DRAFT Technical Memorandum
Coastal Georgia Regional Water Planning Council
Regional Water and Wastewater Forecasts, Identification of Gaps between Available Resource and Water Needs

Introduction

In February 2008, the Georgia General Assembly adopted the Georgia Comprehensive State-wide Water Plan (Plan) dated January 8, 2008. This Plan established the Regional Planning process that was officially kicked off in March 2009. The Coastal Georgia Regional Water Planning Council (RWPC) is one of 11 planning regions established throughout the state. The Coastal Georgia RWPC is charged with several tasks including: 1) developing water and wastewater forecasts for the region through the year 2050; and 2) identification of management practices to help meet forecasted demands and address regional needs. The Coastal Georgia RWPC boundaries are shown in Figure 1.

Figure 1 – Coastal Georgia RWPC Boundary

This technical memorandum summarizes:

- Water and wastewater forecasts for regional surface and groundwater resources
- Identification of known existing permit capacity and planned projects in relationship to forecasts
- Identification and quantification of regional water and wastewater gaps and needs in terms of both:
    - Existing and planned projects in relationship to forecasts
    - Available surface and groundwater resources in relationship to forecasts
- Draft selected Management Practices to address gaps and needs

In selecting management practices to address current or forecasted regional needs, the RWPC considered plans and activities that are being considered or in use by local or regional entities. The identification of these plans and activities is an essential foundation to determine if further action by RWPC is needed to address water needs and regional goals. Consequently, the RWPC has identified in this document: permitted capacities, planned projects, and if needed, RWPCs selected management practices. Figure 2 provides a visual depiction of the approach used by RWPC. The following sections summarize the individual actions that will help meet regional water needs and goals.

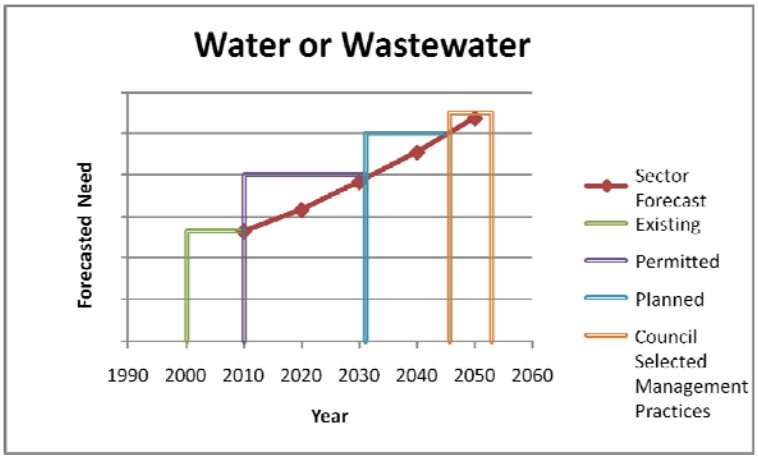


Figure 2 – Conceptual Approach Used to Address Forecasted Needs

Water and Wastewater Overview - Coastal Georgia RWPC

County-level water and wastewater forecasts have been developed at 10-year increments beginning in 2010 and extending to 2050 for the 9 counties within the region. The major water and wastewater sectors include: municipal (domestic and commercial), industrial, agricultural, and energy.

Figures 3 and 4 show the aggregated county forecasts for the Coastal Georgia region in 2010 and 2050. Overall, the regional forecasted water need is expected to increase by approximately 105 million gallons per day (MGD). Note to Council – EPD comments on Sections 1-5 request that additional clarification and justification of the alternate forecast be provided (for both the use of a regional versus County specific GPCD (138) and the additional industrial 35 MGD forecast).

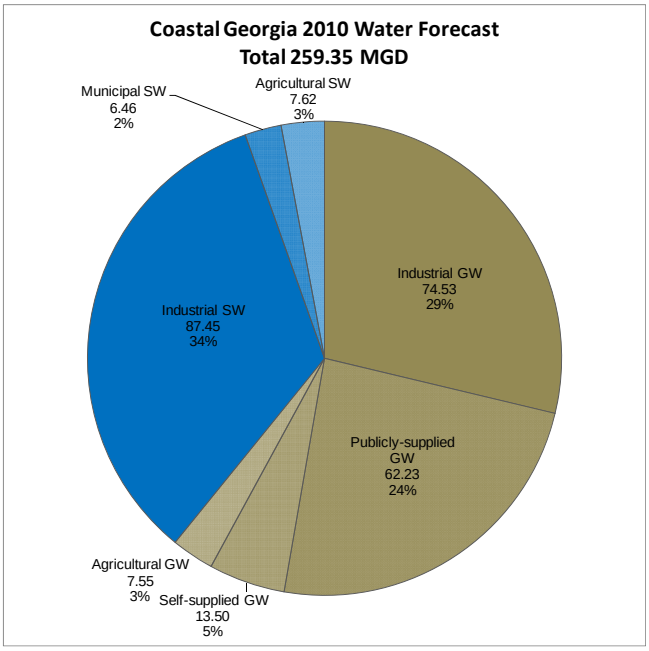


Figure 3 – Coastal Georgia Alternate 2010 Total Water Forecast

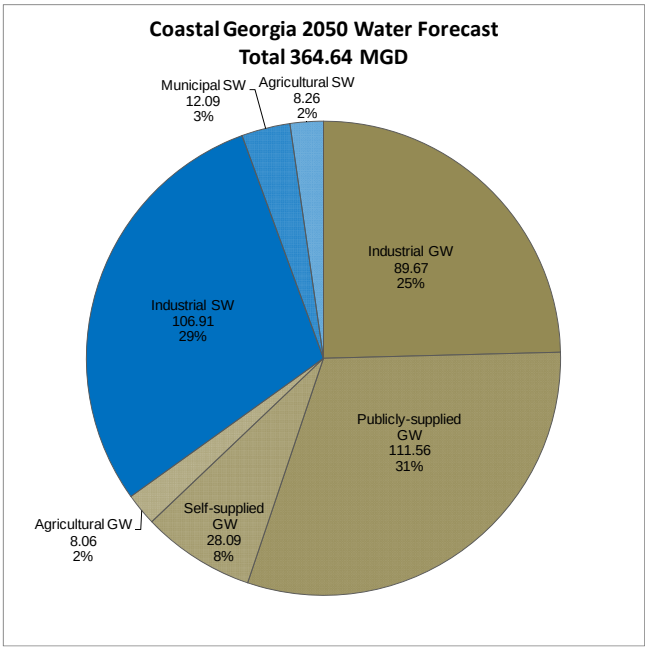


Figure 4 – Coastal Georgia Alternate 2050 Total Water Forecast

These forecasts are associated with water source, either surface water (SW) shown in blue or groundwater (GW) shown in brown. For groundwater, the aquifer from which the water will be withdrawn is also identified. For surface water, the local drainage area (LDA) is identified. Each LDA is identified by the name of its node, the most downstream point within the drainage area.

Figures 5 and 6 show the aggregated county wastewater forecast for the Coastal Georgia region in 2010 and 2050. Overall, the regional forecasted wastewater flows are expected to increase by approximately 84 million gallons per day (MGD).

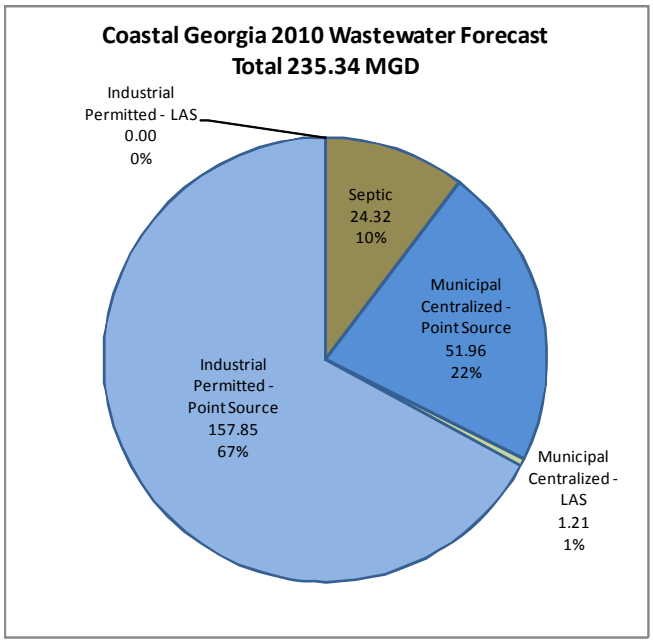


Figure 5 – Coastal Georgia Alternate 2010 Total Wastewater Forecast

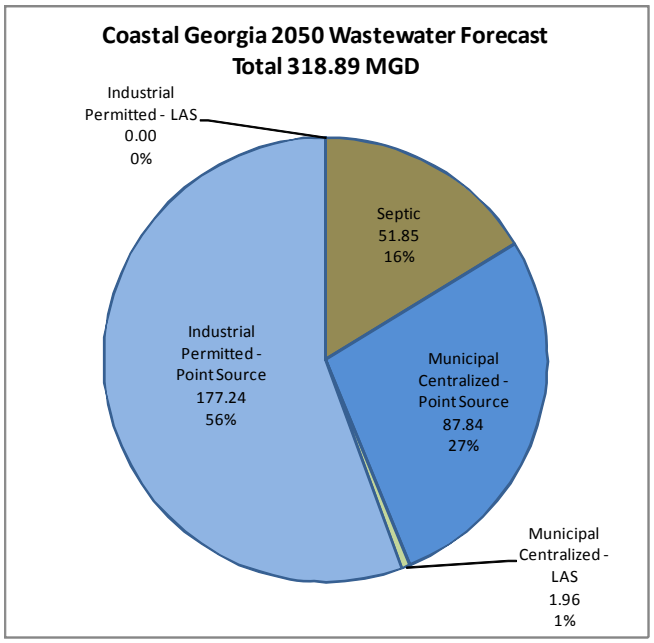


Figure 6 – Coastal Georgia Alternate 2050 Total Water Forecast

Comparing Groundwater Forecasts with Identified Permitted Capacity, Planned Projects, and Available Resource

As summarized below, on a regional basis forecasted publicly-supplied and industrial groundwater demands exceed permitted capacity by 4.9 MGD in 2050.

Based on the Groundwater Resource Assessment, on a regional basis, there are no forecasted gaps identified over the 40 year planning horizon for the modeled portions of the Upper Floridan Aquifer where sustainable yield estimates were completed. However, significant groundwater gaps exist in 5 county/sub-county portions of the region. Figure 7 on the next page shows the geographic coverage of several models that have been and/or are currently in use to evaluate groundwater conditions and characteristics of the region. As shown in the figure, the Resource Assessment Modeling effort included both a Regional Model for the Upper Floridan (model boundary shown in red) and a more detailed Upper Floridan Model (model boundary shown in blue). Within the more detailed Upper Floridan Model Boundary the orange outline shows the area for which sustainable yield estimates were completed. Also

shown in the figure are the modeled areas for the Coastal Sound Science Initiative (CSSI) and the Unities States Geologic Survey (USGS) Brunswick Model.

