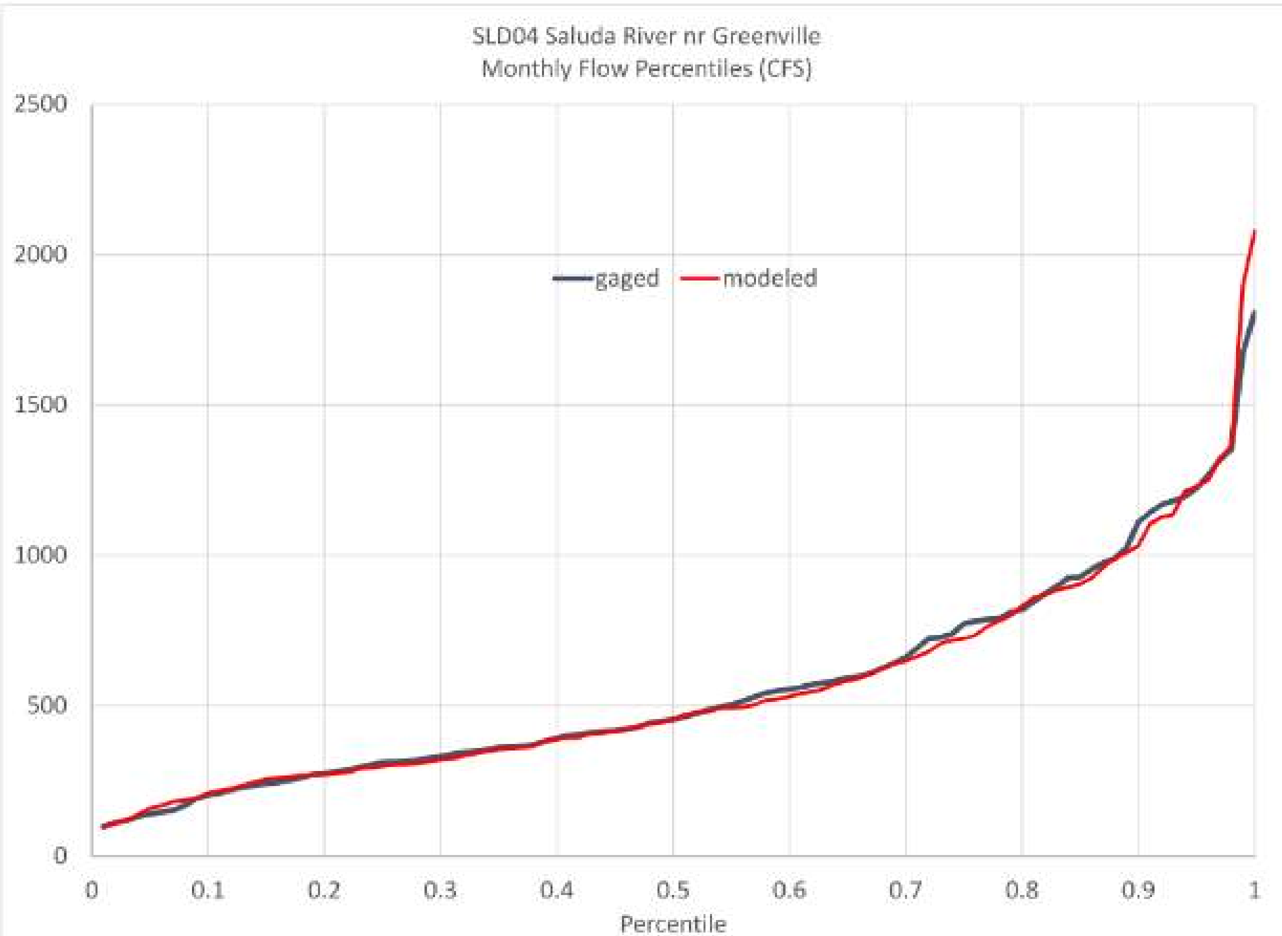


Comparison of Mean Monthly Gaged and Modeled Flows

