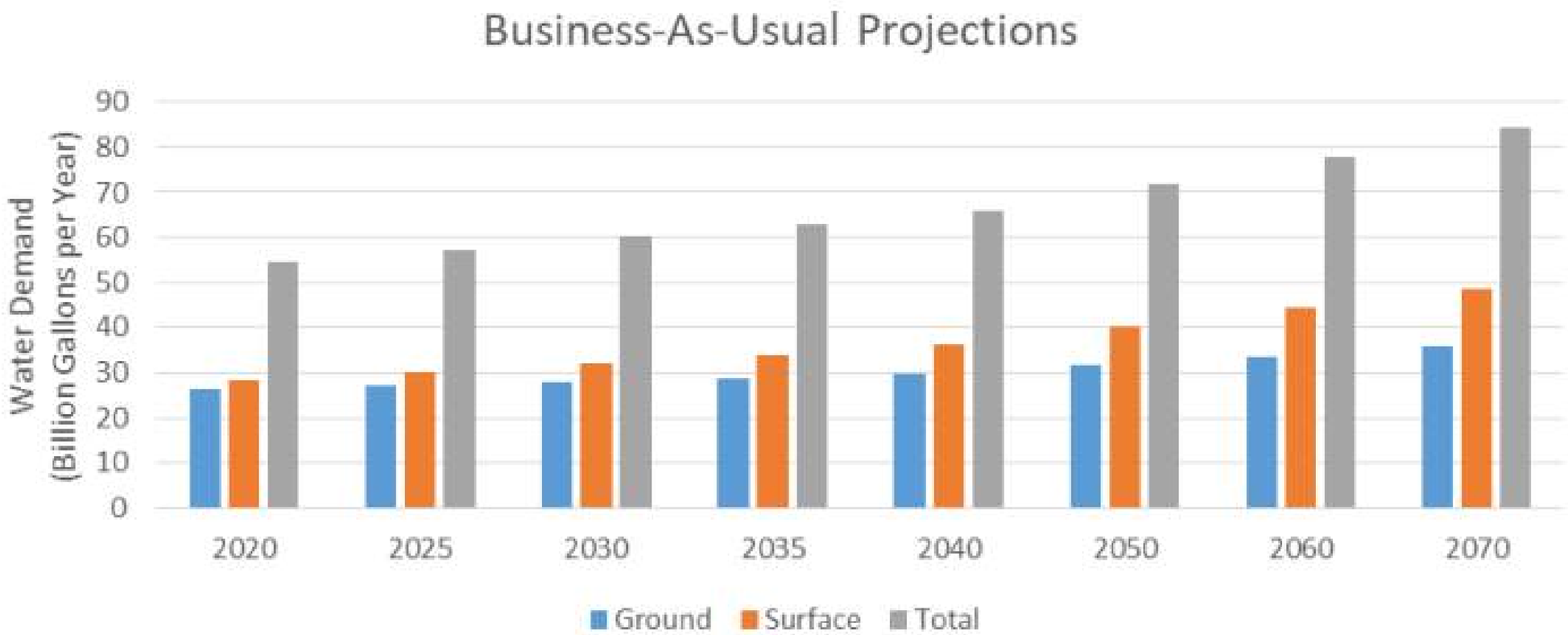
Supply Side Strategy Effectiveness
Conjunctive Use

Conjunctive Use

- **Conjunctive water use** is the combined use of **surface** and **groundwater sources** to optimize water availability, increase the reliability of the water supply, or to offset the negative impacts of using a single source.
- RBCs may consider the implementation of **conjunctive strategies** for the following conditions:
  - If withdrawals from a single source are limited or are unreliable
  - If large withdrawals from aquifers are substantially altering flow patterns or are causing land subsidence or irreversible damage to the aquifers
  - If withdrawals from aquifers are negatively impacting domestic groundwater users
  - If withdrawals from streams are destructive to aquatic ecosystems
  - If water quality from a single source is inconsistent or undesirable

Conjunctive Use

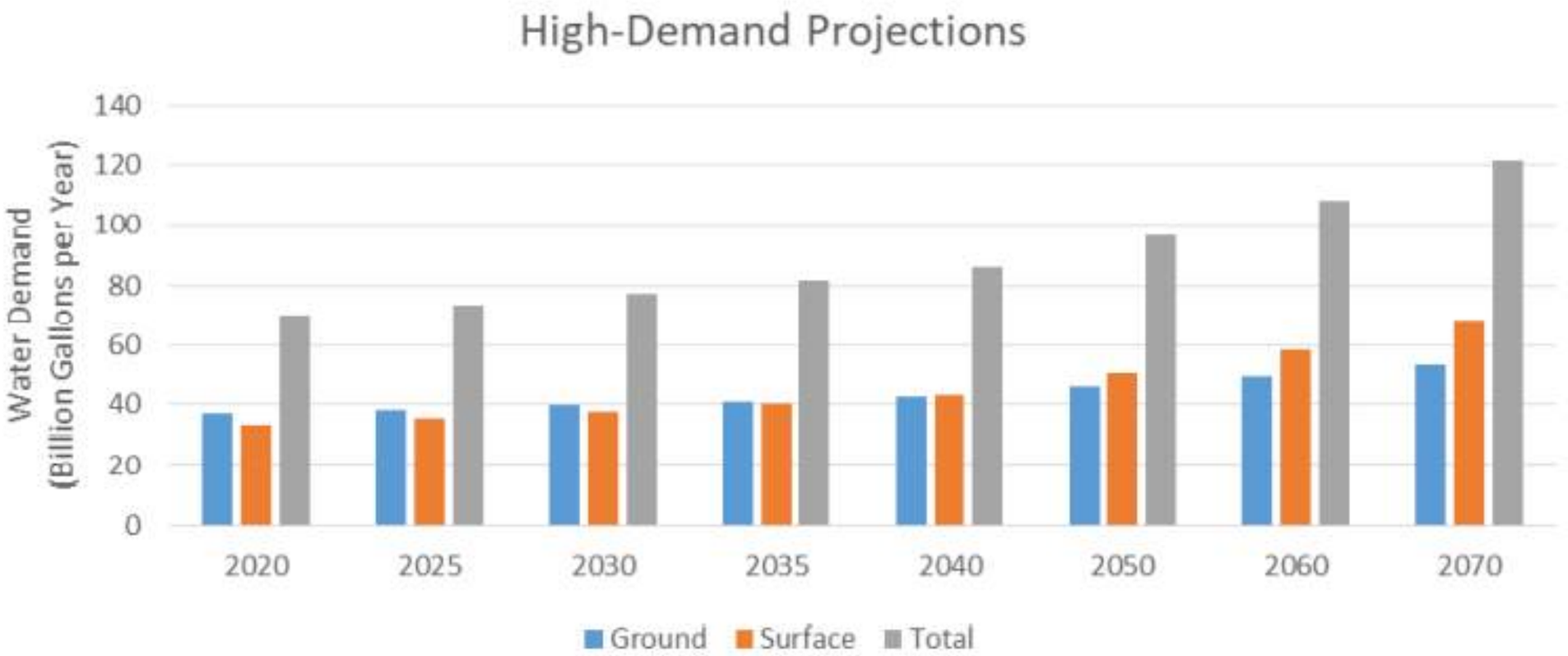
- Groundwater and surface water are currently used in almost equal amounts in the Edisto basin; however, demand projections suggest that surface water use will increase more than groundwater use.



