REGIONAL WATER PLAN

September 2011

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Supplemental Documents

The following supplemental materials have been developed in support of the Coastal Georgia Regional Water Plan and are available electronically as attachments to the Regional Water Plan at www.coastalgeorgiacouncil.org/

- Public Outreach Technical Memorandum
- Vision and Goals Technical Memorandum
- Water and Wastewater Forecasting Technical Memorandum

Acknowledgments

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The Coastal Georgia Council would like to thank Rick Brown and Katherine Zitsch with CDM and Brian Baker and Jeff Larson of Georgia EPD for providing the planning and technical guidance toward the development of this Plan.

Conversion of Units (Water Flow and Volume) Used in Plan (values rounded)

1 cubic foot = 7.48 gallons

1 cubic foot per second = 0.646 million gallons per day or 646,272 gallons per day

1 million gallons per day = 1.55 cubic feet per second

1 million gallons = 3.069 acre-feet (1 acre-foot is enough water to cover a football field with about 9 inches of water)

1 cubic foot per second = 1.98 acre-feet per day

1 acre-foot = 325,851 gallons

1 acre-foot = 0.326 million gallons

List of Acronyms

AAD-MGD	Annual Average Day in million gallons per day
ASR	Aquifer Storage and Recovery
ASWS	Additional/Alternate Surface Water Supply
BMP	best management practice
cfs	cubic feet per second
CRD	Coastal Resources Division
CWA	Clean Water Act
CWCS	Comprehensive Wildlife Conservation Strategy
CWSRF	Clean Water State Revolving Fund
DCA	Department of Community Affairs
DCAR	Data Collection/Additional Research
DNR	Department of Natural Resources
DO	dissolved oxygen
DWSRF	Drinking Water State Revolving Fund
EDU	Educational Needs
EPA	U.S. Environmental Protection Agency
EPD	Environmental Protection Division
FERC	Federal Energy Regulatory Commission
GEFA	Georgia Environmental Finance Authority
Georgia DOA	Georgia Department of Agriculture
GFC	Georgia Forestry Commission
gpcd	gallons per capita per day
GSWCC	Georgia Soil and Water Conservation Commission
GW	groundwater

List of Acronyms (Continued)

I/I	inflow and infiltration
IGWPC	Industrial Groundwater Permit Capacity
IWWPC	Industrial Wastewater Permit Capacity
LAS	land application system
LDA	local drainage area
M	million
MG	million gallons
MGD	million gallons per day
MGWPC	Municipal Groundwater Permit Capacity
MNGWPD	Metropolitan North Georgia Water Planning District
MOA	Memorandum of Agreement
MWWPC	Municipal Wastewater Permit Capacity
N/A	not applicable
NPDES	National Pollutant Discharge Elimination System
NPS	non-point source
NPSA	Agricultural Best Management Practices
NPSF	Forestry Best Management Practices
NPSR	Rural Best Management Practices
NPSU	Urban Best Management Practices
NRCS	Natural Resources Conservation Service
NUT	nutrients
O.C.G.A.	Official Code of Georgia Annotated
OCP	Ordinance and Code Policy
OPB	Office of State Planning and Budget

List of Acronyms (Continued)

OSSMS	on-site sewage management systems
PIP	Public Involvement Plan
PS	point source
PSDO	Point Sources – Dissolved Oxygen
mi^2	square miles
SW	surface water
TMDL	total maximum daily load
UGA	University of Georgia
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WC	water conservation
WCIP	Water Conservation Implementation Plan
WRD	Wildlife Resources Division
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

Executive Summary

Introduction and Overview of the Coastal Georgia Region

Of all of Georgia's natural resources, none is more important to the future of our State than water. Over the last several decades, Georgia has been one of the fastest growing states in the nation. According to the U.S. Census Bureau, between 2000 and 2010, Georgia ranked 4th in total population gain (1.5 million new residents) and 7th in percentage increase in population (18%). During a portion of this same period, our State also experienced unprecedented drought. Georgia's growth and economic prosperity are vitally linked to our water resources.

As our State has grown, the management and value of water resources has also changed. Ensuring a bright future for our State requires thoughtful planning and wise use of our water resources. In 2008, the State of Georgia's leadership authorized a comprehensive state-wide water planning process to help address these challenges and take a forward look at how our State is expected to grow and use water over the next 40 years. The Coastal Georgia Regional Water Planning Council (Coastal Council) was established in February 2009 as part of this state-wide process. The Coastal Council is one of 11 planning regions charged

Water Resource Trends and Key Findings for the Coastal Georgia Region

The Coastal Georgia Region includes nine counties in southeast Georgia. Over the next 40 years, the population of the region is projected to double from approximately 630,000 to 1.3 million residents.

Key economic drivers in the region include industry, business, tourism, trade, government facilities, and transportation, especially associated with the Brunswick and Savannah Harbors and Interstate 95. Energy production is also significant to the region. Agriculture production occurs across the region, especially in the northern portion. Water supplies, wastewater treatment, and related infrastructure will need to be developed and maintained to support these economic drivers. Management of water resources to sustain the unique coastal environment is an important goal of the region.

Groundwater from the Upper Floridan Aquifer is needed to meet about 61% of the municipal, industrial, and agricultural needs, with the municipal and industrial uses being the dominant demand sectors. Surface water is needed to meet about 39% of these needs, with industry as the dominant demand sector. Thermoelectric energy is a major user of surface water, but most of the water withdrawn is returned to the surface water source.

Water resource challenges in the region include: salt water intrusion concerns in the Savannah-Hilton Head area and in the Brunswick area in Glynn County; surface water shortfalls during some periods on the Canoochee, Ogeechee, and Satilla Rivers; and water quality challenges associated with low dissolved oxygen in some portions of the region, most notably the Savannah River Harbor.

Management practices are needed to address these challenges including: water conservation; refining planning information; alternate sources of supply in areas where groundwater or surface water availability may be limited; maximizing use of existing aquifer; consideration of engineered solutions to address salt water intrusion; consideration of aquifer storage and recovery; improving/ upgrading wastewater treatment; and addressing non-point sources of pollution.

Figure ES-1: Coastal Georgia Regional Water Planning Council

with developing Regional Water Plans, and encompasses nine counties in the southeast portion of Georgia (shown in Figure ES-1). An overview of the initial findings and recommendations for the Coastal Georgia Region are provided in this Executive Summary. The Coastal Council's Regional Water Plan is available at: www.coastalgeorgiacouncil.org.

Georgia has abundant water resources, with 14 major river systems and multiple groundwater aquifer systems. These waters are shared natural resources; streams and rivers run through many political jurisdictions. The rain that falls in one region of Georgia may replenish the aquifers used by communities many miles away. And, while water in Georgia is abundant, it is not an unlimited resource. It must be carefully managed to meet long-term water needs. Since water resources vary greatly across the State, water supply planning on a regional and local level is the most effective way to ensure that current and future water resource needs are met.

The Coastal Georgia Region encompasses several major population centers, including Savannah, Statesboro, Hinesville, St. Marys, and Brunswick. When compared to other planning regions, the Coastal Georgia Region is projected to have the 4th largest total growth in the State. In the metropolitan Savannah area, in the northeast portion of the region, Chatham, Effingham and Bryan Counties are forecasted to grow by approximately 149,000 residents, or 43%, from 2010 through 2030 (Georgia's Office of Planning and Budget, 2010). Based on the trends through 2030, the population of the region will double from approximately 630,000 to 1.3 million people in 2050. These population centers, along with smaller cities and towns in the region, require reliable water supplies and sufficient wastewater treatment to meet their growing needs. In addition, the region has thriving industrial and commercial sectors as well as a vibrant agricultural base, especially in the northern portion of the region.

Key economic drivers in the Coastal Georgia Region include industry; U.S. Government facilities including Fort Stewart and Hunter Army Airfields, Kings Bay Naval Submarine Base, and the Federal Law Enforcement Training Center; and the Coastal Region's key transportation corridor, which includes the ports of Savannah

and Brunswick and Interstate 95. Additionally, the important economic sectors in the region include paper, food and chemical industries, tourism, trade, transportation, utilities, education and health services, and leisure and hospitality among others.

Wetlands and forested lands are major land covers in the region along with urban/suburban development and agricultural lands. This is the only region in Georgia that contains seashore, barrier islands, and nine major estuaries. Estuaries within the coastal marshlands are an important ecosystem. A significant portion of the Atlantic seaboard's salt marshes and thousands of acres of rare tidal freshwater wetlands are located within the Coastal Georgia Region. Shrimp, oysters, clams, and various species of freshwater and salt water fish provide a vibrant and significant recreational and commercial resource, both ecologically and economically.

Establishing a Water Resource Vision for the Coastal Georgia Region

A foundational part of the water planning process was the development of a vision for the region that describes the economic, population, environmental, and water use conditions that are desired for the region. On September 24, 2009, the Coastal Council adopted the following Vision for the region.

"The Coastal Georgia Regional Water Planning Council seeks to conserve and manage our water resources in order to sustain and enhance our unique coastal environment and economy of Coastal Georgia."

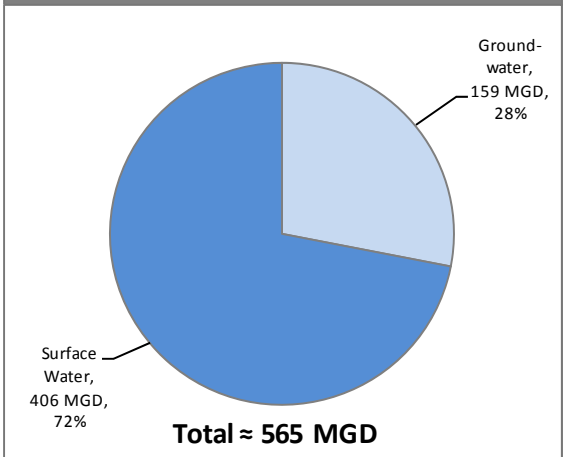
On November 17, 2009, the Coastal Council identified six goals to complement the Vision. These goals can be found in Section 1 of the Regional Water Plan.

Overview of Water Resources and Use in the Coastal Georgia Region

Surface Water

The Coastal Georgia Region covers the lower portion of five major river basins, listed from north to south: Savannah, Ogeechee, Altamaha, Satilla, and St. Marys Rivers. Water is supplied in the Coastal Georgia Region by a combination of surface water and groundwater. As shown in Figure ES-2, surface water is expected to provide 72% of the water supply within the region. However, as described below, the majority of surface water withdrawals is for the energy sector and is non-consumptive. Based on water use trends and forecast information though 2050, the majority of the industrial, municipal, and agricultural

Figure ES-2: 2005 Water Supply by Source Type



Data Source: "Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005" (USGS, 2009).

surface water use in the region is projected to come from the Savannah River (70-75%), Satilla River (18-23%), and Ogeechee Rivers (7%). This information is based on the assumption that future use will follow current practices and trends. However, as described in more detail below, additional surface water use is one option for addressing concerns associated with salt water intrusion into the Upper Floridan Aquifer, so this usage may increase.

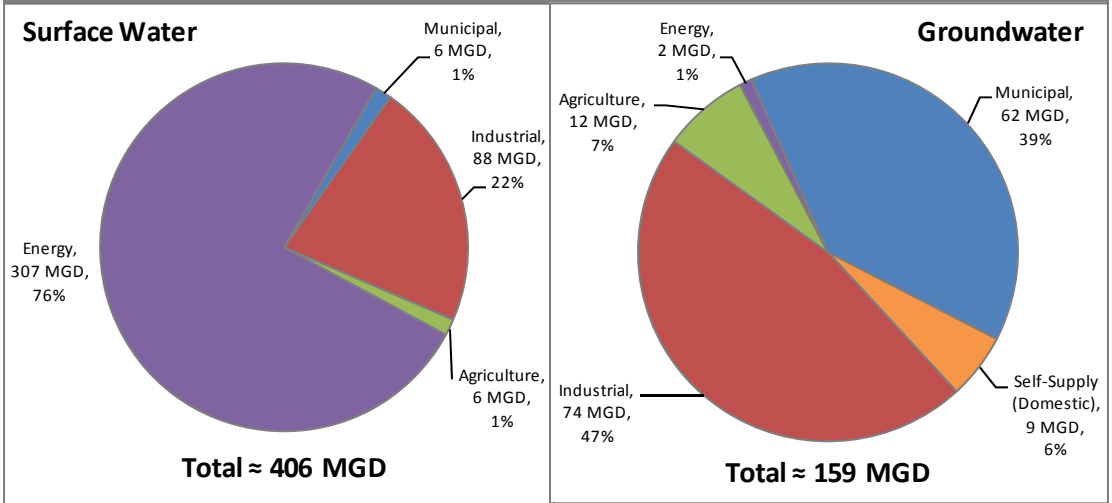
Groundwater

As shown in Figure ES-2, groundwater is projected to meet about 28% of the region's water supply needs. Based on 2010 forecasted groundwater withdrawal data, approximately 99% of groundwater in the region is supplied from the Floridan aquifer, which is one of the most productive groundwater aquifers in the United States.

Water and Wastewater Needs in the Coastal Georgia Region – A Closer Look

Figure ES-3 presents surface water and groundwater use by sector in the Coastal Georgia Region. About 76% of surface water withdrawals in the region are for the energy sector. However, the majority of this water (305 MGD) is returned to the surface water, with only 4 MGD consumed. Industry is also a major user (88 MGD) of surface water in the region. About 159 MGD of groundwater is expected to be used to supply the industrial (47%), municipal, (39%), self-supply (homes with groundwater wells), agricultural, and energy water use sectors.

Figure ES-3: 2005 Water Use by Category

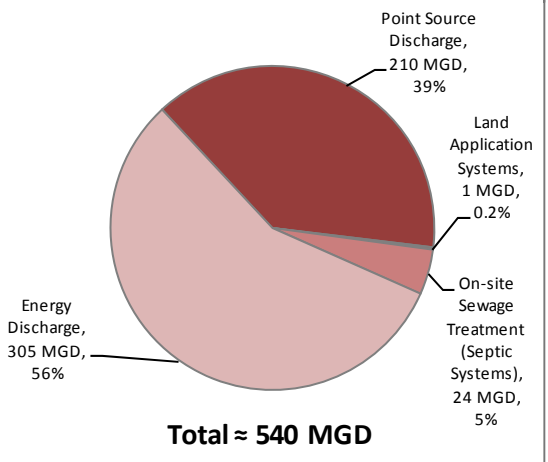


Data Sources: a) "Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005" (USGS, 2009); b) EPD permit withdrawal data for Year 2006 (Energy only).

Total energy withdrawal is 309 MGD with 307 MGD from surface water and 2 MGD from ground water sources; 4 MGD of the total 309 MGD (1.3%) is consumptive with the remainder (305 MGD) discharged back to surface waters as return flow.

Surface Water withdrawals for municipal and industrial categories were adjusted based upon feedback from water providers.

Figure ES-4: Trends in Wastewater and Return Flows



Data Sources: a) EPD permit withdrawal data for Year 2006 (Energy only); b) Coastal Georgia Water and Wastewater Forecasting Technical Memorandum (CDM, 2011).

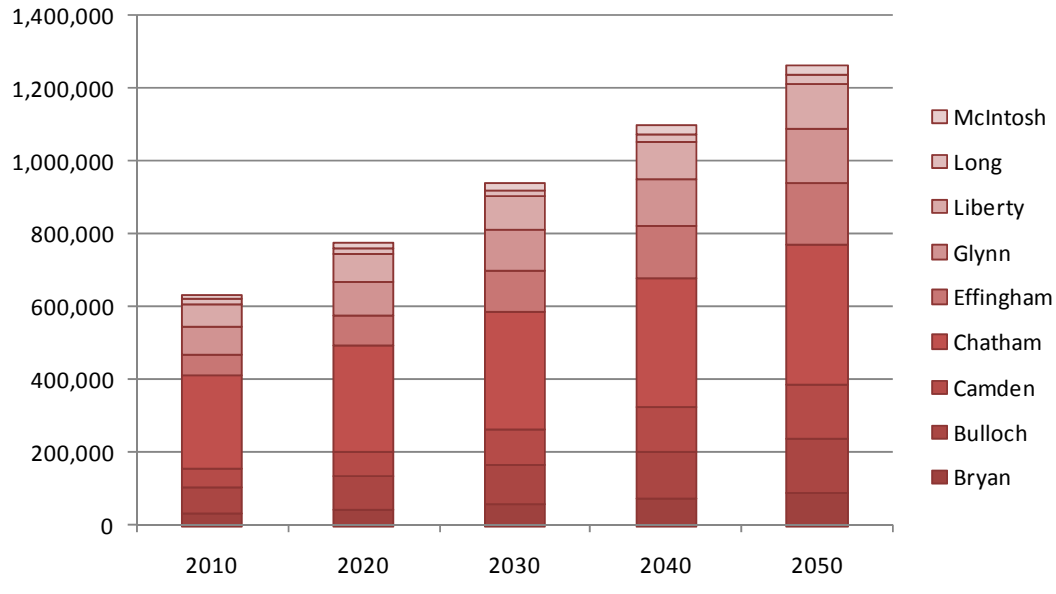
Energy totals shown represent total thermoelectric water withdrawal; 4 MGD of the total 309 MGD (1.3%) is consumptive, the remainder (305 MGD) is discharged back to surface waters as return flow.

Wastewater treatment types/values representing past trends and forecasted use in the region are shown in Figure ES-4. According to the Coastal Georgia Water and Wastewater Forecast developed for the Regional Water Plan (CDM, 2011), 95% of treated wastewater in the region is disposed of as a municipal/industrial point source discharge (39%), energy discharge (56%), or to a land application system (0.2%). The remaining wastewater is treated by on-site sewage treatment (septic) systems (5%).

Coastal Georgia Forecasted Water Resource Needs from the Year 2010 to 2050

Municipal water and wastewater forecasts are closely tied to population projections for the counties within the Coastal Georgia Region. The population projections were developed by the Georgia Governor's Office of Planning and Budget and are shown in Figure ES-5. Overall, the region's water supply needs are expected to grow by 16% (96 MGD) in demand from 2010 through 2050. Wastewater and return flows are expected to grow by 11% (63 MGD) from 2010 through 2050.

Figure ES-5: Coastal Georgia Region Population Projections (2010-2050)

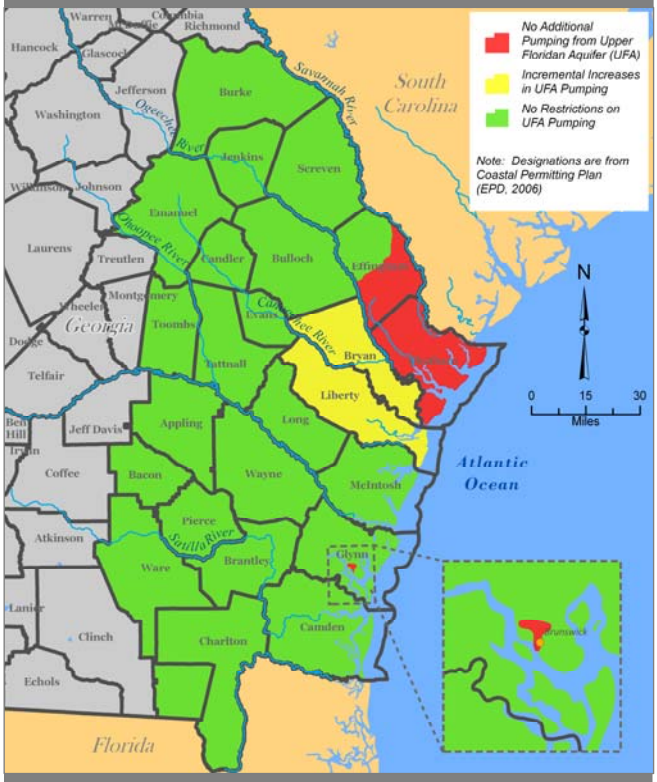


Comparison of Available Resource Capacity to Future Water Resource Needs

Groundwater Availability

Groundwater from the Upper Floridan Aquifer is a vital resource for the Coastal Georgia Region. Several groundwater modeling tools were developed as part of the water planning process to estimate the amount of water that can be sustainably pumped from select regional aquifers, including the Upper Floridan; also referred to as sustainable yield. Overall, the results from the Groundwater Availability Resource Assessment (EPD, March 2010) indicate that the sustainable yield for the modeled portions of the regional aquifer(s) is greater than the forecasted demands. However, groundwater pumping or withdrawals in coastal regions can lead to salt water intrusion or the movement of saline waters into freshwater aquifers. As shown in Figure ES-6, 24 counties in southeast Georgia are subject to the Coastal Georgia Water and Wastewater Permitting Plan for Managing Salt Water Intrusion (Coastal Permitting Plan) (www.gadnr.org/cws). As a result of concerns over salt water intrusion, the Coastal Permitting Plan specifies that no additional withdrawals beyond current allowable levels be permitted from the Upper Floridan Aquifer in all of Chatham County, the southern portion of Effingham County, and a small portion of Glynn County near Brunswick. Both Bryan and Liberty Counties are also subject to the Coastal Permitting Plan, and there are limitations on how much additional Upper Floridan Aquifer withdrawals may be allowed in these counties. Studies regarding salt water intrusion at Hilton Head Island are ongoing. The results of these studies and discussions regarding potential solutions to salt water intrusion concerns are also part of ongoing bi-state discussions between Georgia and South Carolina.

Figure ES-6: Coastal Georgia Sub-regions



Source: Coastal Georgia Water and Wastewater Permitting Plan for Managing Salt Water Intrusion

To accommodate both the regional planning process and bi-state discussions, the Coastal Council developed a flexible and adaptive approach for meeting regional groundwater needs. For planning purposes, the Coastal Council considered several scenarios to meet regional water needs, with a range of assumed allowable Upper Floridan withdrawals. As described below, a variety of water supply strategies, also called management practices, were developed for the region. Additional detail will be needed for some management practices before final recommendations can be determined or implemented.

Surface Water Availability

Surface water is also an important resource used to meet current and future needs of the Coastal Georgia Region. In order to determine if there is sufficient surface water to meet both off-stream uses of water and instream flow needs, a Surface Water Availability Resource Assessment model was developed by EPD and used in the state water planning process.

The results of the future conditions modeling from the Surface Water Availability Resource Assessment (EPD, March 2010) show that in many portions of the region, there are sufficient surface water supplies to meet forecasted water supply needs. However, in dry years, during some portions of the year, the modeled demand for off-stream uses of water results in projected impacts to instream flow needs (referred to as a "gap").

Figure ES-7: 2050 Surface Water Gaps

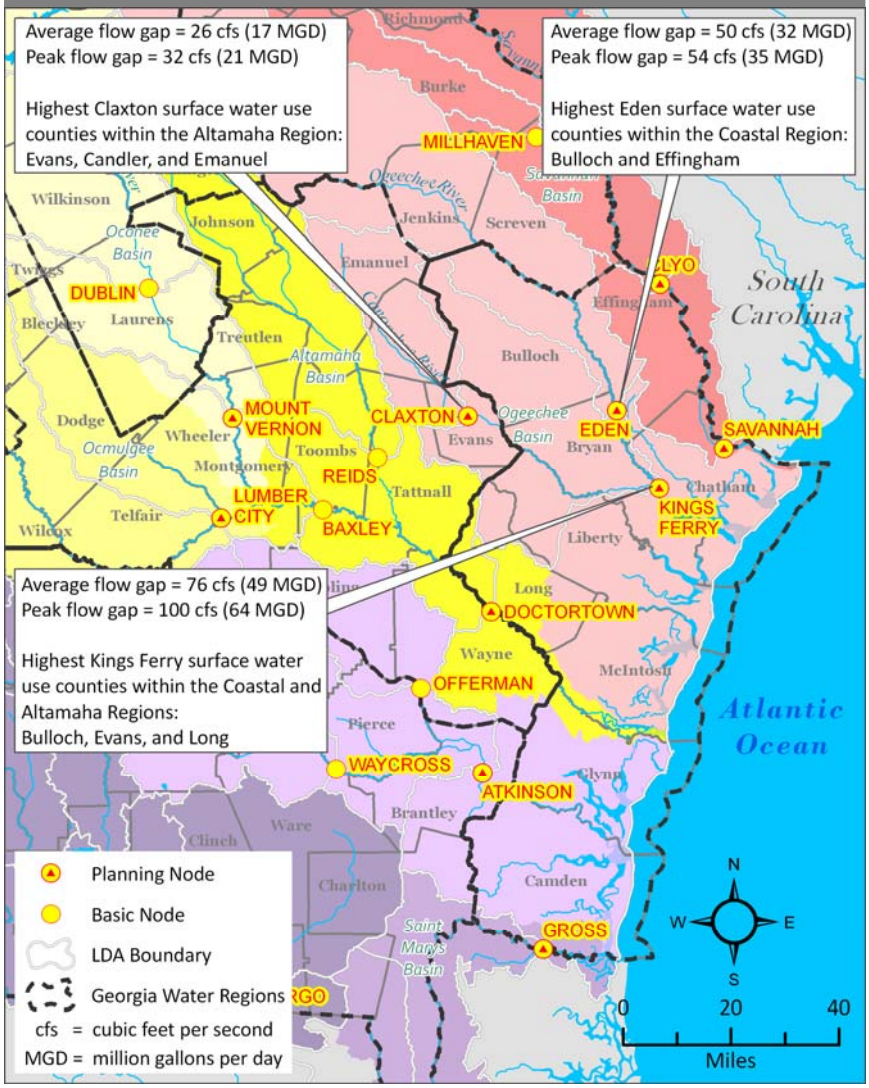


Figure ES-7 summarizes the locations in or near the region where there is a forecasted gap between available surface water resource and forecasted need. There are current and 2050 forecasted surface water gaps at the following locations in and near the region: Atkinson (Satilla River just west of the Coastal Council boundary), Claxton (Canoochee River just west of the Coastal Council boundary), Eden (Ogeechee River), and Kings Ferry (Ogeechee River). At each of these locations, the dominant water use type is agricultural. The projected increase of agricultural surface water use for the counties within the Coastal Georgia Region that contribute to current and/or future gaps is 0.65 MGD. Since there are current gaps at the referenced locations, it will be difficult to develop additional surface water to meet projected needs without increasing current gaps. As described below, management practices are recommended by the Coastal Council to address surface water gaps.

In Figure ES-7, the terms “planning node” and “basic node” refer to locations in the region with long-term river flow measurement data. In most instances, basic nodes are located at or near U.S. Geological Survey stream gages or at dams. Planning nodes are basic nodes where water availability assessments are performed.

Assessment of Water Quality Conditions

One measure of the capacity of surface water to maintain its health and the health of the aquatic species living therein is the amount of residual dissolved oxygen in the water. As part of the Surface Water Quality (Assimilative Capacity) Resource Assessment (EPD, March 2010), modeling of dissolved oxygen concentrations was performed for each surface water reach in the region that has upstream wastewater discharges to the reach. The modeling estimates the ability of the surface water to assimilate the amount of waste being discharged (also referred to as assimilative capacity). Each modeled river segment was classified as exceeding dissolved oxygen capacity, meeting dissolved oxygen capacity, or having available dissolved oxygen capacity. Table ES-1 summarizes the results of the assimilative capacity assessment for dissolved oxygen at baseline and/or permitted conditions including recommendations to address potential future (2050) water quality needs. Assimilative capacity assessments indicate the potential need for improved wastewater treatment in some facilities within the Ogeechee and Altamaha River Basins. Information is also included for portions of the river basin where additional treatment of nitrogen and/or phosphorus and/or ammonia may be needed.

Table ES-1: Surface Water Quality (Assimilative Capacity) Assessment Recommendations

River Basin	Recommendation	Number of Affected Stream Reaches
Ogeechee	Expand/construct new facility to meet future wastewater flows	2
	Improve level of wastewater treatment to improve instream dissolved oxygen	2
	Wastewater facility no longer discharges	1
	Improve wastewater treatment for nutrients (nitrogen and phosphorus)	2
Altamaha	Monitoring and data collection	1
	Expand/construct new facility to meet future wastewater flows	1
	Implement ammonia limits on wastewater discharge	1
	Improve wastewater treatment for nutrients (nitrogen and phosphorus)	1

Source: Coastal Georgia Gap Analysis Technical Memorandum; CDM, 2011.

Under Section 303d of the federal Clean Water Act, a total maximum daily load must be developed for waters that do not meet their designated uses. A total maximum daily load represents the maximum pollutant loading that a water body can assimilate and continue meeting its designated use (i.e., not exceeding State water quality standards). A water body is deemed to be impaired if it does not meet the applicable criteria for a particular pollutant; consequently, total maximum daily loads are required to be established for these waters to reduce the concentrations of the exceeding parameters in order to comply with State water quality standards.

For the Coastal Region, there are 52 impaired stream reaches (total impaired length of 582 miles) and 2 impaired sounds. Total maximum daily loads have been completed for 36 of the impaired stream reaches and both impaired sounds. The majority of impairments are due to low dissolved oxygen and fecal coliform.

A draft total maximum daily load was completed in April 2010 for the Savannah River Harbor by the U.S. Environmental Protection Agency. The *Savannah River Harbor Total Maximum Daily Load Stakeholder Group* was formed to develop a strategy for reducing pollutant loading to the Savannah River and for complying with *total maximum daily load* requirements. Critical data and preferred strategies are likely to emerge from this stakeholder process, a process comprised of permit holders from both Georgia and South Carolina, which would establish a clearer path toward addressing current and future resource management priorities. Discharge to the Savannah River will be affected by the results of the total maximum daily load stakeholder process.

Summary of Resource Assessment Results

Management Practices should be developed and implemented to address water resource shortfalls as determined by the three Resource Assessments.

Groundwater: *Overall, results indicate that the sustainable yield for the modeled portions of the regional aquifer(s) is greater than the forecasted demands. However, groundwater pumping in certain areas of the Coastal Region can lead to saltwater intrusion. Groundwater supplies in these areas may be limited.*

Surface Water Quantity: *There are sufficient surface water supplies at many locations throughout the Coastal Region, but there are also projected surface water shortfalls at the Atkinson, Claxton, Eden, and Kings Ferry nodes.*

Surface Water Quality: *There are four river reaches within the Ogeechee River Basin, one river reach within the Altamaha River Basin, and possibly Brunswick Harbor Estuary (under future conditions) that exceed assimilative capacity. In addition, a draft total maximum daily load has been established for the Savannah River Harbor, which will affect discharges to the river.*

Identifying Water Management Practices to Address Water Resource Shortfalls and Future Needs

The comparison of EPD's March 2010 Resource Assessments and forecasted demands identified the region's likely resource shortfalls or gaps and demonstrated the necessity for region and resource specific water management practices. In selecting the actions needed (i.e., water management practices), the Coastal Council

considered practices identified in existing plans, the Region's Vision and Goals, and coordinated with local governments and water providers as well as neighboring Councils that share these water resources.

The Coastal Council has developed a management practice strategy based on the best data and modeling results available. The Council recognizes that as data are refined and modeling results improve – including water and wastewater projections and Resource Assessments – the resulting future needs and gaps may change. Therefore, the Council has prioritized short-term management practices to address gaps with the understanding that more complex management practices may be required in the future. These short-term management practices are presented in Tables ES-2 and ES-3.

Table ES-2: Short-Term Water Quantity Management Practices (0 – 10 Years)

Utilize surface water and groundwater sources within the available resource capacities
For Red and Yellow Zones, management practices include a range of options including: – Replacing groundwater with surface water – Replacing Red Zone groundwater withdrawals with groundwater withdrawals outside the Red and Yellow zones – Engineered barrier(s) – Aquifer storage and recovery – Optimization of all aquifers – Water reuse
Water conservation
Data collection and research to confirm the frequency, duration, severity, and drivers of surface water gaps (forecast methodology assumptions and Resource Assessment modeling)
Evaluate and ensure that future surface water permit conditions do not contribute to low flow concerns
Encourage sustainable groundwater use as a preferred supply in regions with surface water low flow concerns and adequate groundwater supply
Identify incentives and a process to sustainably replace a portion of existing surface water use with groundwater use to address low flow concerns
Evaluate the potential to use existing storage to address low flow concerns
Education to reduce surficial aquifer groundwater use impacts to 7Q10 low flow concerns

Table ES-3: Short-Term Water Quality Management Practices (0 – 10 Years)

Point Sources: – Support and fund current permitting and waste load allocation process to improve treatment of wastewater and increase treatment capacity – Data collection and research to confirm discharge volumes and waste concentrations as well as receiving stream flows and chemistry
Non-point Sources: – Data collection to confirm source of pollutants and causes; encourage stormwater ordinances, septic system maintenance, and coordinated planning – Ensure funding and support for Best Management Practices programs by local and state programs, including urban/suburban, rural, forestry, and agricultural Best Management Practices
Non-point Source Existing Impairments: – Total maximum daily load listed streams: Improve data on source of pollutant and length of impairment; Identify opportunities to leverage funds and implement non-point source Best Management Practices

The Coastal Council's efforts in developing management practices were significantly affected by the scale and complexity of the groundwater resource gaps that are associated with the Bi-state Salt Water Intrusion Stakeholder Process in the Savannah-Hilton Head Island regions and the water quality gap associated with the Savannah River Harbor Total Maximum Daily Load Stakeholder Process. Critical data and preferred strategies are likely to emerge from these stakeholder processes, which would establish a clearer path toward addressing current and future resource management priorities. The Coastal Council wished to avoid getting ahead of these parallel processes and consequently has provided a "tool box" of management practices, which may ultimately be implemented to varying degrees and/or eliminated from future consideration. In addition, results and recommendations from the U.S. Army Corps of Engineer's Savannah River Basin Comprehensive Study (a cost-share study with Georgia and South Carolina), as well as other planning needs that may be identified through South Carolina's water planning process, will need to be evaluated and considered in future iterations of the Coastal Council Regional Water Plan. The Coastal Council intends to revisit this Plan to evaluate any substantial new information that may emerge to determine if modification of the Plan is warranted. Council expects that a formal decision to continue Council will be made to facilitate accomplishing this objective. Members of the Coastal Council have invested significant time and expertise into the planning process and wish to capitalize on the expertise gained by the Council prior to the end of their initial term as Council members (February 2012).

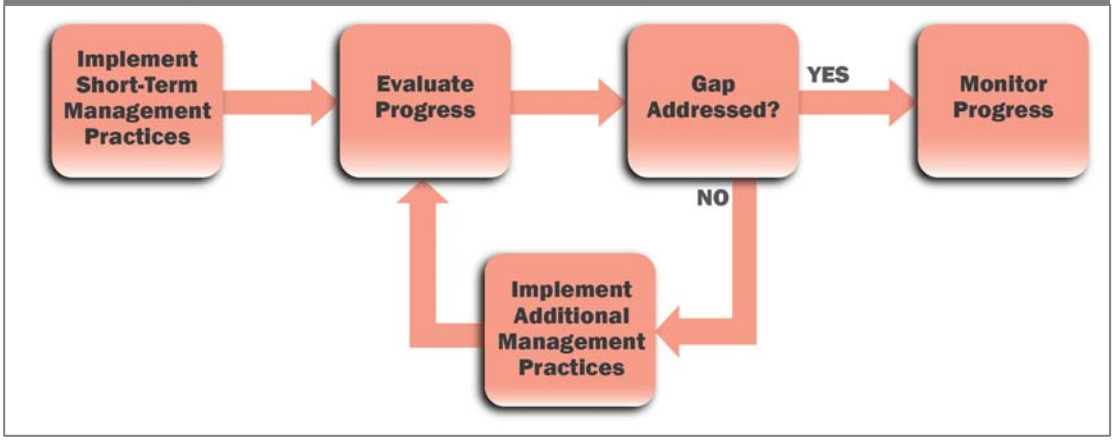
The Coastal Council believes the Regional Water Plan should be reviewed in defined increments in the future such as every five years to evaluate how the implemented management practices are performing toward addressing gaps and meeting forecasted needs and what additional measures might be required. If the selected management practices have not sufficiently closed the gaps identified by the Resource Assessments, then additional management practices should be selected and implemented. The selected management practices will over time address identified gaps and meet future uses when combined with practices for all shared resource regions. The Council further believes that triggering events might cause the need for the plan to be revisited at a smaller time increment. These triggering events could include items such as a large water using industry moving into the region, significant changes in regulatory policy, and results of the bi-state negotiations that alter the findings of the Regional Water Plan.