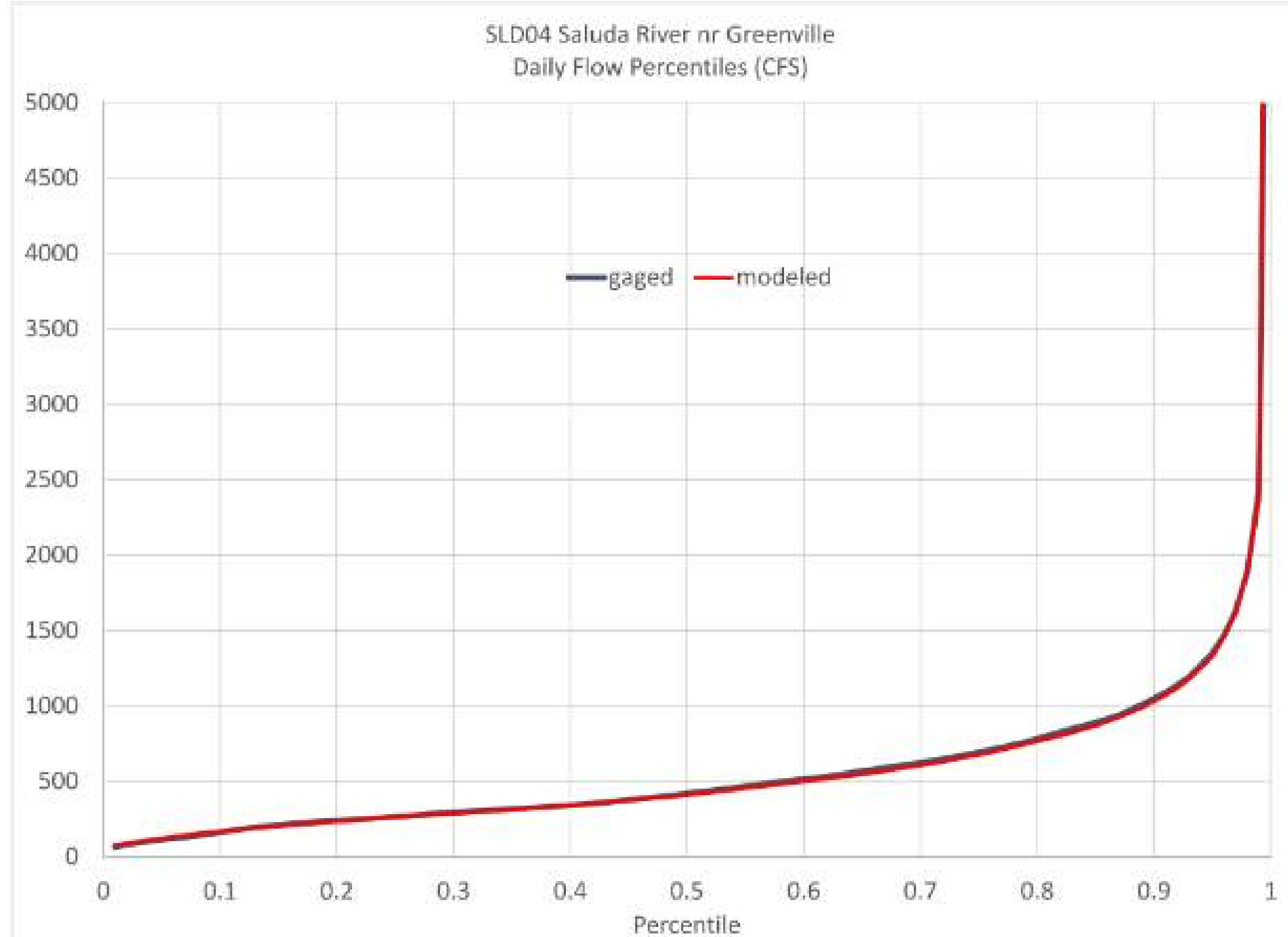


Comparison of Gaged and Modeled Flow Percentiles

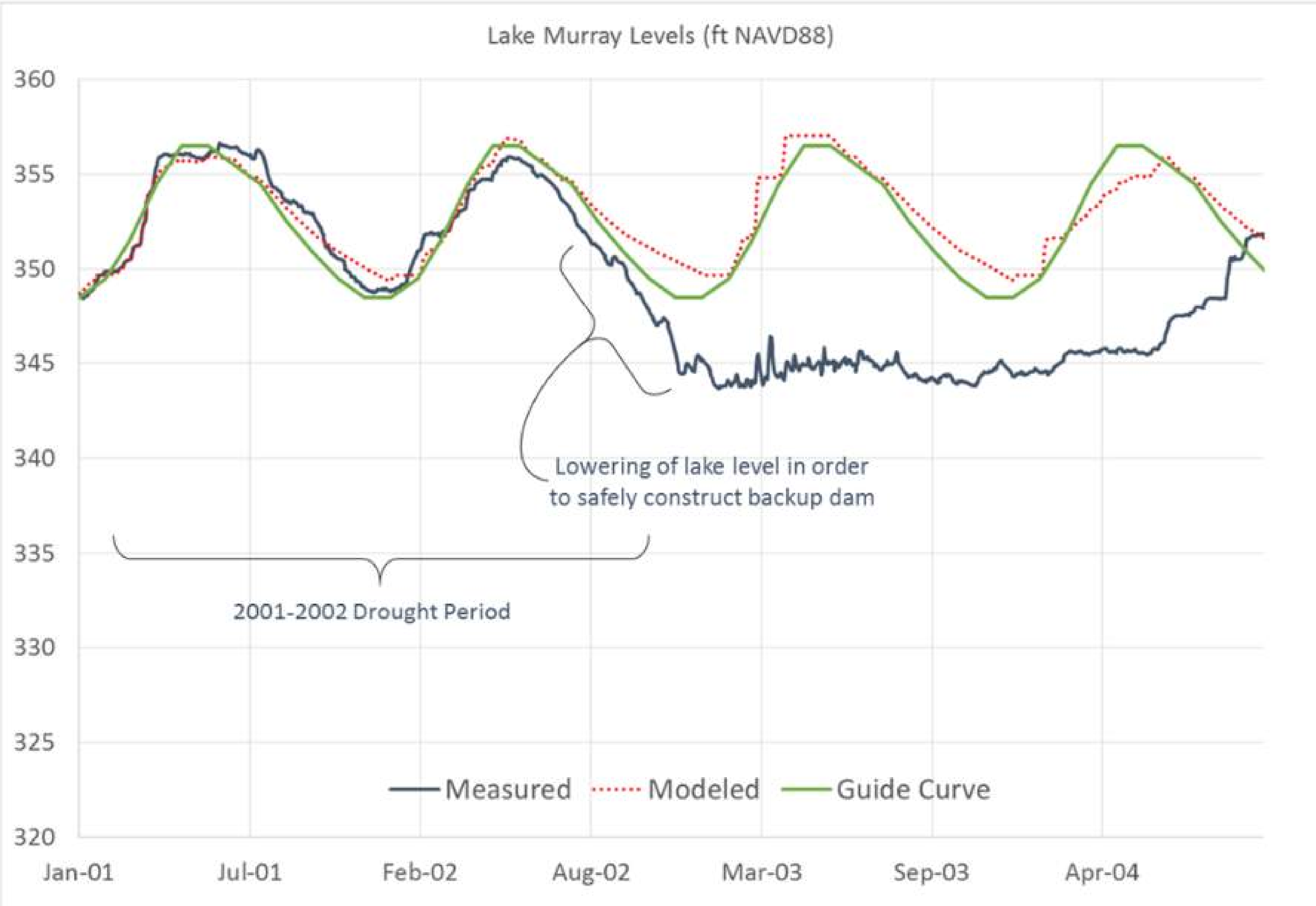