Source: Water-Demand Projections for the Edisto River Basin, 2020–2070, C. Alex Pellett, SCDNR, 2021.

Conjunctive Use

- Groundwater and surface water are currently used in almost equal amounts in the Edisto basin; however, demand projections suggest that surface water use will increase more than groundwater use.



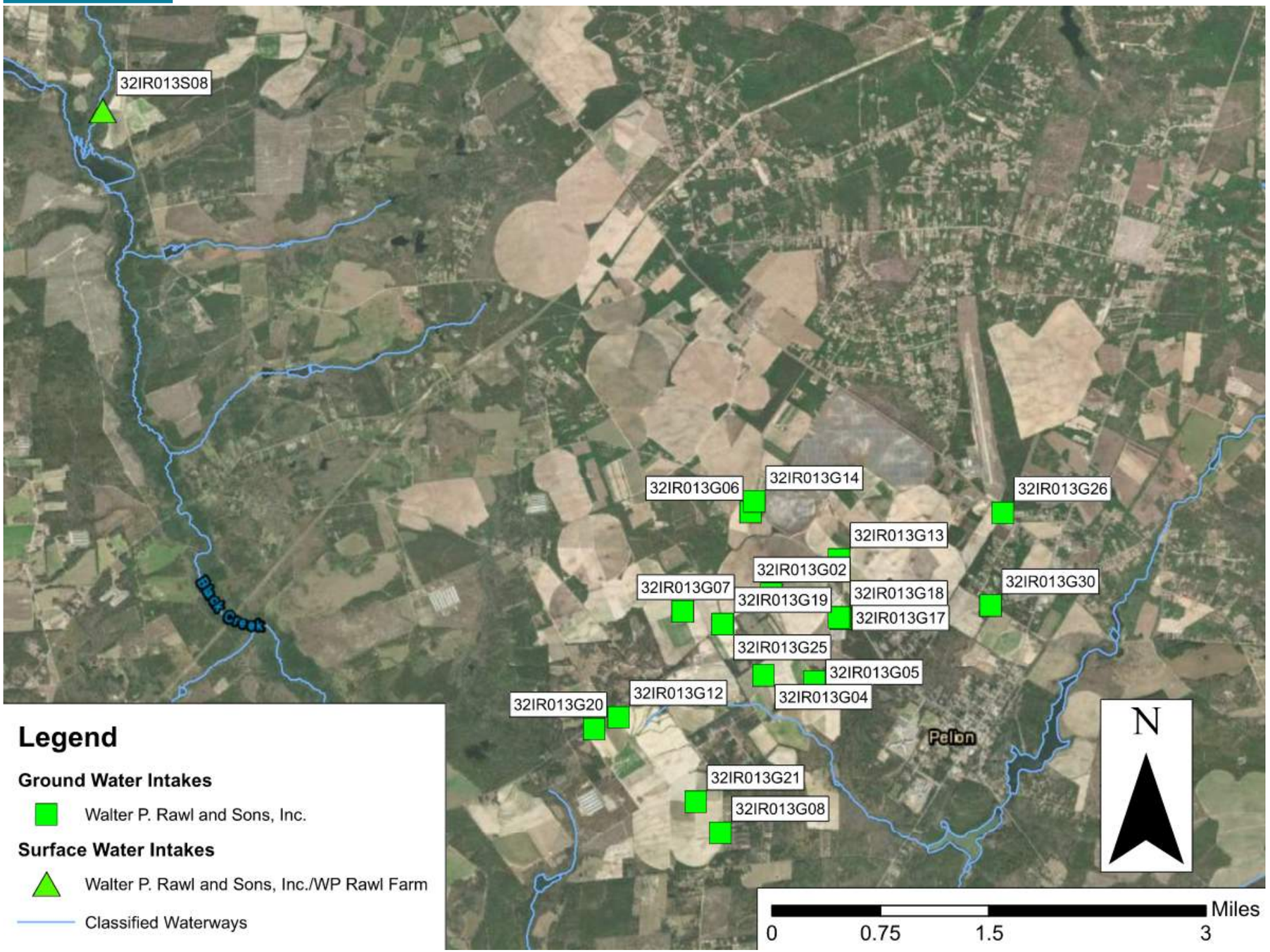
Source: Water-Demand Projections for the Edisto River Basin, 2020–2070, C. Alex Pellett, SCDNR, 2021.

Conjunctive Use

Differentiating Conjunctive at the basin scale vs. at a local scale

- Conjunctive use at the **basin scale** already occurs in the Edisto
- Examples of **local scale** conjunctive use in the Edisto Basin:

1. **Full Conjunctive Use:** The ability of a water user to meet 100 percent of water demands from either groundwater or surface water
    - ***Example:*** **Dominion Energy Cope Station**
2. **Partial Conjunctive Use:** The ability of a water user to meet a portion of demands from either groundwater or surface water
    - ***Example:*** **Walther Farms**
3. **Non-centralized Conjunctive Use:** Using both surface and groundwater but no ability to replace one with the other due to separate systems of delivery.
    - ***Example:*** **Walter P. Rawl & Sons**



Walter P. Rawl & Sons

1 Surface water intake
(4% of total water use)

17 Groundwater wells
(96% of total water use)

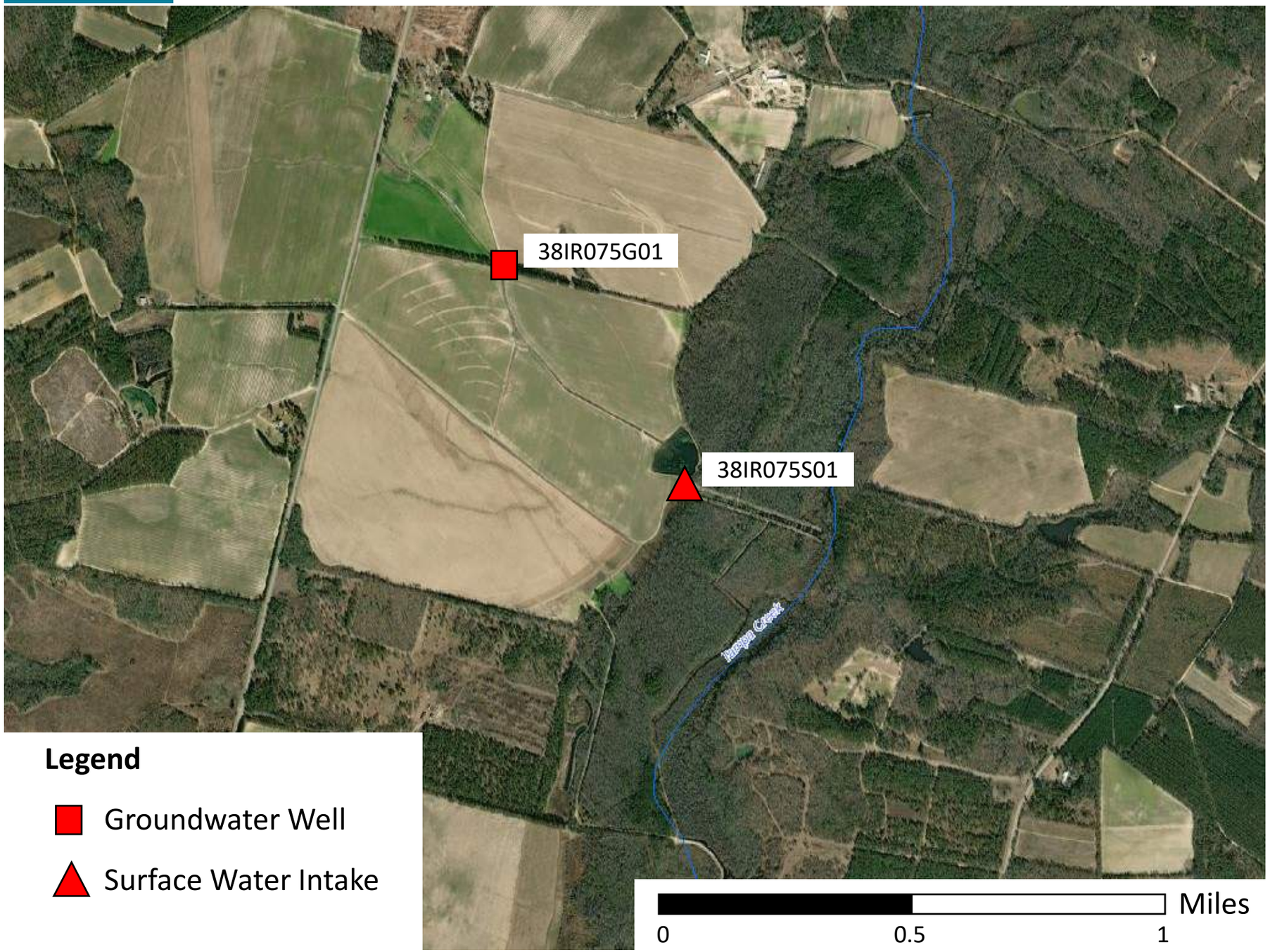
Non-centralized
No ability to use sources interchangeably

