

# **Industrial Water Use:** A Study of Managing for Efficiency in Southeast Georgia

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Prepared for

ONE HUNDRED MILES



Prepared by

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## **EXECUTIVE SUMMARY**

Considerable work has been done within the industrial sector in Georgia to improve water efficiency, although little attention has been paid to these success stories. This study was initiated to highlight those successes and bring forward important information to assist managers and citizen leaders in managing limited water resources. The geographic area of this study includes the 24-county coastal region, but the nine counties located in the Coastal Georgia Regional Water Planning (CG-RWP) district were explored in depth to update water use forecasting in the CG-RWP with recent data.

The Floridan aquifer is the region's primary water supply for domestic and commercial uses, and it is used in many industrial processes because of its high quality. Historic groundwater withdrawal in coastal Georgia and South Carolina have created conditions allowing saltwater to infiltrate into the pristine fresh water of the Floridan aquifer. Saltwater intrusion has already occurred in the Hilton Head Island area of South Carolina and within the City of Brunswick, Georgia, and it is a growing concern throughout Coastal Georgia. Because of these conditions, the Georgia Environmental Protection Division (EPD) has classified areas that have the highest vulnerability for saltwater intrusion as the "Red Zone." The Red Zone includes Chatham County, the southern half of Effingham County, and a small portion of Brunswick, in Glynn County. Permits for new or expanded groundwater withdrawals in the Red Zone are restricted in order to minimize the threat of increased saltwater intrusion. Because of the threat facing water supplies in the Red Zone, this study targeted investigations on the industrial groundwater withdrawal permittees within the Red Zone and the largest water users in the 24-county area. This study also analyzed county-by-county and permit-by-permit water withdrawals and changes over time. Other groupings included in the study are the 9-county area included in the CG-RWP and the coastal counties not included in the CG-RWP.

The primary objectives of this study were:

1. Summarize current groundwater and surface water withdrawals by the industrial sector in Coastal Georgia.
2. Evaluate changes in groundwater withdrawals for industrial permittees from 2005 to 2016.
3. Summarize conservation-related reports and associated reductions in water withdrawals submitted to EPD by individual permittees.
4. Compare industrial water withdrawal forecasting from the 2011 and 2017 CG-RWPs with reported withdrawals.
5. Provide an updated industrial water use forecast that can inform regional and local water planning.

This study was initiated in 2017, so all data analysis comparing reported withdrawals with permit limits is built around 2016 data, the most recent full year at the time of the analysis. Nineteen out of 30 active permittees (65%) in 2016 were using less than 50% of their permit limit. This shows that many permittees are only using as much as they need and not as much as they are allowed. Only five out of 30 active permittees (16%) were within 20% of their permit limit. Two of the five are located in the Red Zone, where EPD has initiated permit limit reductions.

This study also investigated site-specific investments in industrial water efficiency, as reported to the EPD. In calculating the net change in withdrawals from 2005 to 2015, Georgia-Pacific's Brunswick Cellulose Plant in Glynn County, reduced withdrawals of groundwater by 8.35 MGD

and withdrawals of surface water by 22.58 MGD for a total reduction of 30.93 MGD. This facility, as well as International Paper in Chatham County, Interstate Paper in Liberty County, and Rayonier Performance Fibers in Wayne County are highlighted in this study to show the impact that conservation efforts can have on increasing production efficiency and reducing pressure on regional water supplies. These four were selected because they are the largest groundwater users in Coastal Georgia. Three are located in an area with immediate concern for saltwater intrusion (Red Zone and Yellow Zone), and the fourth is located outside the area of concern for saltwater intrusion, in the Green Zone, in Wayne County.

This study also summarizes details from EPD mandated conservation-related reports and programs. In compliance with a State plan designed to address the threat of saltwater intrusion, industrial groundwater withdrawal permits that were renewed in 2007/2008 or issued after this period in the coastal counties included several special permit conditions for conservation and reuse. Many of the special permit conditions had deadlines for implementation or compliance by the end of 2008 or in 2009. Special permit conditions included: (1) Water Conservation Education Program, (2) Water Meter Calibration, and Repair and Replacement Program, (3) Outdoor Watering Schedule, (4) Alternate Water Sources, (5) Water Reuse Feasibility Study, (6) Water Audit, and (7) Water Leak Detection and Repair Program. Water Conservation Progress Reports were also required as a special permit condition for large water withdrawal permittees. Alternative Water Source Evaluation results were explored for permittees in the Red Zone. It was found that cost was a major factor in the viability of alternative water sources, and water quality was also a concern because extensive treatment would be required for production processes.

The CG-RWP forecasts water use by the industrial sector to 2050. The industrial forecasts presented in the 2017 update of the CG-RWP utilized the same 2005 water use data that was analyzed in the original 2011 Plan. The 2017 Plan shifted the “current” condition from 2010 to 2015 by calculating the midpoint between years 2010 and 2020 from the original projection. Based on reported withdrawals from 2015, the current CG-RWP overestimated water withdrawals from the industrial sector by 43.98 MGD (36%). Forecasted surface water withdrawals in 2015 were overestimated by 26.94 MGD and groundwater withdrawals were overestimated by 17.03 MGD. This study offers an updated forecast of future industrial water use because it accounts for the recent reductions in withdrawals that have resulted from significant investments in operations and more efficient equipment, but it still utilizes the rate of industrial growth that was used in the CG-RWP (additional 35 MGD from 2010 to 2050). The resulting updated forecast only predicted 133.52 MGD used by industrial permittees in 2050, which is 28.46 MGD (17.5%) less than the 2010 base year in the original 2011 CG-RWP forecast.

Other water withdrawal reductions were accounted for in forecasting future water use. In 2015 EPD adjusted industrial permits to help reduce impacts on the Floridan aquifer. The new permits require reductions in groundwater withdrawal permit limits for all Red Zone permittees by 2025. Two facilities are currently operating above their 2025 permit limits, so mandatory reductions will reduce groundwater withdrawals from these facilities by 2.75 MGD in 2025. Additionally, one permittee ceased surface water withdrawals in 2016, reducing overall future demand by an additional 16.34 MGD.

## 1. INTRODUCTION

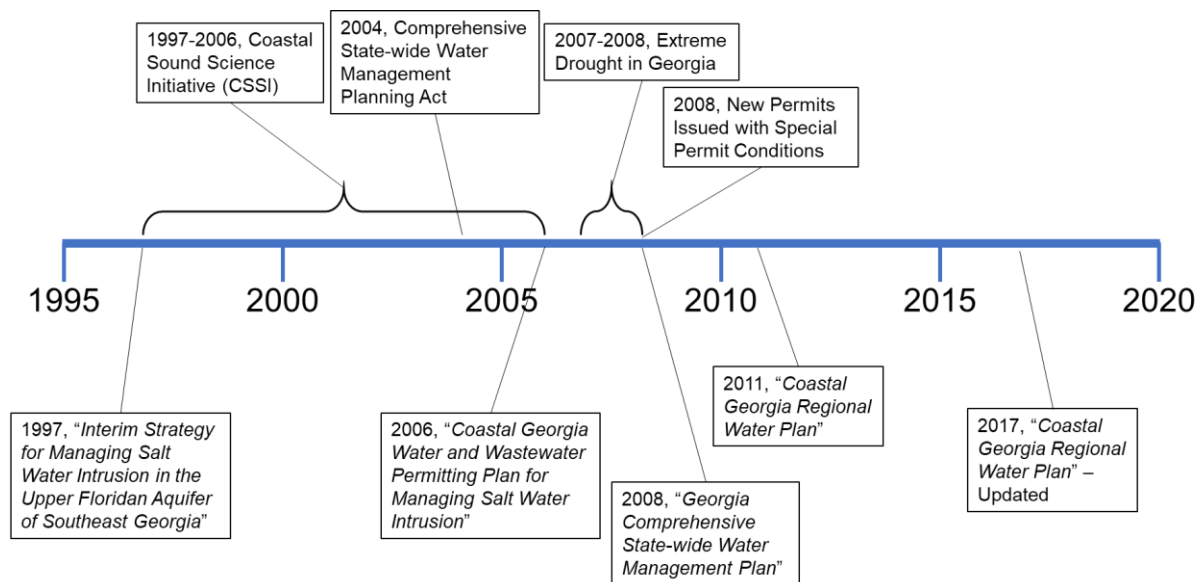
In Georgia, water is an essential natural resource to sustain economic prosperity and preserve diverse aquatic habitats for wildlife and recreation. The needs and concerns for this finite resource vary across the state, and several issues span into neighboring states.

Managing shared water resources is complex and requires up-to-date data and scientific information, as well as input from citizens and businesses who depend on the resource. The state of Georgia manages all water resources in trust for the citizens of the state, and the Georgia Environmental Protection Division (EPD) regulates most water-related activities (such as withdrawals and discharges).

A general timeline of Coastal Georgia-related water planning activities and development of planning documents is presented in **Figure 1**. In the 1990s, scientists discovered that saltwater was intruding into the Floridan aquifer, southeast Georgia's primary water source. Through a Joint Senate-House subcommittee of the Georgia General Assembly, EPD initiated a two-stage approach in 1997 to resolve saltwater intrusion. The first stage was development of the "Interim Strategy for Managing Salt Water Intrusion in the Upper Floridan Aquifer of Southeast Georgia," which issued a temporary moratorium on groundwater withdrawal permits from the Upper Floridan aquifer in the 24-county coastal region for municipal, industrial, and agricultural uses. The second stage was creation of the Coastal Sound Science Initiative (CSSI), which was a funded program for scientific and feasibility studies to refine the plan for managing saltwater intrusion. The CSSI included a technical advisory committee, and the United States Geologic Survey (USGS) partnered with the Georgia Department of Natural Resources to study the situation. This study documented that groundwater levels in Chatham County and in areas of Glynn County were declining and that saltwater was contaminating freshwater sources. The CSSI findings resulted in the 2006 "Coastal Georgia Water and Wastewater Permitting Plan for Managing Saltwater Intrusion," which described management strategies and permitting changes implemented by EPD. The 2006 permitting plan classified the Georgia coast into three management zones to implement region-specific policies and permitting requirements to slow saltwater intrusion and implement water conservation and reuse practices.

- The Red Zone includes all of Chatham County, the southern half of Effingham County, and a small portion of Brunswick, in Glynn County. This zone has the highest vulnerability for saltwater intrusion based on the groundwater cone of depression caused by extensive groundwater withdrawals.
- The Yellow Zone includes Bryan and Liberty counties because they are also vulnerable but to a lesser degree.
- The Green Zone includes areas not currently at risk of saltwater intrusion; therefore, there are no restrictions on Floridan aquifer pumping.

No net increases of water withdrawals were allowed in the Red Zone, and limited withdrawals were allowed in the Yellow Zone. Additionally, conservation and reuse requirements were included as permit conditions in the Red and Yellow Zones. As a result of these regulations on future withdrawals, many industries and municipalities are considering incorporating surface water or other alternative sources.



**Figure 1. Timeline of Coastal Georgia-Related Water Planning Activities and Documents**

In 2008, EPD released the “Georgia Comprehensive State-wide Water Management Plan,” as required in the 2004 Comprehensive State-wide Water Management Planning Act. The State Water Plan specified creating regional water councils to convene and initiate more rigorous water planning throughout the state. In 2011, the state of Georgia adopted 10 regional water plans (RWP) that comprised the state’s first comprehensive state-wide water management plan. The intent of the statewide planning effort was to ensure each region's water resources are sustainably managed through at least 2050. The Regional Water Councils created in the Act consist of government officials, citizens, businesses, and non-profits and convenes to guide the development of each regional plan and provide insight into water resource issues. The second RWPs were adopted in 2017.

All 10 RWPs include information about current groundwater and surface water use, as well as forecasted demand for four major water use sectors to 2050, including, municipal, agricultural, energy, and industrial. The Coastal Georgia RWP (CG-RWP) district is the only RWP district located solely in the 24 coastal counties, and it encompasses nine coastal counties – Bryan, Bulloch, Camden, Chatham, Effingham, Glynn, Liberty, Long, and McIntosh counties. The remaining 15 coastal counties are located in three other RWP districts that extend inland. The RWPs are an important planning tool allowing industries, citizens, and municipalities to set regional expectations and incorporate those into larger statewide resource management strategies.

The 2017 CG-RWP update included revisions to the water forecasts for the municipal, agricultural, and energy sectors. The industrial water and wastewater forecasts presented in the 2017 update of the CG-RWP were not revised; they utilized the same 2005 water use data that was analyzed in the original 2011 Plan. The 2017 Plan shifted the “current” condition from 2010 to 2015 by calculating the midpoint between years 2010 and 2020 from the original projection.<sup>1</sup>

<sup>1</sup> In the original projection from the 2011 CG-RWP, EPD used data from 2005 industrial permit database to determine the “current” withdrawal amounts for the base year of 2010.



Locally, the Chatham County-Savannah Metropolitan Planning Commission initiated the “Red Zone Water Supply Management Plan.” This group convened all the industrial, municipal and private water permittees within the Red Zone with the goal of reducing groundwater withdrawals in the region to slow the migration of saltwater into the Floridan aquifer and address the reduced water withdrawal permit limits established by EPD for 2025. The study completed by the Red Zone Task Force determined that groundwater usage by the industrial sector in Chatham County has been cut in half from 36.47 MGD to 17.73 MGD during the last quarter-century (1992 to 2015). The Red Zone Water Supply Management Plan investigated municipal and industrial water users, but most of the information, management strategies, and resources focused on the municipal sector.

The population of the nine counties within the CG-RWP is expected to grow 49% from 681,698 in 2015 to 1,012,621 by 2050<sup>2</sup>. Water supply resources in the Red and Yellow Zones are already limited. As such, it is critical that accurate information be used in all planning exercises and that investments in conservation and efficiency are applauded and encouraged. The population in the other 15 counties in the 24-county coastal region, which is entirely in the Green Zone, is only expected to grow by 15% from 287,895 in 2015 to 331,787 by 2050<sup>2</sup>.

One Hundred Miles (OHM) initiated this project to highlight industrial investments and practices that have resulted in reduced water withdrawals in southeast Georgia. Considerable work has been done within this sector to improve water efficiency, although little attention has been paid to these success stories.

This “Industrial Water Use Study,” allows for a deeper investigation into water use within the industrial sector, documents recent progress, and identifies practices and requirements that have had the greatest impact on reducing water withdrawals in areas with limited supplies. It includes a review of the industrial water withdrawal reductions that have resulted from adjusted permits and showcases site-specific practices that have been implemented to achieve the reductions. With such a varied group of industrial water users in the state, documenting successful reductions based on increased efficiency, will promote greater implementation statewide. The specific objectives of this study were:

- Summarize current groundwater and surface water withdrawals by the industrial sector in Coastal Georgia.
- Evaluate changes in groundwater withdrawals for industrial permittees from 2005 to 2016.
- Summarize conservation-related reports and associated reductions in water withdrawals submitted to EPD by individual permittees.
- Compare industrial water withdrawal forecasting from the 2011 and 2017 Coastal Georgia Regional Water Plans with reported withdrawals.
- Provide an updated industrial water use forecast that can inform state, regional, and local water planning.