Implementing Water Management Practices

The Coastal Council supports the concept of regional water resource planning with a focus on planning Councils composed of local governments, water users, water providers, industry, business and affected stakeholders. Local representatives are typically most familiar with local water resource issues and needs. The State has a vital role providing technical support, guidance, and funding to support locally focused water resource planning.

Implementation of the Coastal Georgia Regional Water Plan will be primarily by various water users and wastewater utilities in the region. The most cost-effective and more readily implemented management practices will be prioritized for short-term implementation via an incremental and adaptive approach as shown in Figure ES-8. If resource needs are not met and/or gaps are not addressed, then more complex management practices will be pursued. Future planning efforts should confirm current assumptions and make necessary revisions and/or improvements to the conclusions reached during this round of planning.

Figure ES-8: Implementation of Management Practices



Cost Considerations

Planning level cost estimates were prepared for the various categories of management practices. A detailed summary of costs can be found in Section 7 of the Regional Water Plan. In general, addressing surface water needs in the region from both a water supply and a water quality perspective are expected to present the largest challenges and have the most fiscal impact. For the Regional Water Plan to be most effective wastewater utilities and agricultural water users will need planning and implementation support to help them meet current and future needs. It is anticipated that several different funding sources and options will be used to secure funding for the various management practices outlined in the Regional Water Plan, and adequate funding will be a critical component of the successful implementation of the state-wide water planning effort.

Water conservation remains a cost effective means to address future water supply needs, and could be applied region-wide and especially in areas of development affected by groundwater withdrawal restrictions in the Red and Yellow Zones. It appears more costly solutions such as surface water supply or engineered solutions may also be required in these areas. Wastewater treatment will likely also require funding sources, both to upgrade plants and to address aging infrastructure.

Implementation Considerations and Benchmarks – Helping Ensure Progress toward Meeting Future Needs

Effective implementation of the Regional Water Plan will require the availability of sufficient funding in the form of loans, and in some cases, possibly grants. In addition, many of the proposed management practices require ongoing coordination with affected stakeholders/water users and collaboration to help ensure successful solutions are identified and implemented. Finally, in many cases, monitoring progress toward addressing future needs will require improved data and information on the current actions and management practices that are already in place.

To assess progress toward meeting regional needs, the Coastal Council identified several benchmarks, which can be used to evaluate the effectiveness of the Regional Water Plan. The benchmarks are shown in Section 8 of the Regional Water Plan and include both the activities that should be accomplished and the measurement tools that can be used to assess progress. In the Coastal Georgia Region, there are several issues that may require the development of regional solutions and the benchmarks were developed with this information in mind.

The Coastal Council supports the concept of regional water planning led by local representatives. The Council members wish to express their gratitude to former Governor Sonny Perdue, Lieutenant Governor Casey Cagle, and former Speaker of the House Glenn Richardson for their nomination to the Coastal Council. The Regional Water Plan provides a recommended path forward to help achieve social, economic, and environmental prosperity for the region. The Council members are grateful for the opportunity to serve the region and State and wish to remain involved in facilitating attainment of the Regional Water Plan benchmarks and making necessary revision to the Plan either through the Coastal Georgia Regional Commission or other avenues.

1. INTRODUCTION

Section 1. Introduction

Over the last decade, Georgia was one of the fastest growing states in the nation. During this same period, the State experienced unprecedented drought. In addition, we have seen increased competition for water supplies, and our perspectives on how we use and value water have also changed. In response to these challenges, a State Water Council was formed to develop a state-wide water planning process.

Summary

The Coastal Georgia Regional Water Planning Council, established in February 2009 under the State Water Plan, has adopted a Vision and Goals for prioritizing water resource use and management within the region.

These guiding principles were used to identify and select water management practices that best address the needs and resource conditions of the Coastal Georgia Region.

In 2008, the State Water Council submitted the *Georgia Comprehensive State-wide Water Plan* (State Water Plan) to the Georgia General Assembly and the water planning process was approved. The purpose of the State Water Plan is to guide Georgia in managing water resources in a sustainable manner to support the State's economy, protect public health and natural systems, and to enhance the quality of life for all our citizens. The State Water Plan identifies state-wide policies, provides planning guidance, and establishes a planning process for completion of Regional Water Development and Conservation Plans (Regional Water Plans). The Coastal Georgia Regional Water Planning Council (Coastal Council) was formed to help guide the completion of the Regional Water Plan. The Coastal Council is composed of membership based on a nomination and appointment process by the Governor, Lieutenant Governor, and Speaker.

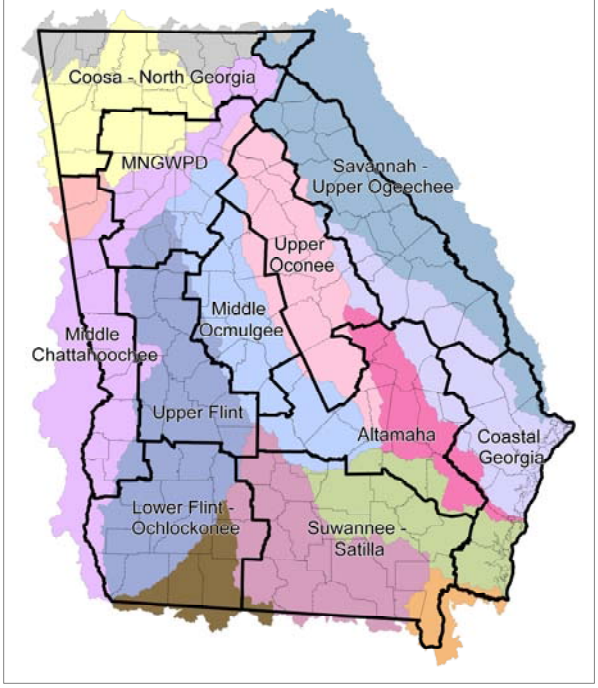
1.1. The Significance of Water Resources in Georgia

Of all Georgia's natural resources, none is more important to the future of our State than water. Georgia has abundant water resources, with 14 major river systems and multiple groundwater aquifer systems. These waters are shared natural resources. Streams and rivers run through many political jurisdictions. The rain that falls in one region of Georgia may replenish the aquifers used by communities many miles away. And, while water in Georgia is abundant, it is not an unlimited resource. It must be carefully managed to meet long-term water needs.

Since water resources, their conditions, and their uses vary greatly across the State, selection and implementation of management practices on a regional and local level is the most effective way to ensure that current and future needs for water supply and assimilative capacity are met. Therefore, the State Water Plan calls for the preparation of ten Regional Water Plans. The eleventh regional water planning district, the Metropolitan North Georgia Water Planning District (MNGWPD, also known as "the District"), was created by State law in 2001 and had existing plans in

place. Figure 1-1 illustrates the 11 council boundaries and major surface watersheds, which are shown by the different background colors.

Figure 1-1: Regional Water Planning Councils

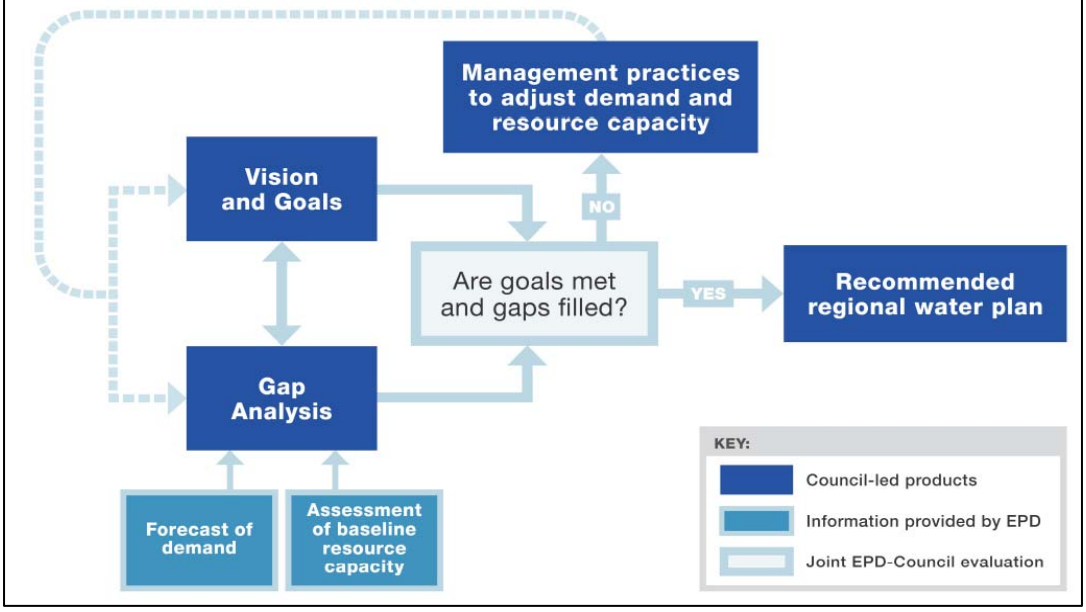


This Regional Water Plan prepared by the Coastal Council describes the current and projected water resource needs of the region and summarizes regionally appropriate management strategies (also referred to as water management practices) to be employed in Georgia's Coastal Water Planning Region over the next 40 years to help meet these needs.

1.2. State and Regional Water Planning Process

The State Water Plan calls for the preparation of Regional Water Plans designed to manage water resources in a sustainable manner through 2050. This Regional Water Plan has been prepared following a consensus-based planning process illustrated in Figure 1-2. As detailed in the Coastal Council's Memorandum of Agreement with the Georgia Environmental Protection Division (EPD) and Department of Community Affairs (DCA) as well as the Council's Public Involvement Plan (PIP), the process required and benefited from input of other regional water planning councils, local governments, and the public.

Figure 1-2: State Water Planning Process



1.3. The Coastal Georgia Water Planning Region Visions and Goals

Following the process established in the State Water Plan, the Coastal Council was established in February 2009. The Coastal Council has 30 members, which includes 3 alternates and 2 Ex-Officio members. Figure 1-3 provides an overview of the Coastal Region and the residential locations of the Coastal Council members.

Figure 1-3: Locations of Coastal Georgia Council Members

The Coastal Council met collectively for the first time on March 13, 2009 at a kickoff meeting for the ten regional water planning councils. The meeting focused on: providing an orientation to the water planning process; a preliminary overview of Georgia's water resources; and establishing an understanding of the schedule for completing the Regional Water Plan, the Council's meeting schedule, and requirements.

Developing the Region's Council Procedures

Initially, the planning process focused on establishing the Coastal Council leadership along with operating procedures and rules for conducting meetings. The operating procedures and rules were appended to the Memorandum of Agreement that was executed between the Coastal Council, EPD, and DCA. The Memorandum of Agreement was unanimously approved by the Coastal Council and executed on June 25, 2009. A copy of the Memorandum of Agreement can be accessed at: www.coastalgeorgiacouncil.org/documents/CGA_MOA_Signed-3.pdf.

In support of the Memorandum of Agreement, the Coastal Council formed six subcommittees to provide planning guidance during various development stages of the Regional Water Plan. The subcommittees consisted of the following: Vision and Goals, Municipal Water and Wastewater Forecasting, Public Involvement Plan, Plan Drafting (Table of Contents), Plan Drafting (Report), and Management Practices.

Developing Regional Vision and Goals

A major element of Georgia's state and regional water planning process is the identification of the Vision and Goals that describe the economic, population, environmental, and water use conditions desired for each region. The Vision and Goals described below summarize the Coastal Council's priorities for water resource use and management. This information is used to help guide the identification and selection of water management practices for the Coastal Georgia Region and to communicate these priorities and values to other regions of the State.

Vision Statement (As established September 24, 2009)

"The Coastal Georgia Regional Water Planning Council seeks to conserve and manage our water resources in order to sustain and enhance our unique coastal environment and economy of Coastal Georgia."

Goals (As Established November 17, 2009)

The Coastal Council has identified six goals for the region. It is important to note that the goals summarized below are not presented in order of priority, but rather were assigned a number to identify specific goals addressed as part of the water management practice selection process (Section 6).

1. Manage and develop high quality water resources to sustainably and reliably meet domestic, commercial, industrial and agricultural water needs.
2. Identify fiscally responsible and implementable opportunities to maximize existing and future supplies including promoting water conservation and reuse.
3. Optimize existing water and wastewater infrastructure, including identifying opportunities to implement regional water and wastewater facilities.
4. Protect and maintain regional recreation, ecosystems, and cultural and historic resources that are water dependent to enhance the quality of life of our current and future citizens, and help support tourism and commercial activities.
5. Identify and utilize best available science and data and apply principles of various scientific disciplines when making water resource management decisions.
6. Identify opportunities to manage stormwater to improve water quantity and quality, while providing for wise land management, wetland protection, and wildlife sustainability.

More information regarding the region's Vision and Goals can be found at: www.coastalgeorgiacouncil.org/documents/CGA_Vision_Goals_Adopted.pdf.

The Coastal Council's Public Involvement Plan

A foundational principle of the Georgia water planning process is an emphasis on public and stakeholder participation and coordination among multiple interests. The Coastal Council developed a Public Involvement Plan to help guide and implement an inclusive planning process. The Public Involvement Plan was adopted by the Coastal Council on November 17, 2009 and is available at:

www.coastalgeorgiacouncil.org/documents/CGA_Public_Involvement_Plan_Adopted.pdf.

Outreach to the public, local governments, water providers, and users was accomplished by e-mail correspondence, direct communication, and updates provided by Council members at local government and other interest group meetings. Opportunity for public and local government comment was provided at each Council meeting. More information regarding public outreach can be found in the Coastal Council Public Outreach Technical Memorandum available at:

www.coastalgeorgiacouncil.org/documents/CoastalGAPublicOutreachTM050211.pdf.

2. THE COASTAL GEORGIA WATER PLANNING REGION

Section 2. The Coastal Georgia Water Planning Region

2.1. History and Geography

Georgia's Lower Coastal Plain, an environmental region of the Coastal Plain Province, contains some of the State's most well known geographic features. The State's lowest elevations have the highest percent of wetlands, bottom lands, and hardwood swamps. In addition, there are several subregions, or physiographic districts, based on topography, geology, soil, flora, fauna, and other factors. The most notable of these districts are the Barrier Island Sequence, which includes historic seashore and present day coastline.

Surface Water Resources

The Coastal Georgia Region covers the lower portion of five major river basins, listed from north to south: Savannah, Ogeechee, Altamaha, Satilla, and St. Marys. All rivers contained in these basins discharge to the Atlantic Ocean after flowing through coastal marshlands.

Figure 2-1 provides an overview of the surface water resources in the Coastal Region. Carp, shrimp, oysters, clams, and various species of fish provide a vibrant and significant recreational and commercial resource, both ecologically and economically. It is estimated that the sales effect from the commercial fishing industry from Georgia's coast provides over $23 million to the economy each year (NOAA, 2008). Estuaries within the coastal marshlands are also important ecosystems. A significant portion of the Atlantic seaboard's salt marshes and thousands of acres of rare tidal freshwater wetlands are located within the Coastal Georgia Region.

Summary

The Coastal Georgia Region encompasses nine counties in the southeast coastal portion of Georgia and is bordered by South Carolina and Florida. Predominant land cover in the region includes forest, wetland, and urban areas.

Major surface water resources in the region include the Savannah, Ogeechee, Altamaha, Satilla, and St. Marys Rivers, which provide significant recreational and economic benefits to the area.

The Upper Floridan Aquifer, one of the most productive aquifers in the United States, is the primary source of groundwater in the region.

The regional domestic, commercial, industrial, agricultural, thermoelectric power, and recreational water uses are vital to the region's economy and quality of life.

The Savannah River is 350 miles long and has a drainage area of approximately 10,577 square miles (mi^2), 55% of which lies in Georgia (EPD, 2007) and the remainder in North and South Carolina. The headwaters begin in the Blue Ridge Mountains in northeast Georgia and across the state borders in North and South Carolina. The largest off-stream water use is power generation, including two power facilities located within the Coastal Georgia Region. The Savannah River Basin is

Figure 2-1: Surface Water Resources, Counties, and Major Cities

home to 108 species of fish and supports significant wetlands areas in the southern part of the basin. The Savannah River discharges to the Atlantic Ocean at the Port of Savannah, which is a major shipping port for the eastern United States.

The Ogeechee River is 245 miles long and has a drainage area of approximately 5,540 mi^2 between the Altamaha and Savannah River Basins (EPD, 2007). The main tributary in this basin is the Canoochee River, which flows through extensive river swamps in the Coastal Plain before joining the Ogeechee River. Fishing and swimming are popular along both rivers. The Ogeechee basin is home to 59 species of fish, including large numbers of catfish and sunfish The Ogeechee River supports Georgia's largest commercial American shad harvest. In addition, the Wildlife Resources Division raises bass at the Richmond Hill Hatchery in Bryan County for stocking streams across Georgia.

The Altamaha River, located between the Ogeechee and Satilla River Basins, is 137 miles long and has a drainage area of approximately 14,000 mi^2, including the upstream drainage area of the Ocmulgee River and Oconee River (EPD, 2003). There is some commercial navigation in the lower Altamaha River near the Intracoastal Waterway. The Altamaha River is a popular fishing resource to the region and is home to 74 species of fish, including sunfish, largemouth bass, bluegill, black crappie, and catfish.

The Satilla River is 200 miles long and has a drainage area of approximately 3,940 mi^2 between the Altamaha and Suwannee River Basins (EPD, 2007). The Satilla River is a blackwater stream consisting of tannins and other natural leachates, which cause the river to have a darkly stained appearance. Power generation is a significant off-stream water use in the basin, including an oil-fired power plant in Turtle Creek, near Brunswick. During dry periods, many smaller streams within the basin have virtually no flow. Diversity of fish species within the Satilla River is limited by extreme variations in flows and the relatively homogenous habitat present through

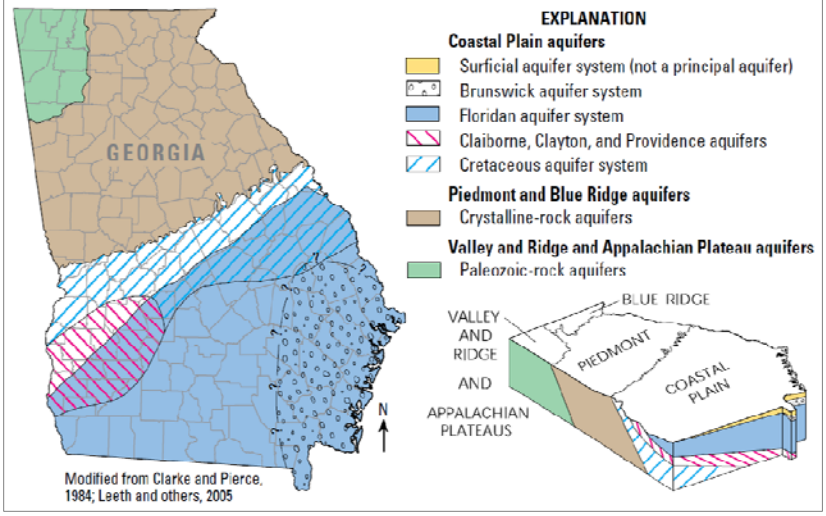
most of the river. However, the river does support major fisheries for redbreast sunfish and catfish.

The St. Marys River is 90 miles long and has a drainage area of approximately 1,300 mi^2, 59% of which lies in Georgia (EPD, 2007) and the remainder in Florida. The St. Marys River is also a blackwater stream and flows north and east, forming the border between southeast Georgia and northeast Florida. This river is well-known for its near-natural conditions. Large families of sunfish, minnows and catfish can be found in the St. Marys River in addition to various coastal and riparian species that inhabit the marshlands.

Groundwater Resources

Groundwater is a very important resource for the Coastal Georgia Region. Figure 2-2 depicts the major aquifers of Georgia. Three aquifers beneath the Coastal Georgia region are the surficial aquifer, Brunswick aquifer, and the Floridan aquifer. The thickness of the surficial aquifer is typically less than 50 feet and consists mostly of beds of unconsolidated sand and shell. The Brunswick aquifer occurs between the surficial and Floridan aquifers. The thickness of the aquifer ranges from less than 100 to 200 feet. The Brunswick Aquifer is commonly utilized as an alternate water source to the Upper Floridan Aquifer within the Coastal Georgia Region. Groundwater levels in the lower unit of the Brunswick Aquifer typically respond to pumping from the Upper Floridan Aquifer.

Figure 2-2: Major Georgia Aquifers



Based on 2010 forecasted groundwater withdrawal data, approximately 99% of groundwater supplied in the region is from the Floridan aquifer system, which is one of the most productive aquifers in the United States. The Floridan aquifer is primarily comprised of limestone, dolostone, and calcareous sand. The aquifer is generally confined, but at its northern extent there are unconfined and semi-confined zones. The Floridan aquifer increases in thickness eastward across the state and is approximately 400 feet thick in Glynn County. The aquifer is very productive, with typical well yields of 1,000-5,000 gallons per minute. However, high volumes of pumping of groundwater aquifers in coastal regions can lead to salt water intrusion or the movement of saline waters into freshwater aquifers. Due to concerns over salt water intrusion, there are localized restrictions on groundwater withdrawals in the Coastal Region as discussed in Section 3.2.3.

Climate

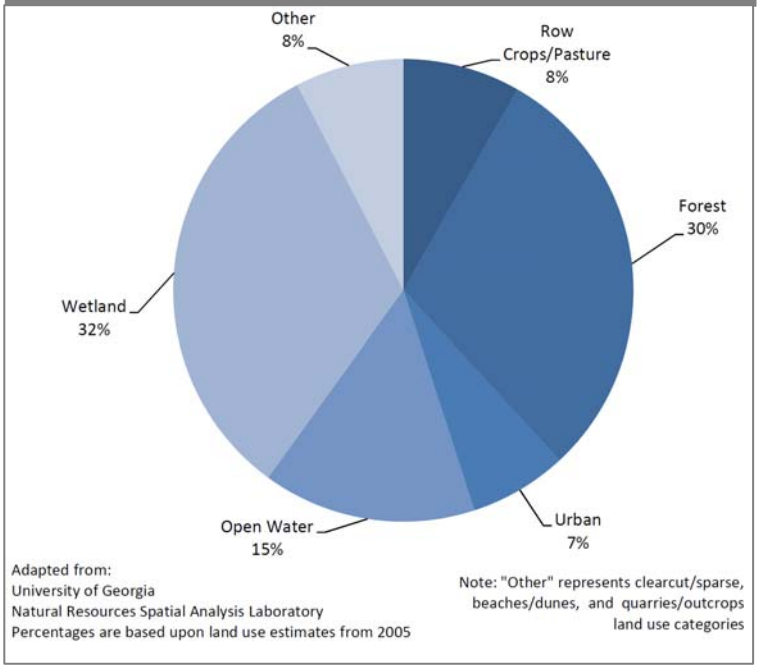
A review of available data for the region from the Southeast Regional Climate Center indicates that the climate is temperate with mild winter and hot summers. Average maximum temperatures are around 92°F in July and average minimum temperatures are near 40°F in January. The area receives abundant rainfall, approximately 46-51 inches per year, with the greatest rainfall occurring during July and August inland and in September along the coast. The driest month in the region is November. Snowfall is rare and historical averages for the region are 0.1 inches near the coast to 0.3 inches further inland.

2.2. Characteristics of Region

The Coastal Council's planning boundaries encompass nine counties in the southeast portion of Georgia with a projected 2010 population of approximately 633,000 (Office of Management and Budget, 2010). The counties and major towns and cities are shown in Figure 2-1. Effingham and Chatham Counties are bordered to the north by the Savannah River and South Carolina and Camden County is bordered to the south by Florida. The major population centers in the region include Savannah, Statesboro, Hinesville, St. Marys, and Brunswick.

A summary of 2005 land cover distribution is shown in Figure 2-3, based on data obtained from the University of Georgia Natural Resources Spatial Analysis. The top two land covers in the Coastal Georgia Region are wetlands and forests, which cover 32% and 30% of the planning region, respectively. The term wetland refers to land cover and does not infer a regulatory determination. Agriculture accounts for 8% of the land cover and urban development accounts for only 7% of the land cover within the Coastal Georgia Region. The remaining land cover (23%) consists of water and open spaces. Based on the inventory developed of Georgia's irrigated croplands for the year 2008 (UGA Cooperative Extension Irrigation Survey and Dr. Jim Hook), peanut crops occupy nearly half of the irrigated acreage within the Coastal Georgia Region. Cotton, corn, and soybeans are also planted widely within this area.

Figure 2-3: Land Cover Distribution



The dominant economic drivers in the region are the Georgia Port Authority (Ports of Savannah and Brunswick) and the U.S. Government, including Fort Stewart and Hunter Army Airfields, Kings Bay Naval Submarine Base, and the Federal Law Enforcement Training Center. Additionally, the dominant economic sectors in the region include tourism, trade, transportation, utilities, education and health services, and leisure and hospitality.

The region includes four colleges and universities within the University System of Georgia: Georgia Southern University in Statesboro, Armstrong Atlantic State University and Savannah State University in Savannah, and the College of Coastal Georgia in Brunswick. The Georgia Institute of Technology's Savannah campus and Savannah College of Art and Design also offer four-year programs and the Technical College System of Georgia offers programs at the Ogeechee Technical College in Statesboro and Savannah Technical College. Altamaha Technical College in Jesup also serves citizens from the Coastal Region. In addition to county jails, there are four correctional facilities which are important employers and water users in the Coastal Region, including: Bulloch County Correctional Institution, Coastal State Prison and Coastal State Transitional Center in Chatham County, and Effingham County Correctional Institution.

2.3. Local Policy Context

Regional Commissions

Regional Commissions are agencies of local governments and representatives from the private sector that facilitate coordinated and comprehensive planning at the local and regional levels. Regional Commissions often assist their membership with conformity to minimum standards and procedures and serve as liaisons with state and federal agencies. There are 12 Regional Commissions in Georgia. The Coastal Regional Commission covers the same counties as the Coastal Council with the exception of Screven County.

In July 2009, the Georgia Department of Community Affairs required the Regional Commissions to adopt, maintain, and implement a Regional Plan (DCA Rule 110-12-6). The Coastal Regional Commission's Regional Plan provides guidance to regional and local business leaders, local governments, state and federal agencies, and citizens to promote quality growth in region. It is a vision of the future for the region and includes quality community based objectives related to water resources such as water supply, wastewater, and stormwater management. A key component is the establishment of "performance standards", which are actions, activities, or programs a local government can implement or participate in that will advance their efforts to meet the vision of the Regional Plan. The Coastal Regional Commission's Regional Plan defines two achievement thresholds (Minimum and Excellence), which are attained by implementing the performance standards. Local governments are required to achieve the Minimum Standard to maintain their Qualified Local Government status, which qualifies them for certain state funding. By achieving the Excellence Standard, a local government may be eligible for special incentives.

3. WATER RESOURCES OF THE COASTAL GEORGIA REGION

Section 3. Water Resources of the Coastal Georgia Region

3.1. Current Major Water Use in Region

Based on data summarized from the 2009 U.S. Geological Survey (USGS) report "Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005", water supply in the Coastal Georgia Region for 2005 totaled approximately 565 million gallons per day (MGD) and was comprised of 28% groundwater and 72% surface water, as shown in Figure 3-1. A total of 406 MGD was withdrawn from surface waters in the region to supply the energy, industrial, municipal, and agricultural sectors as shown in Figure 3-2. The majority of this withdrawal is returned back to the surface water. Figure 3-3 shows that about 159 MGD of groundwater withdrawn was predominantly used to supply industrial (47%) and municipal uses (39%), while self-supply, agricultural, and energy made up the remaining uses. Wastewater flows in the region are shown in Figure 3-4. According to the Coastal Georgia Water and Wastewater Forecasting Technical Memorandum (CDM, 2011), 95% of wastewater in the region will be disposed of as a municipal/ industrial point source discharge (39%), energy discharge/return flow (56%), or to a land application system (0.2%). The remaining wastewater is forecasted to be treated by on-site sewage treatment (septic) systems (5%).

Summary

In 2005, surface water and groundwater withdrawal in the region totaled approximately 565 MGD to accommodate municipal, industrial, agricultural, and energy demands.

The majority of wastewater in the region is disposed of as a point source discharge from municipal, industrial, and energy uses.

The availability of surface water to meet current uses varies significantly across the region. Most of the region has sufficient surface water supplies. However, on smaller rivers (i.e., Ogeechee and Canoochee Rivers) with higher water use, river flows are at times (during drier years) insufficient to meet both off-stream uses and instream needs.

Regionally, for the modeled portions of the aquifer(s), there is sufficient groundwater to meet current needs; however, pumping restrictions have been locally implemented in response to effects from saltwater intrusion.

Under current conditions, there are several locations in the region where dissolved oxygen levels may be insufficient to assimilate wastewater discharges.

Water quality in several river reaches and water bodies does not meet the designated use for the resource. The majority of these occurrences are associated with low dissolved oxygen and fecal coliform.

The estuaries, tidal rivers, salt water and brackish marshes, and inshore marine waters are unique resources to the eastern seaboard and are not found in any other regions of Georgia.

Figure 3-1: 2005 Water Supply by Source Type [1a, 1b, 2]

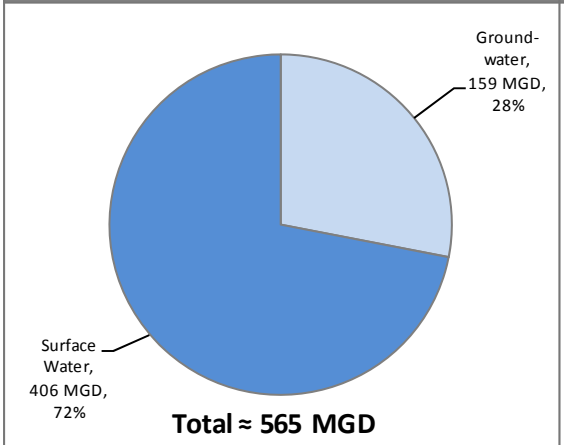


Figure 3-2: 2005 Surface Water Withdrawal by Category [1a, 1b, 2, 3]

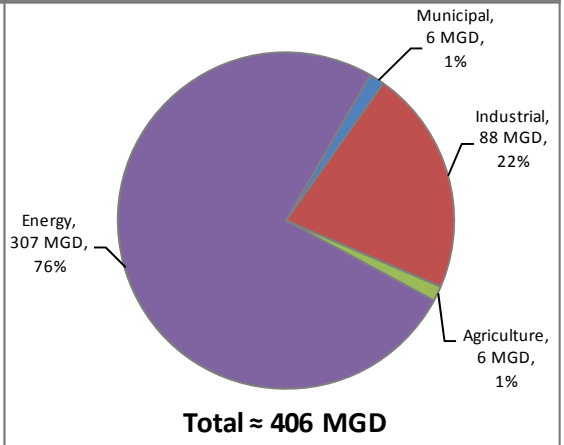


Figure 3-3: 2005 Groundwater Use Withdrawal Category [1a, 1b, 2]

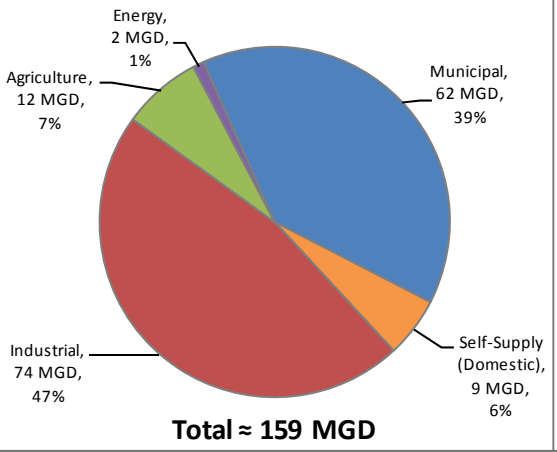
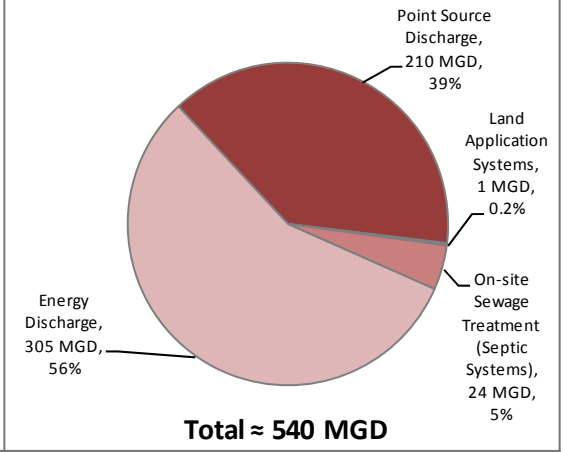


Figure 3-4: 2005 Wastewater/ Return Flow by Category [1b, 1c, 2]



[1] Data Sources: a) "Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005" (USGS, 2009); b) EPD permit withdrawal data for Year 2006 (Energy only); c) Coastal Georgia Water and Wastewater Forecasting Technical Memorandum (CDM, 2011).

[2] Energy totals shown represent total thermoelectric water withdrawal; 4 MGD of the total 309 MGD (1.3%) is consumptive, the remainder (305 MGD) is discharged back to surface waters as return flow.

[3] Surface Water withdrawals for municipal and industrial categories were adjusted based upon feedback from water providers.

3.2. Resource Assessments

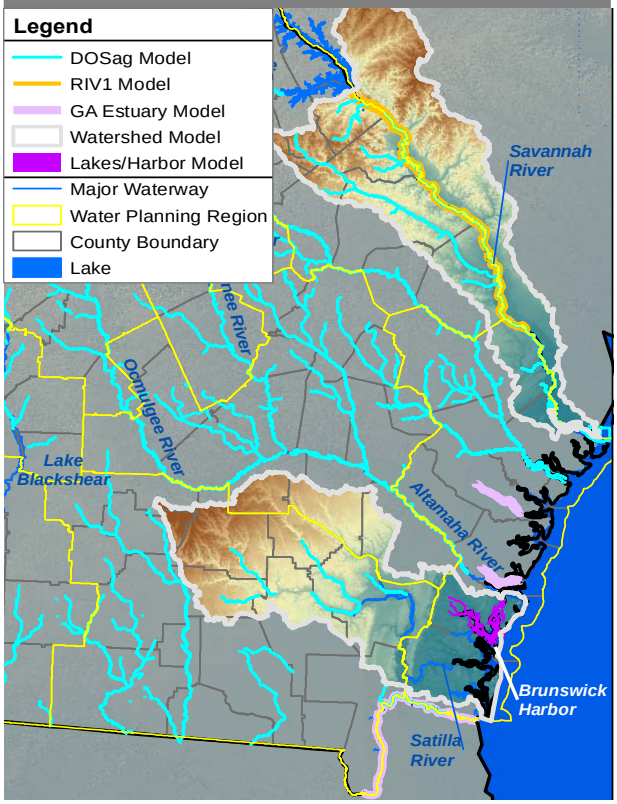
EPD developed three Resource Assessments to evaluate surface water quality, surface water availability, and groundwater availability throughout the State. These assessments determined the capacity of water resources to meet demands for water supply and wastewater discharge without unreasonable impacts according to metrics established by EPD. The assessments were completed on a resource basis (river

basins and aquifers), but are summarized herein as they relate to the Coastal Georgia Region. As described in more detail below, the term "gap" is used to indicate when the current or future use of water has been identified as potentially exceeding the long-term sustainability of the water resource. Full details of each Resource Assessment can be found on the EPD website at: www.georgiawaterplanning.org/pages/resource_assessments.

3.2.1. Current Surface Water Quality (Assimilative Capacity)

The Surface Water Quality (Assimilative Capacity) Resource Assessment (EPD, March 2010) estimates the capacity of Georgia's surface waters to assimilate pollutants without unacceptable degradation of water quality. The term assimilative capacity refers to the ability of a water body to naturally assimilate pollutants via chemical and biological processes without exceeding State water quality standards or harming aquatic life. The current (also referred to as baseline) assimilative capacity results focus on dissolved oxygen (DO), nutrients in some areas of the State (specifically nitrogen and phosphorus), and chlorophyll-a (a parameter that is closely tied to lake water quality). The assessments evaluate the impact of current wastewater and stormwater discharges with current (2005) withdrawals, land use, and meteorological conditions. Additional details are provided in the Surface Water Quality Resource Assessment Synopsis (EPD, March 2010).