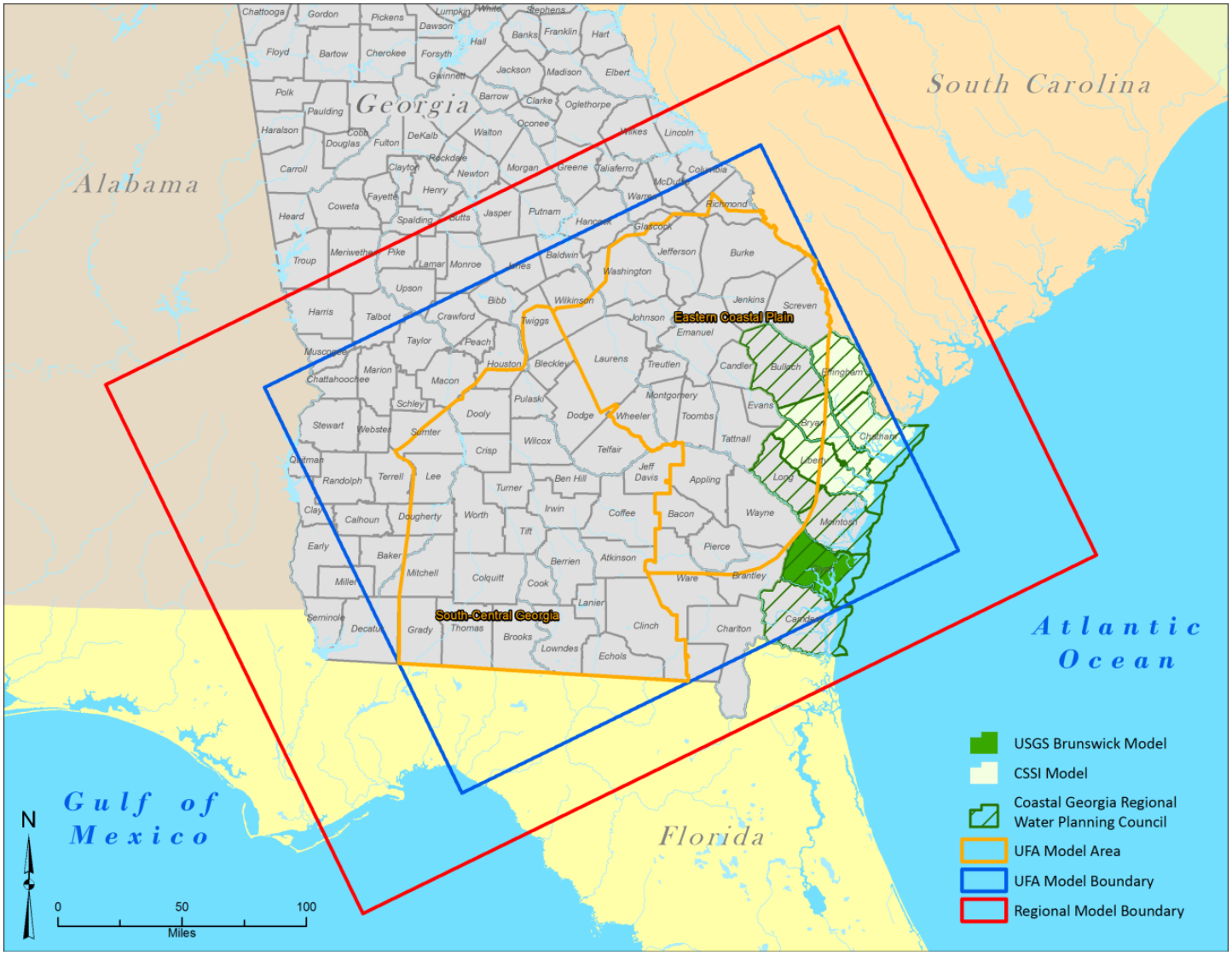


Figure 7: Groundwater modeling boundaries in South Georgia

For the Coastal region the most significant groundwater issue is salt water intrusion in the Hilton Head Savannah Region and Brunswick area. Saltwater intrusion was not modeled by the regional model or the zoomed-in Upper Floridan models completed as part of the State-wide Groundwater Resource Asssesment. It has been modeled through the CSSI effort. Saltwater intrusion has led to restrictions in Chatham and South Eastern Effingham County, and the “T” shaped salt water plume area near Brunswick (red zone – no additional withdrawals) and

limitations on withdrawals in Bryan and Liberty Counties (yellow zone). These areas are governed by the Coastal Georgia Water and Wastewater Permitting Plan to Manage Salt Water Intrusion, June 2006 (Permitting Plan). The full document can be viewed at the following site: http://www1.gadnr.org/cws/Documents/saltwater_management_plan_june2006.pdf. The Permitting Plan covers the 24 counties shown in Figure 8. Specific limitations on groundwater withdrawals only occur in the red and yellow zones shown in the Figure. The green zone requires certain practices to be implemented including water conservation.

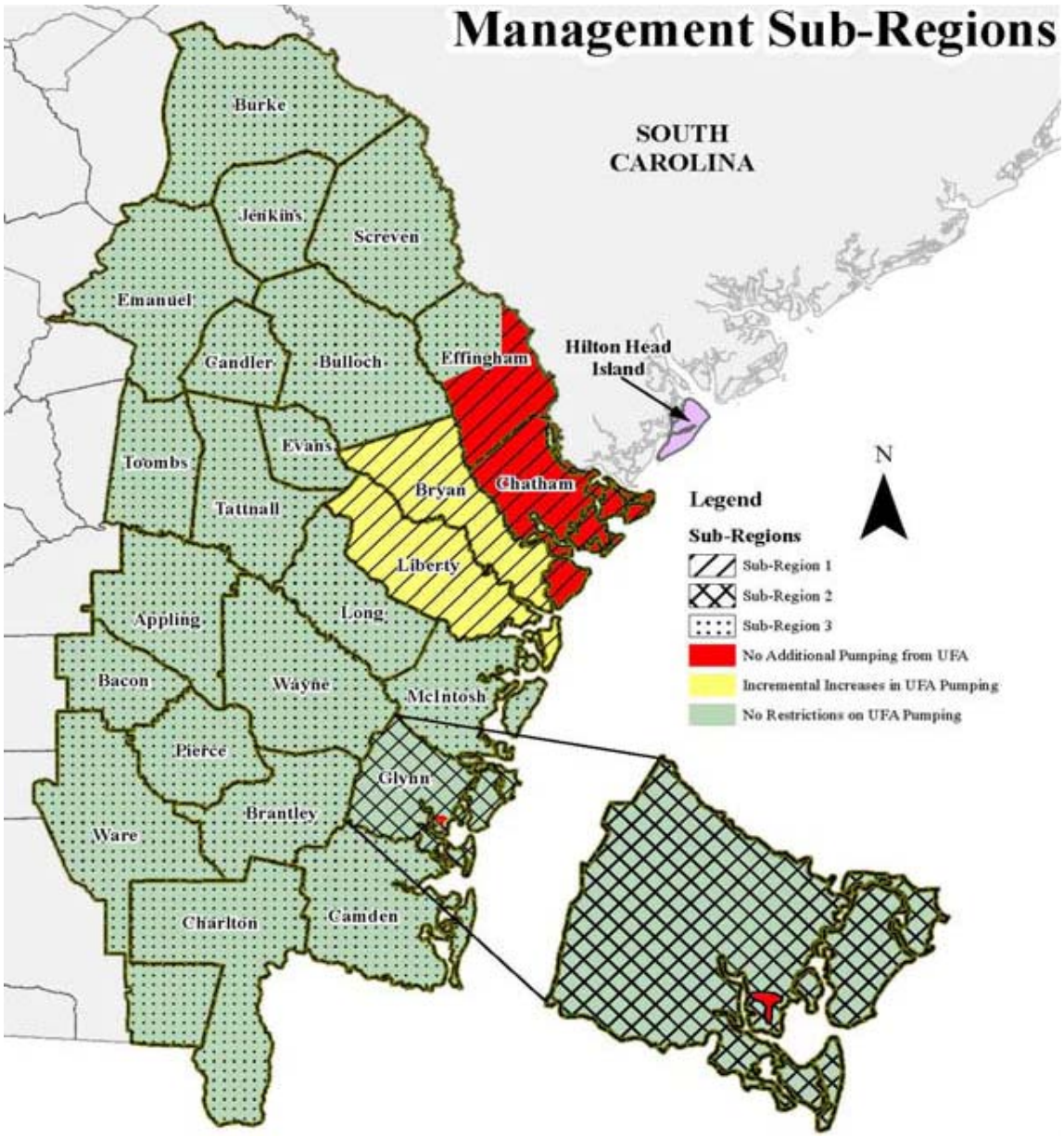


Figure 8: Coastal Georgia Permitting Plan Management Zones

As shown in Figures 3 and 4, regional water needs are expected to grow by 105 MGD between 2010 and 2050, and 79 MGD is expected to come from groundwater sources if current trends continue. However, based on the results of the CSSI modeling and the Permitting Plan, it is apparent that meeting forecasted demands within some portions of the region is not possible without additional saltwater intrusion impacts to the Upper Floridan aquifer. The Coastal Georgia RWPC is faced with the significant challenge of identifying potential management practices to address the gaps that occur in the red and yellow zones. This effort is made especially difficult as there are bi-state discussions occurring between Georgia and South Carolina and there are currently advisory groups that are charged with examining potential comprehensive management strategies. The RWPC has elected to "bracket" possible outcomes of both the technical analysis and the bi-state discussions as a means of addressing the dynamic nature of this issue. There are four ranges of outcomes that the RWPC is considering:

- No additional Upper Floridan groundwater can be withdrawn from the red and yellow zones.
- Current levels of Upper Floridan aquifer withdrawals may need to be reduced, in some cases drastically.
- All forecasted needs in the yellow zone can be meet with additional Upper Floridan groundwater withdrawals in yellow zone.
- Some portion of the forecasted needs in the yellow zone can be met with additional Upper Floridan groundwater from within the yellow zone.

Figure 9 and Table 1 provide a summary of the specific forecasted water needs for the groundwater gap areas. For regional planning purposes, it is assumed that the water needs for the Brunswick area can be met by additional groundwater withdrawals outside the boundary of the "T" shaped salt water plume. As shown in the Figure 9, management practices by 2050 may be needed to:

- Provide 29 MGD if no additional withdrawals can occur in the yellow and red zones and this value grows to 99 MGD by 2050 if no withdrawals can occur in the red and yellow zones.
- Provide 21 MGD if half of the future need can be met with additional yellow zone withdrawals.

Insert Figure 9: Groundwater Forecast and Gap Brackets for the Red and Yellow Zones

Table 1: Groundwater Forecast from Floridan Aquifer in Red and Yellow Zones

County	Sector	2010	2050	Increase in Water Use from 2010 to 2050
Bryan	GW Municipal public-supply	2.94	7.34	4.39
	GW Municipal self-supply	1.20	2.93	1.73
	GW Industrial	0.00	1.80	1.80
	GW Agricultural	0.04	0.04	0.01
	GW Total	4.18	12.11	7.92
Liberty	GW Municipal public-supply	7.18	13.35	6.17
	GW Municipal self-supply	0.99	1.80	0.81
	GW Industrial	9.03	13.54	4.51
	GW Agricultural	0.00	0.00	0.00
	GW Total	17.20	28.69	11.48
Total Yellow Zone		21.38	40.79	19.41
Yellow Zone without self-supply		**19.19**	**36.07**	**16.87**
Chatham	GW Public-supply	26.76	36.89	10.13
	GW Self-supply	3.22	4.29	1.07
	GW Industrial	21.28	21.36	0.08
	GW Agricultural	0.23	0.26	0.03
	GW Total	51.48	62.80	11.32
Effingham	GW Municipal public-supply	2.13	6.11	3.98
	GW Municipal self-supply	2.52	7.09	4.56
	GW Industrial	1.98	1.98	0.00
	GW Agricultural	0.88	0.92	0.05
	GW Total	7.51	16.09	8.59
Total Red Zone assuming half demand from Effingham		55.24	70.85	15.61
Red Zone without self-supply assuming half demand from Effingham		**50.76**	**63.02**	**12.26**

Total Red and Yellow Zones	76.62	111.64	35.02
Red and Yellow Zones without self-supply	**69.95**	**99.08**	**29.13**

Note: Assuming half demand in Effingham is probably an underestimate of southern geographic demand where development is more dense (suburb of Savannah)

The information summarized below is provided to highlight what is known about the region in terms of current trends and permitted and planned projects. The summary does not take into account any assumptions about the how these activities may be impacted by the range of groundwater that may or may not be available in the future.