Agricultural Water User	No. of Surface Water Intakes	No. of Groundwater Wells
Walthers Farms	1	1
Pebble Creek Enterprises	1	1
Phil Sandifer & Sons Farms	2	2
Double B Farms	1	7
Rob Bates Farms	1	3
Gregg B Bates Farms	2	1
Cotton Lane Farms	3	1
Haigler Farms Partnership	4	25
Titan Peach Farms	16	1
1 **Walter P. Rawl and Sons**	**1**	**17**
T&R Farms	1	1
Millwood Farm	3	3
Springfield Grain Co Brown Kirby & Sons	1	2
Shady Grove Plantation & Nursery	1	14
Gray Farm	1	1
Willshire Farms	2	6
Norway Farm	1	1
2 **Tampa Creek Farms**	**1**	**1**
Turf Connections - Springfield	1	1

Edisto Basin Agricultural Water Users with both Surface Water and Groundwater Sources

19 of 50 **agricultural surface water users** also have one or more **groundwater sources**

Red = These **Ag Water Users** had a modeled surface water shortage in all planning scenarios



Tampa Creek Farms

1 Surface water intake
(7% of total water use)

1 Groundwater well
(93% of total water use)

Centralized
Can use sources interchangeably, but limitations exist

Diesel pump limits surface water use

Quality (hardness) of groundwater makes it not as favorable as surface water

Modeling Approach

- **Purpose:** Evaluate the effectiveness of switching from surface water to groundwater when river flows are low (i.e., partial conjunctive use)
- **For All Scenarios:** When flow drops below 312 cfs at Givhans Ferry, **Ag Water Users** and **Orangeburg** switch to meeting a portion of surface water demand from groundwater
  - **Scenario A** – Switch to meet 20% of surface water demand from groundwater
  - **Scenario B** – Switch to meet 50% of surface water demand from groundwater
  - **Scenario C** – All previously evaluated demand side strategies plus switch to meet 20% of surface water demand from groundwater.
  - **Scenario D** – All previously evaluated demand side strategies plus switch to meet 50% of surface water demand from groundwater.
- **Dominion's Cope Station** will switch to 100% groundwater when flow drops below 192 cfs
- **Aiken** already uses more groundwater (86%) than surface water (14%) on average

Modeling Approach

Review of Demand (and Some Supply) Side Strategies that were evaluated last month:

- **Scenario 1 evaluated Drought Management Plan** actions of CWS, Orangeburg, Aiken, and Batesburg-Leesville. *Some of their actions are considered supply side strategies.*
- **Scenario 2 added Agriculture Water Efficiency Strategies**
  - Assumed that 70% of existing and future irrigators achieve **15% reduction in projected demand** via water audits followed by nozzle retrofits and/or other measures, such as deployment of smart irrigation technologies, use of cover crops, and crop selection.
  - Includes Scenario 1 strategies
- **Scenario 3 added Municipal Water Efficiency Strategies**
  - Assumed that municipal water users achieve a **15% reduction in projected demand** by implementing a portfolio of water conservation and water efficiency/loss strategies.
  - Includes Scenarios 1 and 2 strategies

Results for Business as Usual 2070 Scenarios Comparison to Minimum Instream Flows (MIFs)

Percentage of Months below 20/30/40 threshold (Mean)

Strategic Node	Scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Outlet of Shaw Creek	**UIF Scenario**						**2**						
	Business as Usual (2070)				**1**	**2**	**7**	**1**	**1**				
	BAU 2070 Scenario A				1	2	7	1	1				
	BAU 2070 Scenario B				1	2	7	1	1				
	BAU 2070 Scenario C				1	1	5		1				
	BAU 2070 Scenario D				1	1	5		1				
EDO3	**UIF Scenario**						**2**						
	Business as Usual (2070)						**5**		**1**				
	BAU 2070 Scenario A						3		1				
	BAU 2070 Scenario B						3		1				
	BAU 2070 Scenario C						3		1				
	BAU 2070 Scenario D						3		1				
EDO13	**UIF Scenario**	**5**	**2**		**3**	**9**	**13**	**6**	**5**	**2**	**3**	**2**	**2**
	Business as Usual (2070)	**6**	**2**	**1**	**7**	**22**	**29**	**21**	**20**	**19**	**11**	**3**	**5**
	BAU 2070 Scenario A	6	2	1	7	22	29	21	20	19	11	3	5
	BAU 2070 Scenario B	6	2	1	7	22	29	21	20	19	11	3	5
	BAU 2070 Scenario C	6	2	1	7	21	25	18	18	18	9	3	5
	BAU 2070 Scenario D	6	2	1	7	21	25	18	18	18	9	3	5
EDO11	**UIF Scenario**						**2**						
	Business as Usual (2070)						**5**						
	BAU 2070 Scenario A						5						
	BAU 2070 Scenario B						5						
	BAU 2070 Scenario C						5						
	BAU 2070 Scenario D						3						

Only the strategic nodes where the percentage of months for the scenarios changed by 2% or more compared to the base Business as Usual 2070 scenario are listed. The Unimpaired Flow (UIF) scenario is also shown for comparison.