Figure 3-5: Assimilative Capacity Models



Assimilative Capacity Modeling (Dissolved Oxygen)

One measure of the capacity of a stream to maintain its health and the health of the aquatic species living therein is the amount of residual DO in the waters of the stream. As shown in Figure 3-5, DO modeling was performed by EPD for each reach that has upstream wastewater dischargers (light blue segments). Each segment was classified as exceeding DO capacity, meeting DO capacity, or having available DO capacity. The results of the current DO modeling are presented in Table 3-1 and in Figures 3-6a through 3-6d. The baseline assimilative capacity represents the model results based on discharge amounts as reported by wastewater treatment plants in 2007. When reviewing the figures, the following points should be kept in mind: segments shown which exceed assimilative capacity may result from a number of factors including: point and/or non-point sources of pollutants; modeling assumptions regarding wastewater discharge, stream flow and temperature; and

naturally low DO conditions in the receiving stream. When model results show DO assimilative capacity as exceeded, a potential "gap" exists between the amount of pollutants discharged and the ability of the receiving stream to assimilate the pollutants. These points were considered when developing recommended strategies to address water quality needs in the region.

Table 3-1: Baseline DO Assimilative Capacity in Coastal River Basins

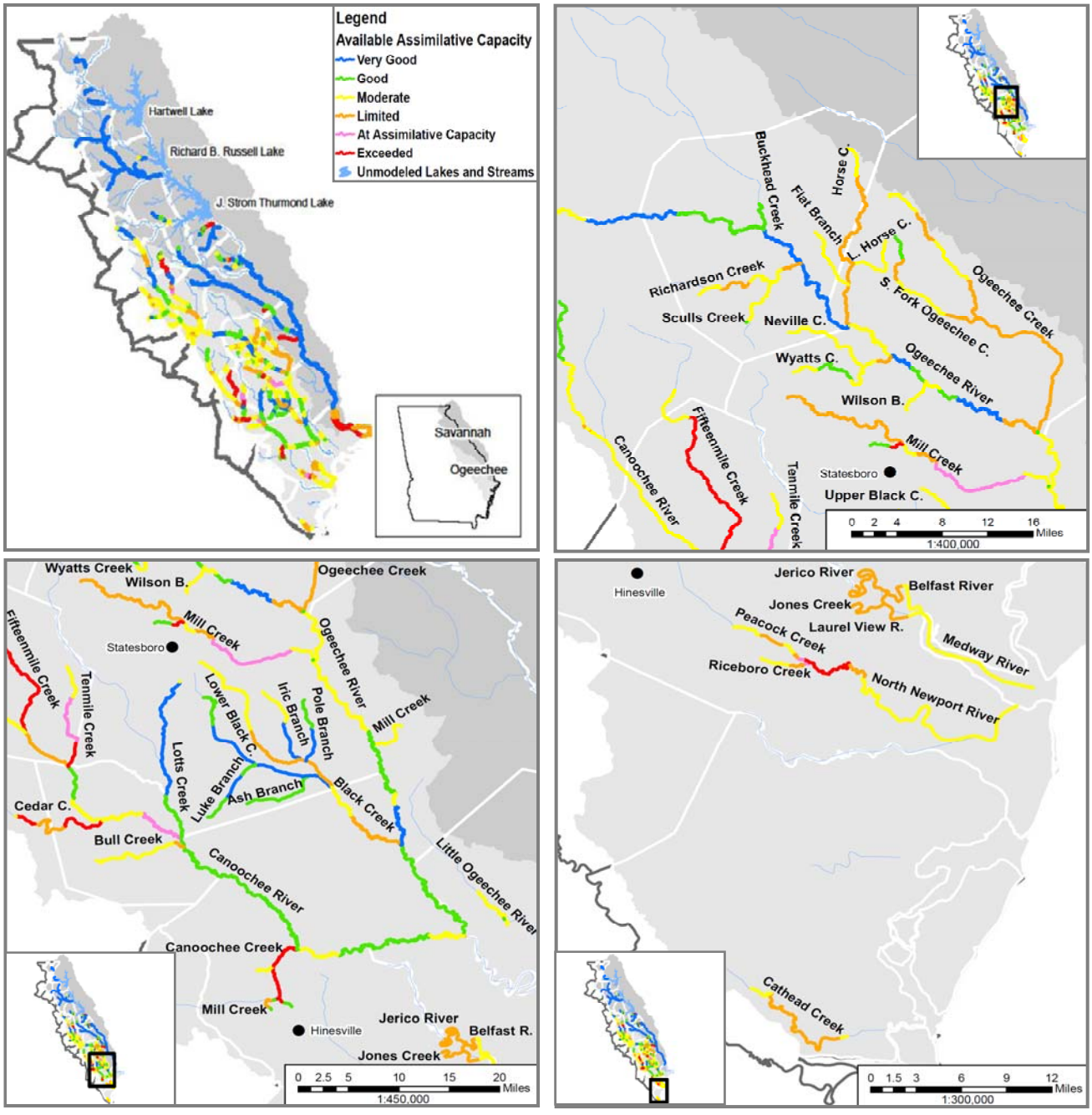
Model Run	Basin	Available Assimilative Capacity (Total Mileage)					Total Modeled River Basin Miles[1]
		Very Good (≥1.0 mg/L)	Good (0.5 to <1.0 mg/L)	Moderate (0.2 to <0.5 mg/L)	Limited (>0.0 to <0.2 mg/L)	None or Exceeded (<0.0 mg/L)	
Baseline	Savannah	449	33	9	3	56	550
	Ogeechee	96	218	307	103	211	935
	Altamaha	169	66	61	80	45	421
	Satilla	147	76	20	18	39	300
	St. Marys	0	0	15	29	32	76

Source: Surface Water Quality Resource Assessment; EPD, March 2010.
[1] Total miles include tributaries and main stem of the rivers within and outside of the Coastal Council boundary.

Nutrient Modeling

In addition to Assimilative Capacity modeling for DO, EPD completed nutrient (nitrogen and phosphorus) modeling for the Satilla and Savannah River Watersheds. The location of the watershed model boundaries, and lakes, harbors and estuaries model locations are shown in Figure 3-5. There are currently no nutrient standards for nitrogen and phosphorus, but these standards may be established in forthcoming years. The nutrient modeling show contribution of nutrients from upstream watersheds to downstream watersheds that discharge in the rivers and streams during the wet years. The Coastal Council proactively identified several non-point source best management practices (BMPs) that can be used to help reduce nutrient loading and this information can be found in Section 6.

Figure 3-6a: Results of Assimilative Capacity Assessment – DO at Baseline Conditions (Savannah and Ogeechee River Basins)



Source: Additional Supporting Material for Baseline Water Quality Resource Assessment; EPD, October 2010.

Very Good: ≥ 1 mg/L of dissolved oxygen (DO) available (above the water quality standard of 5 mg/L)
Good: 0.5 mg/L to < 1.0 mg/L of DO available
Moderate: 0.2 mg/L to <0.5 mg/L of DO available
Limited: >0.0 mg/L to <0.2 mg/L of DO available
At assimilative capacity: 0.0 mg/L of DO available
None or Exceeded Capacity: <0.0 mg/L of DO available

Figure 3-6a (cont.): Results of Assimilative Capacity Assessment – DO at Baseline Conditions (Savannah and Ogeechee River Basins)

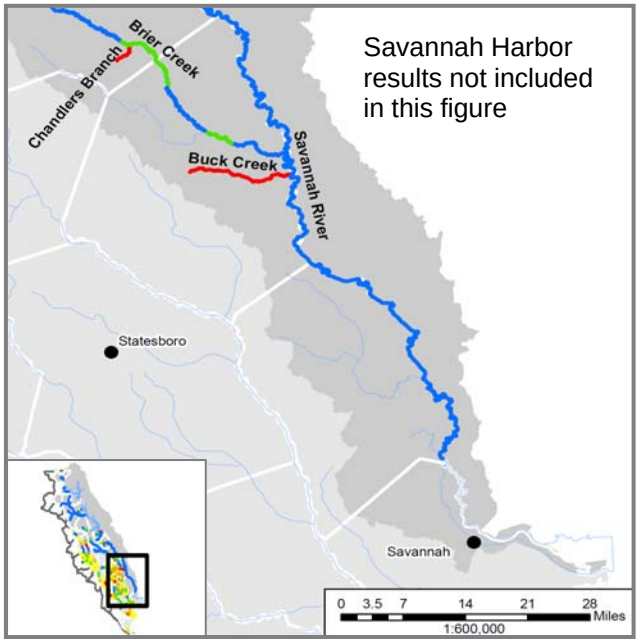
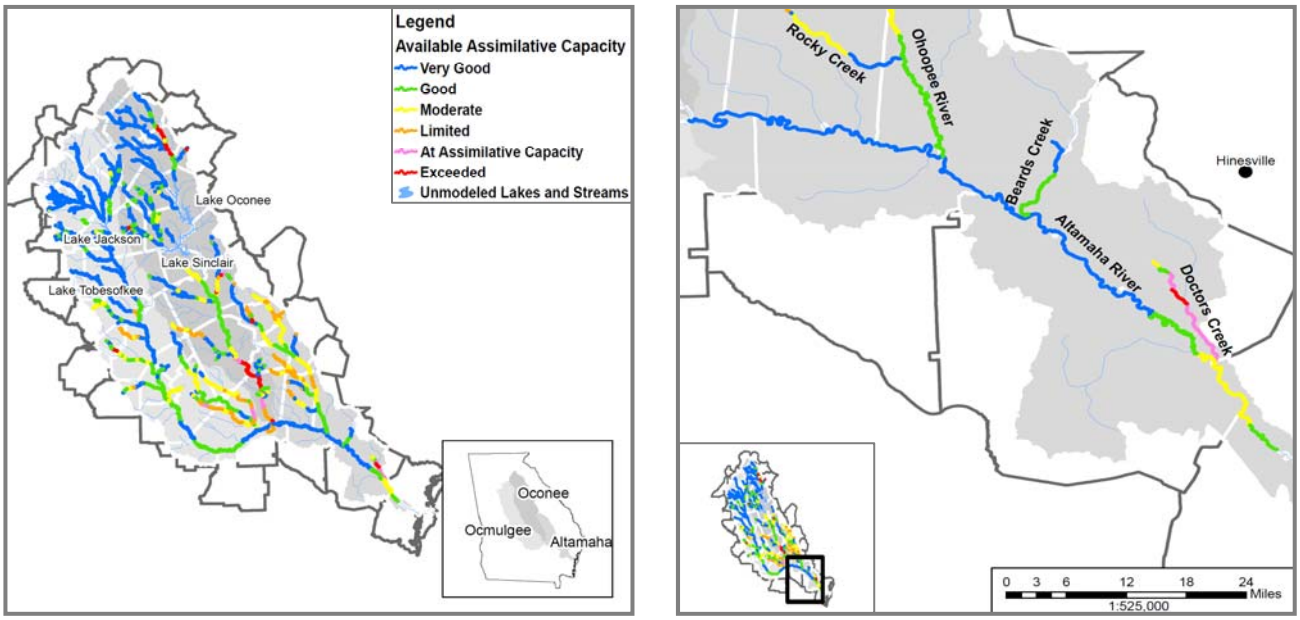


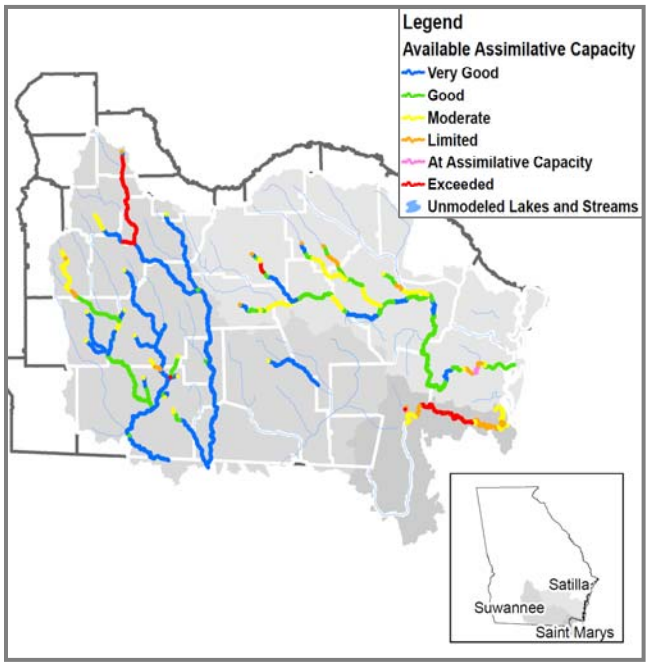
Figure 3-6b: Results of Assimilative Capacity Assessment – DO at Baseline Conditions (Oconee, Ocmulgee, and Altamaha River Basins)

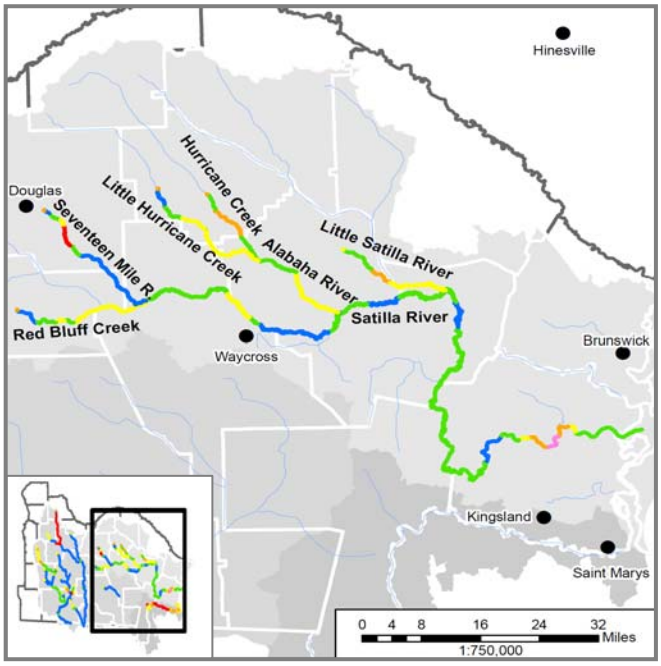


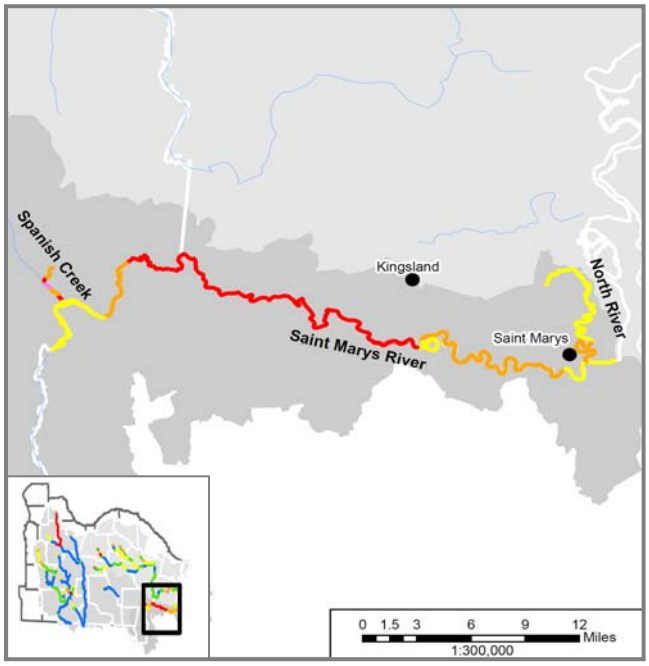
Source: Additional Supporting Material for Baseline Water Quality Resource Assessment; EPD, October 2010.

Very Good: ≥ 1 mg/L of dissolved oxygen (DO) available (above the water quality standard of 5 mg/L)
Good: 0.5 mg/L to < 1.0 mg/L of DO available
Moderate: 0.2 mg/L to <0.5 mg/L of DO available
Limited: >0.0 mg/L to <0.2 mg/L of DO available
At assimilative capacity: 0.0 mg/L of DO available
None or Exceeded Capacity: <0.0 mg/L of DO available

Figure 3-6c: Results of Assimilative Capacity Assessment – DO at Baseline Conditions (Suwannee, Satilla, and St. Marys River Basins)



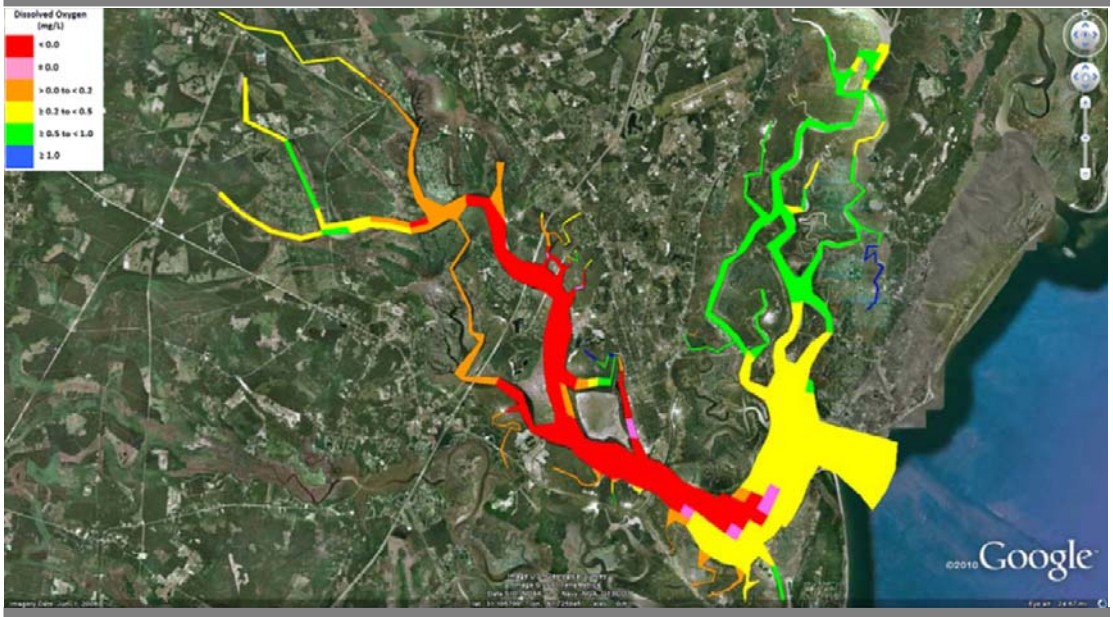




Source: Additional Supporting Material for Baseline Water Quality Resource Assessment; EPD, October 2010.

Very Good: ≥ 1 mg/L of dissolved oxygen (DO) available (above the water quality standard of 5 mg/L)
Good: 0.5 mg/L to < 1.0 mg/L of DO available
Moderate: 0.2 mg/L to <0.5 mg/L of DO available
Limited: >0.0 mg/L to <0.2 mg/L of DO available
At assimilative capacity: 0.0 mg/L of DO available
None or Exceeded Capacity: <0.0 mg/L of DO available

Figure 3-6d: Results of Assimilative Capacity Assessment – DO at Baseline Conditions (Brunswick Harbor)



Source: Additional Supporting Material for Baseline Water Quality Resource Assessment; EPD, October 2010.

3.2.2. Current Surface Water Availability

The Surface Water Availability Resource Assessment (EPD, March 2010) estimated the availability of surface water to meet current and future municipal, industrial, agricultural, and thermoelectric power water needs as well as the needs of instream and downstream users. Instream uses include fish, wildlife habitat, recreation, and dilution of wastewater, among others. The March 2010 Surface Water Availability Resource Assessment used specific minimum flow levels as indicators of the ability to support instream uses. Minimum instream flows were based on State policy, existing Federal Policy, or existing Federal Energy Regulatory Commission (FERC) license requirements. The assessment determines the reliability of the surface water to meet off-stream demands without impacting minimum instream flow requirements. The results of the assessment are provided in terms of both severity (i.e., the amount by which the stream flow would drop below minimum instream flow requirements) and frequency (i.e., number of days below minimum instream flow requirements).

As shown in Figure 3-7, there are several surface water planning nodes located in the Coastal Georgia Region. Planning nodes are locations along a river where there is a long-term record of river flow measurements. At each node, the surface water availability models applied the current cumulative upstream consumptive uses of water (i.e., withdrawal minus discharge returns) and authorized reservoir operations to stream flows from 1939 to 2007. For the March 2010 Surface Water Availability Resource Assessment, the term “gap” is used when the mathematical modeling

results indicate that forecasted off-stream uses of water increase the severity and/or frequency of critical low flow periods. In the Coastal Georgia Region and surrounding area, surface water gaps exist under current conditions at the following planning nodes: Claxton (Canoochee River just west of the Coastal Council Boundary), Eden (Ogeechee River), and Kings Ferry (Ogeechee River). At these nodes, during certain low flow periods, there is not sufficient water to meet current off-stream demands and also meet the targets for support of instream uses.

In the Coastal Georgia Region and surrounding area, critical low flow conditions occur on river systems that do not have any upstream storage reservoirs. In these situations, the March 2010 Surface Water Availability Resource Assessment uses the unimpaired (meaning estimated flows without off-stream uses) monthly 7 day low flow that occurred over a 10 year period or the daily unimpaired flow (whichever is the lowest value) to determine the critical low flow level/target. It is important to note that when a surface water gap exists, management practices are needed to address times when off-stream uses increase the severity and/or frequency of critical low flow conditions. Low flow conditions have been and will continue to occur; and the Coastal Council's management practices are not utilized to address naturally occurring low flow conditions.

Figure 3-7: Surface Water Planning Nodes

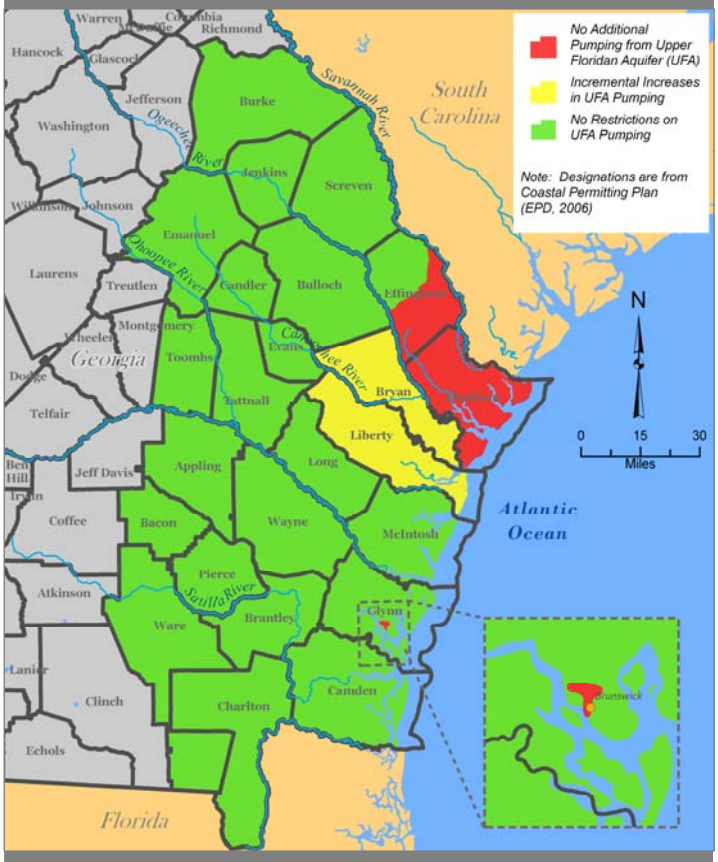
Table 3-2 shows modeled results with information on the size of projected current gaps, with current withdrawals, expressed as changes to natural flow conditions. The values are presented as an average annual flowrate and it is important to note that this summary does not take into account seasonal peaks in consumption and the effects on river flows on a monthly basis. Additional analysis was performed to assess monthly flow conditions. For example, impacts to stream flows are higher in the summer months and lower in the winter months. Additional details are provided in the Coastal Georgia Gap Analysis Technical Memorandum (CDM, 2011).

Table 3-2: Magnitude of Current Surface Water Availability Gaps			
Node	Length of Shortfall (Percent of Time)	Average Shortfall	
		(MGD)	(CFS)
Claxton	18	3.2	5.0
Eden	6	12.3	19.1
Kings Ferry	6	22.6	35.0
Source: Surface Water Availability Resource Assessment; EPD, March 2010.			

3.2.3. Current Groundwater Availability

The Groundwater Availability Resource Assessment (EPD, March 2010) estimates the sustainable yield for prioritized groundwater resources based on existing water use data and aquifer characteristics. EPD prioritized the aquifers based on the characteristics of the aquifer, evidence of negative effects, anticipated negative impacts, and other considerations. The Groundwater Availability Resource Assessment identifies the sustainable yield, or the volume of groundwater that can be used without negative impacts. Negative impacts include limiting use of neighboring wells (drawdown as a consequence of withdrawal), significantly reducing groundwater contributions to stream baseflows, and the permanent reduction of groundwater levels. If negative impacts occur or are expected to occur, then a groundwater "gap" exists.

Figure 3-8: Sub-regions Associated with the Coastal Permitting Plan



Source: Coastal Georgia Water and Wastewater Permitting Plan for Managing Salt Water Intrusion

Groundwater from the Upper Floridan Aquifer is a vital resource for the Coastal Georgia Region. In 2005, groundwater was relied upon to meet about 28% of the water use in the region (USGS, 2009). Overall, the results from the March 2010 Groundwater Availability Resource Assessment indicate that on a regional basis, for the modeled portions of the prioritized aquifers, there is sufficient groundwater supply to meet forecasted demands in some portions of the region. However, significant localized issues exist as described below.

High levels of groundwater pumping or withdrawals in coastal regions can lead to salt water intrusion or the movement of saline waters into freshwater aquifers. As shown in Figure 3-8, 24 counties in southeast Georgia are subject to the Coastal Georgia Water and Wastewater Permitting Plan for Managing Salt Water Intrusion, June 2006 (Coastal Permitting Plan) (www.gadnr.org/cws/). The Coastal Permitting Plan specifies that no additional withdrawals beyond current allowable levels be permitted from the Upper Floridan Aquifer in all of Chatham County, the southern portion of Effingham County, and a small portion of Glynn County near Brunswick due to concerns regarding salt water intrusion. Both Bryan and Liberty Counties are also subject to the Coastal Permitting Plan, and there are limitations on how much additional Upper Floridan Aquifer withdrawals may be allowed in these counties. The remaining counties that are subject to the Coastal Permitting Plan do not have pumping restrictions, but do have water conservation requirements related to groundwater withdrawals.

In the Coastal Region, the groundwater model developed for the Coastal Sound Science Initiative was used to evaluate Upper Floridan Aquifer conditions in Chatham, Effingham, Bryan, and Liberty Counties. The Coastal Plain Groundwater Model developed for the state-wide Resource Assessment was used in other portions of the Coastal Region to evaluate sustainable yields of the Upper Floridan Aquifer. Sustainable yield estimates were not completed in Glynn, Camden, and the majority of McIntosh Counties and the above four counties since these areas are east of the boundary of the Coastal Plain Groundwater Model.

3.3. Current Ecosystem Conditions and Instream Uses

The rivers and estuaries of coastal Georgia support a diversity of fish and wildlife, and many of the amphibians, fish, mammals, mollusks, and reptiles living here depend on coastal rivers and estuaries for part or all of their lifecycle. Coastal riverine systems and processes provide the wide variety of habitats—alluvial rivers and swamps, bottomland hardwood forests, brackish and salt water marshes, canebreaks, estuarine and inshore marine waters, open-water ponds and lakes, tidal rivers, and freshwater tidal marshes—that allow the area to support a rich complex of plants and animals.

The coastal area contains a unique combination of fresh, brackish, and salt water environments. The area is defined by barrier islands, sand beaches, open Atlantic Ocean, and there are 9 major estuaries including 350,000 acres of salt marsh and 150,000 acres of open water. Shipping channels are maintained in three estuaries – the lower Savannah River, St. Simons, and Cumberland. Otherwise, the remainder is very similar in depth, size and other physical characteristics as they were at the time of European settlements of Georgia.

An estuary is a semi-enclosed body of water, which has a free connection with the sea and within which sea water is measurably diluted with fresh water. Without the fresh water input, such areas in Georgia would be salt water lagoons or bays. A key characteristic of an estuary is salinity, which can be highly variable depending on the

location within the estuary and the estuary itself. Sources of freshwater in estuaries include: freshwater river discharges, industrial and municipal discharges of groundwater after use and treatment, and upwelling of groundwater through geologic features. Estuarine environments support a diversity of life, both aquatic and terrestrial, unparalleled in other portions of the State. Hundreds of species of animals and plants exist because of the unique mixing of salt water and fresh water. If the fresh water were removed, the diversity would change immensely from what is found today. Maintaining fresh water inputs to Georgia's estuaries is vital for maintaining a unique coastal environment, which provides a myriad of social and economic benefits, as well as invaluable ecological services to the citizens of Georgia. (Personal Communication Spud Woodward, Coastal Resources Division, Georgia Department of Natural Resources).

The coastal area also provides numerous recreational and commercial opportunities for Georgians; with over 1.29 million resident anglers fishing is the most popular wildlife-related activity in Georgia (DNR-WRD 2006). Some of the most sought-after freshwater sport fish in the region include largemouth bass, striped bass, bluegill, redear sunfish, black crappie, channel catfish, and chain pickerel. In support of these and other fisheries, the Department of Natural Resources (DNR) operates Richmond Hill Fish Hatchery, located in the Coastal Region. This facility produces many freshwater species but is most noted for producing the majority of the striped bass and all of the hybrid striped bass that are stocked throughout the state. The stocking of these two species supports fisheries in reservoirs and rivers that would not otherwise be able to maintain those fisheries. DNR also manages ten Wildlife Management Areas in the region and maintains several public boat ramps that provide public access to coastal rivers for fishing, hunting, boating, and other recreational activities.

In addition to the freshwater resources associated with coastal rivers, many of the ocean species in the area utilize the river systems either directly, by inhabiting the brackish estuarine areas during some life stage, or indirectly, by feeding on organisms that are directly dependent on these areas. Important salt water sport fish in the coastal area include red drum, spotted sea trout, flounder, black drum, tripletail, and sheepshead. Salt water commercial fisheries are also important in the Coastal Region and include shrimp, crab, and eel. Georgia's coastal rivers also provide important riverine habitat for several anadromous fish, including American shad, hickory shad, Atlantic sturgeon, shortnose sturgeon, and striped bass. Anadromous fish migrate from the ocean or estuaries into rivers to spawn.

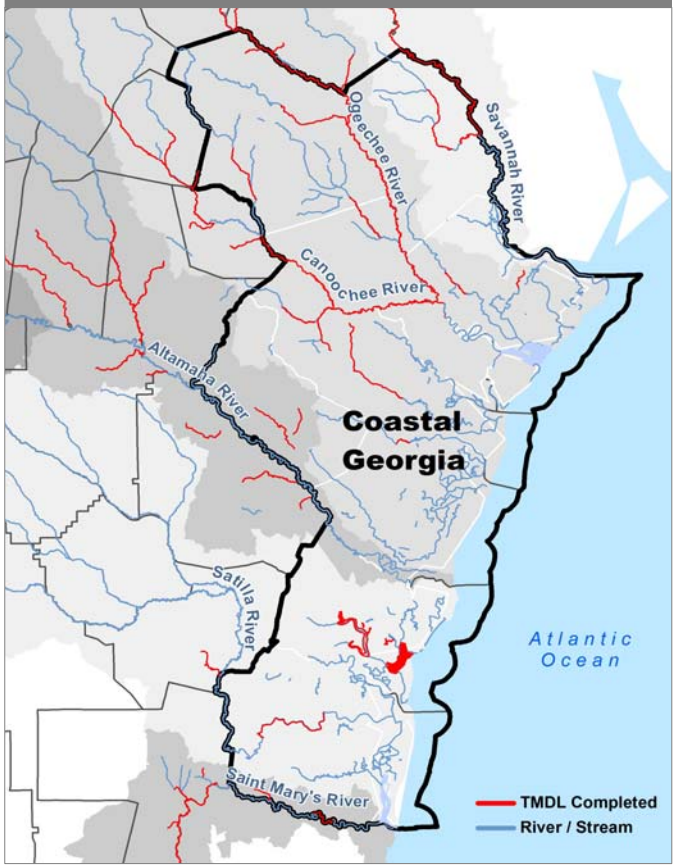
The 2005 Comprehensive Wildlife Conservation Strategy identified 71 high priority animals that inhabit the southern Coastal Plain ecoregion (more information is available at www.georgiawildlife.com/node/1370). In addition, there were 25 high priority habitats identified in the southern Coastal Plain ecoregion (for more information on high priority waters and protected species in the region please go to www.georgiawildlife.com/node/1377 and www.georgiawildlife.com/node/1366).

Several rivers and river corridors in the Coastal Plain have been identified as ecologically important including the Altamaha, Savannah, and Ogeechee Rivers. In the southern Coastal Plain ecoregion, conservation lands make up 14% of the land area (CWCS, 2005). A map of *potential* conservation opportunity areas identified in Georgia (WRD Nongame Wildlife and Natural Heritage Section 2005) is available at: www.georgiawildlife.com/sites/default/files/uploads/legacy_assets/Documents/gnhp/provisional_conservation_opportunity_map.jpg.

Impaired Water Bodies

Under Section 303 (d) of the federal Clean Water Act (CWA), a total maximum daily load (TMDL) must be developed for waters that do not meet their designated uses. A TMDL represents the maximum pollutant load that a water body can assimilate and still continue to meet its designated use (i.e., not exceed state water quality standards). A water body is deemed to be impaired if it does not meet the applicable criteria for a particular pollutant; consequently, TMDLs are required to be established for these waters to reduce the concentrations of the exceeding parameters in order to comply with state water quality standards. For the Coastal Region, there are 52 impaired stream reaches (total impaired length of 582 miles) and 2 impaired sounds (total impaired area of 8,960 acres).

Figure 3-9: Impaired Water Bodies with Completed TMDLs



Of the impaired reaches in the region (note that a reach may be impaired for more than one parameter):

- 63% are impaired for low dissolved oxygen
- 35% are impaired for Fecal Coliform
- 12% are impaired for Enterococci
- 13% are impaired for trophic-weighted residual mercury in fish tissue

- 12% are impaired for Shell Fishing Ban
- 13% are impaired for Fish Consumption Guidance
- 4% are impaired for Mercury
- 2% are impaired for pH
- 2% are impaired for Cadmium
- 2% are impaired with a Commercial Fishing Ban

Both impaired sounds in the region are impaired for low dissolved oxygen. TMDLs have been completed for 36 impaired stream reaches and 2 impaired sounds as shown in Figure 3-9. A draft TMDL was completed by the EPA in April 2010 for the Savannah River Harbor. A Georgia and South Carolina stakeholder group was formed to develop a strategy for reducing pollutant loads to the Savannah River and harbor. The Coastal Council categorized these TMDL listed segments and more information on the listed segments can be found in the Coastal Georgia Gap Analysis Technical Memorandum (CDM, 2011).

4. FORECASTING FUTURE WATER RESOURCE NEEDS

Section 4. Forecasting Future Water Resource Needs

Water and wastewater demand forecasts, along with the Resource Assessments (Section 3), form the foundation for water planning in the Coastal Georgia Region and serve as the basis for the selection of water management practices (Sections 6 and 7). The tables and graphics in this section present the regional water and wastewater forecasts for 10-year intervals from 2010 through 2050 for four water use sectors: municipal, industrial, agriculture, and thermoelectric generation.

Summary

Over the next 40 years, the population of the region is projected to approximately double, increasing the demands for surface water and groundwater and increasing the quantity of wastewater generated.

Total water withdrawals by municipal, industrial, agricultural, and energy sectors are forecasted to increase by 16 percent (96 MGD) from 2010 to 2050.

Total wastewater flows are projected to increase by 11 percent (63 MGD) over the same period.

During the regional planning process, the majority of Council members identified the following objectives for the forecast process:

- Ensure accurate data and
- Ensure that data are not used to establish regional or local mandates.

