



Water and Wastewater Forecasting Technical Memorandum

Coastal Georgia Regional Water
Planning Council

Cumberland Island

Supplemental Material
Initial Recommended Coastal Georgia
Regional Water Plan

May 2011



*Cumberland Island
photo courtesy of the Georgia
Department of Industry,
Trade & Tourism*

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1. Introduction

This report summarizes the results and methods that were used to complete water and wastewater forecasts for the Coastal Georgia Regional Water Planning Council. These forecasts and related elements of water resource planning are being conducted pursuant to a framework plan that is known as the Georgia Comprehensive State-wide Water Management Plan (CSWMP). For more information and to review the CSWMP please visit

http://www.gawaterplanning.org/pages/technical_guidance/state_water_plan.php

Section 14 of the CSWMP empowers each of the Regional Water Planning Councils to prepare plans for the long-term water resource management needs in their respective regions. A map showing the boundaries of the Regional Councils is shown in **Figure 1** (color shading depicts discrete surface water drainage basins).

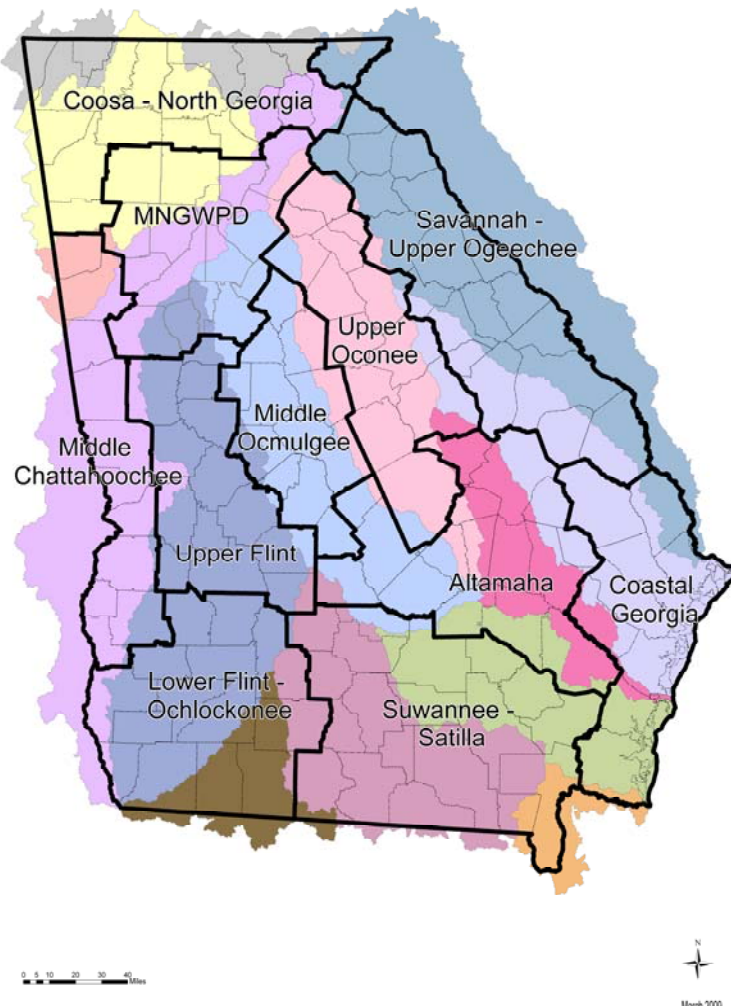


Figure 1: Georgia State-wide Water Planning Regions

At the heart of the state planning process is recognition of the importance to wisely and comprehensively manage Georgia's water resource to benefit current and future generations. To accomplish this goal, there is a commitment to:

- Develop resource assessments to evaluate current and future resource conditions
- Develop regional forecasts of water supply and assimilative capacity demands through the year 2050
- Employ a planning process that focuses on regional planning by tasking local regional water planning councils with the development of Regional Water Plans
- Employ an iterative process of developing and improving planning over time, rather than developing a one-time plan. The regional plans will be updated at 3-5 year intervals.

Information regarding the other elements of water resource planning in the above list will be developed and described in the recommended Regional Water Plans, which are scheduled to be submitted to the Georgia Environment Protection Division (EPD) in April 2011. These plans will undergo formal public comments and then the Director of EPD will either: adopt the plan; advise the Regional Water Planning Council as to additional measures that should be taken to allow the plan to be adopted; or adopt the recommended plan with conditions.

The remainder of this report will focus on bullet 2 from the above list – the quantification of current water uses and conditions and forecasts of future water resource needs.

The Georgia water planning process examines and forecasts four major demand sectors:

Municipal – this sector includes domestic, commercial, and lower water use industries

Industrial – this sector includes higher water use industries

Agricultural – this sector includes major crops such as cotton, corn, peanuts, soybean, pecans, specialty crops, and nursery and horticulture; a snapshot of major livestock water use and golf course water use

Energy – this sector includes thermoelectric power generation

Each of the above water demands and forecasts was undertaken concurrently by different expert. This report will provide detailed information on the municipal and industrial water and wastewater forecast and will provide references and brief summaries for the agricultural and energy forecasts.

Forecasting water demand involves two critical components: rate of water use and the number of water users. As described in more detail below for municipal water, the average per capita use is multiplied by the number of people using the water. For industrial water, the average water demand per employee is multiplied by the number of employees. In both cases, determining the appropriate water use rate and estimating the number of users are fundamental elements.

During the regional planning process, the majority of Council members identified some level of concern with the forecast process. The two primary concerns were:

- Ensuring accurate data
- Ensuring that data is not used to establish regional or local mandates

Central to these concerns is the fact that a goal of state and regional planning is the development of consistent and comparable sets of data. This means that one must rely on select data sets (common year for data inputs and comprehensive coverage of the state) that in many cases have broader coverage of the state, but may not be as precise as local provider level data. During development of the regional plan, there was a concerted effort to strike a balance between broad coverage and local data by using consistent data collection on a regional basis modified as appropriate with local provider input. These data and resulting forecasts are not applicable between regions or between providers within the region.

2. General Forecasting Methodology and Purpose

The process used to produce forecasts of municipal water/wastewater needs from population projections and industrial water/wastewater needs from employment projections is described below. The methodology described provides a means of maintaining consistency in the forecasting efforts in each of the planning regions, while still allowing for the incorporation of some regional variation. Beginning in 2010, Councils developed water and wastewater demand forecasts at 10 year increments through the year 2050 for the region to:

1. understand the changes the region may experience; and
2. identify future needs and any "gaps" that may exist between the capabilities of the available water resources, as articulated by the resource assessments, and the future regional water needs.

The methodology to forecast water and wastewater demands is based primarily on the assumption that there will be a continuation of existing trends and practices. It does not make a determination regarding the efficiency or inefficiency of forecasted demands, only that they are expected to occur given current trends. Initial forecasting does not take into account management practices, including water conservation (other than passive conservation as described in more detail below) that may be adopted by Regional Water Planning Councils to reduce the expected magnitude of demand. Additionally, this forecasting effort does not change EPD requirements related to individual permitting decisions, but represents a forecast for regional water planning.

It is also important to note that the parameters identified in forecasts should not be used as performance standards or for water resource allocation. These parameters are provided to evaluate future needs, trends, and to help make informed decisions on how to meet future needs within the capacity of available resources.

2.1. Forecasting Categories

The basic methodology for forecasting water demand is to estimate demand separately for each major water use sector (municipal, industrial, agricultural, and thermoelectric power). For each sector, water demand will be estimated using a 'driver' multiplied by the rate of use approach. The driver is defined as a countable unit of water use, which can be projected in future years, such as number of people, number of employees in a business, unit of production, etc. The rate of use is defined as the quantity of water used by the driving unit per unit of time, such as gallons per person (capita) per day (GPCD).

2.2 Rate of Water Use

A per unit rate of water use, or water use factor, can be developed for most water use sectors given historical water use data and a defined demographic unit. Projection of future water demand then requires having projected values of the defined demographic unit. With this approach, the water use factor of each sector can be assumed to either remain constant into the future, decrease over time due to increases in water use efficiency, or increase over time due to more intensive water use.

While trends in future water use are uncertain, reasonable assumptions can be made that provide the foundation for estimating trends in the future. Scenarios can be developed that consider demands under potential alternative conditions. For municipal water and wastewater demand forecasts, population projections will provide the basis for estimates of future growth. For industrial water and wastewater demand forecasts, employment projections will provide the basis for estimates of future growth.

2.3 Population and Employment Projections

Population projections were prepared by the Governor's Office of Planning and Budget (OPB), the state agency responsible for demographic data, with assistance from the Applied Demography Program at the University of Georgia's (UGA's) Carl Vinson Institute of Government. Population projections were developed for each county in the state. The population projections reflect a single 'most likely' growth scenario. Projecting population involves many variables. Therefore, it is important to continually update projections as new information becomes available.

The Regional Water Planning Councils were provided with the opportunity to evaluate preliminary water use forecasts to determine if there was a need to develop an alternative forecast scenario(s) to reflect either higher or lower regional water use. All scenario(s) identified by the Councils will be evaluated in order to produce a set of forecasts of regional municipal water and wastewater demand.

Table 1 shows OPB's population projections by county in 10 year increments through 2050.

Industry-specific employment projections were prepared by UGA for Georgia EPD. These employment forecasts are utilized to forecast industrial water demand for the major water using industries in Georgia. Because the distribution of industrial demand may not directly follow population growth, the location of these industrial demands will not use population projection data by county. Regional industrial water demand forecasts will be driven by regional employment projections by industry category.

Table 1: Population Projections by County

County	PROJECTED POPULATION					Projected Population Increase 2010 to 2050	Percent Increase 2010 to 2050
	2010 ¹	2020 ¹	2030 ¹	2040 ²	2050 ²		
Bryan County	33,326	45,272	59,534	72,277	87,417	54,091	162%
Bulloch County	70,872	88,071	109,034	129,873	150,448	79,576	112%
Camden County	50,515	70,548	96,743	122,355	150,066	99,551	197%
Chatham County	257,402	290,615	324,098	355,207	385,588	128,186	50%
Effingham County	56,177	80,563	112,062	141,927	169,753	113,576	202%
Glynn County	78,627	93,461	109,771	127,340	146,557	67,930	86%
Liberty County	61,940	78,740	93,821	107,259	122,440	60,500	98%
Long County	11,893	14,386	17,171	20,446	24,280	12,387	104%
McIntosh County	12,061	16,039	20,686	24,833	29,433	17,372	144%
Total	632,813	777,695	942,920	1,101,517	1,265,982	633,169	100%

¹Source: Georgia 2030 Population Projections, Governor's Office of Planning and Budget, March 2010.

²Data based on the 2010-2030 projections extrapolated to 2040 and 2050.

2.4 Data Sources

Several data sources were used in developing municipal and industrial water and wastewater demand forecasts. In general, the data utilized came from two categories: permitted water withdrawals/discharges and demographic data.

The two primary sources of base year water use data are the 2009 USGS report, *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005* by Fanning and Trent, and Georgia EPD water withdrawal and discharge permit databases. The USGS report contains 2005 water use data for each county in Georgia by category and source. The report also provides county level information on total population and population served by public water suppliers. Permitted water withdrawal data was received from Georgia EPD in August 2009 in the form of two Microsoft Access databases, one containing records for surface water withdrawal and wastewater discharge permits and another containing records for groundwater withdrawal permits.

As the forecasting process progressed, additional data sources became available that helped to fill in data gaps and improve specific forecasting parameters. A database of all permitted land application and point source wastewater dischargers in the State of Georgia was made available to the planning contractors to supplement information that was otherwise unavailable in the EPD wastewater discharge permit database.

This data allowed for a better understanding of the regional ratio of wastewater discharged by land application or point source returns. In addition, Georgia EPD provided the planning contractors with discharge monitoring report (DMR) compliance spreadsheet data upon request in order to identify permits and flow data for wastewater facilities absent from both the EPD wastewater discharge permit database and the supplemental wastewater permit database mentioned above.

Demographic data utilized in developing the municipal and industrial water and wastewater demand forecasts included information pertaining to county population and population served by public water suppliers, housing stock estimates by county, and existing septic systems within a county. County population and population served by public water suppliers was available in the USGS report by Fanning and Trent. County population was cross-checked with U.S. Census Bureau data. The Georgia Drinking Water System Survey (DWSS) provided data on the population served by individual public water suppliers. This data was cross-checked with the USGS estimates of population served. The DWSS also contributed to the development of supplier-specific per capita water use rates. Public supplier per capita use rates for each county were weighted by the supplier's population served to calculate a county-specific municipal water use rate. Further discussion of the development of county water use rates can be found in Section 3.2 of this report.

3. Municipal Water Forecasting

For this state planning effort, municipal water includes uses for residential, commercial, and non-major water using industrial purposes. This water may be self-supplied by the user (such as individual wells) or publicly-supplied (which includes all public and private providers with 15 or more taps or that serve at least 25 people).

Residential water use is defined as water used for normal household purposes. This category includes water used for drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, watering lawns and gardens, residential car washing and swimming pools. Commercial uses include water used by hotels, restaurants, retail stores, office buildings and institutions, both civilian and military. This category also includes water for hospitals, schools, fire fighting, and recreational water uses such as water parks, as well as water losses in the treatment and distribution of water. Demands for major water using industries are projected separately utilizing a different methodology as described in Section 5.

3.1 Methodology

The municipal water forecasts are determined by multiplying the baseline per capita water use rate by the population served. Since the per capita rate for public water systems is different than those served by self-supply, the demands are calculated separately and then added together.

The self-supplied residential per capita water use rate of 75 gallons per capita per day (GPCD) was derived by USGS (Fanning & Trent, 2009) and was recommended for use to forecast future self-supplied residential water demand unless region specific factors necessitate modification of this value. As described in more detail below, the Coastal Georgia Regional Council elected to use 100 GPCD for the self-supplied forecasts.

The publicly-supplied water use rate is also expressed as GPCD and is determined by dividing the water supplier's daily average water withdrawal rate by the population served by that provider:

$$\text{GPCD} = [\text{Publicly Supplied Water Withdrawal (gallons per day)} / \text{Population Served by Public Supplier}]$$

This publicly-supplied water use rate is typically higher than the self-supply rate since public supply includes commercial water use as described above. It should also be pointed out that public supply withdrawal quantities include non-revenue water (NRW), which will be included in the per capita water use rate for each county. NRW includes losses during the treatment and distribution of water. The term "Unaccounted-for Water" was commonly used in previous years; however, NRW is the current term recommended by the American Water Works Association. NRW includes water losses and usage that is authorized but does not generate revenues.

The formulas used to calculate future self-supplied and publicly-supplied residential water demand are shown below:

*Future Self-Supplied Demand = 100 GPCD * Projected Self-Supplied County Population*

*Future Publicly-Supplied Municipal Demand = 2005 Per Capita Municipal Water Use Rate * (Projected County Population – Projected Self-Supplied County Population)*

Total Municipal Water Demand = Future Self-Supplied Demand + Future Publicly-Supplied Demand

Table 2 shows the division between the publicly-supplied and self-supplied populations by county for the Coastal Georgia planning region.

Table 2: Division of Population by Water Supply Category in 2005

COUNTY	2005 County Population ¹	Population Served by Public Supply ^{1,2}	Percent of County Population Publicly-Supplied ³	Percent of County Population Self-Supplied ³
Bryan	28,549	18,280	64%	36%
Bulloch	61,454	48,470	79%	21%
Camden	45,759	31,170	68%	32%
Chatham	238,410	208,610	88%	12%
Effingham	46,924	25,840	55%	45%
Glynn	71,874	62,600	87%	13%
Liberty	57,544	48,340	84%	16%
Long	11,083	3,350	30%	70%
McIntosh	11,068	5,380	49%	51%
REGIONAL TOTALS	572,665	452,040	79%	21%

Notes:

¹Data for 2005 from USGS 2009 report called Water Use in Georgia by County for 2005

²USGS defines public supply as any public or private water system that provides water to at least 25 people or if there are a minimum of 15 hookups or water connections.

³Calculated values. Population data is used only to derive percent publicly-supplied and self-supplied. Population data is not used for defining existing conditions.

3.2 Publicly-Supplied Water Use Rates

3.2.1 Data Sources

Three primary sources of data were used to calculate initial publicly-supplied per capita water demand rates by county:

- The U.S. Geological Survey (USGS) 2009 report entitled *Water Use in Georgia by County for 2005 and Water-Use Trends for 1980-2005* by Fanning and Trent. For each county in the state, this document shows the 2005 county population, public supply water demand, and population served by all public suppliers in the county. This report was the sole data set used to calculate the initial estimates for county publicly-supplied per capita demand rates. Please note that the USGS data include all public-supply water for each county, not just the major suppliers they list by name. USGS defines public supply as any public or private system that provides water to at least 25 people or a minimum of 15 hookups or water connections.
- The Georgia Environmental Protection Division (EPD) water withdrawal permit database 1997-2007. This database contains withdrawal totals for each surface water and groundwater withdrawal permit in the state. Municipal withdrawal permits in the database were used to cross-reference and confirm or identify discrepancies with USGS withdrawal estimates for major public suppliers. Discrepancies among the two data sources were noted as issues for follow up with major public suppliers.
- The EPD Drinking Water System Survey 2006-2009 (DWSS) is a database of self-reported public water supplier data including population served estimates. Population served totals for major public suppliers in this database were used along with USGS data to calculate GPCD values for major public suppliers. It is important to note that this data set is more likely to have subjective estimates of population and therefore the results should be used with caution.

3.2.2 Refinement Methodology

The initial calculation of county per capita municipal demand rates using USGS data revealed which counties had data that produced unusually high or low GPCD values. The 75 to 175 GPCD range appeared to be a 'typical' water use (most water use across the state fits into this range) and counties falling outside of this range were identified for potential follow up and outreach. The first adjustment made to the USGS GPCD rates was based upon feedback received by EPD following their information and outreach efforts in September and October of 2009 (Municipal Ad Hoc meetings in Columbus and Augusta).

The next step involved comparing GPCD values derived from the USGS 2005 water use data to weighted county GPCD values. The weighted county GPCD estimates were calculated from the EPD Drinking Water System Survey population served data and the USGS public supply withdrawal data for major public suppliers. The resulting GPCD values for major suppliers were then weighted by population served

to derive the weighted county GPCD estimates. In some cases, the two GPCD values were close while some were quite different. When the differences were more than 20 percent, these public suppliers were flagged for follow up.

As an added element of the analysis, an estimate of the percent of the total county population served by each of the county's major public suppliers was made by dividing DWSS supplier population served numbers by the USGS total county population value. A county-wide percent of population served by major suppliers was calculated for each county. For many of the rural counties, the USGS-identified 'major suppliers' only supply a small portion of the overall county population. This analysis allowed a determination of whether the population served by 'major suppliers' represented a significant portion of the overall county population and, thus the degree to which a weighted county GPCD may accurately represent the overall county publicly-supplied per capita water use.

The initial calculations of county GPCDs were shared with members of the Coastal Georgia Council Water and Wastewater Forecasting Ad Hoc subcommittees. Participants reviewed the data, and were asked for concurrence with those counties where additional follow up was recommended, any recommendations based upon verifiable local information, and lists of other water suppliers that should be contacted.

Based on this input, ultimately three criteria were used as guidance in determining which individual water supplier would be contacted:

1. Large water suppliers in each region in terms of population served.
2. GPCD value derived from USGS 2005 data was not within 20 percent of the GPCD value derived with population from the EPD Drinking Water System Survey Database.
3. County water use values were outside the 'normal' range of 75 to 175 GPCD.