Blank cells represent zero months below 20/30/40 threshold

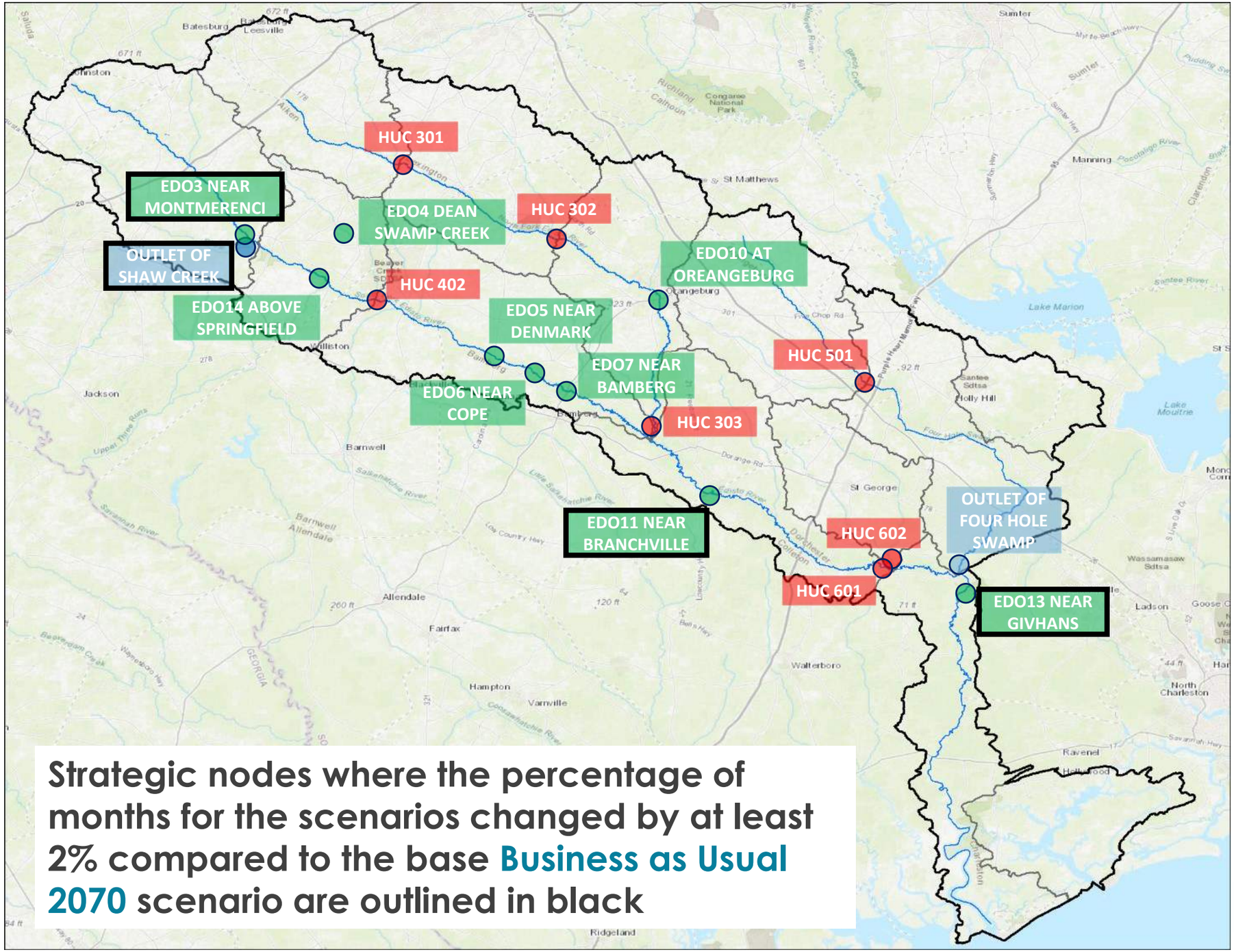
Green cells indicate a change in percentage compared to the Business as Usual 2070 scenario

Strategic Nodes

HUC 10 Outlet

USGS Gage

Other Strategic Nodes



Strategic nodes where the percentage of months for the scenarios changed by at least 2% compared to the base Business as Usual 2070 scenario are outlined in black

Results for High Demand 2070 Scenarios Comparison to Minimum Instream Flows (MIFs)

Percentage of Months below 20/30/40 threshold (Mean)

Strategic Node	Scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EDO05	**UIF Scenario**						**2**						
	High Demand (2070)				**1**	**3**	**10**	**3**	**2**				
	HD 2070 Scenario A				1	2	8	2	1				
	HD 2070 Scenario B				1	2	7	2	1				
	HD 2070 Scenario C				1	2	8	2	1				
	HD 2070 Scenario D				1	2	8	2	1				
Outlet of Shaw Creek	**UIF Scenario**						**2**						
	High Demand (2070)				**1**	**6**	**11**	**6**	**2**	**1**	**1**		
	HD 2070 Scenario A				1	6	11	5	2	1	1		
	HD 2070 Scenario B				1	6	11	5	2		1		
	HD 2070 Scenario C				1	3	7	1	1				
	HD 2070 Scenario D				1	3	7	1	1				
EDO03	**UIF Scenario**						**2**						
	High Demand (2070)						**5**		**1**				
	HD 2070 Scenario A						3		1				
	HD 2070 Scenario B						2		1				
	HD 2070 Scenario C						3		1				
	HD 2070 Scenario D						3		1				

Only the strategic nodes where the percentage of months for the scenarios changed by 2% or more compared to the base High Demand 2070 scenario are listed. The Unimpaired Flow (UIF) scenario is also shown for comparison.

Blank cells represent zero months below 20/30/40 threshold.

Green cells indicate a change in percentage compared to the High Demand 2070 scenario

(Table continued on next slide)

Results for High Demand 2070 Scenarios Comparison to Minimum Instream Flows (MIFs)

Percentage of Months below 20/30/40 threshold (Mean)

Strategic Node	Scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EDO13	**UIF Scenario**	**5**	**2**		**3**	**9**	**13**	**6**	**5**	**2**	**3**	**2**	**2**
	High Demand (2070)	**6**	**2**	**1**	**9**	**29**	**33**	**28**	**26**	**27**	**15**	**7**	**6**
	HD 2070 Scenario A	6	2	1	9	29	33	28	26	27	15	7	6
	HD 2070 Scenario B	6	2	1	9	29	33	28	26	27	15	7	6
	HD 2070 Scenario C	6	2	1	9	24	30	25	26	23	14	5	6
	HD 2070 Scenario D	6	2	1	9	24	30	25	26	22	14	3	6
Outlet of 4 Hole	**UIF Scenario**	**18**	**11**	**7**	**20**	**38**	**40**	**37**	**35**	**45**	**43**	**31**	**20**
	High Demand (2070)	**17**	**9**	**7**	**20**	**36**	**40**	**36**	**34**	**41**	**41**	**30**	**19**
	HD 2070 Scenario A	17	9	7	20	36	40	36	34	41	41	30	19
	HD 2070 Scenario B	17	9	7	20	36	40	36	34	41	41	30	19
	HD 2070 Scenario C	17	9	7	20	36	40	34	34	41	41	30	19
	HD 2070 Scenario D	17	9	7	20	36	40	34	34	41	41	30	19
HUC 303	**UIF Scenario**						**1**						
	High Demand (2070)						**5**						
	HD 2070 Scenario A						3						
	HD 2070 Scenario B						3						
	HD 2070 Scenario C						3						
	HD 2070 Scenario D						3						
EDO10	**UIF Scenario**						**1**						
	High Demand (2070)						**3**						
	HD 2070 Scenario A						3						
	HD 2070 Scenario B						1						
	HD 2070 Scenario C						2						
	HD 2070 Scenario D						1						

Only the strategic nodes where the percentage of months for the scenarios changed by 2% or more compared to the base High Demand 2070 scenario are listed. The Unimpaired Flow (UIF) scenario is also shown for comparison.