Central to these objectives is the overarching goal to develop consistent and comparable sets of data. This means that select data sets (common year for data inputs and comprehensive coverage of the State) in many cases have broader coverage of the State, but may not be as precise as local provider data. During development of the Regional Water Plan, there was a concerted effort to strike a balance between broad coverage and local data. This was accomplished by using consistent data collection on a regional basis modified as appropriate with local provider input. These data and resulting forecasts are not always applicable between regions or between providers within the region due to local/region specific differences.

The methodology to forecast water and wastewater demands is based primarily on the assumption that there will be a continuation of existing trends and practices. It does not make a determination regarding the efficiency or inefficiency of forecasted demands, only that they are expected to occur given current trends. Initial forecasting does not take into account management practices, including water conservation (other than passive conservation as described in more detail below) that may be adopted by Regional Water Planning Councils to reduce the expected magnitude of demand (see Sections 6-8 for additional details on water conservation and other management practices). Additionally, this forecasting effort does not change EPD requirements related to individual permitting decisions, but represents a forecast for regional water planning that will help guide permitting and funding decisions.

4.1. Municipal Forecasts

Municipal water includes water supplied to residences, commercial businesses, and small industries (water use by higher water using industries are forecasted separately and those major industrial sectors are identified in Section 4.2.) Residential water uses include water for normal household purposes: cooking, bathing, and clothes washing, among others. Commercial water uses include water used by hotels, restaurants, retail stores, and office buildings, among others. Municipal water demands may be served by public water systems, private water systems, or self-supplied by the user (such as individual wells.)

Population Projections

Municipal water and wastewater forecasts are closely tied to the population projections for the counties within the Coastal Region. The population projections were developed by the Georgia Governor's Office of Planning and Budget, which is charged in State law (O.C.G.A. 45-12-171) with the responsibility for preparing, maintaining, and furnishing official demographic data for the State. The population projection results by county are shown in Table 4-1.

Table 4-1: Population Projections by County

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

[1]Source: Georgia 2030 Population Projections, Georgia Governor's Office of Planning and Budget, 2010.
[2]Data based on the 2010-2030 projections used for State Water Planning purposes and extrapolated to 2040 and 2050.

Municipal Water Forecasts

The municipal water forecasts were calculated by multiplying a per capita water use rate by the population served. Per capita water use rates are different for public water systems in comparison to self-supplied water use; therefore, demands are calculated separately and then summed together. At Council Meeting 5 (April 6,

2010), the Coastal Council decided to utilize a uniform publicly-supplied water use of 138 gpcd for all counties in the region. The self-supply per capita demand is estimated at 100 gpcd. The publicly-supplied per capita water demand is generally higher than self-supplied due to several factors including commercial and transient/tourism water use that is provided by public water suppliers.

The forecasted water use rates for the Coastal Georgia Region were further adjusted based on two plumbing code changes which mandate new water saving lavatory fixtures. The National Energy Policy Act of 1992 reduced the maximum toilet flush volume from 3.5 to 1.6 gallons per flush for all toilets available in the U.S. starting in 1994. The Georgia Water Stewardship Act of 2010 reduces the maximum flush volume to 1.28 gallons per flush for all new toilets installed in Georgia after July 1, 2012. As new homes are constructed and less efficient toilets are replaced within existing housing stock, the water use rate is reduced over time. Additional information on plumbing code efficiency adjustments and rationale for per capita water use is available in the Coastal Georgia Water and Wastewater Forecasting Technical Memorandum (CDM, 2011). Table 4-2 summarizes the estimated water savings from both acts. On a regional basis, municipal water demands are expected to be about 7% lower as a result of water demand reduction (11 MGD in 2050) that can be attributed to passive conservation.

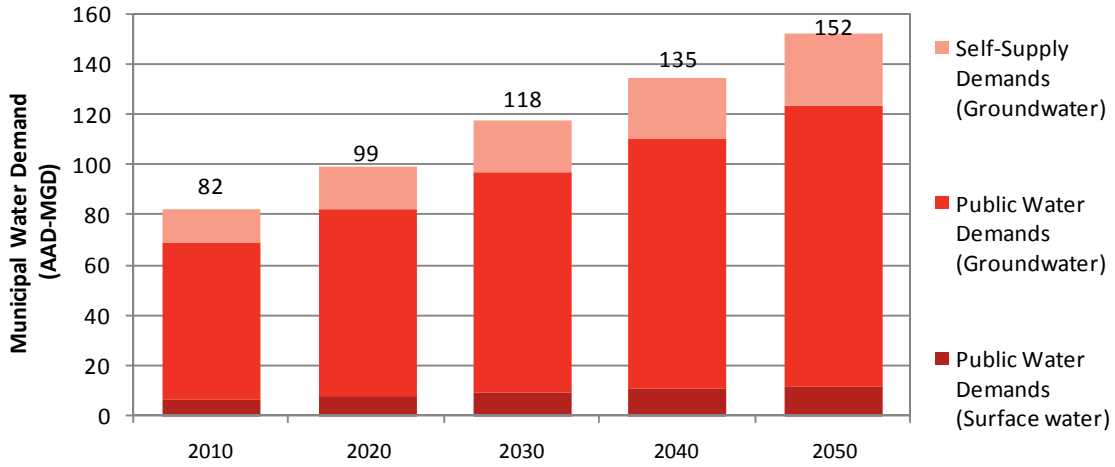
Table 4-2: Estimated Municipal Water Demand Reductions from Lower Flush Volume Toilets (AAD - MGD)[1]

Category	2010	2020	2030	2040	2050
Passive Conservation Reduction from 1992 National Energy Policy Act	0.0	1.2	2.7	4.3	5.9
Additional Passive Conservation Reduction from 2010 Water Stewardship Act	0.0	0.4	1.4	2.9	5.0
Total Passive Conservation Savings	**0.0**	**1.7**	**4.1**	**7.1**	**10.9**

Source: Coastal Georgia Water and Wastewater Forecasting Technical Memorandum; CDM, 2011.
[1]These estimates are based upon reduced flush volume toilets, but do not include the 2010 Water Stewardship Act provisions for more efficient showers, urinals, and faucets in newly constructed or renovated homes.
[2] The individual conservation reduction components do not sum up to the Total Passive Conservation Savings for 2020 and 2040 due to rounding.

Total regional municipal water demands are shown in Figure 4-1 for the Coastal Georgia Region. In addition, this figure shows the distribution in demands resulting from public water systems (by source) and self-supply systems. In the Coastal Georgia Region, public water demands and self-supply demands are satisfied by utilizing groundwater as the main source for withdrawals. To a lesser extent, surface water is also utilized to meet public water demands.

Figure 4-1: Total Municipal Water Use Forecast (in AAD-MGD)



Source: Coastal Georgia Water and Wastewater Forecasting Technical Memorandum; CDM, 2011.

Municipal Wastewater Forecasts

Municipal wastewater forecasts are based on estimates of indoor municipal (public and self supplied) water use. Indoor water use may be treated by centralized treatment plants or onsite sanitary sewage (septic) systems. Centralized treatment plants may discharge to a water body or to a land application system (LAS).

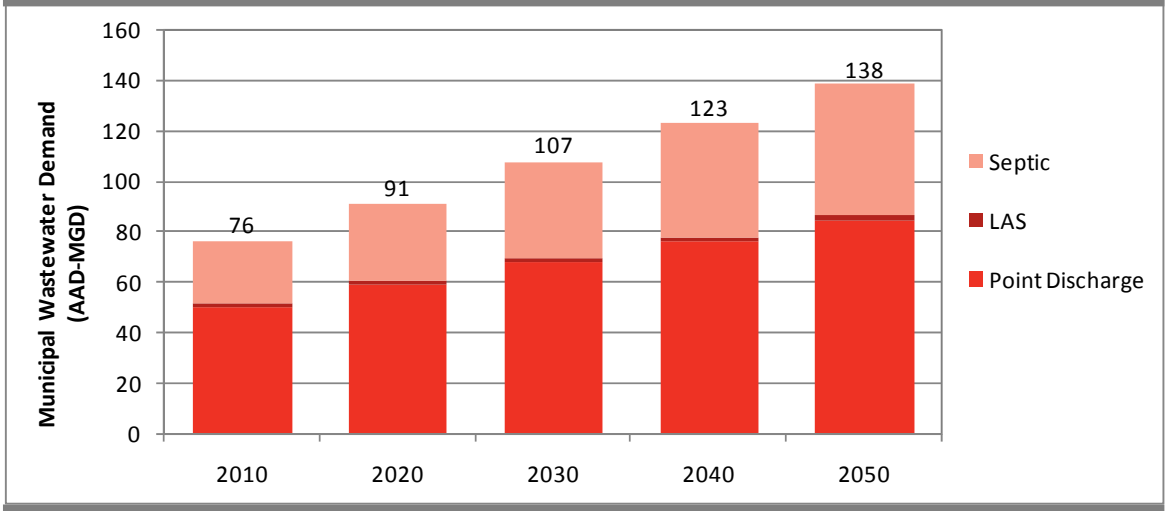
Estimates of wastewater generated from publicly-supplied and self-supplied water use (from the passive conservation scenario above) were calculated and then assigned to septic and centralized wastewater flows. U.S. Census data on the percent of households with septic systems were obtained by county. For planning purposes, it was estimated that all of the wastewater generated from self-supplied water use was disposed of via septic system. Dividing the number of municipally supplied households on septic by the U.S. Census estimate of the number of households by county provided an estimate of the percent of municipally supplied households that discharged to septic systems in 2005.

Estimates of flows treated at centralized wastewater treatment plants are derived from the portion of non-septic wastewater flow. In addition, a percent of flow is added to account for infiltration and inflow (I/I) that occurs in the wastewater collection system before reaching the treatment facility. I/I is a term used to describe groundwater and stormwater that enters into the dedicated wastewater system.

Finally, wastewater effluent flow from centralized treatment facilities is either discharged as a point source to a receiving water body or to a land application system. Information obtained from existing EPD permit data as well as feedback from municipal suppliers was used to determine the ratio of point discharge to land

application systems for each county. Municipal wastewater forecasts are shown in Figure 4-2.

Figure 4-2: Total Municipal Wastewater Generation Forecast (in AAD-MGD)



Source: Coastal Georgia Water and Wastewater Forecasting Technical Memorandum; CDM, 2011.

4.2. Industrial Forecasts

Industrial forecasts show the future need from the major water using industries including: food, paper, chemical, petroleum, stone and clay, and primary metals. Industries require water for processes, sanitation, cooling, and other purposes, in addition to domestic (employee) water use. Some industries, such as poultry processors, operate under strict U.S. Department of Agriculture guidelines that require water use to maintain sanitary conditions within the facilities. Water need (i.e., the total water requirements of an industry, or the water withdrawals) is based on either production or employment, depending on the available information.

Employment Projections

The employment projections provided information on the anticipated employment growth rate for each industrial sector. The University of Georgia produced the industry-specific rates of growth for employment for EPD, which were then used to calculate the future water needs for specific industries within the Coastal Georgia Region. General employment in industries such as textile, petroleum, rubber, stone and clay, fabricated metal products, and auto manufacturing sectors shows an upward trend throughout the 40 year planning period, while employment projections in the food, chemicals, primary metals, and electrical equipment sectors decreased. In situations where there was a decrease in employment for major water using industries, the water use forecast was held constant over the planning horizon.

Industrial Water Forecasts

Industrial water use was calculated based on available information including water need per unit of production, units of production per employee, and water need by employee. For industries where information was available on water use per unit of production, water forecasts were based on production. For industries where product based forecasting was not possible, industry-specific workforce projections were used to project the rate of future growth in water use within the industry. Industry employment data are readily available, and employment is linked to production, and thus indirectly linked to water requirements. By assuming that water use per production unit, and production per employee remain the same over the forecast period, future water needs can be estimated by future employment. Table 4-3 shows the baseline and alternate industrial water demands over the planning period.

Table 4-3: Baseline and Alternate Industrial Water Demands (in AAD-MGD)

Category	2010	2020	2030	2040	2050
Baseline Industrial	161.0	161.1	161.3	161.4	161.6
Alternate Industrial	162.0	170.0	182.9	190. 6	196.6

Source: Coastal Georgia Water and Wastewater Forecasting Technical Memorandum; CDM, 2011.

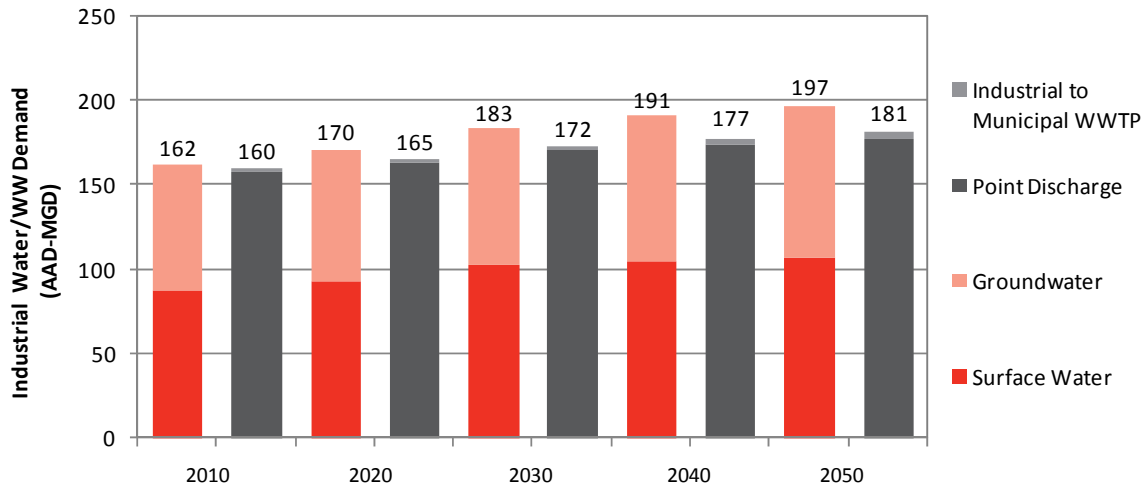
The existing major water using industries historically operating in the Coastal Georgia Region are projected to have limited employment growth with current operations over the 2010-2050 planning horizon. The Coastal Council believes that these past trends may not accurately reflect future trends in industrial growth and requested the development of an alternate industrial forecast that would reflect potentially higher industrial growth. The key reasons for potentially higher industrial growth are: proximity to major surface transportation network(s); the current access to, use of, and potential expansion of the Brunswick and Savannah Harbors; innovation and technological advancements in process manufacturing, and the projected relatively high rate of population growth associated with the region. In addition, it was noted that employment may not be the best metric for determining water use needs; this is especially true for industries that may have increased automation and expanding water use.

The results of the State-wide approach to industrial forecasting were presented at Council Meeting 5 on April 6, 2010. The Coastal Council agreed to gather information about potential new industry from their local county's economic development authorities and also asked for the Coastal Regional Commission to identify existing and potential industrial sites within the region as well as potential new industry types and future water needs.

Discussions with the Coastal Regional Commission revealed that the locations of existing and near-term industrial sites are well established, but predicting the type of industry that may locate there as well as that future industry's water demand are more elusive. However, the Coastal Regional Commission foresees future industry

growth in the region occurring in four main categories: energy, aerospace, general manufacturing, and warehouse distribution. Energy water use was forecast separately from industry, but was included in the overall water demand for the region. The Coastal Council recommended (alternate) industrial water and wastewater forecast is shown in Figure 4-3. Additional information on industrial water and wastewater forecasts are provided in the Coastal Georgia Water and Wastewater Forecasting Technical Memorandum (CDM, 2011).

Figure 4-3: Total Industrial Water and Wastewater Forecast (in AAD-MGD)



Source: Coastal Georgia Water and Wastewater Forecasting Technical Memorandum; CDM, 2011.

Industrial Wastewater Forecasts

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

Once the industrial wastewater flows were estimated, the flows were separated between point discharges and land application. The industrial wastewater forecasts are presented in Figure 4-3 by the anticipated disposal system type: industrial wastewater treatment (point discharge), land application system, or discharge to the

municipal wastewater treatment. These are based upon the industrial water forecasts presented in Table 4-3.

4.3. Agricultural Forecasts

The agricultural water use forecasts include irrigation demands for both crop and non-crop (including livestock, nurseries, and golf courses) uses. The crop forecasts, developed by the University of Georgia for 2011 through 2050, provide a range of irrigation water use from dry to wet climate conditions based on the acres irrigated for each crop. Table 4-4 lists a drier-than-normal year crop irrigation forecast for each county.

The University of Georgia also compiled non-crop (including non-permitted) agricultural water demand with the assistance of industry associations. Similar to crop irrigation, forecasts for nursery and greenhouse water use were also developed for a range of climate conditions over the planning period. For planning purposes, the drier-than-normal nurseries/greenhouse forecasts are presented in Table 4-4. For golf courses and livestock production, current (2011) water forecasts were developed, but future forecasts were not developed for this first round of regional water planning due to lack of available data. Current water demands were held constant throughout the planning period for these water use sectors. Full documentation of the methodology and results of the agricultural forecasts developed by the University of Georgia are available at:
www.nespal.org/sirp/waterinfo/State/awd/agwaterdemand.htm.

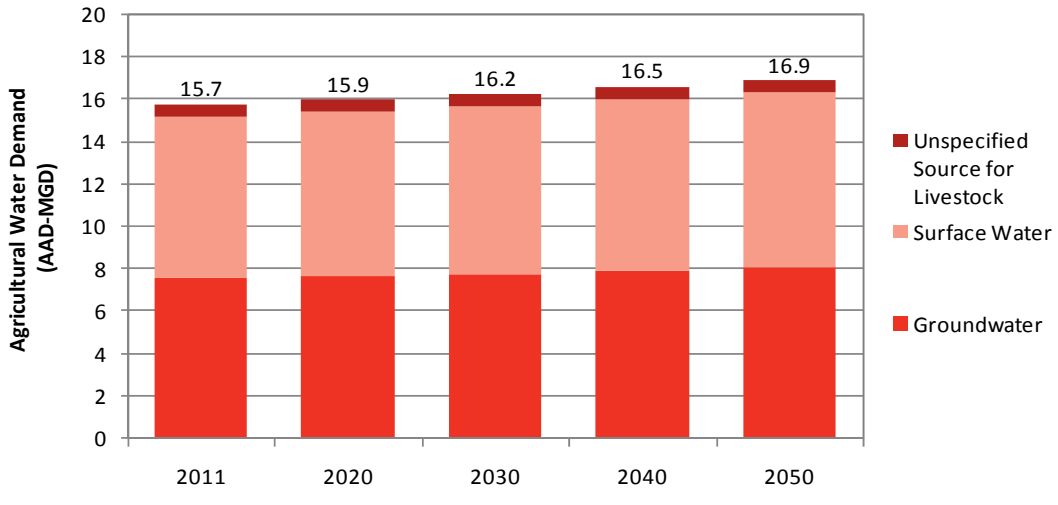
Figure 4-4 shows the regional agricultural demands by source of supply. The Coastal Georgia Region as a whole is expected to see a 7% increase in agricultural water demand by 2050. Bulloch County has the highest agricultural water forecast in the region with average daily demand above 11 MGD in 2011 with an 8% increase by 2050. All other counties have forecasted demand less than 1.2 MGD. As shown in Figure 4-4, about half of the agricultural withdrawals are supplied by groundwater and the remainder by surface water.

Table 4-4: Agricultural Water Forecast by County (in AAD-MGD)[1-3]

County	2011		2020		2030		2040		2050	
	Crop	Non-Crop	Crop	Non-Crop	Crop	Non-Crop	Crop	Non-Crop	Crop	Non-Crop
Bryan	0.06	0.04	0.07	0.04	0.07	0.04	0.07	0.04	0.07	0.04
Bulloch	10.87	0.92	11.02	0.93	11.24	0.94	11.48	0.95	11.75	0.97
Camden	0.00	0.80	0.00	0.80	0.00	0.80	0.00	0.80	0.00	0.80
Chatham	0.00	0.59	0.00	0.60	0.00	0.61	0.00	0.62	0.00	0.63
Effingham	0.97	0.16	0.98	0.16	0.99	0.16	1.00	0.17	1.02	0.17
Glynn	0.00	0.35	0.00	0.35	0.00	0.35	0.00	0.35	0.00	0.35
Liberty	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Long	0.56	0.05	0.58	0.05	0.61	0.05	0.64	0.05	0.67	0.05
McIntosh	0.00	0.34	0.00	0.34	0.00	0.34	0.00	0.34	0.00	0.34
Sub-Total	**12.5**	**3.3**	**12.7**	**3.3**	**12.9**	**3.3**	**13.2**	**3.3**	**13.5**	**3.4**
Total	**15.7**		**15.9**		**16.2**		**16.5**		**16.9**	

[1]Source: University of Georgia, 2010.
[2]Crop demands represent dry year conditions, in which 75% of years had more rainfall and 25% of years had less based on rainfall records from 1950 to 2007. Non-crop demands consist of livestock, nurseries, and golf course uses.
[3]Agricultural withdrawals (crop and non-crop) are supplied by groundwater and surface water.

Figure 4-4: Total Agricultural Water Forecast (in AAD-MGD)



Source: Coastal Georgia Water and Wastewater Forecasting Technical Memorandum; CDM, 2011.
Livestock demands do not have information on source of supply and are not included in forecasts that are reported by source of supply.

4.4. Water for Thermoelectric Power Forecasts

Thermoelectric water withdrawal and consumption demands were developed for the State of Georgia based on forecasted power generation needs and assumptions regarding future energy generation processes. Full details of the state-wide energy sector water demand forecast can be accessed on the EPD website at: www.georgiawaterplanning.org/pages/forecasting/energy_water_use.php.

Thermoelectric water demands for the Coastal Georgia Region are shown in Tables 4-5 and 4-6. The first two rows of both tables show the regional forecast of water demand for existing facilities and facilities planned to become operational by 2020. Beyond 2020, the location of generating facilities that may be built is not known. Therefore, water demands beyond 2020 associated with this unplanned power capacity need were developed on a state-wide basis and not disaggregated regionally. The state-wide forecasts show that in 2030, an additional 58 MGD of water consumption (106 MGD of withdrawal) is needed to meet projected state-wide energy production requirements, with 170 MGD of consumption (313 MGD of withdrawal) needed state-wide in 2050.

The Coastal Council acknowledges that some portion of the future additional generating capacity may be constructed in the Coastal Georgia Region in future years. For the purposes of water planning, the Coastal Council evaluated two water demand scenarios shown in Tables 4-5 and 4-6 for 2030-2050, with the acknowledgement that actual demand may vary considerably. The first scenario (Table 4-5) is based upon the 2020 percentage of power production regionally in relationship to the State's total power production by "water-using" power generation processes. This percent production approach results in 3.8% of the state-wide consumptive use being projected to occur in the Coastal Georgia Region from 2030 through 2050. The second scenario (Table 4-6) is based upon the ratio of the region's forecasted state-wide population growth from 2020 to 2050. This population growth approach results in 6.5% of the state-wide consumptive use being projected to occur in the Coastal Georgia Region from 2030 through 2050.

Table 4-5: Regional Thermoelectric Water Forecasts by Regional Percent Production (in AAD-MGD)

Category	2010	2020	2030[1]	2040[1]	2050[1]
Existing and Planned Facilities' Withdrawals	340.6	310.9	310.6	310.6	310.6
Existing and Planned Facilities' Consumption	2.5	1.8	1.6	1.6	1.6
Regional Portion of Unassigned Withdrawals	-	-	4.0	7.8	11.7
Regional Portion of Unassigned Consumption	-	-	2.2	4.3	6.4
Total Regional Withdrawals	**340.6**	**310.9**	**314.6**	**318.4**	**322.3**
Total Regional Consumption	**2.5**	**1.8**	**3.7**	**5.8**	**7.9**

Source: State-wide Energy Sector Water Demand Forecast Technical Memorandum, CDM, 2010.
[1]Water Demand Forecasts from 2030 to 2050 were decided by the Council based on the state-wide forecast of unassigned thermoelectric power water demands.

Table 4-6: Regional Thermoelectric Water Forecasts by Regional Population Growth (in AAD-MGD)					
Category	**2010**	**2020**	**2030[1]**	**2040[1]**	**2050[1]**
Existing and Planned Facilities' Withdrawals	340.6	310.9	310.6	310.6	310.6
Existing and Planned Facilities' Consumption	2.5	1.8	1.6	1.6	1.6
Regional Portion of Unassigned Withdrawals	-	-	6.9	13.7	20.4
Regional Portion of Unassigned Consumption	-	-	3.8	7.4	11.1
Total Regional Withdrawals	**340.6**	**310.9**	**317.5**	**324.3**	**331.0**
Total Regional Consumption	**2.5**	**1.8**	**5.4**	**9.0**	**12.7**

Source: State-wide Energy Sector Water Demand Forecast Technical Memorandum, CDM, 2010.
[1]Water Demand Forecasts from 2030 to 2050 were decided by the Council based on the state-wide forecast of unassigned thermoelectric power water demands.

4.5. Total Water Demand Forecasts

Total water demand forecasts for the Coastal Georgia Region are summarized in Figure 4-5. This figure presents the forecasts for municipal, industrial (alternate forecast), agricultural, and thermoelectric power. Overall, the region is expected to grow by 16% (96 MGD) in water demand from 2010 through 2050.

Total wastewater and return flow forecasts for the Coastal Georgia Region are summarized in Figure 4-6. This figure presents the forecasts for municipal, industrial, and thermoelectric power discharges. Overall, the region is expected to grow by 11% (63 MGD) in wastewater flows from 2010 through 2050.

Figure 4-5: Water Demand in 2010[1] and 2050[1, 2]

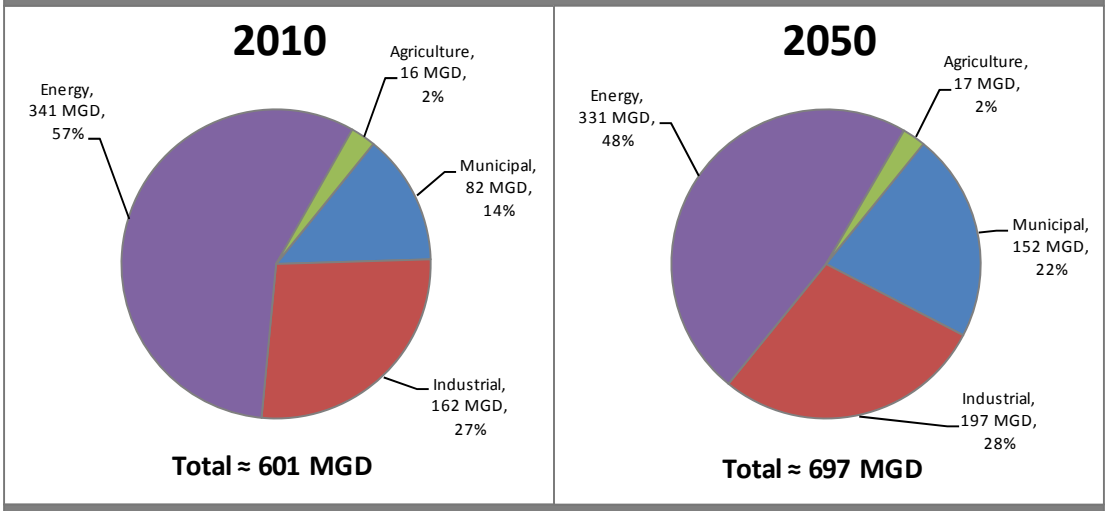
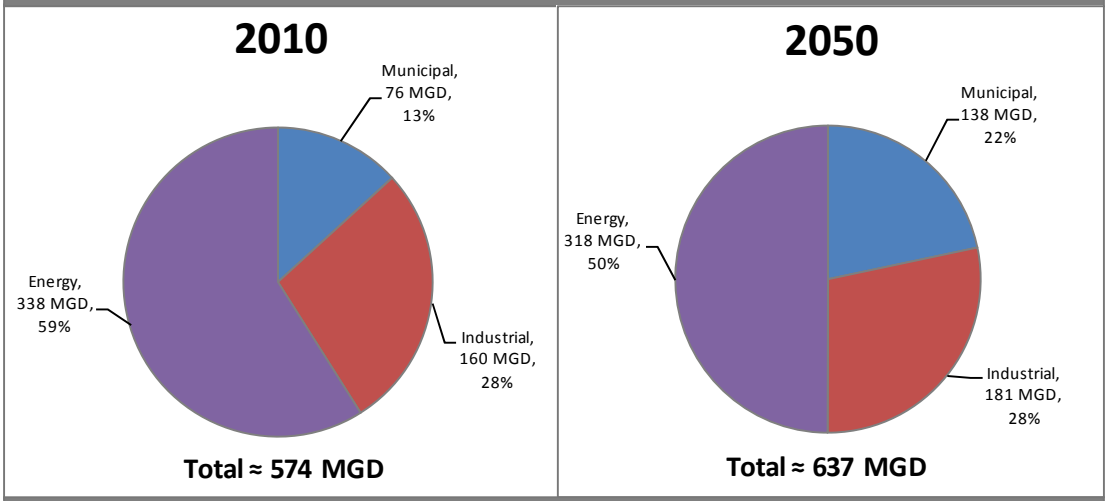


Figure 4-6: Wastewater/Return Flow in 2010[1] and 2050[1, 2]



Source: Coastal Georgia Water and Wastewater Forecasting Technical Memorandum; CDM, 2011.

[1] Energy totals shown represent total thermoelectric withdrawal based on the regional population growth approach; For 2010, 2.5 MGD of the total 341 MGD (0.7%) is consumptive, the remainder is discharged back to surface waters as return flow. For 2050, 12.7 MGD of the total 331 MGD (3.8%) is consumptive, the remainder is discharged back to surface waters as return flow.

[2] The portion of thermoelectric withdrawal (20.4 MGD) and return flow (9.3 MGD) associated with future unplanned generating capacity is not assigned to specific resources; and therefore, is not included in resource assessments.

5. COMPARISON OF AVAILABLE RESOURCE CAPACITY AND FUTURE NEEDS

Section 5. Comparison of Available Resource Capacity and Future Needs

This Section compares the water and wastewater demand forecasts (Section 4), along with the Resource Assessments (Section 3), providing the basis for selecting water management practices (Sections 6 and 7). Areas where future demands exceed the capacity of the resource have a gap that will be addressed through water management practices. This Section summarizes the gaps and water supply needs for the Coastal Georgia Region.

Summary

Regionally, for the modeled potions of the priority aquifers, there is sufficient groundwater to meet forecasted needs over the next 40 years; however, meeting the increase in demands in areas where groundwater supplies may be limited is a significant challenge.

Forecasted surface water demands within and outside the region, will at times, exceed the available resource at some locations in the region (Canoochee and Ogeechee Rivers).

The outcomes from the Bi-state Stakeholder process regarding saltwater intrusion will need to be considered in determining groundwater use in some portions of the region.

Water quality conditions indicate the potential need for improved wastewater treatment within the Ogeechee and Altamaha river basins. A separate TMDL stakeholder process for the Savannah Harbor is ongoing.

Non-point sources of pollution and existing water quality impairments will likely influence how future needs are met.

5.1. Groundwater Availability Comparisons

Groundwater from the Upper Floridan Aquifer is a vital resource for the Coastal Georgia Region. Overall, the results from the Groundwater Availability Resource Assessment (EPD, March 2010) indicate that the sustainable yield for the modeled portions (Bulloch, Long, and southwestern portion of McIntosh Counties) of the priority regional aquifer(s) is greater than the forecasted demands. However, significant localized issues exist as described below.

As shown in Figure 3-8, all of Chatham County, the southern portion of Effingham County, and a small portion of Glynn County near Brunswick ("T" shaped plume) are located in a Red Zone and are subject to groundwater withdrawal restrictions per the Coastal Georgia Water and Wastewater Permitting Plan for Managing Salt Water Intrusion (Coastal Permitting Plan; EPD, 2006). Future water supply needs in these areas will need to come from sources other than new permits or increases to existing groundwater permits from the Upper Floridan Aquifer. Furthermore, Bryan and Liberty Counties are located in a Yellow Zone where there is also uncertainty regarding how much additional withdrawal of groundwater from the Upper Floridan Aquifer may occur in the future. This decision and potential solutions regarding salt water intrusion are also part of ongoing bi-state discussions between Georgia and South Carolina.

With these issues in mind, the Upper Floridan Aquifer groundwater resource gap due to salt water intrusion concerns can be characterized into several possible scenarios as depicted in Figure 5-1. A worst case scenario may be that the Upper Floridan will not be available to meet current demand as well as future increases in demand in Chatham, Bryan, Liberty Counties and the Red Zone portion of Effingham County. This scenario results in a 99 MGD shortfall between supply and demand; consisting of 70 MGD of 2010 forecasted demand with 29 MGD additional demand by 2050. Another scenario considered is that 2010 pumping rates will be maintained, but no additional withdrawals will be allowed resulting in a 29 MGD shortfall. The final scenario considered is that no additional withdrawals will be allowed in the Red Zone, but half of the additional forecast demand in the Yellow Zone may be allowed by 2050. This scenario results in a 21 MGD shortfall. It should be noted that the above scenarios assume that current and future self supplied groundwater will continue to be met by groundwater.

There are currently no anticipated regional groundwater resource gaps expected over the 40 year planning horizon in Bulloch, Camden, Long, and southwestern McIntosh Counties. However, localized gaps could occur if well densities and/or withdrawal rates result in exceedance of sustainable yield metrics. Sustainable yield data were not developed for Glynn, Camden, and the remaining portion of McIntosh Counties. In addition, all counties within the planning area except Glynn County may need additional permitted capacity if future demand for groundwater exceeds permitted groundwater withdrawal limits. The comparison of existing groundwater permitted capacity to forecasted future demand in Coastal Georgia is shown in Table 5-1. Please note that sufficient capacity at the county level does not preclude localized municipal permit capacity shortages. Local water providers in counties with large demand forecasts should review their permitting needs.