This study does not investigate water withdrawals by power generating facilities. While water withdrawals for Georgia Power, power plants, are noted in the Red Zone Water Supply Management Plan as industrial, the RWPs consider these as the energy sector, separate from

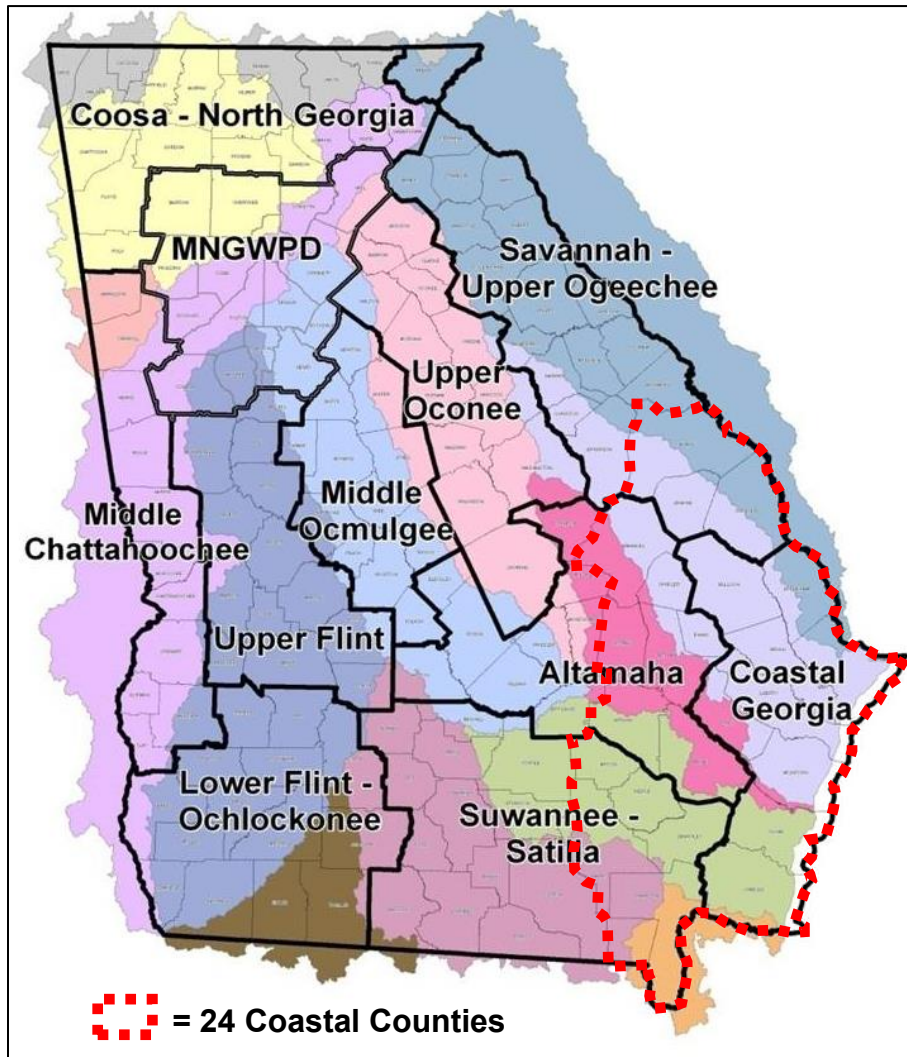
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<sup>2</sup> The 2015 populations were based on the 1-year estimates from the American Community Service of the U.S. Census Bureau, and the 2050 populations were the most recent (2013) population projections from the Georgia Governor’s Office of Planning and Budget (OPB).

industrial. Energy facilities within the CG-RWP district include: Effingham County Power Plant, Plant McIntosh, Plant McManus, and Plant Wentworth (Kraft). Plant Kraft shut down in 2015, so it was assumed retired in the forecasts following 2015.

## 2. DATA ASSESSMENT

This section presents an analysis of water withdrawals by groundwater and surface water permit holders from the industrial sector, located in Coastal Georgia. The geographic study area includes the 24-county coastal region, including the nine counties in the CG-RWP – Bryan, Bulloch, Camden, Chatham, Effingham, Glynn, Liberty, Long, and McIntosh. The 9-counties included in the CG-RWP were explored in depth to compare water forecasting presented in the CG-RWP. **Figure 2** presents the 24-county coastal region and RWP boundaries.



**Figure 2. Map of RWP Districts and 24-County Coastal Region**

Industrial facilities that withdraw over 100,000 gallons per day (GPD) from groundwater or surface water sources are required to obtain a permit from EPD. The water withdrawal permits mandate that the industries submit monthly water withdrawal records, as well as copies of special permit conditions requirements (e.g., reuse feasibility studies, alternative water source evaluation, water conservation plan, water conservation progress report, and water audits). The following information was requested and obtained from EPD for this study: water withdrawal data from industrial water users, documentation from special permit conditions, as well as information on industrial water usage forecasting use in creation of the CG-RWPs (2011 and 2017). Information

was accessed from the EPD Coastal District Office in Brunswick and the EPD Watershed Protection Branch headquarters in Atlanta.

## 2.1. Summary of Industrial Water Withdrawal Permits

**Table 1** summarizes industrial groundwater withdrawal permits by county. All total, there are 31 industrial groundwater withdrawal permits for the Floridan aquifer in the 24-county coastal region, with a combined annual average permit limit of 171.911 MGD. There are 17 groundwater withdrawal permits in the 9-county CG-RWP region, with a combined annual average permit limit of 93.811 MGD. The remaining 14 industrial permits are located in the 15 counties not included in the CG-RWP, and they have a combined annual average permit limit of 78.100 MGD.

**Table 1. Summary of 2017 Industrial Groundwater Withdrawal Permits from Floridan Aquifer in the 24 Coastal Counties**

District	County	Industrial Groundwater Withdrawal Permits (Floridan aquifer)	2018 Permit Limit, Annual Average (MGD)
Coastal Georgia Regional Water Plan (CG-RWP)	Bryan	0	0
	Bulloch	0	0
	Camden	0	0
	Chatham	9	21.386
	Effingham	1	1.695
	Glynn	6	58.730
	Liberty	1	12.000
	Long	0	0
	McIntosh <sup>1</sup>	0	0
	<b>Total</b>	<b>17</b>	<b>93.811</b>
Other Counties in 24-County Coastal Region	Bacon	3	0.820
	Charlton	1	0.504
	Emanuel	1	1.700
	Evans	1	2.200
	Pierce	2	0.704
	Screven	2	3.030
	Tattnall	1	0.300
	Ware	2	0.842
	Wayne	1	68.000
	<b>Total</b> <sup>2</sup>	<b>14</b>	<b>78.100</b>
<b>Both</b>	<b>Total</b> <sup>3</sup>	<b>31</b>	<b>171.911</b>

Data Source: Georgia EPD

<sup>1</sup> The 2011 CG-RWP counted a City of Darien permit (#098-0005) as industrial, but its permit with EPD is categorized as municipal. It could be from an industrial customer purchasing water from a municipal provider. This permit utilizes the Brunswick (Miocene) aquifer, so it was excluded here.

<sup>2</sup> Six counties in this region do not have industrial groundwater withdrawal permits: Appling, Brantley, Burke, Candler, Jenkins, and Toombs.

<sup>3</sup> Energy permittees were not included on this list. They include: Georgia Power power plants (Plant McIntosh in Effingham County, Plant McManus in Glynn County and recently closed Plant Kraft in Chatham County) and Hatch Nuclear Plant in Appling County.

Surface water withdrawals by industrial users were also investigated in the CG-RWP district because surface water is included in future water use forecasting. **Table 2** summarizes the number of surface water withdrawal permits and monthly average permit limits by county. In total, there are five surface water withdrawal permits with a combined monthly average permit limit of 188.50 MGD. The permit limit units vary in **Table 1** and **Table 2** because surface water withdrawal permit limits are specified for monthly averages and daily maximums in MGD and groundwater withdrawal permit limits are specified for annual and monthly averages in MGD. Coastal counties not part of the CG-RWP counties do not have any surface water withdrawal permits for industrial users that use water from rivers or creeks. There is one facility in Charlton County that uses an on-site pond, and one in Wayne County that uses a borrow area.

**Table 2. 2017 Industrial Surface Water Withdrawal Permits in CG-RWP Counties**

County	Industrial Surface Water Withdrawal Permits	2018 Permit Limit, Monthly Average (MGD)
Bryan	0	0
Bulloch	0	0
Camden	0	0
Chatham <sup>1</sup>	2	47.50
Effingham <sup>2</sup>	2	85.00
Glynn	1	56.00
Liberty	0	0
Long	0	0
McIntosh	0	0
<b>Total</b>	<b>5</b>	<b>188.50</b>

Data Source: Georgia EPD

<sup>1</sup> One permit has not had any records of withdrawals from February 2016 to current (March 2018) – Weyerhaeuser NR Port Wentworth Mill (permitted monthly average withdrawal of 27.5 MGD).

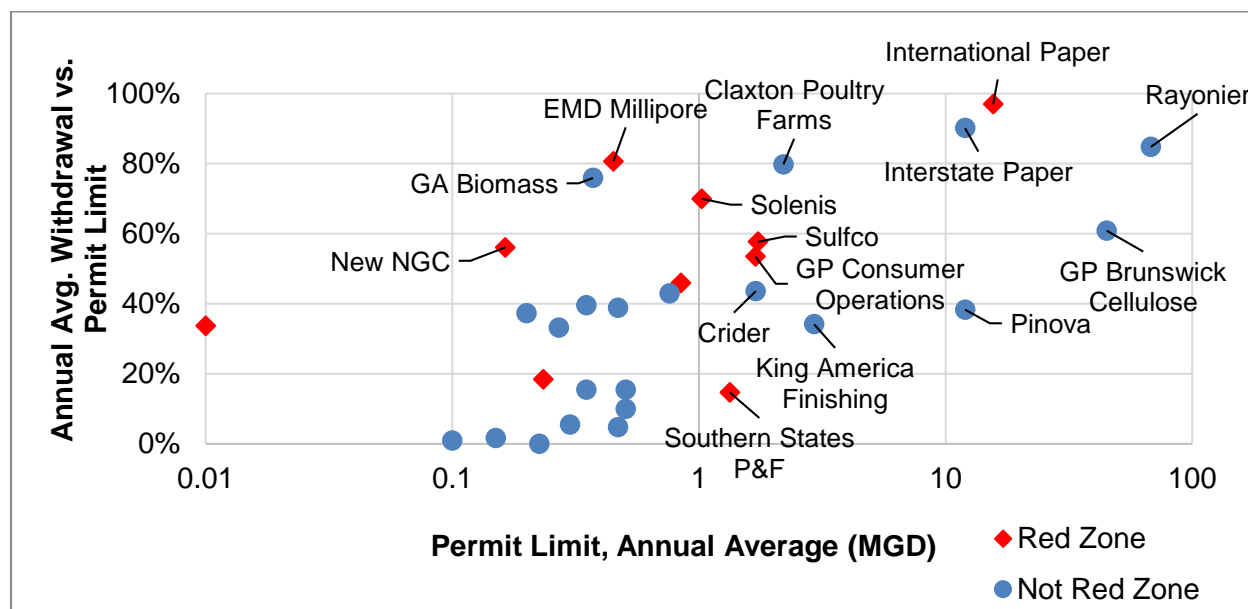
<sup>2</sup> One permit is for Savannah Industrial and Domestic Water Treatment Plant (permitted monthly average withdrawal of 50 MGD), and the majority of their distribution is to customers in Chatham County.

## 2.2. Trends in Coastal Georgia Groundwater Conservation, 2005-2016

This study evaluated reductions in groundwater withdrawals from 2005 to 2016. The data request and analysis started in late 2017, so 2016 was the most recent year with complete data. Current status in 2016 was first evaluated by comparing reported withdrawals with permit limits. The data was then divided into three-year segments to explore conservation trends over the past decade.

There are 10 industrial permits for groundwater withdrawal in the northern Red Zone (Chatham and Effingham counties) and 21 industrial groundwater permits in the other 24-county coastal region. The analysis below only includes 30 permits because Permit No. 003-0004 in Bacon County did not receive a permit until 2017. The median ratio of total usage versus permit limit is 0.55 for Red Zone permittees and 0.38 for other coastal county permittees, meaning that about one-half of the Red Zone permittees are using less than half of their permit limit and one-half of the other coastal county permittees are using less than one-third of their permit limit. The authors

suspect that the Red Zone permittees have a higher ratio because they recently experienced a reduction in permit limits in 2005. Each permittee is included in **Figure 3**. The x-axis is on a log-scale because the range in permit limits is 0.01 to 68 MGD and 18 out of 30 have a permit limit less than 1 MGD. The 12 permittees with permit limits greater than 1 MGD in **Figure 3** are labeled, as are three that withdraw less than 1 MGD but are utilizing greater than 50% of their permit limit. Five out of 30 permittees (17%) were within 20% of their permit limits, and the two from the Red Zone, International Paper and EMD Millipore, would exceed their reduced 2025 permit limits at their 2016 withdrawal rates. Nineteen out of 30 permittees (63%) were using less than 50% of permit limits in 2016, indicating that most were only using as much as they needed and not as much as they were allowed.



**Figure 3. 2016 Annual Average Withdrawal vs. Permit Limit**

*Data Source: Georgia EPD*

Annual average withdrawals in the 24-county coastal region were analyzed for 2005 to 2016. The 12-year dataset was divided into four 3-year periods: (1) 2005-2007, (2) 2008-2010, (3) 2011-2013, and (4) 2014-2016. These periods allow for an analysis of trends in timeframes that capture shifts in regulations. The first period, 2005-2007, captures water withdrawals before additional regulations were added in response to the state water management planning and a severe drought. EPD released the “Georgia Comprehensive State-wide Water Management Plan,” in January 2008, which specified creating regional water councils to convene and initiate more rigorous water planning throughout the state, and in 2007 and 2008, Georgia was experiencing severe drought conditions. Also, in 2007 and 2008, EPD renewed groundwater withdrawal permits that included a series of special permit conditions, which are detailed below in *Section 2.3.1*. Several programs and analysis were required by the end of 2008 and others in 2009. Therefore 2008-2010, the second period evaluated, is considered a transition period in which the new regulations were enacted. The next two periods, 2011-2013 and 2014-2016, represent post-regulation periods in

which EPD required less regular follow-up and no additional documentation because many permits were in effect until the end of 2017. The permittees were also separated into groups based on threat for saltwater intrusion and geography. The following geographic zones were explored: (1) northern Red Zone (Chatham and Effingham Counties), (2) Other CG-RWP counties with some threat of saltwater intrusion (Glynn and Liberty counties), and (3) coastal counties not in CG-RWP (Green Zone).

**Figures 4–6** demonstrate trends in water withdrawal by geographic zone for the four periods described above. Each geographic zone was plotted separately in **Figure 4** (Chatham and Effingham counties / Red Zone), **Figure 5** (Glynn and Liberty counties / mixture of Red, Yellow, and Green Zones), and **Figure 6** (coastal counties not in CG-RWP / Green Zone), and each figure includes the average for all facilities in the respective geographic zone. Individual facilities that had annual average withdrawals less than 0.01 MGD were omitted from the graphs, as were facilities that had new permits after 2011. These categories included: 9, 6, and 8 permittees, respectively. In order to present the data on the same scale, the data was normalized by dividing each 3-year period by the 12-year average for each permittee individually. The ratio of the 3-year period average divided by the 12-year average is presented on the y-axis. The x-axis includes the permit number and 12-year annual average groundwater withdrawal rate to indicate the magnitude of their withdrawals. The 3-year average withdrawal rate for the specific period can be calculated by multiplying the ratio on the y-axis by the 12-year annual average listed on the x-axis. All groundwater withdrawal permittees in the coastal counties are described in **Table 3**. This table summarizes the permit limits, 12-year average withdrawal from 2005 to 2016, and the net change in groundwater withdrawals from the first period (2005–2007) to the fourth period (2014–2016).

