Pee Dee River Basin Surface Water Availability Modeling Results

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Agenda Item 3

River Basin Planning Process

Phase 2	- **Evaluate current and future water availability issues** - Identify and quantify shortages, select surface water conditions, reaches of interest and groundwater areas of concerns
Phase 3	- Develop and evaluate **water management strategies** - Recommend and prioritize strategies

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- **Surface Water Condition** – a physical limitation on the amount of water that can be withdrawn from a surface water source and is independent of water demand.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.
- **Regulatory Shortage** – occurs when the water demand exceeds the permitted or registered amount for a water user.
- **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.

Surface Water Scenarios

Base Scenarios

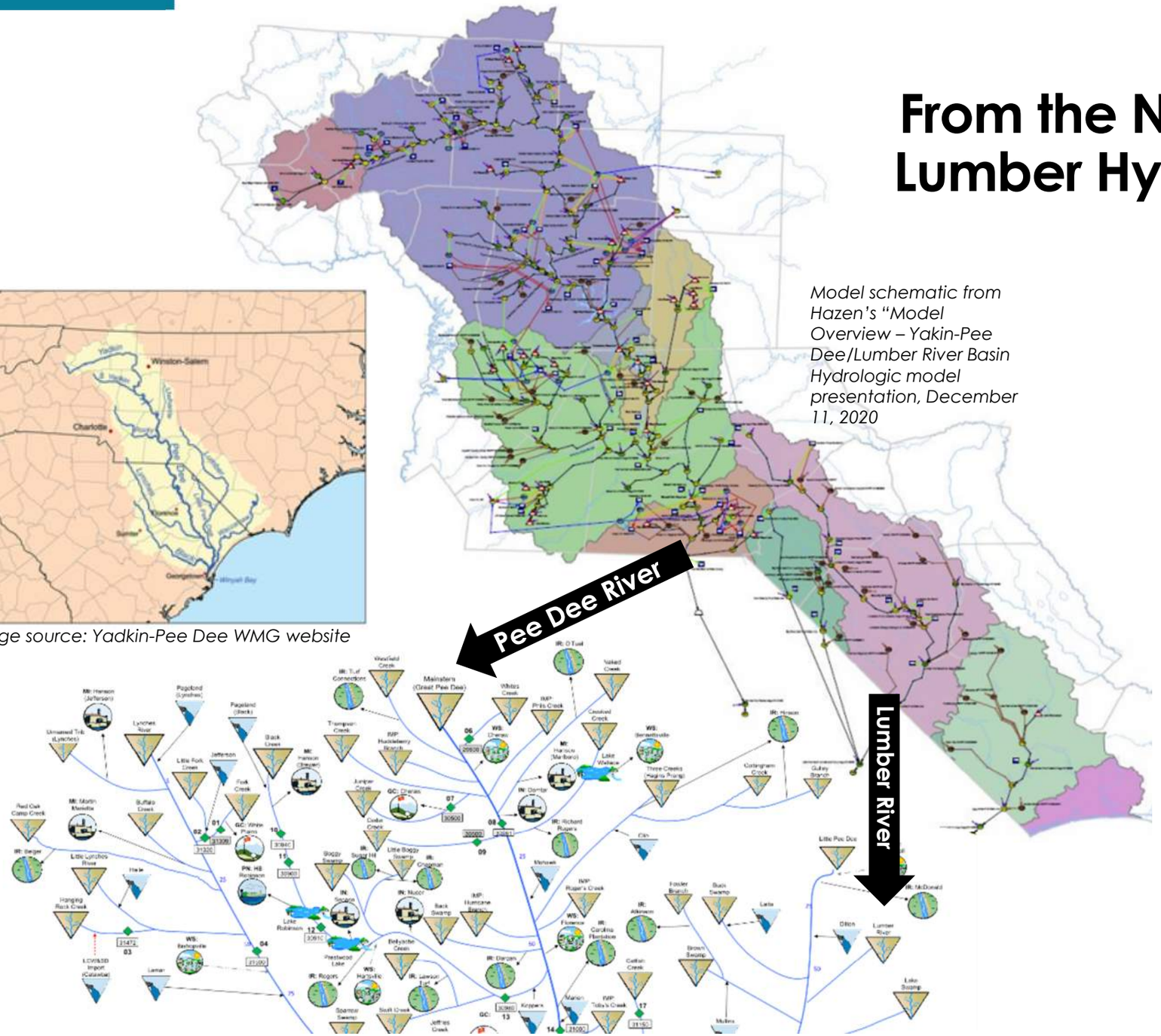
- Current Surface Water Use Scenario
  - *Uses most recent 10-yr average withdrawals (as reported by month)*
- Permitted and Registered (P&R) Surface Water Use Scenario
  - *Uses current fully-permitted and registered amounts*
- Moderate Water Demand Projection Scenario
  - *Future water demand projection 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

- Unimpaired Flow (UIF) Scenario
  - *Naturalized conditions (no surface water withdrawals, discharges, or reservoirs)*

North Carolina Inflows From the NC Yadkin-Pee Dee and Lumber Hydrologic Model (OASIS)

Image source: Yadkin-Pee Dee WMG website



Model schematic from Hazen's "Model Overview – Yakin-Pee Dee/Lumber River Basin Hydrologic model presentation, December 11, 2020

- Daily and monthly inflows provided by HDR for the **UIF** and **Current Use Scenarios**
- Negative flows in the daily inflow data set for the Pee Dee River were adjusted by interpolating from the previous and ensuing positive daily flows.
- Monthly inflows were recalculated, after adjusting the daily inflows to remove the negatives.

Summary of Average Annual Surface Water Demands by Scenario (in MGD)

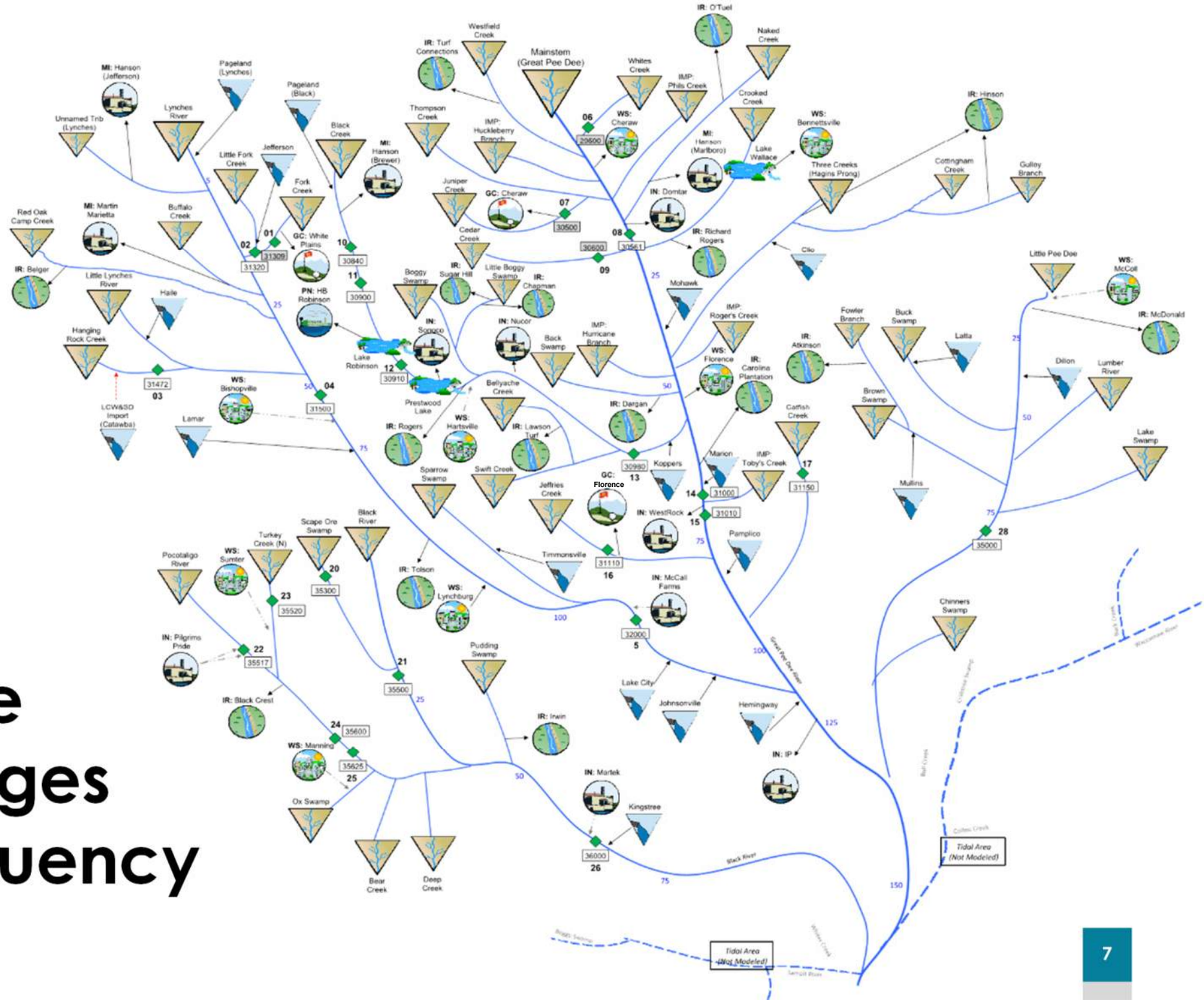
- Not including tidal-area surface water users that are not in the SWAM model