Table 2 shows the breakdown of the regional groundwater forecast by aquifer. Note that over 96% of groundwater is forecast to come from the Floridan aquifer which refers to both Upper and Lower Floridan aquifers combined.

Table 2: Regional Groundwater Forecast by Aquifer (Average Annual Day, MGD)

Total Regional Groundwater Forecast			**Aquifer**			
2010	2050	Increase from 2010 to 2050	Name	2010	2050	Increase from 2010 to 2050
157.82	237.37	79.55	Brunswick	4.78	8.30	3.52
			Floridan	153.05	229.08	76.03

At a county level, the 2050 forecast for publicly-supplied groundwater is greater than current permitted capacity in Bryan, Bulloch, Camden, Effingham, Liberty, and Long Counties. For industrial water need, the 2050 forecast exceeds existing permitted capacity in Bryan, Bulloch, Effingham, Liberty and McIntosh Counties. For more detailed information, see the gap analysis table for each individual county. It is important to note that this data should be viewed with caution. Localized gaps may exist within a county in situations where one entity has significant permit capacity, but a separate entity does not have capacity and may be experiencing a large amount of the county's overall growth.

Table 3 shows the portion of the groundwater forecast for publicly-supplied municipal and industrial. The permitted capacity by aquifer is shown for each sector as well as any surplus or gap between the permitted capacity and 2050 forecast.

Table 3: Groundwater Forecast and Permitted Capacity by Aquifer (Average Annual Day, MGD)

Aquifer	**Municipal Publicly-Supplied**				**Industrial**			
Name	2010 Forecast	2050 Forecast	Permitted Capacity	2050 Surplus / **Gap(-)**	2010 Forecast	2050 Forecast	Permitted Capacity	2050 Surplus / **Gap(-)**
Brunswick	3.69	6.38	9.57	3.19	0.04	0.06	0.71	0.65
Floridan	58.54	105.17	89.60	**-15.57**	74.50	89.62	96.47	6.86
Total	**62.23**	**111.56**	**99.18**	**-12.38**	**74.53**	**89.67**	**97.18**	**7.51**

In the Coastal Georgia Region, there are many applications for either new or increased groundwater withdrawal permits currently filed with Georgia EPD. Table 4 summarizes the increase in permit capacity by county if these permits are approved as filed.

Table 4: Planned Groundwater Projects

		Municipal	Industrial
County	City or Utility	Increase in Permitted Yearly Average (MGD)	Increase in Permitted Yearly Average (MGD)
Bryan - Upper Floridan	County Board of Commissioners, Consolidated Utilities, Middle Georgia Water Company, Pembroke, Richmond Hill, South Atlantic Utilities	4.459	
Bryan - Lower Floridan	Richmond Hill	-0.238	
Bulloch - Upper Floridan	Statesboro	4.125	
Chatham - Upper Floridan	Chatham County Water, Chatham Water Company, Nassau Woods Utility Company, River Oaks Water System, South Atlantic Utilities	1.281	
Chatham - Lower Floridan	Consolidated Utilities, Garden City, Hunter Army Airfield, Pooler	3.9998	
Effingham - Upper Floridan	Coastal Georgia Water, Lakeside Water Company, Rincon, South Atlantic Utilities	1.16	
Effingham - Lower Floridan	Coastal Georgia Water & Sewerage Company	1	
Liberty - Upper Floridan	Coastal Georgia Water Company, Hinesville, County Board of Commissioners, Middle Georgia Water Company, Midway, Walthourville	5.32	
Liberty - Lower Floridan	DPW Environmental Division	1	
McIntosh - Upper Floridan	South Atlantic Utilities	0.23	
Effingham - Lower Floridan			0.21
Liberty - Upper Floridan			0.7
Upper Floridan Total		16.58	0.70
Lower Floridan Total		5.76	0.21
Combined Floridan Total		22.34	0.91

Table 5 shows the groundwater forecast by aquifer for the two remaining sectors: agriculture and self-supplied municipal (individuals with private wells serving less than 25 people and fewer than 15 connections). Agricultural withdrawal permits are expressed in terms of maximum pumping flow rate which cannot be compared to the agricultural forecast expressed in average annual day.

Table 5: Municipal Self-Supplied and Agricultural Groundwater Forecast by Aquifer (Average Annual Day, MGD)

Aquifer	Municipal Self-Supplied			Agriculture		
Name	2010	2050	Increase from 2010 to 2050	2010	2050	Increase from 2010 to 2050
Brunswick	1.00	1.81	0.80	0.04	0.05	0.01
Floridan	12.50	26.28	13.78	7.51	8.01	0.50
Total	**13.50**	**28.09**	**14.58**	**7.55**	**8.06**	**0.51**

Comparing Surface Water Forecasts with Identified Permitted Capacity, Planned Projects, and Available Resource

As summarized below, on a regional basis there are no surface water infrastructure gaps for municipal or industrial use.

However, surface water resource gaps exist at two locations in the region – Eden and Kings Ferry. These are most likely related to agricultural uses upstream of the Coastal region. The surface water planning nodes located in and around the Coastal region are summarized below (nodes located within the planning region boundaries are shown in bold text):

- Atkinson (Satilla River) – surface water gaps under current and future conditions; related to uses upstream of the Coastal RWPC boundary.
- Claxton (Canoochee River) – surface water gaps under current and future conditions; primarily related to uses upstream of the Coastal RWPC boundary and possibly some Bulloch County surface water use.

- Clyo (Savannah River) – no surface water gaps under current and future conditions.
- Doctortown (Altamaha River) – no surface water gaps under current and future conditions.
- **Eden (Ogeechee River)** – surface water gaps under current and future conditions; related to upstream uses and agricultural surface water uses in Bulloch, and Effingham Counties.
- **Gross (St. Mary's River)** - no surface water gaps under current and future conditions.
- **Kings Ferry (Ogeechee River)** – surface water gaps under current and future conditions; related to uses upstream of the Coastal RWPC boundary (above Claxton and Eden nodes) and possibly agricultural surface water uses in Bryan (0.03 MGD total 2010), north west Chatham (0.36 MGD total 2010), and the extreme south western portion of Effingham Counties (0.14 MGD total 2010). Note that county surface water agricultural use for the above three counties may not all be from Ogeechee River and/or tributaries as measured at Kings Ferry.
- **Savannah (Savannah River)** – no surface water gaps under current and future conditions.

In the Coastal region, there is a portion of municipal water need met in Chatham and Effingham Counties with surface water from the Savannah River. For industry, there are surface water demands from upstream and downstream of the Savannah node as well as downstream of the Atkinson node. Table 6 shows both the municipal and industrial forecasts compared to the existing permitted capacity. Note that the 50 MGD permitted capacity shown under municipal also is used to supply water to industries in the Savannah area.

Table 6: Municipal and Industrial Surface Water Forecast and Permitted Capacity (Average Annual Day, MGD)

	Municipal				Industrial				Combined M&I 2050 Surplus/ Gap (-)
Planning Node	**2010 Forecast (Average Day)**	**2050 Forecast (Average Day)**	**Monthly Permitted Capacity**	**2050 Surplus/ Gap (-)**	**2010 Forecast (Average Day)**	**2050 Forecast (Average Day)**	**Monthly Permitted Capacity**	**2050 Surplus/ Gap (-)**	
SAVANNAH	6.46	12.09	50.00	37.91	58.33	77.79	112.50	34.71	**72.62**
DOWNSTREAM -SAVANNAH	0.00	0.00	0.00	0.00	6.54	6.54	20.00	13.46	**13.46**
DOWNSTREAM -ATKINSON	0.00	0.00	0.00	0.00	22.58	22.58	56.00	33.42	**33.42**
DOWNSTREAM -KINGSFERRY	0.00	0.00	0.00	0.00	0.00	0.00	10.10	10.10	**10.10**
Regional Totals	**6.46**	**12.09**	**50.00**	**37.91**	**87.45**	**106.91**	**198.60**	**91.69**	**129.60**

Only one new surface water permit application was found on file with Georgia EPD as of March 31, 2010. This application is for the Savannah Regional Industrial Landfill in Port Wentworth for 0.16 MGD maximum day/ 0.11 MGD monthly average from a sediment pond. The only other surface water permit applications on file were renewals with no change to the permit limits.

Table 7 shows the regional surface water forecast for agriculture on an average annual day basis. Agricultural withdrawal permits are expressed in terms of maximum pumping flow rate which cannot be compared to the agricultural forecast expressed in average annual day.

Table 7: Surface Water Agricultural Forecast (Average Annual Day, MGD)

	Agriculture		
Source	**2011 Forecast**	**2050 Forecast**	**Increase from 2010 to 2050**
Surface Water	7.62	8.26	0.64

Existing or Proposed Projects - Reservoirs

EPD in-house applications for water supply reservoirs – None identified in Coastal Georgia counties

GEFA Reservoir Study – None identified in Coastal Georgia counties

Comparing Wastewater Forecasts with Identified Permitted Capacity, Planned Projects, and Available Resource

As described in more detail below, municipal wastewater flows treated at centralized facilities in the region are expected to increase from approximately 53 MGD in 2010 to 90 MGD in 2050. Regionally, there is permit capacity for 101MGD; therefore, no regional wastewater infrastructure gaps exist. On a county level, the 2050 forecast exceeds existing permitted capacities in Bryan, Camden, and Liberty Counties. There are several planned projects which may help address these infrastructure gaps.

According to results from the Water Quality Resource Assessments, low dissolved oxygen conditions exist in several locations within the region. We are currently reviewing the revised baseline and permitted water quality model runs to identify reaches with no DO assimilative capacity and point sources that may be associated with these reaches.

About 25% of the total regional wastewater flow will be directed to municipal centralized treatment with ultimate discharge either directly to streams (point source) or through land application systems (LAS). Table 8 shows the forecasts and permitted capacity for these systems. The difference between the existing permitted capacity and the 2050 forecast is also listed for each county in terms of either surplus or gap. The last column lists any planned wastewater projects that will increase the county's wastewater treatment capacity.