Table 5-1: 2050 Forecast versus Groundwater Permitted Capacity

County	Municipal			Industrial		
	2050 Publicly-Supplied Demand Forecast (AAD – MGD)	Existing Municipal Groundwater Permitted Yearly Average (MGD)	Municipal Permitted Capacity Need in 2050 (MGD)	2050 Industrial Demand Forecast (AAD – MGD)	Existing Industrial Groundwater Permitted Yearly Average (MGD)	Industrial Permitted Capacity Need in 2050 (MGD)
Bryan	7.4	4.5	2.9	1.8	0.0	1.8
Bulloch	15.4	6.6	8.8	2.2	0.5	1.7
Camden	13.4	12.9	0.5	1.7	1.7	None
Chatham	37.0	35.1	1.9	21.4	21.6	None
Effingham	6.1	3.8	2.3	2.0	1.7	0.28
Glynn	16.4	22.6	None	46.8	59.0	None
Liberty	13.4	11.6	1.8	13.5	12.5	1.0
Long	1.0	0.6	0.4	0.0	0.0	None
McIntosh	1.9	1.5	0.4	0.3	0.2	0.1

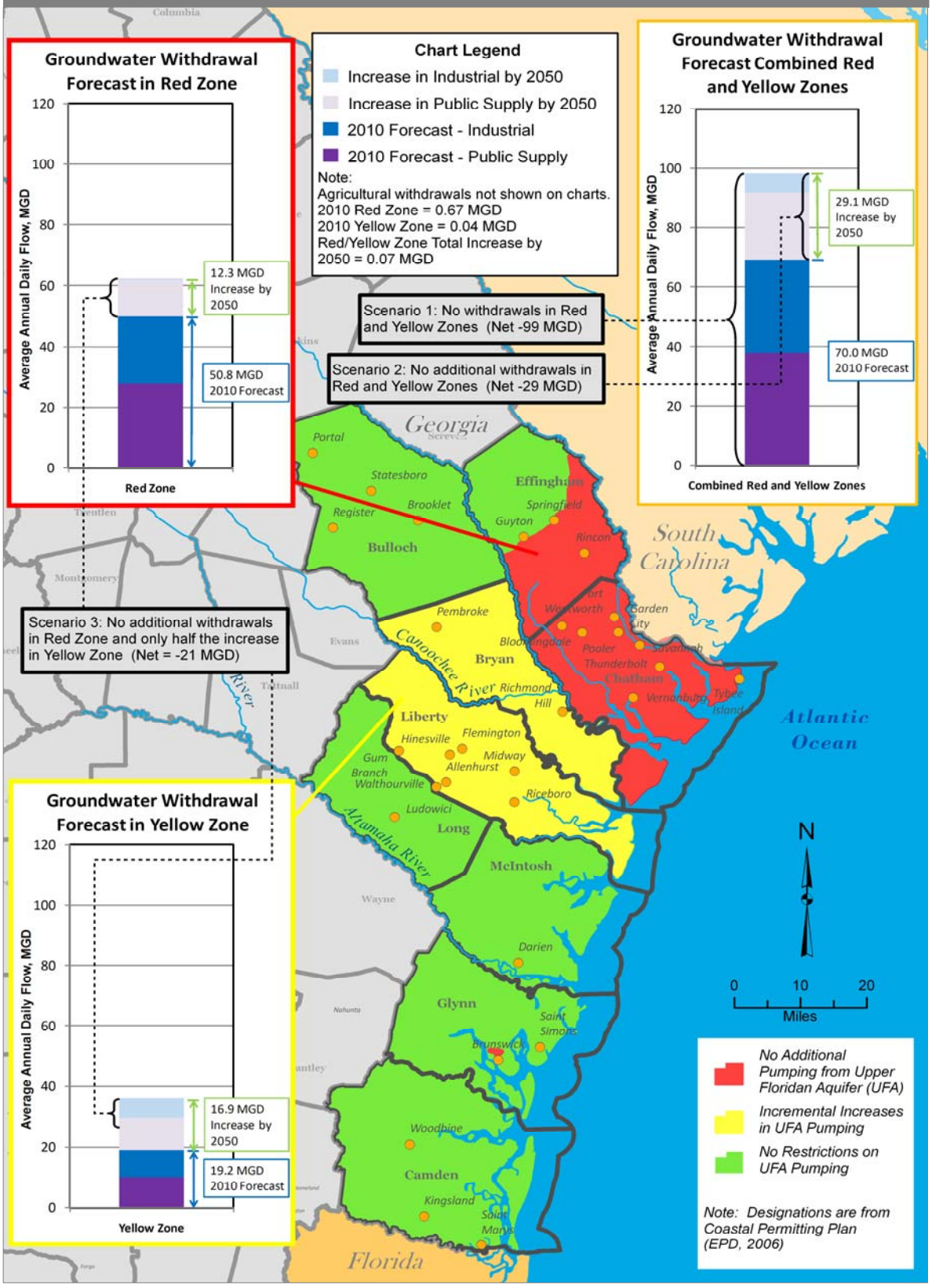
Source: Coastal Georgia Gap Analysis Technical Memorandum; CDM, 2011.

5.2. Surface Water Availability Comparisons

The Surface Water Availability Resource Assessment (EPD, March 2010) includes results from modeling projected surface water demands in 2050. This assessment shows surface water gaps (i.e., there are times when there is insufficient water to meet off-stream demands and also meet the targets for support of instream uses) at the following planning nodes: Claxton (Canoochee River), Eden (Ogeechee River), and Kings Ferry (Ogeechee River). When assessing this issue, the Coastal Council recognized that surface water gaps are driven by both net consumption (withdrawal minus returns) and year to year variations in river flows. In wet years, the region is likely to not experience any shortfalls to off-stream uses and instream needs. In dry years, the shortfalls are likely to be more severe. In order to better assess these shortfalls and to better understand the types of management practices that may be required, a more detailed quantification of the frequency and severity of shortage was completed.

First, a quantification of the largest flow shortfall was completed. This quantification estimated the average flow of water that would be needed to increase stream flows to their minimum target levels, and it quantified the number of days that the flow would be needed. The flow needed and the number of days that it is needed results in an estimate of the total volume of water that would be needed to address the largest flow shortfall.

Figure 5-1: 2050 Groundwater Use Projections and Gap Scenarios



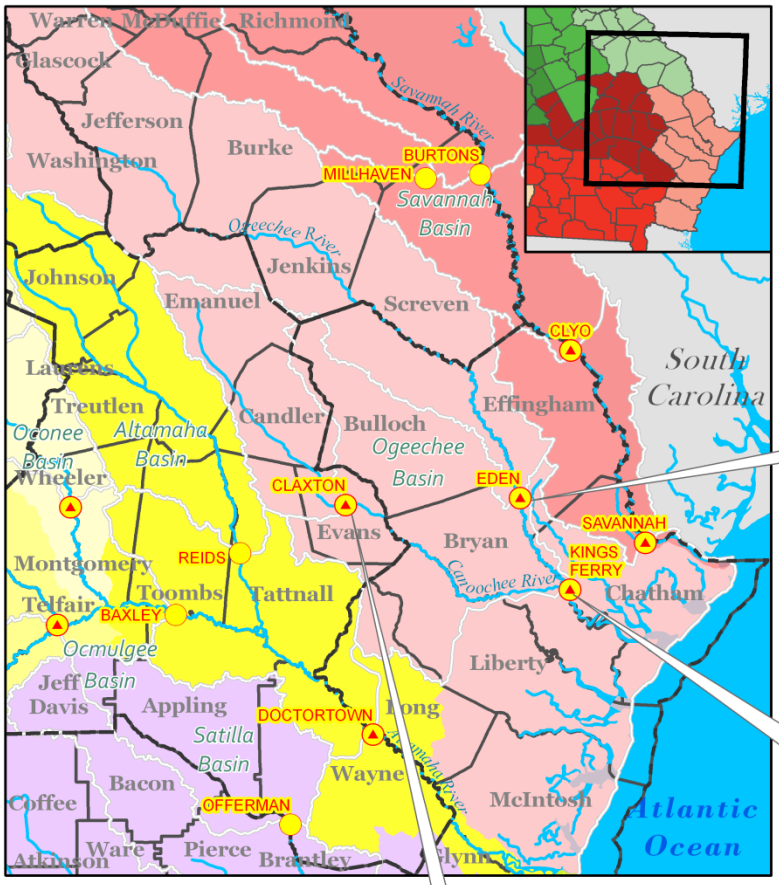
Using the same approach outlined above, quantification of shortfalls was completed for the average flow needed to address 90% of the shortages and 50% of the shortages. It is important to note that in some cases, the largest flow shortage did not always correspond to the largest volume shortage because some shortfalls are lower in flow rate, but longer in duration.

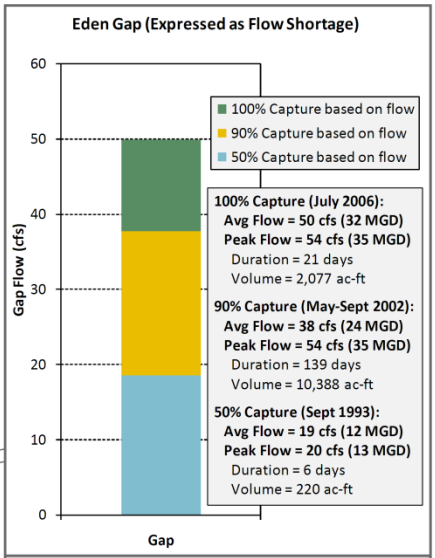
The quantification of shortfalls is especially relevant when selecting water management practices. For example, if the preferred management practice is to replace surface water diversions with groundwater withdrawals, it is important to know how much flow needs to be generated and for what length of time. This process will in turn dictate the number and size of wells needed to generate the flow. If a reservoir is the preferred practice then one needs to know the largest volume of storage needed because stream flow needs can then be addressed by controlling the rate of flow released from the reservoir. In addition, since the largest shortages occur less frequently there are important cost-benefit considerations associated with addressing the largest and more infrequent shortfalls.

The geographic location of the modeled regional surface water gaps are shown in Figure 5-2. The gaps are quantified in terms of flow. The flow values depicted in the charts represent the average additional flow at that node that would be needed to close the specified gap occurrence. These flows are presented on a percent capture basis. The term “capture” refers to the percent of all gap occurrences at a node that are less than or equal to this flow value. For example, the 50% capture value indicates the flow that would be needed to close half the gap occurrences at a particular node, and the 100% capture value indicates the flow that would be needed to close all gap occurrences at a particular node. In addition to flow, values are given for gap duration (number of days the flow is below 7Q10) and volume (total volumetric shortfall to 7Q10 expressed in acre-feet) at each node. The years and months listed in the figure are tied to the hydrologic data set used in the modeling. The specific years and months are the periods of time when the referenced gap occurred. For example, at the Claxton node the largest flow gap (100% capture) occurred between June and August 1952.

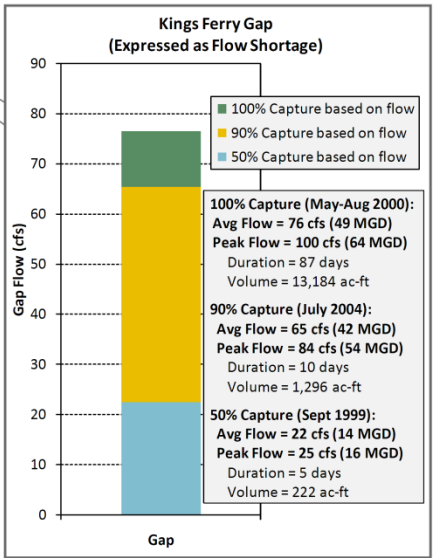
The projected surface water use increases for the counties within the Coastal Georgia Region are shown in Table 5-2. Only agricultural demands are presented because there are no forecasted municipal and industrial surface water demands within the Coastal Georgia Region at the Claxton, Eden, and Kings Ferry planning nodes. Since there are current gaps at the referenced planning nodes, development of additional surface water to meet projected needs will need to done in a manner that does not increase current gaps.

Figure 5-2: 2050 Surface Water Gap Summary

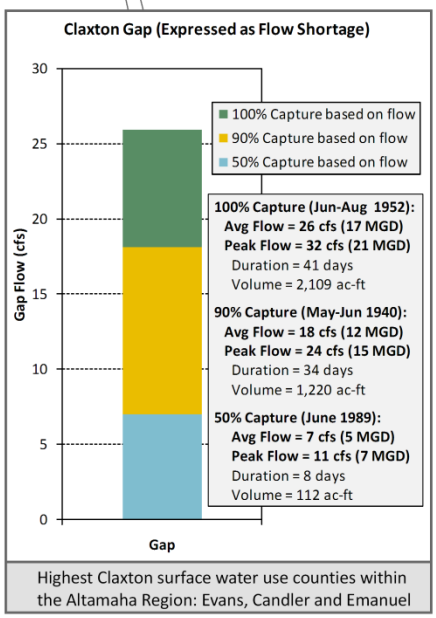




Highest Eden surface water use counties within the Coastal Region: Bulloch and Effingham



Highest Kings Ferry surface water use counties within the Coastal and Altamaha Regions: Bulloch, Evans, and Long



Highest Claxton surface water use counties within the Altamaha Region: Evans, Candler and Emanuel

Notes:
The term "Capture" as used in these charts refers to the percent of all gaps in the period of record at a node that are less than or equal to this average flow value. For example, the 50% Capture average flow indicates half of the gaps are smaller than this value and half of the gaps are larger than this value. Month and year denote the timeframe in which the gap occurs.
cfs = cubic feet per second
MGD = million gallons per day

Table 5-2: 2050 Surface Water Gap Forecast (in AAD-MGD)		
County	**Planning Node with Gap**	**Total County Increase in Agriculture Demand by 2050[1]**
Bryan	Eden and Kings Ferry	0.01
Bulloch	Eden and Kings Ferry	0.52
Effingham	Eden	0.01
Long	Kings Ferry	0.11

Source: Coastal Georgia Gap Analysis Technical Memorandum; CDM, 2011.
[1]A portion of this increased demand falls within the local drainage area of the planning node with gap.

5.3. Surface Water Quality Comparisons (Assimilative Capacity)

This section summarizes the results of Resource Assessment modeling when all municipal and industrial wastewater treatment facilities operate at permit conditions, and provides a comparison of existing wastewater permitted capacity to the projected 2050 wastewater forecast flows. A discussion on non-point source pollution is also included.

Future Treatment Capacity Needs

Existing municipal wastewater permitted capacities were compared to projected 2050 wastewater flows to estimate future treatment capacity needs by county. This analysis was done for both point sources and land application systems, both of which are permitted under the National Pollutant Discharge Elimination System (NPDES). As shown in Table 5-3, Bryan, Camden, Liberty and Long Counties may have infrastructure needs by 2050, although all but Long County were found to have planned projects to obtain sufficient treatment capacity underway through EPD's permitting process. It should be noted that the comparison in Table 5-3 was completed at the county level and localized shortages in treatment capacity may exist.

Assimilative Capacity Assessments

The Assimilative Capacity Assessment at permit conditions (EPD, March 2011) was developed to estimate the ability of streams, estuaries, and harbors to assimilate pollutants under future conditions. The modeling was focused on dissolved oxygen (DO) and based upon municipal and industrial wastewater facilities operating at their full permitted levels in terms of flow and effluent discharge limits. The results of the DO modeling are presented in Table 5-4 and in Figures 5-3a through 5-3c.

Table 5-3: 2050 Municipal Wastewater Forecast versus Existing Permitted Capacity (MGD)

County	Point Source (PS)			Land Application Systems (LAS)			Combined PS and LAS
	2050 Forecast[1]	Permitted Capacity	2050 Surplus or Gap (-)	2050 Forecast[1]	Permitted Capacity	2050 Surplus or Gap (-)	Planned Projects Increase in Capacity
Bryan	2.3	1.5	-0.8	0.0	0.3	0.3	2.5
Bulloch	6.6	10.0	3.4	0.0	0.0	0.0	-
Camden	12.7	10.0	-2.7	0.0	0.0	0.0	3.1
Chatham	42.1	43.8	1.7	1.0	3.3	2.3	0.5
Effingham	1.8	3.5	1.7	0.2	1.3	1.1	1.0
Glynn	11.0	18.6	7.6	0.2	0.2	0.1	2.0
Liberty	10.8	7.2	-3.6	0.6	0.7	0.1	4.0
Long	0.3	0.2	-0.1	0.0	0.0	0.0	-
McIntosh	0.4	0.6	0.2	0.0	0.0	0.0	-
Total	**88.1**	**95.5**	**7.4**	**2.0**	**5.8**	**3.8**	**11.1**

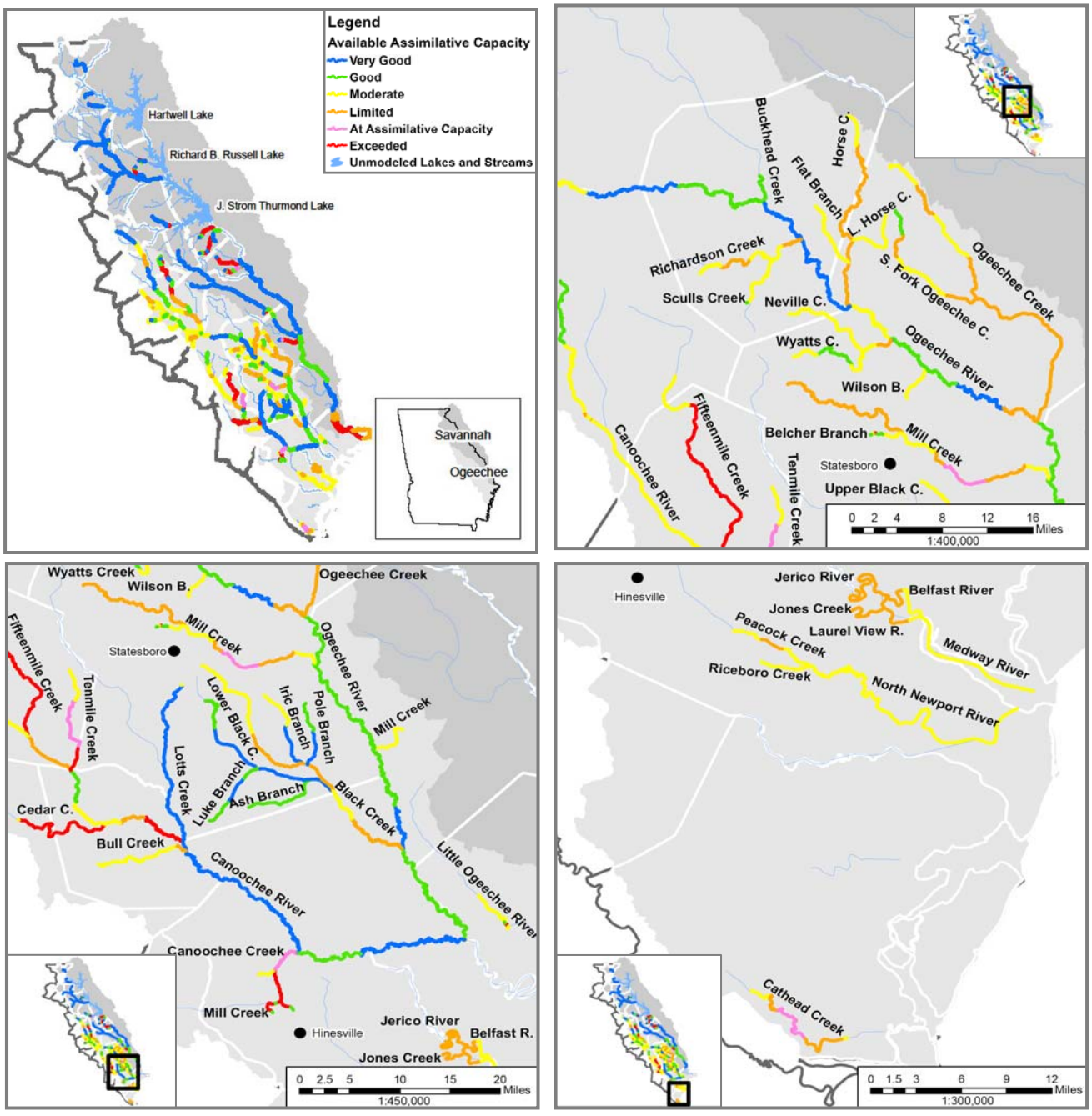
Source: Coastal Georgia Gap Analysis Technical Memorandum; CDM, 2011.
[1] Includes industrial wastewater expected to be treated at municipal facilities.

Table 5-4: Permitted Assimilative Capacity for DO in Coastal River Basins

Model Run	Basin	Available Assimilative Capacity (Mileage within Coastal Region boundaries)						Total Modeled River Basin (miles)[1]
		Very Good (≥1.0 mg/L)	Good (0.5 to <1.0 mg/L)	Moderate (0.2 to <0.5 mg/L)	Limited (>0.0 to <0.2 mg/L)	At Assimilative Capacity (0.0 mg/L)	None or Exceeded (<0.0 mg/L)	
Permitted	Savannah	26	22	0	0	0	0	550
	Ogeechee	100	92	111	70	14	11	935
	Altamaha	14	8	2	15	0	22	421
	Satilla	26	20	3	6	3	0	300
	St. Marys	0	0	12	23	0	21	76

Source: Email transmittal from EPD Watershed Protection Branch (December 2010).
[1]Total miles include tributaries and main stem of the rivers within and outside the Coastal Council boundary.

Figure 5-3a: Results of Assimilative Capacity Assessment – DO at Permitted Conditions (Savannah and Ogeechee River Basins)



Source: Additional Supporting Material for Permitted Water Quality Resource Assessment; EPD, October 2010.

Very Good: ≥ 1 mg/L of dissolved oxygen (DO) available (above the water quality standard of 5 mg/L)
Good: 0.5 mg/L to < 1.0 mg/L of DO available
Moderate: 0.2 mg/L to <0.5 mg/L of DO available
Limited: >0.0 mg/L to <0.2 mg/L of DO available
At assimilative capacity: 0.0 mg/L of DO available
None or Exceeded Capacity: <0.0 mg/L of DO available

Figure 5-3a (cont.): Results of Assimilative Capacity Assessment – DO at Permitted Conditions (Savannah and Ogeechee River Basins)

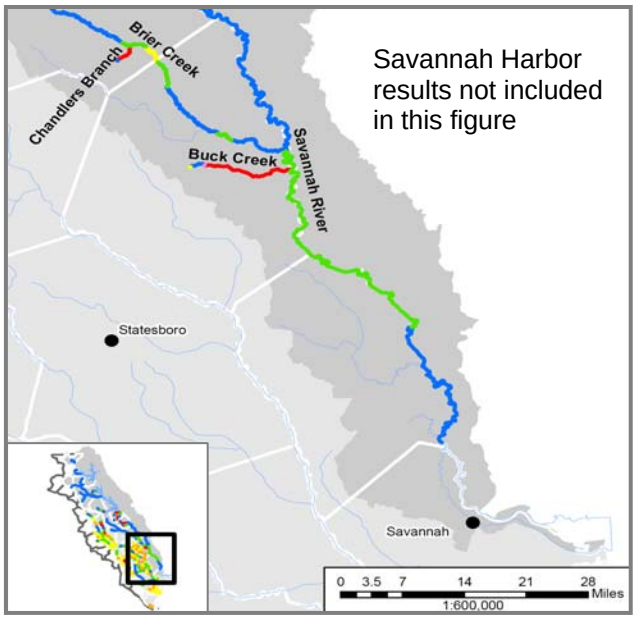
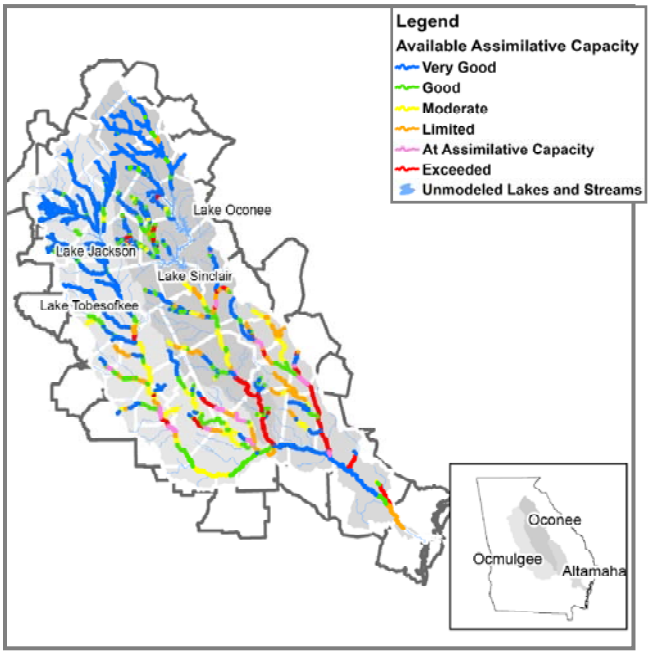
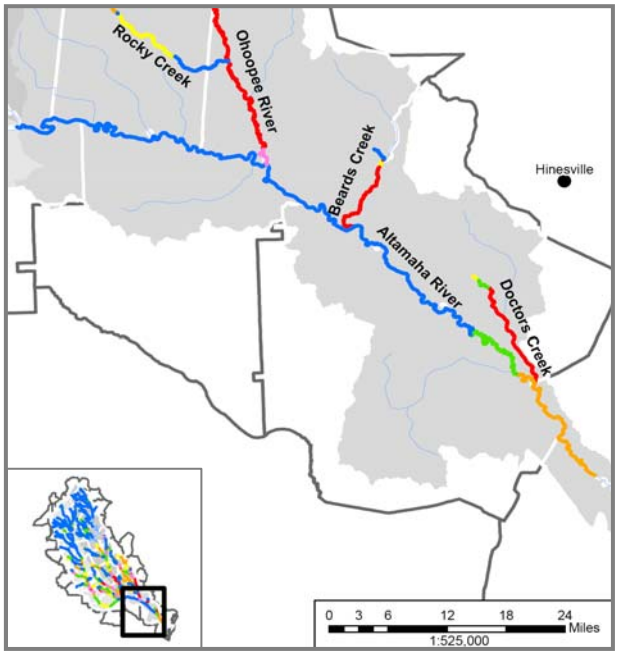


Figure 5-3b: Results of Assimilative Capacity Assessment – DO at Permitted Conditions (Oconee, Ocmulgee, and Altamaha River Basins)

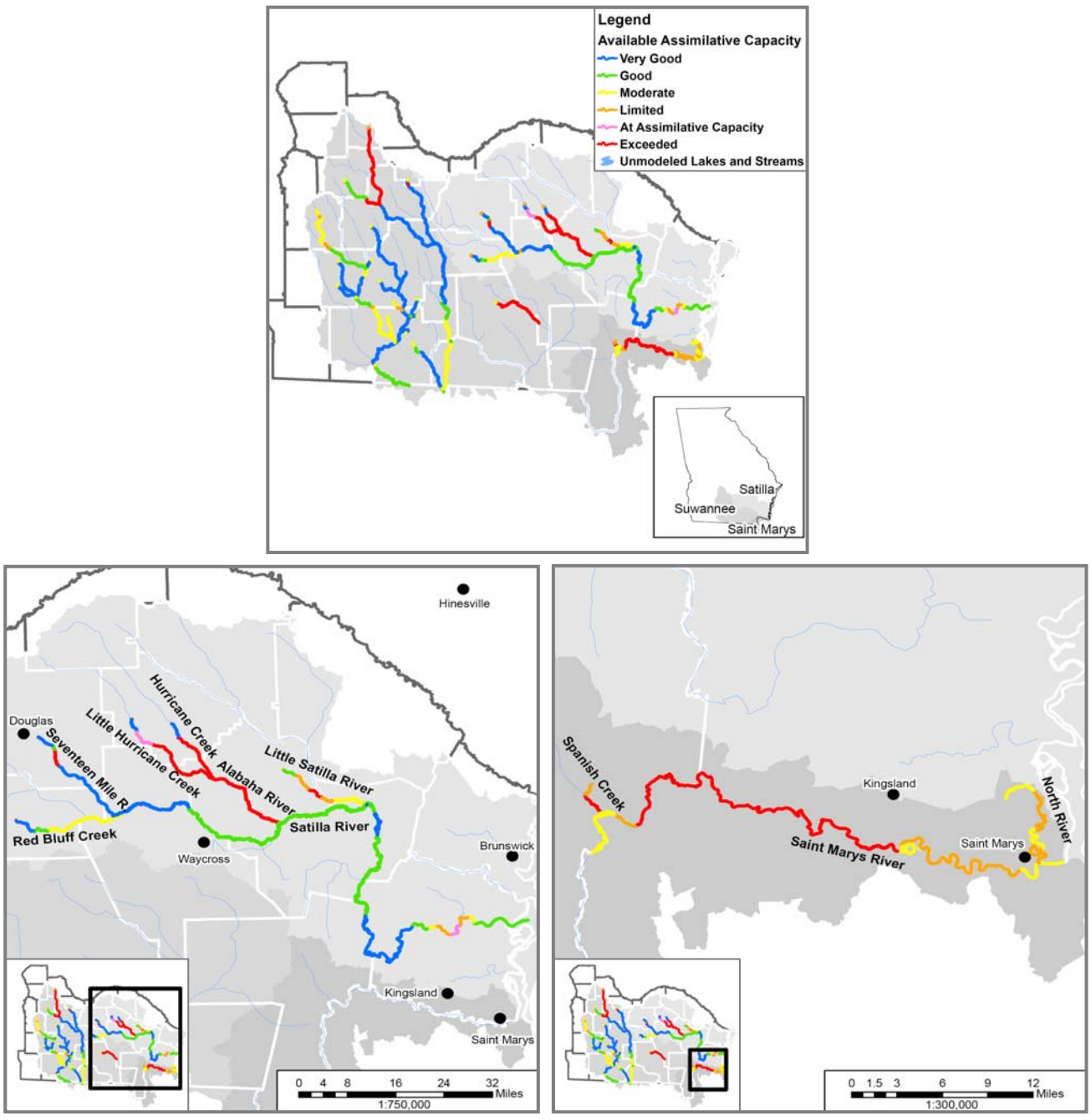




Source: Additional Supporting Material for Permitted Water Quality Resource Assessment; EPD, October 2010.

Very Good: ≥ 1 mg/L of dissolved oxygen (DO) available (above the water quality standard of 5 mg/L)
Good: 0.5 mg/L to < 1.0 mg/L of DO available
Moderate: 0.2 mg/L to <0.5 mg/L of DO available
Limited: >0.0 mg/L to <0.2 mg/L of DO available
At assimilative capacity: 0.0 mg/L of DO available
None or Exceeded Capacity: <0.0 mg/L of DO available

Figure 5-3c: Results of Assimilative Capacity Assessment – DO at Permitted Conditions (Suwannee, Satilla, and St. Marys River Basins)



Source: Additional Supporting Material for Permitted Water Quality Resource Assessment; EPD, October 2010.

Very Good: ≥ 1 mg/L of dissolved oxygen (DO) available (above the water quality standard of 5 mg/L)
Good: 0.5 mg/L to < 1.0 mg/L of DO available
Moderate: 0.2 mg/L to <0.5 mg/L of DO available
Limited: >0.0 mg/L to <0.2 mg/L of DO available
At assimilative capacity: 0.0 mg/L of DO available
None or Exceeded Capacity: <0.0 mg/L of DO available

Figure 5-4 illustrates the number of reaches within each river basin in the region that have exceeded their DO assimilative capacity in either the baseline or permitted model runs or both. It is important to note that exceedance of assimilative capacity on a reach could be the result of a point source discharge, non-point source loading, or a naturally low DO condition. The river basin tables in the figure summarize recommendations that arose out of coordination with EPD's Watershed Protection Branch and the number of reaches within the basin for which these recommendations apply. In addition to improving low DO conditions in surface waters, these recommendations are aimed at providing sufficient future wastewater permit capacity and preparing for future nutrient standards in receiving waters.

There is a proposed EPA TMDL for DO in the Savannah River Harbor that replaces an existing 2006 TMDL. The proposed TMDL includes more than 20 wastewater dischargers from both Georgia and South Carolina with about an equal mix of industrial and municipal facilities. This TMDL provides the framework for State permitting agencies to determine the appropriate range of oxygen-demanding substance permit limits. The bi-state stakeholders are working toward developing an allocation formula for all dischargers and this process is expected to be complete by the end of 2011.

Finally, under current (baseline) and future conditions (2050) the Coastal Council recognizes the importance of managing both point source and non-point sources, which may impact water quality in the Brunswick Harbor estuary and all significant estuary resources of coastal Georgia.

Non-Point Source Pollution

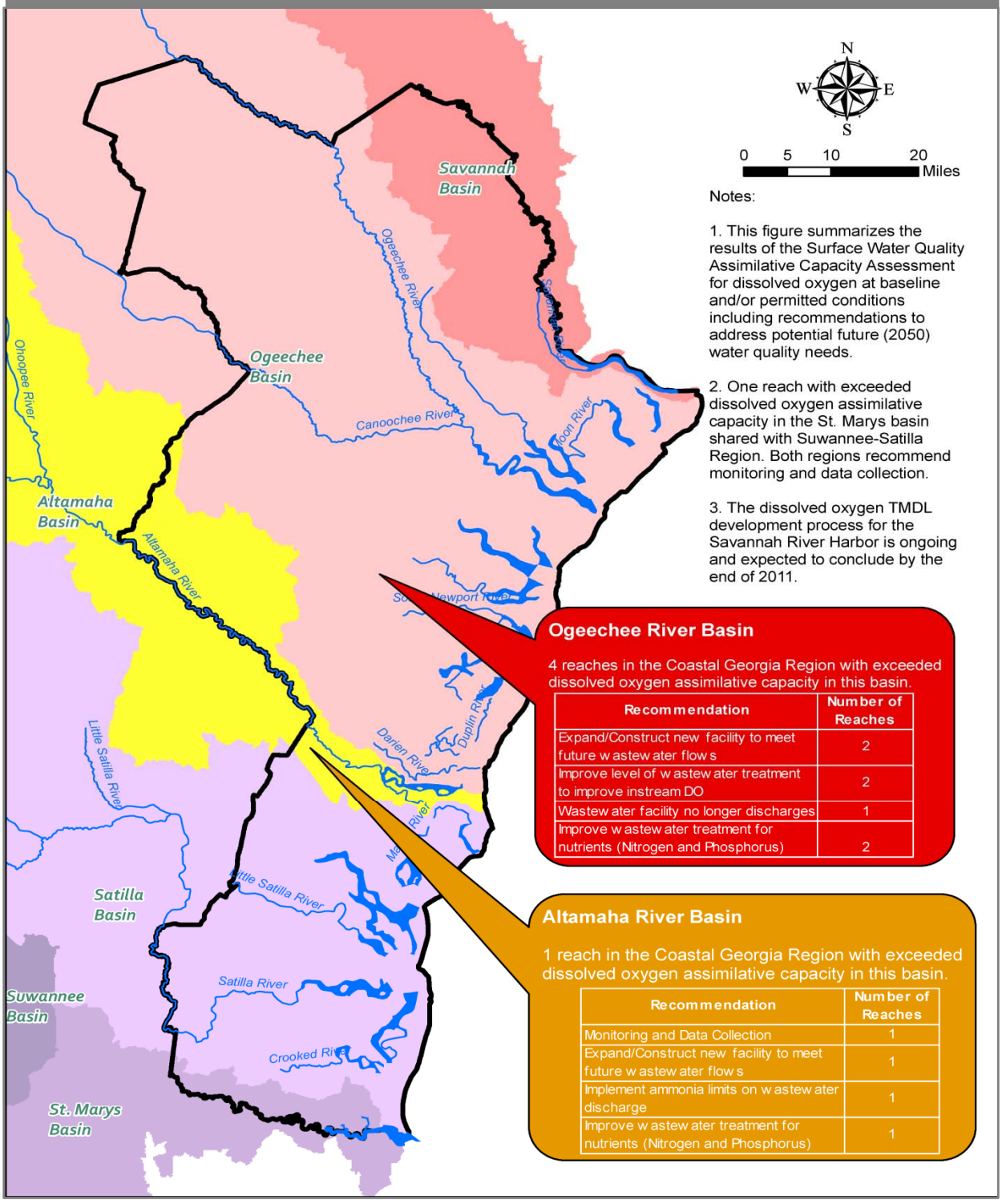
Non-point source pollution accounts for the majority of surface water impairments in the region according to the 2008 303(d) list of Rivers, Streams, Lakes, and Reservoirs published by EPD. Non-point source pollution can occur as a result of human activities, including urban development, agriculture,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

Watershed nutrient (nitrogen and phosphorus) modeling was conducted for the Savannah River and Brunswick Harbor/Satilla River watersheds. The goal was to identify nutrient loading rates from different portions of the watershed under various hydrologic conditions and evaluate them in relation to corresponding land uses and potential non-point source contributions. Results of watershed nutrient modeling identify portions of the watershed where there are higher concentrations of nutrients (nitrogen and phosphorus) in stormwater runoff than other parts of the watershed.

There are currently no nutrient standards in place for the Coastal Georgia Region, so there is no absolute threshold against which these nutrient loadings are compared. Rather, the nutrient model results are beneficial for relative comparisons to target areas where implementation of non-point source control management practices will have the greatest benefit. Nutrient and non-point source control management

practices specific to land uses within the Coastal Georgia Region are discussed in Section 6.

Figure 5-4: Surface Water Quality Gap Summary



6. ADDRESSING WATER NEEDS AND REGIONAL GOALS

Section 6. Addressing Water Needs and Regional Goals

Summary

The Coastal Council selected management practices to help address surface water low flow conditions at the Claxton, Eden, and Kings Ferry planning nodes.

A variety of management practices have been identified to address current and future groundwater use in areas that are affecting salt water intrusion into the Upper Floridan Aquifer.

Water quality management practices focus on addressing dissolved oxygen conditions at select locations and best management practices to address non-point sources of pollution and help reduce nutrient sources.

Additional water and wastewater permit capacity, data collection, and new/upgraded infrastructure will be needed to address existing and/or future uses.

This Section presents the Coastal Council's water management practices selected to address resource shortfalls or gaps identified and described in Section 5, and/or to meet the Council's Vision and Goals described in Section 1.