A questionnaire was developed and used to conduct outreach phone calls. The questionnaire was designed to gather information pertaining to the verification of population served estimates, water withdrawal rates, water sold and/or purchased wholesale, and identification of large industrial or agricultural uses of publicly-supplied water.

Overall, the outreach effort was successful with seventy-five percent of suppliers responding to information requests. Critical information provided by suppliers resulted in adjustments to the calculated GPCD water use rates. Some municipal systems were called, but contact with appropriate personnel was not accomplished.

The feedback received as a result of the outreach effort was documented and tracked in an Excel spreadsheet. Data received allowed for adjustments to the GPCD for individual municipalities. Adjustments to individual municipal water system GPCDs, in turn, had an effect on the respective weighted county GPCDs.

Note that total county population numbers were not revised based upon information gathered from individual municipal water systems.

3.2.3 Results

The publicly-supplied water use rates for each county within the three planning regions are presented in **Table 3**. The major public suppliers identified by the USGS 2009 report are listed for each county. Column C shows the original USGS County GPCD calculated from base year 2005 data listed in the USGS report. After the Municipal Ad Hoc Committee meetings in Augusta and Columbus, adjustments were made to the USGS GPCD based upon information provided by EPD and feedback they received from individual suppliers. Column D shows the USGS County GPCD after these initial adjustments were made.

Column E shows the major public supplier GPCD calculated using population served from the EPD Drinking Water System Survey (2006-2009). Column F shows the population-weighted County GPCD. Column G shows the adjusted major supplier GPCD after incorporating feedback from outreach to individual suppliers. These adjusted individual supplier data were then used to recalculate the population-weighted county GPCD as shown in Column H. Finally, the recommended County GPCD is listed in Column I. The recommended county GPCD is based upon a review and rounding of prior calculations and adjustments.

Figure 2 shows the recommended municipal water use rates by county geographically.

In some counties, additional follow up was not necessary because the USGS County GPCD and population-weighted GPCD values were within 20 percent of each other, and individual major supplier water use rates were within expected ranges.

When choosing between USGS and population-weighted GPCD without additional supplier feedback, the USGS value is chosen because the population-weighted GPCD value is calculated using the EPD Drinking Water System Survey population served data for years 2006-2009 rather than the 2005 base year. Also, as previously mentioned, the EPD DWSS data appears to have a higher degree of uncertainty.

In several counties, the population-weighted GPCD was notably different from the USGS GPCD and feedback obtained through outreach produced a more credible water use rate. A few examples are discussed below. For example, in Bulloch County the USGS County GPCD is 82.7 while the population-weighted County GPCD is 111.9. These values are slightly more than 35 percent different. Hence, the water use rates for the individual major suppliers in this county were evaluated.

Table 3: Municipal GPCD Development by County

A	B	C	D	E	F	G	H	I
County	Major Public Suppliers Listed by USGS ¹	Original USGS County GPCD ¹	USGS County GPCD After First Adjustment ²	Major Public Supplier GPCD ³	Population-Weighted County GPCD ³	Adjusted Major Public Supplier GPCD ⁴	Adjusted Population-Weighted County GPCD ⁴	Recommended County GPCD
Bryan	City of Pembroke City of Richmond Hill	94.6	94.6	89 119	112.4	115.4	109.7	110
Bulloch	Town of Brooklet Nevels Water Association Town of Portal Register Water System City of Statesboro	82.7	82.7	82 241 73 95 114	111.9	109.6	107.6	108
Camden	City of Kingsland City of St. Marys City of Woodbine USN Base Support	130.3	130.3	89 87 93 452	108.9			130
Chatham	City of Garden City	160.7	160.7	212	135.1	228.3	135.8	136
	Hunter Army Airfield			130				
	Town of Pooler			42		107.9		
	City of Port Wentworth			36				
	City of Savannah			146		124.0		
	Skidaway Island Util			unknown				
	City of Tybee Island			130				
Savannah - Glen Robin	128							
Savannah I & D						435.9		
Effingham	Coastal Water & Sewer	1404.4	78.1	unknown				119
	City of Guyton			92		82.9		
	Town of Rincon			203	154.4	116.5		
	City of Springfield			137		165.0		

A	B	C	D	E	F	G	H	I
County	Major Public Suppliers Listed by USGS ¹	Original USGS County GPCD ¹	USGS County GPCD After First Adjustment ²	Major Public Supplier GPCD ³	Population-Weighted County GPCD ³	Adjusted Major Public Supplier GPCD ⁴	Adjusted Population-Weighted County GPCD ⁴	Recommended County GPCD
	Savannah I & D		Facility supplies mainly industry in Chatham County, raw water intake physically located in Effingham County					
Glynn	City of Brunswick	157.3	157.3	152	146.4		108.6	157
	Jekyll Island Water Authority			509				
	Glynn Co - St. Simons			94				
	Sea Island Services			478				
Liberty	City of Hinesville	100.1	95.6	125	134.8	83.4	108.6	109
	City of Midway			89				
	City of Walthourville			107				
	City of Riceboro			548		255.4		
	Fort Stewart					173.1		
Long	City of Ludowici	444.8	444.8	812	811.6	116.4	116.4	116
McIntosh	City of Darien	135.7	135.7	99	97.8	166.2	161.4	136
	Hog Hammock Commission			67				

Maximum Coastal Georgia Region GPCD 157

Minimum Coastal Georgia Region GPCD 108

Population-Weighted Coastal Georgia Regional GPCD 129

Sources:

1. USGS Water Use in Georgia by County for 2005

2. First Adjustments to USGS County GPCD:

Effingham County - Subtracted 34.33 mgd provided by Savannah Industrial and Domestic water provider from the total public supply withdrawals. Subtracted 750 people served by the Savannah Industrial and Domestic provider. It is assumed that not all water supplied by Savannah Industrial and Domestic is for industrial use; Additional data to account for water supplied to industrial vs. domestic users is pending.

Liberty County - Adjustment based on water withdrawal permit data for the Fort Stewart - Department of the Army facility (1.99 MGD) (GA EPD Permit Database). Adjusted GPCD calculation includes additional water use and additional population served (23,000) by the Fort Stewart drinking water system

3. Georgia EPD Drinking Water System Survey (2006-2009)

4. Feedback from outreach to public suppliers

5. Fort Stewart was not listed as a major supplier in the USGS report, but was added to this table based upon feedback from Ad Hoc Committee members. Supplier GPCD is based upon Ft Stewart's 2005 average withdrawal rate (1.99 MGD) and base force population of 11,384 (interpolated for 2005 based upon US Census data).

- Contacted for more information due to discrepancy between USGS and EPD Survey values OR abnormally high or low values
- One of top suppliers in region based upon population served
- One of top suppliers flagged for followup due to data discrepancies or anomalies



Figure 2: Municipal Water Use Forecasting – GPCD Numbers by County

The largest water supplier for the county is the City of Statesboro who serves approximately 25,000 people or 42 percent of the total county population. Their water use rate was estimated to be 114 GPCD based upon EPD DWSS data. As a result, Statesboro was selected for outreach. The Statesboro Water and Sewer Superintendent provided additional information for calendar year 2005 including actual population served numbers, average daily water withdrawal rate and average daily industrial

water use. Using these updated numbers, the adjusted municipal water use rate was calculated to be 109.6 GPCD for Statesboro during 2005. Next, the population-weighted county GPCD was recalculated using Statesboro’s revised number. This reduced the population-weighted county GPCD from 111.9 to 107.6. The 108 GPCD value is recommended for Bulloch County municipal water rate because the numbers are based upon actual data from the largest major supplier in the County.

In a few cases, the population-weighted GPCD was drastically different from the USGS GPCD and the values were outside reasonable ranges. In all of these cases, feedback obtained through outreach produced a more credible water rate. For example in Long County the USGS County GPCD was calculated as 444.8 while the population-weighted county GPCD was calculated as 811.6. Both of these values appear unusually high, so the major water supplier for the County, the City of Ludowici, was contacted to obtain additional information. Based upon this contact, the estimated population was increased from 1,651 to 1,976 and the average daily water withdrawal rate was reduced from 1.34 MGD to 0.23 MGD. These changes resulted in the adjusted supplier rate of 116 GPCD, a more reasonable value based upon local data.

For more details regarding the publicly-supplied municipal GPCD calculations including population served data and specific feedback data received from each provider, refer to the detailed tables in Appendix A.

Regional publicly-supplied municipal water use rates were also calculated from the recommended county water use rates. This data is presented in **Table 4** for the planning region.

Table 4: Regional Municipal Water Use Rates

Region	Category	Water Use Rate (GPCD)
Coastal Georgia	Maximum publicly-supplied county rate	157
	Minimum publicly-supplied county rate	108
	Population weighted regional average	129
	Alternate scenario regional water use rate	138
	Self-supplied	100

The Coastal Georgia Regional Council utilized the recommended publicly-supplied county water use rates for the baseline municipal forecast. The Coastal Georgia Council also developed an alternate scenario which utilizes a regional water use rate of 138 GPCD for every county rather than the individual county rates. The Council believes that a single number is better suited for regional planning and also believes that as the region grows, the mix of commercial/residential water use may be more similar to Chatham County.

3.2.4 Additional Considerations

It is recognized that in many parts of Georgia, transient populations due to visitation or non-residential status at university, training/educational facilities, military installations, or seasonal tourism can have a significant effect on water use rates. However, the water use by transient population is likely already included in the current and historical water withdrawals. Therefore, the calculation of the per capita water use rates for each county includes water use from any such transient populations. The population projections provided by OPB do not include information about significant changes in transient populations into the future. For forecasting purposes, the basic assumption is that initially the ratio of population captured by US Census to transient population will remain the same over the forecast period. Council was asked if changes are appropriate and for this round of planning Council agreed to this assumption but also recognized that if a major shift occurred such as a shift in military populations, this assumption may need to be revisited.

3.3 Self-Supplied Water Use Rates

There are many residents that supply their own water, typically through private wells located on their own property. Generally these households are in more rural areas and their wells are typically not metered. Based upon a survey conducted in Athens, Georgia in 1983, the USGS 2009 report estimates self-supply per capita water use in Georgia as 75 GPCD. The Coastal Georgia Council chose to use a self-supplied water use rate of 100 GPCD. This rate was selected based upon local knowledge and water planning practice for some of the region's utilities that utilize 300 gallons per day per equivalent residential unit (ERU) or household. With a regional average of 2.6 persons per household (calculated from U.S. Census Bureau 2005-2009 American Community Survey data), this equates to 116 GPCD.

The 100 GPCD self-supply water use rate is well within Georgia's recommended septic tank design guidelines. The Georgia Manual for On-site Sewage Management Systems (p. D-15) states that in the absence of actual flow data, treatment units will be sized based upon 150 gallons per day flow per bedroom. With a regional average of 2.8 bedrooms per household (calculated from U.S. Census Bureau 2005-2009 American Community Survey data), this equates to an average recommended septic tank design capacity of 414 gallons per day. With 2.6 persons per household at the assumed 100 GPCD water use rate with a regional average of 82% indoor water use, one household would generate 212 gallons per day of wastewater. This wastewater flow projection is about 50% of the septic tank design capacity of 414 gallons per day. Therefore, the wastewater flow generated by the typical self-supplied household in the region using 100 GPCD of water is well within the septic tank design standards for Georgia.

3.4 Plumbing Code Efficiency Adjustments

Since 1994, the national plumbing codes have mandated lower maximum flush rates for toilets available in the United States (US), which has resulted in significant reductions in water use in Georgia and nationwide, and will continue to do so over the 40-year planning period for this forecasting. The National Energy Policy Act of 1992 (NEP Act) reduced the maximum flush volume for toilets from 3.5 gallons per flush to 1.6 gallons per flush (also called Ultra Low Flow Toilet, or ULFT) for all toilets available in the US starting in 1994. Furthermore, Georgia state code, Title 8, Section 8-2-3 states that after April 1, 1992, all residential buildings of all types shall not be constructed with a toilet that uses more than 1.6 gallons of water per flush. In addition to affecting new construction, when an older, high flush-toilet is replaced after 1992 due to remodel or replacement, it was replaced with an ULFT. This replacement of older fixtures lowers the water use rate over time.

Georgia Senate Bill 370, passed in March of 2010, mandates that on or before July 1, 2012, the Georgia Department of Community Affairs shall amend applicable state minimum standard codes to require the installation of high-efficiency plumbing fixtures in all new construction permitted on or after July 1, 2012. This legislation requires that any new buildings or any alterations made to existing buildings shall include the replacement of a malfunctioning, unserviceable, or obsolete toilet with a 1.28 per gallon flush High Efficiency Toilet (HET).

To account for increased efficiency of indoor plumbing fixtures resulting from replacement of old fixtures and construction of new homes required to install 1.28 gallons per flush HETs, the municipal water demand forecast model uses an adjusted county per capita water demand rate for each forecast year for both publicly-supplied and self-supplied categories. The estimated adjustment to per capita water demand is based upon the anticipated rate of replacement of higher flush volume toilets with HETs. The effect of the adjustment for increased efficiency in toilets is commonly referred to as passive conservation.

The calculation of the per capita water use rate using current (2005) withdrawal data described in the previous section already reflects the effect of the plumbing codes over the 13-year period of 1992-2005. However, an estimate needs to be made for the effect of the plumbing code requirement due to toilet replacement over the period of 2010-2050. This section describes the methodology for estimating the reduction of the water use rate due to the effect of the plumbing code on the publicly-supplied municipal water demand projections for the planning horizon of 2010 through 2050.

Methodology

The steps to estimate this reduction due to the plumbing code are described below. A sample calculation is provided in Appendix B.

Step 1. Estimate the current mix of toilets for each county by flush volume based on the US Census Age of Housing Units information. This estimate is based on the following timeline for different flush volume toilets in the Georgia.

- Toilets installed prior to 1980 use an average of 5 gallons per flush
- Toilets installed between 1980 and 1994 use an average of 3.5 gallons per flush
- Toilets installed after 1992 use 1.6 gallons per flush (ULFT)

Step 2. Estimate the water savings that will occur when these higher volume per flush toilets are replaced with HETs based on an estimate of the natural replacement rate of the current mix of toilets by county throughout the 40-year planning period. The recommended replacement rate value is 2 percent per year, which corresponds to a life of 50 years per toilet, and is consistent with other regional water planning efforts in Georgia (Metropolitan North Georgia Water Planning District).

The replacement of higher volume per flush toilets with HETs creates a changing mix of the number of toilets in each flush volume category mentioned in Step 1 for each county. The number of 1.28 gallon per flush toilets increases annually, replacing the toilets in the other volume per flush categories equally throughout the 40-year planning period. Based on the changing ratio of toilets by flush volume category, the total water saved as a result of the replacement of higher volume per flush toilets is calculated as the difference between the water demand of the base year mix of toilets and the water demand of the mix of toilets following the replacement.

Step 3. Apply the plumbing code adjustment as a reduction to the calculated per capita water use rate for each county over the planning period. The annual water savings calculated in Step 2 is converted into a per capita savings based upon the county population to determine the gallons per capita per day reduced as a result of replacement with HETs.

This adjustment to the water use rate is made before the wastewater forecasting is performed. See Appendix B for example calculations.

3.5 Municipal Water Forecasting Results

Municipal water needs are calculated in ten year increments for the 40 year planning horizon. **Table 5** presents the baseline data showing both publicly-supplied and self-supplied water needs separately and then totaled. For Coastal Georgia, current municipal water needs are met with groundwater in all counties except Chatham and Effingham. Along with groundwater, these counties utilize surface water from the Savannah River treated at the Savannah Industrial & Domestic Water Plant to meet 14% of the total water need in Chatham County and 50% of the total water need in Effingham County. The proportion of water demand met with surface water and groundwater is held constant throughout the planning horizon. Changes in these ratios can be addressed by Councils as part of management practices.

Table 5: Baseline Municipal Water Needs

Region	Category	Water Use Rate (GPCD)	2010	2020	2030	2040	2050	Percent Increase 2010 - 2050
Coastal Georgia	Publicly-supplied	by county	64.76	76.96	90.24	102.50	114.79	77%
	Self-supplied	100	13.50	16.94	20.92	24.57	28.19	109%
	Total		78.27	93.89	111.17	127.07	142.97	83%

Table 6 shows the forecasted municipal water needs by county in the Coastal Georgia region. These numbers are depicted graphically in **Figure 3** with the 2010 forecast demand shown in blue and the incremental increases in demand for each sequential 10 year period shown in other colors.

For Coastal Georgia, increases in forecast water demand are the greatest in Camden and Effingham Counties with estimated water demand nearly tripling by 2050. The municipal water demands in Bulloch, Chatham and Glynn Counties also show significant increases by 2050.

Table 6: Coastal Georgia Region Total Municipal Water Demand (MGD), Average Annual Demand (AAD)

COUNTY	2010	2020	2030	2040	2050	Percent Increase 2010- 2050
Bryan	3.55	4.74	6.14	7.33	8.72	146%
Bulloch	7.53	9.18	11.14	13.00	14.75	96%
Camden	6.09	8.39	11.34	14.13	17.07	180%
Chatham	33.80	37.41	40.86	43.84	46.57	38%
Effingham	6.20	8.75	11.98	14.93	17.57	183%
Glynn	11.79	13.79	15.94	18.18	20.58	75%
Liberty	6.64	8.29	9.69	10.87	12.17	83%
Long	1.25	1.48	1.74	2.03	2.37	90%
McIntosh	1.42	1.85	2.34	2.75	3.20	126%
Grand Total	78.27	93.89	111.17	127.07	142.97	83%

The municipal water forecasts include a reduction to the publicly-supplied and self-supplied water use rate over time beginning in 2020 due to passive conservation as described above in Section 3.3. **Table 7** depicts this reduction in terms of municipal flowrate and percent decrease by county.