Monthly



Daily



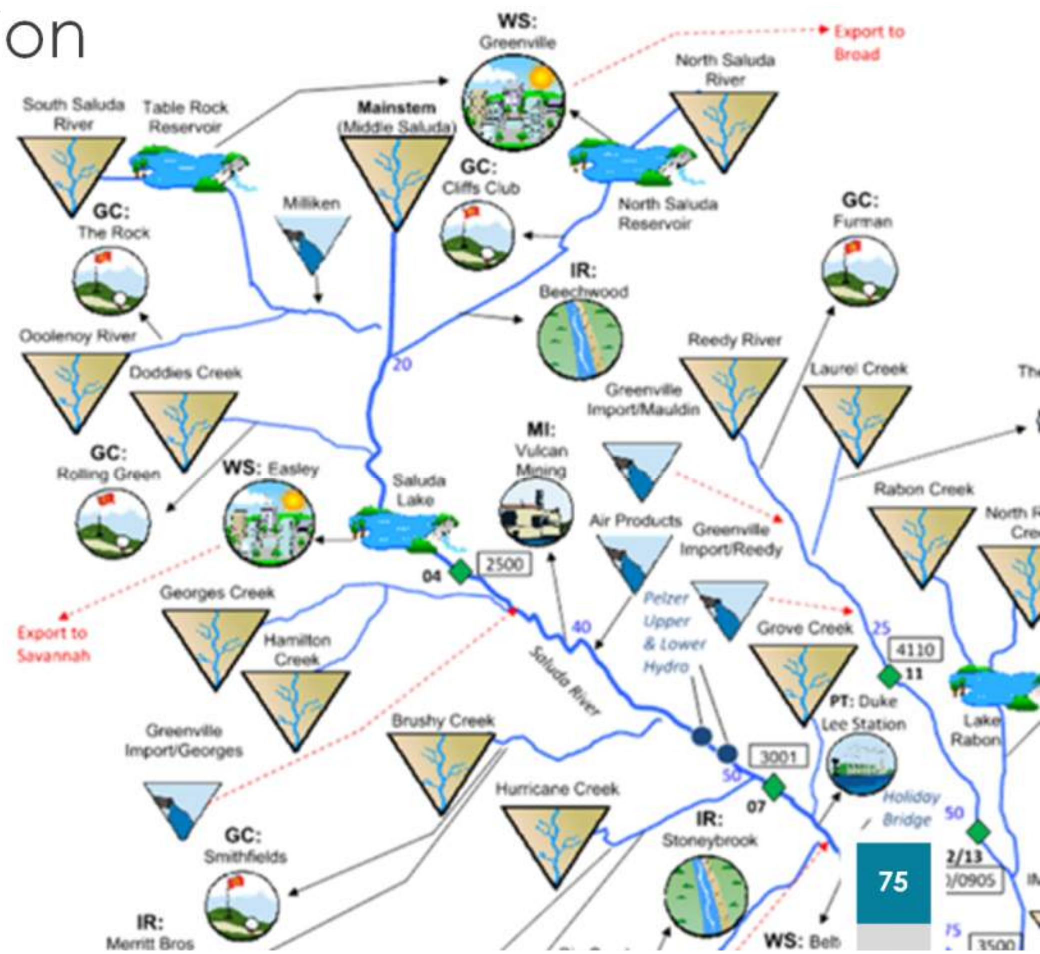
Comparison of Measured and Modeled Lake Levels