6.1. Identifying Water Management Practices

The comparison of Resource Assessments and forecasted demands presented in Section 5 identifies the region's likely resource shortfalls or gaps and demonstrates the necessity for region and resource specific water management practices. In cases where shortfalls or gaps appear to be unlikely, the Council identified needs (e.g., facility/infrastructure needs and practices, programmatic practices, etc.) and corresponding management practices that are aligned with the region's Vision and Goals. In selecting the actions needed (i.e., water management practices), the Council considered practices identified in existing plans, the region's Vision and Goals, and coordinated with local governments and water providers as well as neighboring Councils who share these water resources.

Review of Existing Plans and Practices

The Council conducted a comprehensive review of existing local and regional water management plans and relevant related documents to frame the selection of management practices. The types of plans/studies that were reviewed to support identification and selection of management practices for the Coastal Georgia Region consisted of the following:

- Best Management Practices (forestry, agriculture, and stormwater management)
- Comprehensive Work Plans (local and regional scale)
- EPD databases (permitted withdrawals, planned projects, and proposed reservoirs)

- Regional infrastructure and permitting plans
- State-wide guidance documents (conservation, cost, and water planning)
- TMDL evaluations
- Water quality studies, including watershed protection plans (basin, watershed, and local scale)

When possible, successful management practices already planned for and/or in use in the Coastal Georgia Region formed the basis for the water management practices selected by the Council.

6.2. Selected Water Management Practices for the Coastal Georgia Region

Table 6-1 summarizes the Coastal Council's selected management practices by source of supply for the relevant demand sector(s), including permitted municipal and industrial water and wastewater capacity, water quality assimilative capacity (dissolved oxygen) challenges, current water quality impairments, and nutrient considerations for the Satilla and Savannah River watersheds. The table summarizes general information regarding management practices needed to meet forecasted needs, and more detailed information on management practices needed to address gaps between available resources and forecasted needs. Information on shared resources is provided at the end of the table to identify where management practices in other regional Councils are also needed to address identified gaps. The Coastal Council reviewed a number of existing local and regional water management plans and related documents during the development and selection of management practices. A detailed list of plans and documents that were considered can be found in the Coastal Georgia Plans Reviewed in Selecting Management Practices Technical Memorandum (CDM, 2011).

The Coastal Council's efforts in developing management practices were significantly affected by the scale and complexity of the groundwater resource gap that is associated with the *Bi-state Salt Water Intrusion Stakeholder Process in the Savannah/Hilton Head Regions,* and the *Savannah River Harbor TMDL Stakeholder Process,* which is focused on improving water quality in the Savannah Harbor area. Critical data and preferred strategies are likely to emerge from these stakeholder processes, which would establish a clearer path toward addressing current and future resource management priorities. The Coastal Council wished to avoid getting ahead of these parallel processes and consequently has provided a "tool box" of management practices which may ultimately be implemented to varying degrees and/or eliminated from future consideration. The Coastal Council intends to revisit this Plan to consider any substantial new information that may emerge in the coming months to determine if modification of the Plan is warranted. Members of the Coastal Council have invested significant time and expertise into the planning process and

wish to have the entities responsible for this Council capitalize on this expertise prior to the end of their initial term as Council members (February 2012) and beyond.

The Coastal Council considered a number of practices to address surface water availability gaps, ranging from agricultural conservation to one or more regional reservoirs. While reservoirs would provide multiple potential benefits, the flat topography of the region makes siting of regional reservoirs difficult, expensive, and may have associated impacts. The Coastal Council concluded that integrating practices, rather than using a single practice, would be more effective at addressing gaps and more economically feasible.

With this information in mind, Figure 6-1 illustrates the Coastal Council's recommended suite of groundwater and surface water availability management practices, which will be implemented via an incremental and adaptive approach. Those practices that are less costly and more readily implemented are prioritized for short-term implementation. If resource needs are not met and/or gaps are not addressed, then more costly and complex management practices will be pursued.

Figure 5-1 shows the location and general information regarding groundwater gaps in the Coastal Georgia Region (Red and Yellow Zones) associated with potential limited supply availability and increases in multi-sector water demands. This figure should be referenced to provide the geographic focus of the management practices. Groundwater is primarily used by the municipal and industrial sectors.

The groundwater gap in Chatham, Southeastern Effingham, Liberty, and Bryan Counties, and the "T" shaped salt water plume area of Glynn County, and future uses will be addressed either through alternate sources and/or treatment and/or engineered barriers. For planning purposes, management options range from eliminating all pumping from the Red and Yellow Zones, and replacing with other sources, to maintaining and increasing pumping to meet future demands with either treatment of salt water in South Carolina and/or hydrologic barriers. Management practices may also include combinations of reduction in groundwater pumping and replacement with other sources, treatment, and hydrologic barriers.

Figure 5-2 shows the location and magnitude of regional surface water gaps and should be referenced to provide the geographic focus of the management practices. Surface water consumption in the region is primarily associated with the municipal/industrial, agricultural, and thermoelectric demand sectors. The surface water availability gaps are primarily driven by upstream and regional agricultural irrigation usage. Therefore, the majority of the surface water supply management practices in Table 6-1 are intended to address groundwater and agricultural surface water use (in the table the term 7Q10 refers to the 1 in 10 year 7 day monthly low flow condition).

Surface water gaps (increased frequency or severity of 7Q10 low flow conditions) in the region exist under current and future conditions at the Eden and Kings Ferry planning nodes and will be addressed by management practices including those that

reduce net consumption, replace surface water use with groundwater use, improve data on frequency and magnitude of gaps, and assessing the impact of infrequent surface water gaps and the associated costs associated with these gaps, among others. The gaps at Eden and Kings Ferry occur primarily as a result of net consumption associated with agricultural water use in the May–July timeframe. A significant portion of the surface water consumption occurs upstream of the region on the Ogeechee River at Eden and on the Canoochee River at Claxton and above Kings Ferry. The Coastal Council's management practices will address approximately 11% of the gap at Eden, 9% of the cumulative gap at Kings Ferry, and 8% of the gap at Claxton and when combined with management practices from the Altamaha, Upper Oconee, and Savannah-Upper Ogeechee water planning regions will over time address surface water gaps.

Figure 6-2 illustrates the Council's approach to water quality and Table 6-1 also include the Coastal Council's recommended management practices to address water quality gaps, including watersheds with limited localized dissolved oxygen assimilative capacity and insufficient wastewater permit capacity. The Coastal Council addresses gaps by: identifying and recommending specific actions to add/improve infrastructure and improve flow and water quality conditions.

In addition to addressing gaps, the Coastal Council identified several management practice recommendations in Table 6-1 to address forecasted future uses. These recommendations include such practices as the additional sustainable development of groundwater and surface water in areas with sufficient water supply; management of other water quality issues such as non-point source runoff, nutrient loadings, and TMDLs in the region; and additional educational and ordinance practices. Maintaining suitable water quality in Brunswick Harbor and all coastal estuaries can be achieved by local and regional implementation of both point source and non-point source management practices found in Table 6-1 including: PSDO-1 through PSDO-3; SW-2; PSAN-1 through PSAN-3; NPS-1 and NPS-2; NUT-1; non-point source best management practices for urban/suburban, rural, forestry, and agriculture; ordinance/code considerations; and educational programs. The selected management practices will over time address identified gaps and meet future uses when combined with practices for all shared resource regions.

Figure 6-1: Recommended Surface Water Availability Management Practices in a Phased Approach

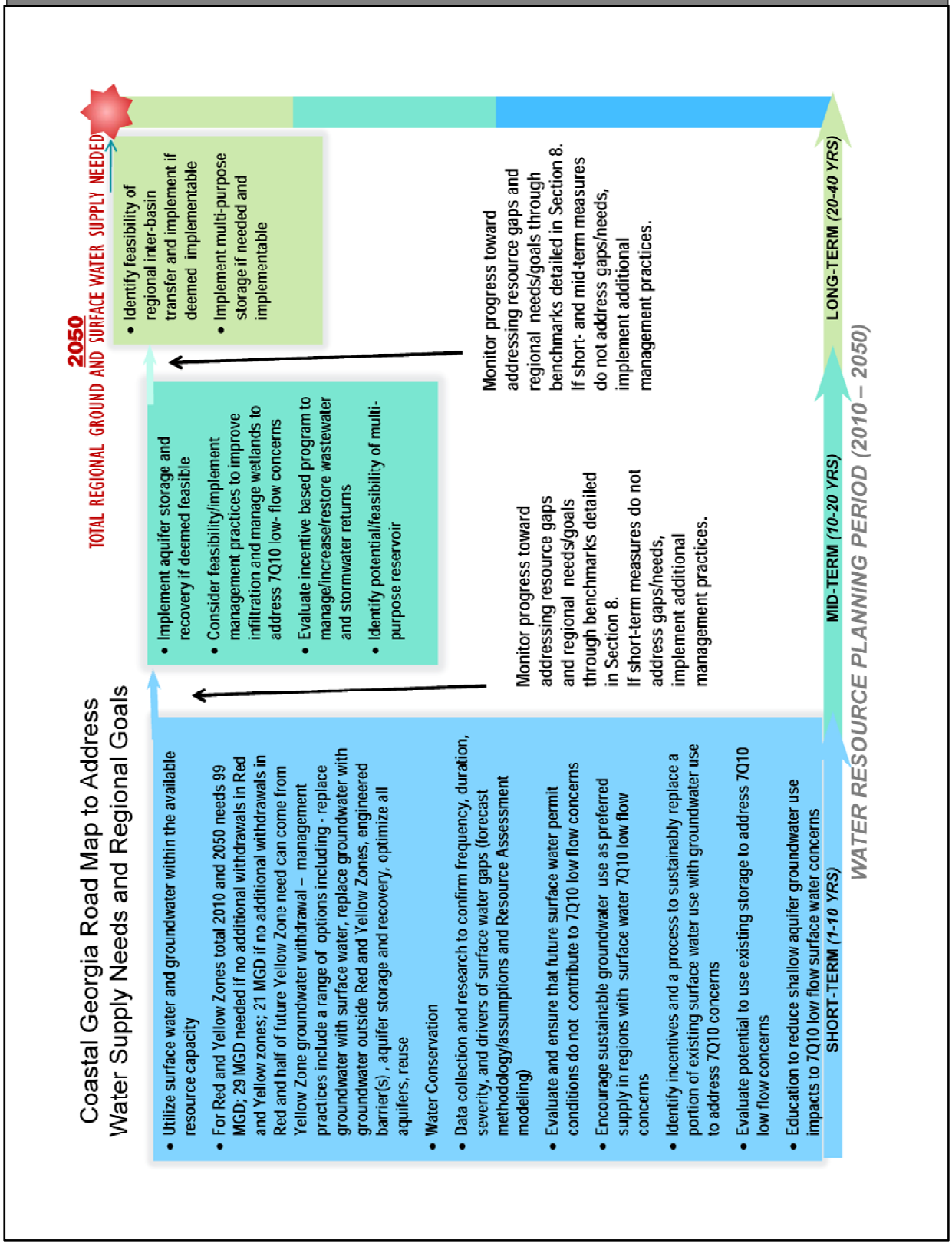


Figure 6-2: Recommended Surface Water Quality Management Practices in a Phased Approach

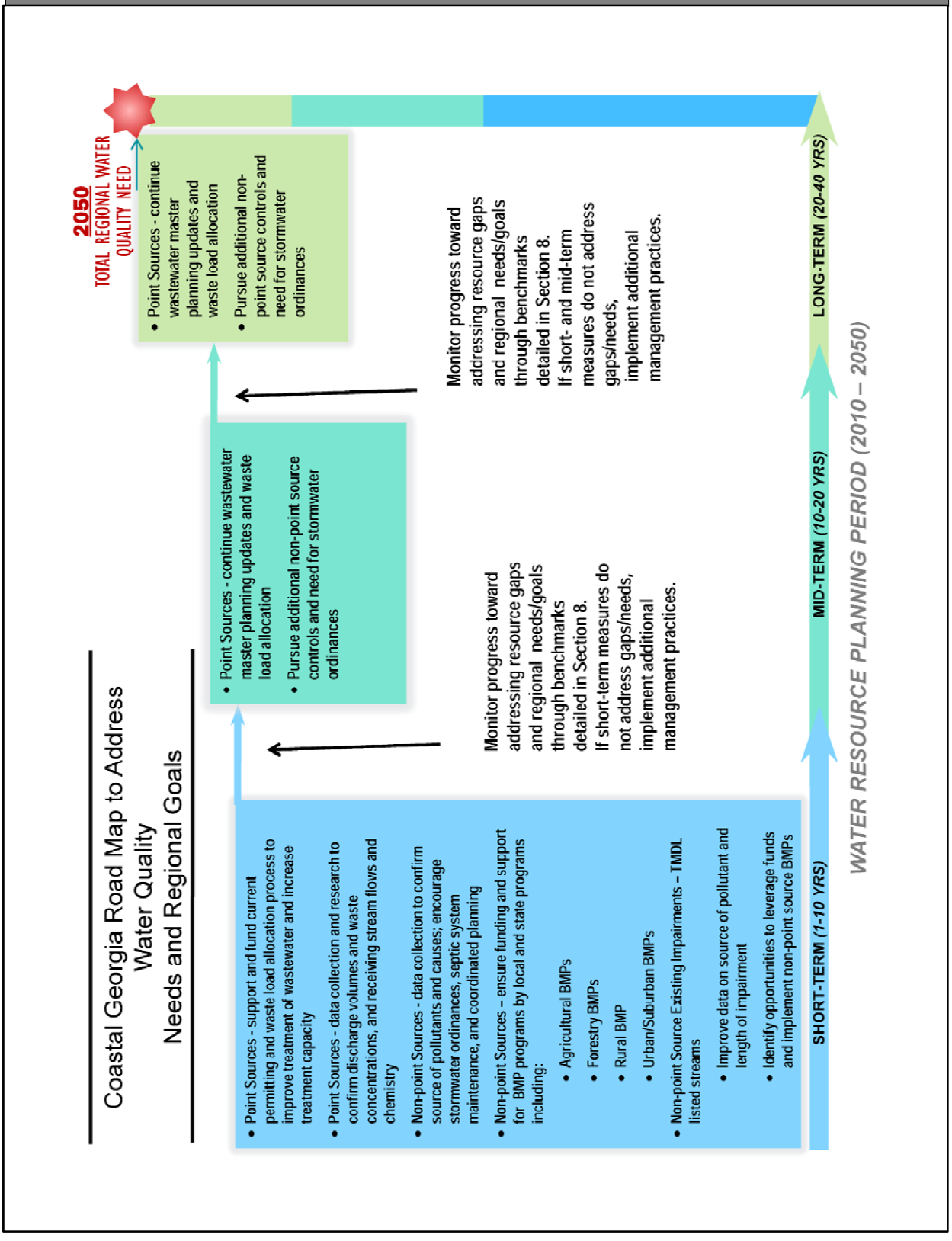


Table 6-1: Management Practices Selected for the Coastal Georgia Region			
Management Practice Number	**Issue(s) to be Addressed by Action(s)**	**Description/Definition of Action**	**Relationship of Action or Issue to Vision and Goals (Section 1.4)**
Action Needed - Water Conservation (WC) - Address current and future gaps and meet water needs by efficient water use. The Coastal Council supports the 25 water conservation goals contained in the March 2010 Water Conservation Implementation Plan (WCIP), and supports collecting water use data according to demand sector (residential, commercial, and industrial).			
WC-1 Tier 1 and Tier 2 Measures for Municipal and Industrial Users	Help meet current and forecasted municipal and industrial surface water and groundwater supply needs throughout the region	Municipal and Industrial water uses - encourage implementation and adherence to Tier 1 and 2 water conservation measures established in existing and future rulemaking processes and plans (WCIP procedures, Coastal Georgia Water and Wastewater Permitting Plan to Control Salt Water Intrusion (Coastal Permitting Plan), June 2006, and Water Stewardship Act of 2010) by local governments/utilities. Council also recommends that local governments consider requiring rain/ moisture sensor shut-off devices for irrigation systems in new construction.	1-3
WC-2 Tier 3 and Tier 4 Measures for Municipal and Industrial Users in the Red and Yellow Zones	Help meet current and forecasted municipal and industrial groundwater water supply needs/gaps in the Red and Yellow Zones	Municipal and Industrial groundwater uses -The following Tier 3 and 4 municipal and industrial water conservation practices, established in the Coastal Permitting Plan, June 2006, and are supported by Council. - Maximize use of recycled or reclaimed water - Adopt water conservation education programs - For Golf Courses: 1) conduct reclaimed water feasibility study and 2) comply with Best Management Practices MOA by Georgia Golf Course Superintendents Assoc./EPD, May 2004. Council also recommends that local governments consider requiring rain/ moisture sensor shut-off devices for irrigation systems in new construction.	1-3

Management Practice Number	Issue(s) to be Addressed by Action(s)	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
Action Needed - Water Conservation (WC) Continued - Address current and future gaps and needs by efficient water use – Agricultural Tier 3 Conservation Practices[2]			
WC-3 Audits	- Help meet current and future agricultural ground and surface water supply gaps/needs throughout the region - Help meet current and forecasted agricultural groundwater use in the Red and Yellow Zones - Help address surface water gap on Ogeechee River at Kings Ferry and Eden and Canoochee River at Claxton	Conduct irrigation audits	1,2,4
WC-4 Metering		Meter irrigation systems	1,2,4
WC-5 Inspections		Inspect pipes and plumbing to control water loss	1,2,4
WC-6 Minimize High-Pressure Systems		Minimize or eliminate the use of high-pressure spray guns on fixed and traveler systems where feasible	1,2,4
WC-7 Efficient Planting Methods		Utilize cropping and crop rotation methods that promote efficiency	1,2,4,5
Action Needed - Water Conservation (WC) Continued - Address current and future gaps and needs by efficient water use – Agricultural Tier 4 Conservation Practices[2]			
WC-8 Conservation Tillage	- Help meet current and future agricultural ground and surface water supply gaps/needs throughout the region - Help meet current and forecasted agricultural groundwater use in the Red and Yellow zones - Help address surface water gap on Ogeechee River at Kings Ferry and Eden and Canoochee River at Claxton	Practice conservation tillage	1,2,4
WC-9 Control Loss		Control water loss	1,2,4
WC-10 End-Gun Shutoffs		Install end-gun shutoff with pivots	1,2,4
WC-11 Low Pressure Systems		Install low pressure irrigation systems where feasible (soil-specific)	1,2,4
WC-12 Application Efficiency Technologies		Encourage and improve use of soil moisture sensors, evapotranspiration sensors, or crop water use model(s) to time cycles	1,2,5

Management Practice Number	Issue(s) to be Addressed by Action(s)	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
Action Needed - Additional/Alternate Sources to Present Groundwater Source(s) in Gap Areas (AAGS)[1]. Note – future groundwater use in Glynn County near Brunswick can be met by drilling groundwater wells outside the hydrologic boundaries that induce upward movement of salt water from a deeper geologic unit in the area of the "T" shaped salt water plume.			
AAGS-1 Cross-Jurisdictional Collaboration	Help meet current and forecasted municipal and industrial groundwater use in the Red and Yellow Zones	Multi-jurisdictional groundwater development and/or management in multi-county areas outside Red and Yellow zones	1-3
AAGS-2 Increase Surface Water Supplies		Develop/utilize additional surface water supplies to meet multi-sector uses (i.e., City of Savannah Industrial and Domestic Plant or other sources)	1-5
AAGS-3 Additional Reservoir Storage		Increase surface water storage (reservoirs)	1-5
AAGS-4 Study Aquifer Storage and Recovery in Addressing Gaps		Conduct research to determine the feasibility (technical, financial, legal, political), role, and potential benefits and limitations of aquifer storage and recovery (ASR) in critical gap areas and/or recharge of surficial and other aquifers	1,5
AAGS-5 Surface Water Storage in Aquifers		Increase surface water storage (ASR); feasibility based on outcome of AAGS-4	1-3,5
AAGS-6 Additional Aquifer Use		Optimize the use of additional regional and local aquifers	1-3
AAGS-7 Reuse		Implement water reuse	1-5
AAGS-8 Determine Desalination Feasibility	Help meet current and forecasted municipal and industrial groundwater use in the Red and Yellow Zones (Note: This option is pending feasibility of other options)	Desalination - consider feasibility of removal of salt from ocean water and distribution of water to help meet water needs in gap areas	1,5

Management Practice Number	Issue(s) to be Addressed by Action(s)	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
AAGS-9 Determine Reverse Osmosis Feasibility	Help meet current and forecasted municipal and industrial groundwater use in the Red and Yellow Zones (Note: These options are pending feasibility of other options)	Reverse Osmosis treatment of brackish water - consider feasibility of additional treatment at source of supply through treatment of brackish surface water and distribution of water to help meet water needs in gap areas	1,5
AAGS-10 Inter-basin Transfers		Inter-basin transfers from within the region or collaborating regions to meet regional water needs and benefit both the areas from which the transferred water is withdrawn and the area receiving the water	1, 3, 4
Action Needed - Institutional (I) Practice(s)[1] to Help Meet Water Needs in Groundwater Gap Areas			
I-1 Cross-Jurisdictional Groundwater Coordination Group	Coordinate and optimize water development and distribution for both groundwater and surface water municipal and industrial uses	Formation of a multi-jurisdictional groundwater use and development "Group" to coordinate groundwater development, infrastructure development/use, and optimize yield and sustainability	1-3,5
Action Needed - Engineered Solution(s) to Address Salt Water Intrusion (ES)[1] and Help Meet Water Needs in Gap Areas			
ES-1 Engineered Solution	Meet current and forecasted needs in Red and Yellow Zones and address salt water intrusion in the Floridan Aquifer	Pending outcome of Bi-state salt water intrusion stakeholder process - Options could range from well head treatment to hydrologic barrier(s), etc.	1,4
Action Needed - Address Current and Future Surface Water Use in Gap Areas **Data Collection/Additional Research (DCAR)** to confirm frequency, duration, and severity of agriculturally-driven shortages to 7Q10 low flow conditions			
DCAR-1 Agricultural Consumption Data	Improve understanding and quantification of agricultural water use and the projected surface water gaps on the Ogeechee River at Eden and Kings Ferry	Acquire additional data/information on agricultural consumptive use to confirm or refine if agricultural consumption is less than 100% consumptive. Conduct "modeling scenario analysis to bracket a reasonable range of consumption" with Resource Assessment models with "new" information on consumptive use to assess effect on surface water gap.	5

Management Practice Number	Issue(s) to be Addressed by Action(s)	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
DCAR-2 Source of Supply Data to Refine Forecasts	Improve understanding and quantification of agricultural water use and the projected surface water gaps on the Ogeechee River at Eden and Kings Ferry	Refine surface water agricultural forecasts and Resource Assessment models to improve data on source of supply and timing/operation of farm ponds	5
DCAR-3 Better Understand Demand and Impacts on Projected Gaps	Improve understanding and quantification of agricultural water use and the projected surface water gaps on the Ogeechee River at Eden and Kings Ferry	Refine and improve surface water Resource Assessment and agricultural forecasts to address spatial and temporal hydrologic variations in relationship to forecasts, climate conditions, and other non-water use variables	5
DCAR-4 Improve Data Quality and Analysis	Obtain additional data and improved understanding of actual versus forecasted water use	Continue to fund, improve, and incorporate agricultural water use metering data and use this information in Regional Water Plan updates	5
DCAR-5 Irrigation Efficiency Education and Research	Improvement of surface water flows (Ogeechee River at Eden and Kings Ferry) via reduced surface water use while maintaining/improving crop yields	Collaborate/support research (University, State and Corporate) on improved irrigation efficiency measures and development of lower water use crops	5
DCAR-6 Understand Optimum Application Methods	Improvement of surface water flows (Ogeechee River at Eden and Kings Ferry) via reduced surface water use while maintaining/improving crop yields	Improve education and research on when and how much water is needed to maximize crop yield with efficient irrigation	5
DCAR-7 Minimize Groundwater Use Impacts to Surface Water	Improvement of surface water flows (Ogeechee River at Eden and Kings Ferry) in areas where ground and surface water are hydrologically connected and groundwater use impacts surface water flows	Promote management practices and educate stakeholders to minimize impacts to surface water associated with excessive pumping/use of aquifers that may impact surface water flows and estuary health	2,4

Management Practice Number	Issue(s) to be Addressed by Action(s)	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
DCAR-8 Analyze Addressing Extreme Conditions	Cost effectively address surface water low flow conditions (Ogeechee River at Eden and Kings Ferry) while avoiding undue adverse impacts on water users and uses in the planning area	Conduct analysis of the socioeconomic benefits and cost in comparison to ecological benefits of addressing surface water gaps that are larger in magnitude, but occur infrequently	5
DCAR-9 Study Potential Use of Aquifers to Address Gaps	Examine potential role and feasibility of storage of surface water to help meet municipal and industrial needs; especially in Red and Yellow Zones (possible alternate supply) and/or for use in improving surface water flows (in gap areas).	Conduct research to determine the feasibility and potential benefits and limitations of aquifer storage and recovery for confined aquifers; and determine the feasibility and potential benefits to recharge surficial aquifers to increase stream baseflow to address gaps	5
DCAR-10 Restoration Impact on Low Flow Conditions Analysis	Examine potential role of wetlands restoration and implementation considerations in addressing surface water low flow conditions	Conduct research and identify incentives to restore wetlands and other areas to determine if this practice can improve river flows during shortages to 7Q10 low flows	2,4,6
Action Needed - Address Current and Future Surface Water Use in Gap Areas Additional/Alternate to Existing Surface Water Supply Sources (ASWS)			
ASWS-1 Consider Low Flow Conditions in Future Surface Water Permitting	Help ensure that future surface water use does not contribute to frequency and severity of low flow conditions within the Local Drainage Areas that contribute flow to the Eden and Kings Ferry gauges	Future surface water uses - If surface water (ponds and withdrawals) is sought for future water supply (new permits), the Applicant, GSWCC, and EPD should work collaboratively to demonstrate that future surface water uses will not contribute to frequency or magnitude of gaps[2]	1,2,4
ASWS-2 Incentives for Dry-Year Releases from Ponds	Help improve surface water flow on the Ogeechee River at Eden and Kings Ferry during low flow conditions	Future surface water uses - Utilizing incentives and collaborative partnerships, examine opportunities to optimize farm and other pond operations to obtain releases during gap periods[2]	1,2,4,5

Management Practice Number	Issue(s) to be Addressed by Action(s)	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
ASWS-3 Substitute Future Surface Water Use with Groundwater in Dry Years	Help improve surface water flow on the Ogeechee River at Eden and Kings Ferry during low flow conditions	Future surface water uses - Encourage use of groundwater within the sustainable yield of the groundwater aquifer (outside) as an alternate source to surface water use during 7Q10 low flow conditions[2]	1,2,4
ASWS-4 Substitute Existing Surface Water Use with Groundwater in Dry Years		Existing surface water uses - Replace portion of existing surface water use with groundwater, within the sustainable yield of the groundwater aquifer (outside Red and Yellow Zones) in times of shortage to 7Q10 low flow conditions, so long as use of groundwater sources does not impact surface water flow in other areas	1,2,4
ASWS-5 Opportunities and Incentives for Dry-Year Releases from Ponds		Existing surface water uses - Utilizing incentives and collaborative partnerships, identify opportunities to allow use of agricultural pond storage to augment river flows in times of shortage to 7Q10 low flow periods	1-4
ASWS-6 Ecological Restoration Incentive Program		Based on the outcome of research (DCAR-10 above), consider incentive based programs to restore wetlands and other areas if this practice can improve river flows during shortages to 7Q10 low flow periods	2,4,6
ASWS-7 Land Management Incentives		Incentive-based land use practices to help promote infiltration and aquifer recharge	2,6
ASWS-8 Incentives for Greater Wastewater Return Flows		Evaluate incentive-based programs to increase wastewater returns; modify land application systems, septic systems, and manage stormwater to improve return flows while maintaining water quality	1-3,6
ASWS-9 Multi-Region Reservoir		Possible joint non-main stem reservoir to serve multiple regions/regional council boundaries with Savannah-Upper Ogeechee and Oconee Councils	1-5

Management Practice Number	Issue(s) to be Addressed by Action(s)	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
ASWS-10 Inter-Basin Transfers	Help improve surface water flow on the Ogeechee River at Eden and Kings Ferry during low flow conditions	Inter-basin transfers from within the region or collaborating regions that can address regional water needs and benefit both the areas from which the transferred water is withdrawn and the area receiving the water	1-3
Action Needed - Address Water Quality (Dissolved Oxygen Levels)			
Point Sources – Dissolved Oxygen (PSDO)			
PSDO-1 Collect Water Quality Data	Verification of Water Quality Resource Assessment Data and Assumptions to determine dissolved oxygen conditions (see Figure 5-3 for more information)	Data collection to confirm loading and/or receiving stream chemistry	5
PSDO-2 Point Discharge Relocation	Improve dissolved oxygen levels in receiving streams (see Figure 5-3 for more information)	Modification of wastewater discharge location. In areas without shortages to 7Q10 low flow conditions, identify feasibility to move discharge location to higher flow streams with greater assimilative capacity.	3,4
PSDO-3 Enhance Point Source Treatment		Upgrade/improve treatment to address low dissolved oxygen conditions in receiving streams	3,4
Action Needed - Address Wastewater Permit Capacity Needs/Gaps			
Municipal Wastewater Permit Capacity (MWWPC)			
MWWPC-1 Increase Wastewater Permit Capacity	Additional municipal wastewater treatment capacity may be needed in Bryan, Camden, Liberty and Long Counties	Expand or construct new facilities and/or obtain additional wastewater permit capacity to meet forecasted needs.[3] Planned municipal projects in Bryan, Camden, Effingham, and Liberty Counties.	3,4
Industrial Wastewater Permit Capacity (IWWPC)			
IWWPC-1 Collect Additional Industrial Permit Data	Collect additional data where needed on industrial flow volumes and permit conditions to verify permitted versus forecasted needs	Obtain additional permit data regarding flow volumes and permit conditions for industrial wastewater facilities forecasted needs[4]	5

Management Practice Number	Issue(s) to be Addressed by Action(s)	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
Action Needed - Address Water Withdrawal Permit Capacity Needs/Gaps			
Municipal Groundwater Withdrawal Permit Capacity (MGWPC)			
MGWPC-1 Increase Municipal Groundwater Permit Capacity	2050 municipal groundwater forecast exceeds existing permit capacity in all counties except Glynn	For Green Zone, obtain groundwater permit capacity and construct new or expanded facilities to meet forecasted need. For Red and Yellow Zones, consider alternate source of supply[5].	3,4
Industrial Groundwater Permit Capacity (IGWPC)			
IGWPC-1 Increase Industrial Groundwater Permit Capacity	2050 industrial groundwater forecast exceeds existing permit capacity in Bryan, Bulloch, Effingham, Liberty, and McIntosh Counties	For Green Zone, obtain groundwater permit capacity. For Red and Yellow Zones, consider alternate source of supply[6]. Construct new or expanded facilities to meet forecasted need.	3,4
The following Coastal Council management practices are programmatic in nature and are therefore described in general terms.			
Action Needed – Utilize Groundwater (GW) to meet Current and Future Needs			
GW-1 Develop and Practice Sustainable Groundwater Use	• For cities, counties, and utilities outside the Red and Yellow Zones, continue to sustainably provide and manage water from the Upper Floridan Aquifer and other significant aquifers in areas not impacting salt water intrusion, following EPD permitting protocol regarding leakage between aquifers (especially the Upper and Lower Floridan aquifers) • Construct new or expanded facilities to meet forecasted need		1-3,5
GW-2 Promote Aquifer-Friendly Land Use Practices	• Encourage land use practices that sustain and protect aquifer recharge areas (both inside and outside the region) for the aquifers present in the region • Counties and local governments should consider practices to promote infiltration and aquifer recharge		2,6
GW-3 Research and Analyze Sustainable Groundwater Management	• Continue to monitor and improve understanding of historic, current, and future trends in groundwater levels; use best available science when evaluating potential value and/or impact associated with aquifer storage and/or recovery of surface water • Utilize sound science and continue to improve data and sustainably manage groundwater resources		5

Management Practice Number	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
Management Practices to Address Current and Future Surface Water (SW) Needs		
SW-1 Surface Water Use Within Available Capacity	• Continue to apply for permits to use surface water within the available surface water resource capacity	1,3-5
SW-2 Monitor and Evaluate Estuaries	• Monitor Atlantic slope river flow conditions to sustain estuary conditions	5
Management Practices to Address Water Quality Point Source Needs - Ammonia and Nutrients (PSAN)		
PSAN-1 Ammonia Limits	• Implementation of ammonia limits, where applicable (see Figure 5-4 for more information)	1,4,5
PSAN-2 Enhance Nutrient Treatment	• Improve/upgrade treatment for nutrients (phosphorus and/or nitrogen) (see Figure 5-4 for more information)	1,4
PSAN-3 Eliminate Illicit Discharges	• Identify and eliminate illicit discharges to surface waters (as found in Glynn County, City of Darien, City of Pooler, Bryan County, and City of Savannah Watershed Protection Plans)	1,4
Management Practices to Address Water Quality Non-Point Source (NPS) Needs		
(Dissolved oxygen, fecal coliform, nutrients, and other impairments)		
NPS-1 Study Human Impacts on Water Quality	• Data collection/analysis to confirm if dissolved oxygen and/or fecal coliform is human induced	4,5
NPS-2 Monitor and Address NPS Nutrient Loading	• Support efforts to monitor and determine sources of nutrient loading and other NPS impairments to waters of the State, and upon confirmation of source, develop specific management programs to address these needs	1,4-6
The following practices are selected by the Costal Council to encourage implementation by the applicable local or State program(s).		
Urban/Suburban Best Management Practices (NPSU)		
NPSU-1 Control Erosion	• Use soil erosion and sediment control measures	4,6

Management Practice Number	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
NPSU-2 Manage Stormwater Runoff	• Stormwater retention ponds, wetlands, swales, filter strips, and bank stabilization to manage runoff and help support river flows (as found in City of Pooler, City of Richmond Hill, and City of Savannah Watershed Protection Plans)	2,4,6
NPSU-3 Increase Stormwater Infiltration	• Consider measures to promote increased infiltration of stormwater to reduce nutrient and other pollutant runoff	2,4,6
NPSU-4 Riparian Buffers	• Protect and maintain riparian buffers along urban streams	4,6
Rural Best Management Practices (NPSR)		
NPSR-1 Advocate Implementing Road Runoff BMPs	• Implement BMPs to control runoff from dirt roads by encouraging County implementation of BMPs indentified in Georgia Resource Conservation and Development Council, "Georgia Better Back Roads – Field Manual"	4,6
Forestry Best Management Practices (NPSF)		
NPSF-1 Support Forestry Commission Water Quality Program	• Support Georgia Forestry Commission's (GFC) water quality program consisting of BMP development, education/outreach, implementation/compliance monitoring, and complaint resolution process	4,6
NPSF-2 Improve BMP Compliance	• Improve BMP compliance through State-wide biennial BMP surveys and BMP assurance exams, Master Timber Harvester workshops, and continuing logger education	4-6
NPSF-3 Wetland and Forest Restoration Incentives and Support	• Incentives to restore wetlands and historically drained hardwood and other areas. Where applicable, support United States Department of Agriculture (USDA) incentive programs through the Farm Service Agency and NRCS to restore converted wetlands back to forested conditions.	4,6
Agricultural Best Management Practices for Crop and Pasture Lands (NPSA) - Support and encourage implementation of Georgia Soil and Water Conservation Commission (GSWCC) BMP and Education Programs		
NPSA-1 Soil Erosion Reduction Measures	• Conservation tillage and cover crop	4,6

Management Practice Number	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
NPSA-2 Utilize Buffers	• Field buffers, riparian forested buffers, and strip cropping to control run-off and reduce erosion	4,6
NPSA-3 Livestock Management	• Livestock exclusions from direct contact with streams and rivers and vegetation buffers	4,6
NPSA-4 Manure Control	• Responsible manure storage and handling	4,6
NPSA-5 Wetland and Forest Restoration Incentives	• Incentives to restore wetlands and historically drained hardwood and other areas	4,6
Existing Impairments and Total Maximum Daily Load Listed Streams (TMDL)		
TMDL-1 Evaluate Impairment Sources	• Data collection and confirmation of sources to remove streams listed due to "natural sources"	4,5
TMDL-2 Analyze Impaired Segments and Sources	• Data collection to refine river/stream reach length for impaired waters; focus on longest reaches to refine location and potential sources of impairments	4,5
TMDL-3 Stormwater Management BMPs	• Stormwater Management: - Agricultural, Forestry, Rural, and Urban/Suburban Best Management Practices (BMPs) *See Above Non-Point Source for Details*	4,6
Nutrients – Satilla and Savannah River Nutrient (Phosphorus and Nitrogen) Watershed Models (NUT)		
NUT-1 Link Nutrient Loading With Current Land Use	• Align current land use with phosphorus and nitrogen loading data to help optimize effectiveness of management practice based on consideration of land uses and actual nutrient loading contribution to surface water resources (i.e., predominant land use is not necessarily the predominant source of nutrients) - Agricultural, Forestry, Rural, and Urban BMPs *See Above Non-Point Source for Details*	4,5

Management Practice Number	Description/Definition of Action	Relationship of Action or Issue to Vision and Goals (Section 1.4)
Management Practices to Address Future Educational Needs (EDU)		
EDU-1 Promote Conservation Programs	• Support Water Conservation Programs	2,5
EDU-2 Stormwater Education	• Support Stormwater Educational Programs	2,6
EDU-3 Septic System Maintenance Education	• Support Septic System Maintenance Programs	2,3
EDU-4 Forestry BMP Education	• Support GFC Forestry BMP and UGA-SFI Logger Education Programs	2,6
Management Practices to Address Future Ordinance and Code Policy Needs (OCP)		
OCP-1 Engage Local Governments in Stormwater Issues	• Encourage local government to develop ordinances and standards to implement and/or update stormwater regulations (as found in Glynn County, City of Darien, City of St. Marys, City of Port Wentworth, Town of Portal, City of Rincon, and City of Hinesville Watershed Protection Plans). Possible resource documents include: Georgia Stormwater Management Manual, Coastal Stormwater Supplement, and Metro North Georgia Water Planning District Model Ordinance.	4,6
OCP-2 Green Space Opportunities and Incentives	• Identify opportunities for green space on incentive and voluntary basis	2,4
OCP-3 Promote Integrated Planning	• Encourage coordinated environmental planning (land use, water supply, stormwater, wastewater and compliance with the *Environmental Planning Criteria* developed pursuant to Part V of the Georgia Planning Act and in the Mountain and River Corridors Protection Act	1-6
OCP-4 Local Government Erosion Control Measures	• Encourage local governments to implement, inspect, and enforce Erosion and Sedimentation Control Measures (as found in City of Darien, City of Pooler, Bryan County, City of Rincon, and City of Hinesville Watershed Protection Plans)	2,6

Summary of Management Practices for Shared Resources – The Coastal Georgia Region will combine its management practices with the following Councils to address shared resource gaps. The management practices that address gaps at Claxton and Eden will also help address the gap at Kings Ferry.