Surface Water Use Sector	Current Use	Permitted and Registered (P&R)	Current Use as a Percent of P&R
Mining	0.2	15.3	1%
Agriculture	2.1	19.8	11%
Golf Courses	0.2	4.8	5%
Industrial/Manufacturing	79.5	184.3	43%
Public Water Supply	18.8	58.2	32%
Thermoelectric[1]	475	864.1	55%
Total all Sectors*	576	1,147	50%
Percent Increase Compared to Current Use:		99%	
Total without Thermoelectric*	101	282	36%
Percent Increase Compared to Current Use:		180%	

** Rounded to nearest MGD*

[1] Greater than 99% of the thermoelectric withdrawals are returned

Preliminary Planning Scenario Model Results (monthly timestep)



Where do we see simulated shortages and at what frequency and magnitude?

Current Use Scenario

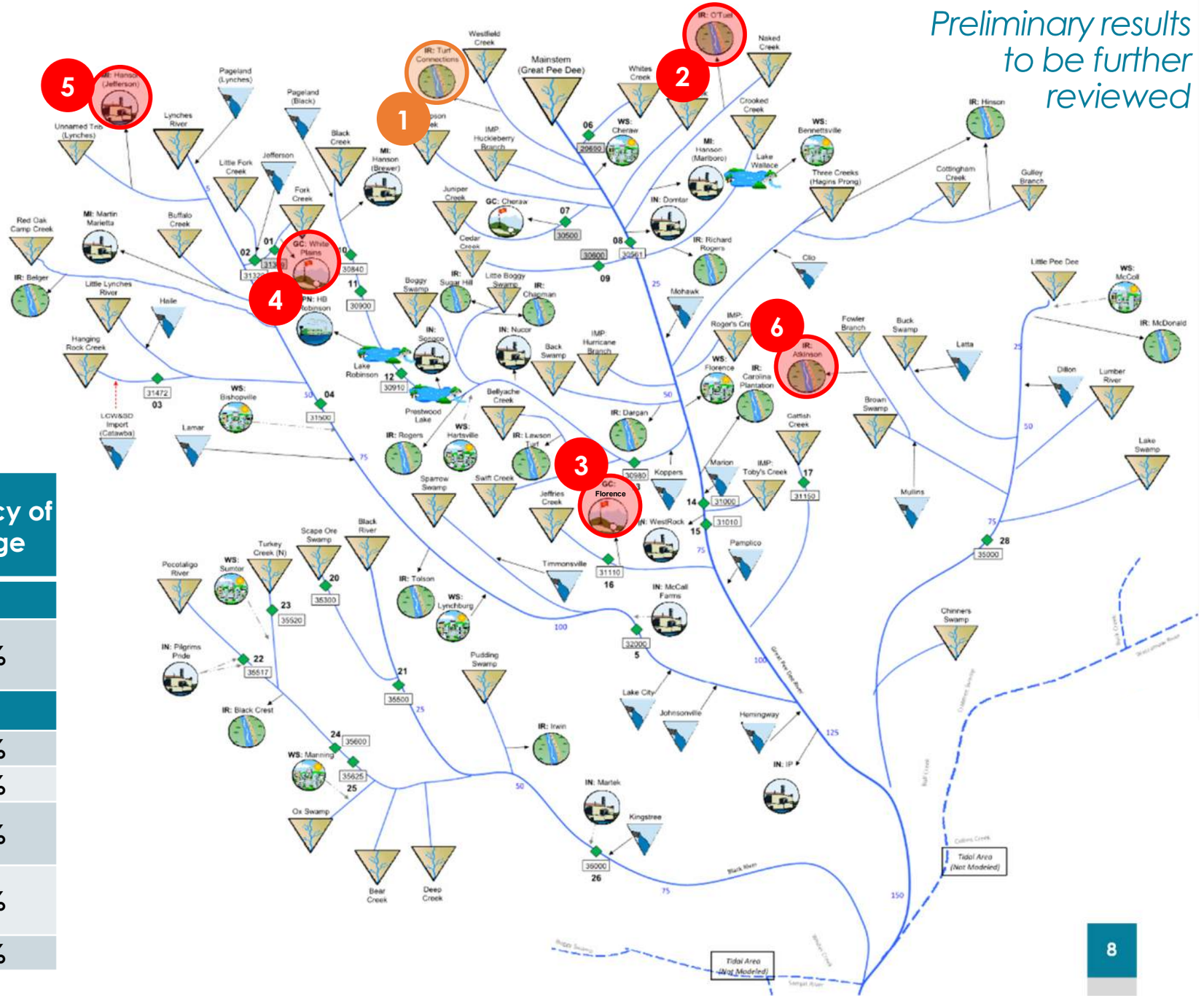
Preliminary results to be further reviewed