**Table 3. Industrial Groundwater Withdrawal Permittees in 24-County Coastal Region**

Ground-water Permit Number	Permit Holder	County	Permit Limit Annual Avg. (MGD)	Reported 12-yr Avg. Withdrawal, [2005–2016] (MGD)	Net Change 3-yr Avg. 2005–2007 to 2014–2016 (MGD) <sup>1</sup>
025-0004	New NGC, Inc.	Chatham	0.164	0.069	+0.018
025-0006	Savannah Sugar Refinery	Chatham	0.845	0.493	–0.100
025-0008	Suloco, LLC	Chatham	1.737	0.973	–0.878
025-0009	International Paper - Savannah Plant	Chatham	15.588	15.548	–2.487
025-0011	Southern States Phosphate and Fertilizer	Chatham	1.333	0.969	–0.774
025-0013	GAF Materials Corporation	Chatham	0.234	0.229	–0.244
025-0025	Solenis, LLC	Chatham	1.025	0.722	–0.157
025-0030	EMD Millipore Corp.	Chatham	0.450	0.368	–0.006
051-0006	Georgia-Pacific Consumer Operations, LLC	Effingham	1.695	1.059	–0.792
063-0001	King & Prince Seafood Corp.	Glynn	0.270	0.115	–0.033
063-0003	Brunswick Cellulose, LLC	Glynn	45.000	28.594	–6.950

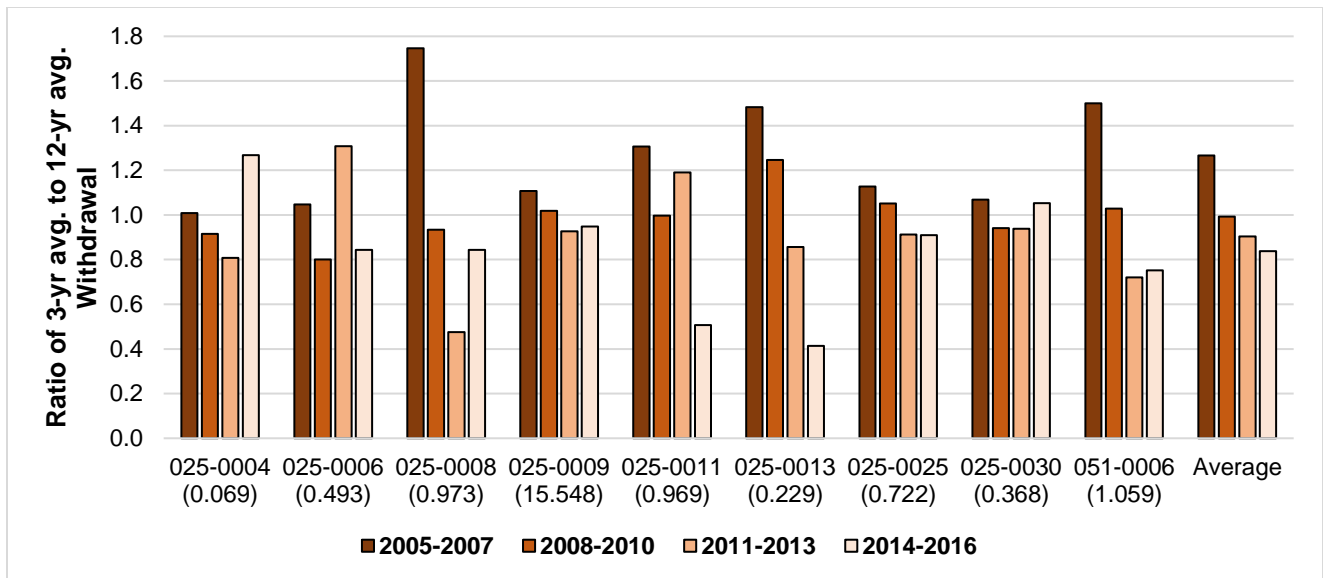


Ground-water Permit Number	Permit Holder	County	Permit Limit Annual Avg. (MGD)	Reported 12-yr Avg. Withdrawal, [2005–2016] (MGD)	Net Change 3-yr Avg. 2005–2007 to 2014–2016 (MGD) <sup>1</sup>
063-0008	Pinova, Inc.	Glynn	12.000	5.952	-2.524
063-0014	Symrise, Inc.	Glynn	0.760	0.330	-0.001
063-0015	Rich Products Corporation	Glynn	0.350	0.165	-0.043
063-0049	Georgia-Pacific WFS LLC - Thalmann Woodyard	Glynn	0.350		New in 2015
089-0001	Interstate Paper, LLC	Liberty	12.000	9.778	<b>+0.455</b>
003-0002	Milliken & Company - Alma Plant	Bacon	0.470	0.220	-0.040
003-0003	American Proteins, Inc.	Bacon	0.150	0.004	0.000
003-0004	D.L. Lee & Sons, Inc.	Bacon	0.200		New in 2017
024-0004	Southern Ionics, Inc.	Charlton	0.504		New in 2014
053-0002	Crider, Inc.	Emanuel	1.700	0.814	-0.236
054-0002	Claxton Poultry Farms	Evans	2.200	1.577	<b>+0.158</b>
113-0003	Rayonier Performance Fibers, LLC - Offerman Fiber Facility	Pierce	0.200	0.059	<b>+0.028</b>
113-0005	Southern Ionics Inc.	Pierce	0.504		New in 2015
124-0001	King America Finishing, Inc. - Plant 1	Screven	2.930	1.617	-0.524
124-0003	Wall Timber Products	Screven	0.100	0.002	-0.001
132-0005	Rayonier Performance Fibers, LLC - Collins Fiber Facility	Tattnall	0.300	0.043	-0.026
148-0002	CSX Transportation	Ware	0.470	0.026	-0.013
148-0009	Georgia Biomass, LLC	Ware	0.372		New in 2011
151-0001	Rayonier Performance Fibers, LLC – Jesup Plant	Wayne	68.000	58.777	-2.368

<sup>1</sup> Bolded values with a “+” indicate a net increase in the 3-yr average from 2005–2007 to 2014–2016.

Data Source: Georgia EPD

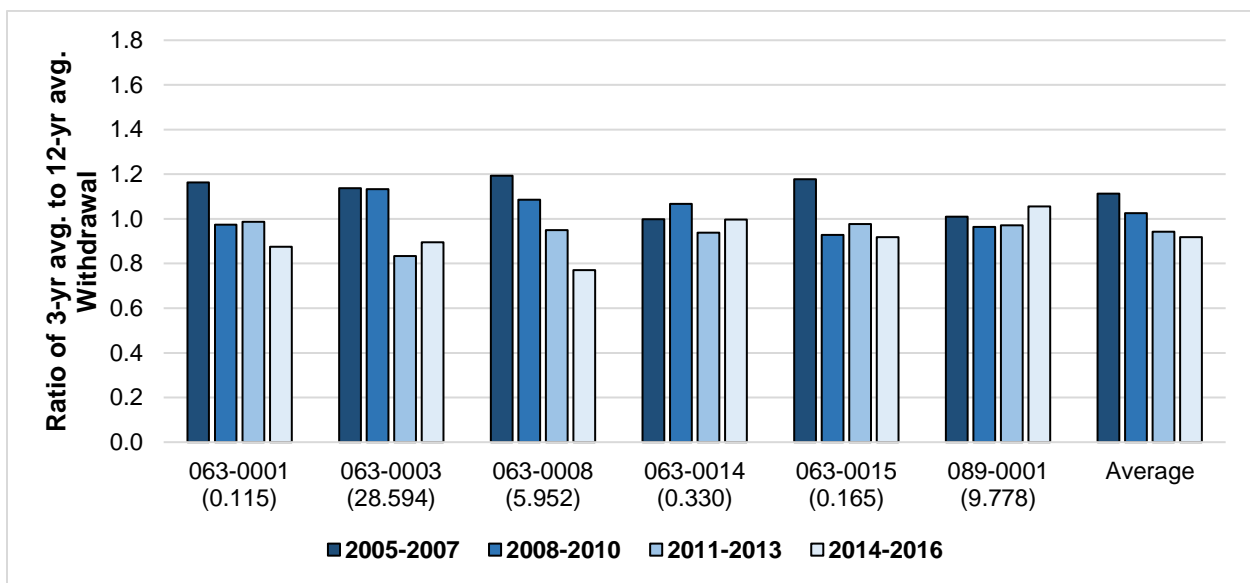




**Figure 4. Groundwater Withdrawal Changes from 2005-2016 in Chatham and Effingham Counties (Northern Red Zone)**

Note: Permit number is listed on the x-axis (see *Table 3* for names), and the 12-year annual average is presented in parentheses.

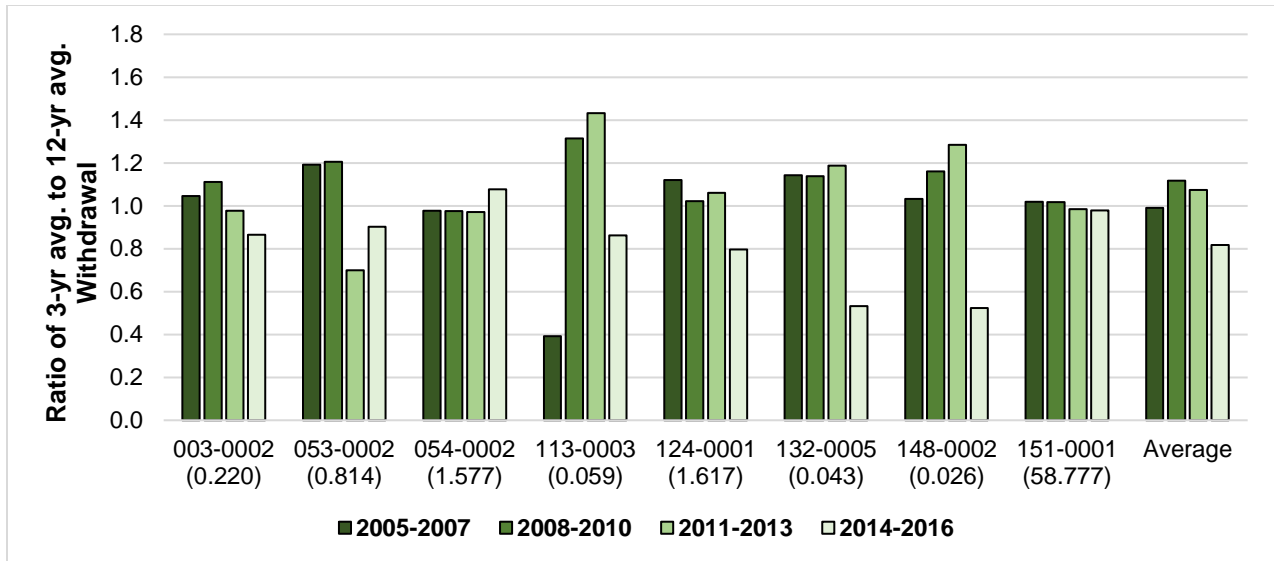
Data Source: Georgia EPD



**Figure 5. Groundwater Withdrawal Changes from 2005-2016 in Glynn and Liberty Counties (Other CG-RWP Counties)**

Note: Permit number is listed on the x-axis (see *Table 3* for names), and the 12-year annual average is presented in parentheses.

Data Source: Georgia EPD



**Figure 6. Groundwater Withdrawal Changes from 2005-2016 in Coastal Counties Not in CG-RWP**

Note: Permit number is listed on the x-axis (see *Table 3* for names), and the 12-year annual average is presented in parentheses.

Data Source: Georgia EPD

Overall, all nine industrial permittees in the Red Zone experienced a decrease in 3-year average from the first period to the second. This reduction may be the result of new regulations to accommodate drought conditions and reductions in water availability. In Glynn and Liberty counties, 5 of 6 facilities had a decrease in withdrawals; however, the Green Zone counties outside of the CG-RWP only had a reduction in 4 of the 8 facilities. Over the subsequent periods, second to third and third to fourth, the number of facilities in the Red Zone with a reduction in average withdrawals reduced from 9 to 7 and then to 4. In Glynn and Liberty counties, the number of facilities with a reduction in average withdrawals reduced from 5 to 3 and stayed at 3. There was general conservation from all three geographic zones from the first period to the fourth, as presented in *Table 4*. Only one facility in the Red Zone, one facility in Glynn and Liberty counties, and two facilities in other coastal counties reported a net increase for the 3-year average from 2005-2007 to 2013-2016.

**Table 4. Summary of Permittees with a Decrease in Groundwater Withdrawals**

Period	Chatham and Effingham Counties (Northern Red Zone)	Glynn and Liberty Counties (Other CG-RWP Counties)	Coastal Counties Not in CG-RWP (Green Zone)
Number of Permittees	9	6	8
Number of permittees with a reduction from period to period			
2005–2007 to 2008–2010	9	5	4
2008–2010 to 2011–2013	7	3	4

Period	Chatham and Effingham Counties (Northern Red Zone)	Glynn and Liberty Counties (Other CG-RWP Counties)	Coastal Counties Not in CG-RWP (Green Zone)
2011–2013 to 2014–2016	4	3	6
2005–2007 to 2014–2016	8	5	6

A more rigorous statistical analysis was conducted with an analysis of variance (ANOVA) to determine if average withdrawals varied between periods for each geographic zone. The level of significance used in all statistical tests was  $\alpha = 0.05$ , and statistical analyses were conducted using Microsoft Excel, Analysis ToolPak, as well as R Statistical Package. First, a Shapiro Wilk test was used to test the underlying distribution of the data for each period. The p-value was greater than 0.05 for 11 of the 12 periods, so the null hypothesis that the data was normally distributed failed to be rejected. Therefore, the data was assumed to have a normal distribution, which is an underlying assumption for ANOVA. A one-way ANOVA was run for each geographic zone, with the null hypothesis that the periods were equal. The p-values were less than 0.05 for all three geographic zones so the null hypothesis was rejected, indicating that at least one of the periods was different from the others for each geographic zone. These results, along with the period averages, are presented in *Table 5*.

*Table 5. ANOVA and Post-hoc Statistical Results for Comparison by Period*

Period	Chatham and Effingham Counties (Northern Red Zone)	Glynn and Liberty Counties (Other CG-RWP Counties)	Coastal Counties Not in CG-RWP (Green Zone)
2005–2007 (Period #1)	1.266	1.113	0.990
2008–2010 (Period #2)	0.992	1.026	1.118
2011–2013 (Period #3)	0.904	0.943	1.075
2014–2016 (Period #4)	0.838	0.918	0.817
ANOVA, F-Statistic	F (3,32) = 6.12	F (3,20) = 6.90	F (3,28) = 3.41
ANOVA, p-value	0.0021	0.0023	0.0310
Tukey HSD, Significant pairwise differences (p-value)	1 to 3 (p<0.05) 1 to 4 (p<0.01)	1 to 3 (p<0.01) 1 to 4 (p<0.01)	2 to 4 (p<0.05)

A Tukey’s honestly significant difference (HSD) post-hoc test was run to determine the pairwise differences. The results, presented in *Table 5*, indicated that Period #1 (2005–2007) was significantly different from Period #3 (2011–2013) and Period #4 (2014–2016) for both (1) Chatham and Effingham counties and (2) Glynn and Liberty counties. The coastal counties not in the CG-RWP only had a significant difference between Period #2 (2008–2010) and Period #4 (2014–2016). In all cases, the most recent periods were less than the initial periods, indicating that there was a significant reduction for all three geographic zones in groundwater withdrawals. The

reduction was more apparent in the areas with more stringent regulations (Red and Yellow Zones). Chatham and Effingham counties have the largest range from Period #1 (1.266) to Period #4 (0.838). Since the 3-year period averages were divided by the 12-year average to normalize the data for all facilities, these results indicate that the Red Zone had the largest collective reduction by all permittees.

### **2.3. Conservation Efforts and Progress**

The 2006 “Coastal Georgia Water and Wastewater Permitting Plan for Managing Salt Water Intrusion” included a list of conservation and reuse practices for (1) industrial water users, (2) public and private drinking water providers, (3) agricultural users, and (4) golf courses. These practices became the basis for special permit conditions outlined in groundwater withdrawal permits. Many practices required industrial permittees to adopt or implement programs, or to provide progress updates in 2008 and 2009. The Red Zone has the most stringent regulations regarding water conservation and efficiency. As part of this study, documentation submitted to EPD regarding the special permit conditions for industrial users was reviewed. Through several Georgia Open Records Act (GORA) requests, files related to the industrial permittees and special conditions kept at the EPD Coastal District Office in Brunswick, GA and at the EPD Watershed Protection Branch headquarters in Atlanta, GA were accessed. The findings are synthesized in the subsections below.

#### *2.3.1. Special Permit Condition Documentation, Red Zone*

In 2007 and 2008, EPD added several special permit conditions to non-farm water withdrawal permit holders, including the 10 industrial permittees within the Red Zone. Information about special permit conditions was only available for 8 of the 10 permittees. One permittee without available information was IMMT Epic, LLC (Permit No. 025-0012, formerly Epic Midstream). From 2010 to 2016, their annual average withdrawal was never greater than 0.003 MGD, and in March 2017, their file included a letter from EPD terminating their NPDES permit because they ceased discharging treated wastewater into Savannah River. No other files were available.