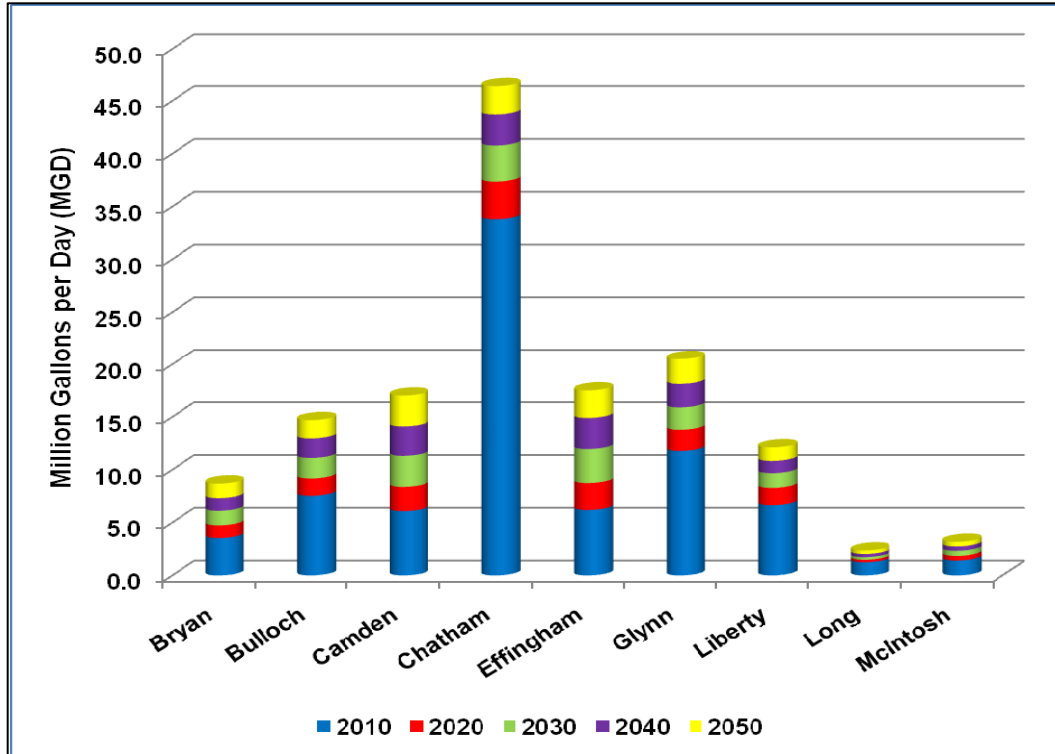


Figure 3: Coastal Georgia Region Municipal Water Demand Forecast 2010 and Incremental Increases to 2050

Table 7: Reduction in Baseline Municipal Water Forecast Due to Passive Conservation

County	Percent Reduction in Municipal Water Demand					Passive Conservation Demand Reduction (MGD)				
	2010	2020	2030	2040	2050	2010	2020	2030	2040	2050
Bryan	0.0%	1.5%	3.1%	4.7%	6.2%	0.00	0.07	0.20	0.36	0.58
Bulloch	0.0%	1.9%	3.9%	5.8%	7.8%	0.00	0.18	0.45	0.81	1.25
Camden	0.0%	1.4%	2.8%	4.3%	5.7%	0.00	0.12	0.33	0.63	1.03
Chatham	0.0%	2.0%	4.0%	6.0%	8.0%	0.00	0.76	1.70	2.81	4.07
Effingham	0.0%	1.5%	3.1%	4.6%	6.2%	0.00	0.13	0.38	0.72	1.16
Glynn	0.0%	1.6%	3.2%	4.8%	6.4%	0.00	0.22	0.52	0.91	1.40
Liberty	0.0%	1.8%	3.7%	5.5%	7.3%	0.00	0.15	0.37	0.63	0.96
Long	0.0%	1.7%	3.5%	5.3%	7.1%	0.00	0.03	0.06	0.11	0.18
McIntosh	0.0%	1.8%	3.7%	5.5%	7.4%	0.00	0.03	0.09	0.16	0.27
Total	0.0%	1.8%	3.6%	5.3%	7.1%	0.00	1.69	4.10	7.14	10.89

Table 8 shows the Coastal Georgia region’s water demands for an alternate scenario utilizing a single regional water use rate for all publicly-supplied water. This approach increases the forecasted municipal water demands from the baseline scenario by about 5% in 2010 to 6.5% in 2050.

Table 8: Alternate Scenario Municipal Water Needs for Coastal Georgia

Region	Category	Water Use Rate (GPCD)	2010	2020	2030	2040	2050	Percent Increase 2010 – 2050
Coastal Georgia	Publicly-supplied	138	68.69	82.12	96.82	110.37	124.00	81%
	Self-supplied	100	13.50	16.94	20.92	24.57	28.19	109%
	Total		82.20	99.06	117.74	134.94	152.19	85%

Table 9 shows a detailed comparison of the baseline to alternate publicly-supplied water demand forecast by county.

Table 9: Total Publicly-Supplied Water Demand (MGD), AAD Comparison of Baseline County-based to Alternate Regional GPCD

COUNTY	2010	2010A	2020	2020A	2030	2030A	2040	2040A	2050	2050A
Bryan	2.35	2.94	3.14	3.95	4.07	5.13	4.86	6.16	5.78	7.35
Bulloch	6.04	7.71	7.36	9.44	8.93	11.51	10.43	13.50	11.83	15.39
Camden	4.48	4.75	6.18	6.55	8.36	8.87	10.43	11.07	12.61	13.40
Chatham	30.59	31.08	33.87	34.43	37.02	37.65	39.75	40.44	42.26	43.00
Effingham	3.67	4.27	5.19	6.05	7.12	8.31	8.88	10.39	10.46	12.26
Glynn	10.78	9.45	12.62	11.04	14.59	12.74	16.66	14.51	18.87	16.40
Liberty	5.65	7.18	7.06	9.00	8.25	10.57	9.26	11.90	10.36	13.38
Long	0.42	0.50	0.50	0.59	0.58	0.70	0.68	0.82	0.80	0.96
McIntosh	0.80	0.81	1.04	1.06	1.32	1.34	1.56	1.59	1.81	1.85
Grand Total	64.76	68.69	76.96	82.12	90.24	96.82	102.50	110.37	114.79	124.00
Increase from County-based to Regional GPCD (mgd)		3.93		5.16		6.58		7.87		9.21
Percent Increase from County-based to Regional GPCD		6.1%		6.7%		7.3%		7.7%		8.0%

3.6 Geographic Distribution of Municipal Water Needs

There are two main sources of municipal water: surface water and groundwater.

Surface water sources include rivers and streams. The land area surrounding a river or stream is called a watershed or river basin. Any rain that falls into this area flows down into small tributaries which then flow into streams and finally into rivers. For planning purposes, river basins are subdivided into areas called local drainage areas (LDAs). There are location(s) called nodes within each LDA that contain surface water flow measuring gauge(s). Node locations where demands can be compared to available supply are called planning nodes. In this forecast, any water withdrawn in the LDA upstream of the node location or at the node location is summed up at the node for that sub-region.

Groundwater is found in aquifers beneath the earth's surface. An aquifer is a layer of permeable rock, sediment or soil that yields water. Aquifers are sometimes layered on top of one another or they can be located in separate areas horizontally at similar sub-surface depths.

Municipal water demand is assigned to a particular watershed or aquifer unit. This assignment is based on the location of current permitted surface water intakes and groundwater wells as well as input from water suppliers.

The forecasted geographic distribution of base year water demand is based upon water withdrawal location and supply source in relationship to the LDA or aquifer unit boundary. For future forecasting purposes, it is assumed that this distribution will remain the same as the base year. Using actual 2005 permitted water withdrawal data from the EPD withdrawal permit database, the ratio of withdrawal by source within a county is calculated. For instance, if 20 percent of the publicly-supplied demand in a county is occurring in Node A, under base scenario conditions, 20 percent of publicly-supplied demands in the county will continue to occur in Node A throughout the planning horizon. The municipal water demand forecast model allows for flexibility of the ratio of publicly-supplied demand by node or aquifer by county. Therefore, the distribution of demand by source within a county can be adjusted at a specific point in time within the forecast horizon.

As part of the planning process, Councils will have the flexibility to assign future water demands (and wastewater returns) to a specific location within an LDA or more detailed geographic location within an aquifer boundary. In making this determination, Councils will likely consider the magnitude and nature of future water needs in relation to available resource capacity.

4. Municipal Wastewater Forecasting

4.1 Methodology

Municipal water demands are the basis for estimating municipal wastewater flows. A portion of water used for residential or commercial purposes flows out of the residence or business as wastewater. This portion of water that returns to the sewer is estimated based on indoor water use because it is not returned directly to the ground through outdoor water uses such as irrigating landscapes or washing vehicles. An indoor water use percentage is multiplied by the estimated publicly-supplied and self-supplied water use to derive estimates of wastewater generated. The percent indoor water use for each county in Georgia was obtained from the Georgia Water Use and Conservation Profiles (CH2M-Hill, March 2008).

Estimates of wastewater generated from publicly-supplied and self-supplied water use are then translated into septic and centralized wastewater flows. U.S. Census data on the percent of households with septic systems in 2005 were obtained by county. For planning purposes, it is assumed that 100 percent of the wastewater generated from self-supplied water use is disposed of via septic system. Therefore, the percent septic value for wastewater generated from self-supplied domestic water use is assumed to be 100 percent. Using Georgia Health Department data on the number of septic systems by county in 2001 and 2007, the average annual addition of septic systems by county from 2002 to 2007 was calculated. Using the average annual addition of septic systems by county, the 2005 number of septic systems by county was interpolated. U.S. Census estimates of county population divided by housing stock allowed for the calculation of the county average number of persons per household. Dividing the USGS 2005 estimate of the self-supplied county population by the U.S. Census estimate of the 2005 persons per household resulted in an estimate of the number of self-supplied households by county in 2005. Subtracting the estimate of the number of self-supplied homes in 2005 from the estimate of the total number of septic systems in 2005 by county yielded the estimate of the number of municipally supplied households on septic in 2005. Dividing the number of municipally supplied households on septic by the U.S. Census estimate of the number of municipally supplied households by county provided an estimate of the percent of municipally supplied households on septic systems in 2005.

The formula for estimating county septic flow from both publicly-supplied municipal water use (PS) and self-supplied residential (SS) water use is as follows:

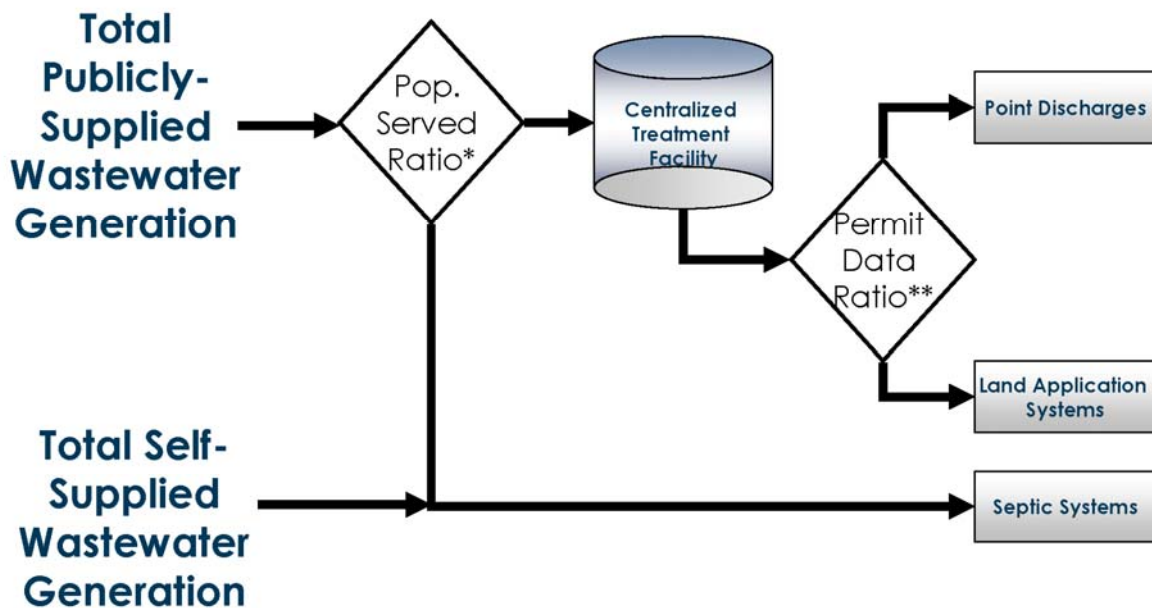
$$\text{Septic MGD} = [(PS \text{ MGD}) \times (\% \text{ indoor}) \times (\% \text{ septic})] + [((SS \text{ MGD}) \times (\% \text{ indoor}) \times (\% \text{ septic}))]$$

Estimates of wastewater flows to centralized wastewater treatment facilities are derived from the portion of wastewater flow that is not septic. In addition, a percent of flow is added to account for infiltration and inflow (I/I) that occurs in the wastewater collection system before reaching the treatment facility.

I&I is a term used to describe the ways that groundwater and stormwater enter into dedicated wastewater or sanitary sewer systems. Inflow is stormwater that enters into sanitary sewer systems at points of direct connection to the systems while infiltration is groundwater that enters sanitary sewer systems through cracks and/or leaks in the sanitary sewer pipes. Since I&I can vary between regions, an average I&I percentage can be determined for each water planning region based on input from water utilities. A 20 percent I/I was used as a reasonable generalization after consultation with EPD and other experts. Thus, the formula for estimating the centralized wastewater flow is as follows:

$$\text{Centralized MGD} = [((\text{PS MGD}) \times (\% \text{ indoor}) \times (1 - \% \text{ septic})) + ((\text{SS MGD}) \times (\% \text{ indoor}) \times (1 - \% \text{ septic}))] \times (1 + \% \text{ I/I})$$

Wastewater effluent flow from centralized treatment facilities is either discharged as a point source to a receiving water body or delivered to a land application system (LAS). Information obtained from existing EPD permit data as well as feedback from municipal suppliers was used to determine the ratio of point discharge to LAS for each county. **Figure 4** shows the simplified progression from municipal wastewater generation to ultimate discharge. Municipal wastewater parameters by county are shown in **Table 10** for the planning region.



*Based on 1990 US Census Bureau Data
 **Based on Existing GA EPD Permit Data

Figure 4: Municipal Wastewater Forecasting Flow Diagram

Table 10: Coastal Georgia Region Wastewater Forecast Parameters

County	Publicly - Supplied Water						Self - Supplied Water	
	Percent Average Indoor Water Use ¹	Percent Inflow and Infiltration	Percent of Households to Septic ²	Percent of Households to Centralized WW	Centralized WW		Percent Average Indoor Water Use ¹	Percent Septic
					Percent Point Source Discharge ³	Percent LAS		
Bryan	77%	20%	67%	33%	100%	0%	77%	100%
Bulloch	77%	20%	63%	37%	100%	0%	77%	100%
Camden	85%	20%	8%	92%	100%	0%	85%	100%
Chatham ⁴	82%	20%	1%	99%	98%	2%	82%	100%
Effingham ⁴	77%	20%	82%	18%	90%	10%	77%	100%
Glynn ⁴	82%	20%	33%	67%	99%	1%	82%	100%
Liberty ⁴	88%	20%	22%	78%	95%	5%	88%	100%
Long	85%	20%	67%	33%	100%	0%	85%	100%
McIntosh	87%	20%	87%	13%	100%	0%	87%	100%

Notes:

¹Data from Georgia Water Use and Conservation Profiles (2008).

² Estimate derived from a combination of 1990 U.S. Census data, 2002 and 2007 GA Health Department estimates of septic systems, USGS estimate of self-supplied population, U.S. Census population estimates, and U.S. Census housing unit estimates

³ Data from Georgia EPD Returns Permit Database (1990 - 2007) for base year 2005.

⁴ Percent point source discharge and percent LAS values were derived from additional Discharge Monitoring Reports provided by EPD. See Appendix C for detailed calculation tables

4.2 Municipal Wastewater Forecast Results

Municipal wastewater estimates are calculated in ten year increments for the 40 year planning horizon. **Table 11** shows the wastewater estimates broken down by disposal system.

Table 11: Municipal Wastewater Forecast by Region

Region	Disposal System	2010	2020	2030	2040	2050	Percent Increase 2010 – 2050
Coastal Georgia	Centralized Treatment - Point Source	48.30	56.29	64.73	76.30	80.29	66%
	Centralized Treatment - Land Application	1.13	1.31	1.49	1.73	1.81	60%
	Septic Systems	22.81	28.74	35.60	43.57	48.24	112%
	Total	72.24	86.34	101.82	121.60	130.34	80%

Figure 5 depicts the proportion of wastewater flow by septic and centralized bin the region. **Figure 6** shows the proportion of centralized wastewater that is discharged via point source or land application systems in the region.

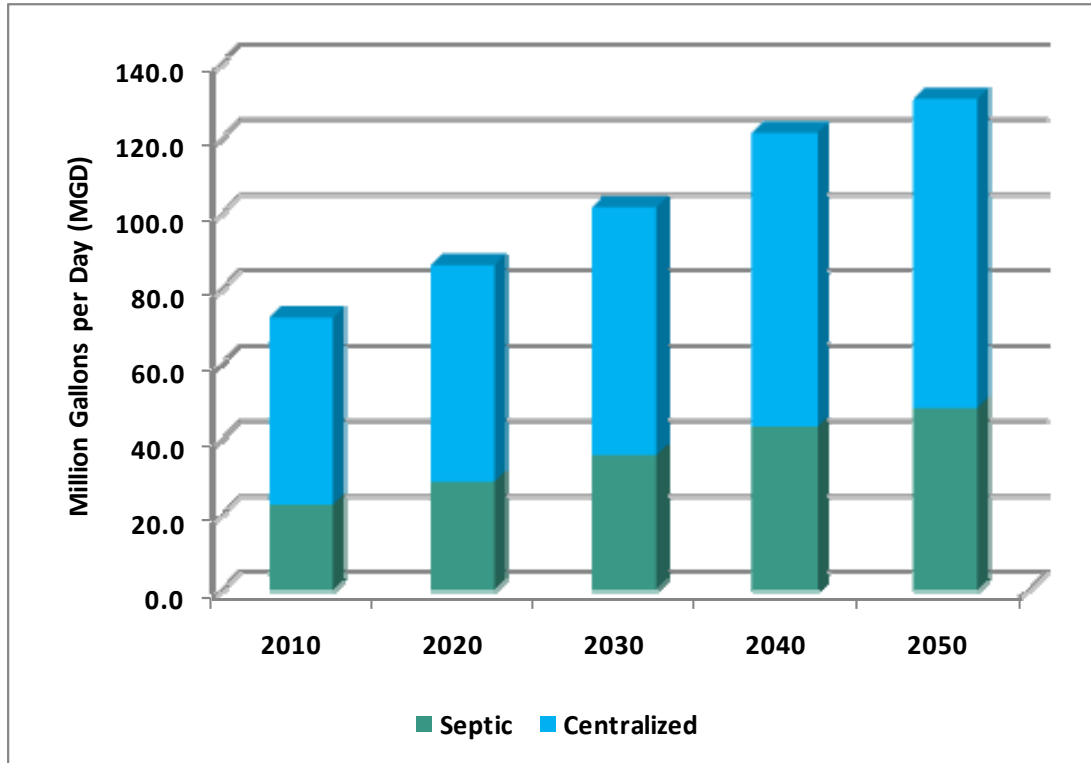


Figure 5: Coastal Georgia Total Municipal Wastewater Discharge, 2010-2050

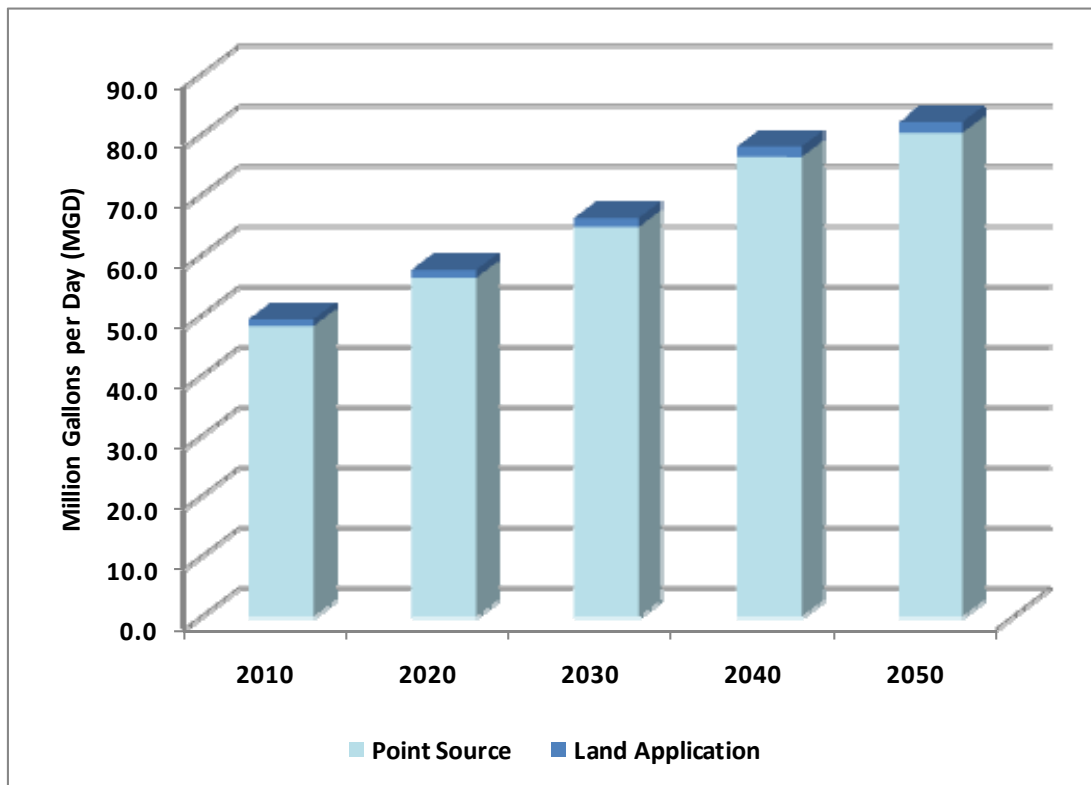


Figure 6: Coastal Georgia Centralized Wastewater Discharge by Type, 2010-2050

Table 12 shows the Coastal Georgia region’s wastewater forecast for the alternate scenario utilizing a single regional water use rate for all publically-supplied water. Since the calculated wastewater generated is based upon water demand, the wastewater forecast is also increased 5% at 2010 and 6.3% at 2050.