Surface Water Quantity – Ogeechee River (Eden and Kings Ferry) and Canoochee River (Claxton)

Coastal Georgia – The Coastal Georgia Regional Council has identified management practices in the above table to address approximately 11% of the cumulative gap at Eden, 9% of the cumulative gap at Kings Ferry, and 8% of the cumulative gap at Claxton.

Altamaha – The Altamaha Regional Council has identified water conservation, replacement of surface water use with groundwater use, refinement of forecasting and modeling data, and potential use of incentives, among others to address the majority of the cumulative gap at Claxton and a portion of the cumulative gap at Kings Ferry.

Savannah-Upper Ogeechee – The Savannah-Upper Ogeechee Regional Council has identified water conservation, replacement of surface water use with groundwater, and agricultural water use monitoring program to address a portion of the cumulative gap at Kings Ferry and the majority of the cumulative gap at Eden.

Upper Oconee – The Upper Oconee Regional Council has identified the use of variable rate irrigation, development of new groundwater wells, and encouraging centralized sewer in developing areas to address a small portion of the cumulative gap at Eden and a small portion of the cumulative gap at Kings Ferry.

Surface Water Quality:

Satilla River Watershed Model – The Suwannee-Satilla Regional Council has identified the same Best Management Practices for reducing nutrient loading as are summarized in the above table for the Coastal Council.

Savannah River Watershed Model – The Savannah-Upper Ogeechee Regional Council is awaiting more information on nutrient standards.

Suwannee-Satilla – There is one reach with exceeded dissolved oxygen assimilative capacity in the St. Marys basin that is shared with the Suwannee-Satilla Region. Both Councils recommend monitoring and data collection.

Surface Water Quality: Support TMDL Stakeholder Group for the Savannah River Harbor.

Groundwater Quantity/Quality: Support Bi-State Salt Water Intrusion Stakeholder Process in the Savannah/Hilton Head Regions.

Ongoing Planning: Research and incorporate South Carolina and Florida water planning data and issues for future modeling and refine modeling, if warranted. Track potential issues/proposed uses that may affect Surface Water Quality and Quantity on the St. Marys River in South Georgia and Florida.

Notes:

[1]The role/selection of specified practice in addressing current gaps and future forecasted needs in the gap areas requires additional data from the Bi-State Salt Water Intrusion Stakeholder Process between Georgia and South Carolina.

[2] For agricultural water users in the Coastal Region, focus management practice on surface water permit holders and new surface water permit requests in Bulloch, Bryan, Effingham, Chatham, and Long Counties; Kings Ferry and Eden nodes (Ogeechee and Canoochee Rivers).

[3] Wastewater utilities should coordinate with EPD to obtain needed capacity. Regionally sufficient capacity exists; however, localized gaps may occur in Bryan, Camden, Effingham, and Liberty Counties.

[4] Additional industrial wastewater capacity may be needed. EPD to update and refine discharge limit databases.

[5] Additional municipal groundwater permit capacity may be needed in Bulloch, Camden, Long, and McIntosh

Counties. Utilities in regions should evaluate long-term needs and, if needed, work with EPD to obtain additional permit capacity. Municipal groundwater forecast above existing permitted capacities in Bryan, Chatham, Effingham and Liberty Counties should be evaluated for alternate source of supply in light of possible outcomes from the Bi-State Salt Water Intrusion Stakeholder Process between Georgia and South Carolina.

[6] Additional industrial groundwater permit capacity may be needed in Bulloch and McIntosh Counties. Industrial groundwater forecast above existing permitted capacities in Bryan, Effingham and Liberty Counties should be evaluated for alternate source of supply in light of possible outcomes from the Bi-State Salt Water Intrusion Stakeholder Process between Georgia and South Carolina.

7. IMPLEMENTING WATER MANAGEMENT PRACTICES

Section 7. Implementing Water Management Practices

Summary

Implementation of the Coastal Georgia Regional Water Plan will be primarily by various water users and wastewater utilities in the region. The most cost effective and more readily implemented management practices will be prioritized for short-term implementation via an incremental and adaptive approach. If resource needs are not met and/or gaps are not addressed, then more complex management practices will be pursued.

As new information becomes available, it is important the Plan remain a living document and be updated to incorporate new findings.

This Section presents the Coastal Georgia Council's estimated timeframes for the implementation of the water management practices identified in Section 6. Schedules for implementation, in addition to the early step(s) required to initiate implementation of a given practice, are presented for both short- and long-term actions. The Coastal Georgia Council has defined short-term as years 2010 to 2020 and long-term as 2020 to 2050. As the State Water Plan provides, this Plan will be primarily implemented by the various water users in the region; therefore, the Coastal Georgia Council has described the roles and responsibilities of the implementing parties as well as the fiscal implications of the practices.

The Coastal Council also emphasizes that the implementation of recommended management practices are predicated on a number of planning assumptions and/or may be impacted by unanticipated or currently unknown factors including: projected growth of population, industry, agricultural and energy needs; shared resources with surrounding regions; future identification/proposal of a significant upstream water resource project; data sets and assumptions related to water use, water withdrawals and returns; data regarding water quality and watershed models; rules and regulations regarding water resource use and management; and Resource Assessment tools for surface water availability, surface water quality, and groundwater availability. Consequently, significant changes or departures from these planning assumptions, forecasts, and Resource Assessment tools may require a modification of the recommended management practices, the implementation schedule, and/or the implementing entities/affected stakeholders. Future planning efforts should confirm current assumptions and make necessary revisions and/or improvements to the conclusions reached during this round of planning.

7.1. Implementation Schedule and Roles of Responsible Parties

Table 7-1 ties the resource shortfalls and the needs specified by the Council and the corresponding management practices detailed in Table 6-1 to the parties who will implement those practices. This table also describes the timeframe for implementation and the specific steps required for implementation.

Table 7-1: Implementation Schedule

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050):	Responsible Parties
Water Conservation (WC)[1]						
WC-1 Tier 1 and Tier 2 Measures for Municipal and Industrial Users	Current and future groundwater and surface water supply needs	Surface water and groundwater withdrawal (Municipal and Industrial)	Conduct outreach/ education/incentives to encourage implementation of conservation measures	Implement water conservation practices through 01/2020	Verify conservation savings estimates	EPD, Georgia Municipal Association, Georgia Association of County Commissioners, and Water Providers in the Coastal Region
WC-2 Tier 3 and Tier 4 Measures for Municipal and Industrial Users in Red and Yellow Zones	Current and future groundwater supply needs/gaps in the Red and Yellow Zones	Groundwater withdrawal (Municipal and Industrial)				
WC-3 through WC-12 Tier 3 and Tier 4 Measures for Agricultural Users	Current and future agricultural groundwater and surface water supply gaps/needs	Surface water and groundwater withdrawal (Agricultural)				EPD, GSWCC, Georgia Department of Agriculture, and Agricultural water users in the Coastal Region

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050): Further Action to Complete Implementation and Associated Dates	Responsible Parties
Additional/Alternate to Present Groundwater Source(s) in Gap Areas (AAGS)[2]						
AAGS-1 Cross-Jurisdictional Collaboration	Current and future groundwater use in the Red and Yellow Zones	Groundwater withdrawal (Municipal)	Conduct discussions with multi-county, city, and key utilities (01/2011-06/2011)	Track and incorporate major findings from the Bi-state stakeholder group on salt water intrusion (by 01/2012)	N/A	Water Providers outside Red and Yellow Zones in proximity to demand locations[2]
AAGS-2 Increase Surface Water Supplies		Surface water withdrawal Public Water System	Coordinate with City of Savannah Industrial and Domestic Water Plant to utilize excess finished water as needed	Construct distribution infrastructure from City of Savannah Industrial and Domestic Water Treatment Plant to demand locations (by 01/2020)		Water Providers within Red and Yellow Zones, City of Savannah
AAGS-3 Additional Reservoir Storage			N/A	Conduct reservoir reconnaissance and feasibility evaluation (by 01/2020)	If feasible, construct reservoir, treatment plant, and distribution system to demand locations (by 01/2030)	Water Providers within and outside Red and Yellow Zones
AAGS-4 Study Aquifer Storage and Recovery in Addressing Gaps		N/A		Evaluate effectiveness and feasibility of aquifer storage and recovery/aquifer recharge (by 01/2015)	N/A	EPD, Georgia Legislature if evaluation shows effectiveness, feasibility, and need.

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050): Further Action to Complete Implementation and Associated Dates	Responsible Parties
AAGS-5 Surface Water Storage in Aquifers	Current and future groundwater use in the Red and Yellow Zones	Underground Injection Public Water System	Pending favorable results from AAGS-4, perform desktop evaluation to identify and screen potential ASR well sites (by 01/2015)	Drill exploratory ASR wells to confirm feasibility at each site (by 01/2020)	Construct ASR wellfields and complete cycle testing to verify aquifer conditions and yield volumes (by 1/2030)	EPD, Water Providers within Red and Yellow Zones
AAGS-6 Additional Aquifer Use		Groundwater withdrawal (Municipal and Industrial)	Determine feasibility of utilizing alternative aquifers to the Upper Floridan in supplying groundwater withdrawals (by 01/2015)	Install production wells in aquifers other than the Upper Floridan Aquifer and meet sustainable withdrawal rates (by 01/2020)	Continue to regularly update Groundwater Resource Assessment and sustainable yield criteria	EPD, Water Providers within and outside Red and Yellow Zones
AAGS-7 Reuse		General Wastewater	Conduct reuse feasibility studies to determine potential customers and treatment needs (by 01/2012)	Construct treatment upgrades/new facilities and establish contractual agreements with reuse customer base (by 01/2020)	Continue treatment upgrades and seek new customers as additional capacity is provided (by 01/2050)	
AAGS-8 through AAGS-10 Desalination, Reverse Osmosis, and Inter-basin transfers		Options pending feasibility of other options				

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020):	For Long-term Actions (2020-2050):	Responsible Parties
				Further Action to Complete Implementation and Associated Dates		
Institutional (I)[2]						
I-1 Cross-Jurisdictional Groundwater Coordination Group	Current and future groundwater use in the Red and Yellow Zones	Groundwater Withdrawal	Conduct discussions with multi-county, city, and key utilities in support of a regional groundwater coordination group (by 01/2012) Obtain findings from Bi-State salt water intrusion stakeholder process (by 01/2012)	Create a regional groundwater coordination group, if needed (by 01/2013)	Continue to participate in regional groundwater coordination group, as available (by 01/2050)	EPD, Water Providers within and outside Red and Yellow Zones
Engineered Solution(s) to Address Salt Water Intrusion (ES)[2]						
ES-1 Engineered Solution	Current and future groundwater use in the Red and Yellow Zones	Underground Injection	Option pending outcome of Bi-State salt water intrusion stakeholder process (e.g., wellhead treatment, hydrologic barrier(s), etc.)			Georgia and South Carolina

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050): Further Action to Complete Implementation and Associated Dates	Responsible Parties
Data Collection/Additional Research (DCAR)						
DCAR-1 through DCAR-6 Agricultural Data Collection and Irrigation Research	Current and future surface water use in gap areas	N/A	Develop scope of work (1/2012-6/2012) and key partnering agencies (06/2012-01/2015)	Complete data collection, research, and evaluation by 01/2015 Incorporate data/findings in next Regional Water Plan revision	N/A	EPD, GSWCC, University of Georgia, Georgia Department of Agriculture (DOA)
DCAR-7 Minimize Groundwater Use Impacts to Surface Water						
DCAR-8 Analyze Addressing Extreme Conditions			Develop scope of work (06/2011-12/2011)			EPD

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050): Further Action to Complete Implementation and Associated Dates	Responsible Parties
DCAR-9 Study Aquifer Potential to Address Gaps	Current and future surface water use in gap areas	N/A	Develop scope of work (06/2011-12/2011) and key partnering agencies (01/2012-01/2015)	Complete data collection, research, and evaluation by 01/2015 Incorporate data/findings in next Regional Water Plan revision	N/A	EPD, GSWCC, University of Georgia, Georgia DOA
DCAR-10 Restoration Impact on Low Flow Conditions Analysis						EPD and other research agencies/entities; USDA and other agencies for funding and incentives
Additional and Alternatives to Existing Surface Water Supply Sources (ASWS)[1]						
ASWS-1[3] Consider Low Flow Conditions in Future Surface Water Permitting	Future surface water use in gap areas	Surface water withdrawal (Agricultural)	EPD to develop Data Needs and Guidance for Analysis Requirements Applicants to submit analysis from 2010-2015	GSWCC to collaborate with EPD, Georgia DOA, and current/future surface water users to develop application process and data needs to streamline application and review process (by 01/2015)	Determine if expedited or revised permitting process is warranted to allow for use of the resource and protection of critical low flows	EPD, GSWCC, Georgia DOA, and Agricultural surface water users in the Coastal Region for implementation
ASWS-2[3] Incentives for Dry-Year Releases from Ponds						

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050): Further Action to Complete Implementation and Associated Dates	Responsible Parties
ASWS-3[3] Substitute Future Surface Water Use with Groundwater in Dry Years	Future surface water use in gap areas	Surface water withdrawal (Agricultural)	EPD to develop Data Needs and Guidance for Analysis Requirements Applicants to submit analysis from 2010-2015	GSWCC to collaborate with EPD, Georgia DOA, and current/future surface water users to develop application process and data needs to streamline application and review process (by 01/2015)	Determine if expedited or revised permitting process is warranted to allow for use of the resource and protection of critical low flows	EPD, GSWCC, Georgia DOA, and Agricultural surface water users in the Coastal Region for implementation
ASWS-4 Substitute Existing Surface Water Use with Groundwater in Dry Years	Current surface water use in gap areas	Surface water/ Groundwater withdrawal (Agricultural)	Develop strategy and work with potential participants/ impacted users to increase support for and implementation of strategy	Evaluate need and feasibility to conjunctively manage groundwater (outside Red and Yellow Zones) and surface water to address 7Q10 low flow conditions (by 01/2015)	N/A	
ASWS-5 Opportunities and Incentives for Dry-Year Releases from Ponds		Surface water withdrawal (Agricultural)		Examine opportunities to modify farm and other pond operations to obtain releases in to address gaps (by 01/2015)	Modify farm and other pond operations to obtain releases to address gaps (by 01/2030)	

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020):	For Long-term Actions (2020-2050):	Responsible Parties
				Further Action to Complete Implementation and Associated Dates		
ASWS-6 Ecological Restoration Incentive Program	Current and future surface water use in gap areas	Wetland Restoration	Encourage research to determine effectiveness and feasibility of restoring wetlands	Determine effectiveness and feasibility of restoring wetlands (by 01/2015)	Restore wetland characteristics (by 01/2030)	EPD
ASWS-7 Land Management Incentives		Stormwater NPDES Discharge	Monitor land use changes and further delineate aquifer recharge areas	Determine effectiveness and feasibility of implementing practice (by 01/2015)	If deemed effective and feasible, implement practice based on status of gap closure (by 01/2025)	EPD, Municipalities and Water/Wastewater Utilities in the Coastal Region
ASWS-8 Incentives for Greater Wastewater Return Flows		Wastewater/ Stormwater NPDES Discharge, Sanitary Sewer Extension	N/A		Continue to monitor land use and hydrologic relationships	
ASWS-9 Multi-Region Reservoir		Surface water withdrawal	Monitor gap closure	Based on rate of gap closure, consider reservoir reconnaissance/feasibility study (by 01/2015)	Construct joint regional reservoir and/or multiple new smaller reservoirs (and/or utilize existing reservoirs) (by 01/2030)	EPD, Water providers in the Coastal Region, other collaborating regions

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050): Further Action to Complete Implementation and Associated Dates	Responsible Parties
ASWS-10 Inter-Basin Transfers	Current and future surface water use in gap areas	Surface water withdrawal	Monitor gap closure	Based on rate of gap closure, consider inter-basin transfer reconnaissance/feasibility study (by 01/2020)	Construct infrastructure for inter-basin transfers, if feasible and needed (by 01/2050)	EPD, Water providers in the Coastal Region, other collaborating regions
Point Sources – Dissolved Oxygen (PSDO)						
PSDO-1 Collect Water Quality Data	Water quality gaps	General Wastewater	N/A	Collect data to confirm loading and/or receiving stream chemistry (by 01/2020)	N/A	EPD, Municipalities and/or wastewater utilities in the Coastal Region
PSDO-2 Point Discharge Relocation				Identify feasibility to move discharge location to higher flow streams with greater assimilative capacity (by 01/2015)	If feasible, and cost effective, relocate discharge location (by 01/2020)	
PSDO-3 Enhance Point Source Treatment			Confirm wastewater facilities to upgrade/improve treatment to address low dissolved oxygen conditions in receiving streams (by 01/2015)	Upgrade/improve treatment of identified wastewater facilities (by 01/2015)	Continue to upgrade/improve treatment of identified wastewater facilities (by 01/2040)	

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020):	For Long-term Actions (2020-2050):	Responsible Parties
				Further Action to Complete Implementation and Associated Dates		
Available Municipal Wastewater Permit Capacity (MWWPC)						
MWWPC-1 Increase Wastewater Permit Capacity	Wastewater permit capacity gap (Bryan, Camden, Liberty, and Long Counties)	Municipal Wastewater	N/A	Expand or construct new facilities and/or obtain additional wastewater permit capacity to meet forecasted needs (by 01/2020)	N/A	EPD, Municipal wastewater utilities in the Coastal Region
Available Industrial Wastewater Permit Capacity (IWWPC)[4]						
IWWPC-1 Increase Wastewater Permit Capacity	Wastewater permit capacity gap	Industrial Wastewater	Obtain additional permit data on flow volumes and permit conditions for industrial wastewater facilities forecasted needs	Expand/construct new facilities and/or obtain additional wastewater permit capacity to meet forecasted needs (by 01/2020)	N/A	EPD, Industrial wastewater facilities in the Coastal Region
Available Municipal Groundwater Permit Capacity (MGWPC)						
MGWPC-1 Increase Municipal Groundwater Permit Capacity	Groundwater permit capacity gap (All Counties except Glynn County)	Groundwater Withdrawal (Municipal)	N/A	Evaluate short-term needs and, if needed, work with EPD to obtain additional permit capacity and/or alternate source of supply (by 01/2020)	Evaluate long-term needs and, if needed, work with EPD to obtain additional permit capacity (by 01/2050)	EPD, Municipal water utilities in the Coastal Region

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050): Further Action to Complete Implementation and Associated Dates	Responsible Parties
Available Industrial Groundwater Permit Capacity (IGWPC)						
IGWPC-1 Increase Industrial Groundwater Permit Capacity	Groundwater permit capacity gap (Bryan, Bulloch, Effingham, Liberty, and McIntosh Cos.)	Groundwater Withdrawal (Industrial)	N/A	Evaluate short-term needs and, if needed, work with EPD to obtain additional permit capacity and/or alternate source of supply (by 01/2020)	Evaluate long-term needs and, if needed, work with EPD to obtain additional permit capacity (by 01/2050)	EPD, Industrial water facilities in the Coastal Region
Groundwater (GW)						
GW-1 Develop and Practice Sustainable Groundwater Use	Future groundwater needs in Green Zone	Groundwater Withdrawal (Municipal, Industrial, and Agricultural)	Verify sustainable yield metrics and consider relevant localized impacts (by 01/2015)	Provide guidance and implement sustainable groundwater withdrawal rates through 01/2020	Modify Resource Assessments and sustainable yield criteria, if necessary (by 01/2050)	EPD, Water Providers outside Red and Yellow Zones
GW-2 Promote Aquifer-Friendly Land Use Practices		N/A	Monitor land use changes and further delineate aquifer recharge areas (by 01/2015)	Encourage land use practices that sustain and protect aquifer recharge areas (by 01/2020)	Continue to monitor land use and hydrologic relationships	EPD, Municipalities in aquifer recharge areas (within and outside the Coastal Region)
GW-3 Research and Analyze Sustainable Groundwater Management			N/A	Continue to monitor and improve understanding of historic, current, and future trends in groundwater levels (by 01/2020)	N/A	EPD

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020):	For Long-term Actions (2020-2050):	Responsible Parties
				Further Action to Complete Implementation and Associated Dates		
Surface Water (SW)[1]						
SW-1 Surface Water Use Within Available Capacity	Current and future surface water use outside gap areas	Surface water Withdrawal	Confirm non-gap areas and available surface water resource capacity (by 01/2015)	Continue to apply for permits and use surface water in non-gap areas within the available surface water resource capacity (by 01/2020)	Verify flow conditions and gaps	EPD, applicable federal agencies, and surface water users in Coastal Region
SW-2 Monitor and Evaluate Estuaries		N/A	Monitor Atlantic slope river flow conditions	Determine flow conditions that sustain estuary conditions (by 01/2020)	N/A	EPD, Coastal Resources Division, Wildlife Resources Division
Point Sources-Ammonia and Nutrients (PSAN)						
PSAN-1 Ammonia Limits	Water quality outside gap areas	General Wastewater	Identify wastewater treatment facilities that would need to be upgraded and determine processes to implement	Improve/upgrade identified wastewater treatment facilities to comply with ammonia and nutrient limits (by 01/2020)	N/A	EPD, Wastewater facilities in the Coastal Region
PSAN-2 Enhance Nutrient Treatment						
PSAN-3 Eliminate Illicit Discharges			Identify options for treating illicit discharges to surface waters	Eliminate illicit discharges to surface waters (by 01/2020)		

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050): Further Action to Complete Implementation and Associated Dates	Responsible Parties
Non-Point Sources (NPS) – Urban, Rural, Agricultural, and Forestry Uses						
NPS-1 Study Human Impacts on Water Quality	Water quality outside gap areas	Stormwater (NPDES Discharges)	Collect data to determine dissolved oxygen, fecal coliform, and nutrient sources	Confirm sources of loading and develop programs to address (by 01/2020)	N/A	EPD, Municipalities and Utilities within the Coastal Region
NPS-2 Monitor and Address NPS Nutrient Loading						
NPSU-1 through NPSU-4 Various Stormwater Management Practices Related to Urban Uses			Select best management practices needed for treating stormwater from urban uses	Implement a variety of stormwater best management practices related to urban uses (by 01/2015)		
NPSR-1 Advocate Implementing Road Runoff BMPs			Select best management practices needed for treating stormwater from rural uses	Implement a variety of stormwater best management practices related to dirt road maintenance (by 01/2015)		EPD, Counties (Public Works/Roads and Bridges Departments) within the Coastal Region

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050): Further Action to Complete Implementation and Associated Dates	Responsible Parties
NPSF-1 through NPSF-3 Various Stormwater Management Practices Related to Forestry Uses	Water quality outside gap areas	Stormwater (NPDES Discharges)	Continue to support existing best management practices programs	Implement a variety of BMPs related to forestry and agricultural uses (by 01/2015)	N/A	Georgia Forestry Commission, and possibly county commissions
NPSA-1 through NPSA-5 Various Stormwater Management Practices Related to Agricultural Uses						GSWCC, Agricultural users within the Coastal Region
TMDL-1 through TMDL-3 Evaluate Impaired Segments and Sources			Collect data to confirm impairment and determine sources	Remove streams listed due to "natural sources" (by 01/2020) Refine river/stream reach length for impaired waters (by 01/2020)	Continue collecting data to monitor impairment sources; Support reassessment of stream segment classifications (by 01/2050)	EPD, Municipalities and Utilities within the Coastal Region

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020): Further Action to Complete Implementation and Associated Dates	For Long-term Actions (2020-2050): Further Action to Complete Implementation and Associated Dates	Responsible Parties
NUT-1 Link Nutrient Loading With Current Land Use	Water quality outside gap areas	Stormwater (NPDES Discharges)	Align current land use with nutrient loading data to optimize management practice based on consideration of land uses and actual nutrient contribution to loading	Support research and development of tools such as the Southern Group of State Foresters and USFS Sediment Prediction modeling tool being developed by Auburn University (by 01/2020)	N/A	EPD, GSWCC, Georgia Forestry Commission, Municipalities and Utilities within the Coastal Region, and county commissions
Educational Practices (EDU)						
EDU-1 through EDU-4 Various Educational and Outreach Programs on Conservation/ Water Quality	Education/ outreach support	N/A	Develop educational programs on water conservation, septic system maintenance, and stormwater management	Complete educational programs on water conservation, septic system maintenance, and stormwater management	Continue educational programs on water conservation, septic system maintenance, and stormwater management	EPD, State Agencies with WCIP responsibilities, Municipalities and Utilities within the Coastal Region

Management Practice No. (See Table 6-1)	Issues to be Addressed and Resource(s) Affected	Permittee Category of Responsible Parties (if applicable)	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions (2010-2020):	For Long-term Actions (2020-2050):	Responsible Parties
				Further Action to Complete Implementation and Associated Dates		
Ordinance and Code Policy Practices (OCP)						
OCP-1 through OCP-4 Stormwater Management through Ordinance/ Code Updates and Integrated Planning	Ordinances and code policies	N/A	Identify ordinances and standards to implement/update stormwater and land development (including green space and Erosion and Sedimentation Control Measures) Encourage coordinated environmental planning	Pass ordinances and develop standards on stormwater management and land development (by 01/2020) Conduct regional environmental planning (e.g., land use, water supply, stormwater, wastewater, etc.)	Continue to regulate stormwater management and land development actions consistent with ordinances and codes implemented	EPD, Regional Commissions, Municipalities and Utilities within the Coastal Region and county commissions

Notes:

[1] For agricultural water users in the Coastal Region, focus management practices on surface water permit holders and new surface water permit requests in Bulloch, Bryan, Effingham, Chatham, and Long Counties; Kings Ferry and Eden nodes (Ogeechee and Canoochee Rivers).

[2]The role/selection of specified practice in addressing current gaps and future forecasted needs in the gap areas requires additional data from the Bi-State Salt Water Intrusion Stakeholder Process between Georgia and South Carolina.

[3]Possible areas include: Effingham, Bulloch, Evans, Tattnall, Long, McIntosh, Glynn, and Camden Counties [(Effingham, Chatham Red Zone); [Bryan, Liberty Yellow Zones)]

[4] Additional industrial wastewater capacity may be needed. EPD to update and refine discharge limit databases to confirm flow and quality assumptions.

7.2 Fiscal Implications of Selected Water Management Practices

The following subsections discuss planning level cost estimates for the water management practices selected by the Coastal Council and potential funding sources and options. Successful implementation of the Regional Water Plan is highly dependent on the ability of state and local governments, water providers, and utilities, to fund the needed implementation actions.

Planning Level Cost Estimates

Planning level cost estimates were prepared for each management practice as shown in Table 7-2 using planning guidance documents, the knowledge base of previous state and utility planning efforts, and other sources of information, as listed below:

- Georgia Environmental Protection Division Supplemental Guidance for Planning Contractors: Water Management Practice Cost Comparison dated March 2010 (Revised March 2011).
- Water Conservation Technical Memorandum to Supplement Council's Plan prepared by CDM for Georgia EPD draft dated July 2011.
- CDM Water Supply Cost Estimation Study prepared for the South Florida Water Management District dated February 2007.
- EPA Report titled Costs of Urban Stormwater Control Practices – Preliminary Report dated February 5, 2006.
- EPA Report titled Costs of Urban Stormwater Control dated January 2002.
- St. Johns River Water Management District Report titled Water Supply Needs and Sources Assessment Alternative Water Supply Strategies Investigation, Water Supply and Wastewater Systems Component Cost Information dated 1997 (Publication Number SJ97-SP3).
- Preliminary estimates of production well yields and costs from local licensed well drillers in Georgia (Bishop Well and Pump Service and Grosch Irrigation Company.)
- Irrigation Conservation Practices Appropriate for the Southeastern United States. Project Report 32. Prepared in cooperation with the Georgia DNR, EPD under Proposal No. ES61135FC1.
- Groundwater Flow Modeling of the Coastal Plain Aquifer System of Georgia. Draft Report completed for EPD as part of State of Georgia Groundwater Resource Assessment (December 2009).

- FY 2004 Sussex Conservation District Cover Crop Program Fact Sheet. Sussex Conservation District, Georgetown, Delaware. Dated 2003.
- North Carolina State University Department of Forestry Costs of Forestry Best Management Practices in the South: A Review.
- Recent bid tabulations for wastewater treatment facilities.

The cost estimates are unit cost estimates where there is a lack of detail or specificity about the management practice. For example, for an inter-basin transfer of water, the cost is driven by the length and size of the pipeline and the quantity to be transferred. If the connection locations and or the transfer quantity are not known, a unit cost per mile of pipeline is given. Where there is detail about the management practice, unit cost data were used to develop an approximate capital/programmatic cost. The capital costs were adjusted to 2010 dollars using the Engineering News Record Cost Index. In summary, some cost estimates are unit costs with different unit basis and some costs are approximate capital costs. Therefore, each management practice was assigned a cost (where applicable) rather than rolling up the costs into general categories since they may not be additive. The cost information provided in this document will be used to pursue loans, grants, and other funding options that can be prioritized throughout the region.

Funding Sources and Options

Several different funding sources and options will be used to secure funding for the different management practices outlined in this Plan including:

- The State Revolving Fund Program
- Other State of Georgia Funding Programs
- State and Federal Grants
- Water/Wastewater System Revenues
- State and local government incentive programs

More details on potential loan and grant programs are provided for the management practices in Table 7-2. Below is a list of some of the larger organizations and agencies that provide funding for the types of management practices recommended in this Plan. It is important to note that funding sources and opportunities change on a yearly basis.

Environmental Protection Agency (EPA) Programs

The EPA provides grants to States, non-profits, and educational institutions to support high-quality research that will improve the scientific basis for decisions on national environmental issues and help the EPA to achieve its goals. The EPA

provides research grants and graduate fellowships; supports environmental education projects that enhance the public's awareness, knowledge, and skills to make informed decisions that affect environmental quality; offers information for State and local governments and small businesses on financing environmental services and projects; and provides other financial assistance through programs such as the Drinking Water State Revolving Fund (DWSRF), the Clean Water State Revolving Fund (CWSRF), and the Brownfield Program. More information on the EPA can be accessed at: www.epa.gov.

The EPA offers the following grant programs:

- Continuing Program Grants
- Project Grants
- Clean Water State Revolving Fund Program
- Water Pollution Control Program
- Water Quality Cooperative Agreements Program
- Water Quality Management Planning Program
- Onsite Wastewater Management Planning Program
- Drinking Water State Revolving Fund Loan Program

Georgia Environmental Protection Division (EPD)

The mission of EPD is to help provide Georgia's citizens with clean air, clean water, healthy lives and productive land by assuring compliance with environmental laws and by assisting others to do their part for a better environment. As a result of the Clean Water Act, each year the State of Georgia receives funding from the U.S. Environmental Protection Agency to assist the State with addressing environmental issues. EPD offers the following grant programs:

- Section 319 (h) Grants
- Section 604 (b) Grants

U.S. Department of Agriculture – Natural Resource Conservation Service (USDA-NRCS) Conservation Programs

The USDA-NRCS offers a number of funding opportunities as a result of the Farm Security and Rural Investment Act of 2002. This Act is landmark legislation for conservation funding and for focusing on environmental issues. The conservation provisions will assist farmers and ranchers in meeting environmental challenges on their land. This legislation simplifies existing programs and creates new programs to

address high priority environmental and production goals. The USDA-NRCS offers the following funding options:

- Conservation of Private Grazing Land Program
- Conservation Security Program
- Environmental Quality Incentives Program
- Farmland Protection Program
- Resource Conservation and Development Program
- Wetlands Reserve Program
- Wildlife Habitat Incentives Program

Table 7-2: Cost Estimates for the Implementation Responsibilities				
Management Practice No. (See Table 6-1)	**Issue to Be Addressed**	**Capital/ Programmatic Cost**	**Funding Sources and Options[1]**	**Notes and Sources for Costs**
Water Conservation (WC)				
WC-1 Tier 1 and Tier 2 Measures for Municipal and Industrial Users	Help meet current and forecasted surface water and groundwater supply needs throughout the region	$0.1 to $0.2 million (M)	Local governments; utilities	Supplemental Guidance
WC-2 Tier 3 and Tier 4 Measures for Municipal and Industrial Users in the Red and Yellow Zones		$3.5M		50 golf courses times $70,000 per Reuse Feasibility Study
WC-3 Audits		$1,300/system	State/federal loan or grant	Irrigation Conservation Practices Appropriate for the Southeastern United States
WC-4 Metering		$0.47M		(528 existing irrigation pumps) times 10% increase in pumps times $800/totalizer
WC-5 Inspections		$0 to $0.9M		$0 to $0.7 per capita per Supplemental Guidance. Total population in 2050: 1,266,000
WC-6 Minimize High-Pressure Systems		$4,700/system		Irrigation Conservation Practices Appropriate for the Southeastern United States
WC-7 Efficient Planting Methods		$0.1 to $0.2M		Educate farmers on benefits of cropping and crop rotation
WC-8 Conservation Tillage		$0.1 to $0.2M		Educate farmers on benefits of conservation tillage
WC-9 Control Loss		$0.1 to $0.2M		Educate farmers on practices to prevent water loss through more efficient detention of rainfall
WC-10 End-Gun Shutoffs		$700/system		Irrigation Conservation Practices Appropriate for the Southeastern United States

Management Practice No. (See Table 6-1)	Issue to Be Addressed	Capital/ Programmatic Cost	Funding Sources and Options[1]	Notes and Sources for Costs
WC-11 Low Pressure Systems	Help meet current and forecasted surface water and groundwater supply needs throughout the region	$3,400/system	State/federal loan or grant	Irrigation Conservation Practices Appropriate for the Southeastern United States
WC-12 Application Efficiency Technologies		$2,000/system		
Additional/Alternate to Present Groundwater Source(s) (AAGS) – Gap: 21 to 99 MGD				
AAGS-1 Cross-Jurisdictional Collaboration	Current and Future Groundwater Use in Gap Areas	$150M to $240M	GEFA Drinking Water State Revolving Fund Loan Program and Georgia Fund Loan	Includes new wells, cost of groundwater treatment, and pipeline for 29 to 50 MGD and 10 miles of pipeline. Unit costs for wells taken from local driller cost data. Unit costs for treatment and pipelines taken from Supplemental Guidance. Costs do not include storage.
AAGS-2 Increase Surface Water Supplies		$170M to $390M		Includes cost of surface water treatment and pipeline for 29 to 50 MGD and 10 miles of pipeline. Unit costs for treatment and pipelines taken from Supplemental Guidance. Costs do not include storage.
AAGS-3 Additional Reservoir Storage		$0.21M to $15M	GEFA Georgia Reservoir and Water Supply Fund	$0.01M to $0.15M/MGD to increase storage at existing surface water reservoirs from Supplemental Guidance and CDM Water Supply Cost Estimation Study
AAGS-4 Study Aquifer Storage and Recovery in Addressing Gaps		$0.5M to $1M	GEFA Georgia Reservoir and Water Supply Fund/Utilities	Various recent similar projects
AAGS-5 Surface Water Storage from Aquifers		$0.21M to $99M		$0.015M to $1M/MGD from Supplemental Guidance, CDM Water Supply Cost Estimation Study and various recent projects. Higher end of cost range includes pretreatment to prevent arsenic mobilization in ASR storage zone.