Table 8: Centralized Municipal Wastewater Forecast, Permitted Capacity, and Gap (Average Annual Day, MGD)

	Municipal Point Source (PS)				Municipal Land Application Systems (LAS)				Combined PS and LAS
County	**2010 Forecast**	**2050 Forecast**	**Permitted Capacity**	**2050 Surplus or Gap (-)**	**2010 Forecast**	**2050 Forecast**	**Permitted Capacity**	**2050 Surplus or Gap (-)**	**Planned Projects Increase in Capacity**
Bryan	0.91	2.32	1.50	**-0.82**	0.00	0.00	0.25	0.25	2.5
Bulloch	2.79	6.58	10.02	3.43	0.00	0.00	0.00	0.00	-
Camden	4.53	12.65	9.98	**-2.67**	0.00	0.00	0.00	0.00	1.1
Chatham	30.44	41.96	43.81	1.85	0.72	1.00	3.31	2.31	0.5
Effingham	0.63	1.81	3.52	1.71	0.07	0.21	1.29	1.08	1.0
Glynn	6.45	10.94	18.64	7.71	0.09	0.16	0.23	0.07	2.0
Liberty	5.91	10.81	7.15	**-3.66**	0.32	0.60	0.67	0.07	4.0
Long	0.17	0.32	0.24	-0.08	0.00	0.00	0.00	0.00	-
McIntosh	0.13	0.45	0.63	0.18	0.00	0.00	0.00	0.00	-
Regional Total	**51.96**	**87.84**	**95.48**	**7.64**	**1.21**	**1.96**	**5.76**	**3.80**	**11.1**

About 60% of the total regional wastewater flow is discharged through industrial wastewater facilities. Table 9 outlines these industrial wastewater flows and lists the anticipated increase by 2050. Industrial treatment facilities typically do not have flow limits in their permits so the forecast cannot be compared to existing treatment capacity.

Table 9: Industrial Wastewater Forecast (Average Annual Day, MGD)

	Industrial		
Category	**2010**	**2050**	**Increase from 2010 to 2050**
Point Source	157.85	177.24	19.40
LAS	0.00	0.00	0.00
Regional Total	**157.85**	**177.24**	**19.40**

There are also several wastewater treatment plant expansions and/or improvements in the application process at Georgia EPD. Table 10 lists these planned projects by County. There are

currently no industrial wastewater treatment facility applications on file with EPD in the Coastal Georgia Region.

Table 10: Municipal Wastewater Treatment Facilities - Applications on File with EPD

County	City	Type	Application Stage
Bryan	Richmond Hill	Point Source	Waiting on WLA
Bulloch	Statesboro	Point Source	Reviewing DDR for reuse system
Camden	Saint Marys	Point Source	Site Inspection
Camden	Woodbine	Point Source	WLA
Chatham	Pooler	Point Source	ANTIDEG
Chatham	Tybee Island	Point Source	EID
Chatham	Larchmont	Point Source	DDR
Effingham	Guyton	Point Source	DDR
Effingham	Springfield	LAS	DDR
Glynn	North Glynn Co. WWTP	Point Source	WLA
Liberty	Liberty County IDA	Point Source	DDR
McIntosh	McIntosh Co.	Point Source	Waiting on Draft Permit to review

Definitions: WLA – Waste Load Allocation, DDR – Design Development Report, ANTIDEG – Anti-degradation report, EID – Environmental Impact Document

Approximately 16% of the region's wastewater flow will be treated by On-site Sewage Management Systems (Septic). Table 11 shows the septic forecast by county and the estimated increase in flow rate between 2010 and 2050.

Table 11: Regional Septic Forecast (Average Annual Day, MGD)

	On-Site Sewage Management Systems (Septic)		
County	**2010 Forecast**	**2050 Forecast**	**Increase from 2010 to 2050**
Bryan	2.43	6.02	3.58
Bulloch	4.88	9.66	4.78
Camden	1.68	4.65	2.97
Chatham	2.86	3.83	0.97
Effingham	4.65	13.20	8.56
Glynn	3.40	5.83	2.44
Liberty	2.28	4.20	1.92
Long	0.99	1.87	0.89
McIntosh	1.15	2.59	1.44
Regional Total	**24.32**	**51.85**	**27.53**

Planned Projects Identified in Coastal Georgia Water, Sewer and Stormwater Inventory Summary Report (Thomas & Hutton)

There were several planned projects identified in the January 2010 Coastal Georgia Water, Sewer and Stormwater Inventory Summary Report. These projects are summarized in Table 12 below.

Table 12: Planned Projects Identified in the Coastal Inventory Summary Report

County	City	Planned Project
Bulloch	Statesboro	Additional groundwater well
Camden	Kingsland	New wastewater treatment facility
	St. Marys	Expansion of wastewater treatment facility
Chatham	Port Wentworth	New reuse wastewater treatment facility
Effingham	Near I-16	Proposed industrial water system
	Rincon	Conversion of existing wastewater facility to reuse
Glynn	South Glynn - County system	Currently constructing new wastewater facility with reuse component
Liberty	Mid-Coast Industrial Park	New wastewater treatment facility
	Hinesville	New reuse wastewater treatment facility
	Riceboro	Expansion of wastewater treatment facility

Nonpoint Source Pollution

Nonpoint source pollution accounts for the majority of surface water impairments in the region according to the 2008 303(d) list of Rivers, Streams, Lakes, and Reservoirs published by EPD. Nonpoint source pollution can occur as a result of human activities, including urban development, agriculture, and silviculture, and as a result of non-human influences such as wildlife and naturally-occurring nutrients. An important component of any non-point source management program is identifying those pollutant sources that are resulting from human activities.

Results of watershed nutrient modeling identify “hot spots” of Total Nitrogen and Total Phosphorus loading from land uses in the Brunswick Harbor and Satilla River watershed. This nutrient (nitrogen and phosphorus) modeling was conducted to identify nutrient hot spot areas under various hydrologic conditions and evaluate them in relation to corresponding land uses and potential nonpoint source contributions.

Hot spots represent portions of the watershed where the land use results in a higher concentration of nutrients (nitrogen and phosphorus) in stormwater runoff than other parts of the watershed. There are currently no nutrient standards in place for any surface water body in the Brunswick Harbor/Satilla River watershed or the Savannah River watershed, so there is no absolute threshold against which these nutrient loadings are compared. Rather, the nutrient

model results are beneficial for relative comparisons to target areas where implementation of nonpoint source control management practices will have the greatest benefit.

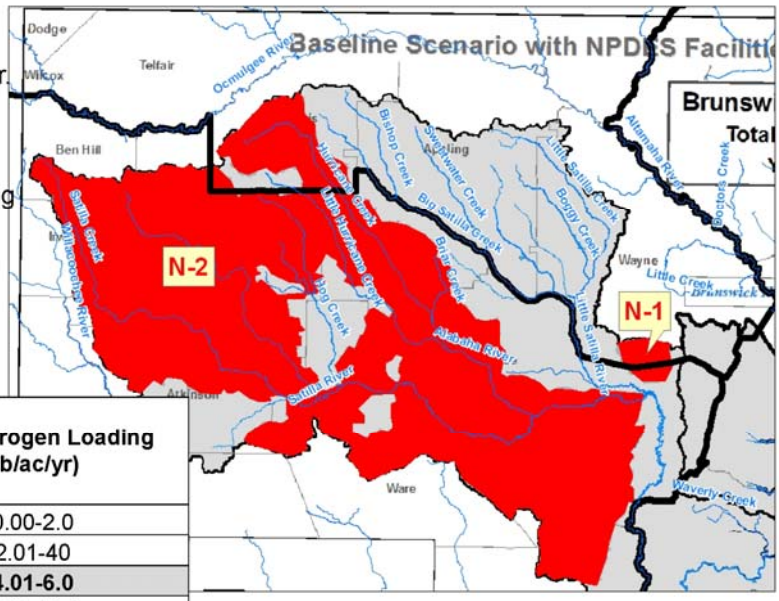
Figures 10 and 11 illustrate Total Nitrogen and Total Phosphorus hot spots within the Brunswick Harbor/Satilla River watershed.

Within both the nitrogen and phosphorus hot spots, forest and agricultural land use account for more than 80% of the land area. Based upon this information, nonpoint management practices for nutrients in these areas could be focused primarily on forestry and agriculture.

Hot Spots #1-2 have rank of 3.

Rank 3 = 4.01 – 6.0 lbs/sc/year.
(1 is lowest loading rate interval.
5 is highest loading interval.)

Rank 3 was the highest loading rate interval for this model scenario.



TN Loading Rate Scale

Hot Spot Rank	Total Nitrogen Loading (lb/ac/yr)
1	0.00-2.0
2	2.01-40
3	**4.01-6.0**
4	6.01-10.0
5	10.01 and higher

Figure 10 – Total Nitrogen Loading Hot Spots in Brunswick Harbor/Satilla River Watershed

Hot Spots 1-7 have "4" rank.

TP Rank 4 = 0.501-0.750 lbs/ac/year.

Rank 4 was the highest loading rate interval for this model scenario.

TP Loading Rate Scale

Hot Spot Rank	Total Phosphorus Loading (lb/ac/yr)
1	0.00-0.150
2	0.151-0.300
3	0.301-0.500
4	**0.501-0.750**
5	0.751 and higher

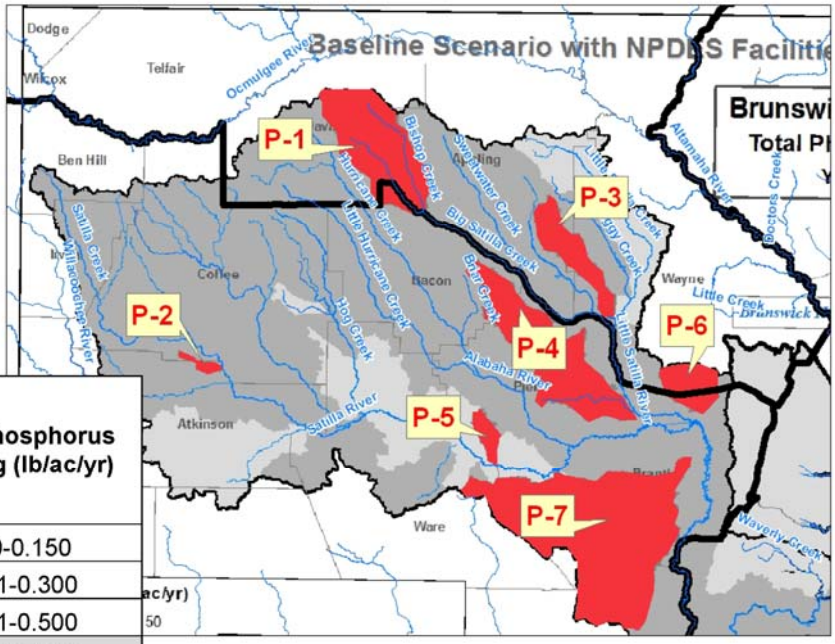


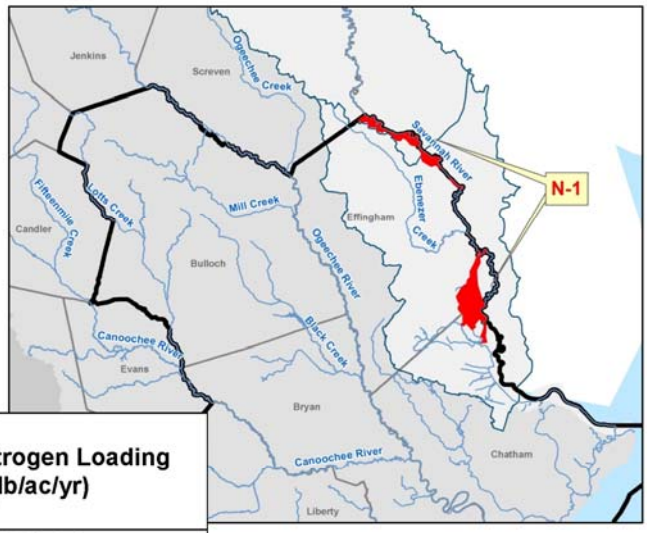
Figure 11 – Total Phosphorus Loading Hot Spots in Brunswick Harbor/Satilla River

Figures 12 and 13 illustrate Total Nitrogen and Total Phosphorus hot spots within the Savannah River watershed inside the Coastal Georgia regional boundaries. Within the nitrogen hot spot, forest and agricultural land use account for more than 75% of the land area. Based upon this information, nonpoint management practices for nitrogen in these areas could be focused primarily on forestry. Within the phosphorus hot spot, urban land use accounts for more than 60% of the land area. Based upon this information, nonpoint management practices for phosphorus in this area could be focused primarily on urban runoff.