Table 12: Alternate Wastewater Forecast for Coastal Georgia

Disposal System	2010	2020	2030	2040	2050	Percent Increase 2010 – 2050
Centralized Treatment - Point Source	50.23	58.79	67.83	76.13	84.52	68%
Centralized Treatment - Land Application	1.21	1.41	1.61	1.79	1.97	63%
Septic Systems	24.32	30.75	38.22	45.11	52.00	114%
Total	75.76	90.96	107.66	123.03	138.49	83%

4.3 Geographic Distribution of Municipal Wastewater Flows

The geographical representation of wastewater generation is determined using existing EPD permit information and input from water utilities. Wastewater discharges and land application volumes are assigned to a watershed based on current distribution of sources from existing EPD permit information. During the selection of management practices by Water Planning Councils, this initial assignment of future wastewater generation locations may be adjusted.

5. Industrial Forecasting

Estimates of industrial water demands for major industrial water-using sectors are determined in each watershed and aquifer unit within the Water Planning Regions. The major water-using industries are shown in **Table 13**. Note that some data sources, such as USGS references, use the older Standard Industrial Classification (SIC) codes to categorize businesses and industries, while other sources use the newer North American Industrial Classification System (NAICS) codes. Both the SIC and NAICS codes are shown in Table 13 for the industries of interest. Other water-using industries in a given region may also be included in this estimation of industrial water use for each region. These demands outside the big 15 categories would be included in the 'Other and Unidentified' industrial category. There are many industries in the 'Other' category that are projected to have significant increases in employment over the planning horizon. These industries include: wholesale trade, retail trade, educational services, healthcare, general warehousing and food services.

Industrial water use for the major water using industries is primarily self-supplied water (that is, these industrial water users have water withdrawal permits). However, major industries that obtain water from municipal water systems are included to the extent that these industrial uses were identified and excluded from the municipal water use estimates as described in Section 3. Also, water use for non-major water using industries will be estimated as part of the municipal water use estimates described in Section 3.

Table 13: Industrial Categories and Codes

Industry	SIC Code	NAICS Code	Industry	SIC Code	NAICS Code
Apparel	23	315	Paper	26	322
Automobile	37	336	Petroleum and Coal Products	29	324
Chemicals	28	325	Primary Metals	33	331
Electrical Equipment	36	335	Plastic and Rubber	30	326
Fabricated Metal Products	34	332	Nonmetallic Mineral Products (includes Kaolin)	32	327
Food – Food Manufacturing	20	311	Textile Mills	22	313
Food - Beverage and Tobacco	20	312	Textile Product Mills (includes Carpet)	22	314
Mining	14	212			

5.1 Water Forecast Methodology

Industries require water for processes, sanitation, cooling, and other purposes, in addition to domestic (employee) water use. Some industries, such as poultry processors operate under strict USDA (U.S. Department of Agriculture) guidelines that require water use to maintain sanitary conditions within the facilities. Water need (i.e., the total water requirements of an industry, or the water withdrawals) is directly linked to production. However, in many instances historical production data and estimates of future production are proprietary information. Industry employment data are readily available, and employment is linked to production, and thus indirectly linked to water requirements.

Thus, by assuming that water use per production unit, and production per employee remain the same over the forecast period, future water needs can be estimated by future employment as follows:

$$\text{Future Water Need by Industry} = (\text{Water Need} / \text{Employment}) \times \text{Future Employment}$$

Since the future employment is the current employment times a rate of growth, the formula can be further simplified as:

$$\text{Future Water Need by Industry} = \text{Current Water Need} \times \text{Employment Growth Rate}$$

Employment projections by industry were prepared for EPD by the University of Georgia. Based upon the employment projections, the average annual growth rates for each of the major water using sectors were determined by planning region for the major industrial sectors at 5-year increments. Employment projections for the largest industrial water users in the Altamaha, Coastal Georgia and Suwannee-Satilla regions show declining trends and modest growth. In situations where there was a projected decline in an industry's employment, the forecast model applies a zero percent average annual growth rate to the base year demand. This approach was chosen instead of applying a negative rate which would have produced a decreasing water demand. Therefore, when an industry's employment is projected to decline or experience minor growth, the current water need remains roughly the same in future years.

The current industrial water use for each category was identified using the 2005 EPD industrial permit database to determine the actual withdrawal amounts for that base year. The 2009 USGS report listings of large industrial water users were also used. Data was collected by performing a query of the EPD database by specific region and industry. Permit location was used to determine the watershed/aquifer unit assignment within the basin. In addition, any large industrial water use extracted from municipal water use is included in the industrial water use if the industrial sector and corresponding employment is known. The water use information is summed for a given industry within a given watershed/aquifer unit to generate the demand on the resource.

As part of the forecast development, EPD conducted outreach meetings with industry stakeholders. Due to proprietary constraints and the complexities of manufacturing processes (e.g., different water requirements for different types of products), industries were unable to provide either water use per product or projections of future product production. Production related water use information was obtained from the Georgia carpet industry and is being incorporated into the water demand forecast for this industry.

EPD's industrial water withdrawal data covers industries that are self-supplied and have permits allowing them to withdraw over 100,000 gallons per day. Industries that are self-supplied, but withdraw less than 100,000 gallons per day are not required to have EPD permits and their actual withdrawals are not tracked by EPD. This category of industrial water use is not expected to be significant for overall forecasting. However, it is recognized that this sector of demand is underrepresented in the current methodology.

Industries that are supplied by municipal water systems are also not directly tracked by EPD. However, the water use for many of these industries was captured during outreach to municipal systems as part of the refinement process used to develop municipal water rates. If a municipal system reported large industrial water use customers, the average daily industrial water rate was subtracted from municipal calculations and added to the industrial forecast as a withdrawal from the same source as the municipal withdrawal. In some cases, the industry category was known and the industrial water use was added to the base year water use in the industrial model for that specific category. In other cases, the type of industry was unknown so the water use was added to an "All other or unidentified" industrial use category for that region.

The intent of the industrial water forecast is to capture water demands and trends among major water users. As noted in the description of the municipal publicly-supplied water demand, there is some publicly-supplied industrial water use represented within the municipal GPCD water use. The industrial water use model reflects large (greater than 100,000 gallons per day) self-supplied industrial water users, plus any indentified municipally supplied industrial large water users that are removed from the municipal GPCD calculations. This method avoids any double counting of industrial water use. However, small (less than 100,000 gallons per day) self-supplied industrial water use may be under-represented.

Beyond the baseline industrial forecast as described above, an alternate scenario can be developed to capture projections of industrial water demand within a planning region or watershed/aquifer unit based on credible and defensible information regarding the geographical distribution of future industrial development within the region. This information is unique for each water planning region and is based upon input provided by representatives from the major water using industries, regional commissions or development authorities and the subsequent direction of each regional water planning council.

In the Coastal Georgia region, the Council elected to develop an alternate forecast to estimate a higher industrial growth rate than the baseline forecast. A complete description of the development and outcome of this alternate forecast is described in Section 5.6.

5.2 Geographical Distribution of Industrial Water Demand

Industrial water demands are distributed by source node and county throughout the region based upon the base year geographic distribution of industrial water withdrawals by industry category. Under baseline conditions, it is assumed that the geographic distribution will not deviate from the base year throughout the planning horizon. The industrial water demand forecast model allows for flexibility of the ratio of forecasted demands by node for each industrial category within a region. Therefore, the distribution of industrial demands by source within a region can be adjusted.

5.3 Wastewater Forecast Methodology

As with the industrial water demand estimates, the industrial wastewater flow estimates are calculated on a regional basis by industry. Industrial wastewater flow is estimated from a wastewater to water ratio developed for each industrial category. For example in the apparel category, for every gallon of water used, there will be 0.6 gallons of wastewater produced. For the paper category, for every gallon of water used, there will be 1.0 gallon of wastewater produced. In some categories, this approach estimates that more wastewater will be produced than the gallons of water used. This occurs when wastewater treatment tanks and ponds are located outside and collect precipitation. This rainwater adds to the total wastewater effluent discharged or land-applied. Stone and gravel quarries also have to discharge rainwater that accumulates in the operational pits, and this flow adds to the permitted discharge. Thus, some industries have a wastewater to water use ratio greater than 1.0.

Data on the ratio of wastewater to water use are limited. Data had to be matched by industry type by permit holder between discharge information and water use information. Few industrial discharge permit holders could be identified by industry type and matched with water use data at the facility level. Thus, the wastewater to water ratios were determined from a limited number of matches between actual water use and actual wastewater discharge identified by an industrial permit holder for the state. These ratios can be adjusted to reflect more localized data by region.

Outreach to industrial stakeholders allowed for industry representatives to offer a stakeholder-approved statewide industry wastewater to water ratio. Two such industries did provide industry-specific statewide recommendations for wastewater to water ratios that were incorporated into the forecast models. The paper industry recommended a wastewater to water ratio of 100 percent and the food manufacturing industry recommended a wastewater to water ratio of 95 percent. If available data allowed for a region-specific industry wastewater to water ratio to be calculated, that

ratio was incorporated into the forecast model. For example, one facility in the Altamaha planning region accounts for 100 percent of the paper industry demands in that region. Available water withdrawal and wastewater discharge permit data made it possible to calculate an average annual wastewater to water discharge ratio for that facility using data from 1997 through 2007. It was determined that the average annual wastewater to water ratio for that facility is 102 percent. This ratio was incorporated into the industrial wastewater forecast model.

Once the industrial wastewater flows are estimated, the flows are separated between point discharges and land application. The percent of permitted point discharges to total discharges for each industry was determined statewide from the EPD's wastewater discharge database. Again, the data was limited because not all industrial discharge permits are identified by industry type. Furthermore, within a particular industry, the number of permits with land application systems is limited. Therefore, the proportion of land application to point discharge (i.e., the percent discharge) can be revised based upon Council input for a specific industry or region. The formulas for estimating point discharge and land application flows by industry and region are as follows:

$$\text{Point Discharge MGD} = (\text{Ind MGD}) \times (\text{ww/w}) \times (\% \text{point discharge})$$

$$\text{Land Application MGD} = (\text{Ind MGD}) \times (\text{ww/w}) \times (1 - \% \text{point discharge})$$

5.4 Geographic Distribution of Industrial Wastewater

Once the industrial wastewater flows are calculated by category for the entire region, the next step is to determine where the flows discharge back into the river basin and how much flow is returned at each location. As discussed in previous sections, each river basin is divided into smaller regions called local drainage areas or LDAs. Distinct points within the LDAs called nodes have surface water gauges to monitor flow rate and elevation. In this forecast, any wastewater discharged into the LDA upstream of the node location or at the node location is summed up at the node for that sub-region. For industrial wastewater forecasting, it is important to know how much flow is going to each node within the region.

The first source of information is normally wastewater discharge permits which contain specific information on geographic location of the discharge point, discharge method (point source or land application), and discharge volume. However, for industrial water users, there is limited wastewater discharge permit data. This is because many industries included in the forecast have permits for water withdrawals, but do not necessarily have permits for wastewater discharges. In many cases, a facility without an EPD discharge permit sends its wastewater to a municipal Publicly Owned Treatment Works (POTW) for treatment. In the absence of permit data, another method was developed for determining the node location and the proportion of industrial wastewater flow at each node.

The first step involves identifying all facilities within the region included in the base year industrial water demand forecast and their respective industry categories. All facilities included in the industrial water demand forecast were cross-referenced with the EPD wastewater discharge database to determine if the facility is permitted to discharge its own wastewater and, if so, the node of discharge. For those facilities permitted to discharge wastewater, either on site or for pre-treatment prior to sending to a municipal wastewater treatment facility, the reported node of return was used in the forecast calculations.

For those not permitted to discharge wastewater, the node of discharge was determined based on the location of the facility's surface water intake or groundwater well. For surface water sources, the wastewater is returned to the same node from which the surface water was withdrawn. For ground water sources, the wastewater is returned to the node representing the drainage area where the groundwater well is located. The EPD withdrawal database includes geographic coordinates for all surface water and groundwater withdrawal permits. These coordinate points were brought into a GIS along with a polygon layer of the nodes. Using this data, the node of the intake or well was determined and assumed to be the same as the node of discharge. For facilities identified as receiving their water supply from municipal providers, the node of discharge was assumed to be the same as the node of withdrawal of the municipality supplying the water.

Once wastewater location is determined, the next step is figuring out what proportion of the flow from each category is returned at each node. Because there is limited data regarding exact wastewater flow volumes by industrial facility, the volume percentages are based upon withdrawal volumes within the node during the base year. For example if the total water withdrawn in the 2005 base year for paper in the Coastal Georgia region is 100 MGD with 20 MGD coming from node A and 80 MGD coming from node B, then 20% of the forecasted paper wastewater flow is returned to node A and 80% of the paper wastewater flow is returned to node B. Thus the ratio of wastewater discharged to a particular node by a particular industry is calculated by dividing the category's withdrawal in the node by the category's withdrawal in the region during the base year.

Since the industrial wastewater forecast model assumes all facilities within an industrial category exhibit the same wastewater to water ratio, using withdrawal volumes does not significantly over or under estimate the distribution of industrial wastewater to any one particular node within a region.

For each node, the ratio of wastewater discharged to point source and land application was calculated for each industrial category. The EPD wastewater discharge database is used to determine an industrial facility's method of discharge. Base year withdrawals for point source discharge industrial facilities are divided by total withdrawals by facilities of the same category and in the same node to derive a percent point source ratio for each category within each node.

If a facility's method of discharge could not be identified in the EPD database, it is assumed that the discharge is point source. These percent point source ratios were input into the industrial wastewater demand forecast model to distribute the forecasted flows within a node by discharge method.

In many counties, a portion of the forecasted industrial wastewater generated by self-supplied facilities is treated by a municipal POTW prior to discharge. The industrial wastewater treated by municipal POTWs, therefore, is identified and separated from the industrial wastewater forecast in order to accurately depict total municipally-discharged and total industrially-discharged wastewater.

To determine the amount of industrial wastewater being sent to municipal POTWs, it is first necessary to identify which self-supplied industrial facilities have EPD wastewater discharge permits and which do not. Those self-supplied industrial facilities without EPD discharge permits are assumed to send their wastewater to a municipal POTW. Within each county, all self-supplied industrial facilities were identified by industrial category. In each county, the ratio of base year withdrawals by facilities with permits to the total withdrawals for each industrial category determines the percent of the forecasted wastewater sent to municipal POTWs for that category in that county. This ratio is applied to the county's forecasted industrial category flows to derive the forecasted industrial flows sent to municipal POTWs. These flows are further separated by method of discharge based upon the method of discharge for the municipal POTW determined to be the most likely destination of the industrial wastewater. As discussed above, the node of discharge is assumed to be the same as the node of withdrawal for self-supplied industrial facilities. For the purposes of this analysis, it is also assumed that a self-supplied industrial facility without an EPD discharge permit sends its wastewater to the nearest municipal POTW.

5.5 Industrial Forecast Results

Industrial water and wastewater forecasts are calculated by category in ten year increments for the 40 year planning horizon. **Table 14** shows the regional industrial water demands by county and the percent increase in demand from 2010 to 2050. Water demand growth is negligible in the Coastal Georgia region due to steady or declining industrial employment projections for industries with current water needs.

The Coastal Georgia Council decided to create an alternate industrial water demand forecast that includes additional growth for future industries that may locate in their respective regions. A detailed description of the Coastal Georgia alternate industrial water forecast is included in section 5.6. The results listed in the remainder of this section represent the baseline forecast.

Table 15 shows the industrial water demand by category for the planning region. **Figure 7** graphically depicts the industrial demand by category for the region.

Industrial water demand is supplied by either surface water or groundwater. **Figure 8** shows the proportion by source for both 2010 and 2050.