Lake Murray

2021 Surface Water Model Updates

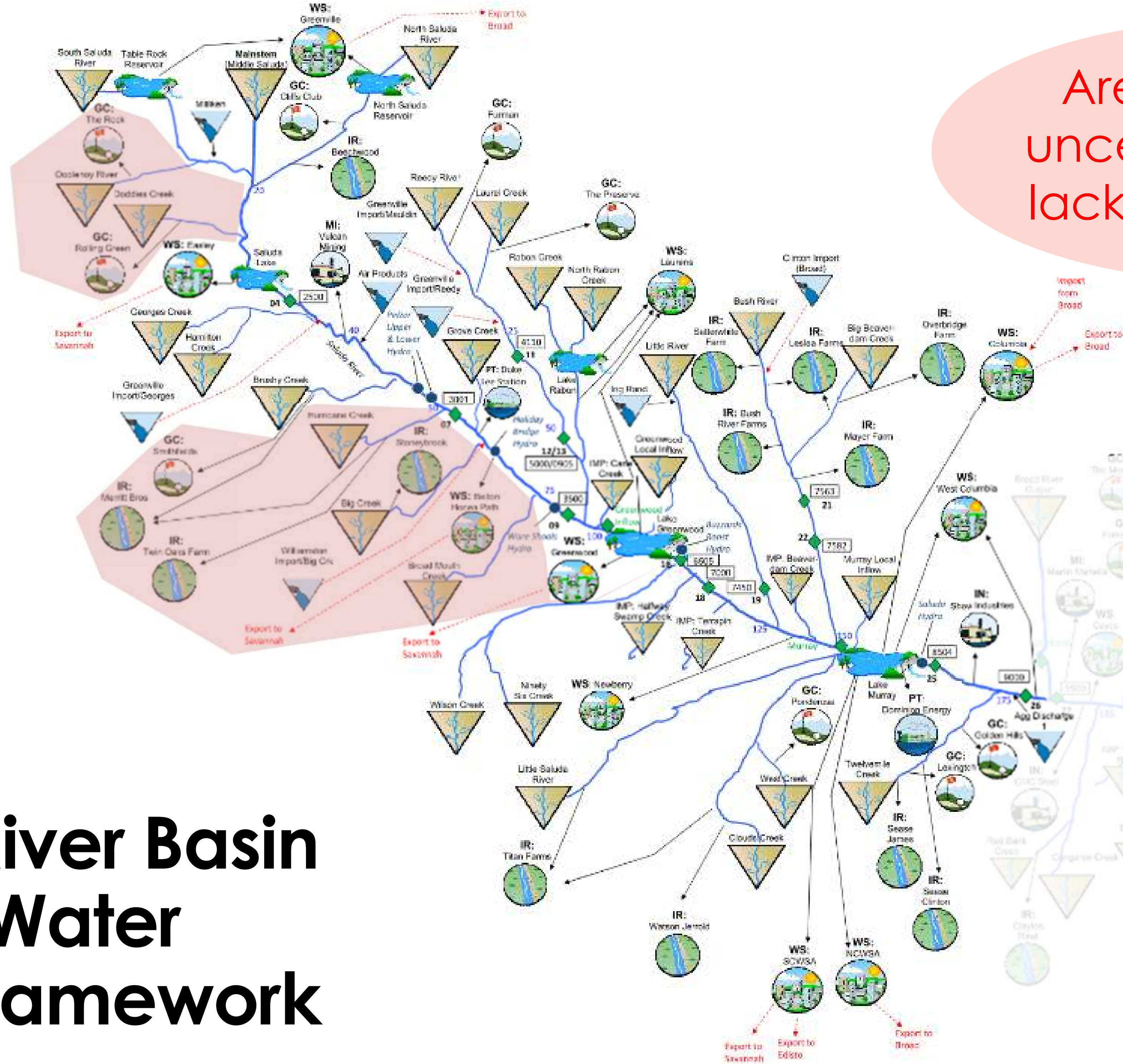
- Extended baseline hydrology through 2019 (added 6 years)
- Updated monthly mean water demands based on recent water use data
- Updated permit and intake location information
- Removed inactive permittees
- Added new registrations
- Software updates