In general, the special permit conditions addressed by most permittees included: (1) Water Conservation Education Program, (2) Water Meter Calibration, and Repair and Replacement Program, (3) Outdoor Watering Schedule, (4) Alternate Water Sources, (5) Water Reuse Feasibility Study, (6) Water Audit, and (7) Water Leak Detection and Repair Program. **Table 3** summarizes the industrial permittees investigated, and **Table 6** summarizes the documentation and date submitted for each of the Red Zone industrial permittees. As a note, an absence of a check box does not indicate the file was not submitted but rather was not available at the time of review at EPD’s offices. One permit holder had a Water Loss Control Program, and another had a Water Conservation Plan. Water Conservation Progress Reports were only required for large water withdrawal permittees. In Chatham County, this was International Paper. Water Conservation Progress Reports were also available from other large users along the coast – Interstate Paper (Liberty County), GP Brunswick Cellulose (Glynn County), and Rayonier Performance Fibers - Jesup Plant (Wayne County). These are summarized in Section 2.3.2 below.

**Table 6. Summary of Special Permit Condition Documentation**

<b>Permit</b>	<b>Water Conservation Education Program</b>	<b>Water Meter Calibration &amp; Repair and Replacement Program</b>	<b>Outdoor Watering Schedule</b>	<b>Alternate Water Source Evaluation</b>	<b>Water Reuse Feasibility Study</b>	<b>Water Audit</b>	<b>Water Leak Detection Repair Program</b>	<b>Water Loss Control Program</b>	<b>Water Conservation Progress Report</b>	<b>Water Conservation Plan</b>
New NGC <b>025-0004</b>	4/09	12/08	12/08 Yes	12/09	11/09 Not required	6/09	6/09			
Tronox (now Sulco) <b>025-0008</b>		12/08		11/09	11/09	6/09	6/09			
International Paper <b>025-0009</b>		12/08	None used	12/09	12/09	6/09	6/09		12/12	
Southern States Phosphate & Fertilizer (P&F) <b>025-0011</b>		12/08	None used	12/09	12/09	6/09	6/09			
GAF Materials Corp. <b>025-0013</b>	3/09	3/09	3/09			7/09	7/09			12/07
Hercules (now Solenis) <b>025-0025</b>	10/09	12/08	None used		12/09	6/09	6/09			
EMD Chemicals (now EMD Millipore Corp.) <b>025-0030</b>	12/08	12/08	12/08	12/09	12/09	6/09	6/09			
Georgia-Pacific Consumer Operations, LLC <b>051-0006</b>	12/08	12/08	12/08 Yes	12/09	12/09	6/09	6/09	6/09		

*Data Source: EPD Coastal District Office, Brunswick, GA and EPD Watershed Protection Branch, Atlanta, GA*

Note: A blank does not mean that the documentation was not submitted but rather was not available for review on the day that documents were accessed at EPD’s office.

No files were found for Savannah Sugar Refinery (025-0006) and IMMT Epic LLC (025-0012).

The reports and documents from these facilities indicated that a source meter was present and part of the permittee’s respective calibration, repair, and replacement programs. A few permittees

noted that they did not have additional service meters throughout their production facilities, so they were unable to fully isolate water losses and unaccounted water.

GAF Materials Corporation, Chatham County, Permit No. 025-0013

GAF was the only Red Zone facility with a Water Conservation Plan in its file on the date of document review at EPD. This Plan, from December 2007 listed that unaccounted for water was 0.037 MGD, or about 10% of total water composition. This facility does not use groundwater for irrigation of any onsite landscaping.

EMD Chemicals, Chatham County, Permit No. 025-0030

EMD Chemicals eliminated all outdoor watering of lawns, flowers, and shrubbery, and eliminated all vehicle washing. In the 2009 Alternate Water Sources study, they also purchased water from City of Port Wentworth to supplement existing demand. One obstacle is that the quality of water from Port Wentworth is not high enough to use in most processes without installation of additional treatment to remove residual Chloramines, which are detrimental to demineralizer units. Another obstacle is cost, because purchasing water from Port Wentworth is more expensive than producing groundwater and therefore adversely impacts the cost of product. EMD's wastewater treatment system does not treat to reuse standards. At the time the 2009 Alternate Water Source report was submitted, Port Wentworth was in the process of building a wastewater treatment plant adjacent to EMD facility, so they initiated discussions regarding opportunities to use their purple pipe discharge. The current status of these connections and whether reclaimed water is utilized is unknown.

In EMD Chemicals' December 2009 Water Reuse Feasibility Study, completed by GE Power & Water, Water and Process Technologies, they identified five opportunities to save up to 70,000 gallons per day (GPD) with cost savings as high as \$48,000 per year. The saving opportunities included: (1) reverse osmosis (RO) system to provide deionized (DI) makeup water, (2) use the reject water produced by the RO for plant washing uses, (3) minimize steam venting and condensate leaks, (4) use condensate from the HVAC system as supplemental cooling tower makeup, and (5) stop using DI water for ammonia scrubbing. Details are unknown at this time because only the Executive Summary of the Water Reuse Feasibility Study was included in the files available for review. As part of a walk-through audit and analysis, EMD Chemicals identified and installed a scrubber vent line from hydrochloric acid tank in the Utility Area to eliminate a water venture scrubber that used 3 gallons per minute (GPM) totaling 4,320 GPD. They rerouted hot water steam into a scrubber recirculation feed water tank (750 GPD) and installed nozzles on wash down hoses to restrict the amount of water being used.

Georgia-Pacific Consumer Operations, LLC, Effingham County, Permit No. 051-0006

The majority of water that Georgia-Pacific Consumer Operations uses is surface water from the Savannah River. The Alternate Water Source and Water Reuse Feasibility Study reports available for review were detailed and contained projections of future usage. This facility only used outdoor irrigation on 0.1 acres, and it followed the specified EPD scheduling protocol. The majority of the groundwater used is for river process water (RPW) makeup, totaling 0.8 MGD. The pumps at river can withdraw a maximum of 17.3 MGD, which is about half of the permit limit. Groundwater is only used when surface water pumps are at capacity and the RPW reservoir level cannot be

maintained. Long-term plans include adding pump capacity at river water pumps. Boiler makeup feed water used 0.096 MGD from groundwater because surface water is not treated to levels needed for the boilers to operate efficiently. There are three boilers, and feed water consisted of 82-85% recovered condensate and 15-18% fresh water from groundwater (0.096 MGD of groundwater). Next, potable water used at this facility totaled 0.06 MGD from groundwater. Groundwater is generally used for potable uses because the current treatment system is not capable of treating surface water to drinking water standards.

Georgia-Pacific identified some short-term water conservation strategies to utilize water reuse via dissolved air flotation units. These units provide a recovery rate of 95-97% (reuse up to 25,000 GPM). Another strategy was to detect leaks in process and equipment monitoring. This permittee noted that there was a 38% reduction in groundwater withdrawals from 2005 to 2008. Based on the most recent annual average withdrawal in 2016, the percent reduction since 2005 has increased to 54%.

#### Solenis, LLC, Chatham County, Permit No. 025-0025

Solenis, when it was known as Hercules, submitted a detailed Water Reuse Feasibility Study that included four options. It is unknown how the ownership change impacted the company's plans to implement the options in the study. The documentation referenced that the facility had shut down some of its older processes that used significant amounts of water for wash down, cooling or scrubbing.

#### New NGC, Inc., Chatham County, Permit No. 025-0004

New NGC creates gypsum wallboards. A total of 98% of water is used for production of wallboard. Based on their Alternate Water Source evaluation, surface water or water from another aquifer contain chlorides which are detrimental to the production of gypsum wallboard. Transfer from a neighboring water supplier was most suitable, but based on increased costs, was not likely because of the impact on production costs. As demonstrated in **Table 4** and **Figure 4**, New NGC is the only facility in the Red Zone that had an increase in groundwater withdrawals from 2005-2007 to 2013-2016.

#### Southern States Phosphate and Fertilizer, Chatham County, Permit No. 025-0011

Southern States Phosphate and Fertilizer purchases drinking water from City of Savannah and does not irrigate landscaping. The primary use of groundwater is process water and cooling water. Once-through cooling water is currently being reused by an on-site tenant (GEO Specialty Chemicals) for process, cooling and boiler makeup water. The vast majority of the water used on site is for evaporative cooling (cooling the highly exothermic reaction of creating and diluting sulfuric acid). The balance is used in the formation of sulfuric acid, steam generation, laboratory operations, tenant operations, and sanitary use.

The Water Audit on file provided conclusions and recommendations for water reduction and efficiency for the following categories: (1) sanitary and domestic uses, (2) cooling coils and towers, (3) once through cooling, and (4) boilers. Sanitary/domestic usage is small, but it was recommended to replace inefficient toilets and fixtures with low-flow and efficient models. The cooling coils and towers utilize about 50% of total water usage at this facility. Recommended

improvements included replacing several of the coils on Plant #1 with a shell and tube heat exchanger and optimizing the operation of the cooling tower for Plant #2. These steps will allow for more efficient heat transfer and reduce losses from windage and evaporation. The boilers are the largest users of the purchased treated surface water at this facility, and the primary water conservation for this equipment is minimizing blowdown and maximizing condensate return. As a result, the recommended improvements included: (1) minimize blowdown from boilers by working with the boiler treatment contractor, (2) install planned steam condensate recapture system for rail cars, and (3) conduct regular inspection of steam traps to ensure maximum condensate return. This facility had recently installed steam condensate recapture systems for conservation at the sulfur storage tank, rail car sulfur pit, and CPI sulfur pit.

Sulco, LLC, Chatham County, Permit No. 025-0008 (was Savannah Acid Plant and prior to that Tronox)

Sulco has groundwater and surface water withdrawal permits, and it also purchases surface water from the City of Savannah's Industrial and Domestic Plant (Savannah I&D). Documentation of conservation efforts were submitted when the plant was known as Tronox. From 2008 to 2009 unaccounted for water decreased from 5% to 0.6% (218 MG to 21.6 MG). The Water Audit discovered leaks, and it included proposed conservation measures. The Water Reuse Feasibility Study found that a dedicated purple-pipe system was not an economically feasible option. The company reported it only uses groundwater when necessary due to chemistry or equipment considerations. They are maximizing use of alternate water sources through river water. In 2008, total water used was 12.7 MGD, which comprised of 66% surface water from the Savannah River, 23% treated surface water purchased from Savannah I&D, and 11% groundwater. In 2009, total water used reduced to 10.0 MGD, which comprised of 72% surface water, 19% purchased surface water, and 10% groundwater.

*2.3.2. Water Conservation Progress Reports*

Water Conservation Progress Reports are a specific special permit condition required for the largest groundwater withdrawal permit holders in Coastal Georgia. These permit holders include: (1) Georgia-Pacific's Brunswick Cellulose Plant in Glynn County, (2) International Paper in Chatham County, (3) Interstate Paper in Liberty County, and (4) Rayonier Performance Fibers in Wayne County. All four of these permittees are in the paper industry. The first three are located in an area with additional concern for saltwater intrusion (Red Zone and Yellow Zone), and the fourth is located in the Green Zone in Wayne County.

The progress reports are due to EPD every five years, and they include an update and summary of site-specific investments in industrial water efficiency. The most recent progress reports available for review for all permittees was 2017, except Interstate Paper, which was 2012. Several submittals also included an updated Water Conservation Plan. The results from these progress reports and updated conservation plans, including earlier versions when available, are summarized below by facility. A common metric reported is production efficiency, which is calculated as the reported groundwater withdrawal divided by the reported weight of product produced. These efficiencies are based on what the permit holder reports to EPD.

Georgia-Pacific, Brunswick Cellulose, LLC, Glynn County, Permit No. 063-0003



Georgia-Pacific (GP), Brunswick Cellulose operates an integrated Kraft fluff pulp mill in Brunswick (Glynn County). In 2016, they were using 61% of the annual average permit limit for groundwater (27.394 out of 45 MGD) and 0% of their monthly average permit limit for surface water (0 out of 56 MGD). The Kraft manufacturing process requires large amounts of clean, fresh water. There is a T-shaped plume of saltwater intrusion beneath the mill site, but EPD and USGS report that it has been stable over the last 15 years. Details of conservation from the Water Conservation Plan and Water Conservation Progress Reports available for review at EPD offices are presented below.

Conservation activities targeted various steps of the industrial process, including: (1) brownstock washing, (2) oxygen delignification, (3) brownstock screening, (4) pulp bleaching, (5) pulp forming, (6) cooling towers and evaporation, (7) maintenance, (8) housekeeping, and (9) metering.

Two projects that had the largest impact targeted: (1) cooling towers and evaporation and (2) pulp bleaching. GP Brunswick Cellulose completed installation of new evaporators and two new cooling towers in 2009, allowing them to discontinue non-consumptive surface water from the Turtle River for cooling purposes. These investments eliminated a potential source of surface water heat pollution. An additional benefit to GP Brunswick Cellulose was that surface water from the Turtle River is brackish and highly corrosive, thus requiring frequent maintenance, replacement of equipment, and higher cost construction materials. The new cooling towers did increase groundwater demand by 0.8 to 1.6 MGD to make up for blow-down and evaporative/entrainment losses. However, a new single-line bleach plant was installed in 2011 to replace three aging bleach plants, and this cut groundwater demand by about 10 MGD once it was fully operational in 2012.

Another project in 2010 established the use of primary clarifier effluent to sluice bark ash at No. 4 Power Boiler. This resulted in a groundwater withdrawal reduction of 1.0 MGD. Overall, in the last decade, GP Brunswick Cellulose has eliminated surface water withdrawals for operations, which totaled 22.6 MGD in 2005 and reduced groundwater withdrawals by 7 MGD (32.53 MGD average for 2005-2007 to 25.58 MGD average for 2014-2016).

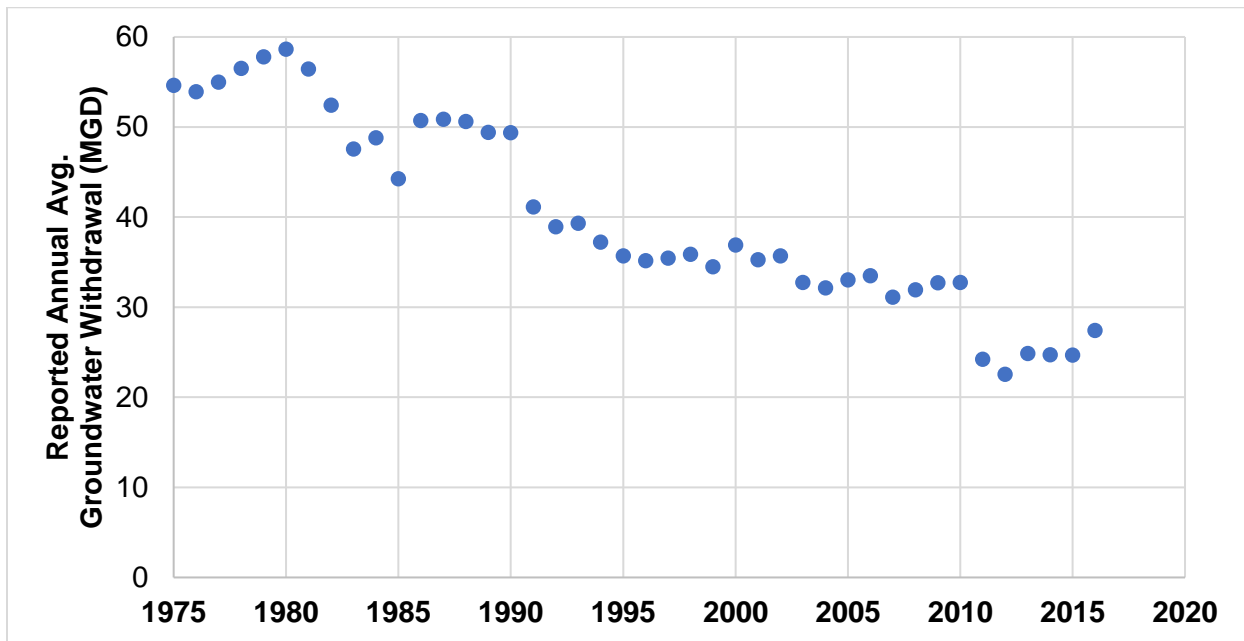
Additional conservation was experienced in the late 1990s when the plant began reusing excess white water in the bleach plants as dilution water. Over the years, the plant upgraded the brownstock washing system to improve chemical recovery and reduce water use. In general, the plant conducts preventative maintenance to repair leaking valves, flanges, fittings, and water seals on pumps. Process water in each major process area is metered. Through automated metering and reading valve positions, a message is displayed in the operator's room when established normal readings are exceeded to provide an alert of a potential leak. A finding from a water audit in 2008 was that minor water conservation could be achieved through small projects, but significant water conservation can only be achieved through capital intensive measures, which had been constrained at the time due to economic conditions. GP's website<sup>3</sup> described that \$400 million has been invested since 2005 to install new process equipment that have resulted in the recent major reductions in water withdrawals. In 2013, GP was awarded the Leadership in Sustainability Water

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<sup>3</sup> [https://www.gppackaging.com/Cellulose/Pages/Case-Study\\_Sustainability\\_Watered-Down-Energy-Consumption.aspx](https://www.gppackaging.com/Cellulose/Pages/Case-Study_Sustainability_Watered-Down-Energy-Consumption.aspx)

Award by the American Forest and Paper Association for water use reduction commitment at the Brunswick Cellulose Mill.