Table 14: Baseline Industrial Water Demand Forecast (MGD)

County	2010	2020	2030	2040	2050	Percent Increase 2010 - 2050
Bryan	0.00	0.00	0.00	0.00	0.00	0%
Bulloch	0.23	0.26	0.28	0.31	0.35	50%
Camden	0.06	0.06	0.06	0.06	0.06	0%
Chatham	69.88	69.98	70.05	70.12	70.23	0%
Effingham	17.75	17.75	17.75	17.75	17.75	0%
Glynn	64.50	64.53	64.56	64.58	64.61	0%
Liberty	8.53	8.53	8.53	8.53	8.53	0%
Long	0.00	0.00	0.00	0.00	0.00	0%
McIntosh	0.04	0.04	0.04	0.05	0.06	57%
Regional Total	160.99	161.14	161.27	161.41	161.58	0%

Table 15: Coastal Georgia Baseline Industrial Water Demand Forecast (MGD)

NAICS	Industry	2010	2020	2030	2040	2050
0	Other Industrial	0.64	0.71	0.79	0.88	1.00
311	Food - Food Manufacturing	3.12	3.12	3.12	3.12	3.12
322	Paper	133.91	133.91	133.91	133.91	133.91
324	Petroleum	0.59	0.64	0.66	0.68	0.71
325	Chemicals	22.50	22.50	22.50	22.50	22.50
327	Stone and Clay	0.21	0.24	0.27	0.29	0.32
331	Primary Metals	0.03	0.03	0.03	0.03	0.03
	TOTAL	160.99	161.14	161.27	161.41	161.58

Note: The following categories have zero forecasted water demand in the Coastal Georgia Region: Mining, Food - Beverage and Tobacco, Textile Mills, Textile Product Mills, Apparel, Rubber, Fabricated Metal Products, Electrical Machinery, and Automotive Manufacturing

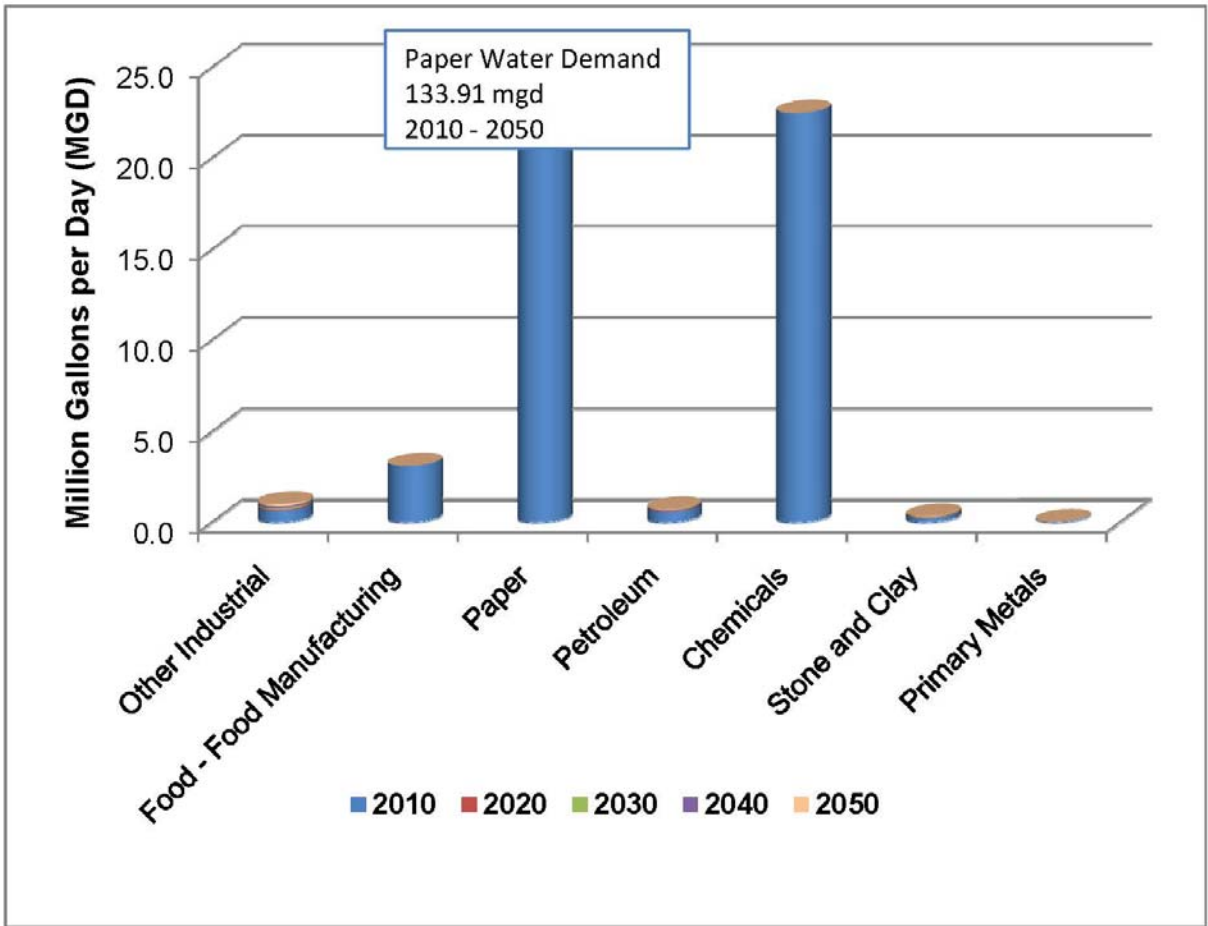


Figure 7: Coastal Georgia Baseline Industrial Water Demand by Category

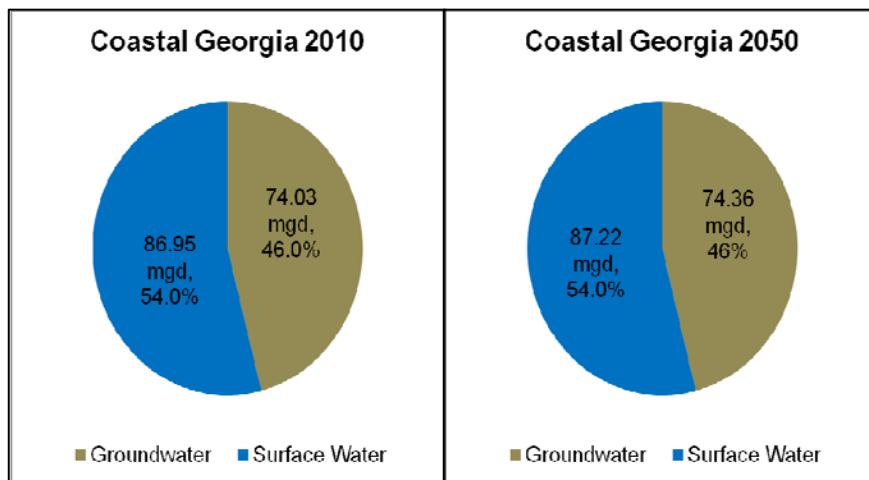


Figure 8: Baseline Industrial Water Demand by Source

The industrial wastewater flow forecast totals for each county and the region are shown in **Table 16**. Totals in Table 16 include the industrial flows to municipal POTWs. **Table 17** shows the forecasted regional wastewater flows by method and location of discharge. The table identifies the industrial point source and LAS flow volumes by permitted industrial facilities as well municipal POTWs.

Table 16: Baseline Industrial Wastewater Demand Forecast (MGD)

County	2010	2020	2030	2040	2050	Percent Increase 2010 - 2050
Bryan	0.00	0.00	0.00	0.00	0.00	0%
Bulloch	0.15	0.16	0.18	0.20	0.22	50%
Camden	0.06	0.06	0.06	0.06	0.06	0%
Chatham	68.40	68.46	68.51	68.56	68.62	0%
Effingham	17.74	17.74	17.74	17.74	17.74	0%
Glynn	64.07	64.13	64.18	64.23	64.27	0%
Liberty	8.50	8.50	8.50	8.50	8.50	0%
Long	0.00	0.00	0.00	0.00	0.00	0%
McIntosh	0.02	0.03	0.03	0.03	0.04	57%
Regional Total	158.94	159.08	159.19	159.31	159.46	0%

Table 17: Baseline Industrial Wastewater Demand Forecast by Discharge Method (MGD)

Discharge Method	2010	2020	2030	2040	2050
Industrial – Point Source	156.81	156.82	156.83	156.84	156.85
Industrial – LAS	0.00	0.00	0.00	0.00	0.00
Total Industrial Discharge	156.81	156.82	156.83	156.84	156.85
Industrial to Municipal POTW – Point Source	1.74	1.80	1.85	1.92	2.00
Industrial to Municipal POTW – LAS	0.00	0.00	0.00	0.00	0.00
Total Industrial to Municipal POTW	1.74	1.80	1.85	1.92	2.00

Figure 9 shows the baseline industrial wastewater flow by discharge method for the region in 2010 and 2050.

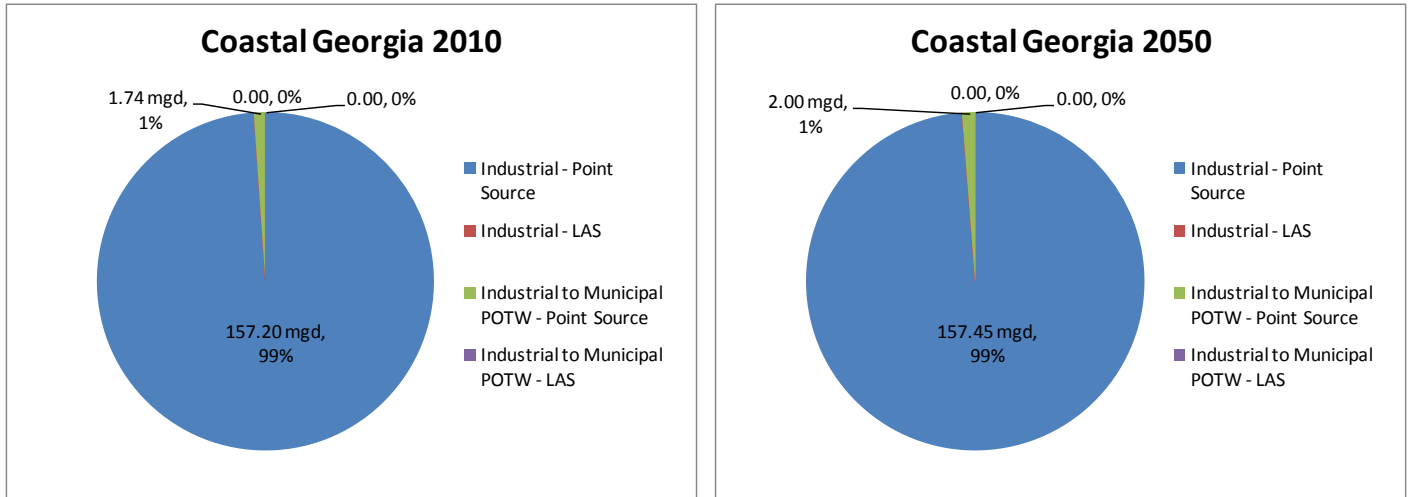


Figure 9: Baseline Industrial Wastewater Flow by Discharge Method

5.6 Coastal Georgia Alternate Industrial Forecast

This section summarizes the approach that was used to develop an Alternate Industrial Water and Wastewater Forecast for the Coastal Georgia Regional Water Planning Council. For the regional water plan, the intent of the industrial forecast is to capture water demand and trends among major water users. The top fifteen industrial water users in the state of Georgia were listed in Table 13 by Standard Industrial Classification (SIC) and North American Industrial Classification System (NAICS) codes. Other water-using industries are included in the industrial forecast in the 'Other and Unidentified' industrial category. The method for forecasting future water and wastewater industrial demands is based on trends in employment for these major industrial sectors (see below for additional details on the industrial methodology).

The major water using industries that have operated in the Coastal Georgia region in the past are projected to have little growth over the 2010-2050 planning horizon. The Coastal Georgia Water Planning Council believes that these past trends may not accurately reflect future trends in industrial growth and requested the development of an alternate industrial forecast that would reflect potentially higher industrial growth than the baseline forecast. The key reasons for potentially higher industrial growth are: proximity to major surface transportation network(s); the current access to, use of, and potential expansion of the Brunswick and Savannah Harbors; and the projected relatively high rate of population growth associated with the region.

Industrial water use for the major water using industries is primarily self-supplied water, meaning that these industrial water users have water withdrawal permits. However, major industries that obtain water from municipal water systems are included to the extent that these industrial uses were identified and the use removed from the municipal water use estimates. For example, in the Coastal Georgia region, the City of Savannah supplies water for many industries in the top 15 and 'other' categories. These demands are included in the industrial forecast.

Future water need by industry is determined by multiplying the current water need by the employment growth rate. Employment projections by industry were prepared for EPD by the University of Georgia. Based upon region-specific employment projections, average annual growth rates were determined for the major industrial categories. The largest industrial water users in the Coastal Georgia region show declining trends or modest growth. In situations where there was a projected decline in an industry's employment, the forecast model applies a zero percent average annual growth rate to the base year demand. This approach was chosen instead of applying a negative rate which would have produced a decreasing water demand. Therefore, when an industry's employment is projected to decline or experience minor growth, the current water need remains roughly the same in future years.

The results of this state-wide approach were presented at Council Meeting 5 on April 6, 2010. During the meeting, Council members expressed concern over the lack of industrial water growth over the forty year planning horizon. As a result, the Council agreed to gather information about potential new industry from their local county's economic development authorities and report back to their planning consultant, CDM. The Council also instructed CDM to work with the Coastal Regional Commission of Georgia to identify existing and potential industrial sites within the region as well as potential new industry types and future water needs.

Future Industry Feedback and Research

Council members did forward some information for Liberty and McIntosh Counties to estimate additional industrial water demand, but the resulting increase was less than 1 MGD.

Discussions with the Coastal Regional Commission of Georgia (CRC) revealed that the locations of existing and near-term industrial sites are well established, but predicting the type of industry that will locate there as well as that future industry's water demand are more elusive. However, the CRC foresees future industry growth in the region occurring in four main categories: energy, aerospace, general manufacturing, and warehouse distribution. Energy water use is forecast separately from industry, but will be included in the overall water demand for the region. Aerospace, general manufacturing and warehouse distribution fall into the 'other' industrial category.

Based upon this information as well as further research into the region, the locations of several key industrial sites were identified as shown in **Figure 10**. These locations represent either existing sites ready to expand or future sites ready for development. The star in Liberty County represents two sites that are designated as Georgia Ready for Accelerated Development (GRAD) sites by Georgia Allies, a partnership between state government and private corporations to promote the state's business development efforts. The locations shown in Bryan and Bulloch Counties are existing industrial parks with infrastructure ready to support additional industries and their associated groundwater demand. The star in Chatham County represents the 'mega-site' promoted by the state economic development authority. The first industry

locating there is Mitsubishi Power Systems, with facilities to build steam and gas turbine engines currently under construction. The mega-site is currently served by a 24-inch water line from the City of Savannah's surface water treatment facility. The star shown in Effingham County represents several key industrial sites that can also be served by the City of Savannah surface water system.

With locations for future industrial growth identified, the remaining forecast parameters needed are industry type, anticipated water demand at each location, timing of future water need, and water source (surface or ground water). Since the known facilities which will become operational in the near-term are coming from industries that fall outside the top 15 water users, the additional water demands are placed in the 'Other and Unidentified' industrial category. This is also consistent with the CRC's estimate of future industrial growth occurring in sectors outside the top 15 water users. For anticipated increased water demand, the Council feels that 35 MGD is a reasonable growth factor given the total projected water demand of 161 MGD in 2010. This represents a 22 percent increase in industrial water use over the 40 year

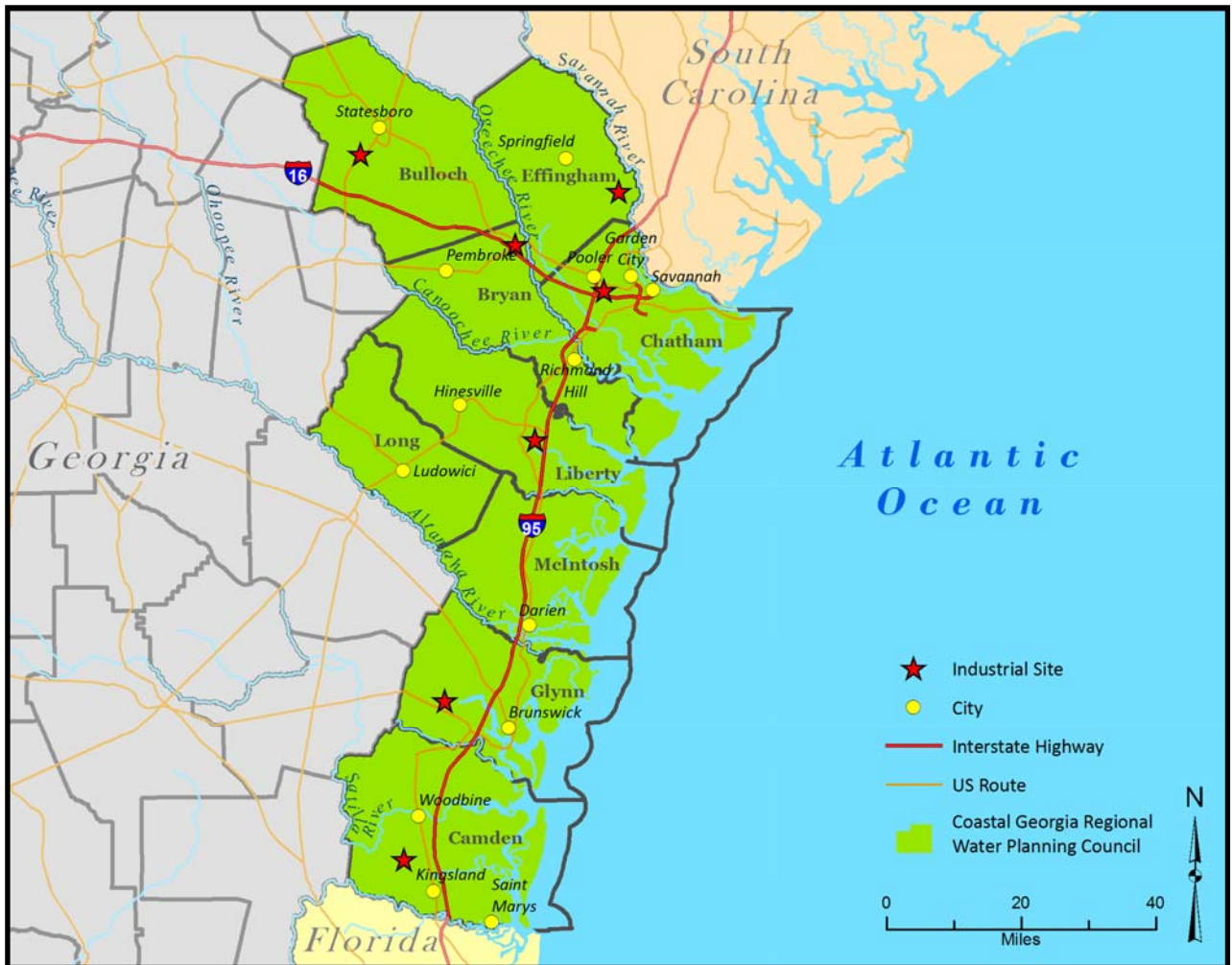


Figure 10: Potential Future Industrial Locations with Additional Water Demands

planning horizon. The Council also estimates that most of this additional demand (75%) would take place by 2030 with the remainder occurring before 2050.

In terms of geographic distribution of additional water demand, there were two options proposed. One approach was a statistical analysis of current industrial water use by county and application of these proportions to the additional water demand. For example, in the 2010 forecast year, 43.4% of the industrial water demand comes from Chatham County. Using this approach, 43.4% or 15.2 MGD of the 35 MGD additional industrial water demand would be anticipated to occur in Chatham County. Using this method, the additional 35 MGD would be distributed mainly among Chatham, Effingham, Glynn and Liberty counties. Another approach was to utilize local knowledge of existing and potential industrial sites and to estimate the distribution of future industrial growth based on:

- Availability to sources of water supply
- Current level of infrastructure development to serve water to these sites
- Proximity to the overland transportation corridors
- Proximity to sea transportation

This approach utilizes the information gathered from the CRC and other economic development authorities as shown above. The remaining forecast parameter needed is water source for these additional demands. Surface water is available at or near the potential industrial locations in both Chatham and Effingham Counties. All other locations would most likely utilize groundwater sources as they currently practice.

Table 18 shows the county distribution of additional water demand utilizing both approaches.

The Coastal Georgia Management Practices Subcommittee recommended and full council accepted that the distribution of future industrial demand should be based upon potential ready sites rather than historic water use percentage because future trends in growth will more likely follow: available sites, infrastructure to serve those sites, water availability, and access to transportation. The recommended timing and quantity of water associated with the recommended alternate industrial forecast is summarized in **Table 19** which shows the additional 35 MGD water demand in the 'Other' category.

The 'Other' category does have employment growth over the planning horizon in the Coastal Georgia region. This employment growth then causes water demand to increase each year of the forecast. Consequently, the sum of the additional demands added to each 10-year increment does not add up to 35 MGD. However, by 2050 the total industrial water demand for the region is 35 MGD greater than the baseline forecast. From Table 15, the total industrial water demand in 2050 for the baseline forecast is 161.58 MGD. From Table 19, the total industrial water demand in 2050 for the alternate forecast is 196.58 MGD which is 35 MGD higher than the baseline.