Model Limitations

- Greater uncertainty in predictions for ungaged reaches compared to gaged
- Model not designed for reach routing of flow changes at a 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 gage data)



Saluda River Basin Surface Water Model Framework

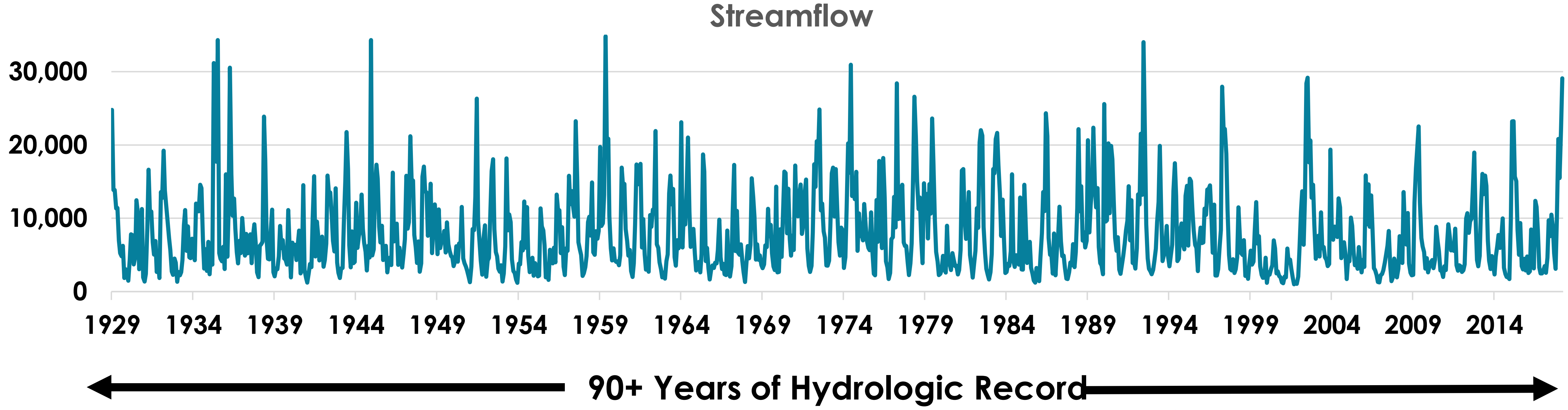
Surface Water Scenarios

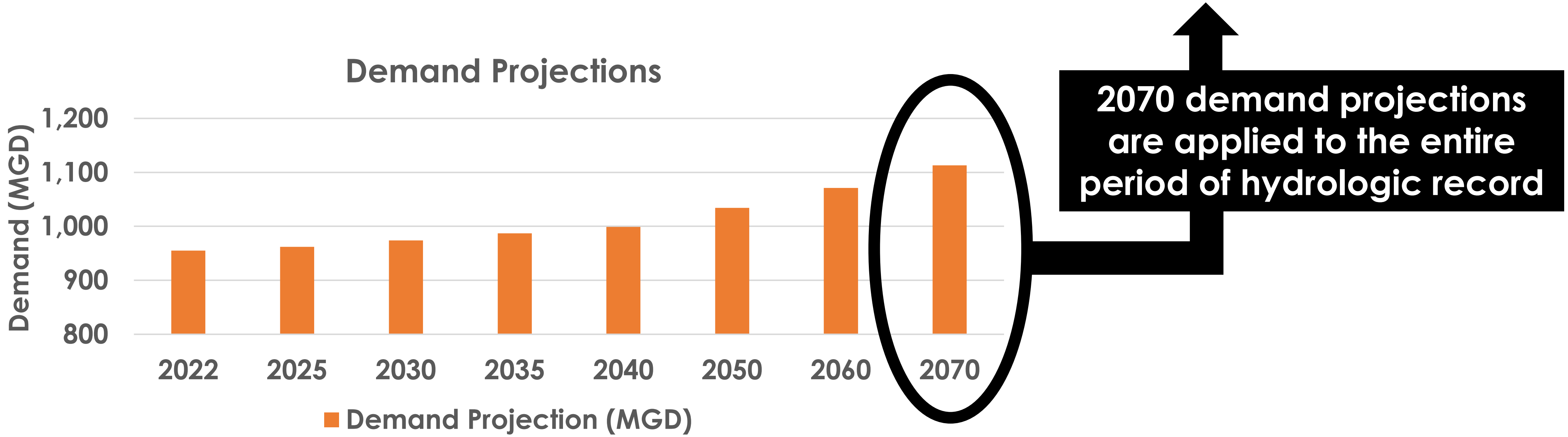
Base Scenarios

- 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*
- Moderate 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