1 **Regulatory Shortage**

2 **Physical Shortage**

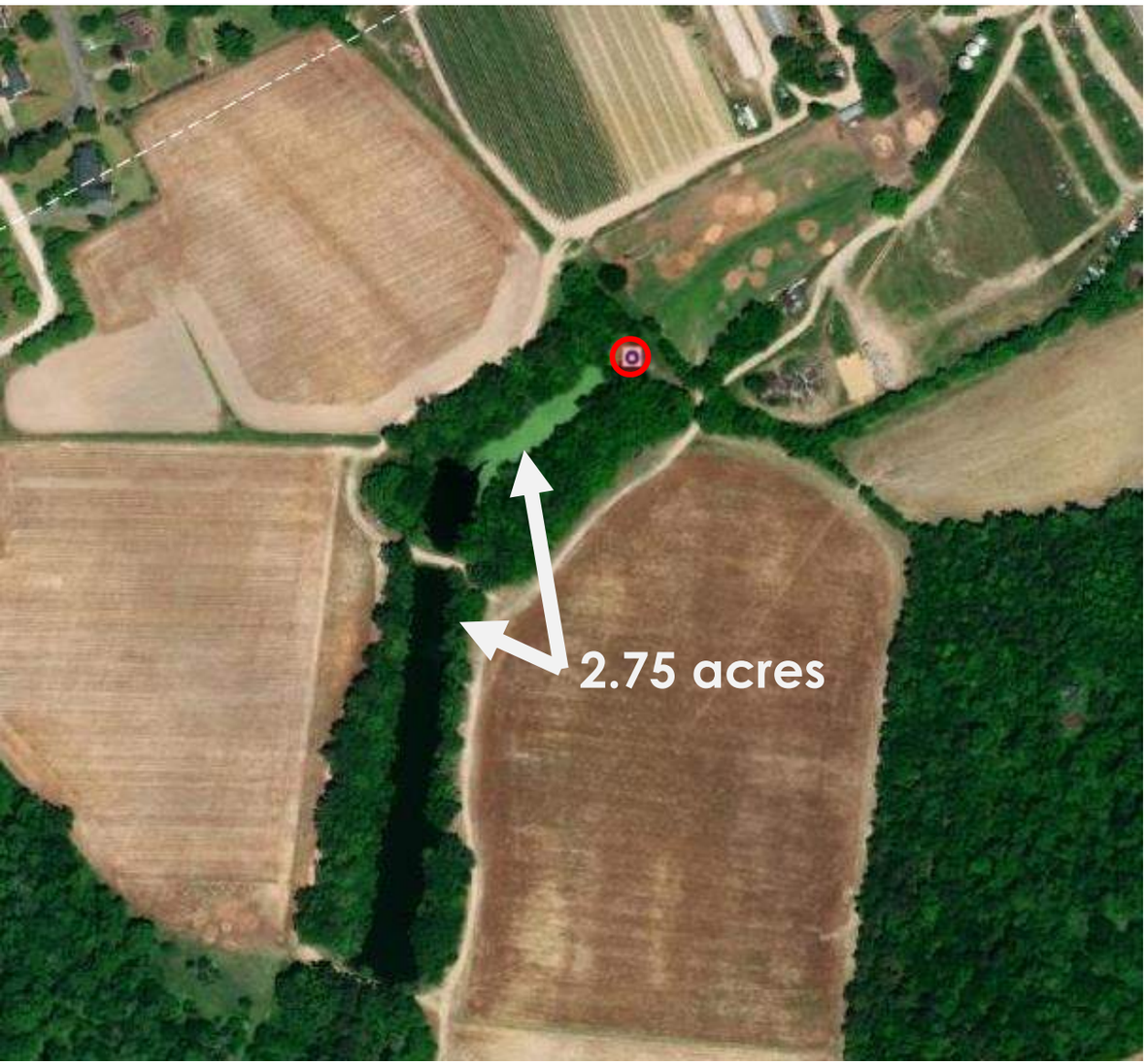
Surface Water Shortage Table

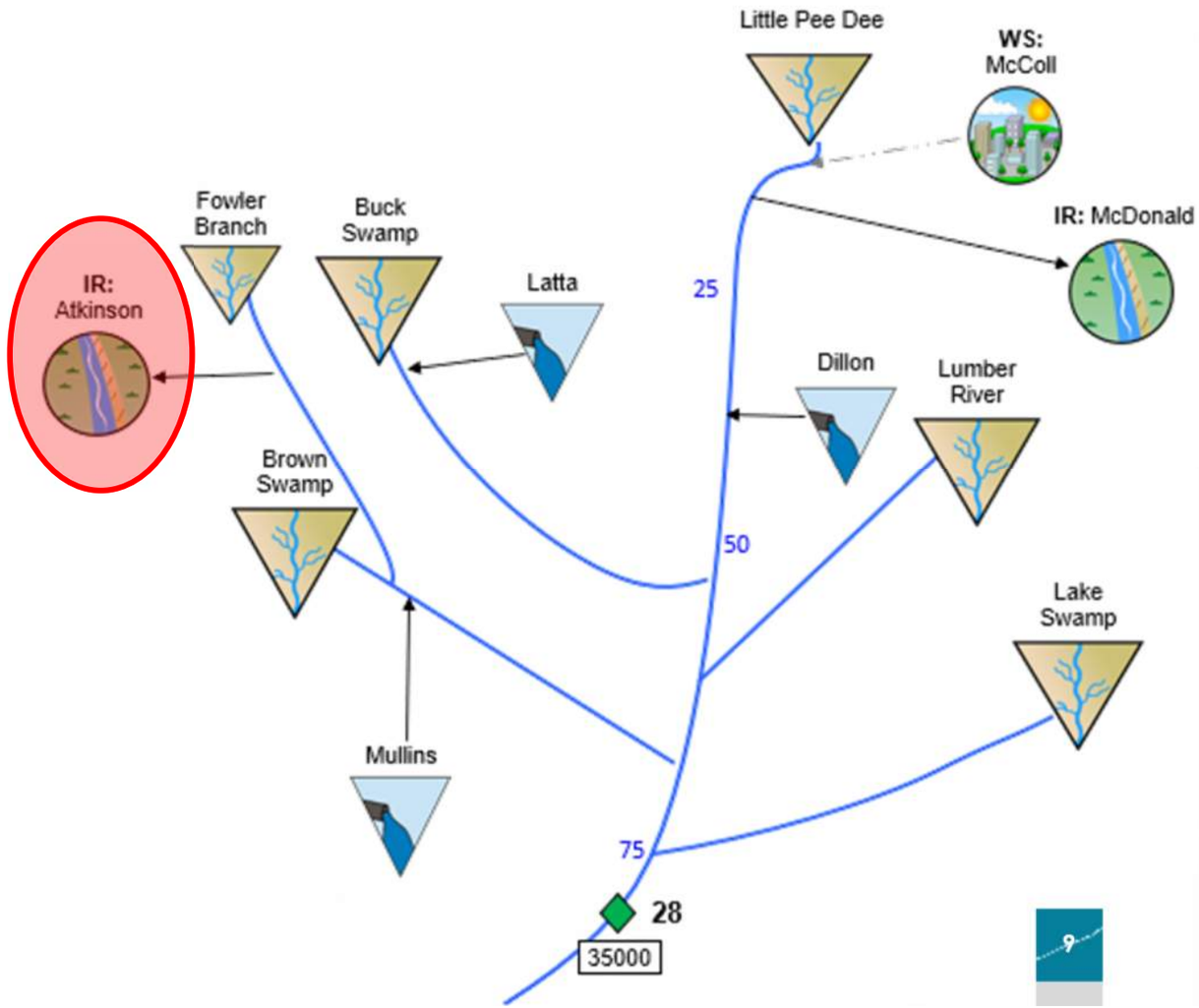
Map ID	Water User	Max Shortage (MGD)	Frequency of Shortage
Regulatory Shortage			
1	IR: Turf Connections	0.1	33.3%
Physical Shortages			
2	IR: O'Tuel	0.3	0.4%
3	GC: Florence	0.1	0.3%
4	GC: White Plains	0.1	7.0%
5	MI: Hanson (Jefferson)	0.05	6.1%
6	IR: Atkinson	0.05	1.2%



IR: Atkinson
2.75-acre impoundment

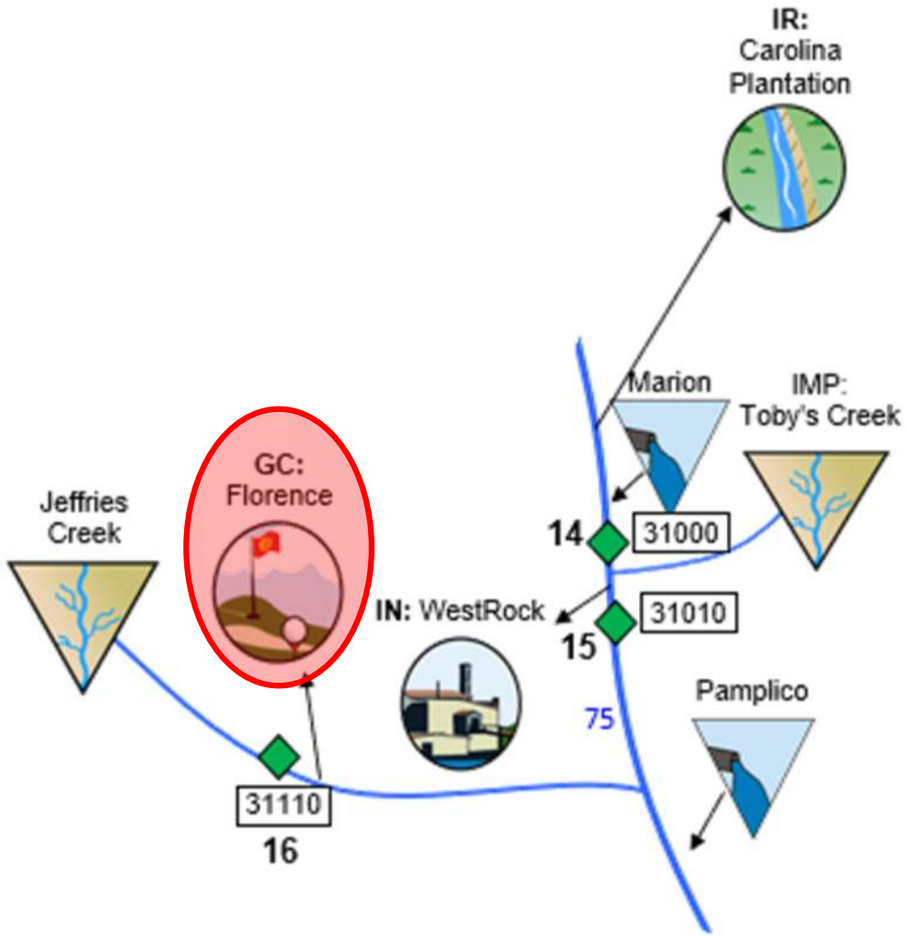
Surface water user with storage not included in the model