Table 18: Geographic Distribution of Additional 35 MGD Industrial Water Demand

County	2010 Industrial Water Forecast Percent by County	Distribution of additional 35 MGD based upon 2010 county percentages	Potential Sites?	Source of Water Supply	Distribution of additional 35 MGD based upon potential ready sites
Bryan	0.0%	0.00	yes	groundwater	2.00
Bulloch	0.1%	0.05	yes	groundwater	2.00
Camden	0.0%	0.01	maybe	groundwater	2.00
Chatham and Effingham ¹	54.4%	19.05	yes	surface water	19.00
Glynn	40.1%	14.02	maybe	groundwater	5.00
Liberty	5.3%	1.85	yes	groundwater	4.80
Long	0.0%	0.00	no	groundwater	
McIntosh	0.0%	0.01	maybe	groundwater	0.20
Total	100.0%	35.00			35.00

¹The industrial demands are combined for Chatham and Effingham County because it is difficult to accurately reflect how the relative distribution of industrial growth will split between these two counties because they are very similar in nature in regard to the distribution factors that were used. In addition, for planning purposes surface water withdrawal locations for both Counties are located above the Savannah River Planning Node/Gauge so further disaggregation of these demands is not critical for regional water planning.

Table 19: Alternate Industrial Forecast for Coastal Georgia (MGD, ADD)

NAICS	Industry	2010	2020	2030	2040	2050	Increase in Water Use
0	Other Industrial	1.64	9.57	22.39	30.03	36.00	34.36
311	Food - Food Manufacturing	3.12	3.12	3.12	3.12	3.12	0.00
322	Paper	133.91	133.91	133.91	133.91	133.91	0.00
324	Petroleum	0.59	0.64	0.66	0.68	0.71	0.12
325	Chemicals	22.50	22.50	22.50	22.50	22.50	0.00
327	Stone and Clay	0.21	0.24	0.27	0.29	0.32	0.11
331	Primary Metals	0.03	0.03	0.03	0.03	0.03	0.00
	TOTAL	161.99	170.00	182.87	190.56	196.58	34.59
	Increase over Baseline	1.00	8.86	21.60	29.15	35.00	
	Percent Increase over Baseline	0.62%	5.50%	13.40%	18.06%	21.66%	

Note: The following categories have zero forecast water demand in the Coastal Georgia Region: Mining, Food - Beverage and Tobacco, Textile Mills, Textile Product Mills, Apparel, Rubber, Fabricated Metal Products, Electrical Machinery, and Automotive Manufacturing

In terms of timing of future water need, approximately 60% of the total 35 MGD increase occurs by 2030. This approach was taken because adding 75% of 35 MGD by 2030 would result in more than 35 MGD by 2050 due to growth from 2030 to 2050.

Figure 11 shows the proportion by source for both 2010 and 2050 for the alternate industrial forecast.

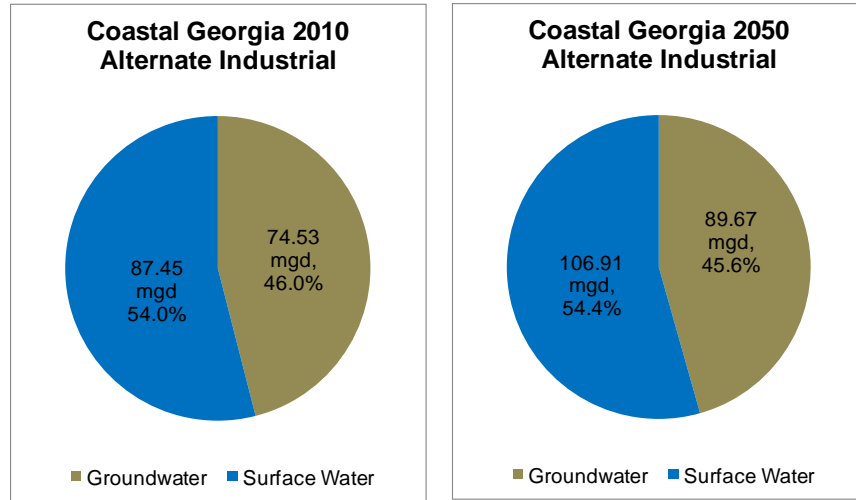


Figure 11: Alternate Industrial Water Demand by Source

Table 20 shows the forecasted regional wastewater flows by method and location of discharge. The table identifies the industrial point source and LAS flow volumes by permitted industrial facilities as well municipal POTWs.

Table 20: Alternate Industrial Wastewater Demand Forecast by Discharge Method (MGD)

Discharge Method	2010	2020	2030	2040	2050
Industrial – Point Source	157.78	162.39	169.84	173.75	177.17
Industrial – LAS	0.00	0.00	0.00	0.00	0.00
Total Industrial Discharge	157.78	162.39	169.84	173.75	177.17
Industrial to Municipal POTW – Point Source	1.75	2.07	2.51	3.32	3.59
Industrial to Municipal POTW – LAS	0.00	0.00	0.00	0.00	0.00
Total Industrial to Municipal POTW	1.75	2.07	2.51	3.32	3.59

6. Agricultural Water Forecasting

The methodology and results of the agricultural forecasts have been developed by the University of Georgia. Full documentation of this work is available at <http://www.nespal.org/sirp/waterinfo/State/awd/agwaterdemand.htm>. A summary of the information is presented below.

6.1 Crop Area

Total current irrigated crop acreage was measured from 2007 and 2008 aerial photos, overlain with Georgia Soil and Water Conservation Commission (GSWCC) or EPD-identified irrigation systems plus additional, visible irrigation systems identified by UGA.

This total irrigated acreage was proportioned by crop type based upon the 2008 UGA Cooperative Extension Irrigation Survey. Projected crop growth rates were based upon the average of projections from three economic models (nation-wide, southeast regional, and Georgia data).

Crop area for specialty and vegetable crops, which comprise 15% of Georgia agriculture, is not available from major crop data. UGA assumed those crops would continue to grow in areas where they have been in production in the past, with growth rates equal to the aggregate growth rate of the state's five major crops (corn, cotton, peanuts, soybeans, and pecans).

6.2 Irrigation Depth

The agricultural forecast uses a precipitation period of record from 1950 - 2007. Using specific crop computer models, UGA calculated irrigation needs for each major crop type for each day during this period of record for each county. The calculations are based on known and accepted plant growth and water balance calculations for each crop type. The calculations are also based on an assumption of 75% irrigation efficiency, meaning 75% of water pumped by the irrigation system is used by the crop and the other 25% is lost due to spray evaporative loss, canopy loss, wind drift, runoff, and deep percolation. UGA summed the calculated irrigation for each month and used the results to tier all years in the period of record into wet, average, and dry years.

For forecasting purposes, UGA used the general observation from the Agricultural Water Pumping Study that, on average, surface water users applied 70% as much water as groundwater users. This ratio was used to reduce estimated/forecasted surface water withdrawals. The Agricultural Water Pumping Study sampled a total of 800 randomly chosen irrigation systems and monitored them monthly from 1999 - 2004. The study also monitored 45 well-to-pond systems and concluded that 70% of the water reaching the field from these systems came from the wells. It also provided a monthly distribution of irrigation depths for specialty crops.

6.3 Irrigation Source

Demands by water source for irrigation were computed using EPD’s Agricultural Water Withdrawal Permitting Program (which identifies withdrawal sources) and an EPD/GSWCC field mapping effort that identified the location of withdrawal sources. Based on this information, UGA made the following assumptions related to water source:

- Fields irrigated by wells are sourced 100% from groundwater.
- Fields irrigated by surface water only, including ponds without refill wells, are sourced 100% from surface water.
- Fields irrigated by ponds supplemented by wells (well-to-pond systems) are sourced 70% from groundwater and 30% from surface water. This ratio is based on 45 well-to-pond systems that were monitored from 1999 – 2004.
- No fields were identified as irrigated by direct surface water withdrawal (no pond) with wells as an additional source.
- Calculated irrigation requirements were assumed to be 100% consumptive.

6.4 Agricultural Forecast Results

Agricultural water needs were calculated in ten year increments for the 40 year planning horizon. **Table 21** shows the forecasted agricultural water needs by county in the Coastal Georgia region. These numbers are depicted graphically in **Figure 12**, with the 2010 forecast demand shown in blue and the incremental increases in demand for each sequential 10 year period shown in other colors.

Table 21: Coastal Georgia Agricultural Demand Forecast (MGD, average annual day)

County	2011	2020	2030	2040	2050	Percent Increase 2010 to 2050
Bryan	0.10	0.10	0.10	0.11	0.11	10%
Bulloch	11.79	11.95	12.18	12.44	12.72	8%
Camden	0.80	0.80	0.80	0.80	0.80	0%
Chatham	0.59	0.60	0.61	0.62	0.63	6%
Effingham	1.13	1.14	1.15	1.17	1.18	5%
Glynn	0.35	0.35	0.35	0.35	0.35	0%
Liberty	0.03	0.04	0.04	0.04	0.04	6%
Long	0.60	0.62	0.65	0.69	0.72	20%
McIntosh	0.34	0.34	0.34	0.34	0.34	0%
Total	15.73	15.93	16.21	16.53	16.88	7%

Includes 2011 livestock water demand carried forward for all forecast years.

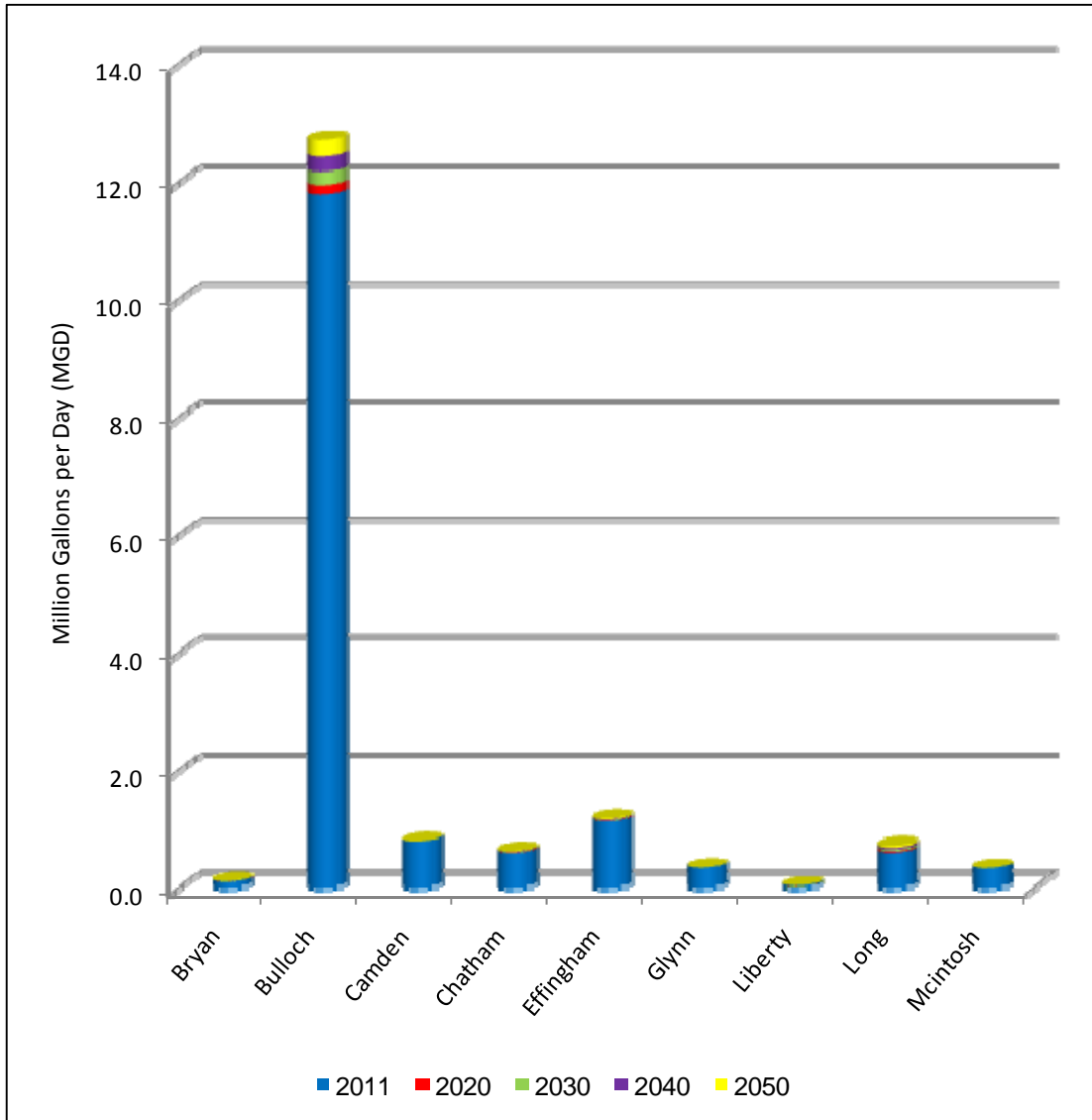


Figure 12: Coastal Georgia Agricultural Forecast by County with Incremental Increases to 2050

The Coastal Georgia region as a whole is expected to see an increase of 7% in agricultural water demand by 2050. Bulloch County has the highest agricultural water forecast in the region with average daily demand above 11 MGD in 2011 with an 8% increase by 2050. All other counties have forecasted demand less than 1.2 MGD. About half of the agricultural withdrawals are supplied by groundwater and the remainder by surface water.

7. Energy Water Forecasting

Evaluating and forecasting water demands for power generation is a critical element to consider in planning for future water needs. This section briefly describes the methods and results of the Georgia statewide energy sector water demand forecast including those demands occurring with the Coastal Georgia Water Planning Region. A detailed and thorough description of the methodology can be found in a technical memorandum called, “Statewide Energy Sector Water Demand Forecast” dated October 29, 2010 (Energy Forecast Tech Memo).

The purpose of the energy sector forecast is to evaluate water withdrawal and water consumption needs to meet the anticipated power needs of Georgia’s citizens through 2050. For the purposes of this analysis, forecasted water demands are associated with future energy sector utilities’ (NAICS 22) power generation. Power generation water demands associated with facilities with other industry codes are captured as part of the municipal and industrial water demand forecasts. This energy forecast is designed to support statewide water resources planning and is not intended to support future energy planning needs.

7.1 Data Sources and Methodology

There were two primary sources of data used to develop the energy forecast. The Georgia EPD water withdrawal permit database provided information on reported water withdrawals and consumptive use for all permitted thermoelectric facilities. The U.S. Department of Energy, Energy Information Administration compiles facility-level data on generating capacity, monthly and annual power generation, facility cooling system type, fuel type and prime mover.

Using this information, average withdrawal and consumption rates, expressed in gallons per megawatt hour (MWh) were calculated for each of four unique power generation processes requiring water for the production of energy. Each generation process uses a unique combination of fuel type, method of converting energy to electricity (prime mover), and cooling type. These processes are henceforth referred to as power generation combinations. For each power generation combination, the average water use rate was multiplied by the estimated power generation for each forecast year:

$$\text{Power Generation Combination Demand} = \text{Combination Average Gallon per MWh} * \text{Estimated Combination Power Generation MWh}$$

Then, the individual power generation combination withdrawal and consumption values were summed for each forecast year to calculate the total statewide demands. Demands were forecasted for the following power generation combinations identified by fuel source/prime mover/cooling type:

- Natural gas/combined-cycle/cooling tower
- Fossil fuel & biomass/steam turbine/once-through

- Fossil fuel & biomass/steam turbine/cooling tower
- Nuclear/steam turbine/cooling tower

The amount of power generated by combination was calculated by multiplying a combination’s available capacity by a combination capacity factor – the percent of capacity utilized:

$$\text{Power Generation Combination Production (MWh)} = \text{Combination Available Capacity (MWh)} * \text{Combination Capacity Factor (\%)}$$

It is recognized that multiple factors can influence a combination’s capacity factor from year-to-year making future combination capacity factors difficult to predict. Future combination capacity factors were guided by recent historical trends in combination capacity factors and insights from an energy sector ad hoc group.

7.2 Energy Forecast Results

The ability to transmit power from the location of generation to the location of demand presents some unique challenges in developing the water needs forecast. Consequently, this forecast does not focus specifically on regional demands, but rather is meant to forecast energy sector water demands at the state level. It was possible to identify statewide demands at a regional level based on a set of assumptions applicable to all power generating facilities in the state and according to the location of known and planned power generating facilities confirmed by the Georgia EPD and the energy sector ad hoc group. Information was available for facilities planned to be built or expanded through the year 2017. Details on the specific assumptions and planned facilities can be found in the Energy Forecast Tech Memo.

Table 22 below shows the Coastal Georgia regional energy sector demand forecast for existing and planned facilities through 2050. The numbers shown represent average annual daily flow rates. Beginning in 2020, the forecasted demand associated with these facilities remains steady throughout the planning horizon.

Table 22: Coastal Georgia Existing and Planned Facilities Forecasted Energy Sector Demands, MGD

Region	Demand Type	2010	2020	2030	2040	2050
Coastal Georgia	Withdrawals	340.6	310.9	310.6	310.6	310.6
Coastal Georgia	Consumption	2.5	1.8	1.6	1.6	1.6

An analysis of Georgia’s existing and planned facilities’ available generating capacity revealed that these plants would not be able to accommodate projected statewide power needs through 2050. In order to meet the projected statewide power needs through 2050, it was assumed that additional generating capacity will be available beyond what currently exists and what is known to be planned through 2020. The demands associated with the additional generating capacity assumed to be available beyond 2020 have not been distributed regionally due to the many unknowns, data gaps, and challenges associated with speculating the location of unplanned generating capacity. Therefore, the demands associated with additional power generating capacity not currently planned through 2020 are not assigned to a particular region. The forecasted statewide unassigned demands are shown in **Table 23**.

Table 23: Unassigned Forecasted Energy Sector Demands, MGD

Region	Demand Type	2010	2020	2030	2040	2050
No Assigned Region	Withdrawals	-	-	106.1	209.6	313.1
No Assigned Region	Consumption	-	-	57.7	114.0	170.5

The Coastal Georgia Water Planning Council has elected to consider the implications of a portion of the unassigned statewide energy sector water demand occurring within the region using two approaches.

Under the first approach, the portion of unassigned demands added to the Coastal Georgia energy sector forecast in 2030, 2040, and 2050 was calculated by multiplying the ratio of the region’s contribution to statewide power generation in 2020 by the future statewide unassigned demands. Statewide power generation totals were only considered for those power generation processes that require water as part of the power production process and for facilities under the electric utility industry code (NAICS 22).

It is estimated that by 2020, the Coastal Georgia region will account for 3.7 percent of the state’s total power production by “water-using” thermoelectric power generation processes. Using this approach, the additional withdrawal and consumptive demands can be calculated. **Table 24** shows the regional demands associated with existing and planned facilities through 2020 as well as the unassigned demands added to the regional forecast following the percent production approach described above.

Under the second approach, the portion of unassigned demands added to the Coastal Georgia energy sector forecast in 2030, 2040, and 2050 was calculated by multiplying the ratio of the region’s forecasted statewide population growth from 2020 to 2050 by the future unassigned demands in each respective year.

The Georgia Office of Planning and Budget (OPB) population forecast shows that Coastal Georgia counties will account for 6.5 percent of the statewide population growth from 2020 to 2050. **Table 25** shows existing and planned facilities’ demands

through 2020 and the unassigned demands added to the regional forecast following the percent population growth approach described above.