Blank cells represent zero months below 20/30/40 threshold.

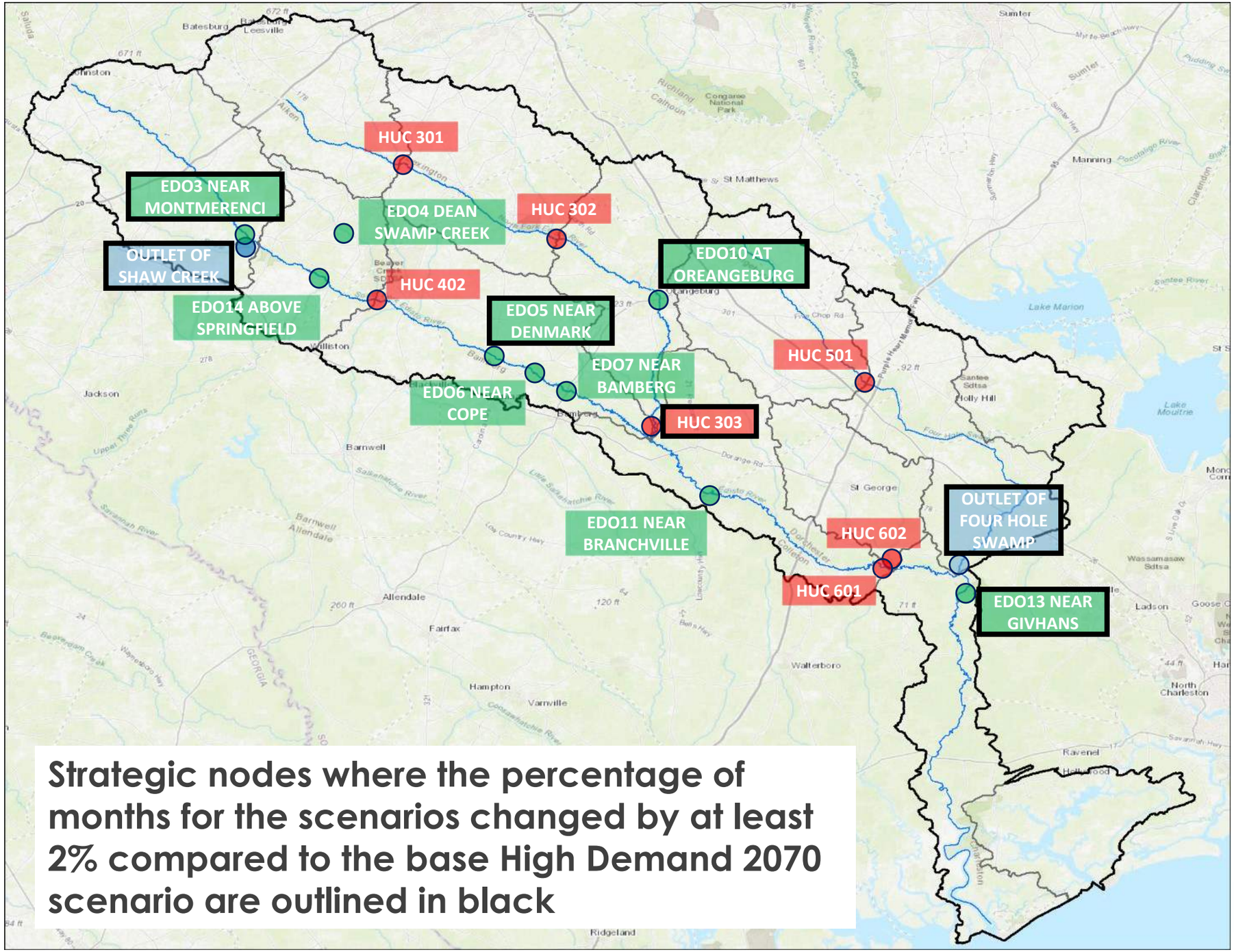
Green cells indicate a change in percentage compared to the High Demand 2070 scenario

Strategic Nodes

HUC 10 Outlet

USGS Gage

Other Strategic Nodes



Results for Business as Usual 2070 Scenarios Comparison of 5th Percentile Flows

5th percentile flows (cfs)	EDO14 SOUTH FORK EDISTO RIVER ABOVE SPRINGFIELD	HUC402 OUTLET	EDO05 SOUTH FORK EDISTO RIVER NEAR DENMARK	EDO06 SOUTH FORK EDISTO RIVER NEAR COPE	EDO07 SOUTH FORK EDISTO RIVER NEAR BAMBERG	EDO11 EDISTO RIVER NEAR BRANCHVILLE	HUC601 OUTLET	EDO13 EDISTO RIVER NR GIVHANS	SHAW CREEK OUTLET	EDO10 NORTH FORK EDISTO RIVER AT ORANGEBURG	HUC303 OUTLET
UIF Scenario	166	187	281	285	296	641	551	623	52	325	336
Business as Usual 2070	132	151	236	240	245	586	493	393	44	305	316
BAU 2070 Scenario A (20% CJU)	132	151	236	240	245	586	493	393	44	305	316
BAU 2070 Scenario A (50% CJU)	133	152	239	243	248	586	493	393	44	305	316
BAU 2070 Scenario C (Demand Side Scenario 3 + 20% CJU)	135	154	240	244	249	591	499	422	46	307	318
BAU 2070 Scenario D (Demand Side Scenario 3 + 50% CJU)	135	154	240	244	249	591	499	422	46	307	318

Only the strategic nodes where there was a change of >1 cfs in the 5th percentile flows compared to the base Business as Usual 2070 scenario are listed. The Unimpaired Flow (UIF) scenario 5th percentile flows are also shown for comparison.