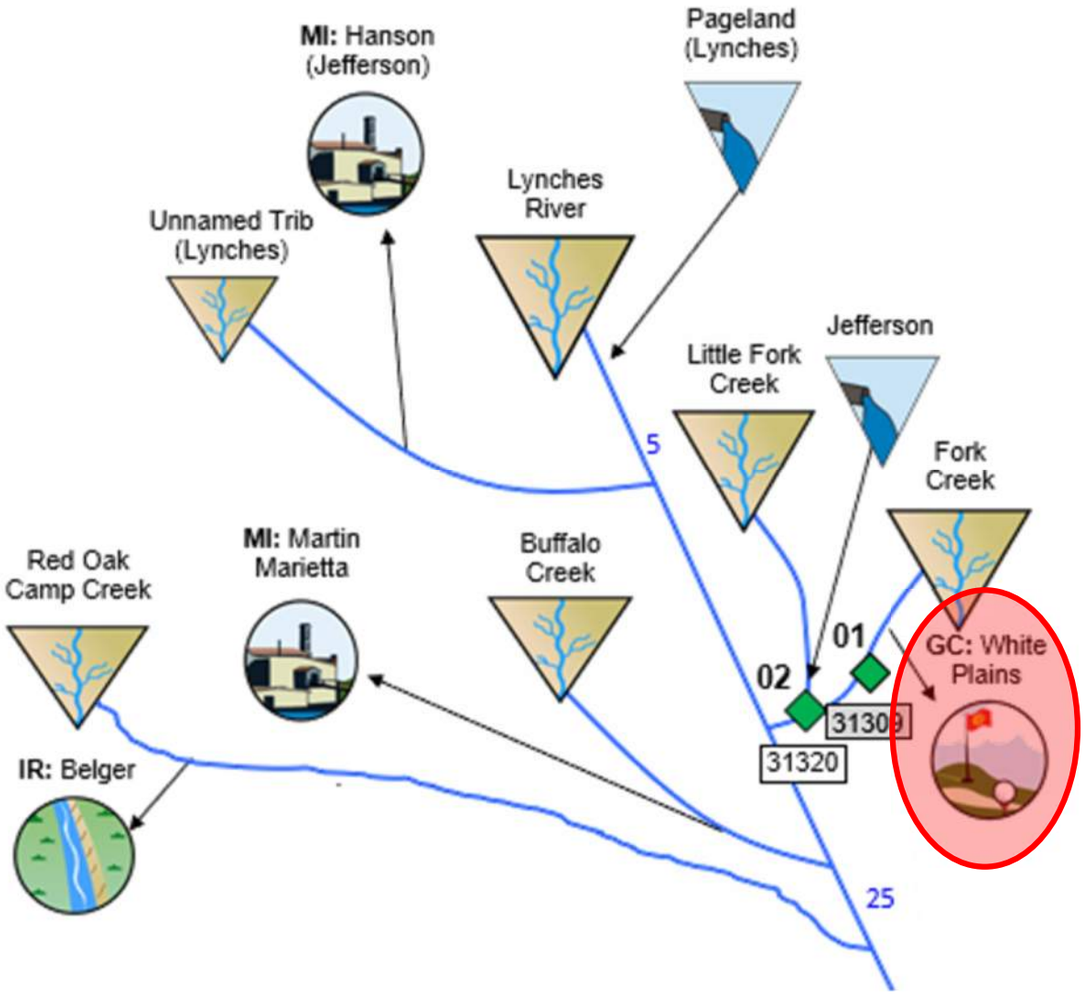
GC: Florence
5-acre impoundment

Surface water user with storage not included in the model



GC: White Plains
2-acre impoundment

Surface water user with storage not included in the model

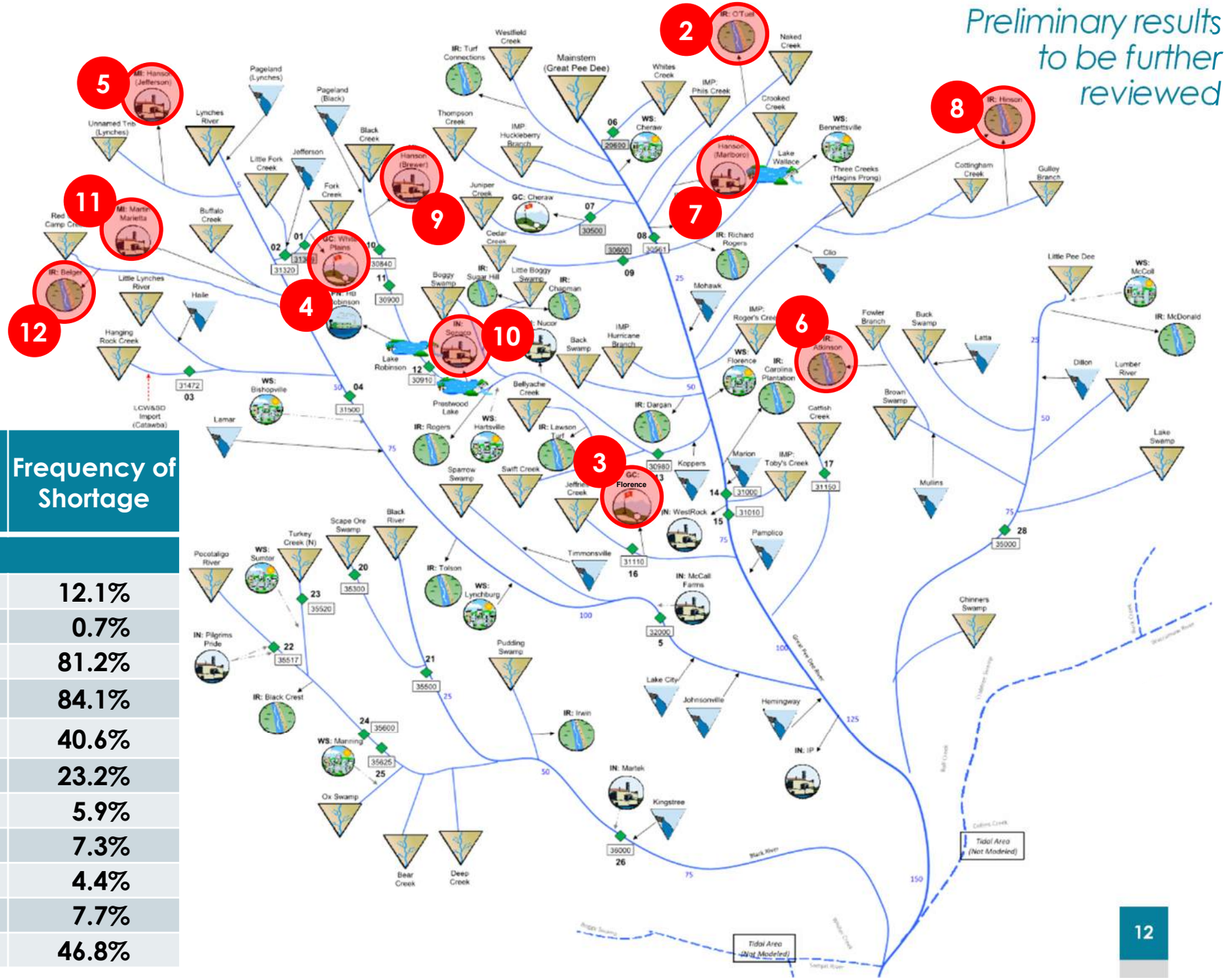


Permitted and Registered (P&R) Scenario

1 Physical Shortage

Surface Water Shortage Table

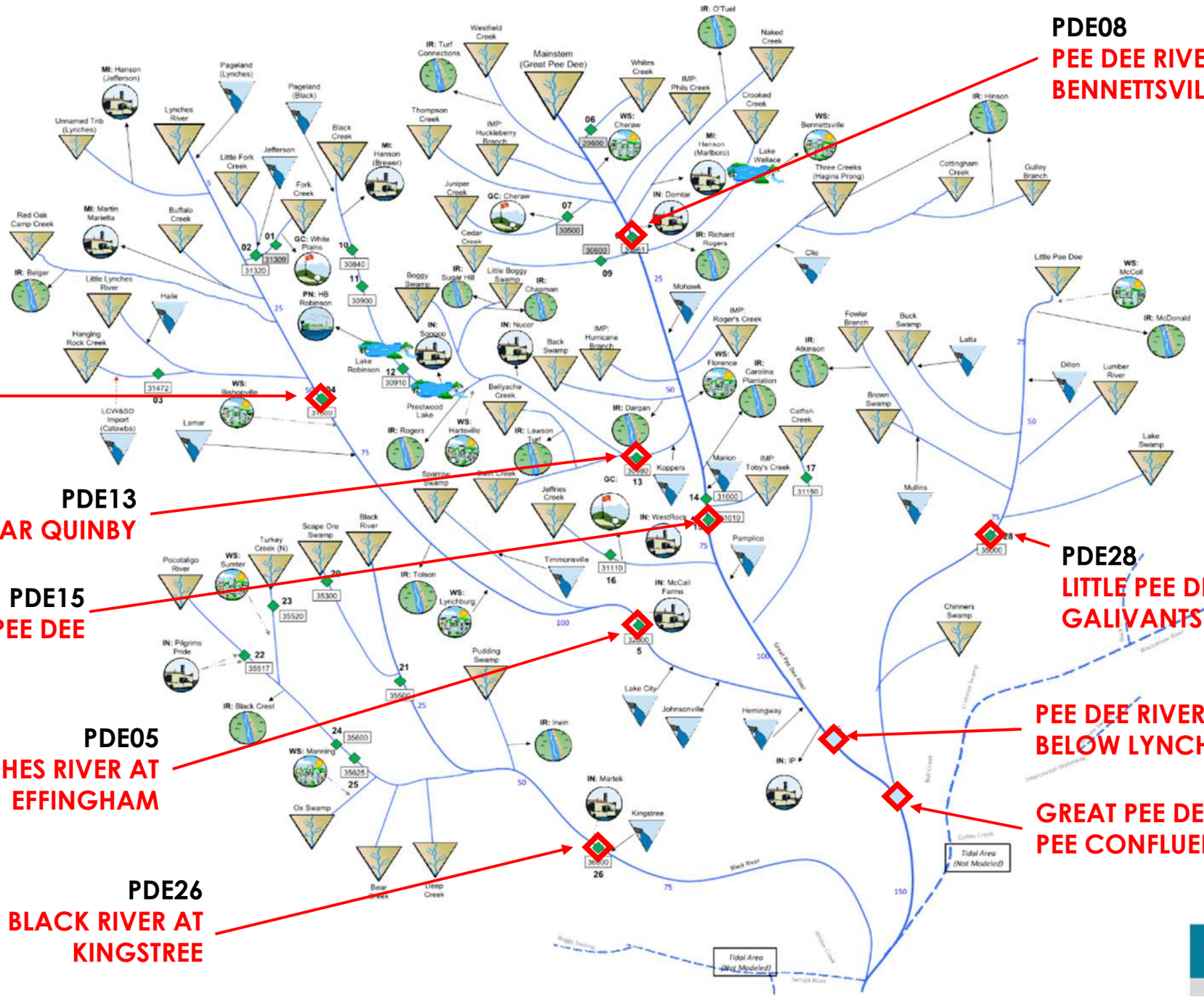
Map ID	Water User	Max Shortage (MGD)	Frequency of Shortage
Physical Shortages			
2	IR: O'Tuel	1.8	12.1%
3	GC: Florence	1.6	0.7%
4	GC: White Plains	1.6	81.2%
5	MI: Hanson (Jefferson)	0.9	84.1%
6	IR: Atkinson	0.3	40.6%
7	MI: Hanson (Marlboro)	3.9	23.2%
8	IR: Hinson	0.3	5.9%
9	MI: Hanson (Brewer)	4.5	7.3%
10	IN: Sonoco	35.5	4.4%
11	MI: Martin Marietta	2.8	7.7%
12	IR: Belger	2.9	46.8%



Summary of Surface Water Supply Shortages

Supply Shortage Metric	Current Use	Permitted & Registered
Total basin annual mean shortage (MGD)	0.03	3.4
Maximum water user shortage (MGD)	0.3	35.5
Total basin annual mean shortage as a percentage of total water demand	0.03%	1.2%
Percentage of water users experiencing a shortage	18.8%	34.4%
Average frequency of shortage (%)	1.5%	9.8%

Strategic Nodes



Strategic nodes are located on all major streams and rivers, downstream of most withdrawals and discharges. For wadable streams, they also they represent potential locations to evaluate flow-ecology relationships.

Simulated Flows (Performance Measures) at Strategic Nodes

Performance Measure	PDE08 Pee Dee River near Bennettsville	PDE15 Pee Dee River below Pee Dee	Pee Dee River Below Lynches River Confluence	Great Pee Dee River below Little Pee Dee Confluence	PDE13 Black Creek near Quinby	PDE04 Lynches River near Bishopville	PDE05 Lynches River at Effingham	PDE28 Little Pee River at Galivants Ferry	PDE26 Black River at Kingstree
	All values in CFS								
UIF Scenario									
mean flow	8,046	9,673	11,732	14,892	540	751	1,001	2,883	984
median flow	6,129	7,457	9,070	11,561	463	524	712	2,162	647
25th percentile flow	3,703	4,638	5,641	7,065	294	279	384	1,197	299
10th percentile flow	2,699	3,263	3,836	4,787	207	177	247	721	166
5th percentile flow	2,229	2,796	3,277	4,051	165	138	193	577	115
minimum flow	689	939	1,126	1,359	70	45	67	202	26
Current Use Scenario									
mean flow	7,935	9,463	11,568	14,795	527	752	1,006	2,917	999