Hot Spot #1 has a rank of 2.

Rank 2 = 2.01 – 4.0 lbs/sc/year.
(Rank1 is lowest loading rate interval.
Rank 5 is highest loading interval.)

Rank 2 was the highest loading rate interval within Coastal Georgia Council for this model scenario.



TN Loading Rate Scale

Hot Spot Rank	Total Nitrogen Loading (lb/ac/yr)
1	0.00-2.0
2	**2.01-4.0**
3	4.01-6.0
4	6.01-10.0
5	10.01 and higher

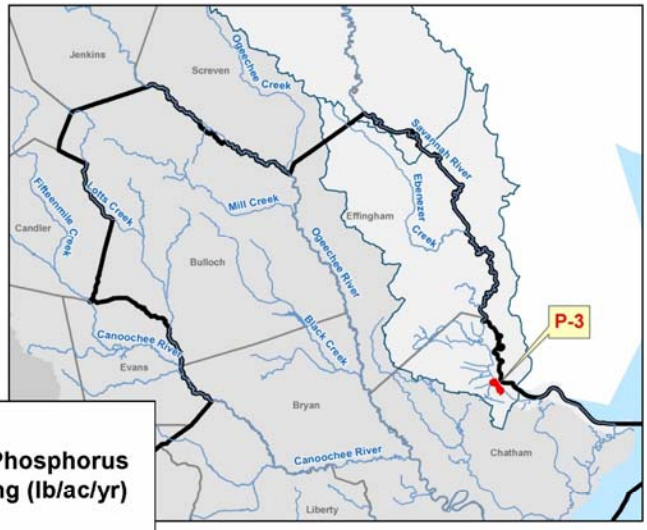
Note: Results include both human and natural sources of Nitrogen.

Figure 12 – Total Nitrogen Loading Hot Spot in Savannah River Watershed

Hot Spot 3 has a rank of "3."

TP Rank 3 = 0.301-0.750 lbs/ac/year.

Rank 3 was the highest loading rate interval for this model scenario within Coastal Georgia Council.



TP Loading Rate Scale

Hot Spot Rank	Total Phosphorus Loading (lb/ac/yr)
1	0.00-0.150
2	0.151-0.300
3	**0.301-0.500**
4	0.501-0.750
5	0.751 and higher

Note: Results include both human and natural sources of Nitrogen.

Figure 13 – Total Phosphorus Loading Hot Spot in Savannah River Watershed

Detailed Analysis of Forecast and Consumption by Local Drainage Area (LDA) or Node

Management Practices for Forecasted Gaps

On a statewide and regional basis, surface water withdrawal forecasts are linked to the LDA where they are located. In most cases, these drainage basin boundaries cross both county and water plan regional boundaries. For example, at the Kings Ferry node located in Bryan County, the local drainage basin covers parts of Bryan, Bulloch, Liberty, and Long Counties within Coastal Georgia, but also includes areas within Evans and Tattnall Counties within the Altamaha region. However, the total water withdrawals and wastewater returns within each LDA are important regardless of region because these are linked to the surface water available from that source at that particular location.

While the total water withdrawal from the LDA is an important factor, accounting for the wastewater put back into the river is also vitally important to the total flow in the river. Consumption is defined as the amount of water withdrawn minus the amount of wastewater returned. Figure 14 shows how consumption is calculated for the Kings Ferry node in 2050.

There are two upstream drainage basins that feed into the Kings Ferry node: Eden and Claxton. The boundaries of these LDAs are shown on Figure 15 along with their respective consumption forecasts for 2050. All three nodes are “Planning” nodes where the surface water resource assessment was done to determine if a gap exists between the forecast and available stream flow. However, what happens upstream in Eden and Claxton has a big impact on stream flows at the Kings Ferry node. Figure 15 shows the cumulative Kings Ferry consumption which is the sum of all three drainage basins.

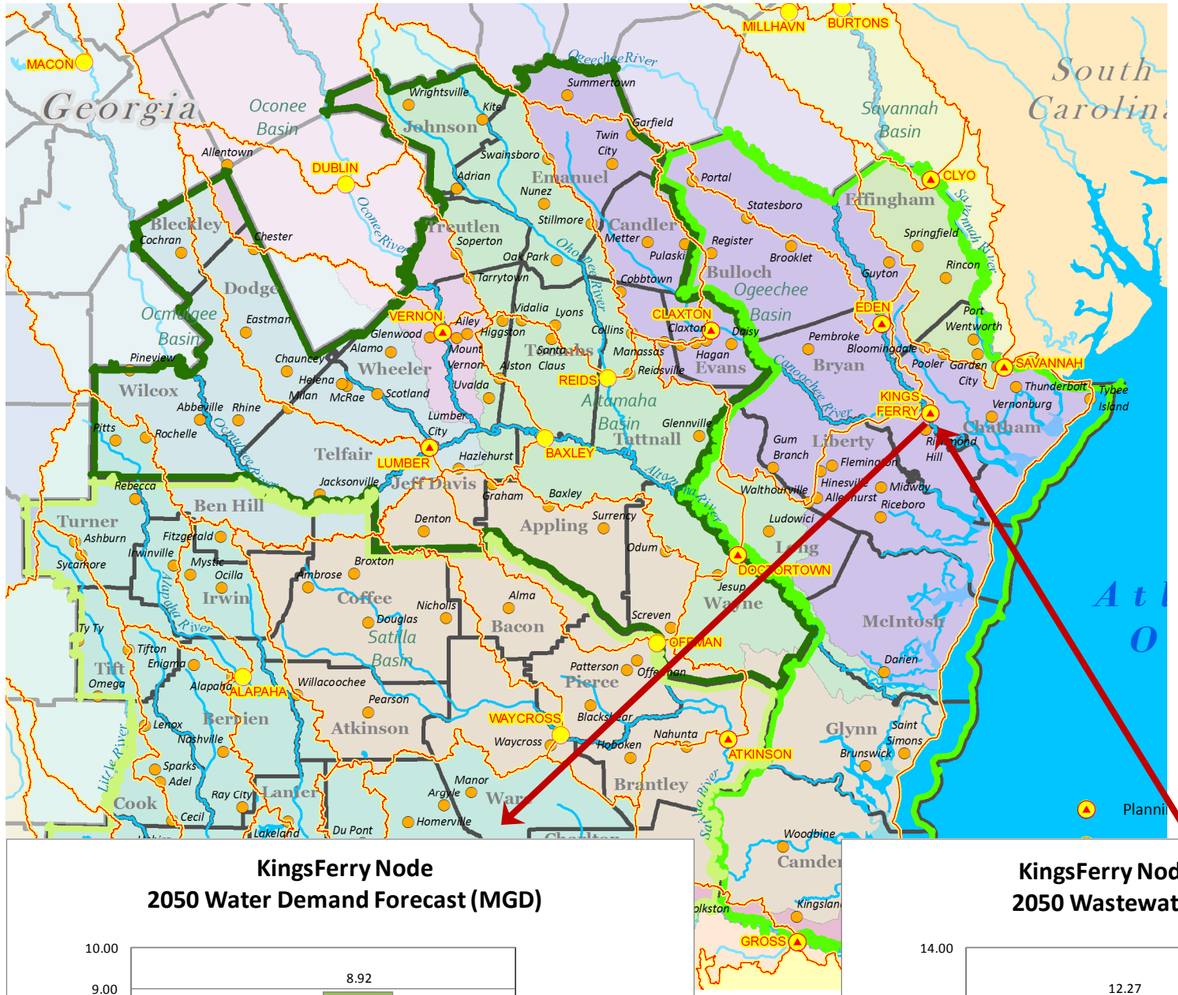
Figure 16 shows the cumulative Kings Ferry consumption and the gap volume determined through surface water resource assessment modeling. A suite of management practices will need to fill the gap.

Management Practices for Forecasted Need

The increase in water demand from 2010 to 2050 must be met through management practices. These can also be examined by aquifer and LDA. Figure 17 shows the cumulative Kings Ferry water forecast and the incremental need associated with each sector. This incremental need

can be met with a suite of Council-recommended management practices as shown in this example.

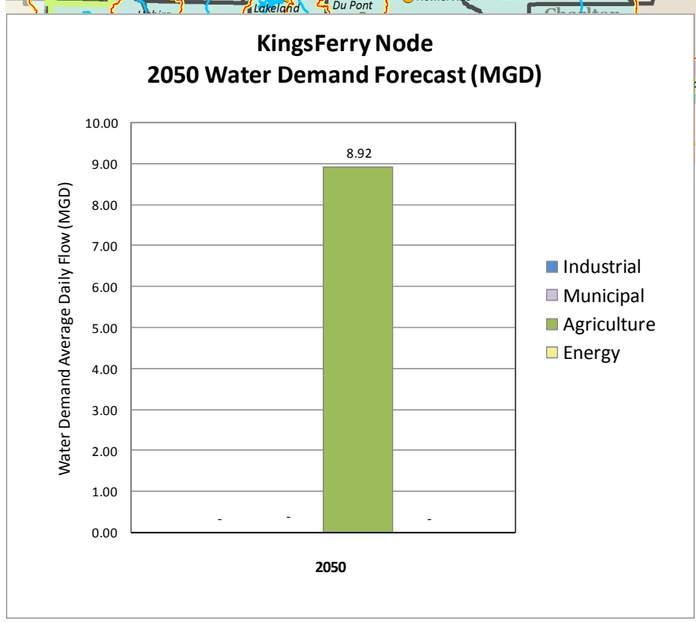
Figure 14: Kings Ferry Planning Node – Determining Consumption

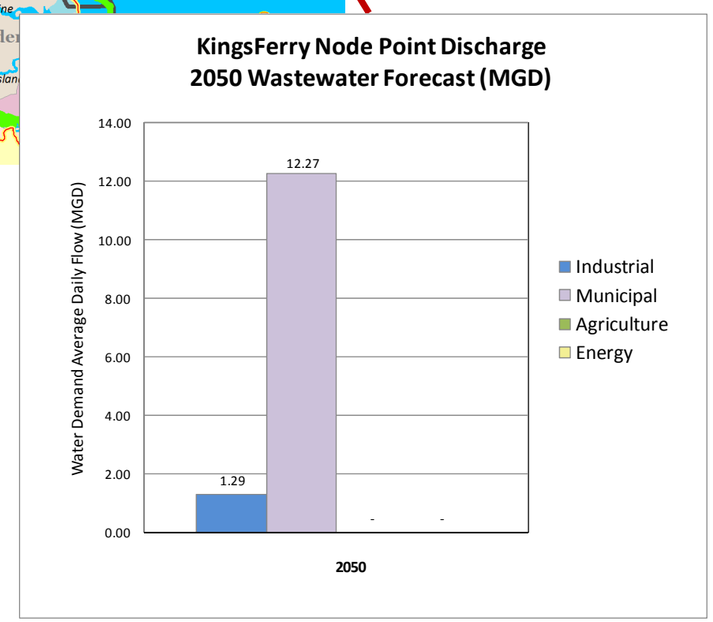


Kings Ferry Consumption at 2050

Consumption = SW WITHDRAWAL – POINT DISCHARGE WASTEWATER RETURNS

Industrial	=	0	-	1.29	=	-1.29 MGD
Municipal	=	0	-	12.27	=	-12.27 MGD
Agriculture	=	8.91	-	0	=	8.91 MGD
Energy	=	0	-	0	=	0 MGD
Net Consumption					=	-4.65 MGD