BAU = Business as Usual; CJU = Conjunctive Use

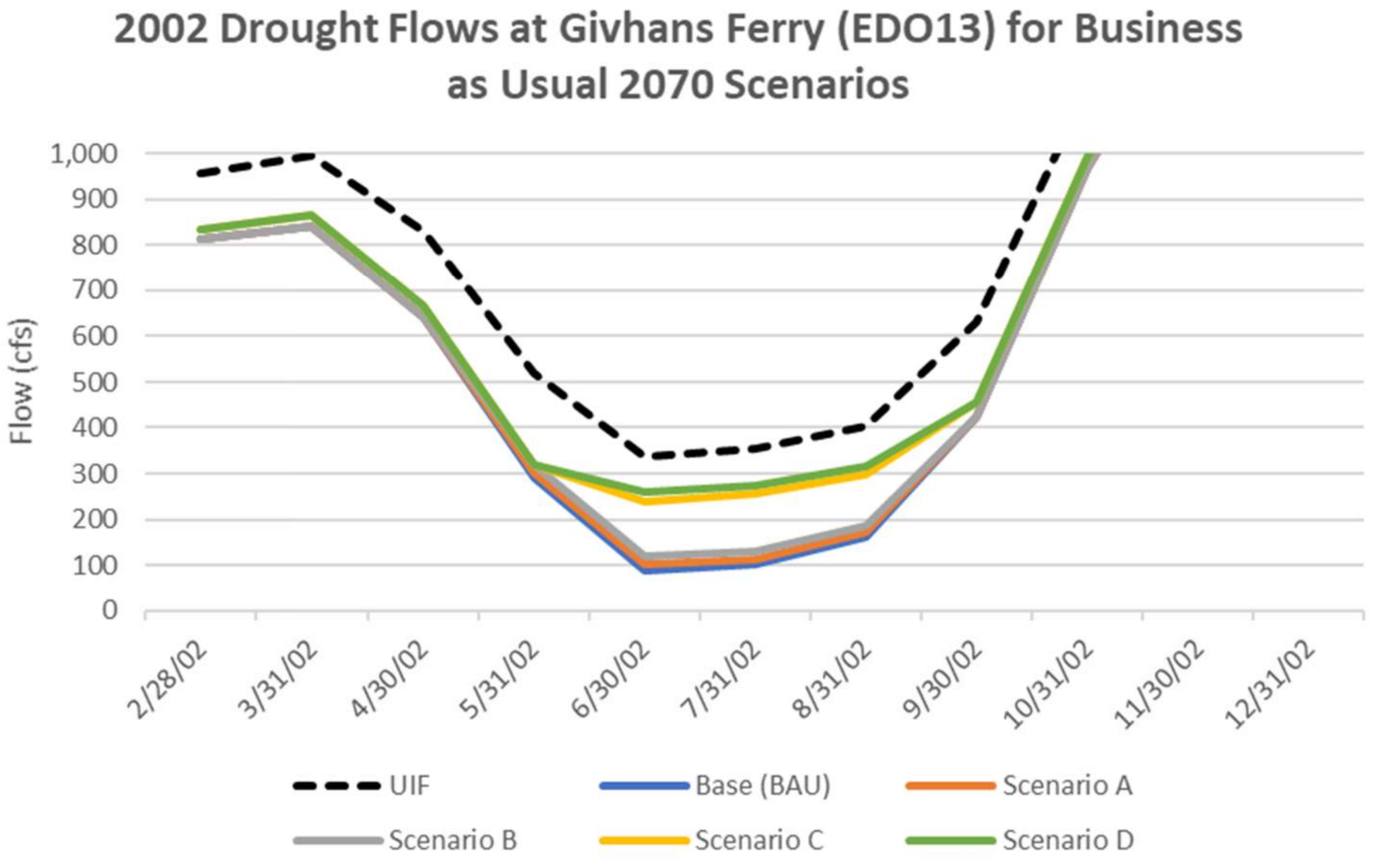
Results for High Demand 2070 Scenarios Comparison of 5th Percentile Flows

5th percentile flow (cfs)	EDO03 SOUTH FORK EDISTO RIVER NR MONTMORENCI	EDO14 SOUTH FORK EDISTO RIVER ABOVE SPRINGFIELD	HUC402 OUTLET	EDO05 SOUTH FORK EDISTO RIVER NEAR DENMARK	EDO06 SOUTH FORK EDISTO RIVER NEAR COPE	EDO07 SOUTH FORK EDISTO RIVER NEAR BAMBERG	EDO11 EDISTO RIVER NEAR BRANCHVILLE	HUC601 OUTLET	EDO13 EDISTO RIVER NR GIVHANS	SHAW CREEK OUTLET	EDO10 NORTH FORK EDISTO RIVER AT ORANGEBURG	HUC303 OUTLET
UIF Scenario	88	166	187	281	285	296	641	551	623	52	325	336
High Demand 2070	78	123	134	219	223	226	541	452	299	38	292	303
HD 2070 Scenario A (20% CJU)	79	126	137	228	232	233	549	462	314	38	294	305
HD 2070 Scenario A (50% CJU)	82	130	142	234	239	241	567	474	325	38	297	307
HD 2070 Scenario C (Demand Side Scenario 3 + 20% CJU)	78	128	140	227	231	233	555	464	371	42	297	307
HD 2070 Scenario D (Demand Side Scenario 3 + 50% CJU)	79	129	141	229	233	235	558	468	370	42	306	311

Only the strategic nodes where there was a change of >1 cfs in the 5th percentile flows compared to the base High Demand 2070 scenario are listed. The Unimpaired Flow (UIF) scenario 5th percentile flows are also shown for comparison.