median flow	6,154	7,384	8,913	11,521	452	525	716	2,190	662
25th percentile flow	3,707	4,510	5,500	7,093	279	280	388	1,223	314
10th percentile flow	2,548	3,058	3,632	4,637	191	177	251	745	180
5th percentile flow	2,020	2,437	2,968	3,778	151	139	197	599	129
minimum flow	991	1,105	1,362	1,670	56	46	71	190	38
P&R Scenario									
mean flow	7,921	9,276	11,429	14,693	496	743	996	2,917	994
median flow	6,141	7,204	8,774	11,427	416	514	708	2,189	657
25th percentile flow	3,692	4,317	5,365	6,988	247	272	381	1,222	309
10th percentile flow	2,533	2,884	3,505	4,527	162	172	245	744	177
5th percentile flow	2,009	2,257	2,868	3,686	138	135	192	598	125
minimum flow	984	965	1,274	1,614	46	46	70	190	36

This is Table 4 of the memo

Difference in Simulated Flows for Current Use and UIF Scenarios at Strategic Nodes

Performance Measure	PDE08 Pee Dee River near Bennettsville	PDE15 Pee Dee River below Pee Dee	Pee Dee River Below Lynches River Confluence	Great Pee Dee River below Little Pee Dee Confluence	PDE13 Black Creek near Quinby	PDE04 Lynches River near Bishopville	PDE05 Lynches River at Effingham	PDE28 Little Pee River at Galivants Ferry	PDE26 Black River at Kingstree
UIF Scenario (cfs)									
mean flow	8,046	9,673	11,732	14,892	540	751	1,001	2,883	984
median flow	6,129	7,457	9,070	11,561	463	524	712	2,162	647
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10th percentile flow	2,699	3,263	3,836	4,787	207	177	247	721	166
5th percentile flow	2,229	2,796	3,277	4,051	165	138	193	577	115
minimum flow	689	939	1,126	1,359	70	45	67	202	26
Current Use Scenario flow minus UIF Scenario flow (cfs)									
mean flow	-111	-210	-164	-97	-13	1	5	34	15
median flow	25	-73	-157	-41	-11	1	4	28	15
25th percentile flow	4	-128	-142	27	-14	1	4	26	15
10th percentile flow	-152	-205	-204	-150	-16	1	4	24	14
5th percentile flow	-209	-359	-310	-273	-14	1	4	22	15
minimum flow	302	166	236	311	-14	1	4	-12	12
Percent Difference between Current Use Scenario flow and UIF Scenario flow									
mean flow	-1.4%	-2.2%	-1.4%	-0.7%	-2.4%	0.1%	0.5%	1.2%	1.5%
median flow	0.4%	-1.0%	-1.8%	-0.4%	-2.5%	0.2%	0.6%	1.3%	2.3%
25th percentile flow	0.1%	-2.8%	-2.6%	0.4%	-5.1%	0.3%	1.1%	2.1%	4.7%
10th percentile flow	-6.0%	-6.7%	-5.6%	-3.2%	-8.5%	0.4%	1.7%	3.2%	7.8%
5th percentile flow	-10.4%	-14.7%	-10.4%	-7.2%	-9.2%	0.6%	2.2%	3.7%	11.3%
minimum flow	30.5%	15.0%	17.3%	18.6%	-25.0%	2.2%	5.6%	-6.3%	31.6%