**Figure 7** presents historical groundwater withdrawals from 1975 to 2016. Peak usage occurred around 1980 at 60 MGD, and in 2016 was about 25 MGD. This figure displays a sharp reduction from 2010 to 2011 as a result of the investments in conservation at this facility.



**Figure 7. Brunswick Cellulose Historical Groundwater Withdrawals**

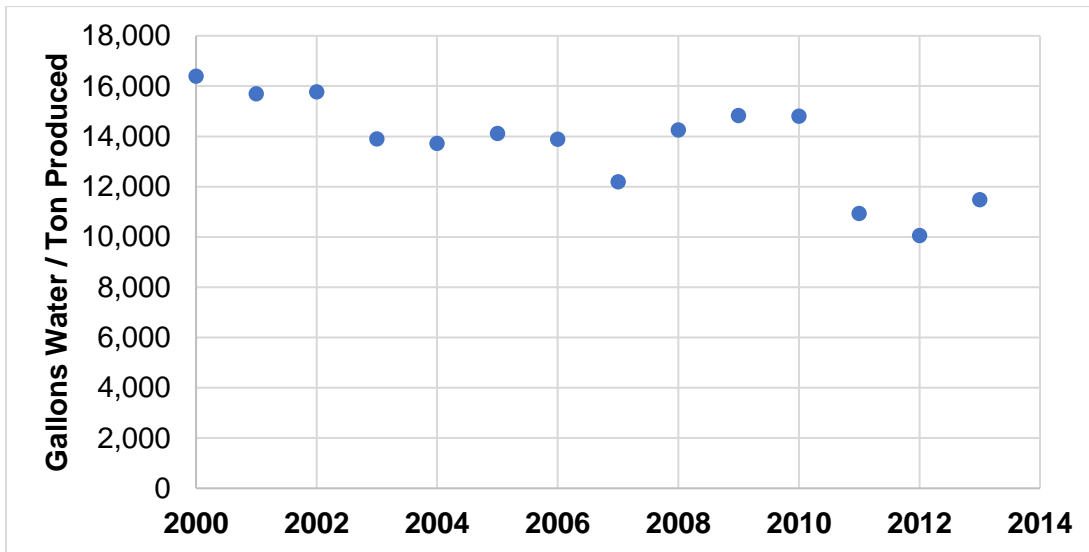
*Data Source: Georgia EPD, 2017 Water Conservation Progress Report*

The Water Conservation Progress Reports reviewed for this study presented efficiency of the plant in terms of gallons of water used per ton of product produced, captured since 1976. It was presented as a graph, so ranges, as interpreted from the image, are described in **Table 7**. Efficiency is more indicative of conservation because a reduction in withdrawals could simply be a result of reduced production. Compared to the late 1970s, this facility is now using about 30% of the water to produce a ton of product as it had in the past. The recent upgrades have increased efficiency from about 13,000-15,000 gallons per ton to about 10,000-12,000 gallons per ton. **Figure 8** presents the detailed data available from the files, 2000 to 2013.

**Table 7. Historical Efficiency Brunswick Cellulose**

Year Range	Reported Efficiency (gal/ton)
1976-1980	36,000-37,000
1981-1982	33,000-35,000
1983-1984	28,000-29,000
1985-1990	25,000-27,000
1991-1993	19,000-21,000
1995-2002	16,000-17,000
2003-2010	13,000-15,000
2011-2016	10,000-12,000

Data Source: Georgia EPD, Water Conservation Progress Report

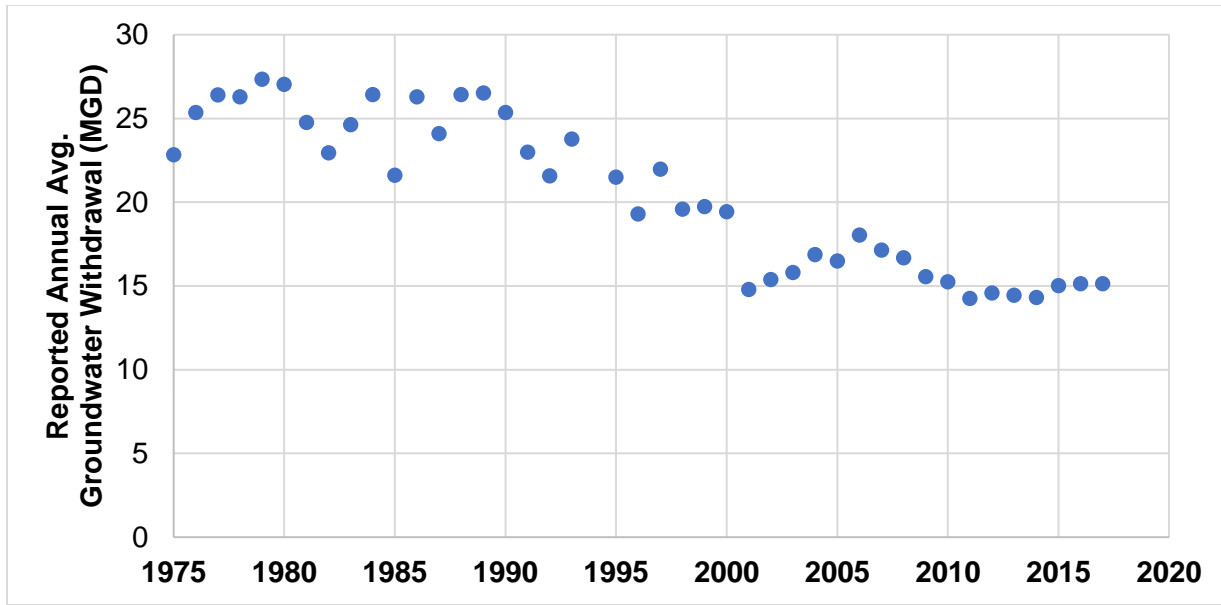


**Figure 8. Brunswick Cellulose Efficiency (2000-2013)**

Data Source: Georgia EPD, Water Conservation Progress Report

International Paper, Chatham County, Permit No. 025-0009

International Paper is located in the City of Savannah, on the Savannah River. **Figure 9** presents their historical groundwater withdrawals from 1975 to 2016. Peak usage occurred around 1980 at about 27 MGD and now is about 15 MGD. In 2016, they were using 97% of their annual average permit limit for groundwater (15.115 out of 15.588 MGD). International Paper’s groundwater withdrawal permit was reduced by 34% from 1996 to 2005 (28.5 MGD to 18.8 MGD).



**Figure 9. International Paper Historical Groundwater Withdrawals**

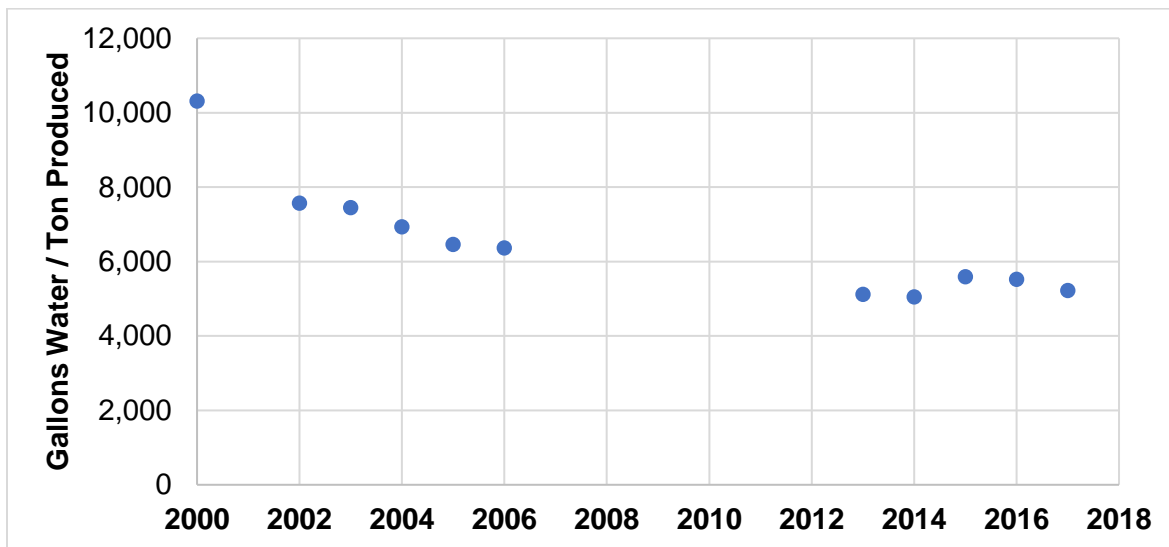
*Data Source: Georgia EPD (Data prior to 2005 was accessed from data request for 2011 CG-RWP)*

International Paper’s 2012 Water Conservation Progress Report noted that there were eight fresh water reclaim/return tanks and four cooling towers in operation, which enable the mill to use a gallon of fresh water approximately 14 times before discharging it to the sewer. Two conservation practices implemented in 2009 each saved an estimated 100 GPM, totaling 0.144 MGD. These practices were: (1) increasing piping around the Kamyr 2 digester freshwater reclaim tank, and (2) adding the ability to supply used white water at the Kamyr 1 repulper. In 2010, the No. 1 paper Machine freshwater reclaim tank was put back into service, saving another 200 GPM (0.288 MGD).

The 2017 Water Conservation Progress Report noted that gravity strainers, that filter white water for reuse, had been added. The facility also invested in a wireless signal relay system to improve the reliability of data capture on remote flow meters in order to monitor flow in real-time. New technology investments were projected to reduce groundwater withdrawals by 0.5 MGD by the end of 2017. Projecting to 2020, the facility’s Strategic Capital Plan includes groundwater conservation projects that will result in another 2 MGD reduction in groundwater withdrawals to meet reduced permit limits for 2020 (13.468 MGD) and 2025 (12.157 MGD).

The Water Conservation Progress Reports on file with EPD present efficiency of the Chatham County plant in terms of gallons of groundwater used per ton of product produced. This information was available from 2000 to 2017, but annual data was not reported in the 2012 Water Conservation Progress Report for 2007 to 2012 (**Figure 10**). The 2012 Progress Report did include a graph of monthly data for 2010 to 2012, which is noted in the summary below. International Paper increased their groundwater efficiency from about 10,000 gallons per ton produced in 2000 to about 6,500 gallons per ton produced in 2005 and 2006. Monthly data from 2010 to 2012 showed International Paper further increased efficiency to about 5,000 to 6,000 gallons per ton

produced, and then it continued to be between 5,000 and 5,600 gallons per ton produced from 2013 to 2017. International Paper uses a mixture of surface water from Savannah’s I&D plant and groundwater from their own permitted wells, but efficiency was calculated for groundwater withdrawals only. In 2000, International Paper was dependent on groundwater sources for 62% of the water used at the plant. Groundwater use was 72% in 2004, 56% in 2005, 71% in 2010, 67% in 2011, and 73% in 2012.



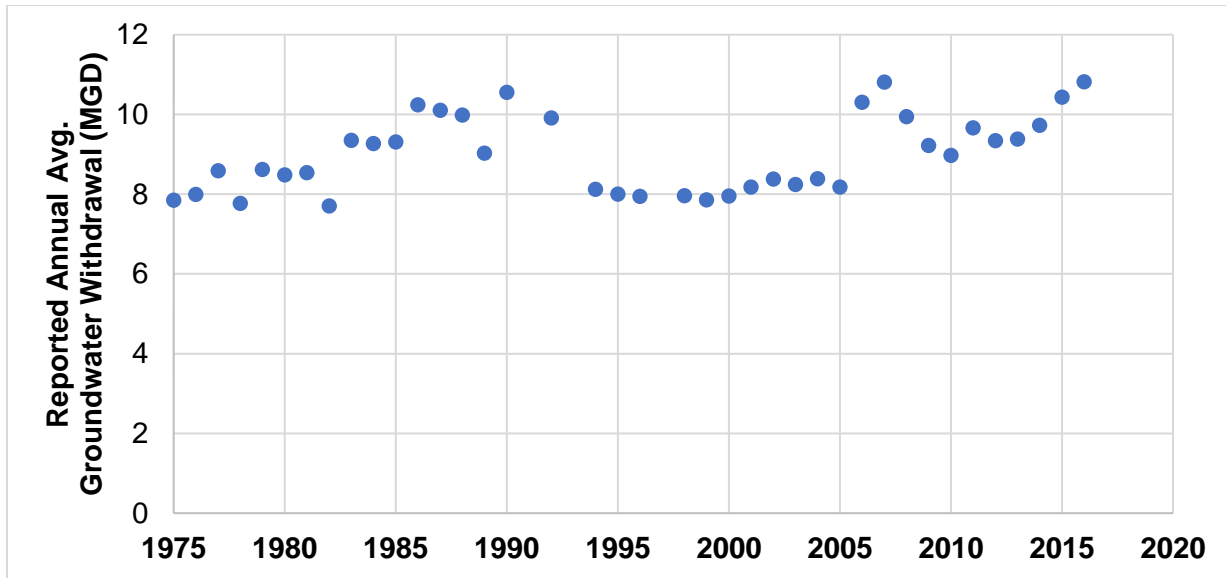
**Figure 10. International Paper Groundwater Efficiency (2000-2017)**

*Data Source: Georgia EPD, Water Conservation Progress Report*

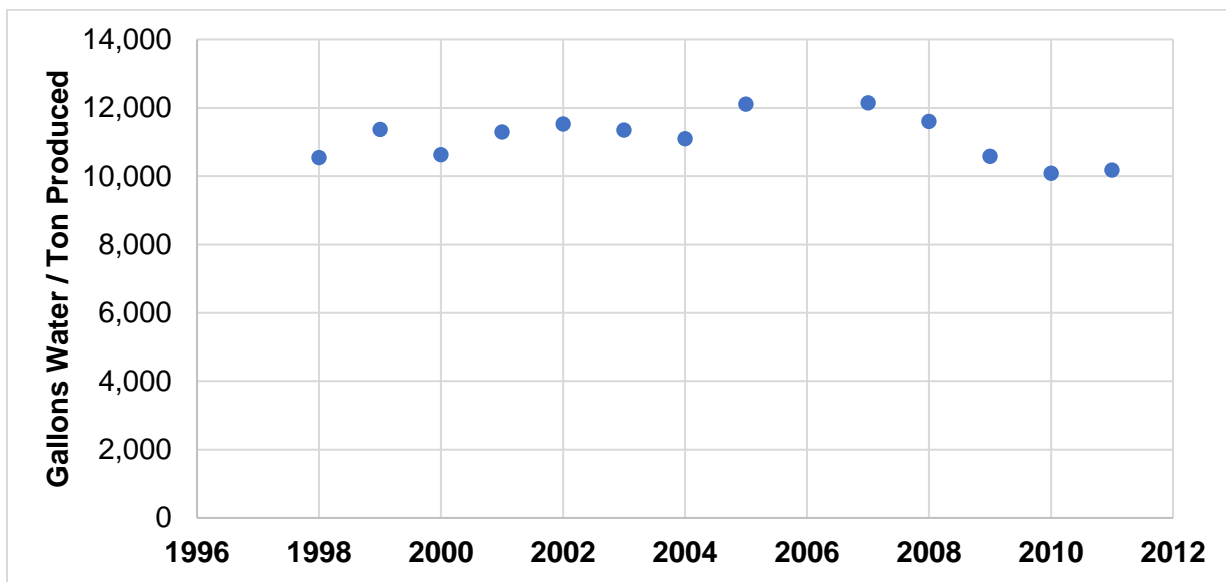
Over the years, International Paper has shut down dated, inefficient equipment and replaced it with newer machinery that can use surface water supplied by the City of Savannah. A significant capital investment is needed to further treat surface water received from the Savannah I&D plant to meet water quality criteria for current processes. The reports state that water reuse is not feasible because finished products are in contact with food products, therefore cannot risk any potential contact of products with fecal coliform or other contaminants.