Table 24: Coastal Georgia Forecasted Energy Sector Withdrawals and Consumption, MGD - Percent Production Approach

Category	2010	2020	2030*	2040*	2050*
Existing and Planned Facilities Withdrawals	340.6	310.9	310.6	310.6	310.6
Existing and Planned Facilities Consumption	2.5	1.8	1.6	1.6	1.6
Regional Portion of Unassigned Withdrawals	-	-	4.0	7.8	11.7
Regional Portion of Unassigned Consumption	-	-	2.2	4.3	6.4
Total Regional Withdrawals	340.6	310.9	314.6	318.4	322.3
Total Regional Consumption	2.5	1.8	3.7	5.8	7.9

*Includes demands associated with existing and planned facilities and the addition of 3.7 percent of the unassigned statewide energy sector withdrawals and consumption.

Table 25: Coastal Georgia Forecasted Energy Sector Withdrawals and Consumption, MGD - Population Growth Approach

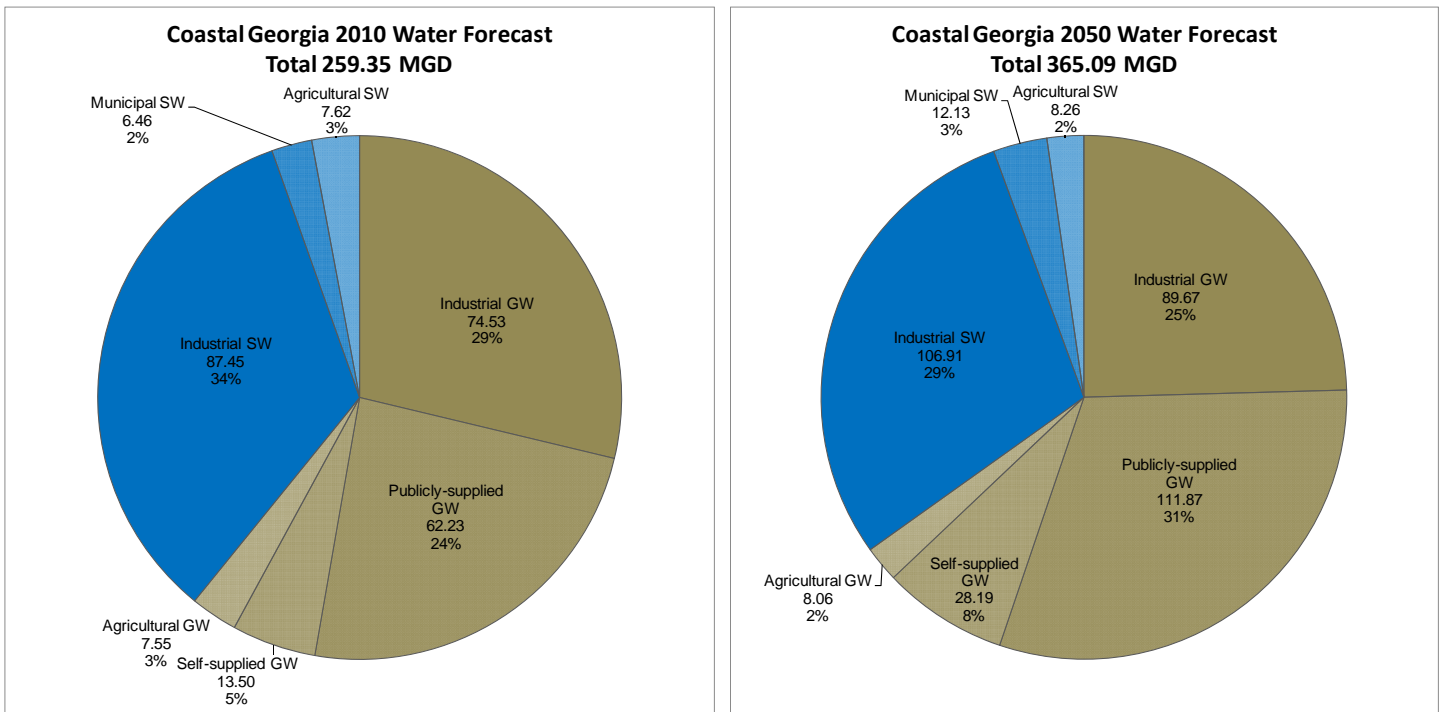
Category	2010	2020	2030*	2040*	2050*
Existing and Planned Facilities Withdrawals	340.6	310.9	310.6	310.6	310.6
Existing and Planned Facilities Consumption	2.5	1.8	1.6	1.6	1.6
Regional Portion of Unassigned Withdrawals	-	-	6.9	13.7	20.4
Regional Portion of Unassigned Consumption	-	-	3.8	7.4	11.1
Total Regional Withdrawals	340.6	310.9	317.5	324.3	331.0
Total Regional Consumption	2.5	1.8	5.4	9.0	12.7

*Includes demands associated with existing and planned facilities and the addition of 6.5 percent of the unassigned statewide energy sector withdrawals and consumption.

8. Regional Summary of Forecasting Results

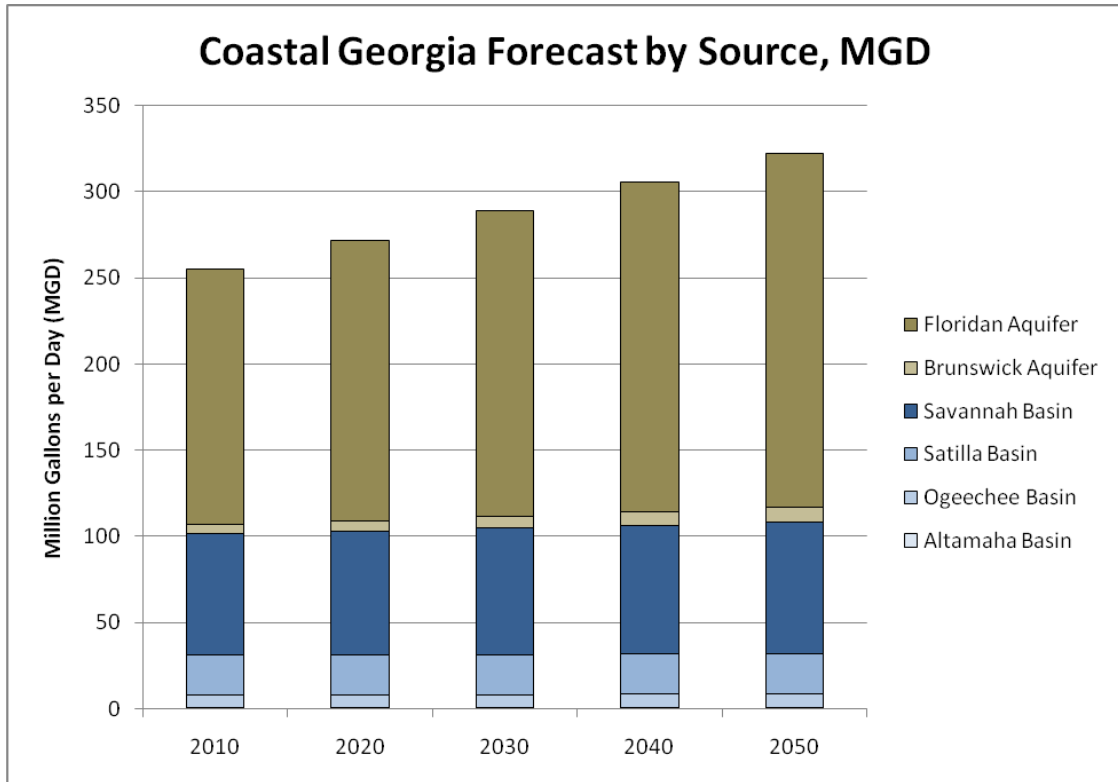
The results of the water and wastewater forecasts for all nine counties within the region are summarized in this section. These forecasts have been developed at 10-year increments beginning in 2010 and extending to 2050. The major water and wastewater sectors include: municipal (domestic and commercial), industrial, agricultural, and energy. The forecast values included in this section are the Council-recommended alternate municipal publicly-supplied and industrial forecasts.

Figure 13 shows the aggregated county water forecasts by supply source for the Coastal Georgia region in 2010 and 2050. **Figure 14** shows the aggregated regional forecast by supply source, identified by river basin for surface water withdrawals and aquifer for groundwater withdrawals. Overall, the regional forecasted water need is expected to increase by approximately 106 million gallons per day (MGD). Note that the agricultural livestock snapshot forecast of 0.6 MGD is not shown because the source of water supply is currently unspecified.



Note: Energy forecasts are not shown. The 2010 energy forecast for surface water withdrawals is 341 MGD with 2.5 MGD consumption. The 2050 energy forecast for surface water withdrawals is 331 MGD with 12.7 MGD consumption based upon the regional population growth approach. Water not consumed is returned to the surface water source.

Figure 13: Coastal Georgia Regional Water Forecast by Supply Source



Note: Energy forecasts are not included in the surface water forecast in the figure above. 2010 energy sector withdrawals are 341 MGD of which 319 MGD comes from the Savannah River Basin and 22 MGD comes from the Satilla River Basin. 2020 energy sector withdrawals are 311 MGD of which 291 MGD comes from the Savannah River Basin and 20 MGD comes from the Satilla River Basin.

Figure 14: Coastal Georgia Regional Forecast by Aquifer and Basin

All other water forecasts are associated with water source, either surface water (SW) shown in blue or groundwater (GW) shown in brown. **Table 26** shows the regional groundwater forecast by aquifer and surface water forecast by river basin. 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 27** summarizes forecasted demands by county, source, and sector.

Table 26: Coastal Georgia Regional Water Demand Forecast by Supply Source

Supply Source		2010	2020	2030	2040	2050	Increase from 2010 to 2050	Percent of Demand by Source
Groundwater	Brunswick Aquifer	4.73	5.53	6.38	7.29	8.27	3.54	3%
	Floridan Aquifer	153.09	170.78	190.01	210.81	229.52	76.43	97%
	Groundwater Total	157.82	176.31	196.40	218.10	237.79	79.97	
	Groundwater Percent of Total	61%	62%	62%	64%	65%	4%	
Surface Water	Altamaha Basin	0.42	0.44	0.47	0.50	0.53	0.11	0.4%
	Ogeechee Basin	7.30	7.47	7.71	7.97	8.26	0.97	6-7%
	Satilla Basin	23.25	23.25	23.25	23.25	23.25	0.00	18-23%
	Savannah Basin	71.46	77.94	89.53	92.85	96.59	25.13	70-75%
	Surface Water Total	102.43	109.11	120.96	124.58	128.64	26.21	
	Surface Water Percent of Total	39%	38%	38%	36%	35%	-4%	
Grand Total		260.25	285.41	317.36	342.67	366.43	106.18	

Note: Energy forecasts are not included in the surface water forecast in the table above. 2010 energy sector withdrawals are 341 MGD of which 319 MGD comes from the Savannah River Basin and 22 MGD comes from the Satilla River Basin. 2020 energy sector withdrawals are 311 MGD of which 291 MGD comes from the Savannah River Basin and 20 MGD comes from the Satilla River Basin. Forecasted energy sector demands are not geographically distributed beyond 2020. Basin and aquifer aggregated totals may not equal county-aggregated totals because surface water agricultural irrigation forecasts by source were not disaggregated by source basin to the county level. The ratio of regional surface water irrigated acres in each basin was used to calculate the regional crop irrigation forecast by source basin.

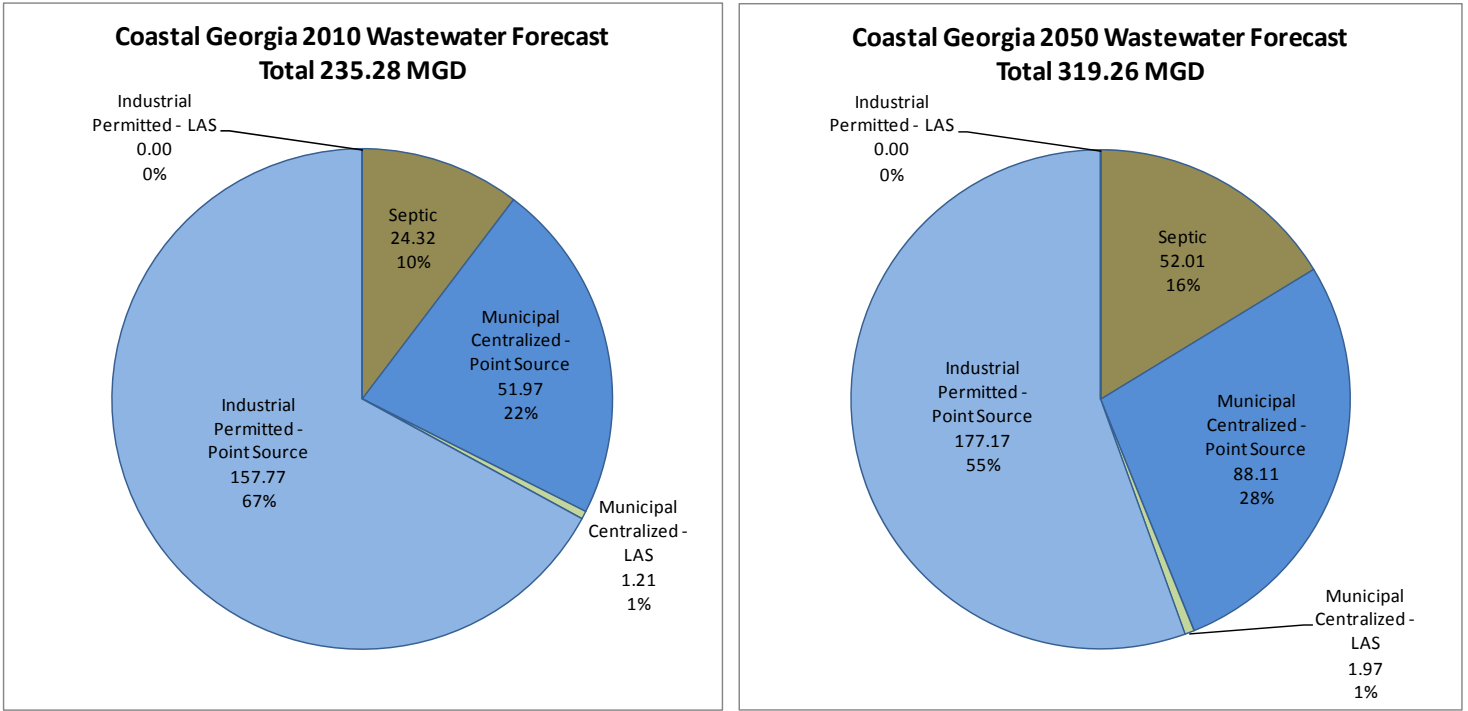
Table 27: County Water Demand Forecast by Sector and Source

County	Sector	2010	2020	2030	2040	2050	Increase in Water Use from 2010 to 2050
Bryan	GW Municipal public-supply	2.94	3.95	5.13	6.16	7.35	4.41
	GW Municipal self-supply	1.20	1.60	2.07	2.47	2.94	1.74
	GW Industrial	0.00	0.20	0.52	1.58	1.80	1.80
	GW Agricultural	0.04	0.04	0.04	0.04	0.04	0.01
	GW Total	4.18	5.79	7.77	10.25	12.13	7.95
	SW Municipal	0.00	0.00	0.00	0.00	0.00	0.00
	SW Industrial	0.00	0.00	0.00	0.00	0.00	0.00
	SW Agricultural	0.03	0.03	0.03	0.03	0.03	0.00
	SW Total	0.03	0.03	0.03	0.03	0.03	0.00
	Total		4.21	5.82	7.80	10.28	12.16
Bulloch	GW Municipal public-supply	7.71	9.44	11.51	13.50	15.39	7.68
	GW Municipal self-supply	1.50	1.82	2.21	2.57	2.92	1.42
	GW Industrial	0.23	0.46	0.80	1.89	2.15	1.92
	GW Agricultural	5.55	5.62	5.73	5.84	5.97	0.41
	GW Total	15.00	17.35	20.25	23.81	26.42	11.43
	SW Municipal	0.00	0.00	0.00	0.00	0.00	0.00
	SW Industrial	0.00	0.00	0.00	0.00	0.00	0.00
	SW Agricultural	5.92	6.00	6.13	6.27	6.43	0.52
	SW Total	5.92	6.00	6.13	6.27	6.43	0.52
	Total		20.91	23.35	26.38	30.08	32.86
Camden	GW Municipal public-supply	4.75	6.55	8.87	11.07	13.40	8.65
	GW Municipal self-supply	1.61	2.21	2.98	3.70	4.45	2.84
	GW Industrial	0.06	0.06	0.06	1.06	1.70	1.64
	GW Agricultural	0.46	0.46	0.46	0.46	0.46	0.00
	GW Total	6.88	9.28	12.36	16.29	20.01	13.13
	SW Municipal	0.00	0.00	0.00	0.00	0.00	0.00
	SW Industrial	0.00	0.00	0.00	0.00	0.00	0.00
	SW Agricultural	0.33	0.33	0.33	0.33	0.33	0.00
	SW Total	0.33	0.33	0.33	0.33	0.33	0.00
	Total		7.21	9.61	12.70	16.62	20.34

County	Sector	2010	2020	2030	2040	2050	Increase in Water Use from 2010 to 2050
Chatham	GW Public-supply	26.76	29.64	32.41	34.81	37.02	10.26
	GW Self-supply	3.22	3.54	3.84	4.09	4.31	1.09
	GW Industrial	21.28	21.31	21.33	21.34	21.36	0.08
	GW Agricultural	0.23	0.24	0.24	0.25	0.26	0.03
	GW Total	51.48	54.73	57.82	60.49	62.95	11.47
	SW Public-supply	4.33	4.79	5.24	5.63	5.98	1.66
	SW Industrial	49.10	53.22	60.99	62.50	64.44	15.34
	SW Agricultural	0.36	0.36	0.36	0.36	0.36	0.00
	SW Total	53.78	58.37	66.58	68.48	70.78	17.00
	Total	105.26	113.09	124.40	128.97	133.73	28.47
Effingham	GW Municipal public-supply	2.13	3.02	4.15	5.18	6.12	3.99
	GW Municipal self-supply	2.52	3.56	4.86	6.05	7.11	4.58
	GW Industrial	1.98	1.98	1.98	1.98	1.98	0.00
	GW Agricultural	0.88	0.88	0.89	0.91	0.92	0.05
	GW Total	7.51	9.44	11.88	14.12	16.13	8.62
	SW Municipal	2.14	3.03	4.16	5.20	6.14	4.00
	SW Industrial	15.77	16.77	19.01	19.39	19.89	4.12
	SW Agricultural	0.14	0.14	0.14	0.15	0.15	0.01
	SW Total	18.05	19.94	23.32	24.74	26.18	8.13
	Total	25.56	29.38	35.20	38.86	42.30	16.75
Glynn	GW Municipal public-supply	9.45	11.04	12.74	14.51	16.40	6.95
	GW Municipal self-supply	1.01	1.18	1.35	1.53	1.71	0.70
	GW Industrial	41.92	42.95	43.59	45.00	46.83	4.91
	GW Agricultural	0.00	0.00	0.00	0.00	0.00	0.00
	GW Total	52.38	55.17	57.68	61.04	64.93	12.55
	SW Municipal	0.00	0.00	0.00	0.00	0.00	0.00
	SW Industrial	22.58	22.58	22.58	22.58	22.58	0.00
	SW Agricultural	0.33	0.33	0.33	0.33	0.33	0.00
	SW Total	22.92	22.92	22.92	22.92	22.92	0.00
	Total	75.30	78.09	80.59	83.96	87.85	12.55

County	Sector	2010	2020	2030	2040	2050	Increase in Water Use from 2010 to 2050
Liberty	GW Municipal public-supply	7.18	9.00	10.57	11.90	13.38	6.20
	GW Municipal self-supply	0.99	1.24	1.44	1.61	1.80	0.81
	GW Industrial	9.03	10.34	11.76	12.94	13.54	4.51
	GW Agricultural	0.00	0.00	0.00	0.00	0.00	0.00
	GW Total	17.20	20.57	23.77	26.46	28.73	11.52
	SW Municipal	0.00	0.00	0.00	0.00	0.00	0.00
	SW Industrial	0.00	0.00	0.00	0.00	0.00	0.00
	SW Agricultural	0.02	0.02	0.02	0.02	0.02	0.00
	SW Total	0.02	0.02	0.02	0.02	0.02	0.00
	Total	17.22	20.59	23.79	26.47	28.74	11.53
Long	GW Municipal public-supply	0.50	0.59	0.70	0.82	0.96	0.46
	GW Municipal self-supply	0.83	0.99	1.15	1.35	1.57	0.74
	GW Industrial	0.00	0.00	0.00	0.00	0.00	0.00
	GW Agricultural	0.06	0.06	0.07	0.07	0.07	0.01
	GW Total	1.39	1.64	1.92	2.23	2.60	1.21
	SW Municipal	0.00	0.00	0.00	0.00	0.00	0.00
	SW Industrial	0.00	0.00	0.00	0.00	0.00	0.00
	SW Agricultural	0.49	0.51	0.54	0.57	0.60	0.11
	SW Total	0.49	0.51	0.54	0.57	0.60	0.11
	Total	1.88	2.16	2.46	2.80	3.20	1.32
McIntosh	GW Municipal public-supply	0.81	1.06	1.34	1.59	1.85	1.04
	GW Municipal self-supply	0.62	0.81	1.02	1.19	1.38	0.76
	GW Industrial	0.04	0.14	0.25	0.28	0.32	0.29
	GW Agricultural	0.33	0.33	0.33	0.33	0.33	0.00
	GW Total	1.80	2.34	2.95	3.40	3.89	2.09
	SW Municipal	0.00	0.00	0.00	0.00	0.00	0.00
	SW Industrial	0.00	0.00	0.00	0.00	0.00	0.00
	SW Agricultural	0.00	0.00	0.00	0.00	0.00	0.00
	SW Total	0.00	0.00	0.00	0.00	0.00	0.00
	Total	1.80	2.34	2.95	3.40	3.89	2.09

Figure 15 shows the aggregated county wastewater forecasts 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).