Evaluating Projected Demands (Example)



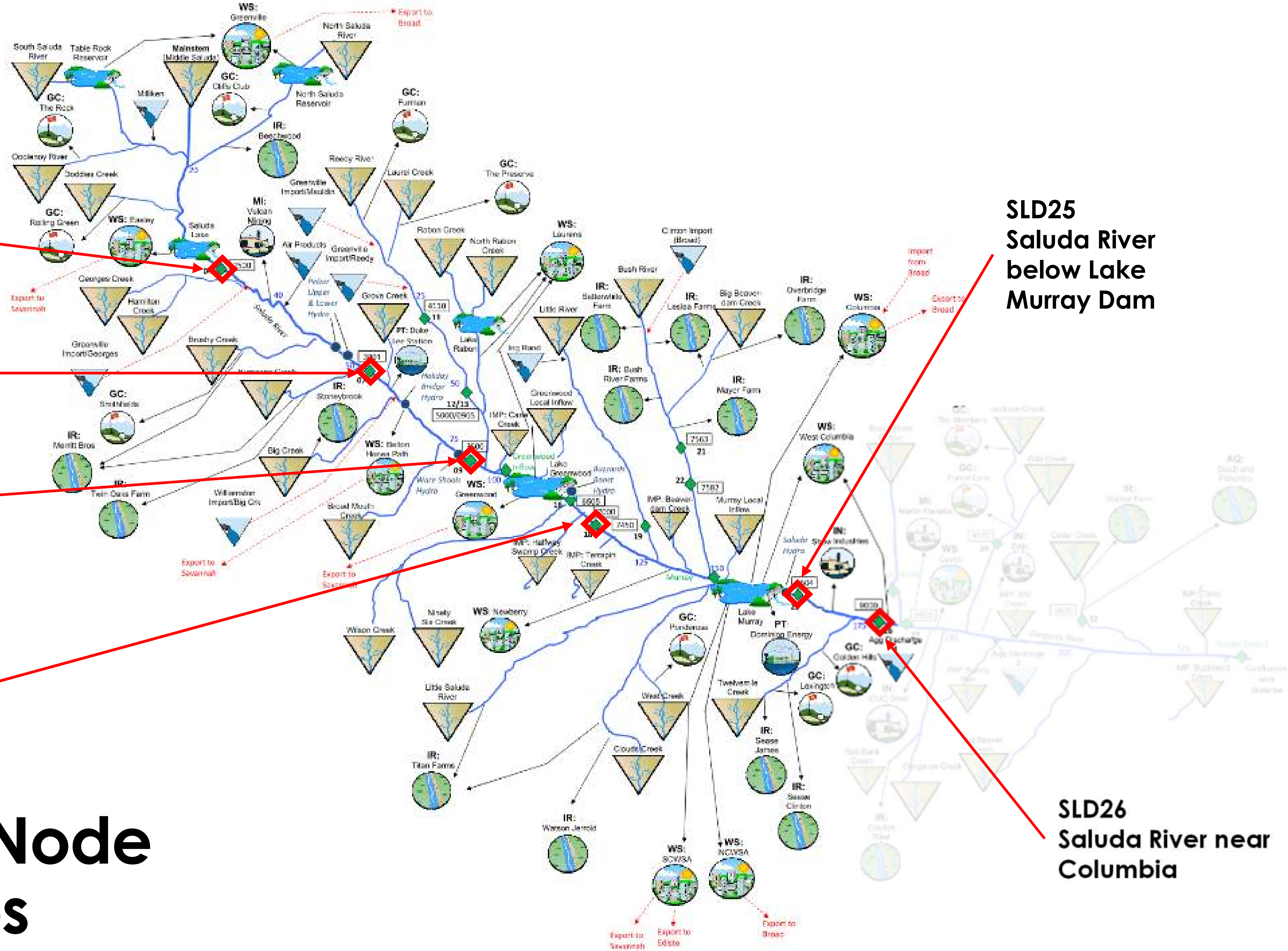


Performance Measures

Assessment of simulation results will focus on quantifying key performance measures for strategic nodes and 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



SLD04
Saluda River near Greenville

SLD07
Saluda River near Williamston

SLD09
Saluda River near Ware Shoals

SLD18
Saluda River at Chappells

SLD25
Saluda River below Lake Murray Dam

SLD26
Saluda River near Columbia

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:

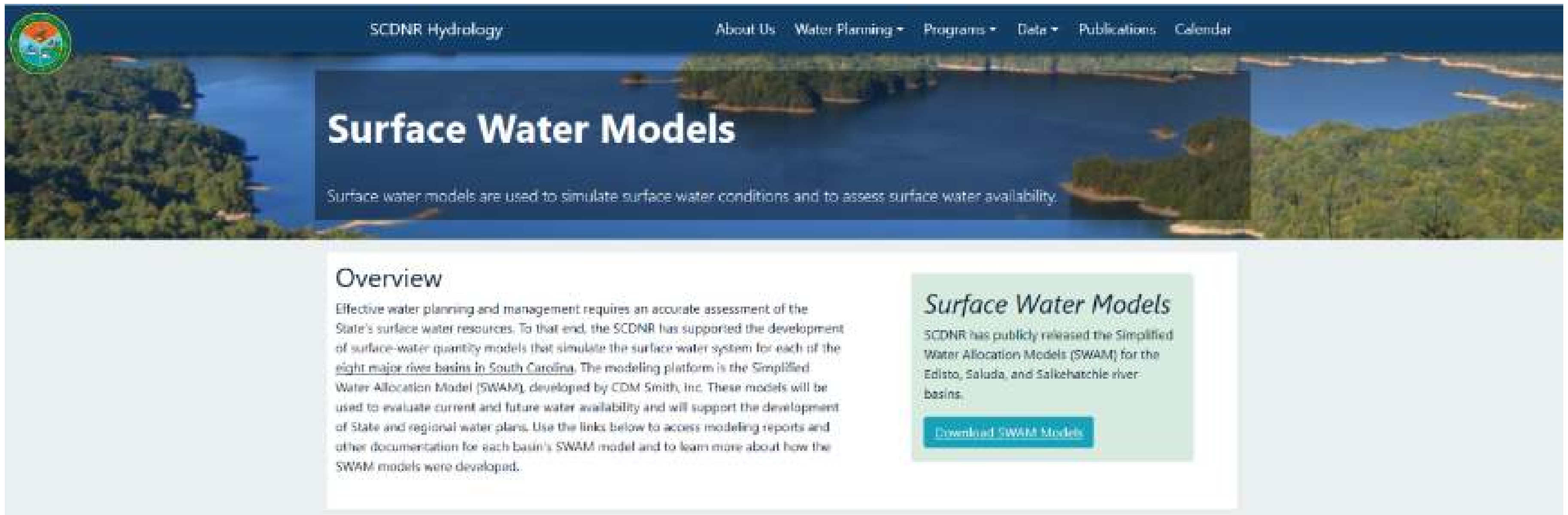
- Recreational flows
- Ecological / in-stream flows
- Designation as a Scenic River
- Listing on the Integrated Report as a Category 4C water (e.g., the 14–mile section of the Saluda River downstream of the Saluda Lake Dam)