Interstate Paper, Liberty County, Permit No. 089-0001

Since 1975, Interstate Paper in Liberty County has used between 8 and 11 MGD (**Figure 11**). In 2016, they were using 90% of their annual average permit limit for groundwater (10.816 out of 12 MGD). The Water Conservation Progress Reports on file at EPD presented efficiency of the plant in terms of gallons of water used per ton of product produced. This information was only available from 1998 to 2011 (**Figure 12**). From 1999 to 2011, the three most recent years have produced the highest efficiencies. Efficiency has improved from about 11,000-12,000 gallons per ton produced in 2001-2008 to about 10,000 to 10,500 gallons per ton produced in 2009-2011.



**Figure 11. Interstate Paper Historical Groundwater Withdrawals**  
 Data Source: Georgia EPD (Data prior to 2005 was accessed from data request for 2011 CG-RWP)



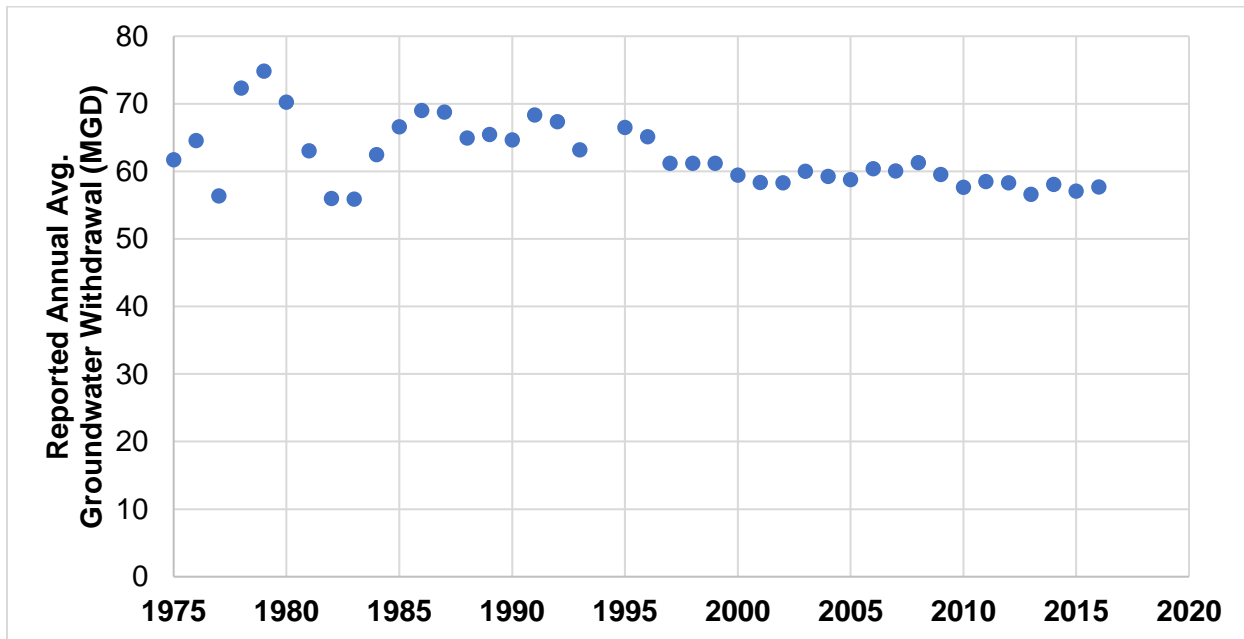
**Figure 12. Interstate Paper Efficiency (1998-2011)**  
 Data Source: Georgia EPD, Water Conservation Progress Report

The 2006 Water Conservation Plan on file describes two long-term projects that were each estimated to save about 0.5 MGD. First, Interstate Paper installed and tuned the mill water storage tank, which enhanced level control. Second, they completed a retubing project for No. 2 evaporator. From 2007 to 2011, the following capital projects were completed to influence output or water generation: (1) bubbling fluidized-bed (BFB) boiler dry ash handling system, (2)

evaporator condensate recovery system, (3) paper machine white water reclamation system (Poseidon/Algas), (4) various cooling water reuse projects, (5) sludge dewatering and disposal system, and (6) sludge dilution using clarified water from clarifier. Interstate Paper also installed dissolved air flotation (DAF) units to reuse whitewater on the paper machine, and they installed filters on the paper machine to allow reuse whitewater in place of freshwater.

Rayonier Performance Fibers, LLC – Jesup Plant, Wayne County, Permit No. 151-0001

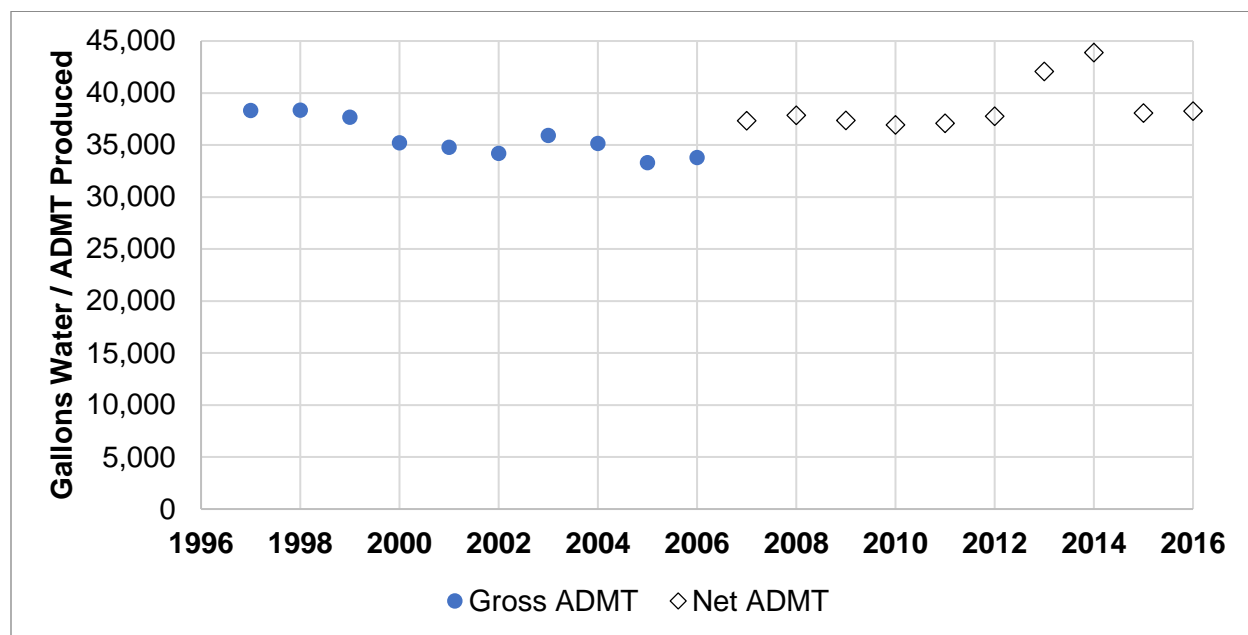
Since 1975, Rayonier Performance Fibers - Jesup Plant in Wayne County has used between 55 and 75 MGD (**Figure 13**). In 2016, they were using 85% of their annual average permit limit for groundwater (57.713 out of 68 MGD). Their permit specifies that they have groundwater withdrawal from both the Floridan and Miocene aquifers; however, about 99.3% is used from the Floridan aquifer for process and maintenance. The remaining 0.7% is used from a mixture of the two aquifers for potable uses. The 2017 Water Conservation Plan noted that production since the late 1980s has increased from 480,000 to 552,000 net air-dried metric tons (ADMT); however, groundwater withdrawals have decreased from an average of 70 MGD to 58 MGD, demonstrating the increase in efficiency. In general, the distribution of water includes: 52.5 MGD for manufacturing, 5.1 MGD for boiler makeup, 0.4 MGD for maintenance and cleanup, 0.4 MGD for domestic and sanitary, and <0.1 MGD for landscape. They have three production lines – A, B, and C Mills.



**Figure 13. Rayonier Performance Fibers Historical Groundwater Withdrawals**  
*Data Source: Georgia EPD (Data prior to 2005 was accessed from data request for 2011 CG-RWP)*

Water Conservation Progress Reports were submitted to EPD in 2012 and 2017, and each had an accompanying Water Conservation Plan to describe specific details. In the efficiency calculations,

the original 2007 Water Conservation Plan presented quantity of product produced in *gross* ADMT per year, where the 2017 reports used *net* ADMT per year. Since the difference between gross and net ADMT is unknown, the results could not be compared across reports, so both are presented separately in **Figure 14**. From 1997 to 2006, the reported water used per gross ADMT per year improved from about 38,000 to about 33,000 gallons per gross ADMT. The data from 2007 to 2016, in terms of reported water per net ADMT per year, has stayed relatively stable at 38,000 gallons per net ADMT per year, with 2013 and 2014 as higher than average.



**Figure 14. Rayonier Performance Fibers Efficiency (1997-2016)**

*Data Source: Georgia EPD, Water Conservation Progress Report*

Rayonier’s 2017 Water Conservation Plan describes that there is no significant unaccounted water at this facility, and there are no active plans to pursue an alternate water source. While surface water is available from the Altamaha River, the purity needed for the pulp manufacturing process is such that Rayonier reports it is not feasible without extensive pre-treatment. The listed 10-year future forecast is to minimize growth of water consumption, with a goal of no net increase. The Plan states that water conservation has been implemented by recycling various process effluents internally for sluicing, cooling, and facility cleanup. Process cooling water is reclaimed through cooling towers. Based on average conditions, a gallon of water is reused four times before being discharged to wastewater treatment. Some large projects have been implemented in the previous five years and estimated savings include: (1) 0.6 MGD for the recovery of annex vacuum pump seal water to white water chest, (2) 3.1 MGD for the reclaim of machine cooling can, felt conditioning, and vacuum pump seal water, (3) 0.33 MGD for recovery of fan and A/C water, and (4) 2.8 MGD for various C Mill projects during the cellulose specialties expansion (CSE) transformation project, which was completed in September 2013. Previously, the C Mill produced commodity-grade absorbent materials. The CSE project cost \$385 million to increase production



capacity of cellulose specialties by 190,000 metric tons.<sup>4</sup> In July 2015, it was announced that the C Mill would be reconfigured back to commodity products based on current market conditions and to improve operating efficiency.<sup>5</sup> Certain equipment installed on the C-line during the CSE were repositioned to the A-line to replace less efficient equipment.<sup>4</sup> The expansion and reconfiguration were likely a cause for the sudden change in efficiency for 2013 and 2014, as presented in **Figure 14**. Cellulose specialties required more water per ton than commodity products.

### *2.3.3. Alternative Water Source Evaluation, Red Zone*

As part of the special permit conditions, each affected industrial permittee was required to conduct an alternative water source evaluation. The mandatory criteria of the evaluation included: (1) operating cost, (2) degree of control, (3) construction cost, (4) reliability of source during peak usage time, (5) flexibility provided by source, (6) long-term viability of source, (7) impact on local or regional water quality, and (8) sustainability of source. Scoring was based on the following metric: “unacceptable” = ‘0’, “difficult but acceptable” = ‘1’, “acceptable” = ‘2’, and “would not be a problem” = ‘3’. Since there are eight categories, a total score of 16 would indicate that the average ratings are “acceptable” and a perfect score, where the alternative water source “would not be a problem,” is 24. The results from the alternative water source evaluations for six permittees, located in the Red Zone, are presented in **Table 8**. There were only four options with a score greater than 16, one of which had a perfect score of 24. Tronox (now Sulfolco) indicated it “would not be a problem” to use surface water with a perfect score of 24 because they already have a surface water withdrawal permit. They also had a score of 18 for alternate aquifer. The only other two options with a score of at least 16 were “Transfers” for EMD Millipore (score = 16) and “Other” for International Paper (score = 16). The “Other” category was evaluated for the strategy of conservation.

International Paper was the only facility that evaluated an “Other” category. They chose to investigate “Conservation” as an alternative because none of the five options included in the Alternative Water Source evaluation seemed feasible or sufficiently cost-effective to meet their needs. As described in Section 2.3.2, International Paper continues to have permit limit reductions because of their location in the Red Zone. They are currently operating near their permit limit, so future reductions in groundwater withdrawals are required to satisfy permit limits.

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<sup>4</sup> Savannah Morning News, October 30, 2013, <http://www.savannahnow.com/exchange/2013-10-30/rayonier-celebrates-completion-385-million-jesup-mill>

<sup>5</sup> RISI Technology Channels, Manufacturing and supply chain news for pulp, paper, and packaging industry, July 30, 2015, <https://technology.risiinfo.com/mills/north-america/rayonier-advanced-materials-announces-25-million-strategic-repositioning-reconfigure-c-line-jesup-ga-fluff-and-viscose>

**Table 8. Summary of Scores for Alternative Water Source Evaluation (Red Zone)**

Permit Holder	Transfers	Alternate Aquifer	Surface Water	Reservoir	Desalinization	Other
New NGC 025-0004	8	5	5	4	6	N/A
Tronox (Sulferco, LLC) 025-0008	0	18	24	0	14	N/A
International Paper 025-0009	12	11	6	3	5	16 Conserva- tion
Southern States Phosphate & Fertilizer 025-0011	7	8	0	0	0	N/A
EMD Chemicals (EMD Millipore) 025-0030	16	11	6	1	0	N/A
Georgia-Pacific Consumer Operations, LLC 051-0006	7	11	13	N/A	9	N/A

*Data Source: Georgia EPD*

The industries evaluated for this section indicate that cost is a major driver for alternative water sources overall. This includes capital cost for construction, operating cost, as well as the cost to purchase treated surface water. Additional production costs would require companies to increase the cost of their products. In many cases, it was noted that a company would not be cost-competitive if required to use an alternative source of water. It was also noted that large capital investments are required to have a significant impact on water conservation, and this is challenging, especially during periods with economic uncertainty. Other than the perfect score of 24, the other three options with a score of at least 16 rated construction cost with a score of ‘1’, meaning it would be “difficult but acceptable.” Overall, operating cost and construction cost were typically a barrier for most alternative sources with scores of ‘0’ and ‘1’. Only two options with a total score less than 16 had a rating of ‘2’ for these categories related to cost.

Another concern related to alternative water sources was water quality. A common concern was that treated surface water, or even water purchased from municipalities, would require extensive treatment for many of the processes currently using groundwater. Additionally, some facilities create products that have contact with food for human consumption, and these have strict bacteria-related regulations. In these situations, water reuse is not feasible because of the potential for trace amounts of fecal coliform and other contaminants.