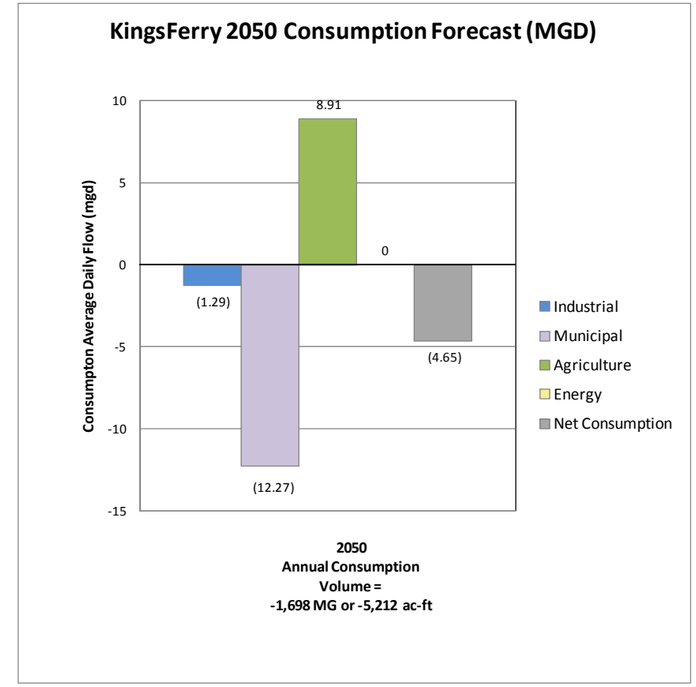
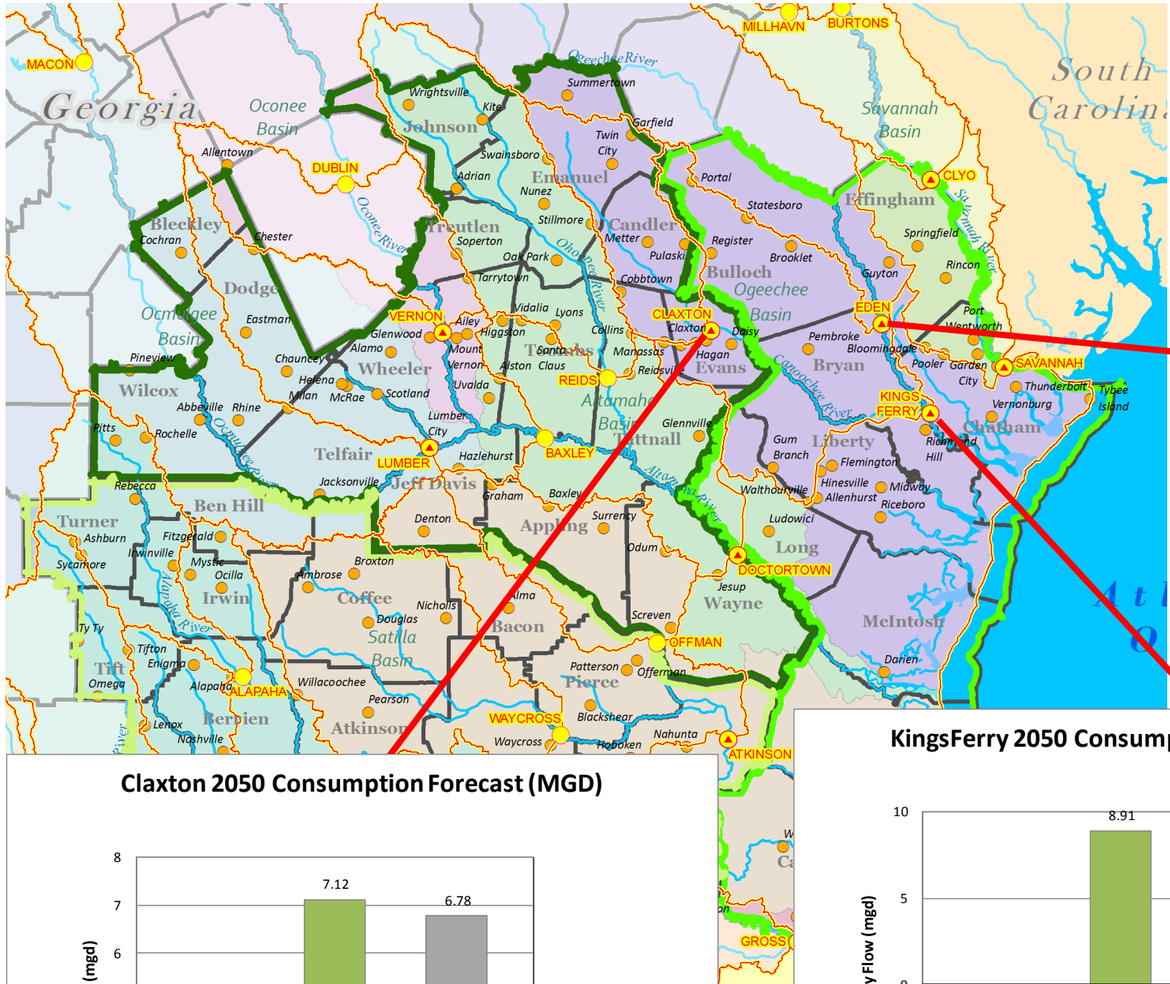
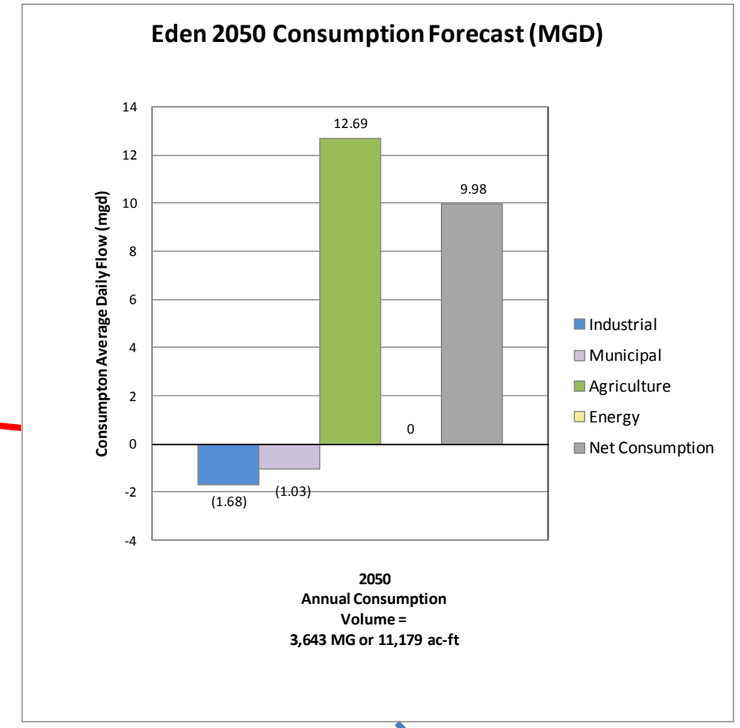
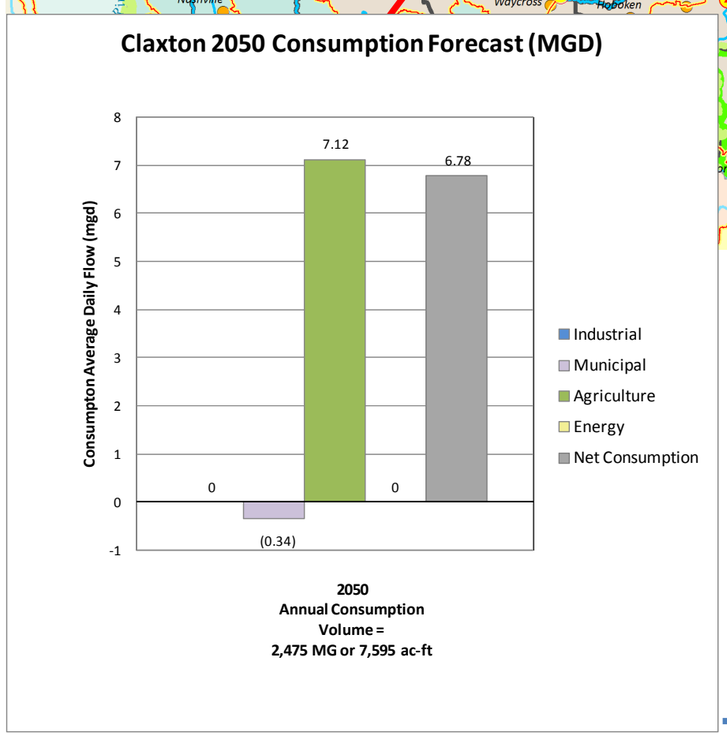
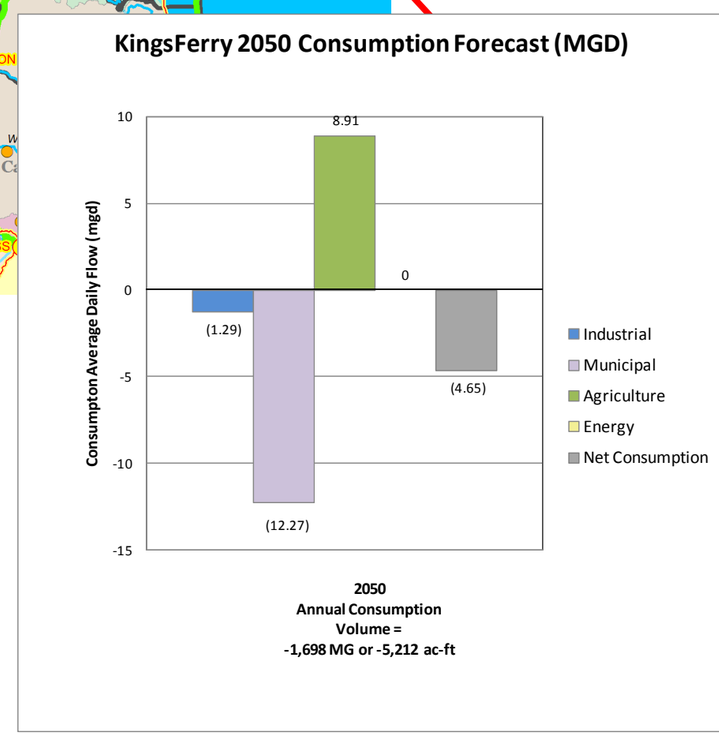