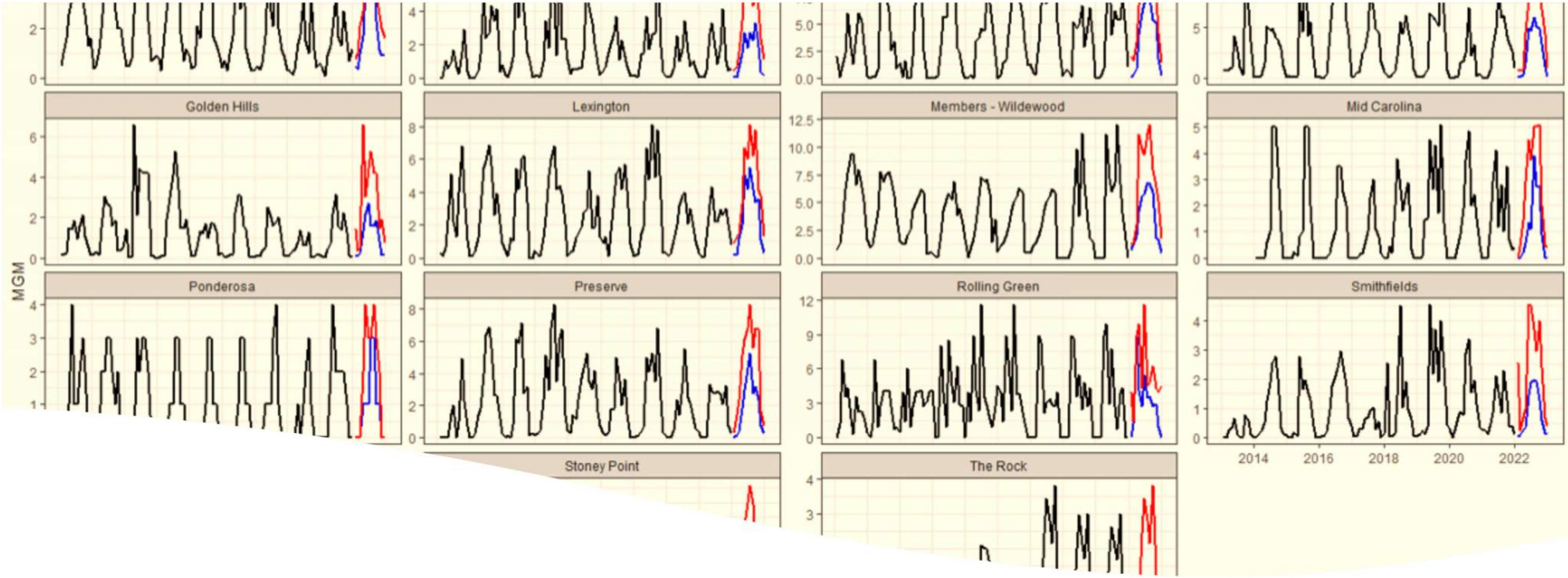
Saluda Water Quantity Model Training

- Training for interested RBC members will occur on **Tuesday**, **October 3**, beginning at 10 a.m. in Columbia (Wells Fargo Building, 1441 Main Street)
- We will provide:
  - a laptop with the Saluda model pre-loaded
  - lunch
  - exercises to work through

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





Demand Projections Update

Alex Pellett, SCDNR

Agenda Item 7

Upcoming Meeting Schedule, Field Trip, and Topics

Agenda Item 8

Saluda RBC Meeting #7

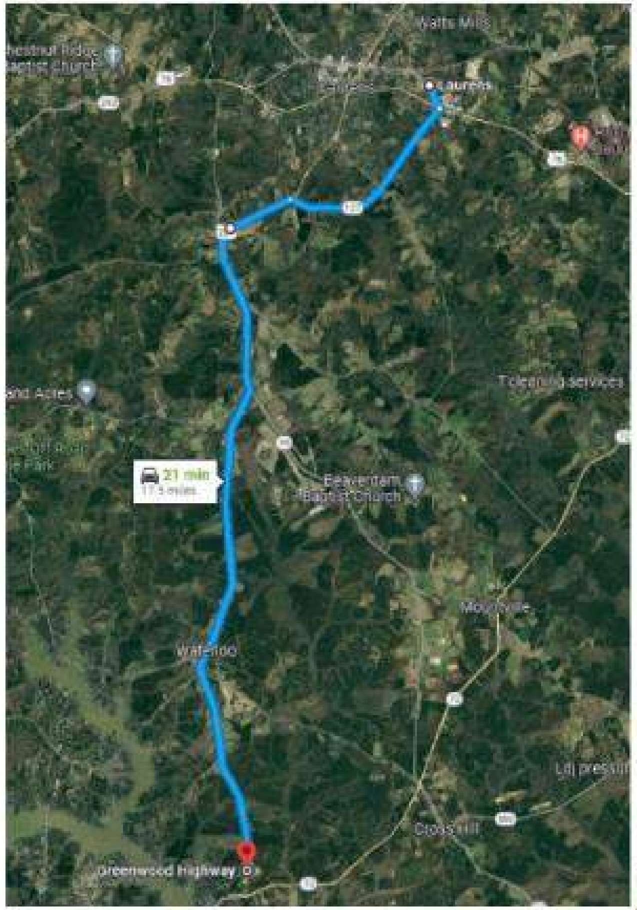
Wed, August 20, 2023 – Dominion Energy Facility, Lake Murray

Informational Topic (Tentative)	Speaker
• SWAM Model Results, Current Use, P&R and UIF Scenarios	CDM Smith
• Recommendations for Flow-Ecology Relationships	Drs. Luke Bower, Joe Mruzek, Brandon Peoples
• Field Trip to Lake Murray Dam and Saluda Hydro Facility	

Informational topics and speakers are tentative

Discussion and Other Items

- Look out for Phase 1 Survey which will include an invitation to RSVP for SWAM Training on October 3



Directions to
Lake Greenwood Water
Treatment Facility
from
The Ridge at Laurens

21 min (17.5 miles)
via US-221 S/US Hwy 221 S
21 min without traffic

Laurens
South Carolina 29360

- Head southeast on Exchange Rd
  0.5 mi
- Continue onto SC-127 W
  3.6 mi
- Turn left onto US-221 S/US Hwy 221 S
  Destination will be on the left
  13.4 mi

LCWSC's
Lake Greenwood Water Treatment
Facility
15865 Highway 221 South
Waterloo, SC 29384

Plant Phone # 864-677-2722
K.C.'s Phone 864-981-1174

Entrance on left of Hwy 221 S