## 2.4. Forecasting in the Coastal Georgia Regional Water Plan

The CG-RWP originally adopted in 2011, and updated in 2017, includes water and wastewater forecasting for municipal, agricultural, energy, and industrial sectors through year 2050. Data used for this part of the study was captured from the “Water and Wastewater Forecasting Technical Memorandum,” supplemental material to the CG-RWP. Municipal, agricultural, and energy forecasts were revised in the 2017 plan update; however, industrial water and wastewater forecasts remained as they were prepared for the initial 2011 plan. The 2011 CG-RWP included projections every 10 years from 2010-2050. The 2017 CG-RWP update shifted the “current” condition from 2010 to 2015 by calculating the midpoint between years 2010 and 2020 from the original projection, based on 2005 data.

As part of the forecast development, EPD conducted outreach meetings with industry stakeholders. Industries were unable to provide either water use per product or projections of future product production because of proprietary constraints and complexities of manufacturing processes, such as variable water requirements for different types of products. As such, the methodology for forecasting industrial water demand was based on future employment projections per industry. Employment data for industrial operations are readily available, and employment is linked to production, and thus indirectly linked to water requirements. The CG-RWP estimated future water need by industry as the product of current water need and employment growth rate. Employment projections, calculated by the University of Georgia, for the largest industrial water users showed either modest growth or declining trends in the coastal region. If there was a projected decline in an industry’s employment, the forecast model applied a zero percent average annual growth rate to the base year demand, resulting in the current water need remaining roughly the same in future years, even if production was predicted to decline.

In the 2011 CG-RWP, EPD used data from 2005 industrial permit database to determine the “current” withdrawal amounts for the base year (2010). EPD also used “Water use in Georgia by county for 2005; and water-use trends, 1980-2005,” published by the USGS in January 2009, to report listings of large industrial water users. Using employment projections, the estimated baseline industrial water demand forecast to 2050 showed a negligible increase, from 160.99 MGD in 2010 to 161.58 MGD in 2050. This is due to the region’s steady or declining industrial employment projections for industries that currently hold water withdrawal permits. As a result, the CG-RWP Council decided to develop an alternate forecast that included a higher industrial growth rate than the baseline forecast. The Council believed past trends may not accurately reflect future trends in industrial growth for the coastal region.

To validate the alternative industrial forecast, the CG-RWP Council collected information about potential new industry from their local county’s economic development authorities. They then instructed their planning consultant, CDM, to work with the Coastal Regional Commission to identify the existing and any potential new industrial sites within the coastal planning region. By coupling the potential new industry with anticipated future water demands, the CG-RWP Council settled on 35 MGD as a reasonable industrial growth factor for the 40-year planning horizon. Most of the future industry growth in the region was expected to occur in the main categories of aerospace, general manufacturing, and warehouse distribution. **Table 9** describes the distribution of the 35 MGD and potential water source (surface or groundwater). The alternate forecast growth rate is about 22% over 40 years, compared with the 0.4% growth rate calculated using the

employment-based baseline forecast. Industrial water use in the region is currently split 54.0% from surface water sources and 46.0% from groundwater sources. This split is assumed to remain the same under the baseline forecast and is adjusted only slightly under the alternate forecast (54.4% / 45.6%) as future demand in Chatham and Effingham Counties is assumed to be supplied by surface water with the remaining counties future demand being supplied by groundwater.

**Table 9. Baseline and Alternate Water Demand Forecast for Coastal Georgia RWP**

County	2010 Baseline Water Demand Forecast (MGD)	2050 Baseline Water Demand Forecast (MGD)	2050 Alternate Water Demand Forecast distributed by County (MGD)	Potential Source of Additional Supply	2050 Alternate Water Demand Forecast (MGD)
Bryan	0.00	0.00	2.0	Groundwater	2.00
Bulloch	0.23	0.35	2.0	Groundwater	2.35
Camden	0.06	0.06	2.0	Groundwater	2.06
Chatham	69.88	70.23	19.0 <sup>1</sup>	Surface Water	106.98
Effingham	17.75	17.75			
Glynn	64.50	64.61	5.0	Groundwater	69.61
Liberty	8.53	8.53	4.8	Groundwater	13.33
Long	0.00	0.00	0.0	Groundwater	0.00
McIntosh	0.04	0.06	0.2	Groundwater	0.26
<b>Total</b>	<b>160.99</b>	<b>161.58</b>	<b>35.0</b>		<b>196.58</b>

Data Source: 2011 CG-RWP

<sup>1</sup> Chatham and Effingham counties are combined because they are very similar in nature, and it is difficult to reflect how industrial growth will be split between these two counties. The source of additional supply is from surface water due to restrictions of reducing groundwater withdrawals in this region (Red Zone).

EPD does not require self-supplied industries withdrawing less than 100,000 GPD to secure water withdrawal permits, so their withdrawals are not tracked by EPD. The 2011 CG-RWP reported that this category of industrial water use is not expected to have a significant impact on demand forecasting. Additionally, some industries are supplied water by municipal water systems. These industrial water uses are also not directly tracked by EPD. Through outreach to the municipal permittees, EPD was able to quantify water use for many of these operations. The municipal-supplied industries, using 2005 data, included the following water usage: (1) 0.35 MGD from the City of Riceboro (Liberty County), 0.0052 MGD from the City of Springfield (Effingham County), and 0.192 MGD from the City of Statesboro (Bulloch County). In total, they account for 0.547 MGD, which is less than 1% of total groundwater withdrawals from industrial permittees.

**Table 10** and **Table 11** summarize industrial water withdrawal as reported to EPD for years 2005, 2010, 2015, and 2016, as well as the permit limit, for each permittee. The approach used to estimate industrial use from municipal water providers in **Table 10** assumes that the industrial water use remained constant from 2005 to 2016. **Table 10** presents reported annual average groundwater withdrawals, and **Table 11** presents surface water withdrawals.

**Table 10. Reported Groundwater Withdrawals for Industrial Water Users in the Coastal Georgia RWP Counties**

Permit No.	Permittee	Reported Annual Average Groundwater Withdrawal (MGD)				2018 Permit Limit, Annual Average (MGD)
		2005	2010	2015	2016	
<b>Bryan County (none)</b>		<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
<b>Bulloch County</b>		<b>0.221</b>	<b>0.192</b>	<b>0.192</b>	<b>0.192</b>	<b>N/A</b>
016-0006	Anvil International	0.029	0.0	0.0	0.0	Permit no longer listed in 2018
Municipal Source*	City of Statesboro	0.192	0.192*	0.192*	0.192*	N/A
<b>Camden County</b>		<b>0.061</b>	<b>0.047</b>	<b>0.016</b>	<b>0.008</b>	<b>0.0</b>
020-0007	Bayer CropScience – Woodbine Plant	0.061	0.047	0.016	0.008	Permit no longer listed in 2017
<b>Chatham County</b>		<b>21.230</b>	<b>18.737</b>	<b>17.614</b>	<b>17.919</b>	<b>21.386</b>
025-0004	New NGC	0.003	0.054	0.085	0.092	0.164
025-0006	Savannah Sugar Refinery	0.435	0.738	0.38	0.388	0.845
025-0008	Sulfco, LLC (was Tronox, then Savannah Acid Plant)	1.623	0.401	0.998	1.002	1.737
025-0009	International Paper	16.486	15.242	14.848	15.115	15.588
025-0011	Southern States Phosphate & Fertilizer (P&F)	1.275	0.932	0.231	0.196	1.333
025-0012	IMTT Epic, LLC	0.028	0.003	0	0.003	0.010
025-0013	GAF Materials Corporation	0.338	0.246	0.047	0.043	0.234
025-0025	Solenis, LLC	0.641	0.762	0.612	0.717	1.025
025-0030	EMD Millipore Corp.	0.401	0.359	0.413	0.363	0.450
<b>Effingham County</b>		<b>1.9762</b>	<b>0.811</b>	<b>0.737</b>	<b>0.911</b>	<b>1.695</b>
051-0006	Georgia-Pacific Consumer Operations, LLC	1.971	0.806	0.732	0.906	1.695
Municipal Source*	City of Springfield	0.0052	0.005*	0.005*	0.005*	N/A

Permit No.	Permittee	Reported Annual Average Groundwater Withdrawal (MGD)				2018 Permit Limit, Annual Average (MGD)
		2005	2010	2015	2016	
<b>Glynn County</b>		<b>41.775</b>	<b>41.223</b>	<b>29.536</b>	<b>32.599</b>	<b>58.730</b>
063-0001	King & Prince Seafood Corp.	0.12	0.105	0.107	0.089	0.270
063-0003	GP Brunswick Cellulose, LLC	33.012	32.712	24.662	27.394	45.000
063-0008	Pinova, Inc.	7.934	7.882	4.249	4.598	12.000
063-0014	Symrise, Inc.	0.323	0.369	0.345	0.326	0.760
063-0015	Rich Products Corporation	0.218	0.155	0.164	0.138	0.350
063-0029	Georgia-Pacific Gypsum	0.168	0	0	0	Permit no longer listed in 2018
063-0049	Georgia-Pacific WFS - Thalmann Woodyard	N/A	N/A	0.009	0.054	0.350
<b>Liberty County</b>						
<b>Liberty County</b>		<b>8.526</b>	<b>9.312</b>	<b>10.780</b>	<b>11.166</b>	<b>12.000</b>
089-0001	Interstate Paper	8.176	8.962	10.430	10.816	12.000
Municipal Source*	City of Riceboro	0.350	0.350*	0.350*	0.350*	N/A
<b>Long County (none)</b>						
<b>Long County (none)</b>		<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
<b>McIntosh County</b>						
<b>McIntosh County</b>		<b>0.033</b>	<b>0.098</b>	<b>0.103</b>	<b>0.048</b>	<b>N/A</b>
098-0005	City of Darien <sup>1</sup>	0.033	0.098	0.103	0.048	N/A
<b>Total</b>		<b>73.822</b>	<b>70.420</b>	<b>58.978</b>	<b>62.844</b>	<b>93.811</b>

Data Source: Georgia EPD

\* It was assumed that municipal withdrawals for industrial use remained constant from those reported in 2005 as part of the 2011 CG-RWP.

<sup>1</sup> Only permittee to use Miocene/Brunswick aquifer. This is a municipal permittee, but it is assumed that water is used for industrial purposes because it was included as industrial in the 2011 CG-RWP.

**Table 11. Surface Water Withdrawals for Coastal Georgia RWP by County**

Permit No.	Permittee	Reported Annual Average Surface Water Withdrawal (MGD)				Permit Limit, Monthly Average (MGD)
		2005	2010	2015	2016	
<b>Chatham County<sup>1</sup></b>		<b>48.389</b>	<b>45.111</b>	<b>49.896</b>	<b>36.331</b>	<b>97.50</b>
025-0192-03	Weyerhaeuser NR Port Wentworth Mill	14.051	13.423	16.342	0.863 <sup>2</sup>	27.50
025-0192-06	Sulfeo, LLC (was Savannah Acid Plant, LLC)	6.458	5.633	7.454	6.457	20.00
051-0115-01	Savannah (I&D): Industrial	27.880	26.055	26.100	29.012	50.00
	I&D: Municipal, Effingham County	1.98	1.98 <sup>3</sup>	2.20 <sup>3</sup>	2.20 <sup>3</sup>	
	I&D: Municipal, Effingham County	4.47	4.47 <sup>3</sup>	4.73 <sup>3</sup>	4.73 <sup>3</sup>	
<b>Effingham County</b>		<b>15.769</b>	<b>14.418</b>	<b>13.170</b>	<b>13.976</b>	<b>35.00</b>
051-0114-01	Georgia-Pacific Consumer Operations, LLC	15.769	14.418	13.170	13.976	35.00
<b>Glynn County</b>		<b>22.583</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>56.00</b>
063-0712-02	GP Brunswick Cellulose, LLC	22.583	0.0	0.0	0.0	56.00
<b>Total</b>		<b>86.741</b>	<b>59.530</b>	<b>63.066</b>	<b>50.307</b>	<b>188.50</b>

Data Source: 2011 CG-RWP and Georgia EPD

<sup>1</sup> Total for Chatham County only includes industrial withdrawals; municipal demand for Chatham and Effingham counties are excluded.

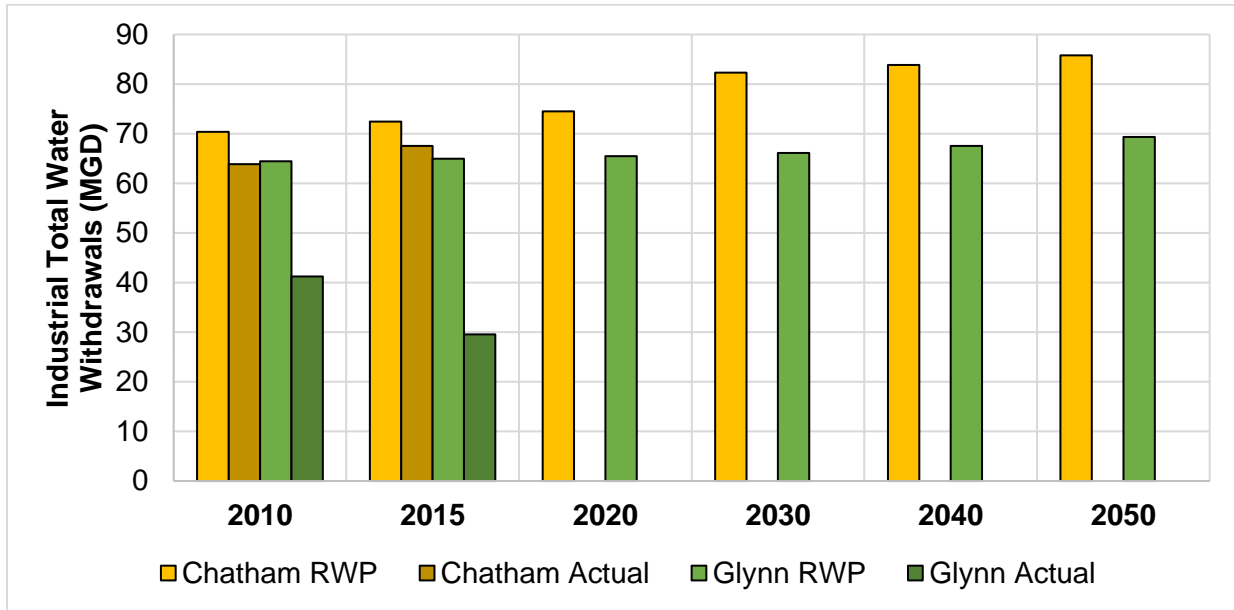
<sup>2</sup> Only January 2016 had reported withdrawals. From February 2016 to current (March 2018), there has been no reported surface water withdrawals from this permit holder.