Management Practice No. (See Table 6-1)	Issue to Be Addressed	Capital/ Programmatic Cost	Funding Sources and Options[1]	Notes and Sources for Costs
AAGS-6 Additional Aquifer Use	Current and Future Groundwater Use in Gap Areas	$0.5M to $1M	GEFA Drinking Water State Revolving Fund Loan Program (DWSRF)	Various recent similar projects
AAGS-7 Reuse		$74M to $400M	Water/ Wastewater system revenues	$0.50 to $1.50/1,000 gallons. Assumes secondary treatment and no additional WWTP upgrades.
AAGS-8 Determine Desalination Feasibility		$290M to $400M	GEFA Georgia Reservoir and Water Supply Fund	Desalination: 29 MGD. $8M to $12M per MGD from CDM Water Supply Cost Estimation Study and Supplemental Guidance. Also includes 10 miles of pipeline. Unit costs for pipeline taken from Supplemental Guidance. Costs do not include storage.
AAGS-9 Determine Reverse Osmosis Feasibility		$620M to $920M		Brackish Water RO: 99 MGD at $5M to $8M per MGD from CDM Water Supply Cost Estimation Study and supplemental Guidance. Also includes 10 miles of pipeline. Unit costs for pipeline taken from Supplemental Guidance. Costs do not include storage.
AAGS-10 Inter-basin Transfers		$25M to $250M	GEFA Georgia Reservoir and Water Supply Fund	Inter-basin transfer function of piping cost. Assume 36 to 84-in pipe costs $4.8M to $12.7M per mile and 5 to 20 mile pipe runs.
Institutional (I)				
I-1 Cross-Jurisdictional Groundwater Coordination Group	Current and Future Groundwater Use in Gap Areas	$0.5M to $1M	State incentive programs	Various recent similar projects

Management Practice No. (See Table 6-1)	Issue to Be Addressed	Capital/ Programmatic Cost	Funding Sources and Options[1]	Notes and Sources for Costs
Engineered Solution(s) to Address Salt Water Intrusion (ES)				
ES-1 Engineered Solution	Current and Future Groundwater Use in Gap Areas	$90M to $700M	GEFA DWSRF/ Georgia Reservoir and Water Supply Fund	Unit cost data for supply, treatment and pipeline costs from Supplemental Guidance
Data Collection/Additional Research (DCAR)				
DCAR-1 Agricultural Consumption Data	Current and Future Surface Water Use in Gap Areas	$0.25M	State incentive programs	Various recent similar projects
DCAR-2 Source of Supply Data to Refine Forecasts		$0.5M	Local governments; State incentive programs	
DCAR-3 Better Understand Demand and Impacts on Projected Gaps		$0.5M		
DCAR-4 Improve Data Quality and Analysis		$0.2M	USDA Rural Development Water and Wastewater loan/grant	
DCAR-5 Irrigation Efficiency Education and Research		$0.1M		
DCAR-6 Understand Optimum Application Methods		$0.05M	Clean Water Act Section 319(h) Grants	
DCAR-7 Minimize Groundwater Use Impacts to Surface Water		$0.075M	Local governments; State incentive programs	

Management Practice No. (See Table 6-1)	Issue to Be Addressed	Capital/ Programmatic Cost	Funding Sources and Options[1]	Notes and Sources for Costs
DCAR-8 Analyze Addressing Extreme Conditions	Current and Future Surface Water Use in Gap Areas	$0.125M	State incentive programs	Various recent similar projects
DCAR-9 Study Aquifer Potential to Address Gaps		$0.15M	GEFA Georgia Reservoir and Water Supply Fund	
Additional/Alternate to Existing Surface Water Supply Sources (ASWS)				
ASWS-1 Consider Low Flow Conditions in Future Surface Water Permitting	Current and Future Surface Water Use in Gap Areas	$0.15M per applicant	State incentive programs; utilities	Various recent similar projects. Includes modeling, permit application, and monitoring.
ASWS-2 Incentives for Dry-Year Releases from Ponds		$1M to $2M	State incentive programs	
ASWS-3 Substitute Future Surface Water Use with Groundwater in Dry Years		$0.01M to $0.15M per MGD	Georgia Fund Loan; Georgia Reservoir and Water Supply Fund	Local well driller data and Supplemental Guidance
ASWS-4 Substitute Existing Surface Water Use with Groundwater in Dry Years		$0.01M to $0.15M per MGD		
ASWS-5 Opportunities and Incentives for Dry-Year Releases from Ponds		$1.1M to $1.4M per mile	State incentive programs	Pipeline cost to connect ponds to nearby rivers. Assume 1 to 2 mile pipe runs. Assume pipe diameters of 10 to 12 inches. Unit costs from Supplemental Guidance.
ASWS-6 Ecological Restoration Incentives		$0.1M/ac	Clean Water Act Section 319(h) Grants	Supplemental Guidance

Management Practice No. (See Table 6-1)	Issue to Be Addressed	Capital/ Programmatic Cost	Funding Sources and Options[1]	Notes and Sources for Costs
ASWS-7 Land Management Incentives	Current and Future Surface Water Use in Gap Areas	$0 to $1/capita	Clean Water State Revolving Fund Loan Program	Supplemental Guidance. Total population in 2050: 1,266,000
ASWS-8 Incentives for Greater Wastewater Return Flows		$0.1M to $1M per MGD		Supplemental Guidance
ASWS-9 Multi-Region Reservoir		$0.1M to $0.35M per MG	GEFA Georgia Reservoir and Water Supply Fund	
ASWS-10 Inter-Basin Transfers		$2.2M per mile		Inter-basin transfer is a function of piping cost. Assume 18 inch pipe. Unit cost from Supplemental Guidance.
Point Sources – Dissolved Oxygen (PSDO)				
PSDO-1 Collect Water Quality Data	Water Quality Gaps	$0.25M to $0.5M	Local governments; utilities	Various recent similar projects
PSDO-2 Point Discharge Relocation		$0.1M to $0.3M	GEFA Georgia Fund Loan; Utilities	
PSDO-3 Enhance Point Source Treatment		$7M to $10M per MGD	GEFA Georgia Fund Loan; Utilities; CWSRF	Supplemental Guidance
Available Municipal Wastewater Permit Capacity (MWWPC)				
MWWPC-1 Increase Wastewater Permit Capacity	Wastewater Permit Capacity Gap	$4M to $10M per MGD	GEFA Georgia Fund Loan	Supplemental Guidance
Available Industrial Wastewater Permit Capacity (IWWPC)				
IWWPC-1 Increase Wastewater Permit Capacity	Wastewater Permit Capacity Gap	$0.1M to $0.2M		Various recent similar projects

Management Practice No. (See Table 6-1)	Issue to Be Addressed	Capital/ Programmatic Cost	Funding Sources and Options[1]	Notes and Sources for Costs
Municipal Groundwater Permit Capacity (MGWPC)				
MGWPC-1 Increase Municipal Groundwater Permit Capacity	Groundwater Permit Capacity Gap	$0.025M to $0.05M	Drinking Water State Revolving Fund (DWSRF) Loan Program	Various recent similar projects
Industrial Groundwater Permit Capacity (IGWPC)				
IGWPC-1 Increase Industrial Groundwater Permit Capacity	Groundwater Permit Capacity Gap	$0.025M to $0.05M	DWSRF Loan Program	Various recent similar projects
Groundwater (GW)				
GW-1 Develop and Practice Sustainable Groundwater Use	Groundwater Needs Outside Gap Areas	$0.01M to $0.15M per MGD	Georgia Reservoir and Water Supply Fund	Local well driller data and Supplemental Guidance
GW-2 Promote Aquifer-Friendly Land Use Practices		$0.15M to $1.3M	State, local governments/ utilities	$0 to $1/capita. Total population in 2050: 1,266,000
GW-3 Research and Analyze Sustainable Groundwater Management		$0.2M to $0.4M		Various recent similar projects
Surface Water (SW)				
SW-1 Surface Water Use Within Available Capacity	Surface Water Needs Outside Gap Areas	$0.05M to $0.1M per applicant	Local governments/ utilities	Includes cost of permitting and impact evaluation
SW-2 Monitor and Evaluate Estuaries		$0.1M to $0.15M	Coastal Incentive Grant Program	Various recent similar projects

Management Practice No. (See Table 6-1)	Issue to Be Addressed	Capital/ Programmatic Cost	Funding Sources and Options[1]	Notes and Sources for Costs
Ammonia and Nutrients (PSAN)				
PSAN-1 Ammonia Limits	Water Quality Point Source Needs	$4M to $10M per MGD	CWSRF; Georgia Fund Loan	Supplemental Guidance
PSAN-2 Enhance Nutrient Treatment		$7M to $11M per MGD		
PSAN-3 Eliminate Illicit Discharges		$0.2M to $0.5M per MGD		Recent Bid Tabs
Dissolved Oxygen, Fecal Coliform, Nutrients, and Other Impairments				
NPS-1 Study Human Impacts on Water Quality	Water Quality Non-Point Source (NPS) Needs	$0.2M to $0.4M	Clean Water Act Section 319(h) Grants (NPS Implementa-tion Grant)	EPA Manual of Costs of Urban Stormwater Control (2002)
NPS-2 Monitor and Address NPS Nutrient Loading		$0.5M to $1.5M		Various recent similar projects
Urban Best Management Practices (NPSU)				
NPSU-1 Control Erosion	Water Quality NPS Needs	$0 to $1.3M	Clean Water Act Section 319(h) Grants (NPS Implementa-tion Grant)	$0 to $1 per capita. Total population in 2050: 1,266,000
NPSU-2 Manage Stormwater Runoff		$6,000 to $65,000 per MG		EPA Manual of Costs of Urban Stormwater Control (2002)
NPSU-3 Increase Stormwater Infiltration		$0 to $0.9M		$0 to $0.7 per capita per Supplemental Guidance. Total population in 2050: 1,266,000
NPSU-4 Riparian Buffers		$0 to $0.9M	GEFA Land Conservation Program	

Management Practice No. (See Table 6-1)	Issue to Be Addressed	Capital/ Programmatic Cost	Funding Sources and Options[1]	Notes and Sources for Costs
Rural Best Management Practices (NPSR)				
NPSR-1 Advocate Implementing Road Runoff BMPs	Water Quality NPS Needs	$2,500 to $75,000 per mile of swale	CWSRF; Clean Water Act Section 319(h) Grants	EPA Manual of Costs of Urban Stormwater Control (2002)
Forestry Best Management Practices (NPSF)				
NPSF-1 Support Forestry Commission Water Quality Program	Water Quality NPS Needs	Continue to fund existing programs		
NPSF-2 Improve BMP Compliance		Continue to fund existing programs		Costs of Forestry Best Management Practices in the South: A Review
NPSF-3 Wetland and Forest Restoration Incentives and Support		$5,000 to $9,000 per credit	Federal grants	Supplemental Guidance. The costs are based on the cost to purchase credits from a restoration bank.
Agricultural Best Management Practices for Crop and Pasture Lands (NPSA)				
NPSA-1 Soil Erosion Reduction Measures	Water Quality NPS Needs	$0.1M to $0.2M		Irrigation Conservation Practices Appropriate for the Southeastern United States
NPSA-2 Utilize Buffers		$0 to $0.9M	GEFA Land Conservation	$0 to $0.7 per capita per Supplemental Guidance. Total population in 2050: 1,266,000
NPSA-3 Livestock Management				
NPSA-4 Manure Control		$0.5M to $1M		Sussex (Delaware) Conservation District Cover Crop Program Fact Sheet
NPSA-5 Wetland and Forest Restoration Incentives		$0.25M to $0.5M		$0 to $0.7 per capita per Supplemental Guidance. Total population in 2050: 1,266,000

Management Practice No. (See Table 6-1)	Issue to Be Addressed	Capital/ Programmatic Cost	Funding Sources and Options[1]	Notes and Sources for Costs
Existing Impairments and Total Maximum Daily Load Listed Streams (TMDL)				
TMDL-1 Evaluate Impairment Sources	Water Quality NPS Needs	$0.5M to $1M	Clean Water Act Section 319(h) Grants	Various recent similar projects
TMDL-2 Analyze Impaired Segments and Sources		$0.035M to $0.13M per impairment		
TMDL-3 Stormwater Management BMPs		$63M to $100M		$50 to $80 per capita per Supplemental Guidance. Total population in 2050: 1,266,000
Nutrients – Satilla and Savannah River Nutrient (Phosphorus and Nitrogen) Watershed Models (NUT)				
NUT-1 Link Nutrient Loading With Current Land Use	Water Quality NPS Needs	$10 to $150 per acre	Clean Water Act Section 319(h) Grants	Align land use with phosphorus and nitrogen loading data
Educational (EDU)				
EDU-1 Promote Conservation Programs	Future Educational Needs	$0 to $2.8M	State incentive programs; Utilities; Local governments	$0 to $2.25 per capita per Supplemental Guidance. Total population in 2050: 1,266,000
EDU-2 Stormwater Education		$0 to $2.8M		
EDU-3 Septic System Maintenance Education		$0 to $0.9M	State incentive programs; Utilities; Local governments	$0 to $2.25 per capita per Supplemental Guidance. Total population in 2050: 1,266,000
EDU-4 Forestry BMP Education		$0.05M to $0.15M		Support Georgia Forestry BMPs
Ordinance and Code Policy (OCP)				
OCP-1 Engage Local Governments in Stormwater Issues	Future Ordinance and Code Policy Needs	$0 to $0.9M	State incentive programs; Utilities; Local governments	$0 to $0.7 per capita per Supplemental Guidance. Total population in 2050:1,266,000

Management Practice No. (See Table 6-1)	Issue to Be Addressed	Capital/ Programmatic Cost	Funding Sources and Options[1]	Notes and Sources for Costs
OCP-2 Green Space Opportunities and Incentives	Future Ordinance and Code Policy Needs	$0 to $0.9M	State incentive programs; utilities, local governments; Georgia Land Conservation Program	Green space incentives $0 to $0.7 per capita. Total population in 2050:1,266,000
OCP-3 Promote Integrated Planning		$0 to $0.9M	State incentive programs; Utilities; Local governments	$0 to $0.7 per capita per Supplemental Guidance. Total population in 2050:1,266,000
OCP-4 Local Government Erosion Control		$0.05M to $0.1M		Enforce Erosion and Sedimentation control practices

[1] Where referenced, GEFA-administered loan programs (e.g., CSWRF, DWSRF) are intended to finance eligible activities related to construction of water infrastructure projects, including site-specific engineering and planning efforts.

7.3. Alignment with Other Plans

The Coastal Council's Plan and management practices selection process was based on identifying and supporting existing policy, planning, and projects. Local comprehensive plans, planned and/or permitted projects were relied upon in developing the Regional Water Plan. This approach is tailored to maintain consistency with, and to maximize support for, locally driven water resource management decisions. The Coastal Council did identify potential challenges associated with both the cost and technical issues that the region may face; especially regarding water and wastewater needs for both new and aging infrastructure. In addition, addressing existing surface and groundwater gaps must be accomplished in a manner that does not cause adverse impacts to local water users and local governments.

Water resource decisions in the Coastal Georgia Region are affected by regulatory process related to Savannah River water quality and bi-state discussions regarding the Savannah River and salt water intrusion in the Savannah/Hilton Head region. The outcome of these discussions and potential recommendations or other decisions will have important implications for the Regional Water Plan and will need to be incorporated and/or reconciled with the Regional Water Plan as this information becomes available.

The challenges of funding Plan recommendations and addressing future technical and regulatory issues is especially difficult for smaller towns and utilities, agricultural

water uses, and small businesses that rely on natural resources. The successful implementation of the Regional Water Plan will be dependent on the principles of support and leadership by state agencies, in a collaborative setting, utilizing incentives and financial assistance to the extent possible.

7.4. Recommendations to the State

The Coastal Council supports the concept of regional water resource planning with a focus on planning Councils composed of local governments, water users, water providers, industry, business and affected stakeholders. Local representatives are typically most familiar with local water resource issues and needs. The State has a vital role providing technical support, guidance, and funding to support locally focused water resource planning.

The Coastal Council is sensitive to unintended consequences if Plan recommendations become mandates. The State must help balance Plan recommendations with assessing measurable progress toward Plan implementation. If additional rules or other administrative or regulatory actions are deemed necessary, the State should work with Councils to help ensure workable solutions.

The following specific recommendations to the State are provided to help aid in the successful implementation of the Plan.

Georgia Environmental Protection Division (EPD)

- Consider "institutionalizing" planning. This would entail a long-term commitment of staff and funding to: monitor and support Plan recommendations; coordinate improved data collection, management and analysis; continue to develop and improve Resource Assessment tools; and help provide funding, permitting and technical support to address gaps and water resource needs.

- Support and facilitate the Savannah River Harbor Total Maximum Daily Load Stakeholder process. Allowing stakeholders from both Georgia and South Carolina to identify possible solutions to pollutant loading will help ensure implementable solutions. EPD's assistance in coordinating, facilitating, and providing technical support to this process is essential. The Coastal Council supports this process and has indicated that a successful conclusion of this process is identification and implementation of pollutant loading strategies (management practices) which can improve dissolved oxygen conditions in the lower Savannah River.

- Provide leadership, coordination, and technical support to the Upper Floridan Aquifer Salt Water Intrusion Stakeholder Process. This bi-state process between Georgia and South Carolina is charged with developing potential comprehensive management strategies to address salt water intrusion in the Savannah/Hilton Head region. The Coastal Georgia Regional Water Plan

provides recommended management practices based on preliminary assumptions on the amounts of groundwater withdrawals that may be allowed to meet current and future demands. The outcome of this stakeholder process could significantly change some of these assumptions and the Council's recommended management practices. Consequently, EPD will also need to continue to serve as a "bridge" between the State water planning process and this stakeholder process.

- Work with Georgia Soil and Water Conservation Commission, Georgia Department of Agriculture, University of Georgia and other relevant institutions to improve agricultural water use data collection and management. This effort would focus on refining source(s) of supply for multiple irrigation sources, continuing to assess data on crop water requirements, evaluating the effects of farm ponds on direct irrigation withdrawals and the hydrologic cycle, and further research on crop consumptive use. This data in turn should be coordinated with Resource Assessment tools to ensure accurate simulation of any gaps and assumptions.

- Focus funding support and permitting assistance to projects and programs aimed at addressing gap areas. Where possible, leverage federal funds to help support and expedite project implementation.

- Consider collaborative approaches to collecting more standardized water use data and improving data on water demands. This would include continued improvement and updating databases used in the planning process. It would also involve working with the Georgia Municipal Association, Georgia Association of County Commissioners, and other relevant stakeholders to improve water use information.

- Working with Georgia Environmental Finance Authority, examine opportunities to improve coordination among water providers and users and create incentives to maximize existing infrastructure and coordinated operations.

- Track, support, and participate in South Carolina water planning efforts. Successful planning in the Coastal Region and Savannah-Upper Ogeechee Region will benefit from constructive and collaborative engagement of South Carolina on issues associated with the current and future use of the Savannah River for both water supply and wastewater assimilation. Sustainable use and management of the Savannah River is critical to the social and economic future of both Georgia and South Carolina.

- Continue to engage in dialogue and data-sharing with the States of Florida and South Carolina regarding current and forecasted groundwater use. South Georgia, North Florida, and South Carolina rely on the Upper Floridan Aquifer to meet water supply needs and it is in EPD's best interest to include the

most accurate available information on growth and groundwater use in both states in the Resource Assessment modeling.

Georgia Environmental Finance Authority (GEFA)

- Meeting forecasted water supply needs will require stable and flexible funding sources to assist water users and water and wastewater utilities in meeting forecasted needs. A stable GEFA financing source(s) should be maintained for necessary water supply, water and wastewater plant construction, and plant upgrades to address current and future gaps.

Georgia Forestry Commission (GFC)

- Continue to support and fund the GFC Forestry Best Management Practices Program. Providing education and incentives to control erosion and sedimentation will help the region prevent/address TMDL listed segments, reduce nutrient loadings, and support wetland areas. This will have the benefit of helping sustain baseflow conditions of streams and water quality.

Georgia Soil and Water Conservation Commission (GSWCC)

GSWCC should continue to provide leadership and locally focused efforts in the following programs:

- Continue education and outreach associated with *Urban Erosion and Sediment Control* program including certification of individuals involved in land disturbing activities and on-site implementation of erosion, sedimentation, and pollution control plans. This will help address the water quality needs of the region.

- Continue education and outreach efforts to agricultural interests through annual Irrigation Meetings and other avenues to inform farmers of available technologies and funding sources to make more efficient use of water resources without incurring hardship.

- Support completion, maintenance and improvement of the *Agricultural Water Use Measurement Program*, which is aimed at cost effectively collecting agricultural water use data across the State, and integrating cooperative arrangements with the private sector and partnerships with other State agencies. This program is a vital component to helping the State and regions effectively manage and utilize water resources.

- Support *Georgia Agricultural Conservation Incentive* program, which provides funding support to help implement conservation practices. Funding for this program is essential to help implement conservation measures, especially in the regional watersheds where there are surface water gaps.

Office of State Planning and Budget (OPB)

- Obtain population census data and compare to population forecasts to track trends in the accuracy of population projections
- Revise population forecasts and support ongoing state-wide planning

Department of Community Affairs (DCA)

- Identify and encourage local governments to integrate Regional Plan management practices with land use and water quality/quantity nexuses into their comprehensive planning efforts.
- Continue to promote coordinated environmental planning

Georgia Department of Agriculture (DOA)

- Provide technical information and participate in needed studies to better characterize agricultural water uses and quantification of shortages to low flow conditions.
- Assist with outreach and education of agricultural uses to obtain greater understanding of surface water resource limitations, both quality and quantity, and to help improve the implementation rate of management practices. Assist EPD and other state agencies in coordinating with the Georgia Farm Bureau to accomplish the above goals.

Georgia Department of Natural Resources [Coastal Resources Division (CRD) and Wildlife Resources Division (WRD)]

- Continue to monitor resources and help sustain, enhance, protect and conserve Georgia's natural, historic and cultural resources.
- Provide technical and ecosystem information to help support state water planning needs.

8. MONITORING AND REPORTING PROGRESS

Section 8. Monitoring and Reporting Progress

The selected water management practices identified in Section 6 will be primarily implemented (as described in Section 7) by the various water users in the region, including local governments and others with the capacity to develop water infrastructure and apply for the required permits, grants, and loans.

Summary

The Coastal Council has identified several benchmarks and means to measure progress toward meeting regional needs and goals. In most cases, efforts will require significant coordination between affected water resource managers, and local and state government. Successful implementation will be dependent on adequate financing, leadership and support by State agencies, and collaboration by multiple stakeholders.

New and/or changing information, particularly regarding salt water intrusion issues and Savannah River Harbor water quality, will likely influence how the recommended practices are ultimately implemented.

8.1. Benchmarks

The benchmarks prepared by the Coastal Council and listed in Table 8-1 will be used to assess the effectiveness of this Plan's implementation and identify any required revisions. As detailed below, the Coastal Council selected both qualitative and quantitative benchmarks that will be used to assess whether the water management practices are closing gaps over time and allowing the water planning region to meet its Vision and Goals. Effective implementation of the Plan will require the availability of sufficient funding in the form of loans, and in some cases, possibly grants. In addition, many of the proposed management practices require ongoing coordination with affected stakeholders/water users and collaboration to help ensure successful solutions are identified and implemented. Finally, in many cases monitoring progress toward addressing future needs will require improved data and information on the current actions and management practices that are already in place. The benchmarks will be used to evaluate the Regional Water Plan's effectiveness at the next 5-year Plan review and will require collection of information in the intervening years to better quantify and document resource conditions and progress to meeting regional needs and goals. The successful implementation of the Regional Water Plan will require both leadership and supporting roles by Georgia EPD, other state agencies, local government and water and wastewater utilities, as well as individual water users.

Table 8-1: Benchmarks for Water Management Plans			
Management Practice No. (See Table 6-1)	**Benchmark**	**Measurement Tools**	**Time Period**
Groundwater quantity and all water use throughout the region Surface water quantity at Kings Ferry, Eden, and Claxton			
WC-1 and WC-2 Tier 1 through Tier 4 Measures for Municipal and Industrial Users	- Maintain or reduce gallons per capita consistent with Tiers 1 and 2 conservation practices - Applicable Tiers 3 and 4 municipal and industrial conservation practices implemented in groundwater gap areas	Assess regional municipal and industrial water use rate trends and practices via periodic survey	2- 5 years
WC-3 through WC-12 Tier 3 and Tier 4 Measures for Agricultural Users	Reduction in agricultural surface water withdrawals while maintaining agricultural production and reduction in surface water gaps at Kings Ferry, Eden, and Claxton	- Survey of agricultural conservation practices implementation rates and trends in water use by GSWCC - Assess flow conditions using water use data and Resource Assessment tools (EPD)	2-5 years
Additional/Alternate to Present Groundwater Source(s) in Gap Areas (AAGS) The role/selection of these management practices for addressing current gaps and future forecasted needs in the gap areas requires additional data from the Bi-state Salt Water Intrusion Stakeholder Process between Georgia and South Carolina			
AAGS-1 through AAGS-10, I-1, ES-1 Variety of alternative water supply sources evaluated as options to groundwater pumping	-Verify that implementable management practices have emerged from stakeholder process - Determine state, local government, and affected water provider support for management practice(s) - Quantity of water supply yielded by management practice determined - Implementation roles for cost sharing and infrastructure constructions identified - Infrastructure needs identified (Joint operating and/or funding agreement or equivalent and implementation plan developed)	- Summary report completed from Bi-state discussion or equivalent - Implementation recommendations report completed and necessary agreement completed	1-2 years 2-5 years

Management Practice No. (See Table 6-1)	Benchmark	Measurement Tools	Time Period
Address Current and Future Surface Water Use in Gap Areas **Data Collection/Additional Research (DCAR)** to confirm frequency, duration, and severity of agriculturally-driven shortages to 7Q10 low flow conditions			
DCAR-1 through DCAR-10 Various Data Collection and Additional Irrigation and Restoration Research Practices	- Develop Plan of Study, obtain funding and stakeholder participation as needed - Completion of work plans and study implementation and documentation of results - Incorporate data and findings into forecasts, Resource Assessments, and Water Plan updates	-Survey or self-reporting of agencies/entities involved in studies -Verify inputs and revisions to water planning tools	2-4 years 5 years
Address Current and Future Surface Water Use in Gap Areas **Additional/Alternate to Existing Surface Water Supply Sources (ASWS)**			
ASWS-1 Consider Low Flow Conditions in Future Surface Water Permitting	- Formation of stakeholder group and consensus reached on new surface water application process in gap areas - Application process and permit conditions developed	Status report from stakeholder group; Report out on usage of process and the number of permits issued with conditions	1-2 years 2-4 years
ASWS-2 Incentives for Dry-Year Releases from Ponds	Incentives identified and operating conditions as part of ASWS-1	Document and maintain volumetric accounting of participating storage facilities	2-5 years
ASWS-3 Substitute Future Surface Water Use with Groundwater in Dry Years	-Information and educational materials developed in conjunction with GSWCC and Georgia DOA to communicate details and goals of improving surface water flows -Methods and incentives identified to increase implementation/participation	- Verify information and educational outreach via survey or direct agency reporting - Monitor and track surface water versus groundwater permit applications	1-3 years 1-5 years
ASWS-4 Substitute Existing Surface Water Use with Groundwater in Dry Years	- Develop information and educational materials in conjunction with GSWCC and Georgia DOA to communicate issue and goals of improving surface water flows - Identify methods and incentives to increase implementation/participation	Identify and monitor participation and conversion rates from surface water to groundwater	1-3 years 1-5 years

Management Practice No. (See Table 6-1)	Benchmark	Measurement Tools	Time Period
ASWS-5 Opportunities and Incentives for Dry-Year Releases from Ponds	-Completion of feasibility study - Working with potential participants opportunities and incentives identified	- Identification of largest storage facilities for potential participation in gap areas - Report summarizing opportunities and implementation	1-3 years 1-5 years
ASWS-6 through ASWS-10 Various land management, disposal, and water storage/transfer measures	-Feasibility studies completed (for short-term studies) -Feasibility studies initiated (for long-term studies/actions)	Assess need based on short-term actions and feasibility studies (see Tables 6-1 and 7-1)	5 years
Address Water Quality (Dissolved Oxygen Levels) – Point Sources (PSDO)			
PSDO-1 Collect Water Quality Data	-Resource Assessment assumptions reviewed and, if necessary, new data collect efforts underway/completed -New findings incorporated into updated Resource Assessment data sets	-EPD/agency summary report complete verifying assumptions and documentation of new data -Incorporation of new findings and update Resource Assessment data	1-4 years
PSDO-2 Point Discharge Relocation PSDO-3 Enhance Point Source Treatment	-Outreach activities to discharges completed and feasible options have been implemented by discharges -EPD to conduct outreach and facilitate improved treatment in low dissolved oxygen reaches	Improved dissolved oxygen is verified in stream reaches by monitoring or discharger reporting	1-5 years
Obtain Additional Municipal and Industrial Water and Wastewater Permit Capacity			
MWWPC-1, IWWPC-1, MGWPC-1, IGWPC-1 Expansion of Wastewater and Groundwater Permit Capacities to Address Gaps/Needs	-Outreach activities completed to water providers in high growth areas -Need for additional permit capacity verified and improved data for discharges obtained	Monitor permit applications and verify that improved data collection for dischargers	5 years

Management Practice No. (See Table 6-1)	Benchmark	Measurement Tools	Time Period
Addressing Current and Future Groundwater Needs for Gap and Non-gap Areas			
GW-1 Develop and Practice Sustainable Groundwater Use	Sufficient permitted capacity to meet forecasted needs; through timely submittal and processing of applications	Monitor permit applications and issuance	1-5 years
GW-2 Promote Aquifer-Friendly Land Use Practices	Counties and local governments consider practices to promote infiltration and aquifer recharge	Evaluate trends in impervious land cover in areas of aquifer recharge	5 years
GW-3 Research and Analyze Sustainable Groundwater Management	Sound science used to improve data and sustainably manage groundwater resources	Groundwater Resource Assessment updated	
Addressing Current and Future Surface Water Needs for Gap and Non-gap Areas			
SW-1 Surface Water Use Within Available Capacity	Sufficient permit capacity exists to meet forecasted needs through timely submittal and processing of applications	Monitor permit applications and issuance	1-5 years
SW-2 Monitor and Evaluate Estuaries	Major water resources diversion/storage projects identified; Upstream actions that would significantly impact flow conditions assessed	Monitoring data collected in estuaries and river flow trend data collected and reviewed	5 years
Programmatic Practices for Water Quality – The following management practices are associated with the Vision and Goals of the Region and are described in general terms as they are either associated with existing state and local programs or are not yet at a point where implementation frameworks have been established by the State			
- Ammonia and Nutrients Point Sources - Nutrient Non-point sources Satilla and Savannah Watershed Models - Urban/Suburban, Rural, Forestry, and Agricultural Non-point source BMPs - TMDL Listed Streams BMPs	- Additional assessments to align sources of contaminants (point and non-point sources) to water quality impairments and land use types - Continue implementation and assessment of the effectiveness of existing state programs including GFC, GSWCC, 319 Water Quality initiatives, and local efforts to improve watershed protection and water quality improvements - Background/natural levels of potential sources established	- Review and assessment of program and information - Complete summaries of watershed conditions using Resource Assessment tools, improved data collection, and synthesis of state program data	1-5 years

Management Practice No. (See Table 6-1)	Benchmark	Measurement Tools	Time Period
Management Practices to Support Educational Needs			
Support education programs for: - Water Conservation - Stormwater Management - Septic System Maintenance -Logger Education -Forestry BMPs	-Data used to identify where future program efforts will be most effective -Funding for programs maintained or improved	Survey and summarize program effectiveness and success stories	1-5 years
Management Practices to Address Ordinance and Code Policy Needs			
- Encourage implementation and/or compliance with Stormwater ordinances and/or regulations - Encourage improved conformance with *Environmental Planning Criteria* developed pursuant to Part V of the Georgia Planning Act - Encourage local government to improved conformance with erosion and sediment control measures	-Select local governments surveyed to identify current knowledge base and recommended areas of improvement -Improved education at state and local government conferences and workshops -Enhanced awareness in Comprehensive Planning by local governments across region	Select follow-up survey of local governments to identify changes and success stories	1-5 years
Shared Resources			
Groundwater quality/quantity – Support Bi-state stakeholder process for salt water intrusion	- Implementable solutions identified - Venue and implementation process/plan established and nexus to state planning completed	-Assess progress and summarize implementation recommendations from Bi-state stakeholders - Develop implementation options	1 year 2-5 years

Management Practice No. (See Table 6-1)	Benchmark	Measurement Tools	Time Period
Combined management practice for the Kings Ferry, Eden, and Claxton surface water gaps Coastal Georgia, Altamaha, Savannah-Upper Ogeechee, Upper Oconee Water Planning Regions	Regional Council-specific management practices implemented	Evaluate project improvement of surface water flows using gauge data and Resource Assessment tools	1-5 years
Savannah River Harbor TMDL - Support stakeholder process	- Waste load allocation process developed for applicable dischargers - Pollution control strategies developed	Summary of implementation recommendations and timelines for water quality improvements	1-5 years
Ongoing Planning coordination with South Carolina and Florida	- Outreach and coordination with states completed and water planning data collected - Review Resource Assessment tools and make modification if warranted	- Report summarizing planning data - Information needs and issues documentation	1-5 years 5 years

8.2. Plan Updates

Meeting current and future water needs will require periodic review and revision of Regional Water Plans. The State Water Plan and associated rules provide that each Regional Water Plan will be subject to review by the appropriate Regional Water Planning Council every five years and in accordance with this guidance provided by the Director, unless otherwise required by the Director for earlier review. These reviews and updates will allow an opportunity to adapt the Regional Water Plan based on changed circumstances and new information arising in the five years after EPD's adoption of these Plans. These benchmarks will guide EPD in the review of the Regional Water Plan.

The Regional Water Planning Councils appointed to prepare future Plan updates will have the opportunity to review the recommendations of past Plans against current available data to make a determination as to which management practices are still appropriate and which ones need to be revised or augmented to meet changing conditions. Future Councils will also have the ability to judge the effectiveness of practices recommended in previous Plans against available benchmark data. This analysis will reveal which practices are effective and what adjustments are necessary to compensate for less effective practices.

8.3. Plan Amendments

The Coastal Council emphasizes that the recommendations in this Regional Water Plan are based on the best information available at the time the Plan was written. New information and issues that may impact the recommendations should be considered and incorporated into relevant implementation decisions and future Water Plan updates. Future planning efforts should confirm current assumptions and make necessary revisions and/or improvements to the conclusions reached during this phase of planning.

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