This is a portion of Table 5 of the memo

Difference in Simulated Flows for Current Use and P&R Scenarios at Strategic Nodes

Performance Measure	PDE08 Pee Dee River near Bennettsville	PDE15 Pee Dee River below Pee Dee	Pee Dee River Below Lynches River Confluence	Great Pee Dee River below Little Pee Dee Confluence	PDE13 Black Creek near Quinby	PDE04 Lynches River near Bishopville	PDE05 Lynches River at Effingham	PDE28 Little Pee River at Galivants Ferry	PDE26 Black River at Kingstree
Current Use Scenario (cfs)									
mean flow	7,935	9,463	11,568	14,795	527	752	1,006	2,917	999
median flow	6,154	7,384	8,913	11,521	452	525	716	2,190	662
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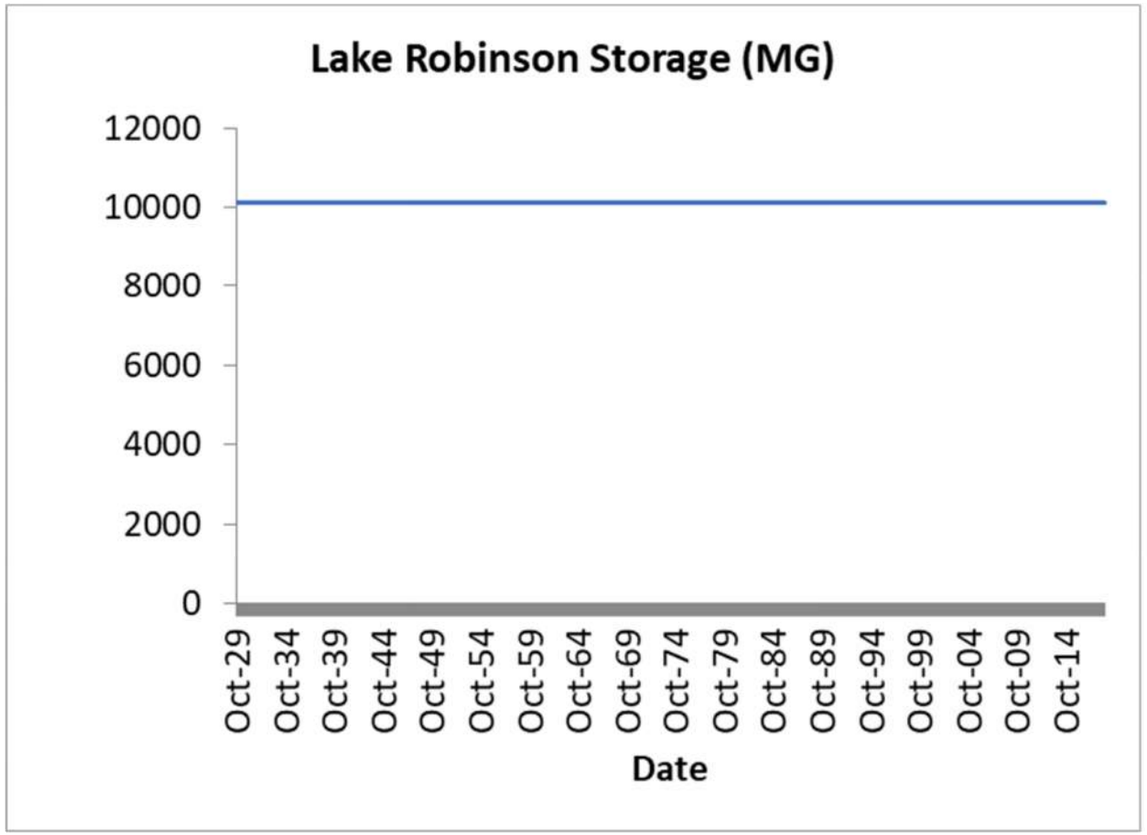
10th percentile flow	2,548	3,058	3,632	4,637	191	177	251	745	180
5th percentile flow	2,020	2,437	2,968	3,778	151	139	197	599	129
minimum flow	991	1,105	1,362	1,670	56	46	71	190	38
P&R Scenario flow minus Current Use Scenario flow (cfs)									
mean flow	-14	-187	-139	-102	-31	-9	-10	-1	-5
median flow	-14	-179	-139	-94	-35	-11	-8	-1	-5
25th percentile flow	-15	-192	-134	-105	-33	-7	-8	-1	-4
10th percentile flow	-15	-174	-127	-110	-29	-6	-6	-1	-3
5th percentile flow	-11	-180	-100	-92	-14	-4	-6	-1	-4
minimum flow	-7	-140	-88	-56	-10	0	-1	0	-2
Percent Difference between Current Use Scenario flow and P&R Scenario flow									
mean flow	-0.2%	-2.0%	-1.2%	-0.7%	-6.2%	-1.2%	-1.0%	0.0%	-0.5%
median flow	-0.2%	-2.5%	-1.6%	-0.8%	-8.5%	-2.1%	-1.1%	0.0%	-0.8%
25th percentile flow	-0.4%	-4.5%	-2.5%	-1.5%	-13.3%	-2.7%	-2.0%	-0.1%	-1.4%
10th percentile flow	-0.6%	-6.0%	-3.6%	-2.4%	-17.8%	-3.3%	-2.3%	-0.1%	-1.6%
5th percentile flow	-0.6%	-8.0%	-3.5%	-2.5%	-10.1%	-2.9%	-2.9%	-0.1%	-3.4%
minimum flow	-0.7%	-14.5%	-6.9%	-3.5%	-21.7%	0.0%	-1.4%	0.0%	-5.6%

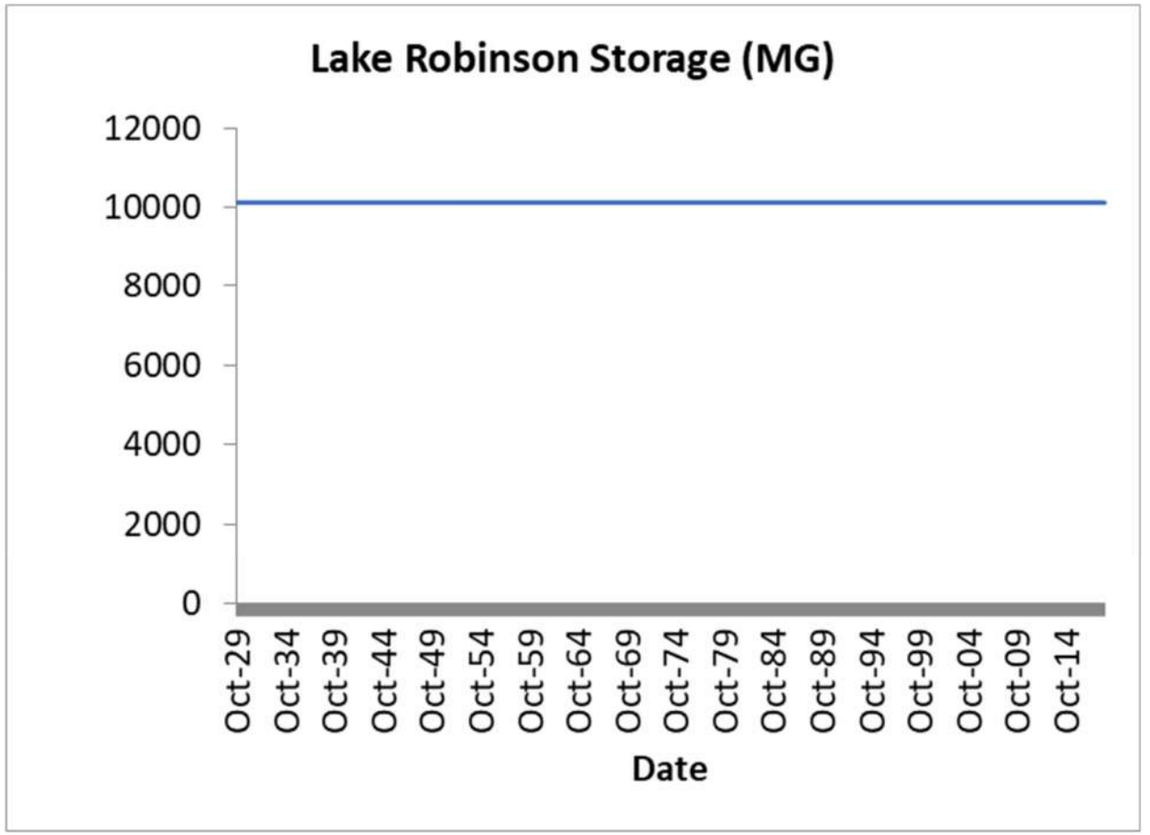
This is Table 6 of the memo

Reservoir Storage – Lake Robinson

Current Use Scenario
(2.0 MGD Consumptive Demand for PN: HB Robinson)