<sup>3</sup> Estimated from 2011 CG-RWP based on projected demand

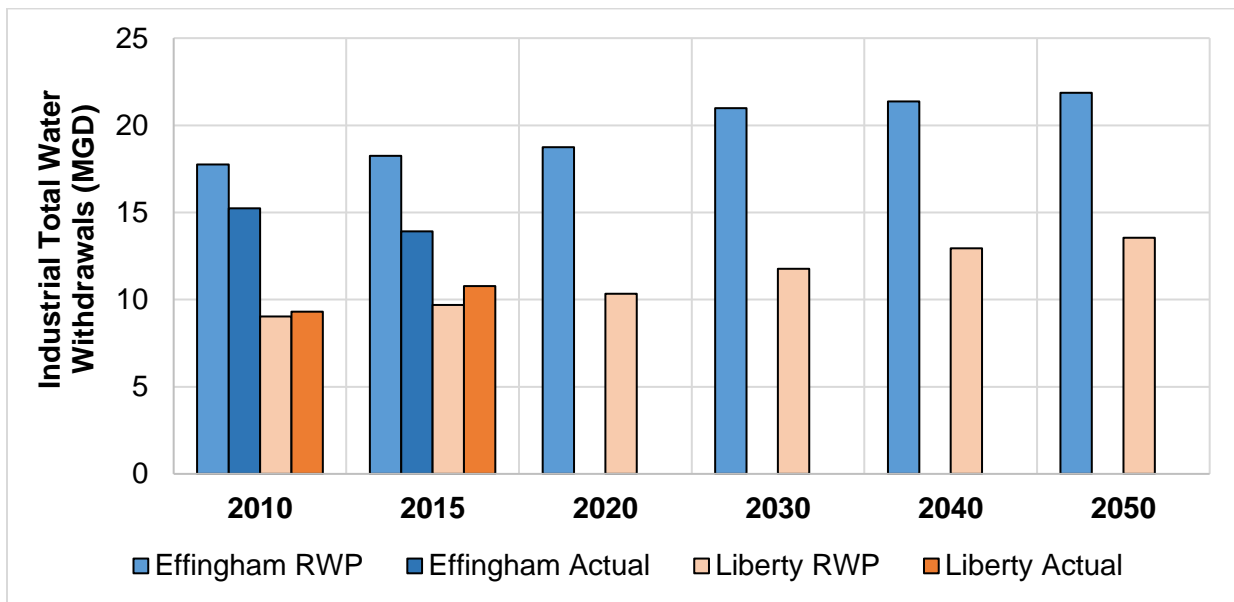
#### 2.4.1. Countywide Comparison of Forecasted vs. Reported Withdrawals

Five of the nine counties in the CG-RWP had annual average water withdrawals less than 0.2 MGD for industrial uses. The two counties with the largest total withdrawals are Chatham and Glynn (**Figure 15**), and the next two counties are Effingham and Liberty (**Figure 16**). In 2015, total water withdrawals in Chatham County were 67.510 MGD. This includes 16.342 MGD of surface water withdrawals from Weyerhaeuser NR Port Wentworth Mill, which stopped withdrawing surface water in February 2016. Removing the contribution from Weyerhaeuser NR

Port Wentworth Mill in 2015 would reduce the reported total water withdrawals for Chatham County to 51.168 MGD.



**Figure 15. Projected Groundwater and Surface Water Withdrawals vs. Reported for Chatham and Glynn Counties, the two highest use counties in Coastal Georgia**



**Figure 16. Projected Groundwater and Surface Water Withdrawals vs. Reported for Effingham and Liberty Counties, the 3<sup>rd</sup> and 4<sup>th</sup> highest use counties in Coastal Georgia**



**Table 12** summarizes the differences between reported and forecasted surface water and groundwater withdrawals in 2015. In 2015, Glynn County's reported water withdrawals were 35.44 MGD less than the projected withdrawals, which was the largest difference for the CG-RWP counties. Chatham County was below the CG-RWP projection by 4.95 MGD and Effingham County by 4.34 MGD. Liberty County exceeded the projection by 1.09 MGD. The CG-RWP forecast, predicted Liberty County's 2015 withdrawal rate would occur between 2020 and 2030, so it was slightly ahead of schedule.

**Table 12. 2015 Groundwater and Surface Water Withdrawals by County Compared with the Coastal Georgia RWP Forecast.**

County	Surface Water Withdrawals (MGD)			Groundwater Withdrawals (MGD)			Total Difference <sup>1</sup> (MGD)
	CG-RWP Projected	Reported	Difference <sup>1</sup>	CG-RWP Projected	Reported	Difference <sup>1</sup>	
Chatham <sup>2</sup>	51.16	49.90	-1.26	21.30	17.61	-3.69	-4.95
Effingham	16.27	13.17	-3.10	1.98	0.74	-1.24	-4.34
Glynn	22.58	0.0	-22.58	42.40	29.54	-12.86	-35.44
Liberty	0.0	0.0	N/A	9.69	10.78	+1.09	+1.09

<sup>1</sup> A negative sign indicates that the reported withdrawals were less than those projected in the CG-RWP.

<sup>2</sup> Assuming Weyerhaeuser NR Port Wentworth Mill continues to no longer withdraw surface water beyond March 2018, the difference for surface water withdrawals in Chatham County would increase to -17.60 MGD and combined with groundwater to -21.29 MGD.

#### 2.4.2. Summary of Water Conservation for Paper and Chemical Industries

The 2005 data, used to calculate baseline forecast for the 2011 CG-RWP, showed the paper industry is the most intensive industrial water user in the coastal region, followed by the chemical industry. The paper industry accounted for 83.2% (133.91 MGD) of the 160.99 MGD total water withdrawals, and the chemical industry accounted for 14.0% (22.50 MGD). The net change in reported withdrawals from 2005 to 2015 is shown below to describe conservation for the largest water users. This range was chosen because the 2005 data was used to create the CG-RWP water forecast and 2015 is the most recent year listed in the CG-RWP. Conservation progress is presented for all four paper-based industrial facilities and the three chemical-based facilities that have demonstrated the most progress with respect to net groundwater withdrawal reduction.

Based on the information in **Table 10** and **Table 11**, the paper industry permittees contributed to the large reductions in water withdrawals presented in **Table 12**. Georgia-Pacific Brunswick Cellulose in Glynn County (Permit Nos. 063-0003 and 063-0712-02) reduced withdrawals from groundwater by 8.35 MGD and surface water by 22.58 MGD for a total of 30.93 MGD. Another industrial permittee with large water withdrawal reductions was Georgia-Pacific Consumer Operations in Effingham County (Permit Nos. 051-0006 and 051-0114-01) which reduced withdrawals from groundwater by 1.24 MGD and surface water by 2.60 MGD for a total of 3.84

MGD. International Paper (Chatham County, Permit No. 025-0009) reduced groundwater withdrawals by 1.64 MGD, but surface water changes were unknown because they purchase surface water from the City of Savannah Industrial and Domestic Water System, and information about individual customers was unavailable from the City of Savannah. From 2005 to 2015, Interstate Paper (Liberty County, Permit No. 089-0001) increased groundwater withdrawals by 2.25 MGD, but as noted in *Section 2.3.2*, it was a result of increased production. This facility has reported an increase in efficiency (gallons of water per ton of product produced), and it is operating under its permit limit of 12.0 MGD (87% of annual average permit limit).

The three chemical-based industrial permittees that have demonstrated the most progress with respect to net reduction of groundwater withdrawals from 2005 to 2015 include Pinova (Glynn County, Permit No. 063-0008) with a net reduction of 3.69 MGD, Southern States Phosphate and Fertilizer (Chatham County, Permit No. 025-0011) with a net reduction of 1.04 MGD, and Sulfco (Chatham County, Permit Nos. 025-0008 and 025-0192-06) with a net reduction of 0.63 MGD. All three of these companies have changed names and ownership at least once in the previous decade, so some of the reduction could be attributed to manufacturing different products. Additionally, while Sulfco had a reduction in groundwater withdrawals, its surface water withdrawals increased by 1.00 MGD.

## **2.5. Updated Industrial Water Forecast**

In an effort to capture a more accurate industrial water use forecast, this study updated the industrial water forecast to account for progress from conservation and efficiency that have helped reduce surface and groundwater withdrawals. In the re-calculated forecast, presented in **Figure 17**, the growth rate projected in the CG-RWP's alternate forecast for each decade through 2050 was maintained, i.e., the slope of the line. However, the reported surface and groundwater withdrawals from 2015 were included in the calculation to reset the forecast for current conditions. The only alterations in the projection after year 2015 are: (1) the removal of 16.342 MGD of surface water from Weyerhaeuser NR Port Wentworth Mill because they have not been actively using surface water since February 2016 (as of March 2018), and (2) a reduction of groundwater by 2.75 MGD in Chatham County for International Paper and EMD Millipore to satisfy the mandatory reductions in the adjusted 2025 permits. As part of the reductions required to meet the adjusted 2025 permit limits for the Red Zone, International Paper and EMD Millipore are the only two industrial permittees with 2015 groundwater withdrawals that exceeded their permit limits for 2025. The reduction in surface water withdrawals from Weyerhaeuser is reflected as surface water conserved in 2020, and the reduction in groundwater withdrawals from the Red Zone industrial permittees currently operating over their reduced 2025 permit limit is reflected in groundwater conserved in 2030. The CG-RWP and updated forecasts, as well as the reported withdrawals, for both groundwater and surface water are detailed in *Table 13*.

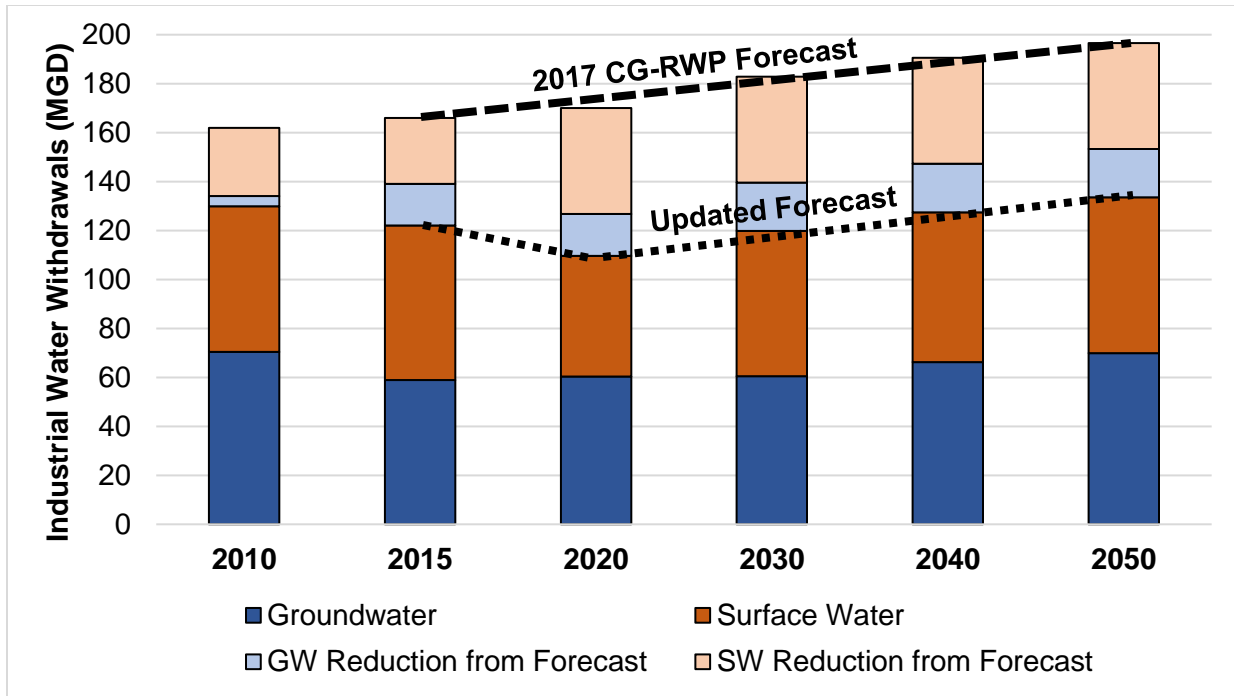


Figure 17. Updated Forecast for Industrial Sector in Coastal Georgia RWP District

Table 13. Coastal Georgia RWP and Updated Total Water Withdrawal Forecast

Forecast	Water Source	2010	2015	2020	2030	2040	2050
<b>2011 &amp; 2017 CG-RWP Forecast (MGD)</b>	Groundwater	74.53	76.01	77.44	80.29	86.07	89.68
	Surface Water	87.45	90.01	92.57	102.58	104.47	106.91
	<b>Total Water</b>	<b>161.98</b>	<b>166.02</b>	<b>170.01</b>	<b>182.87</b>	<b>190.54</b>	<b>196.59</b>
<b>Updated Forecast (MGD)</b>	Groundwater	70.42*	58.98*	60.41	60.51	66.29	69.90
	Surface Water	59.53*	63.07*	49.28	59.29	61.18	63.62
	<b>Total Water</b>	<b>129.95*</b>	<b>122.04*</b>	<b>109.69</b>	<b>119.80</b>	<b>127.47</b>	<b>133.52</b>

Data Source: CG-RWP

\* Withdrawals for 2010 and 2015 in the Updated Forecast are reported withdrawals.

### 3. SUMMARY

The industrial sector in the 24-county coastal region has done considerable work to improve water efficiency. Several of their successes have been highlighted to assist managers and citizen leaders in planning limited water resources. The nine counties located in the CG-RWP district were also assessed to update water use forecasting with recent data.

In 2016, the most recent full year at the time of the analysis, 19 out of 30 active permittees (65%) were using less than 50% of their permit limit. This shows that many permittees are only using as much as they need and not as much as they are allowed. Only five out of 30 permittees (16%) were within 20% of their permit limit. Two of the five are located in the Red Zone, where there have been regular permit limit reductions.

Annual average withdrawals in the 24-county coastal region were analyzed for the time period of 2005 to 2016. The 12-year dataset was divided into four 3-year periods to analyze trends in timeframes that capture shifts in regulations over the past decade: (1) 2005-2007, (2) 2008-2010, (3) 2011-2013, and (4) 2014-2016. Industrial facilities were separated into three geographic zones with varying levels of threat for saltwater intrusion: (1) northern Red Zone (Chatham and Effingham Counties), (2) Other CG-RWP counties with some threat to saltwater intrusion (Glynn and Liberty counties), and (3) coastal counties not in the CG-RWP (Green Zone). All three geographic zones demonstrated reductions in groundwater withdrawals over time and in association with new regulations, but the ones located in or near areas with more stringent regulations (Red and Yellow Zones – Chatham and Effingham counties and Glynn and Liberty counties) had more instances of statistically significant reductions between periods.

In compliance with a State plan designed to mitigate the threat of saltwater intrusion, industrial groundwater withdrawal permits that were renewed in 2007/2008 or issued after this period in the coastal counties included several special permit conditions for conservation and reuse. Many of the special permit conditions had deadlines for implementation or compliance by the end of 2008 or in 2009. Alternative Water Source Evaluation was one special permit condition evaluated for many permit holders in the Red Zone, and cost was determined to be a major factor in the viability of alternative water sources overall. This includes capital cost for construction, operating cost, as well as the cost to purchase treated surface water. In many cases, it was noted that a company would not be cost-competitive if required to use an alternative water source. Water quality of alternative water sources was also a common concern. It was noted that treated surface water, or even water purchased from municipalities, would require extensive treatment for many of the production processes currently using groundwater.

This study also investigated site-specific investments in industrial water efficiency, as reported to EPD, for the four largest groundwater users in Coastal Georgia – Georgia-Pacific's Brunswick Cellulose Plant in Glynn County, International Paper in Chatham County, Interstate Paper in Liberty County, and Rayonier Performance Fibers in Wayne County. In calculating the net change in withdrawals from 2005 to 2015, GP's Brunswick Cellulose Plant in Glynn County had the largest reductions. Groundwater withdrawals were reduced by 8.35 MGD and surface water was reduced by 22.58 MGD for a total of 30.93 MGD. Two recent projects that contributed to these large reductions targeted: (1) cooling towers and evaporation, and (2) pulp bleaching. The

installation of new evaporators and two new cooling towers in 2009 allowed Brunswick Cellulose to discontinue non-consumptive surface water from the Turtle River for cooling purposes. A new single-line bleach plant was installed in 2011 to replace three aging bleach plants, and this cut groundwater demand by about 10 MGD once it was fully operational in 2012.

The CG-RWP forecasted water use by the industrial sector to 2050. The industrial forecasts presented in the 2017 update of the CG-RWP were based upon the same 2005 water use data that was analyzed in the original 2011 Plan. The 2017 Plan shifted the “current” condition from 2010 to 2015 by calculating the midpoint between years 2010 and 2020 from the original projection. Based on reported withdrawals from 2015, the current CG-RWP overestimated water withdrawals from the industrial sector by 43.98 MGD (36%). Forecasted surface water withdrawals in 2015 were overestimated by 26.94 MGD and groundwater withdrawals were overestimated by 17.03 MGD. This study offers an updated forecast of future industrial water use because it accounts for the recent reductions in withdrawals that have resulted from significant investments in industrial operations and more efficient equipment. The resulting updated forecast only predicted 133.52 MGD used by industrial permittees in 2050, which is 28.46 MGD (17.5%) less than the 2010 base year in the original 2011 CG-RWP forecast.

Many industrial facilities have noted that they have replaced outdated or inefficient equipment over the years, and this has resulted in reduced groundwater withdrawals. The results of this study have shown that regulations, especially the special permit conditions, were likely a driver for the reductions in groundwater and surface water withdrawals.