Figure 15: Kings Ferry Planning Node – Cumulative Consumption Forecast









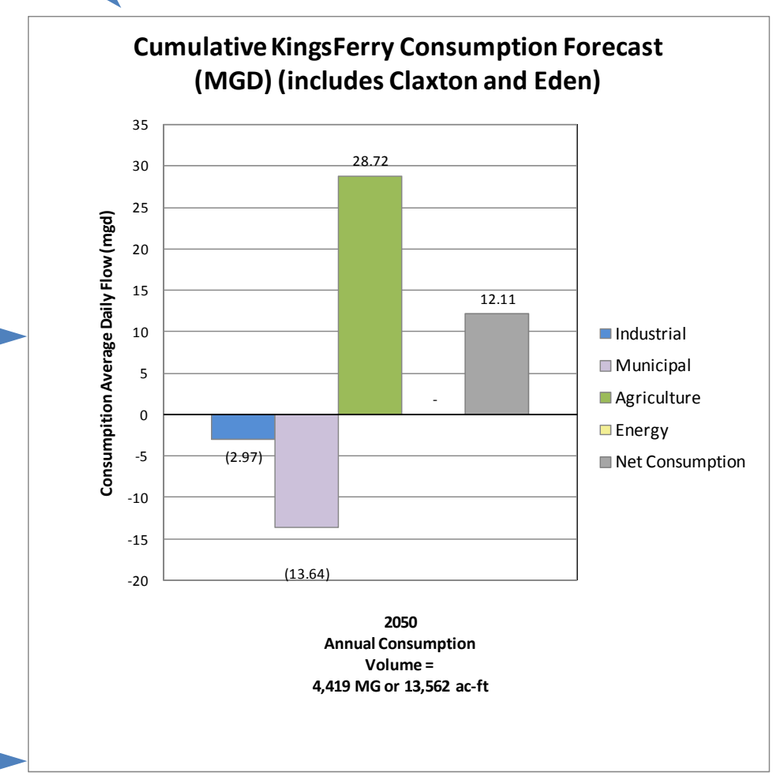
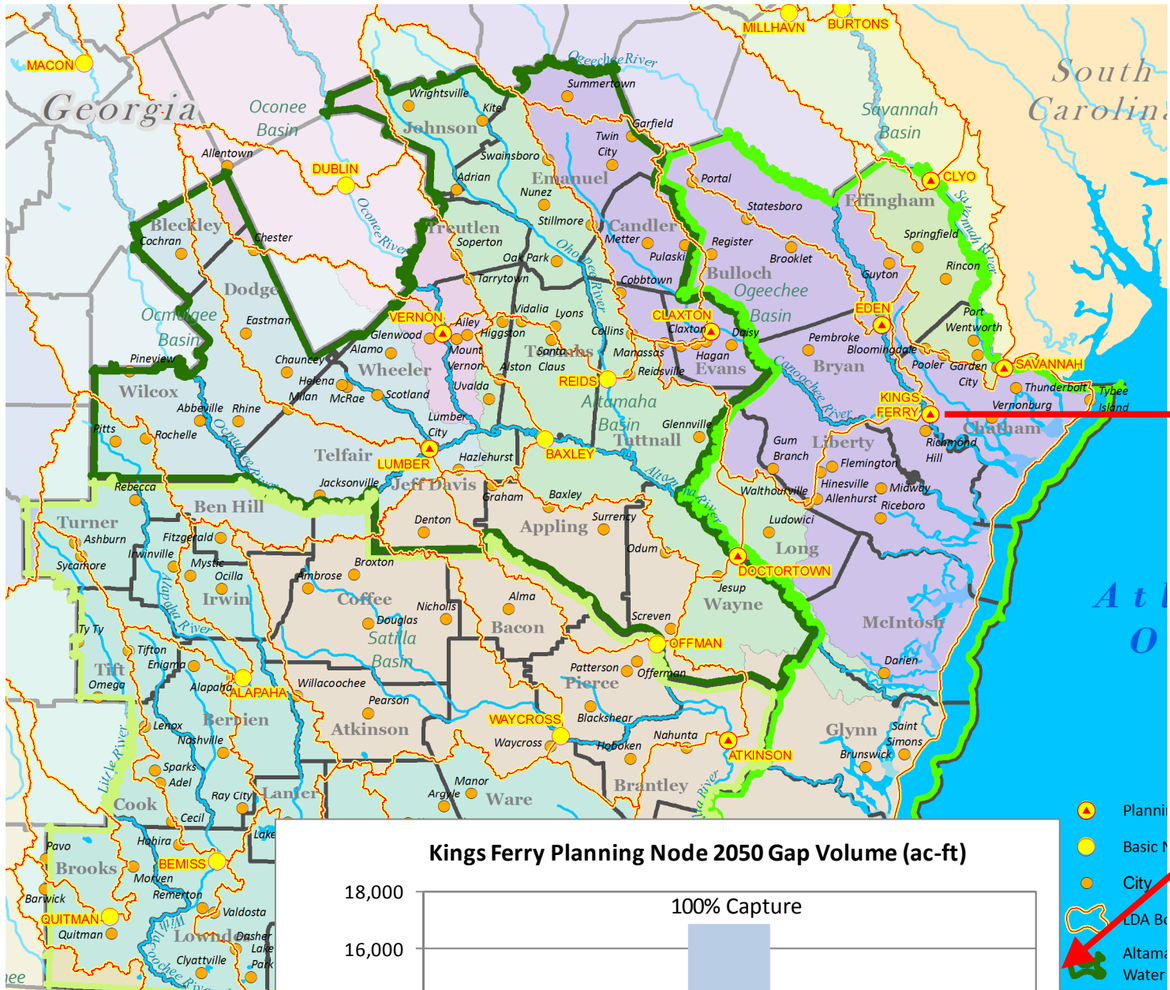
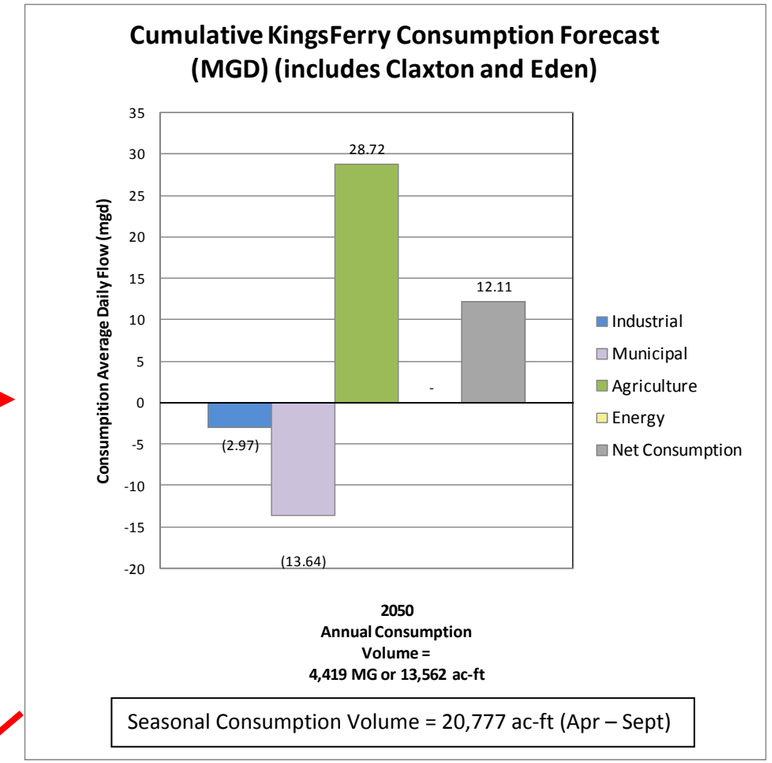
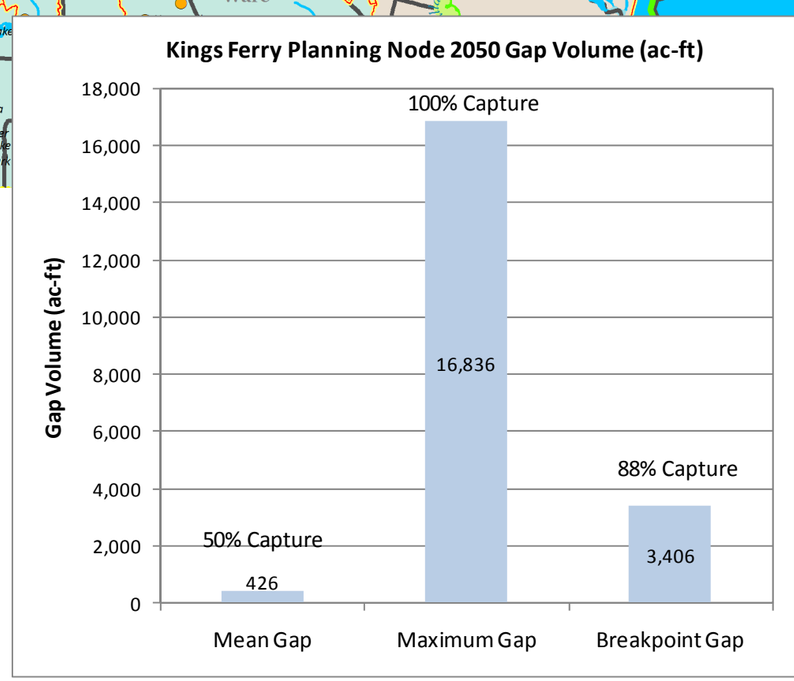