Note: Energy forecasts are not shown above. The 2010 energy forecast for returns is 338 MGD. The 2050 energy forecast for returns is 318 MGD based upon the population growth approach.

Figure 15: Coastal Georgia Regional Wastewater Forecast by Discharge Method

Appendix A: Development of Publicly-Supplied Water Use Rates (GPCD) by County

Coastal Georgia Municipal GPCD Development by County

County	Major Public Suppliers Listed by USGS ²	Original USGS County GPCD ¹	USGS County GPCD After First Adjustment ²	Alternate GPCD Derived from EPD Drinking Water System Survey Data ³					Population-Weighted GPCD percent above or below adjusted USGS value	Follow Up with Public Supplier?	Reason for Follow Up or Comments	Information Gathered during Follow Up					Adjusted Major Public Supplier GPCD ⁴	Adjusted Population-Weighted County GPCD ⁵	Recommended County GPCD
				Population Served By Supplier ³	Percent of County Population Served by Supplier ^{1,3}	Public Supply Withdrawals by Supplier ³ (MGD)	Major Public Supplier GPCD	Population-Weighted County GPCD				Revised Population Served	Revised Water Withdrawal (MGD)	Wholesale Water Purchase (MGD)	Wholesale Water Sale (MGD)	Major Industrial Water Use (MGD)			
Bryan	City of Pembroke	94.6	94.6	2,571	9%	0.23	89.5	112.4	18.8%	no	Member of municipal forecasting subcommittee	9,187	-	-	-	-	115.4	109.7	110
	City of Richmond Hill			8,905	31%	1.06	119.0			yes									
Bulloch	Town of Brooklet	82.7	82.7	1,456	2%	0.12	82.4	111.9	35.3%	no	One of top suppliers in region and calculated GPCD value not consistent with USGS value	24,612	2.89			0.19	109.6	107.6	108
	Nevils Water Association			166	0%	0.04	241.0			no									
	Town of Portal			954	2%	0.07	73.4			no									
	Register Water System			211	0%	0.02	94.8			no									
	City of Statesboro			25,641	42%	2.93	114.3		yes										
Camden	City of Kingsland	130.3	130.3	16,284	36%	1.45	89.0	108.9	-16.4%	no	Higher GPCD explained by water use functions at the Navy Base.								
	City of St. Marys			17,090	37%	1.48	86.6			no									
	City of Woodbine			1,508	3%	0.14	92.8			no									
	USN Base Support			2,124	5%	0.96	452.0			no									

Coastal Georgia Municipal GPCD Development by County

County	Major Public Suppliers Listed by USGS ²	Original USGS County GPCD ¹	USGS County GPCD After First Adjustment ²	Alternate GPCD Derived from EPD Drinking Water System Survey Data ³					Population-Weighted GPCD percent above or below adjusted USGS value	Follow Up with Public Supplier?	Reason for Follow Up or Comments	Information Gathered during Follow Up					Adjusted Major Public Supplier GPCD ⁴	Adjusted Population-Weighted County GPCD ⁵	Recommended County GPCD
				Population Served By Supplier ³	Percent of County Population Served by Supplier ^{1,3}	Public Supply Withdrawals by Supplier ³ (MGD)	Major Public Supplier GPCD	Population-Weighted County GPCD				Revised Population Served	Revised Water Withdrawal (MGD)	Wholesale Water Purchase (MGD)	Wholesale Water Sale (MGD)	Major Industrial Water Use (MGD)			
Chatham	City of Garden City	160.7	160.7	5,460	2%	1.16	212.5	135.1	-16.0%	yes	Calculated GPCD above expected range	5,080	-	-	-	-	228.3	135.8	136
	Hunter Army Airfield			6,000	3%	0.78	130.0			no									
	Town of Pooler			15,080	6%	0.63	41.8			yes	Calculated GPCD below expected range	10,437	0.63	0.50	-	-	107.9		
	City of Port Wentworth			7,985	3%	0.29	36.3			yes	Calculated GPCD below expected range, information pending								
	City of Savannah			163,688	69%	23.98	146.5			yes	One of top suppliers in region - ground water	193,394	23.99				124.0		
	Skidaway Island Utilities			unknown		1.60	-				Private Utility not listed in EPD Drinking Water System Survey								
	City of Tybee Island			6,627	3%	0.86	129.8			no									
	Savannah - Glen Robin			5,000	2%	0.64	128.0			no									
Savannah Industrial & Domestic							yes	Surface water municipal plant serving both industry and municipal	10,000	34.33	0.00	2.06	27.91	435.9					
Effingham	Coastal Water & Sewer	1,404.4	78.1	unknown		0.13	-	154.4	97.7%		Private Utility not listed in EPD Drinking Water System Survey						119		
	City of Guyton			2,165	5%	0.20	92.4			yes	Calculated GPCD value not consistent with USGS value	2,444	0.20	0.00	-	-			82.9
	Town of Rincon			3,600	8%	0.73	202.8			yes	Calculated GPCD value not consistent with USGS value	6,267	-	-	-	-			116.5
	City of Springfield			2,330	5%	0.32	137.3			yes	Calculated GPCD value not consistent with USGS value	2,187	0.37	-	-	0.01			165.0
Savannah Industrial & Domestic			10,500	22%	34.33	-		yes	Intake located in Effingham County, but WTP and water use occurs in Chatham County. Water use is primarily industrial. See Chatham County above.										
Glynn	City of Brunswick	157.3	157.3	30,000	42%	4.57	152.3	146.4	-6.9%	no	One of top suppliers in region, but data appears reasonable						157		
	Jekyll Island Water Authority			2,083	3%	1.06	508.9			no	Higher GPCD explained by tourism								
	Glynn County Board of Commissioners St. Simons Island W&S			29,402	41%	2.76	93.9			no	One of top suppliers in region, but data appears reasonable								
	Sea Island Services			1,841	3%	0.88	478.0			no	Higher GPCD explained by tourism								

Coastal Georgia Municipal GPCD Development by County

County	Major Public Suppliers Listed by USGS ²	Original USGS County GPCD ¹	USGS County GPCD After First Adjustment ²	Alternate GPCD Derived from EPD Drinking Water System Survey Data ³					Population-Weighted GPCD percent above or below adjusted USGS value	Follow Up with Public Supplier?	Reason for Follow Up or Comments	Information Gathered during Follow Up					Adjusted Major Public Supplier GPCD ⁴	Adjusted Population-Weighted County GPCD ⁵	Recommended County GPCD		
				Population Served By Supplier ³	Percent of County Population Served by Supplier ^{1,3}	Public Supply Withdrawals by Supplier ³ (MGD)	Major Public Supplier GPCD	Population-Weighted County GPCD				Revised Population Served	Revised Water Withdrawal (MGD)	Wholesale Water Purchase (MGD)	Wholesale Water Sale (MGD)	Major Industrial Water Use (MGD)					
Liberty	City of Hinesville	100.1	95.6	23,400	41%	2.92	124.8	134.8	41.0%	yes	Calculated GPCD value not consistent with USGS value, one of top suppliers in region and member of municipal forecasting subcommittee	35,000				83.4	108.6	109			
	City of Midway			2,595	5%	0.23	88.6			no											
	City of Walthourville			4,030	7%	0.43	106.7			no											
	City of Riceboro			1,131	2%	0.62	548.2			yes		Calculated GPCD value well above expected range and not consistent with USGS value.	1,363	0.69					-	0.35	255.4
	Fort Stewart											Supplier not listed in USGS 2005 report. Base population served for 2005 interpolated from US Census Group Quarters Data for Liberty County.	11,494	1.99							173.1
Long	City of Ludowici	444.8	444.8	1,651	15%	1.34	811.6	811.6	82.5%	yes	Calculated GPCD value well above expected range and not consistent with USGS value	1,976	0.23				116.4	116.4	116		
McIntosh	City of Darien	135.7	135.7	3,224	29%	0.32	99.3	97.8	-27.9%	yes	Calculated GPCD value not consistent with USGS value	2,948	0.49				166.2	161.4	136		
	Hog Hammock Commission			150	1%	0.01	66.7			no											

Sources:

1. USGS Water Use in Georgia by County for 2005

2. First Adjustments to USGS County GPCD :

Effingham County - S ubtracted 34.33 mgd provided by the Savannah Industrial and Domestic water provider from the total public supply withdrawals. Subtracted 750 people served by the Savannah Industrial and Domestic provider. It is assumed that not all water supplied by Savannah Industrial and Domestic is for industrial use; Additional data to account for water supplied to industrial vs. domestic users is pending.

Liberty County - Adjustment based on water withdrawal permit data for the Fort Stewart - Department of the Army facility (1.99 MGD) (GaEPD Permit Database). Adjusted GPCD calculation includes additional water use and additional population served (23,000) by the Fort Stewart drinking water system

3. Georgia EPD Drinking Water System Survey (2006-2009)

4. Feedback from outreach to public suppliers



Contact for more information due to discrepancy between USGS and EPD Survey values OR abnormally high or low values



One of top suppliers in region based upon population served



One of top suppliers flagged for followup due to data discrepancies or anomalies

Maximum Coastal Georgia Region GPCD 157
 Minimum Coastal Georgia Region GPCD 108
 Population-Weighted Coastal Georgia Regional GPCD 129

Appendix B: Passive Conservation Per Capita Adjustment Calculation

Passive Conservation – Example Calculation of Per Capita Adjustment and Per Capita Adjustments by County

Atkinson County

2000 Housing Units (age of structure)			
	# of units	% of total	gallons/flush
2000-2005	62	2%	1.6
1994-2000	481	15%	1.6
1990-1994	341	11%	3.5
1980-1990	608	19%	3.5
Pre-1980	1,741	54%	5

Source: U.S. Census Bureau

2000 Population	7,609
2005 Population Estimate	7,968

Source: U.S. Census Bureau

2000 Estimate Total Housing Units	3,171
2005 Estimate Total Housing Units	3,233

Source: U.S. Census Bureau

2000 Household Size	2.4
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Source: U.S. Census Bureau

Assumptions

ULFT gallons/flush	1.6
HET gallons/flush	1.28
# toilets per house	2 (assumed, can be modified)
# of flushes per day*	5.05 (assumed, can be modified)
Annual replacement rate of toilets (Equates to a 50 year life)	2% (assumed, can be modified)

*Residential End Uses of Water (American Water Works Association, 1999)

Number of Toilets by Flush/Gallon Category

Gallons/flush	# of toilets	# of toilets calculation
1.6	1,427	= # of structures built between 1994 and 2005 plus half of the structures built from 1990-1994 times # toilets per house $= ((62+481) + (341/2)) * 2$
3.5	1,557	= # of structures built between 1980 and 1990 plus half of the structures built from 1990-1994 times # toilets per house $= ((608) + (341/2)) * 2$
5	3,482	= # of structures built before 1980 times # toilets per house $= 1,741 * 2$
Total	6,466	

Annual Water (MG) by Flush/Gallon Toilets

Gallons/flush	Annual Water (MG)	Annual Water (MG) Calculation
1.6	5.2	=2005 population * (# of 1.6 gal/flush toilets)* # flushes per person per day * gal/flush * 365 / 1,000,000 =7,968 * 1,427 * 5.05 * 1.6 * 365 / 1,000,000
3.5	12.4	=2005 population * (# of 3.5 gal/flush toilets)* # flushes per person per day * gal/flush * 365 / 1,000,000 =7,968 * 1,557 * 5.05 * 3.5 * 365 / 1,000,000
5	39.5	=2005 population * (# of 5 gal/flush toilets)* # flushes per person per day * gal/flush * 365 / 1,000,000 =7,968 * 3,482 * 5.05 * 5 * 365 / 1,000,000
Total	57.1	

Toilet Replacement Calculation

	Year 0	Year 5	Replacement Calculation
Gal/Flush	# Toilets	# Toilets	Annual Toilets Replaced = Total # Toilets * 2% 6,466 * 2% = 129.32 Annual Toilets Replaced by Flush/Gal Category = # of Toilets in 2005 - (((Annual Toilets Replaced) * (% of Toilets in 2005 by Flush/Gal Category) * # Years)
1.28	0	647	= 129.32 * 5
1.6	1,427	1,284	= 1,427 - (((129 * (1,427/6,466)) * 5)
3.5	1,557	1,401	= 1,557 - (((129 * (1,557/6,466)) * 5)
5	3,482	3,134	= 3,482 - (((129 * (3,482/6,466)) * 5)
Total	6,466	6,466	

Annual Water Demand Calculation

	Year 0	Year 5	Annual Water Calculation, Year 5
Gal/Flush	Annual Water (MG)	Annual Water (MG)	=2005 population * (# of gal/flush toilets in year 5)* # flushes per person per day * gal/flush * 365 / 1,000,000
1.28	0	1.9	= (7,968 * (647/6,466)) * 5.05 * 1.28 * 365 / 1,000,000
1.6	5.2	4.7	= (7,968 * (1,284/6,466)) * 5.05 * 1.6 * 365 / 1,000,000
3.5	12.4	11.1	= (7,968 * (1,401/6,466)) * 5.05 * 3.5 * 365 / 1,000,000
5	39.5	35.6	= (7,968 * (3,134/6,466)) * 5.05 * 5 * 365 / 1,000,000
Total	57.1	53.3	

Per Capita Adjustment Calculation

= Annual Water (MG) savings from base year / 2005 population * 1,000,000 / 365

= (57.1 - 53.3) / 7,968 * 1,000,000 / 365

= 1.3 gallons per capita per day adjustment

Coastal Georgia Passive Conservation Per Capita Adjustment by County

County	2010	2020	2030	2040	2050
Bryan	0.0	1.6	3.3	5.0	6.6
Bulloch	0.0	2.0	4.1	6.2	8.3
Camden	0.0	1.7	3.4	5.2	6.9
Chatham	0.0	2.6	5.3	7.9	10.6
Effingham	0.0	1.7	3.4	5.1	6.8
Glynn	0.0	2.4	4.8	7.2	9.5
Liberty	0.0	1.9	3.9	5.9	7.9
Long	0.0	1.8	3.7	5.5	7.4
McIntosh	0.0	2.1	4.3	6.5	8.7

**Appendix C: Municipal Wastewater – Calculating split
between point source and land application systems by
county**

Coastal Georgia Region

County	Permit/ DMR	Facility	LAS	NPDES	Total	% PS
Bryan ¹	Permit	Pembroke		0.29	1.49	100%
		Pembroke Pond		0.07		
		Richmond Hill – Elbow Swamp WPCP		1.12		
Bulloch	Permit	Statesboro WPCP		4.42	4.42	100%
Camden	Permit	Kingsland – Saint Marys WPCP		1.90	3.84	100%
		Saint Marys – Point Peter WPCP		1.17		
		Saint Marys – Scrubby Bluff WPCP		0.00		
		Saint Marys – Weed Street WPCP		0.57		
		St Mary's LAS	0.00			
		Woodbine WPCP		0.20		
Chatham	Permit	Garden City WPCP		0.97	30.62	98%
		Pooler – Bloomingdale WPCP		1.04		
		Savannah – Crossroads WPCP		0.00		
		Savannah – Georgetown WPCP		1.54		
		Savannah – President Street WPCP		21.22		
		Savannah Travis Field WPCP		1.00		
		Savannah – Wilshire WPCP		3.24		
		Tybee Island - WPCP		0.88		
	DMR	Chatham Co. Pine Barren	0.52			
		Savannah – President Street Reuse LAS	0.21			
Effingham ²	Permit	Rincon WPCP		0.49	0.88	90%

County	Permit/ DMR	Facility	LAS	NPDES	Total	% PS
	DMR	Effingham County South ³	0.09			
		Springfield		0.30		
Glynn	Permit	Brunswick – Academy Creek WPCP		8.11	11.86	99%
		Jekyll Island WPCP		0.62		
		Saint Simons Island WPCP		2.96		
	DMR	Glynn Co. I-95/US 17	0.17			
Liberty	Permit	Hinesville – Fort Stewart WPCP		5.64	6.47	95%
			Riceboro WPCP			
		Midway Industrial Park	0.02			
		Midway LAS	0.34			
		Hinesville ⁴		0.47		
Long	Permit	Ludowici WPCP		0.08	0.08	100%
McIntosh	Permit	Darien WPCP		0.42	0.42	100%
	DMR	McIntosh County Industrial Development Authority		0.00		

¹ Identified one LAS permit in Bryan County that was not in the EPD database – Dunham Marsh Plantation. EPD indicated that there is very small discharge and that no data has been provided by the permit holder yet.

² An additional municipal wastewater permit was identified for Effingham County that was not included in determination of percent point source. According to EPD the Effingham County IDA permit (GA02-032), an LAS permit, is still under construction and has not reported flow data.

³ There was no 2005 data available for the Effingham County South permit. Flows represent the average of the annual averages for 2007, 2008, and 2009.

⁴ The Hinesville permit did not become active until 2008. The flow reported is the 2009 average annual discharge.