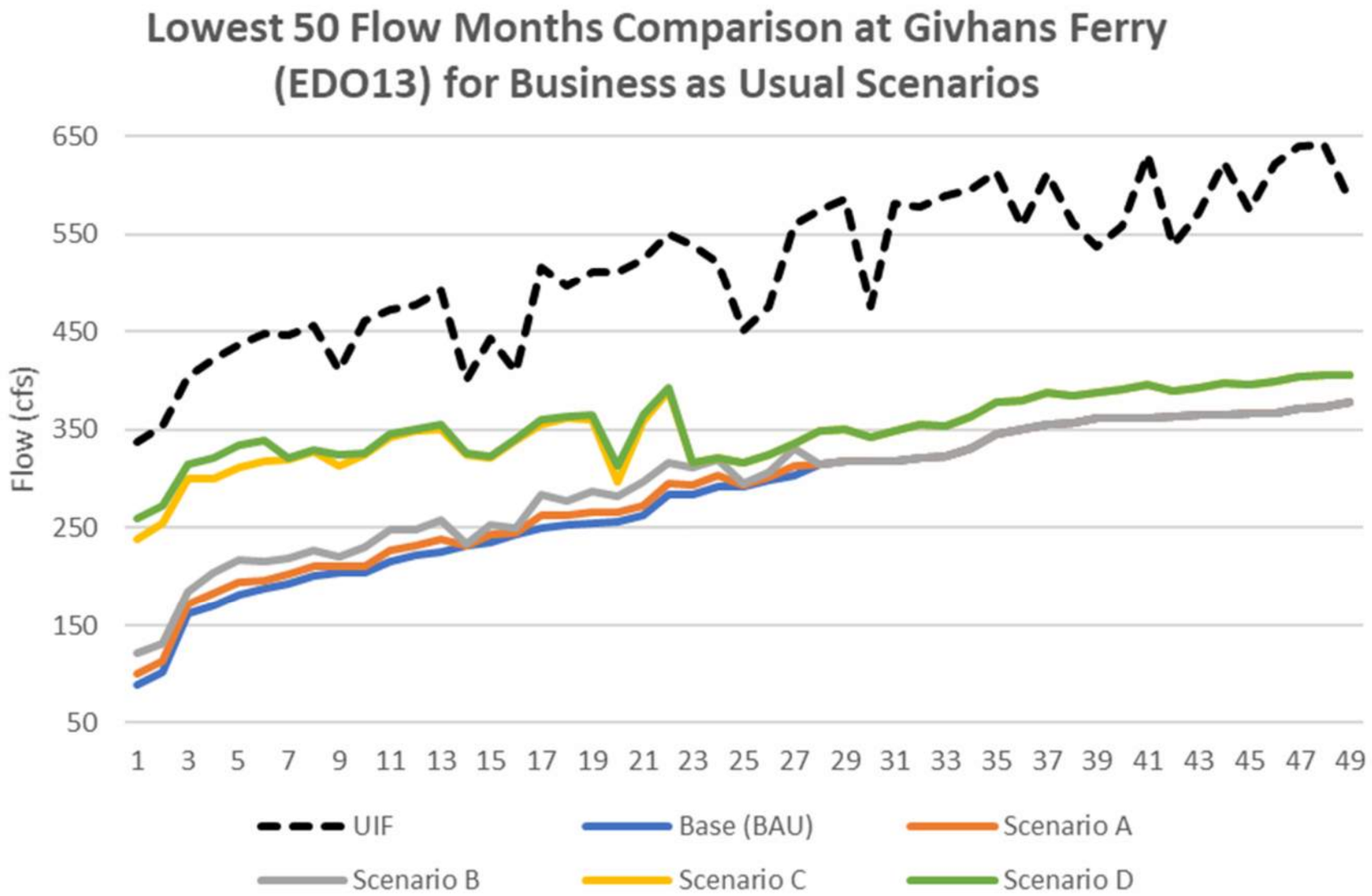
HD = High Demand; CJU = Conjunctive Use

Results for Business as Usual 2070 Scenarios 2002 Drought Flows at Givhans Ferry



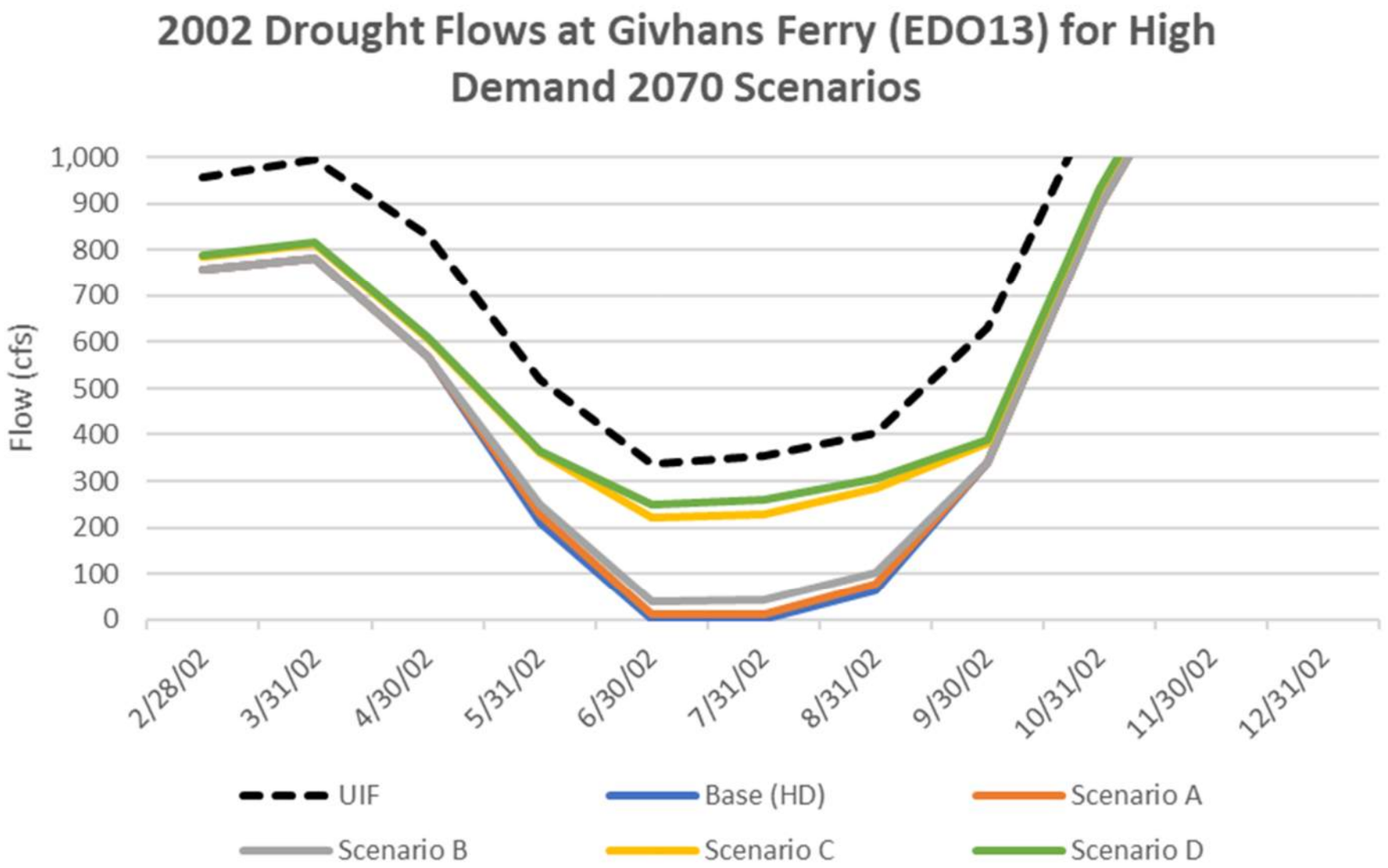
Note: This graph compares flows generated from model simulations using a **monthly** time step. The unimpaired flow (UIF) scenario results are also shown for comparison.

Results for Business as Usual 2070 Scenarios Comparison of Low Flows at Givhans Ferry



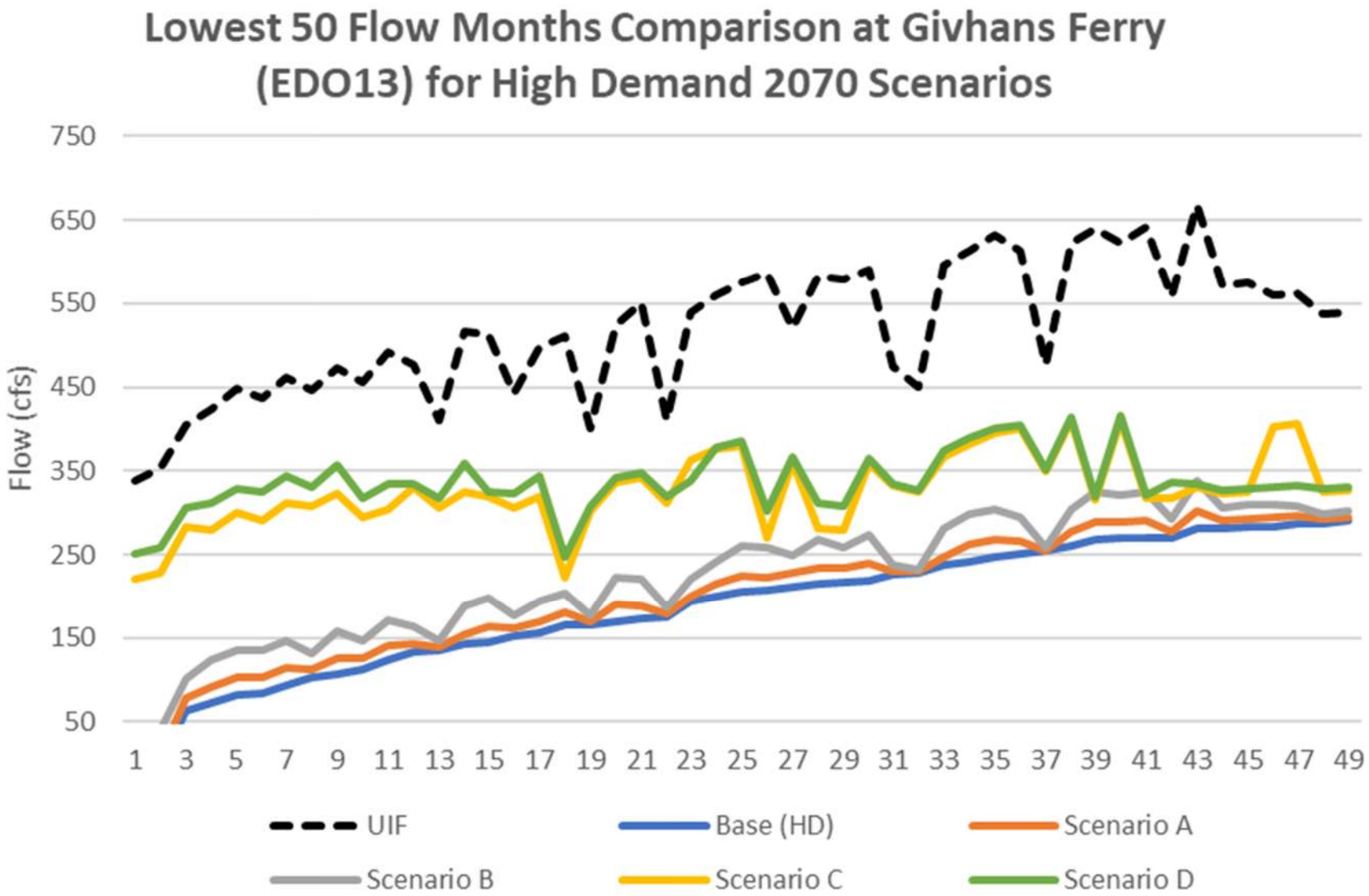
This graph compares flows for each **Business as Usual Scenario** for the 50 lowest flow months at Givhans Ferry. The unimpaired flow (UIF) scenario results are also shown for comparison.