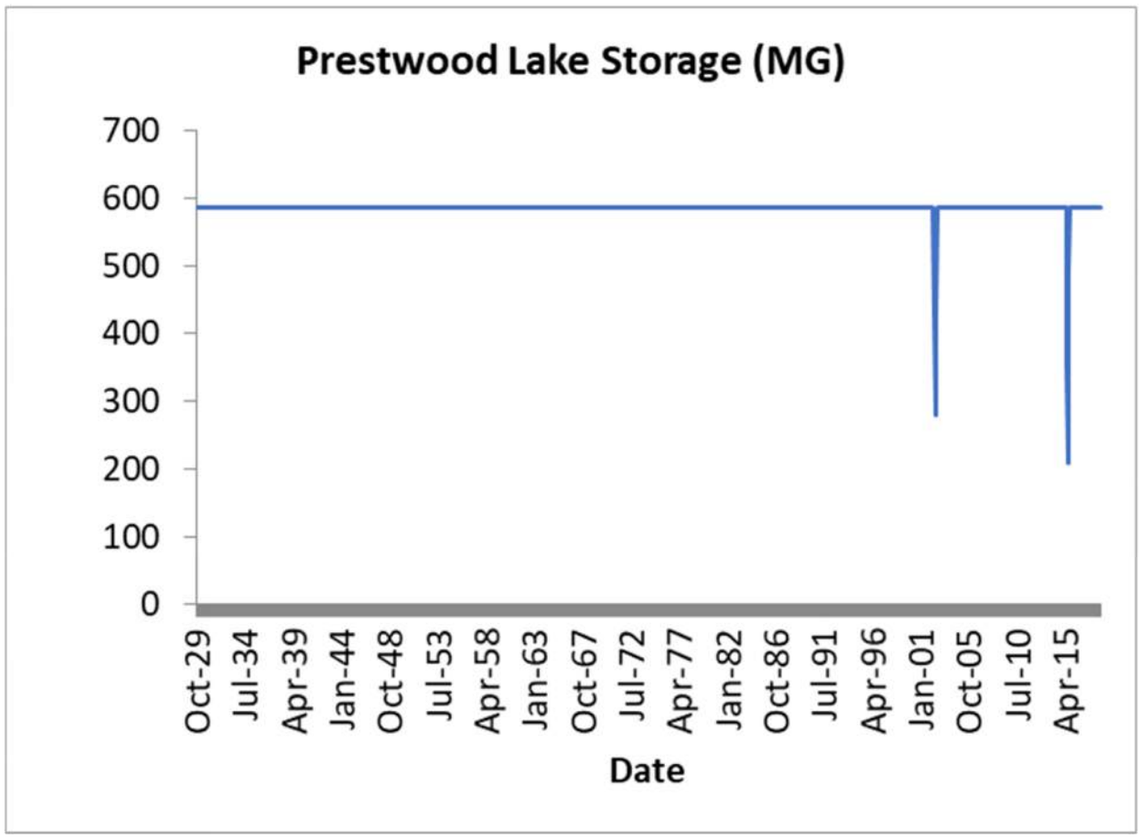


P&R Scenario
(2.4 MGD Consumptive Demand for PN: HB Robinson)

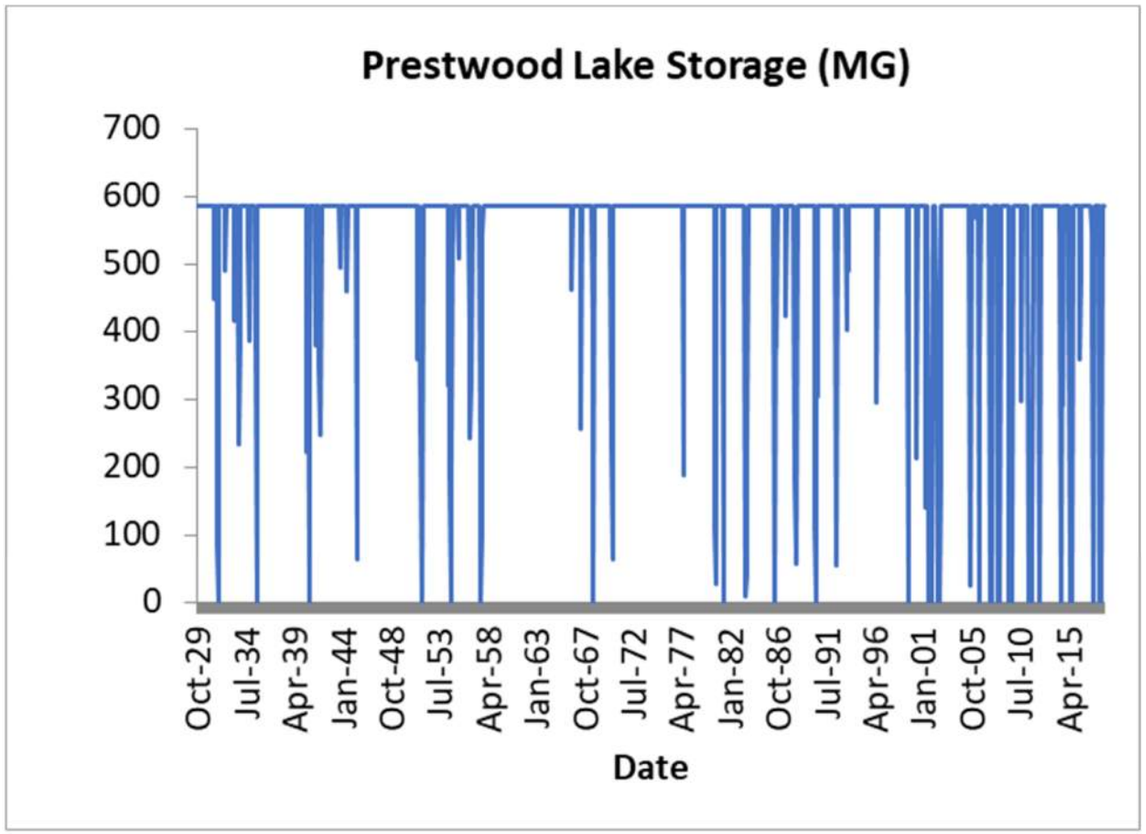


Reservoir Storage – Prestwood Lake

Current Use Scenario
(12.6 MGD Demand for IN: Sonoco)