Figure 16: Kings Ferry Planning Node – Gap Analysis







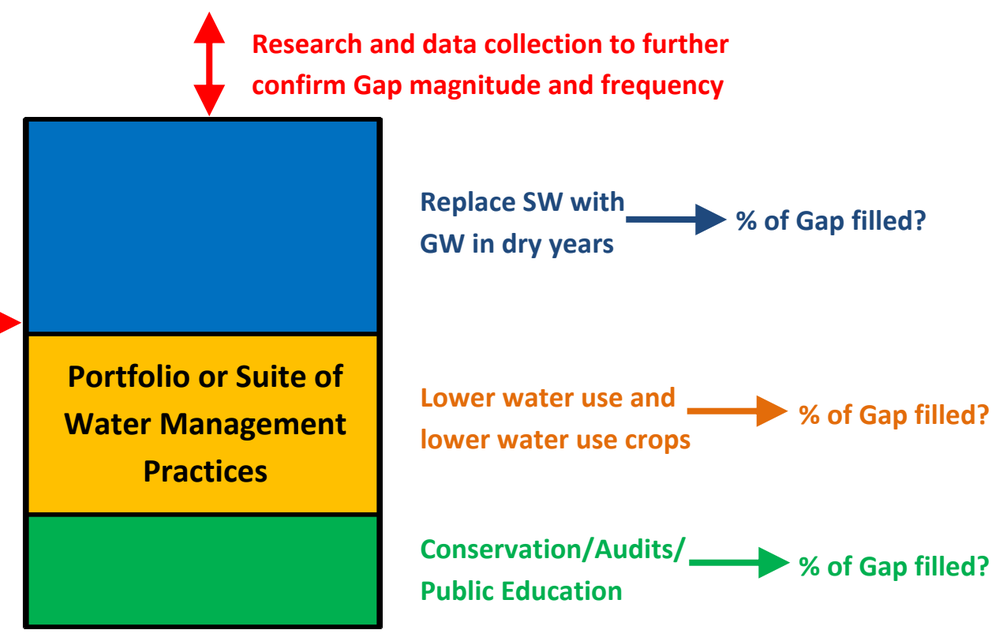
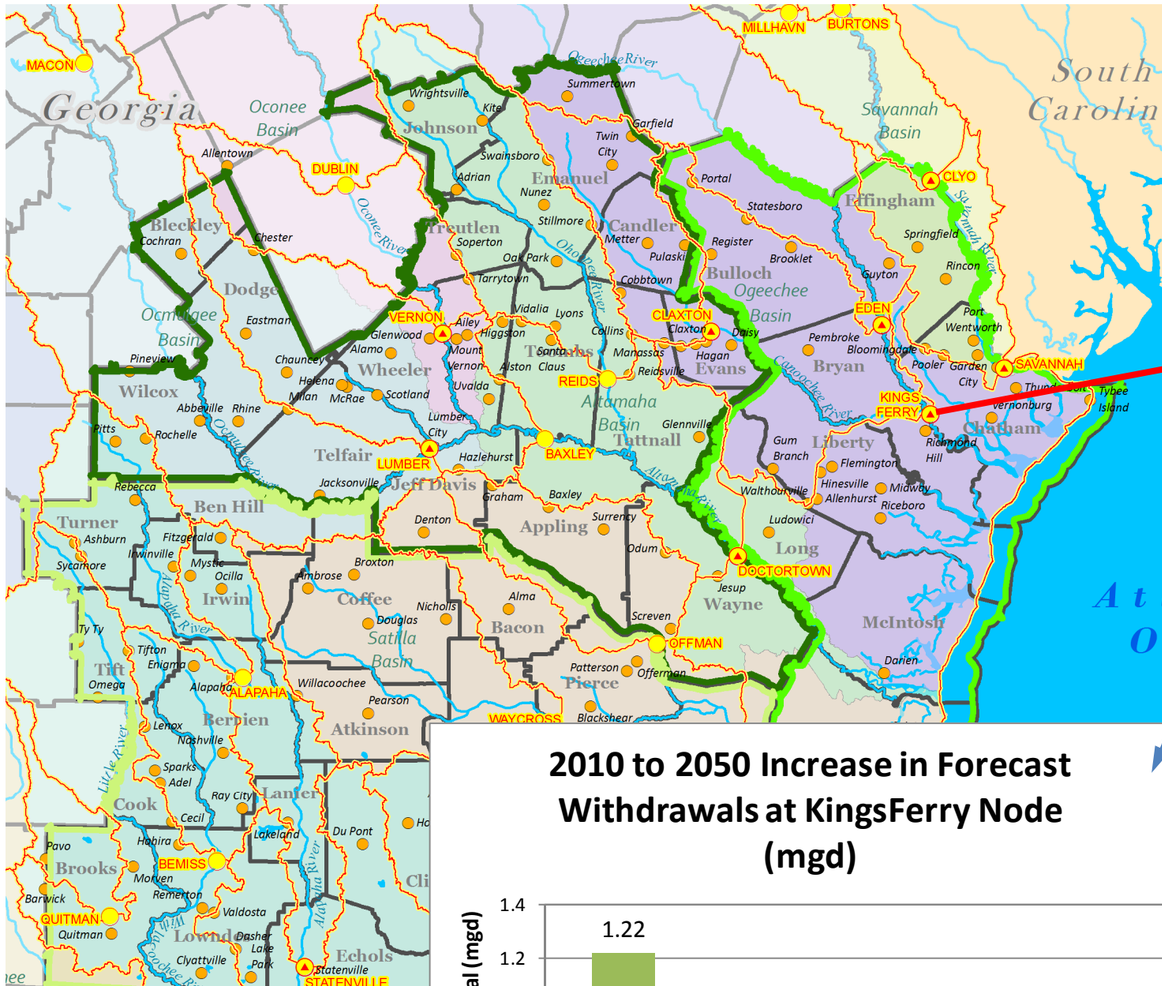
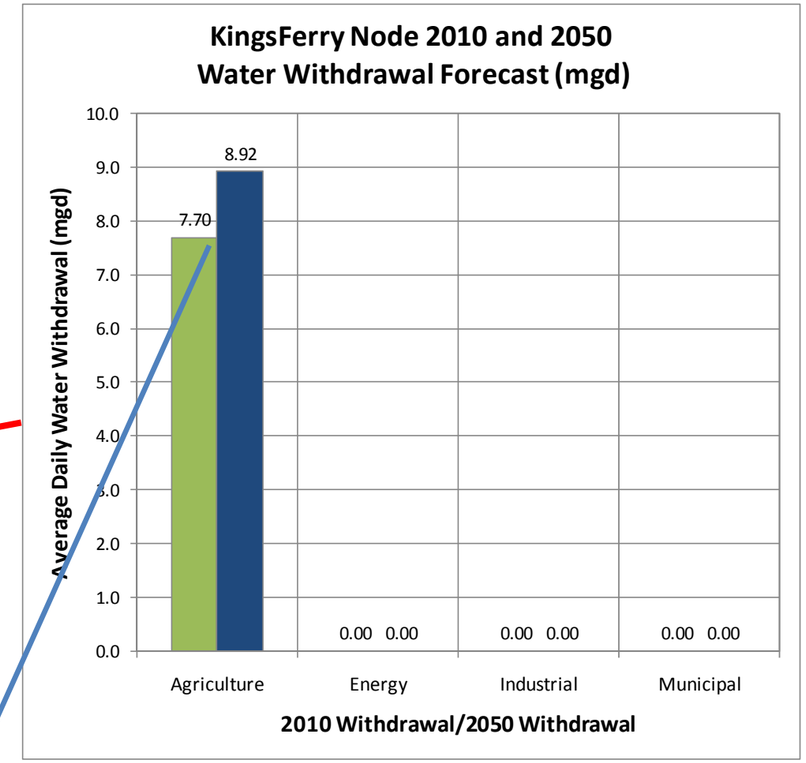
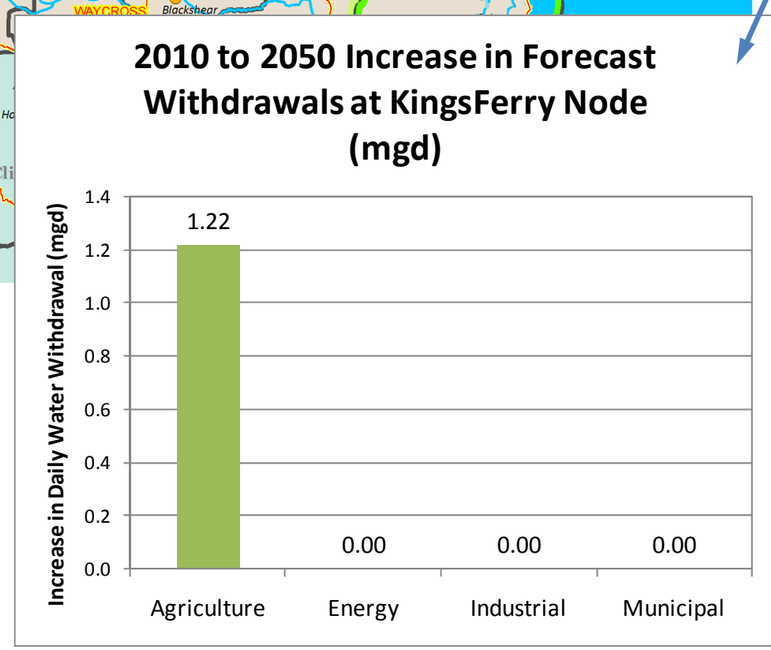
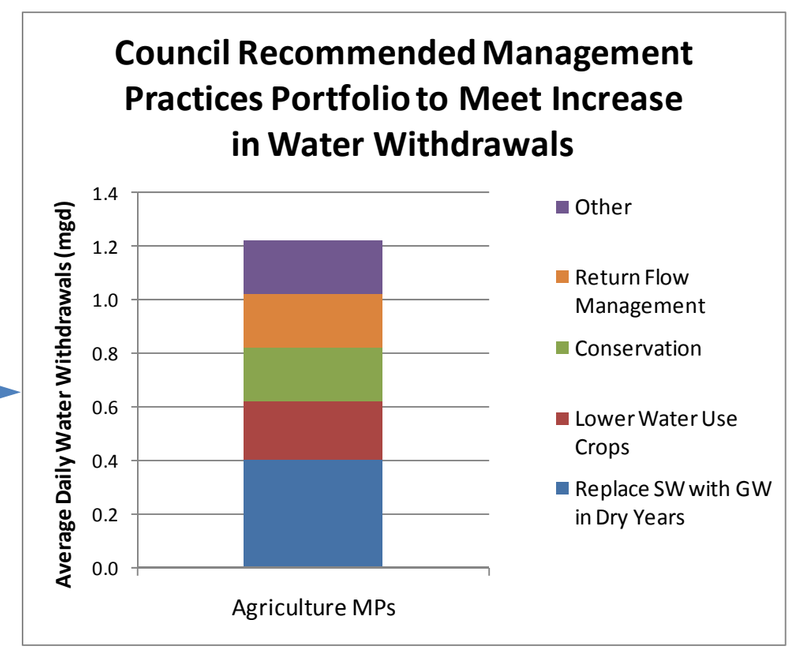


Figure 17: Kings Ferry Planning Node – Management Practices for Forecasted Need









Summary of Surface Water Gaps at Relevant Planning Nodes

Summary of flow regime shortage at Kings Ferry

	Length of shortfall (% of time)	Average shortfall (cfs)	Long-term average flow (cfs)	Maximum shortfall (cfs)	Corresponding flow regime (cfs)
Current	6%	35	3722	75	317
2050	4%	47	3736	100	245

Summary of flow regime shortage at Eden

	Length of shortfall (% of time)	Average shortfall (cfs)	Long-term average flow (cfs)	Maximum shortfall (cfs)	Corresponding flow regime (cfs)
Current	6%	19	2258	41	201
2050	4%	31	2262	54	155

Summary of demand shortage at Claxton

	Length of shortfall (% of time)	Average shortfall (cfs)	Maximum shortfall (cfs)	Corresponding demand (cfs)
Current	10%	5	17	18
2050	11%	11	31	32

Summary of flow regime shortage at Claxton

	Length of shortfall (% of time)	Average shortfall (cfs)	Long-term average flow (cfs)	Maximum shortfall (cfs)	Corresponding flow regime (cfs)
Current	18%	5	457	15	15
2050	17%	5	457	15	15

Summary of Surface Water Gaps at Relevant Planning Nodes Continued

Summary of Atkinson Node (CFS)

Scenario	Length of Shortfall (% of time)	Average Shortfall (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current Demand	11%	26	2257	63	73
2050 Forecasted Demand	7%	29	2269	54	70

Results of Surface Water Resource Assessment at Relevant Planning Nodes

Summary of Savannah Node

	Demand shortage (cfs)	Average at-site flow requirement shortage (cfs)[1]	Minimum conservation storage (acre-feet)	Minimum percent of conservation storage	Basin-wide flow requirement shortage
Current	0	N/A	Hartwell: 467,042 Thurmond: 302,386	Hartwell: 33.00% Thurmond: 28.90%	N/A
2050	0	N/A	Hartwell: 393,418 Thurmond: 258,480	Hartwell: 27.80% Thurmond: 24.70%	N/A

[1]Assumes an at-site flow requirement of 3,600 cfs (from USACE Savannah River Basin Drought Contingency Plan)

Summary of Gross Node (CFS)

Scenario	Length of Shortfall (% of time)	Average Shortfal (cfs)	Long-term Average Flow (cfs)	Maximum Shortfall (cfs)	Corresponding Flow Regime (cfs)
Current Demand	**0%**	**0**	**1240**	**0**	**N/A**
2050 Forecasted Demand	**0%**	**0**	**1240**	**0**	**N/A**

Results of Surface Water Resource Assessment at Relevant Planning Nodes - Continued

Summary of Doctortown Node

	Demand Shortfall	Up Res. Flow Req Shortage	Min Cons. Storage Left (ac-ft)	Column 3/Cons Storage (%)	Basin-wide Flow Req Shortage
Current	0	0	61000 At Lake Jackson and 94230 At Milledgeville	82% At Lake Jackson and 63% At Milledgeville	N/A
2050	0	0	55169 At Lake Jackson and 94676 At Milledgeville	74% At Lake Jackson and 63% At Milledgeville	N/A