Results for High Demand 2070 Scenarios 2002 Drought Flows at Givhans Ferry



Note: This graph compares flows generated from model simulations using a **monthly** time step. The unimpaired flow (UIF) scenario results are also shown for comparison.

Results for High Demand 2070 Scenarios Comparison of Low Flows at Givhans Ferry



This graph compares flows for each **High Demand Scenario** for the 50 lowest flow months at Givhans Ferry. The unimpaired flow (UIF) scenario results are also shown for comparison.

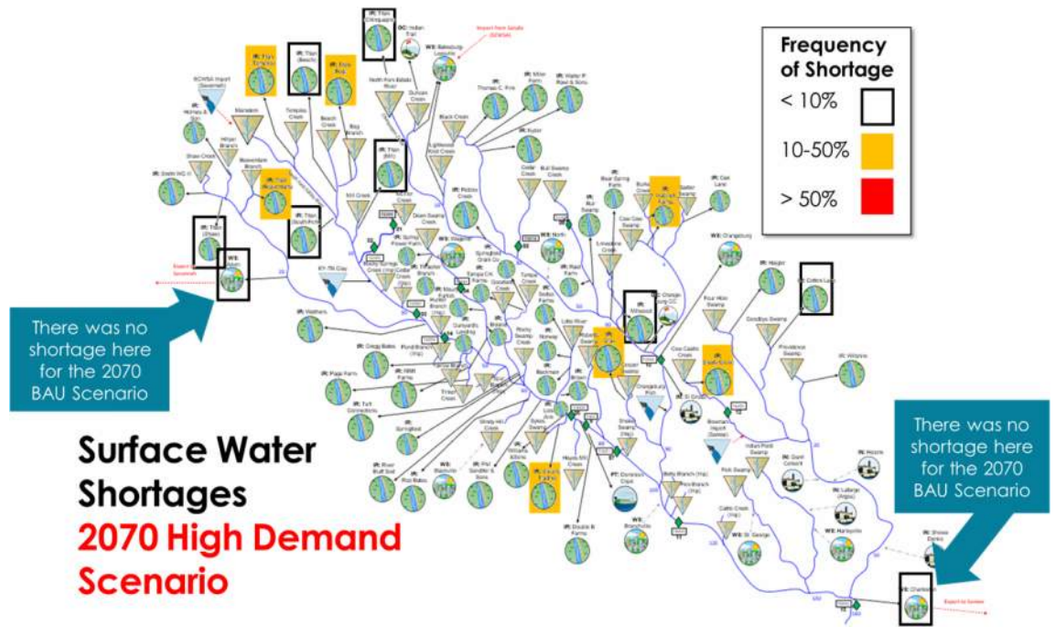
Effect on Reducing Water Shortages

Business as Usual 2070 Scenarios

Supply Shortage Statistics	Base BAU 2070	Scenario A	Scenario B	Scenario C	Scenario D
Total basin annual mean shortage (MGD)	1.54	1.50	1.44	1.41	1.39
Maximum water user shortage (MGD)	4.1	4.1	3.7	3.7	3.7
Percentage of water users experiencing shortage	15.8%	14.5%	14.5%	14.5%	14.5%

High Demand 2070 Scenarios

Supply Shortages:	Base HD 2070	Scenario A	Scenario B	Scenario C	Scenario D
Total basin annual mean shortage (MGD)	1.55	1.47	1.38	1.39	1.36
Maximum water user shortage (MGD)	5.1	4.1	3.7	3.7	3.7
Percentage of water users experiencing shortage	19.7%	17.1%	15.8%	14.5%	14.5%
Maximum Charleston shortage (MGD)	5.1	none	none	none	none
Maximum Aiken shortage (MGD)	0.35	0.07	none	none	none



- Conjunctive use has some effect on reducing modeled shortages, albeit minor
- No shortage for **Charleston** in High Demand 2070 Scenarios A, B, C and D
- Shortage for **Aiken** is reduced in Scenario A and eliminated in Scenarios B, C and D
- Modeled Ag Water User shortages (although perhaps not real) are reduced slightly

Summary

- **Conjunctive use** is already practiced at the **basin scale** in the Edisto
  - Currently, there is a near equal split of surface water and groundwater use
  - Projections suggest surface water use will increase more than groundwater use
- At a **local scale**, several water users can interchangeably use surface water or groundwater (**full** or **partial conjunctive use**)
  - *This enhances resilience and supply reliability*
- At a **local scale**, it is more common for **Ag Water Users** to use both groundwater and surface water, but not have the ability to use them interchangeably (**non-centralized conjunctive use**)

Summary

- **Conjunctive Use Scenarios A** and **B** (20% and 50%) had **limited effect** on:
  - Reducing the percentage of months with flows below MIFs at strategic nodes using the **BAU** and **HD 2070** demand projections
  - Increasing the 5th percentile flows at strategic nodes
  - Improving flows at Givhans Ferry during the 2002 drought of record
- **Conjunctive Use Scenarios C** and **D** (20% and 50% coupled with all Demand Side Strategies) had **more effect** on these same three metrics, but improvements were still minor

Summary

- **Conjunctive Use Scenario A** eliminated the modeled shortage for Charleston and reduced the modeled shortage for Aiken using the **High Demand 2070** projections
- **Conjunctive Use Scenarios B, C and D** eliminated the modeled shortages for both Charleston and Aiken using the **High Demand 2070** projections
- Modeled **Ag Water User** shortages (although perhaps not real) are also reduced slightly for all Scenarios

Summary

- **Conjunctive Use** (as modeled) is effective at eliminating shortages and slightly improves low flow conditions
- Feasibility considerations:
  - Cost-benefit
  - Environmental impacts (wetlands)
  - Constructability (lack of easements)
  - Is there sufficient groundwater to meet additional (short-term) demand?
  - Groundwater quality