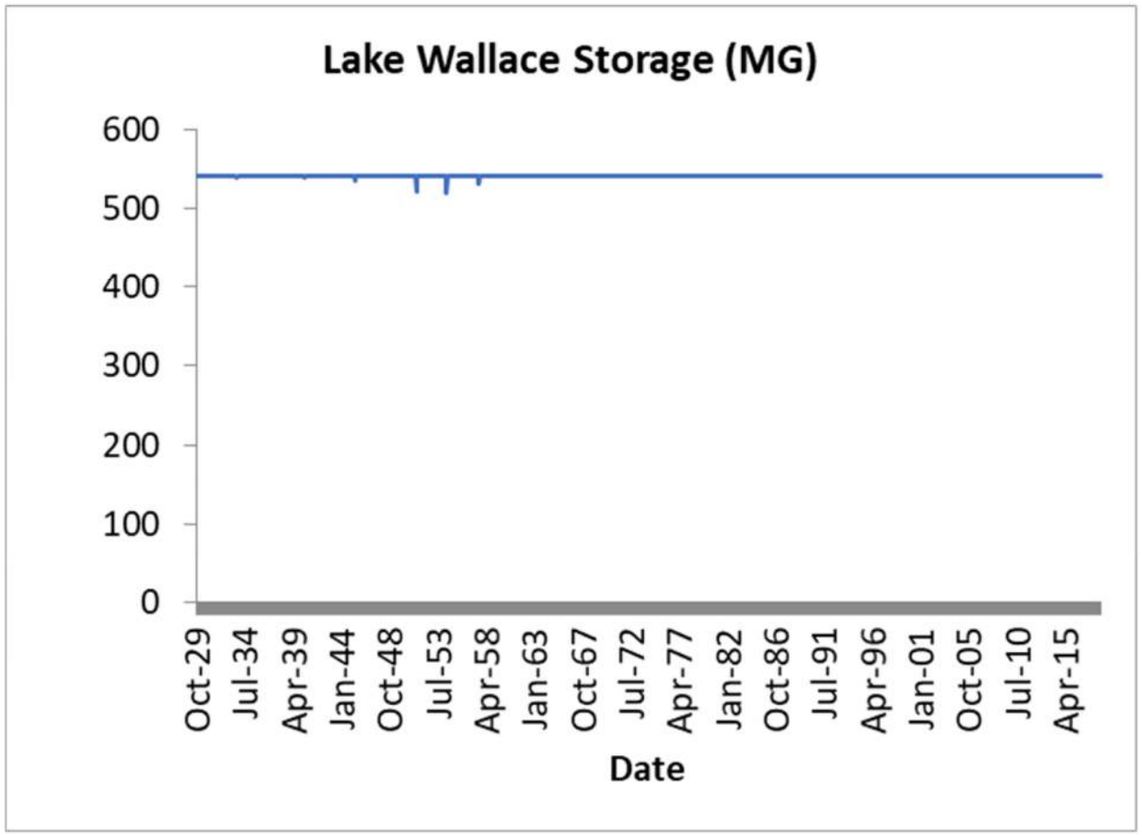


P&R Scenario
(42.6 MGD Demand for IN: Sonoco)

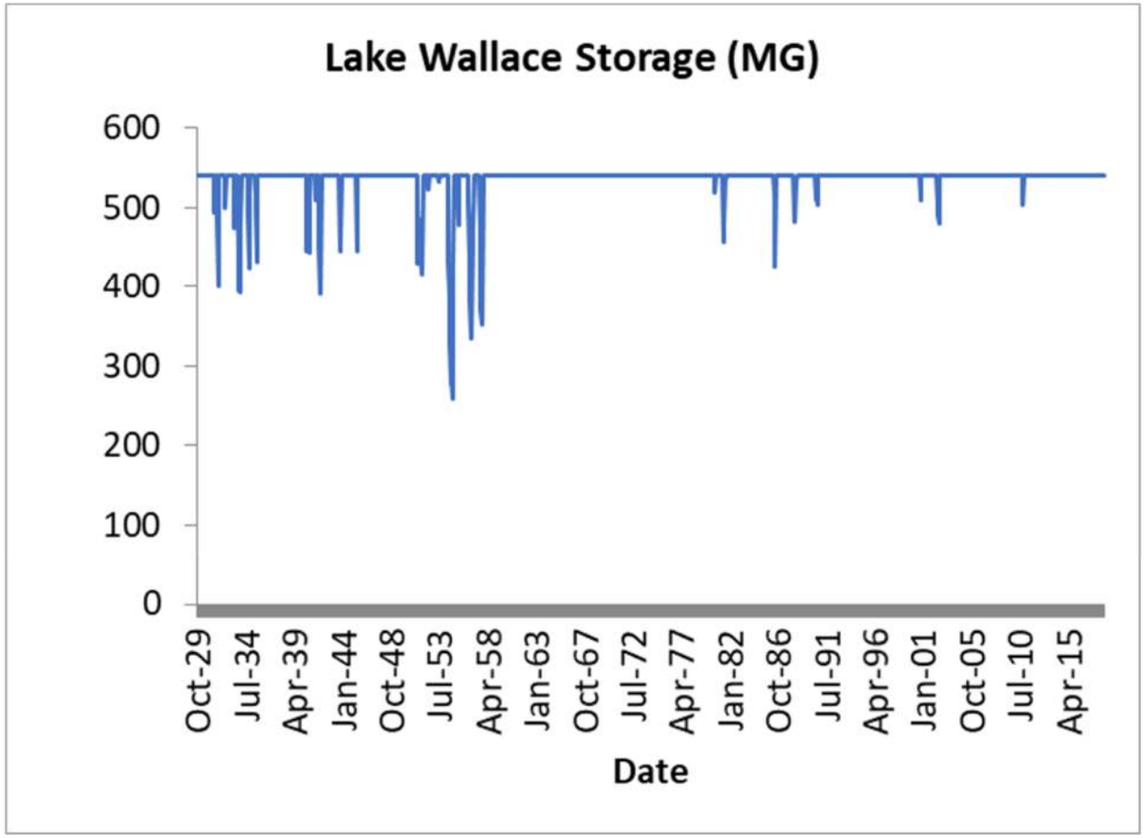


Reservoir Storage – Lake Wallace

Current Use Scenario
(2.2 MGD Demand for WS: Bennettsville)



P&R Scenario
(5.3 MGD Demand for WS: Bennettsville)



Considerations and Next Steps

RBC Considerations Moving Forward

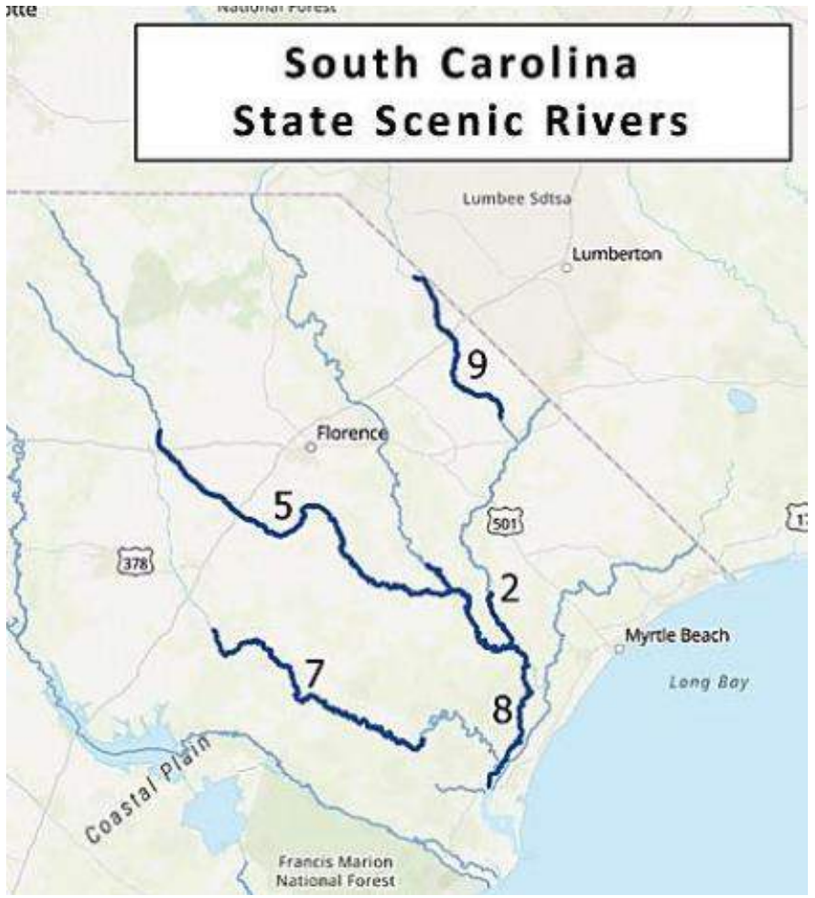
- Would the RBC like to revise or add to the list of **Strategic Nodes**… i.e. evaluate flows at different points in the basin?
- Would the RBC like to see how often simulated flows under each scenario drop below the **Minimum Recommended Instream Flows** (**MIFs**) (even though most water users in the basin are not subject to them).
- Are there additional scenarios the RBC would like to see modeled?
- As additional information is presented, the RBC should continue to consider if there is reason to establish a **Surface Water Condition** at any location.
- As additional information is presented, the RBC should continue to consider if there is reason to establish one or more **Reaches of Interest**.

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



Next Steps

- Continue to review the preliminary modeling scenario results (CDM Smith, RBC, and SCDNR)
- Incorporate **Moderate** and **High Demand Projections** and present these Scenario Results at the March RBC Meeting.
- Select locations to apply **flow-ecology metrics** then evaluate them using SWAM model daily timestep results for each planning scenario (RBC, CDM Smith, TNC, Clemson)
- Other actions, as identified by RBC